STANDARD HIGH PERFORMANCE MAGAZINE

Preliminary Design

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Executive Summary

The High Performance Magazine (HPM) ordnance storage concept was originally developed by the Naval Facilities Engineering Services Center (NFESC) to reduce the encumbered land around an ordnance storage magazine required by the explosives safety quantity distance (ESQD). The ESQD is the distance required around a magazine to limit the risk of injuries from an accidental explosion and prevent sympathetic detonation of ordnance in an adjacent facility. In addition, the HPM concept was intended to relieve the problem associated with storing noncompatible ordnance, particularly where small quantities of explosives are required to be stored.

The purpose of the HPM Preliminary Design was to resolve several engineering issues and to develop the ordnance storage concept into a functional facility at the lowest practical cost.

As compared to current standard magazines, the HPM does reduce the ESQD requirements to inhabited buildings, public traffic routes, and to other ordnance facilities. However, the HPM concept requires unique construction materials as well as operational and performance characteristics that carry with them a higher cost, and a much greater element of uncertainty, or risk, than other types of ordnance storage facilities. The preliminary design attempted to minimize the uncertainties and risk factors to the greatest extent possible, however some of them cannot be completely resolved prior to the design, construction and operation of the first magazine. These uncertainties are related to cost, constructability, operational capability, reliability, and maintenance, and are described in greater detail in Section 1.3 and Chapter 5.0 of this report.

Due to the increased cost and remaining uncertainties associated with the HPM relative to other ordnance storage options, we offer the following recommendations:

- The HPM should only be considered for unique situations where other approved standard magazines are not viable, i.e. where severe land use restrictions exist, or where small quantities of multiple noncompatible ordnance types are required to be stored. (Note: Smaller earth covered magazines may be more suitable for storing small quantities of noncompatible ordnance than the HPM.)

- The first HPM construction project should be considered a prototype facility in order to clarify problems and limitations as well as establish standards for the design of future magazines. It should be anticipated that the initial HPM will carry with it higher design and construction costs as well as increased constructability, operational and maintenance concerns relative to other ordnance storage options.

- Develop the design of modified earth covered above ground magazines utilizing the non-propagation wall technology already approved in concept by the Department of Defense Explosive Safety Board (DDESB). The modified magazines have the potential to significantly reduce ESQD requirements without many of the problems associated with the HPM concept.

- Complete additional evaluation of the lightweight concrete non-propagation wall to determine if it is feasible to relax the strict density and strength limitations.

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1.0 Overview

1.1 PURPOSE

The purpose of this document is to describe the results of the preliminary design for the High Performance Magazine (HPM). This document should be used along with the current versions of references (1), (2), (3), (4) and (5) in the development of a Military Construction Project for a site-specific final design of a High Performance Magazine.

A summary and recommendations are included in Section 1.3 of this chapter. Chapter 2.0 describes the parameters that were used as the basis for the development of the preliminary design. Chapter 3.0 includes the preliminary design construction drawings for the HPM, and Chapter 4.0 includes a parametric construction cost estimate. Special considerations for the planning, design, procurement, construction and operation of the HPM are contained in Chapter 5.0.

1.2 BACKGROUND

The Naval Facilities Engineering Services Center (NFESC) developed and tested the concept for a new ordnance storage magazine. The current NFESC Basis of Design for the HPM is described in reference (1). The anticipated concept of operations is described in reference (2). Reference (3) details the explosive safety design requirements for the HPM. Reference (4) describes the physical security requirements for the HPM and reference (5) details the locking mechanisms for the bay covers.

The Atlantic Division of the Naval Facilities Engineering Command (LANTDIV) was tasked by the Naval Facilities Engineering Command Code 15R to develop a preliminary design and cost estimate for the HPM concept. NAVFAC Code 15R, as the NAVFAC RDT&E Program Manager, managed the development of this tasking. The primary objective was to "provide cost-effective solutions to the engineering issues that required resolution before the HPM design criteria can be finalized." The secondary goal of this tasking was to develop a package that could be used as a starting point for the planning, programming, and design of the first few potential Military Construction projects that chose to implement the HPM concept.

As the preliminary design progressed, the HPM concept was revised and refined to incorporate lessons learned and new information that came to light as a result of the design process. Through this process, LANTDIV worked with the NFESC to ensure that the preliminary design addressed all known outstanding issues and concerns to the fullest extent possible, including explosive safety requirements, physical security, constructability, operational requirements, and occupational safety. Other commands and activities were involved in the development of this package including the Naval Crane Center, the Packaging, Handling, Storing, Transportation Command, NAVFAC Safety and Health Office, and various members of the Navy ordnance community.

The preliminary design and cost estimate for the HPM proceeded to a point of completion, and was issued in March 1998. Over the next months several follow-on actions related to the HPM were completed which included additional testing of the storage and retrieval operations by the Naval Packaging Handling, Storage, & Transportation Center (PHSTC), revision of the technical requirements specification for the procurement of the bridge cranes by the Naval Crane Center (NCC), approval of the HPM concept with respect to explosive safety by the DDESB, and the analysis of various bay ventilation system alternatives.

The preliminary design raised a number of unresolved issues concerning the viability of the HPM concept. These issues deal with:

- protection of both assets and operational capability in the event of an accidental explosion,
- decreased reliability and increased maintenance requirements as a result of a significant increase in the technical complexity of the operating systems of the HPM as compared to that of other ordnance facilities,
- occupational safety concerns resulting from the requirement to work within the confined spaces of the ordnance storage bays,
- operator concerns including difficult access into the storage bays and unconditioned working spaces,
- the feasibility to stack and retrieve ordnance in the indicated configurations,
- the occupational safety and seismic acceptability of stacking ordnance to the indicated heights and spacing,
- and the problems and costs associated with procuring the bridge cranes, straddle lifts, and the computerized bay cover operating system.

Other issues were raised concerning physical security requirements and constructability problems related to the low strength, ultra lightweight concrete.

In late 1998, all residual funding was recalled and LANTDIV's work on the HPM design was for the most part discontinued pending resolution of the issues above.

In January 2000, NFESC had gained the approval of DDESB for the HPM concept design with regard to explosive safety. By July 2000, the NFESC completed the design for the Physical Security requirements for the HPM, updated the HPM concept Basis of Design and Concept of Operations, and developed the draft definitive drawings for the Explosive Safety Requirements for the HPM concept.

As a result of a meeting held in July 2000 to discuss the outstanding issues, NAVFAC Code 15R resolved that further R&D effort would not be productive. The desire was to produce documentation of the work that had been done to date and leave the decision concerning the viability of the HPM concept and whether to continue the design effort to the next set of decision makers.

In November of 2000 a plan of action and milestones(POAM) was developed to update the Preliminary Design of the HPM concept and to develop a "Design Guidance Package" that would address the unresolved issues to the fullest extent practical. The NAVFAC Engineering Innovation and Criteria Office (EICO) provided the necessary funding to complete this effort, the end result of which is this document.

1.3 SUMMARY

The ordnance storage and retrieval concept developed and tested for the HPM by the NFESC, is very different from that of any previous magazine, and requires the use of unique construction materials, operational systems and constraints, and safety considerations.

Some of the important differences between the HPM concept and other ordnance storage facilities include the following:

- Ordnance is stored in underground bays that are required to be considered as confined spaces due to limited means of egress.
- To access ordnance in the storage area, heavy concrete covers must be opened in such a way as to allow access to the desired locations while other areas remain covered.
- The only means to stow and retrieve ordnance is by the overhead bridge crane with an attached articulating straddle lift. Back-up forklift stowage and retrieval is not an option.
- The stowage arrangements developed for the HPM require the ordnance to be stacked much higher than other magazines with narrow spaces between the stacks.
- Ultra lightweight – low strength concrete is required for the storage bay walls and covers.
- A pre-engineered metal building is used to house vital operating components including the bridge crane, and bay cover operating system.

Due to its uniqueness, the HPM concept design carries with it a higher cost as well as a larger element of risk associated with constructability, operational capability, reliability, and maintenance, than other ordnance facilities.

The Preliminary Design has attempted to minimize the cost and risk to the fullest extent possible, however some of the issues and concerns cannot be completely resolved prior to the final design, construction and operation of the first HPM.

The following issues have been specifically identified as potential risk factors and should be considered during the programming, design, and construction of a new HPM. These issues are described in greater detail in Chapter 5.0.

a) Planning and Site Considerations: (Intermagazine distance (IMD) siting relationships are described graphically in Attachments 1) and 2).)

- Tightly grouped HPMs sited at IMD will not experience sympathetic detonation, however they will not be operational following an accidental explosion within a HPM or box magazine in the vicinity.
- Ordnance assets within a HPM sited in the vicinity of either another HPM or an earth covered box magazine will be more susceptible to damage from an explosion in the adjacent magazine than current standard magazines.

b) Constructability Considerations:

- The required characteristics of the ultra lightweight - low strength structural concrete used in the walls and covers of the storage bays are unusual and restrictive. Three sources within the U.S. have been located that can provide concrete that satisfies the required physical properties. The construction of the bays is feasible, however there is a much greater potential for constructability problems and finished product acceptability issues than with other magazines. Additional construction quality control and product testing requirements will be necessary to ensure that the strict guidelines are adhered to during construction.
- The required erection and product tolerances for the lightweight concrete bay covers are more restrictive than normal precast or cast-in-place concrete industry standards. The unknown short and long-term deflection characteristics of the lightweight concrete bay covers are an additional complicating factor. The necessary tolerances will require additional material testing and a much greater attention to finished product tolerances than typical concrete construction.

c) Operational Considerations:

- The maximum capacity stowage arrangements shown in reference (1) reflect the wide variety of ordnance that will be stowed in the HPM. Due to the design and condition of many of the ordnance containers currently in the inventory, the containers must be precisely positioned within the storage bay in order to stack them to the heights indicated. It has been demonstrated that the bridge crane and straddle lift cannot reliably stack some of the ordnance containers with the necessary precision in a completely automated process. Spotters are required to guide or "nudge" some of the containers into the proper stowed position. Line handlers will be required to use tag lines from the aisles or covers above the bay to position the containers. Safety concerns associated with lowering the containers by crane with personnel in the constricted spaces below, restrict or prohibit the use of line handlers in the aisle spaces within the bay. The use of tag lines will in some instances be extremely difficult due to interferences and restricted line of sight. Removable rail sections will be required around the open bay to ensure personnel safety during ordnance stowage. Depending on the stowage operation, portions of the removable rail sections may have to be installed and removed with the movement of each individual container.

  Due to the extreme difficulty to load and unload some of the maximum capacity storage plans, operational load storage plans with reduced storage capacity have been developed by the PHSTC to illustrate efficiency and space requirements for comparison with the maximum efficiency plans.
- Access of personnel into the ordnance storage areas is required to perform routine maintenance and may be required to assist in ordnance stowage and retrieval operations. Egress into the bays is by a vertical ladder extending approximately 20 feet from the platform above. The ladder has been inset into the bay wall in order to accommodate the maximum load stowage plans shown in references (1) and (2). [All of the stowage arrangements have been accommodated except for the tomahawk (VLS-SUB). One or more stacks of these missiles would have to be eliminated or reduced due to the clearance requirements of the access ladder.] After the covers are opened, a removable ladder extension section must be added to the top of the fixed ladder from the platform above in order to access the bays. This method of egress satisfies minimum requirements, however is very difficult for the operators, particularly if access is required on a regular basis.

- The HPM relies upon technically and/or mechanically complex components to operate. The bridge crane, straddle lift, cover operating system, gas monitors, and bay ventilation system are all required to be functional for the stowage and retrieval of ordnance. Back-up and redundant measures have been included to improve reliability as much as practical, however there are greater reliability concerns as well as additional maintenance and operator/systems certification requirements than with other ordnance storage facilities.
- Ordnance personnel are required to work within the confined spaces of the ordnance storage bays, which introduces a greater risk to personnel. Special safety provisions have been included to mitigate the danger including ventilation of the storage bays, air quality monitoring and certification requirements, and the development of specific guidelines when accessing the bays as part of a required Standard Operating Procedure. The extra safety provisions add additional complexity and uncertainties to the operation of the HPM.

d) Procurement Considerations:

- The HPM concept requires several specialized, relatively complex mechanical components and systems including the bridge cranes, Straddle lift, C-grab, cover locking system, air quality system, and computerized bay cover operating system. These components should be designed and fabricated under the same construction contract as the magazine superstructure to ensure the compatibility of the various components. The HPM contractor must have an assembled team that posses the ability to successfully design and construct each of the complex components and to coordinate the overall effort into a completed facility. The selection, review and approval process for the individual components of the construction project will involve the Navy Crane Center for the bridge cranes, PHSTC for the straddle lift and C-grab, the NFESC for physical security and all blast considerations, and NAVFAC for the overall facility, bay cover operating system, and contract administration. The contractor selection process to ensure the adequacy of each of the components, as well as the design review and approval process for the multiple components will be difficult to manage and potentially problematic.

The construction cost for a generic HPM has been estimated to be approximately $5.3 million based upon the assumptions described in Chapter 4.0. For comparison purposes the cost of a generic type ‘M’ and ‘F’ earth covered magazine, using the same assumptions as those used for the HPM estimate, is also provided. The type “M’ magazine is estimated to cost $3.0 million and the type ‘F’ is estimated to cost $1.6 million. Note that these estimates do not include site work or utilities beyond a 75-foot perimeter due to the variabilities of site-specific requirements.

1.4 Recommendations

a) Due to the higher cost and increased risk of the HPM relative to other ordnance storage options, a HPM should only be considered for unique situations where other approved standard magazines are not viable. Situations where the HPM may prove to be advantageous would be where severe land use restrictions exist, or where small quantities of multiple noncompatible ordnance types are required to be stored. (Note: smaller earth covered magazines may be more suitable for storing small quantities of noncompatible ordnance.)

b) Many of the issues and concerns with the HPM concept cannot be completely resolved prior to the design, construction and operation of the first magazine. Therefore, the first HPM construction project should be considered a prototype facility that will carry with it higher design / construction costs and require a longer design phase than other ordnance facilities. The prototype HPM should clarify problems and limitations as well as establish system standards for the design of future magazines, but will have the potential for numerous constructability, operational and maintenance problems.

c) Develop the design of modified earth covered above ground magazines utilizing non-propagation walls. The non-propagation wall technology that resulted from the HPM efforts, and approved in concept by the DDESB, is being evaluated for use in modified versions of current standard earth covered magazines. The application of the non-propagation walls has the potential to result in a magazine with a significant reduction in ESQD requirements, but at less cost than the HPM and without many of the potential problems associated with the HPM concept.

d) Complete additional evaluation of the lightweight concrete non-propagation wall in order to determine if the restrictive density and strength limitations can be relaxed and still achieve adequate non-propagation characteristics.

2.0 PRELIMINARY DESIGN PARAMETERS

2.1 GENERAL

The HPM consists of four separate ordnance storage bays that are treated as independent magazines. Each storage bay can store up to 30,000 lbs of net explosive weight. Each bay can optionally be subdivided into two separate storage areas with the use of the "Re-locatable" Modular Wall. Each subdivided storage area can also store up to 30,000 lbs of net explosive weight, thereby increasing the total storage capacity of the HPM. The separation of the storage bays or subdivided storage areas also allows for the storage of incompatible ordnance in adjacent bays. The maximum storage capacity of a HPM with no subdivided bays is 120,000 lbs net explosive weight (NEW). If all four bays are subdivided, the maximum storage capacity is 240,000 lbs NEW.

Only the ordnance in one storage bay, or individual subdivided storage area, may be exposed at any given time. All other bays must be completely covered to prevent sympathetic detonation in the event of an accidental explosion. This allows a significant reduction in the magnitude of the potential explosion required for siting considerations. A maximum NEW of 60,000 lbs is used for siting a HPM. This includes 30,000 lbs in an exposed storage area as well as an allowance for 30,000 of ordnance that may be temporarily housed within the building superstructure. Alternately, 60,000 lbs NEW may be temporarily stored within the building if all of the storage bays are completely covered.

The construction and thickness of the perimeter walls and covers of the storage bays as well, as the "Re-locatable" Modular Walls, are based upon actual full scale blast testing. These elements do not require consideration for blast effects, however certain critical physical characteristics and dimensions must be strictly adhered to in order to ensure that they perform as intended. These critical requirements for these non-propagation elements are described in references (1) and (3). All other elements of the magazine shall be designed using conventional design considerations.

2.2 SITING CRITERIA (Explosive Safety)

Explosives Safety Quantity Distance (ESQD) requirements provide safe distances to inhabited buildings (IBD), public traffic routes (PTR), other ordnance operational facilities (intraline, ILD) and magazines (IMD). The safe separation distance is based on the formula, $D=KW^{1/3}$, where "D" is the safe separation distance in feet, "W" is the net explosive weight (NEW) in pounds, and "K" is a factor depending upon the degree of exposure that is acceptable. The value of "K" depends on the orientation, construction, and function of the acceptor facility and controls the safe separation distance form a HPM.

2.2.1 Intermagazine Distance (IMD). The IMD to protect against the prompt propagation of an explosion of Class/Division 1.1 material between magazines is provided in table 2-1 of reference (1). As an exposed site, the IMD to prevent propagation of explosion for a HPM is based on a "K" = 1.25 for a side and rear exposure to another HPM or an Earth-covered magazine, and a "K" = 2.75 to a front exposure. For example, a HPM with a potential NEW of 60,000 pounds may be sited 49 feet from another HPM with a side or rear exposure, and 108 feet with a front exposure. A HPM may be sited 79 feet from an Earth-covered magazine with a NEW of 250,000 pounds with a side or rear exposure and 173 feet with a front exposure.

The IMD to prevent damage to ordnance within a HPM is based on a "K" = 9 from an explosion in an adjacent Earth-covered magazine. For example damage may occur to ordnance within an exposed HPM sited less than 567 feet from an Earth-covered magazine with a NEW of 250,000 pounds. According to the NFESC, nearly complete asset protection for the ordnance in a HPM from an explosion in an adjacent HPM can be achieved at a "K"=1.25, which equates to a separation of 49 feet.

The IMD to prevent severe damage to the superstructure and internal bridge crane system of an exposed HPM is based on a "K" = 30. An exterior mobile crane will be required to access to munitions following an explosion at less than "K" = 30. For example severe damage to the superstructure will occur to an exposed HPM sited less than 1,174 feet from another HPM and 1,890 feet from an Earth-covered magazine with a NEW of 250,000 pounds.

Attachments (1) and (2) graphically describe the IMD relationships for the HPM sited both with other HPMs and with an Earth-covered box magazine.

2.2.2 Inhabited Building Distance (IBD). The IBD is the safe separation distance required from an HPM to an inhabited building. As a potential explosion site, the IBD from a HPM is based on a "K" = 35 but not less than 1250 feet. The IBD for a HPM with 60,000 NEW is 1370 feet.

2.2.3 Public Traffic Route (PTR) Distance. The PTR is the safe separation distance required from an HPM to the nearest public traffic route. As a potential explosion site, the PTR from a HPM is based on a "K" = 21. The PTR for a HPM with 60,000 NEW is 822 feet.

2.2.4 Intraline Distance (ILD). The ILD is the safe separation distance required from an HPM to an explosives operating building. The ILD from a HPM as a potential explosion site is provided in table 2-2 of reference (a). The "K" = 9 application applies to an unbarricaded ILD. The "K" = 18 application applies to a barricaded ILD.

2.3 CIVIL / SITE DESIGN

2.3.1 Site Grading. The perimeter of the magazine shall be earth bermed except at the entrance area. The slope of the berm shall be minimum 1.5:1 (Note: It is recommended that the earth berm be placed no steeper than 2:1 if possible to minimize the occurrence of slope failure.) The entrance area is bordered by retaining walls with a paved access road leading to the magazine.

If possible the access road shall be sloped away from the magazine at a 2% slope, and the magazine site graded at a minimum 2% grade from the edge of the earth berm to the security fence to direct storm water runoff around and away from the magazine structure. This is the basis for the preliminary design and will avoid the need for a storm water collection system (except as needed for foundation drains).

2.3.2 Site Pavements. The pavement section assumed for the paved access road is 3 inches of bituminous surface course over 10" of aggregate base course. This may require revision based on project specific analysis of vehicle types, anticipated traffic volume and site-specific soil characteristics. The use of a bituminous pavement section has assumed that vehicles approaching the magazine will have maneuvered into a backing position before reaching the limits of the pavement, and that wheel turning movements will be kept to a minimum on the paved access road.

2.3.3 Site Fencing. The preliminary design assumes a new chain link fence will be provided to enclose the new magazine site. The fence is located 50 feet away from the outside wall of the magazine, and is 8 feet in height. A double-swing gate will be provided at the new access road to control vehicular access to the magazine. Site considerations beyond the fence line are highly dependant on project specific requirements and have not been included in the preliminary design.

2.3.4 Storm Water Collection System. In the event that the site requires that the finished floor elevation of the magazine be dropped below the existing grade, a storm water collection system will be provided. If the entrance road slopes into the magazine's truck entrance area, a trench drain is recommended at the entrance of the magazine to prevent water from entering the shipping and receiving area. In addition, a storm drainpipe may be needed to carry the collected runoff away from the trench drain to an appropriate outfall structure. Culverts may also be needed under the paved entrance road to allow storm water runoff flowing from the surrounding terrain to flow past the site. The preliminary design does not include a storm water collection system.

2.3.5 Erosion Control. The slope of the earth berm shall be protected for long-term slope stability and erosion control. The top of the berm may be sodded or finished with a non-flammable topping to ensure stability of the slope where the berm material has inadequate cohesion.

2.4 BUILDING ENCLOSURE

2.4.1 General. The HPM is a two level structure. The upper level is a conventional framed pre-engineered steel framed structure with light gage metal wall and roof sheathing. The lower level is a reinforced concrete structure with an external earth berm.

Access into the magazine is through an opening in the berm into the shipping and receiving area of the lower level. Vehicular and forklift access is through a 13'-0" wide by 14'-0" high opening protected by an overhead coiling door. Personnel access is through a 3'-0" x 8'-0" metal hinged door adjacent to the vehicular door. The exterior wall at the entrance, including the vehicular and personnel doors, does not require consideration for blast loading.

It is the policy of the Department of Defense to meet the requirements of both the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act Accessibility Guidelines. However, the UFAS provides exceptions for certain military facilities where the intended use is specifically restricted to able-bodied personnel. The Preliminary Design for the HPM is based upon the use of the facility restricted to only non-handicapped able-bodied personnel and therefore conformance to accessibility guidelines is not required. The final design at any location would require the C.O. of the occupying activity to certify that this is the case for each facility.

2.4.2 Design Loads. The design live loads assumed for the Preliminary Design are as follows:

Live Loads:

Walkways and Stairs --------------------------------	100 psf (4.8 kPa)
Storage Bay Covers --------------------------------	50 psf (2.4 kPa)
Transfer Aisle Walls --------------------------------	300 psf (14.4 kPa)
Loading Dock and Storage Bays ------------------	260 psf (12.5 kPa
Relocateable Modular Wall Locations -----------	4200 psf (158.1 kPa)
Roof Live Load ***** ----------------------------------	30 psf (1.4 kPa)
Loading Dock, Ramp -------------------------------	Forklift Wheel Load
Staging Area, Parking Area ------------------------	Forklift & Vehicular Wheel Load

Wind Loads:

Wind Speed * -- (Per ASCE 7-98, Exposure Category 'C')	150 mph (67 m/s)

Seismic Loads:

Seismic Use Group – I (Standard Occupancy Structure)

Site Class * ---	B
Short Period Spectral Response Acceleration* -----------	$S_S = 1.65$ g
One Second Period Spectral Response Acceleration* ---	$S_1 = 0.75$ g

*** Will vary according to site**

The entire structure is assumed to be founded on soil with a minimum allowable bearing capacity of 4500 psf (215.6 kPa) at the relocateable modular wall locations. An minimum allowable bearing capacity of 3500 psf (167.7 kPa) is required at all other locations. If the site soil characteristics indicate a lesser allowable bearing capacity, the foundations must be redesigned to suit actual conditions.

2.4.3 Upper Level. The upper level steel framed pre-engineered structure is intended to provide environmental protection for the lower level structure as well as for the personnel and ordnance handling equipment involved in the handling, storage, and transfer of munitions within the structure. The columns of this structure also support the bridge crane that travels the full length of the building.

The pre-engineered structure is not intended to be capable of resisting the overburden pressures resulting from an explosion of a nearby magazine.

A walkway completely encircles the perimeter of the upper level. This walkway is made of reinforced concrete over the shipping and receiving area and at the end walls. The walkway consists of removable steel grating supported by structural steel beams over the sidewalls of the ordnance storage area. The steel walkway is designed to allow access to the wheel and drive mechanisms of the storage bay covers to accommodate maintenance and repair.

The wall and roof panels of the pre-engineered structure shall be high quality 24-gage minimum metal. The structure shall have an extended 10-year warranty for weather tightness.

2.4.4 Lower Level. The lower level earth bermed reinforced concrete structure is intended to provide a storage area for ordnance as well as areas required for handling and transfer of munitions.

Continuous membrane waterproofing shall be sheet applied to the outside surface of the earth covered concrete walls to prevent migration or condensation of moisture on the interior spaces. The membrane shall be covered by a protection board prior to backfilling the soil against the walls. The floor slab of the ordnance storage bays shall be cast over a 3” thick concrete mud slab with impervious waterproofing membrane sheeting sandwiched between the mud slab and the floor slab to prevent possible moisture penetration or condensation. This is especially recommended where the elevation of the slab is within the possible influence of the water table.

The lower level consists of two distinct functional areas: ordnance storage, and shipping and receiving.

2.4.4.1 Ordnance Storage. The ordnance storage bays are located at each end of the structure. Each storage bay provides a clear storage area 83’-0” long x 21’-0” wide x 16’-0” high. The two storage bays on each end of the structure are separated by a transfer aisle wall 12’-0” wide consisting of sand sandwiched between 1’-4” thick lightweight reinforced concrete walls. The storage bays are separated from the shipping and receiving area by a transfer aisle wall 15’-0” wide consisting of sand sandwiched between 1’-4” thick lightweight reinforced concrete walls. Each storage bay is covered by four overlapping cover segments made of lightweight reinforced concrete 1’-2” thick. The transfer aisle walls and the bay covers are intended to prevent sympathetic detonation from an explosion in another storage bay or elsewhere in the building. The storage bay walls, the transfer aisle walls, and the bay covers do not need to be designed to resist the effects of an accidental explosion. The reinforcement in these elements shall be designed for normal live and dead load combinations including lateral earth pressure and seismic loadings.

The lightweight concrete of the storage bay exterior walls, the transfer aisle walls, and the bay covers shall have a **maximum** density of 85 pounds per cubic foot (pcf). This concrete shall also have a **maximum** 28 day compressive strength, f'_c, of 3000 pounds per square inch (psi), and a **minimum** 28 day compressive strength of 2000 pounds per square inch (psi). The 56-day compressive strength shall have an allowable range of between 2500 and 3500 pounds per square inch (psi). (Three potential sources for lightweight concrete that satisfy these characteristics have been identified by the NFESC.) The inside face of all storage bay walls shall have a **minimum** concrete cover over the reinforcing steel of 9”. Normal weight concrete used throughout the magazine shall have a **minimum** 28 day compressive strength, f'_c, of 3000 psi.

Personnel access into the storage bays is from the walkway level above. Three vertical aluminum personnel ladders shall be located in each storage bay as shown on the preliminary design drawings. A fixed ladder will be located inside the bay from the floor to just below the underside of the lower bay covers. A portable ladder extension will be used to gain access from the walkway level to the fixed ladders in the bays. All ladders and platforms shall be in conformance with minimum OSHA guidelines and regulations.

For physical security, all openings and penetrations in the walls of the storage bays shall be less than 96 in^2 total. Steel wall reinforcement shall be provided within the opening to ensure that a 6-inch sphere cannot pass through.

Maximum capacity stowage plans for various containerized and palletized ordnance have been developed by the Naval Packaging, Handling, Storage, and Transportation Center (PHSTC), and are shown in reference (1).

2.4.4.2 Shipping and Receiving Area. The Shipping and Receiving Area (SRA) is located in the center of the magazine. This area is used to load and unload conveyance vehicles, and for temporary storage of ordnance before transfer. A conveyance vehicle can be parked within the SRA. Ordnance can be transferred to or from the vehicle with the use of a forklift or an overhead bridge crane with either an attached straddle lift or C-grab lifting device. A loading dock in the rear of the SRA allows transfer of ordnance to and from a rear-loaded covered truck using a forklift truck. The rear loading dock and side loading area allow pre-staging or temporary storage of ordnance before transfer. Ordnance may also be pre-staged on top of the transfer aisle walls.

Reference (7) recommended increasing the size of the SRA to provide additional clearance for the forklift to be able to rotate longer ordnance containers and improve operational efficiency. Following discussions with NFESC and the NAVFAC EICO, the SRA was not increased in the final Preliminary Design. It is believed that the two bridge cranes each with rotating hoists, coupled with both the two straddle and C-grab carriers, will achieve adequate efficiency.

No provision has been included for a dock leveler on the loading dock. Therefore, a portable ramp will be required to accommodate differences in elevation between the truck bed and the rear loading dock platform. At locations where no rear-loaded covered trucks will be required to be unloaded may eliminate the loading dock.

Inclined steel ship ladders are located at each end of the Shipping and Receiving Area to provide access to the walkway encircling the perimeter of the upper level structure, and to the top of the transfer aisle walls.

2.5 FACILITY COMPONENTS

2.5.1 Re-locatable Modular Walls. A modular wall can be located within the storage bay to subdivide the bay into two separate storage compartments. By subdividing the bays, the modular walls increase the total net explosives storage capacity of the magazine by allowing each compartment to store up to 30,000 lbs of NEW. The modular wall units consist of prefabricated reinforced hollow Chemically Bonded Ceramic (CBC) block each 7’-11” tall and stacked two high. They are filled with steel grit or shot. The steel grit or shot shall have a minimum density of 270 pounds per cubic foot.

The weight of the Modular Wall with the steel grit is such that special foundation considerations may be required at many locations. The ordnance stowage plans that have been developed for the HPM considered the Modular Wall at either the center or 1/3 point of the storage bay. To accommodate all stowage configurations in each storage bay, foundation for the Modular Wall would be required at eight locations. This flexibility may not be required, and the project development of each HPM should carefully consider the potential current and future ordnance storage needs in order to determine the optimal requirements for the modular wall foundation.

The Modular Walls are re-locatable in the sense that they are not rigidly attached to the building structure or foundation. It is anticipated that in order to relocate the wall, the steel grit would be vacuumed from the cells and stored for reuse. The hollow wall modules are designed to weigh less than the 8 ton capacity of the overhead bridge crane, and could be lifted to their new position. Threaded inserts to lift the CBC modules should be accommodated for in the final design.

The CBC material is a patented product specifically developed under U.S. Navy contract for the NFESC. The CBC module unit shown in the preliminary design was designed and tested to prevent sympathetic detonation between the storage areas. Other materials and designs may be considered, however they must be analyzed and approved by the NFESC for explosives safety.

2.5.2 Storage Bay Covers. Storage bay covers are required over the storage bays to prevent an accidental explosion occurring outside of the covered storage bay from causing sympathetic detonation of the ordnance within the bay. The covers were designed and tested as solid 14" thick lightweight reinforced concrete panels spanning the width of the storage bay. The tested and approved panels have a **maximum** density of 85 pounds per cubic foot (pcf), and an allowable 28 day compressive strength, f'_c, of between 3000 and 2000 pounds per square inch (psi). The 56-day compressive strength must be between 2500 and 3500 psi. The reinforcement of the covers shall be as required for the weight of the cover itself including the indicated live load. The covers shall not be erected until they have reached a minimum compressive strength of 2500 psi.

The covers must be designed so that they can easily be configured to allow complete unobstructed access to the ordnance stored within any bay, and at the same time ensure that all other storage areas are adequately covered. The cover design must also satisfy the interface criteria defined in reference (3), to prevent primary fragment line of sight entry into a closed storage area.

The preliminary storage bay cover design as shown in chapter 3 of this document is based on the ability to accommodate any of the ordnance stowage plans that have been developed for the HPM, both with and without the "Re-locatable" Modular Wall. This design is based upon two upper and two lower covers over each storage bay. The covers are supported by rollers and can move independently on steel rails running horizontally the length of the bay. Each cover consists of four separate panels anchored together with a through rod. Each cover panel is sized to weigh less than 8 tons, allowing installation or replacement by the overhead bridge crane.

The covers are configured so that in the closed position, the upper and lower covers have an overlap allowing for a clearance between the covers to accommodate construction tolerances and differential deflections. The edges of the covers also overlap the walls of the storage bay. The relationship between the amount of overlap and the allowable gap is governed by the interface criteria defined in reference (3).

Adequate vertical and horizontal adjustability in the alignment of the covers may need to be considered in the final design due to the unpredictability of both the long and short-term deflection characteristics of extreme lightweight concrete.

2.5.3 Bay Cover Operating System. The storage bay covers must be easily and quickly maneuvered into the various configurations required to access the stored ordnance. The preliminary design utilizes a tensioned cable pull system along the length of the storage bays to maneuver the covers. This system uses the same principle as a ski lift and consists of a closed wire rope loop around a sheave assembly consisting of a drive sheave at one end of a storage bay and an idler / tensioning sheave at the other end of the bay. A wire rope loop and sheave assembly is located on each side of each storage bay. The two drive sheaves are powered by a single motor and gear reducer through a common drive shaft, thus enforcing synchronized rotation of the drive sheaves on each side of the bay. The wire ropes pass through conduits mounted to the top of the upper cover and just above the wheel axle of the lower cover.

The drive force is imparted to the wire rope through friction between the rope and the drive sheave groove. The normal force between the drive sheave assembly and the rope required to maintain friction is provided by the idler / tensioning sheave assembly. In this configuration, the idler sheave and a set of steel plates are mounted at the opposite ends of an L-shaped frame. The L-shaped frame is attached to a supporting frame through a pivot pin located at the intersection of the legs. Rotational equilibrium of the frame about the pivot pin is maintained by the counteracting force of gravity of the steel plates on one leg and the tension in the wire rope acting on the idler sheave on the other leg. The desired tension in the rope can be attained by adjusting the frame leg lengths and / or the steel plate weights. The idler / tensioning assembly maintains constant tension in the rope loop and will compensate for changes in length which may occur due to changes in temperature or long term stretching.

Each cover is equipped with a pair of devices that clamp the wire rope on each side of the cover when it is to be moved. The devices include of an actuator that controls the clamping and release of the wire rope. The actuators draw power through a series of collectors sliding on electrified bus bars mounted near the rails along the transfer aisle. The clamps are only to be actuated when the wire ropes are stationary in order to reduce wear and tear on the clamps and the ropes.

The cover movement will be limited to only one bay and one cover segment at a time. All opening commands must be initiated from the bay closed position.

It is absolutely critical that only one storage bay or subdivided storage area is open at any given time to prevent sympathetic detonation in the event of an accidental explosion. The cover operating and control system must contain adequate safeguards to ensure that it is not possible to open more than one storage area at a time.

The target design operating speed for the covers is 30 feet per minute (FPM).

Provisions should be made to move the covers manually in the event of a power failure or a mechanical breakdown of a major component of the operating system. It is anticipated that installing an anchorage device on the covers, and rigging a temporary system of winches could accomplish this.

2.5.4 Bay Cover Control System. The control system for the bay covers is an automated computer based system controlled through a master programmable logic controller (PLC) located in Shipping and Receiving Area of the building. Two-way command and status data is transmitted between the master station and the storage bay area through a hardwired data link. The master station shall contain an industrial grade operator interface panel that will provide options for opening configurations as well as information on current cover positions.

The controller will drive the cable motors at each of the four pits. The motors will have variable frequency drives (VFD's) for smooth acceleration and deceleration of the cover segments. Ramp up, ramp down, and running speeds will be configured and fixed at the VFD. Cover segment positions will be monitored by a system of 12 proximity switch sensors located on each bay and 4 proximity switch targets on each cover segment. One slow-down target and one stop target are mounted on each end of each cover. Stationary sensors mounted on the bay walls signal the controller as targets pass for initiation of speed reduction and final positioning. Two electro-mechanical sensors (limit switches) will be located at each end of each storage bay, to provide end-of-travel protection for covers and structures.

2.5.5 Overhead Bridge Crane and Universal Straddle Carrier. The overhead bridge cranes work together with a universal straddle carrier to transport ordnance. The concept for storing and retrieval of ordnance from the bays utilizing the bridge crane and straddle carrier has been developed and approved by the Naval Packaging, Handling, Storage, and Transportation (PHST) Center.

The bridge crane coupled with the straddle carrier or the C-Grab is the only means of conveying ordnance to and from the storage bays of the HPM. A second bridge crane and straddle carrier shall be provided within the HPM to improve reliability and reduce the likely hood of down time due to mechanical malfunction.

The overhead bridge crane has a rated capacity of eight tons. It spans approximately 56 feet across the full width of the HPM and travels the full length of the magazine. It is anticipated that the crane will be supported from the columns of the Pre-engineered building. The trolley has a two point hook hoist equipped to rotate a suspended stack of pallets or containers 180 degrees in a horizontal plane. This rotation capacity allows the length of any stack to be oriented parallel to the storage transfer aisle when transporting the stack between a storage bay and the Shipping and Receiving Area. The maximum required speed for the horizontal movement of the bridge crane is 75 ft/min. The maximum hoist trolley speed along the bridge is 50 ft/min. The maximum required speed for the vertical movement hoist shall be 20 ft/min. All movement of the crane and hoist will have variable speed control.

The limits of travel for the hoist trolley shall be such that the center of the crane hook assembly can travel within 2'-2" of the face of the side walls of the storage bay and within 1'-9" from the face of the storage bay end walls. The maximum hook height shall be located so that the bottom of the ordnance being lifted within the fully extended Universal Straddle Carrier is no higher than 1'-6" above the top of the transfer aisle wall.

The Naval Crane Center (NCC) has developed the performance specification for the bridge cranes, reference (6). The NCC must also be involved in the procurement and certification of the cranes. It is highly recommended that the procurement of the cranes be included as a part of a single construction contracting action for the entire HPM so that a single construction contractor has overall responsibility for project coordination and completion.

The Universal Straddle Carrier (USC) is a device that couples the hoist hooks on the hoist trolley to the unit ordnance load. The unit ordnance load may be a single container, canister, or pallet or a stack of containers, canisters or pallets. This device has the capacity to lift a stack of ordnance weighing a maximum of 12,000 pounds and up to 7'-0" tall. The NEW of explosive that can be picked up during any single lift will be limited to 4000 pounds.

The crane and straddle lift are controlled by an operator on the walkway along the exterior wall of the magazine above the storage bays. The controls are two independent pendant mounted units supported from each side of the bridge. The controls contain a video monitor for viewing the action of the straddle carrier form cameras mounted on the USC. The bridge shall have spotlights for lighting the areas below the crane.

2.5.6 C-Grab Carrier. The C-Grab Carrier is an attachment that couples to the hoist hooks of bridge crane to access the containers from one side only. The current version of the C-Grab has an adjustable inside height and an adjustable carrying angle. These features allow for side removal of containers from flat bed trucks and for the containers to be rotated to the preferred axis for storage.

The C-Grab is recommended by the PHSTC for use in the HPM to improve efficiency of unloading truckloads of containerized ordnance. The C-Grab can reduce delays in staging ordnance while the Straddle carrier is in use and increase the speed at which containers can be staged for proper orientation based on the Load Storage Plans.

2.5.7 Automated Bridge Crane Positioning System. The crane positioning and control system is an optional feature to automate the control of the operation of the overhead bridge crane.

The positioning control system utilizes a non-lasing infrared electronic distance measurement (EDM) / movement control system that automatically controls the positioning of the crane to specific horizontal coordinates for either storage or retrieval of ordnance positioned in predetermined configurations. The system can also automatically control crane acceleration, deceleration and travel speed.

If utilized, this system can be linked with the master programmable logic controller (PLC) used to control the cover operating system described above. Stowage locations can be programmed into the PLC for the specific ordnance storage arrangements within each storage bay. In order to retrieve or store ordnance, the positioning system can automatically position the crane over a specified stack in order to store or retrieve ordnance. The crane operator is required to manually control the final horizontal positioning of the crane and the vertical movement of the hoist.

The positioning system must contain adequate safeguards and controls to ensure that crane movement cannot occur unless the hook is at the maximum height and that the path for the transported ordnance is clear of all obstructions. In the event of the failure of the automated positioning system, the crane must be able to operate under complete manual control.

2.5.8 Forklift Truck. A forklift truck with a lift capacity of 12,000 pounds shall operate within the Shipping and receiving area to assist in the transfer of ordnance to and from the conveyance trucks. Electrical equipment within the Shipping and Receiving area is not required to be explosion proof and therefore the forklift can be either battery or fuel powered. If the forklift is to be dedicated to the HPM, provisions should be made for battery charging or fuel storage within the magazine.

2.5.9 Air Quality Monitoring Provisions. Air sampling must be done prior to and during occupancy of the storage bays to ensure that the oxygen and hydrocarbon concentrations are within acceptable limits and the bays are safe for occupancy. The sampling shall be done by a qualified person, trained and certified in the use, maintenance, and calibration/functional check of test equipment. The activity Confined Space Program Manager shall be responsible for providing training and certification for the testers, as well as for ensuring that suitable testing equipment is available, and that it is properly used, maintained and calibrated per the manufacturer's instruction.

2.5.10 Ordnance Storage Ventilation System. A built in ventilation system is required for the ordnance storage bays. Each storage bay shall have a complete independently controlled system. The ventilation system shall be capable of 12 air changes within each storage bay per hour. The ventilation system shall be designed to optimize the ability to refresh the air within the bay and flush any potential toxic vapors. The ventilation system design shall consider the HPM stowage plans as shown in references (1) and (2) as well as the two possible locations of the relocatable modular walls, in order to prevent blocked vents or the occurrence of inadequately ventilated spots within the storage bay. No pipes or ducts larger than 96 square inches are allowed in the walls of the storage bay. The openings in the walls of the bay shall be such that a 6-inch sphere will not pass through. Openings created by pipes or ducts with a minimum dimension 6 inches or greater must be restricted by steel bars to reduce the minimum dimension of the opening to less than 6 inches.

The preliminary design was based upon an external exhaust fan with pipe vents positioned on the exterior sidewall of each bay. The vent ducts feed into a single exhaust stack for each bay venting to the outside. The supply air is from the interior spaces of the pre-engineered building above, and is typically introduced through the open bay covers.

The exhaust fan motor must be located to prevent contact with the exhaust air stream. The motor is not required to be explosion proof, however, if it is ever anticipated that the HPM will store weapons containing liquid propellants, the exhaust fan motor must comply with Type C spark resistant construction per AMCA 99-0401.

2.5.11 Upper Level / Shipping and Receiving Area Ventilation System. A ventilation system shall be provided to ensure adequate air movement and to minimize the temperature rise in the building. It is recommended that the system be sized for the maximum air flow from either 6 air changes per hour or 10° F maximum temperature rise above the local ambient condition, whichever gives the highest air flow.

The preliminary design was based upon roof mounted exhaust fans with back-draft dampers and bird screens. Make-up air was supplied by wall louvers located around the building perimeter. The wall louvers were electric motor operated (power open and power close) with a security plate over each opening to minimize entry.

2.5.12 Ordnance Storage Temperature / Humidity Control. Certain ordnance has specific temperature and humidity requirements for their storage. If the ordnance anticipated to be stored within a HPM storage bay has environmental requirements, a temperature / humidity control system may be required. If environmental controls are required, it may be feasible to only condition one or more of the storage bays depending upon the users requirements and the need for future flexibility.

The HPM final design must consider the environmental requirements of the ordnance to be stored, desired future flexibility, and the site specific environmental conditions.

The preliminary design contains an option for temperature / humidity control by utilizing an air conditioning system with reheat to dehumidify the air within the storage bay. A Small air-handling unit for each individual bay was used with a DX coil in a split system arrangement and a duct mounted electric heating coil. The reheat coil may be used for heating the bays if required.

2.5.13 Upper Level / Shipping and Receiving Area Environmental Control. The requirement for environmental controls in the Upper Level and Shipping and Receiving Area of the HPM would be based upon user requirements and local site environmental conditions. The preliminary design does not include environmental controls, however it does provide insulation for the prefabricated building to minimize condensation and to reduce corrosion of the metal portions of the building.

2.5.14 Interior Electrical Distribution System.

2.5.14.1 Power System Characteristics. Provide power for the magazine at 480Y/277 volt, 3-phase, 4-wire from the service entrance power panelboard inside the magazine. Provide 120/240 volt, single-phase power to receptacles and small motors from a dry-type step-down transformer and secondary panelboard. Electrical power capacity requirements shall be developed for the HPM based upon the requirements of the individual electrical loads.

An external connection point and pad shall be provided so that a portable generator can be brought in to provide emergency back-up power in the event of an electrical failure. The generator pad must be located at least 50 feet from the building, and a separate ground conductor shall be provided for the generator frame. The generator shall be sized to support 100-percent of the building electrical load. The generator connection into the building power system shall be hard-wired through a disconnect switch.

All wiring systems and equipment within the storage bay, below the bay covers, shall conform to NFPA-70 requirements for a Class I, Division 2 hazardous location. All wiring systems and equipment above the storage bay covers, including the cover operating system, shall conform to NFPA-70 requirements for general use, non-hazardous locations.

Wiring shall be run in rigid galvanized steel conduit and liquid tight flexible conduit. Voltage drop shall be designed to not exceed 3% for branch circuits and 2% for feeder circuits.

Power and lighting conductors shall be copper with 75°C-type THW or THWN insulation, except conductors for lighting fixtures shall be rated 90°C-type as required. Ground conductors, other than for lighting and power circuits, shall be bare copper cable.

2.5.14.2 Lighting System. Interior lighting levels shall be 10 foot-candles at the working level in the ordnance storage and the upper storage level. Interior lighting levels shall be 30 foot-candles at the working level of the shipping and receiving area. Fluorescent lighting fixtures shall be used throughout the interior of the magazine. Fixtures inside the storage bays shall be recessed into the wall and equipped with protective wire guards; in all other spaces with the magazine, the fixtures shall be surface or pendant mounted. High-pressure sodium fixtures shall be used on the exterior of the magazine.

Battery pack emergency lighting units shall be provided for identification of exit doors and paths of egress. Lithium batteries shall not be used.

2.5.14.3 Special Systems. Wiring, raceway, outlets and service entrance equipment shall be provided for telephones.

Wiring, raceway, devices, and equipment for an Intrusion Detection System as described in 2.5.16 shall be provided for the magazine.

2.5.14.4 Lightning Protection and Grounding System. The metal components of the building and all conductive bodies attached to or inside the structure shall be bonded to ground in accordance with NAVSEA OP-5.

Electrical equipment and services shall be grounded in accordance with NFPA-70.

Lighting arresters shall be provided for all ungrounded conductors entering the building.

2.5.15 Exterior Electrical Distribution System

2.5.15.1 Power. Provide power from the existing 3-phase overhead primary distribution system (assumed approximately 800 feet) to the site. Provide secondary power at 480Y/277 volts, 3-phase, 4-wire via a new 112.5 KVA, three-phase pad-mounted transformer located at the periphery of the site. Increase transformer size to 150 KVA if air conditioning for the magazine is chosen. Service conductors shall be copper type USE cable in an underground metallic concrete-encased conduit run a minimum distance of 50 feet from the transformer pole to the service panelboard inside the magazine.

2.5.15.2 Communications. Provide communications service through an extension of the existing communications lines located on overhead power poles (assumed 12 pair approximately 800 feet). Transition to communications lines in underground metallic concrete-encased conduit at the transformer pole serving the magazine to the telecommunications backboard inside the magazine.

2.5.15.3 Lightning Protection. Provide 24-inch (minimum) high air terminals with a spacing based on 100-foot striking distance. Interconnect air terminals with No. 1/0 bare copper conductor. Provide two-way paths for each air terminal to ground. Provide a minimum of two down conductors.

2.5.15.4 **Grounding.** Provide No. 2/0 bare copper primary ground loop around the building perimeter for lightning protection system grounding. Provide No. 2/0 bare copper secondary ground loop around the building perimeter inside the primary ground loop for electrical system and structural grounding.

2.5.16 Physical Security

2.5.16.1 **Threat.** The threat definition for the HPM has been developed by the NFESC, Code ESC66, as stated in reference (1).

2.5.16.2 **Security Concept.** Hardening to prevent intrusion shall be provided for each of the four ordnance storage bays. Hardening considerations as shown in reference (3) and (5), have been designed and certified by the NFESC. Other hardening designs may be considered, however the final design must be reviewed and approved by the NFESC Code ESC66.

Internal locking devices shall also be provided for each of the four ordnance storage bays. A detailed locking mechanism described in reference (4) has been designed and certified by NFESC. Other locking designs may be considered, however the final design must be reviewed and approved by the NFESC Code ESC66.

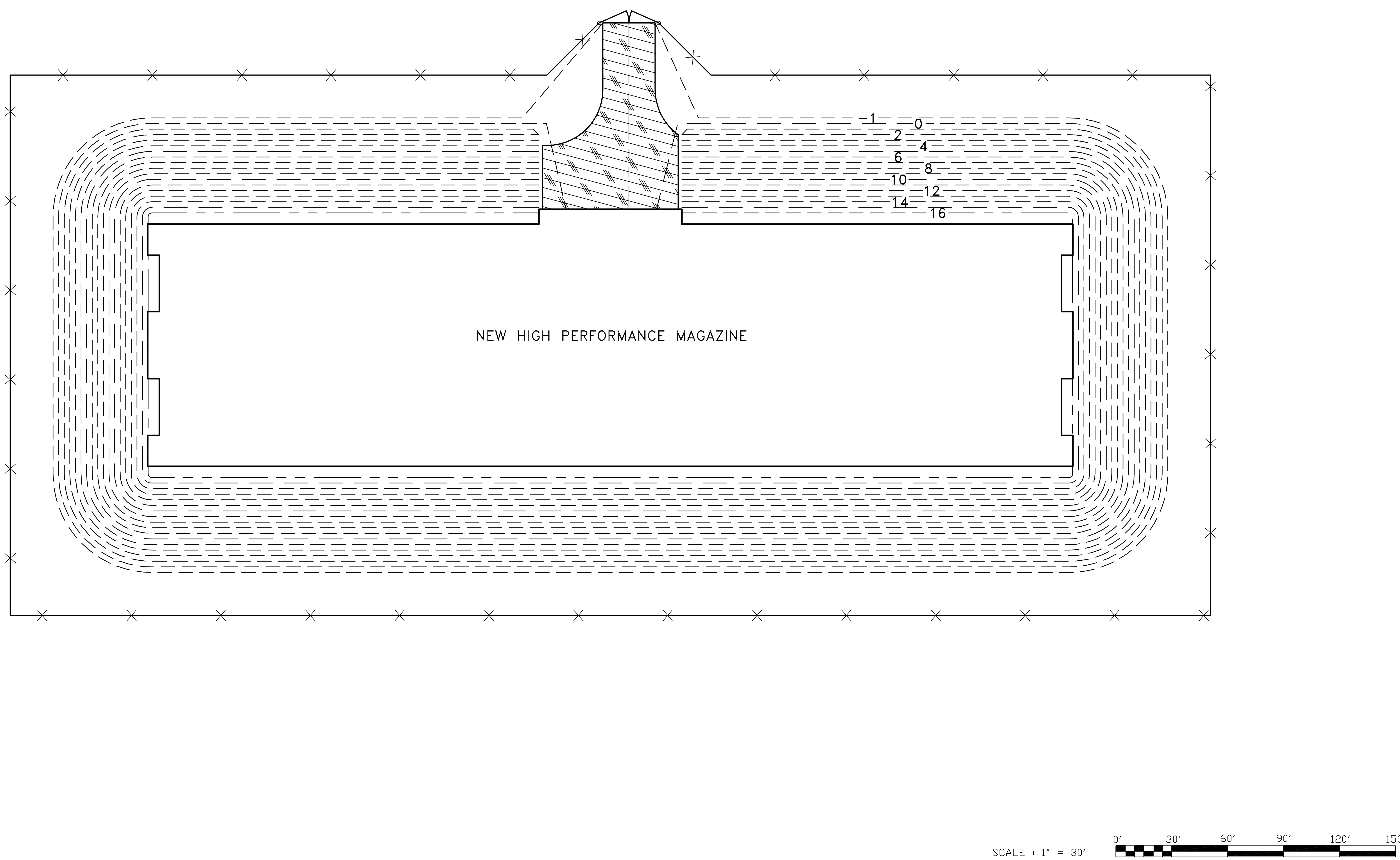
Intrusion Detection is accomplished by a volumetric Intrusion Detection System (IDS) that generates an alarm when eithor the Pre-fabricated metal building or roll up vehicle door is breached. The IDS shall be installed inside of the pre-engineered building above the storage bay covers and shall consist of microwave or passive infrared sensors. The IDS shall be designed to provide 100% coverage of the storage bay covers and locking systems. A balanced magnetic switch shall be located on the vehicle and personnel entrance door of the Shipping and Receiving Area to detect intrusion. The balanced magnetic switches and the volumetric IDS shall send out an alarm and disable and lock out all power to the structure in the event of a triggering event.

A special high security lock will not be required on the vehicular or personnel access door to the Shipping and Receiving Area of the HPM.

3.0 PRELIMINARY DESIGN CONSTRUCTION DRAWINGS

List of Drawings:

DWG NO.	**DWG TITLE**
C-1	SITE LAYOUT PLAN
C-2	STANDARD SITE SECTIONS
A-1	ELEVATIONS
S-1	FOUNDATION/LOWER LEVEL PLAN
S-2	UPPER LEVEL PLAN
S-3	WALKWAY PLAN
S-4	TYPICAL BAY COVER PLAN
S-5	LONGITUDINAL BUILDING SECTION
S-6	BUILDING SECTIONS
S-7	FOUNDATIONS SECTIONS AND DETAILS
S-8	FOUNDATION SECTIONS
S-9	SECTIONS
S-10	SECTIONS AND DETAILS
S-11	SECTIONS AND DETAILS
S-12	SECTIONS
MO1	BAY COVER CONFIGURATIONS
MO2	MACHINERY LAYOUT
MO3	BAY COVERS-PLANS AND ELEVATIONS
MO4	CABLE TENSIONING DEVICE
MO5	BAY COVER DRIVE MACHINERY
MO6	MISCELLANEOUS DETAILS
M-1	VENTILATED MAGAZINE (12 AIR CHANGES)
M-2	AIR CONDITIONED MAGAZINE (12 AIR CHANGES)
E-1	LIGHTING PLAN – FIRST LEVEL
E-2	LIGHTING PLAN – SECOND LEVEL
E-3	VENTILATED MAGAZINE
E-4	AIR CONDITIONED MAGAZINE
E-5	LIGHTING PLATES
E-6	DETAILS
E-7	LIGHTING PROTECTING PLAN
SK-HPM-1	CELL WALL BLOCK – BASIC UNIT
SK-HPM-2	CELL WALL BLOCK – BASIC UNIT
SK-HPM-5	CELL WALL BLOCK – BOTTOM UNIT
SK-HPM-6	CELL WALL BLOCK – BOTTOM UNIT



REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

A/E		EFD
	DESIGN	
	DRAWN	
	REVIEW	
	QC	
	CHIEF ARCH./ ENGR.	
PROJECT MANAGER		
FIRE PROTECTION		
BRANCH MANAGER		
DESIGN DIRECTOR		

DESIGNED & ENGINEERED BY:

LANTDIV

NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY – SATISFACTORY TO

APPROVED DATE

FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

SITE LAYOUT PLAN

CODE ID. NO. 80091	SIZE D
SCALE:	
EFD NO.	
STA. PROJ. NO.	
SPEC. NO.	
CONSTR. CONTR. NO.	
NAVFAC DRAWING NO.	
SHEET	OF

C–1

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DRAWFORM REVISION 25 SEPT 96

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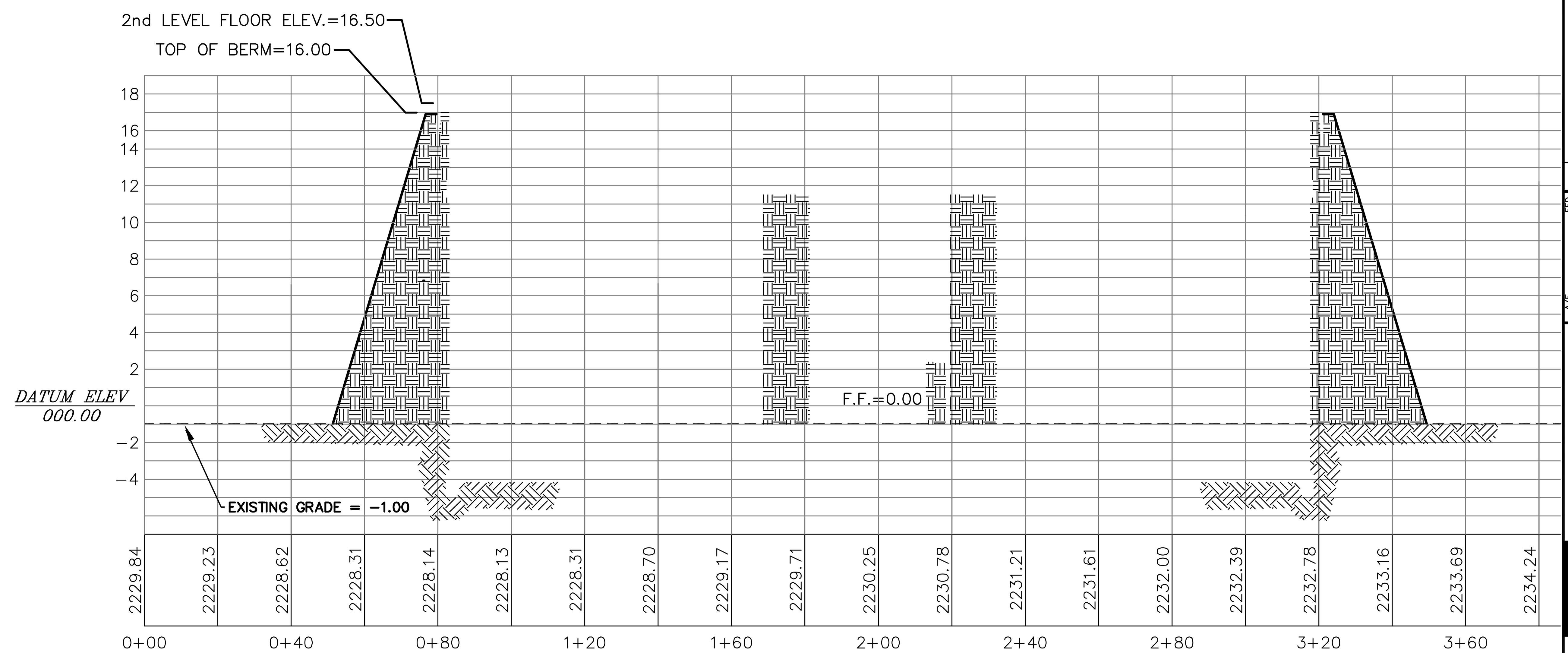

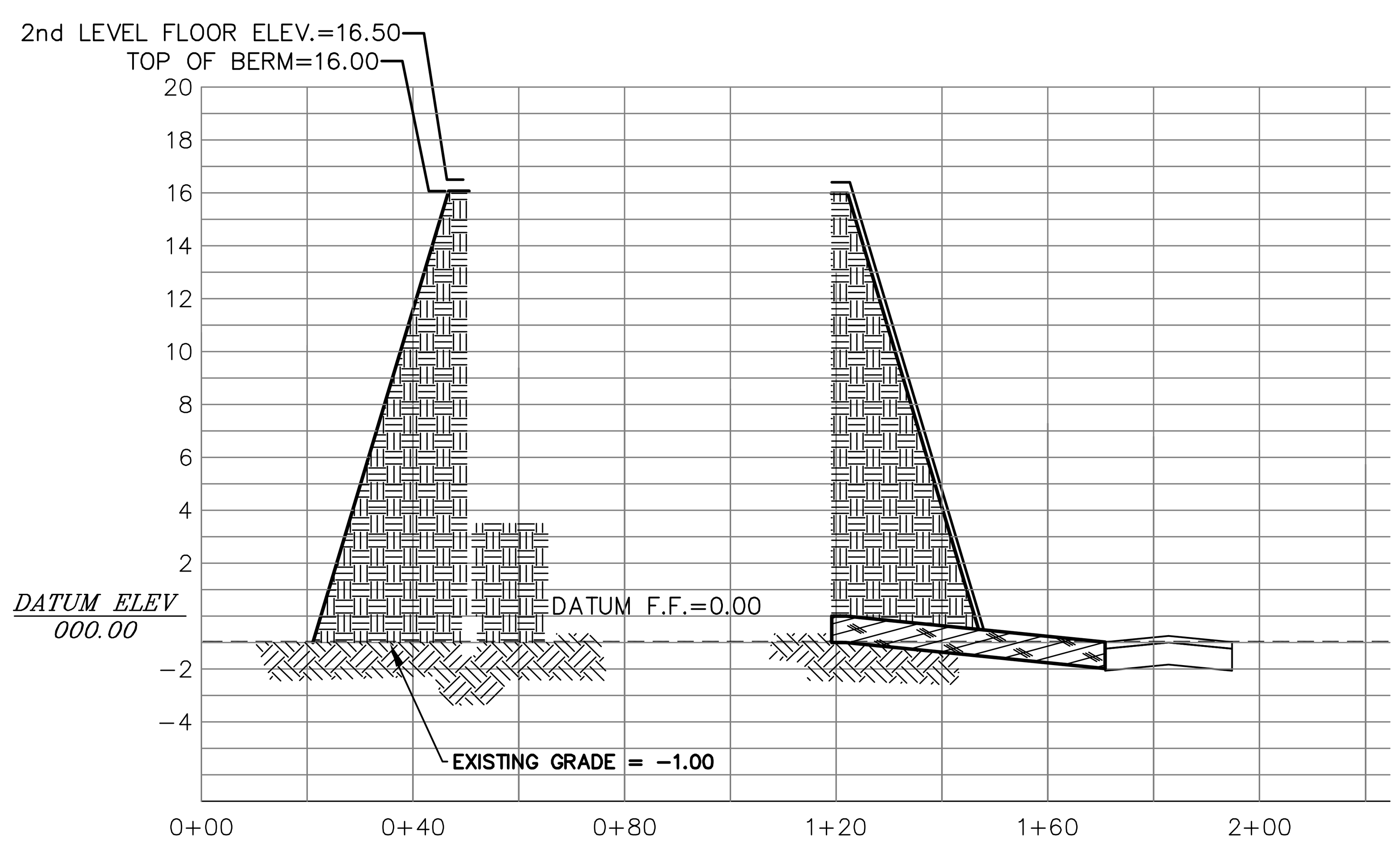

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN PAM
DRAWN PAM

ACTIVITY - SATISFACTORY TO

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

STANDARD SITE SECTIONS

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET OF
C-2

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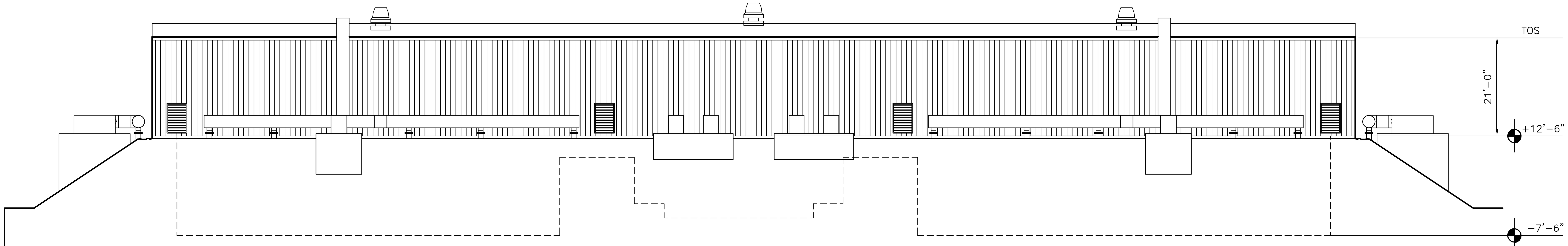

REAR ELEVATION (A / S1 A3)

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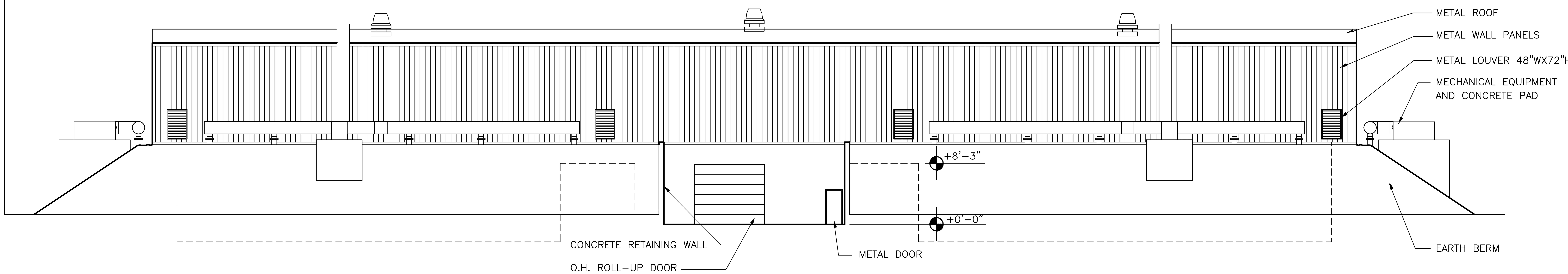

FRONT ELEVATION (B / S1 A3)

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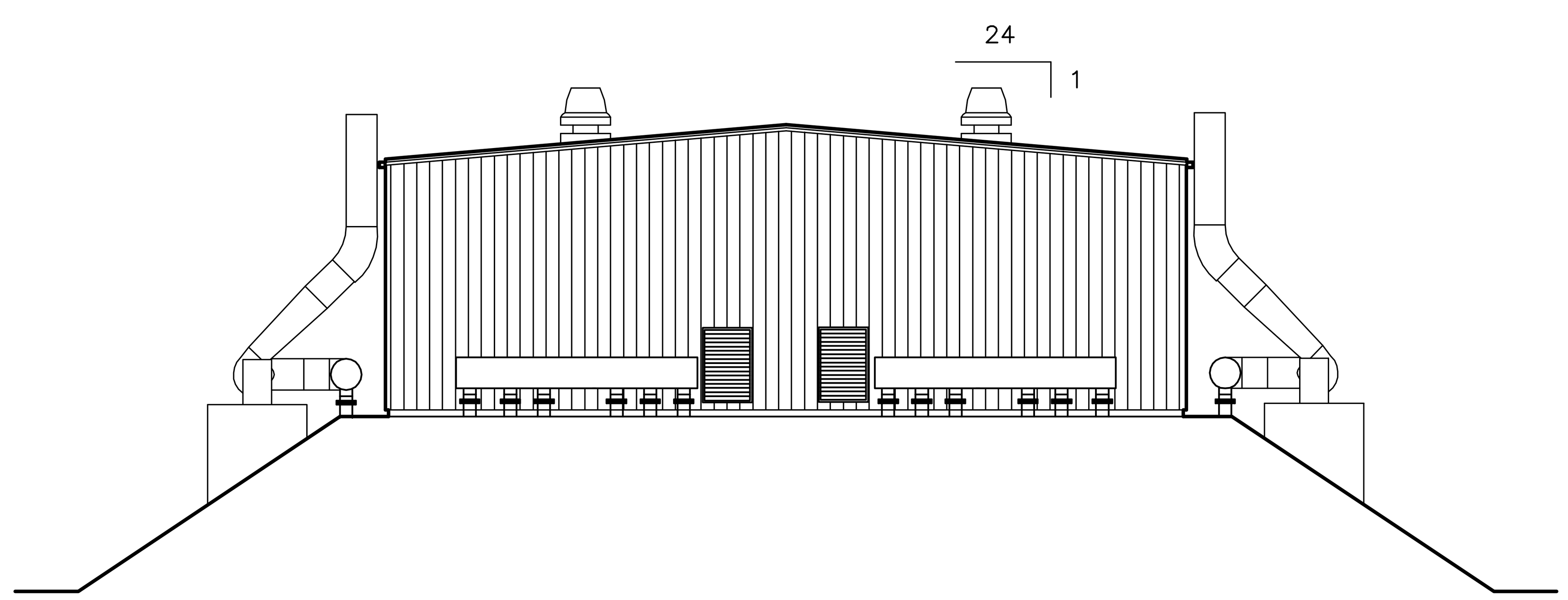

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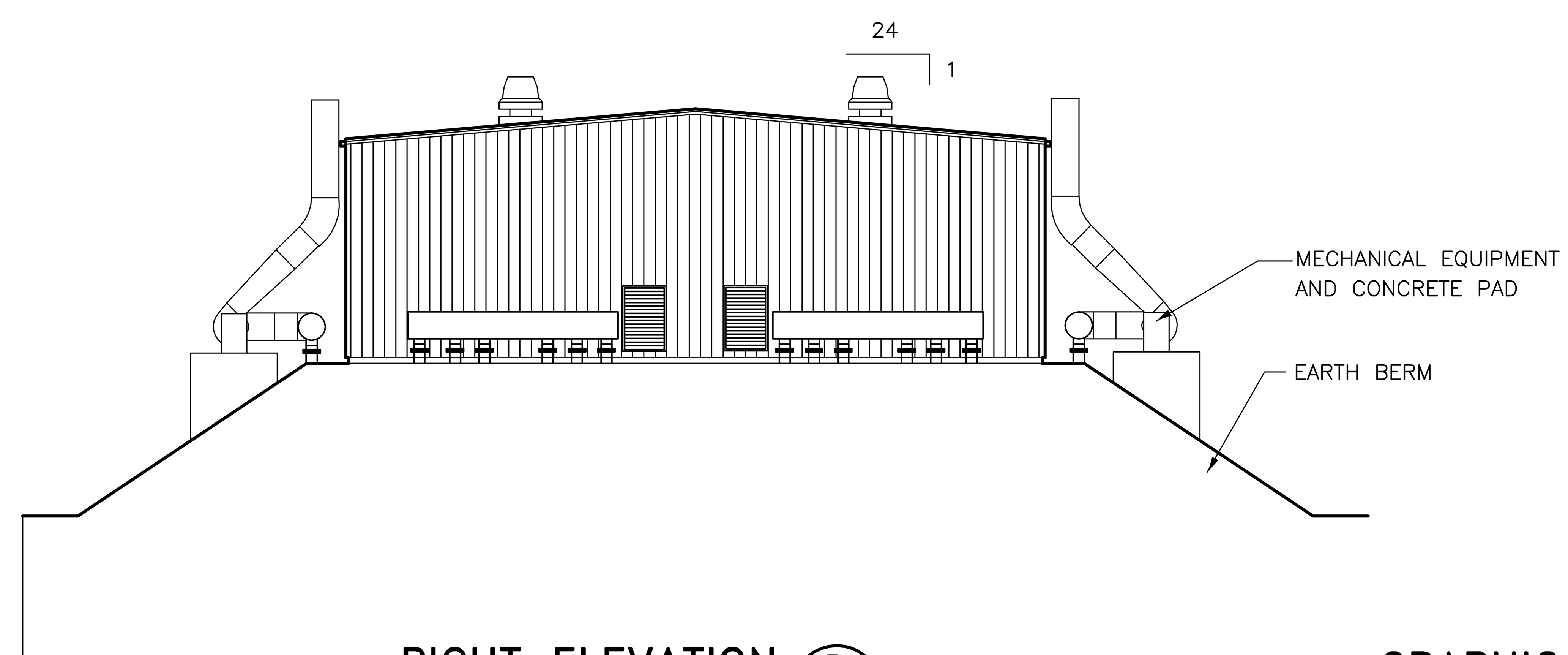

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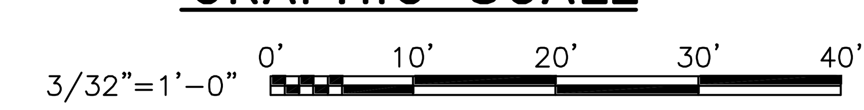
GRAPHIC SCALE



REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

A/E: DESIGN MOA, DRAWN MOA, REVIEW, QC, CHIEF ARCH./ENGR., PROJECT MANAGER, FIRE PROTECTION, BRANCH MANAGER, DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND — DATE

APPROVED — ACTIVITY — SATISFACTORY TO — DATE

APPROVED — FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION — NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

ELEVATIONS

CODE ID. NO. 80091 | SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

SHEET OF

A-1

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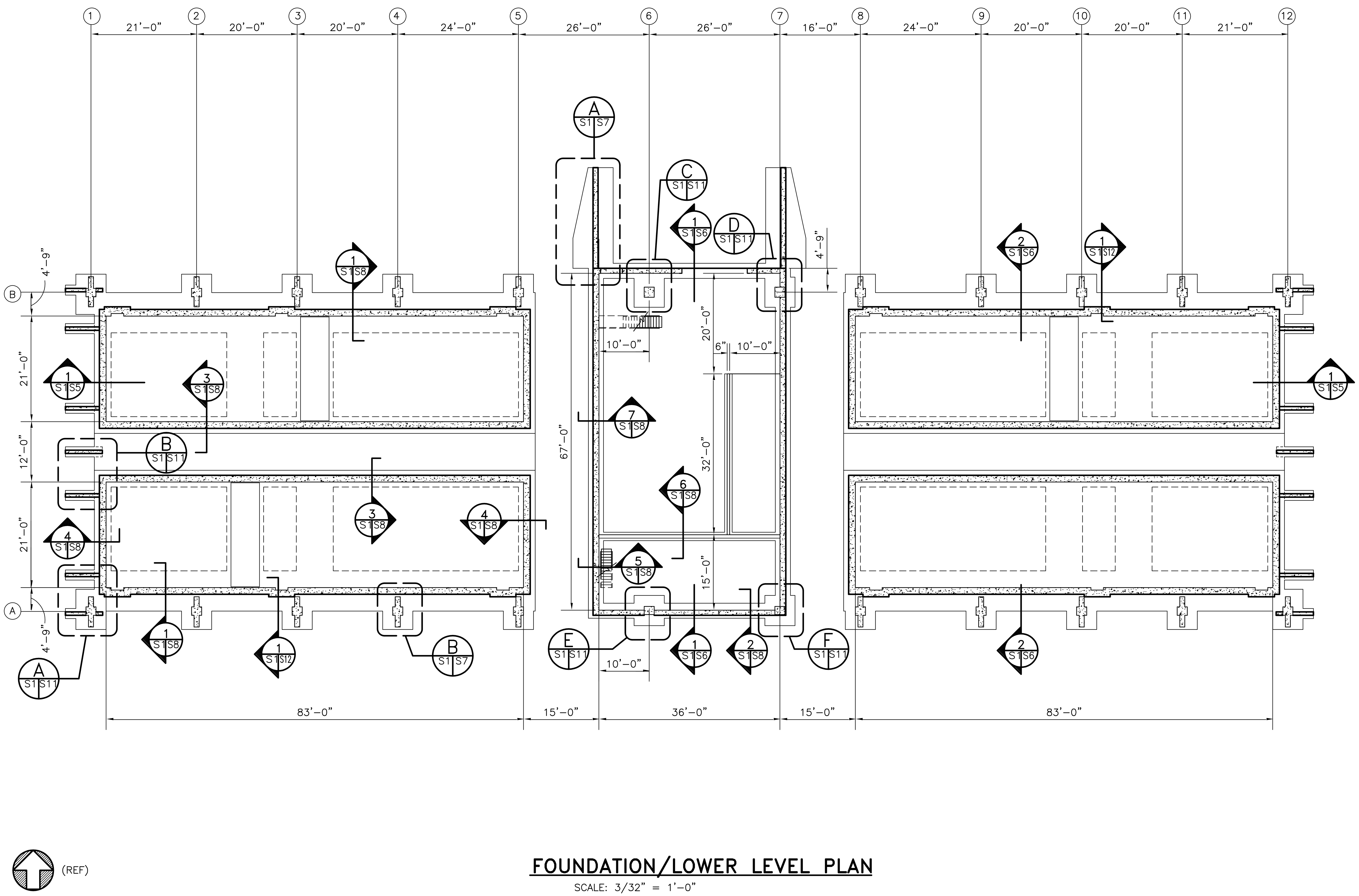
DRAWFORM REVISION 25 SEPT 96

8 7 6 5 4 3 2 1

D C B A



FOUNDATION/LOWER LEVEL PLAN

SCALE: 3/32" = 1'-0"

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN OLH
DRAWN OLH

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

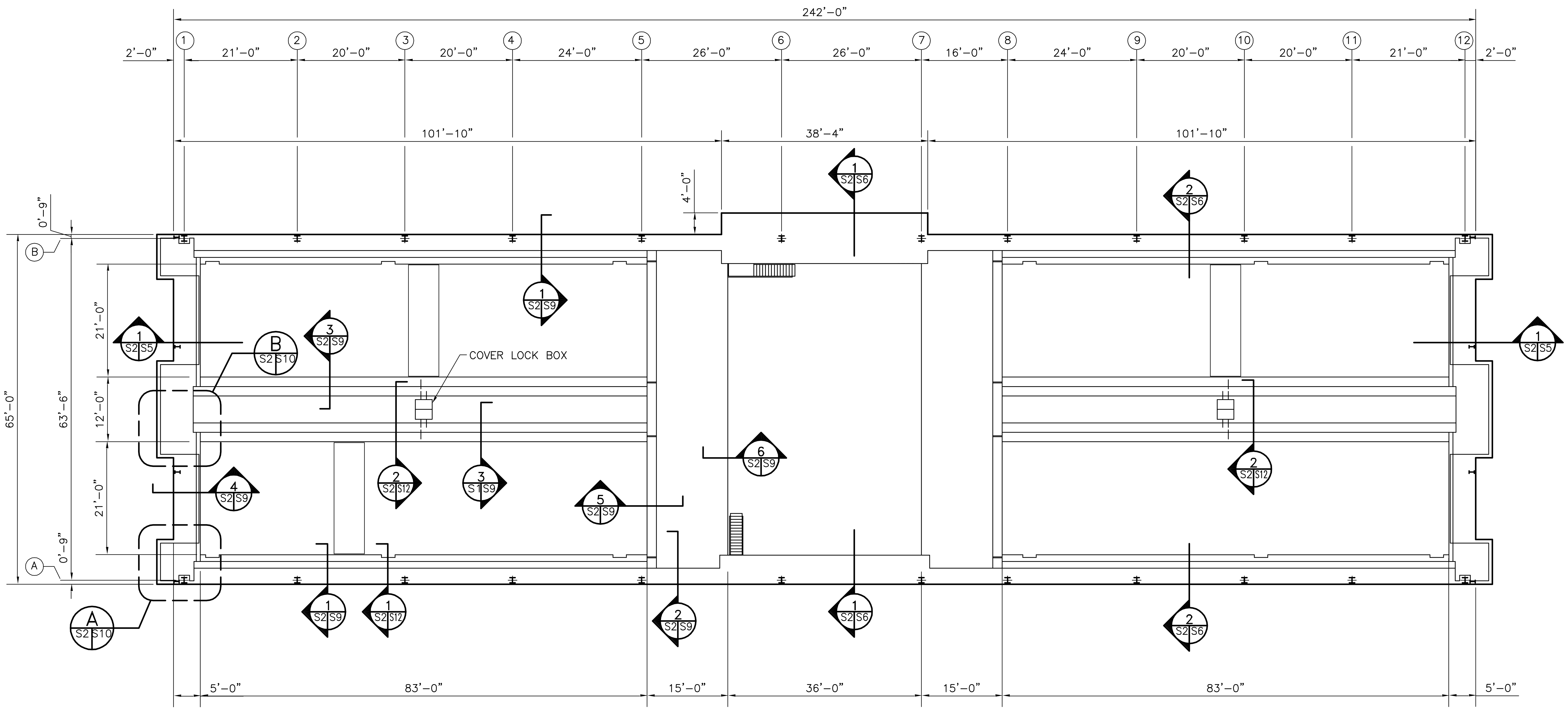
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

FOUNDATION/LOWER LEVEL PLAN

CODE ID. NO. 80091 SIZE D

S-1

FILENAME: 7605S001.DWG, UPDATED ON 07/10/01 AT 11:34, XREFS: MODEL-PLAN



UPPER LEVEL PLAN

SCALE: 3/32" = 1'-0"

(REF)

NOTE:
STEEL WALKWAY AND BAY COVERS
NOT SHOWN FOR CLARITY.

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

A/E: DESIGN OLH, DRAWN OLH, REVIEW, CHIEF ARCH./ENGR., PROJECT MANAGER, FIRE PROTECTION, QUALITY CONTROL, BRANCH MANAGER, DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED — DATE

ACTIVITY — SATISFACTORY TO — DATE

APPROVED — FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION — NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

UPPER LEVEL PLAN

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

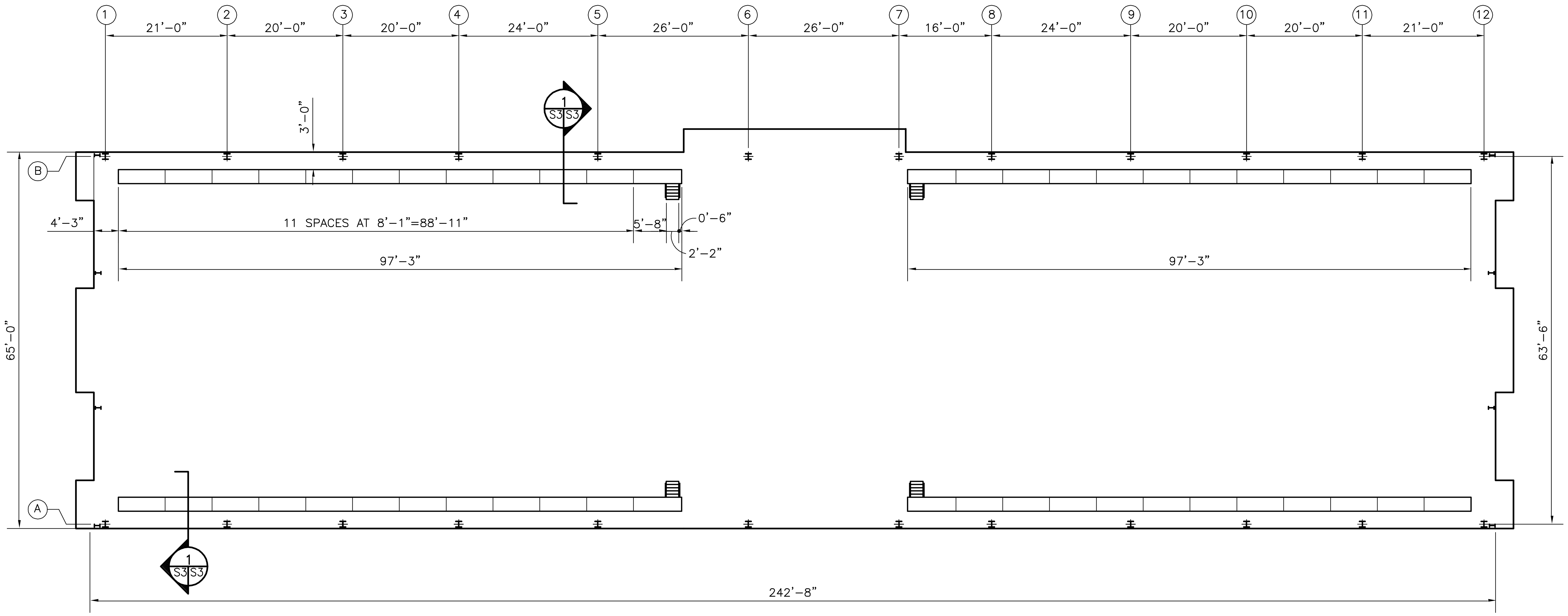
CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

SHEET OF

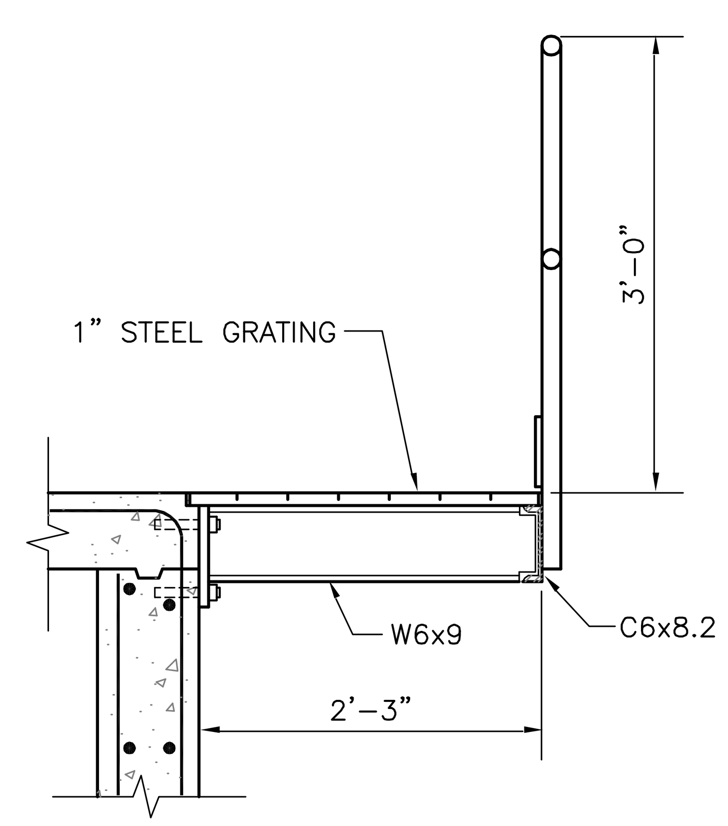
S-2

FILENAME: 7605S002.DWG, UPDATED ON 07/10/01 AT 11:37, XREFS: MODEL-PLAN



WALKWAY PLAN

SCALE: 3/32" = 1'-0"



SECTION

SCALE: 1" = 1'-0"

1
S3 S3

GRAPHIC SCALES

3/32"=1'-0" 0' 10' 20' 30' 40'

1"=1'-0" 1' 6" 0' 1' 2' 3'

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

A/E

DESIGN OLH

DRAWN LOH

REVIEW

CHIEF ARCH./ ENGR.

PROJECT MANAGER

FIRE PROTECTION

QUALITY CONTROL

BRANCH MANAGER

DESIGN DIRECTOR

APPROVED

ACTIVITY — SATISFACTORY TO DATE

APPROVED DATE

FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

WALKWAY PLAN

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

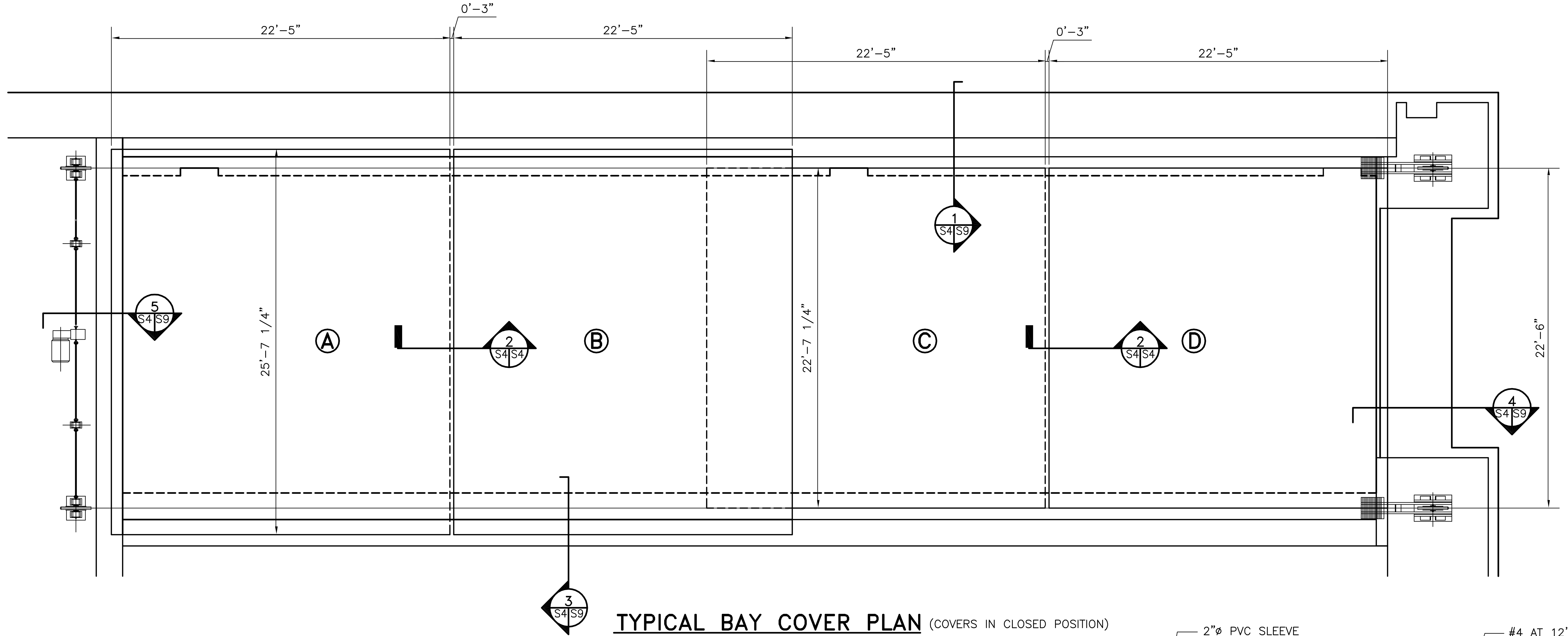
CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

SHEET OF

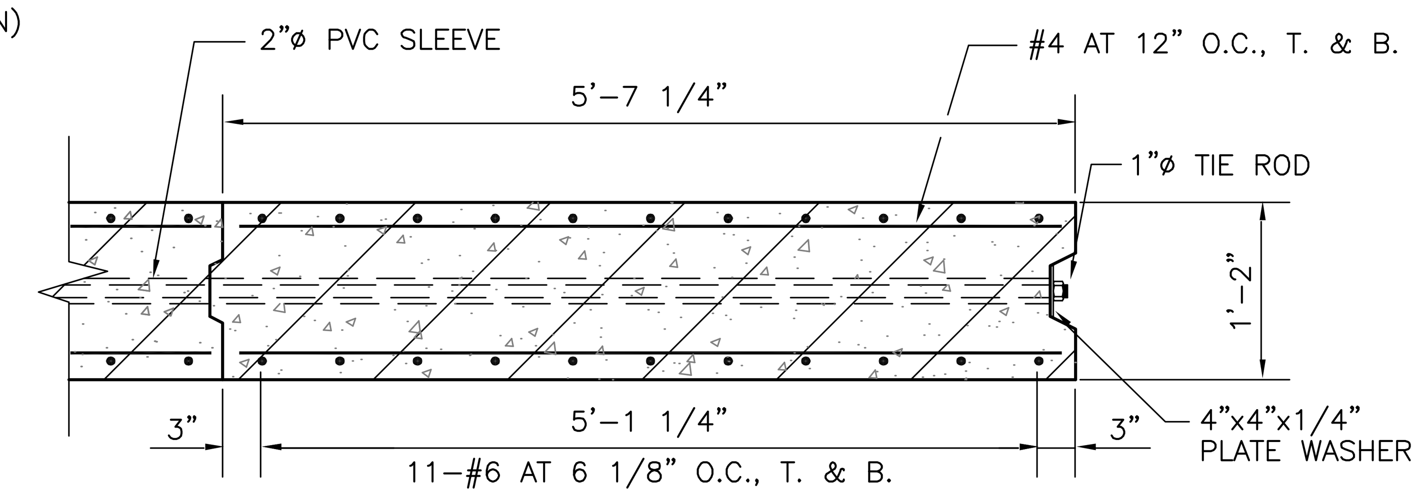
S-3

FILENAME: 7605S003.DWG, UPDATED ON 07/03/01 AT 13:36, XREFS: MODEL-PLAN



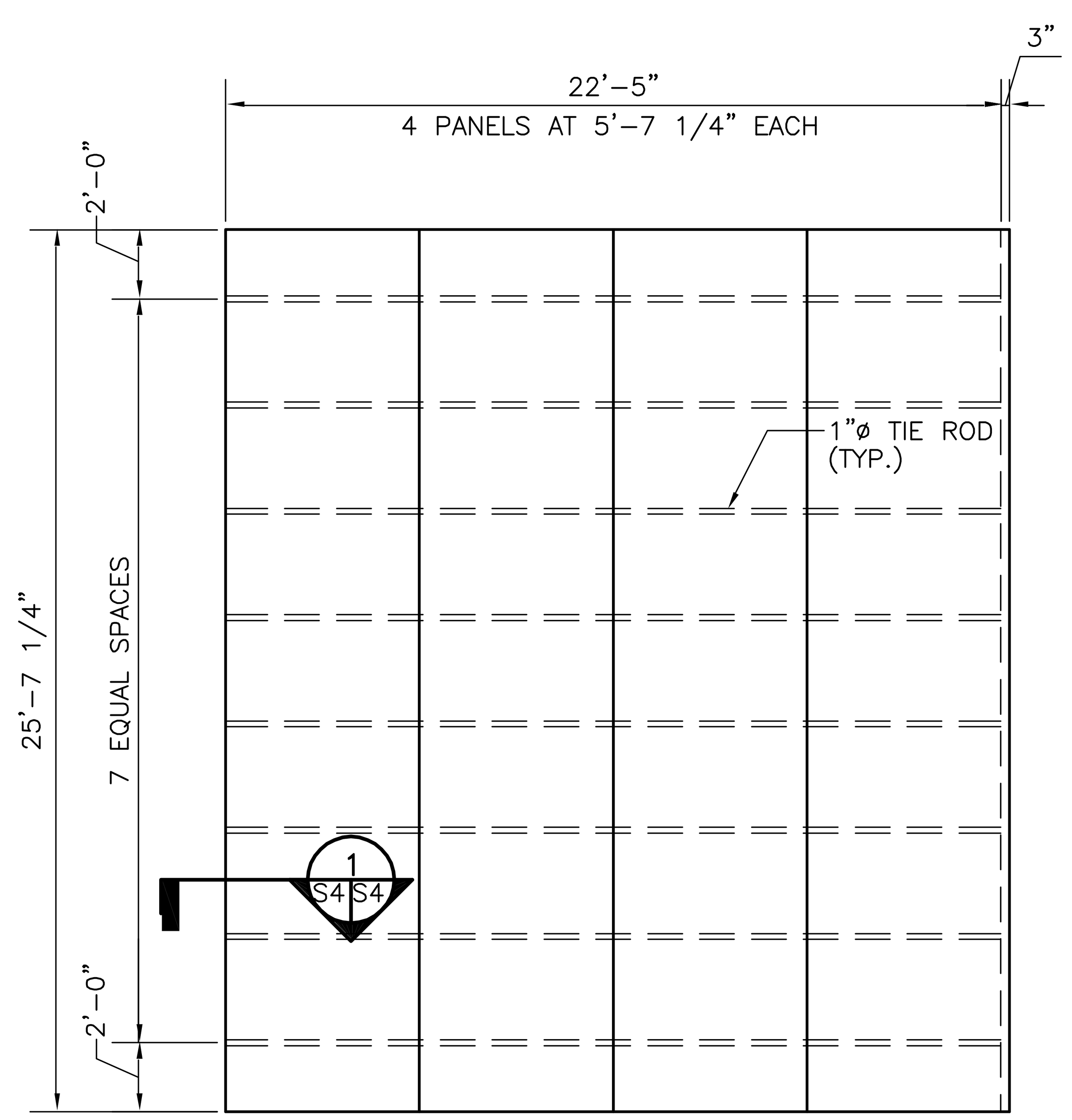
TYPICAL BAY COVER PLAN (COVERS IN CLOSED POSITION)

SCALE: 1/4" = 1'-0"



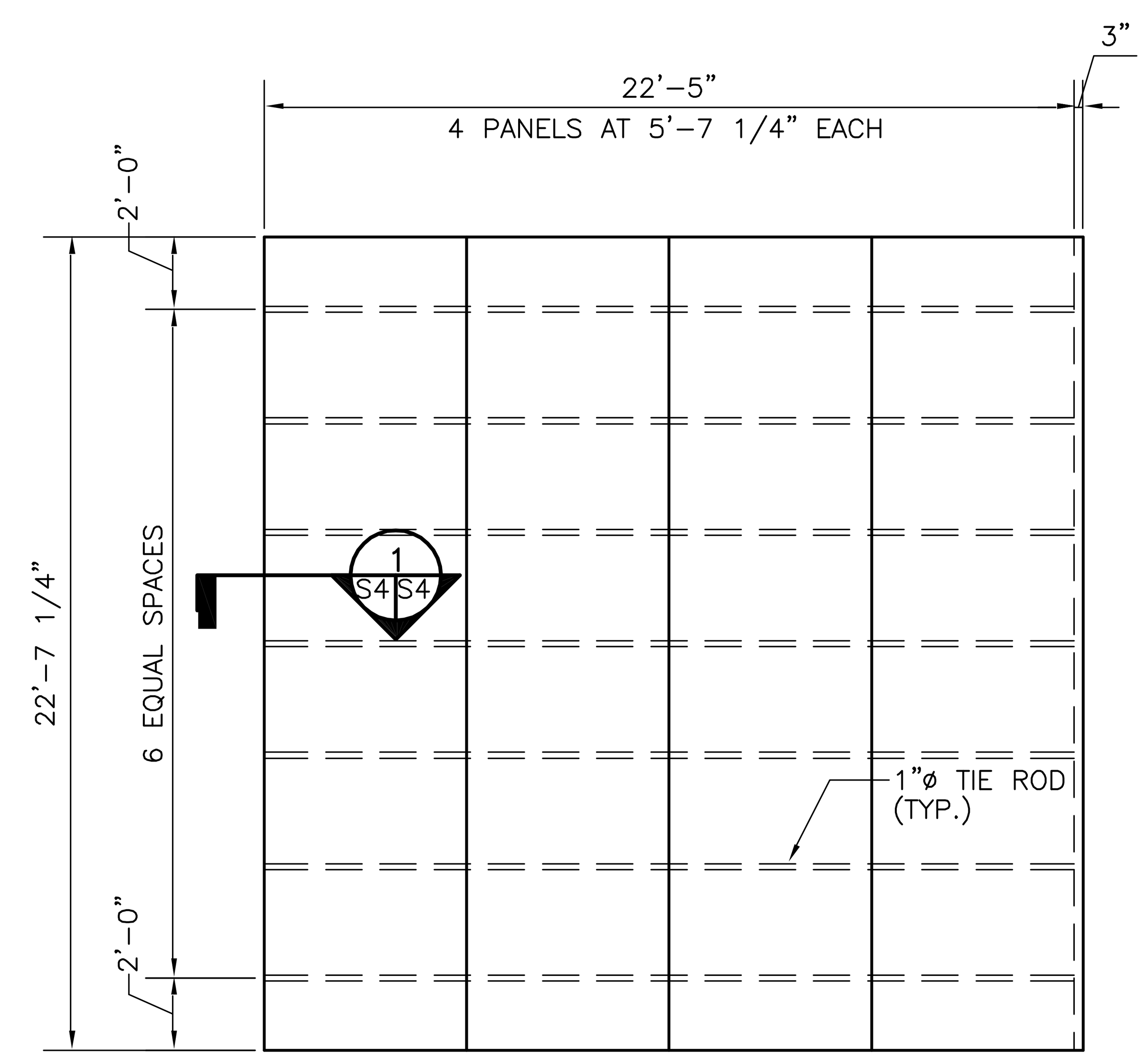
SECTION 1 S4 S4

SCALE: 1" = 1'-0"



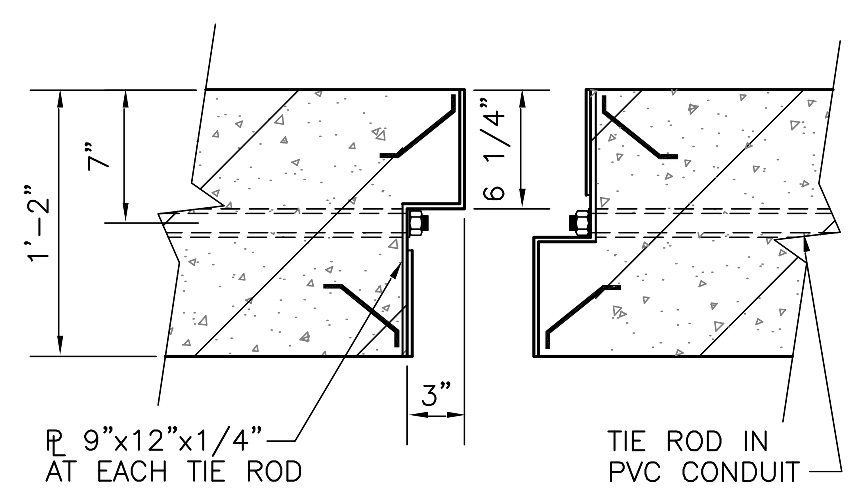
BAY COVERS A & B OPP HAND-SIM

SCALE: 1/4" = 1'-0"



BAY COVERS C & D OPP HAND-SIM

SCALE: 1/4" = 1'-0"

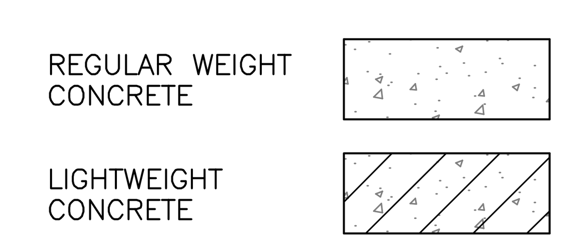


NOTE:
COVER REINF. NOT SHOWN FOR CLARITY

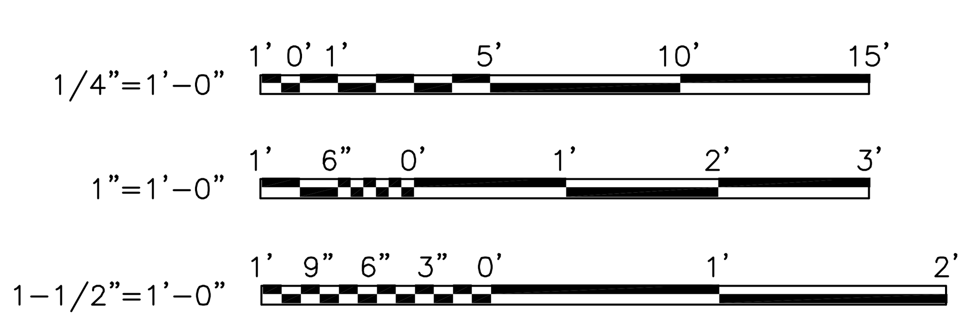
SECTION 2 S4 S4

SCALE: 1 1/2" = 1'-0"

LEGEND



GRAPHIC SCALES



REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

A/E

DESIGN OLH
DRAWN OLH
REVIEW OLH
CHIEF ARCH./ ENGR.
PROJECT MANAGER
FIRE PROTECTION
QUALITY CONTROL
BRANCH MANAGER
DESIGN DIRECTOR

APPROVED DATE
ACTIVITY – SATISFACTORY TO DATE
APPROVED
FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA
NAVAL STATION

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

TYPICAL BAY COVER PLAN

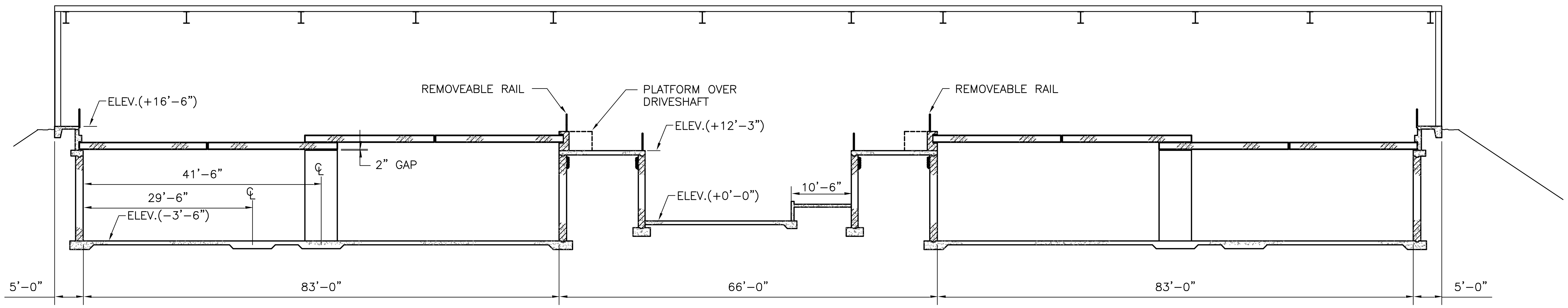
CODE ID. NO. 80091 SIZE D
SCALE:
EFD NO.
STA. PROJ. NO.
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET OF

S-4

FILENAME: 7605S004.DWG, UPDATED ON 07/03/01 AT 13:37, XREFS: MODEL-PLAN

D C B A

8 7 6 5 4 3 2 1



SECTION

SCALE: 3/32" = 1'-0"

1 S1 S5 S2

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM. DESCRIPTION DATE APPROVED

A/E EFD

DESIGN OLH

DRAWN OLH

REVIEW

QC

CHIEF ARCH./ ENGR.

PROJECT MANAGER

FIRE PROTECTION

BRANCH MANAGER

DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY - SATISFACTORY TO DATE

APPROVED

FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

LONGITUDINAL BUILDING SECTION

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

CONSTR. CONTR. NO.

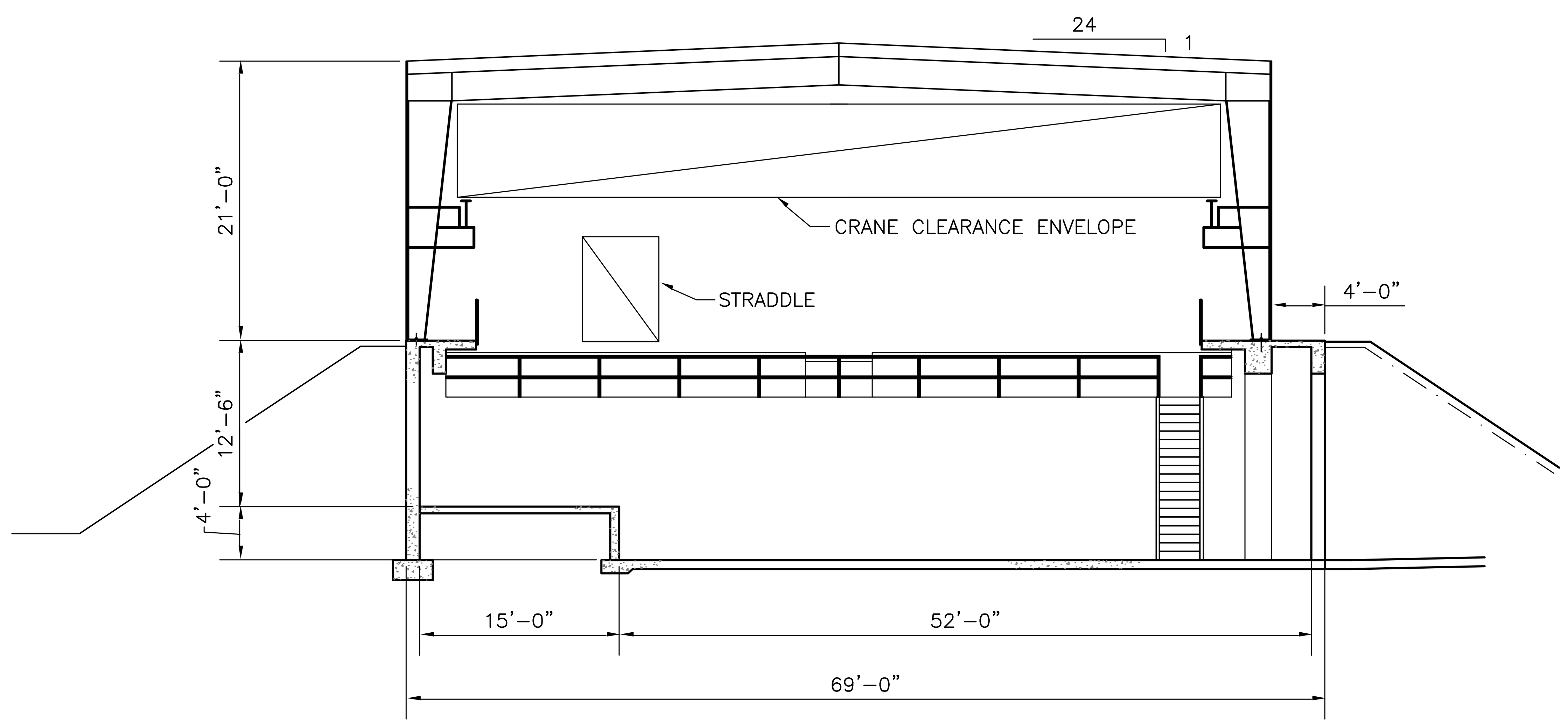
NAVFAC DRAWING NO.

SHEET OF

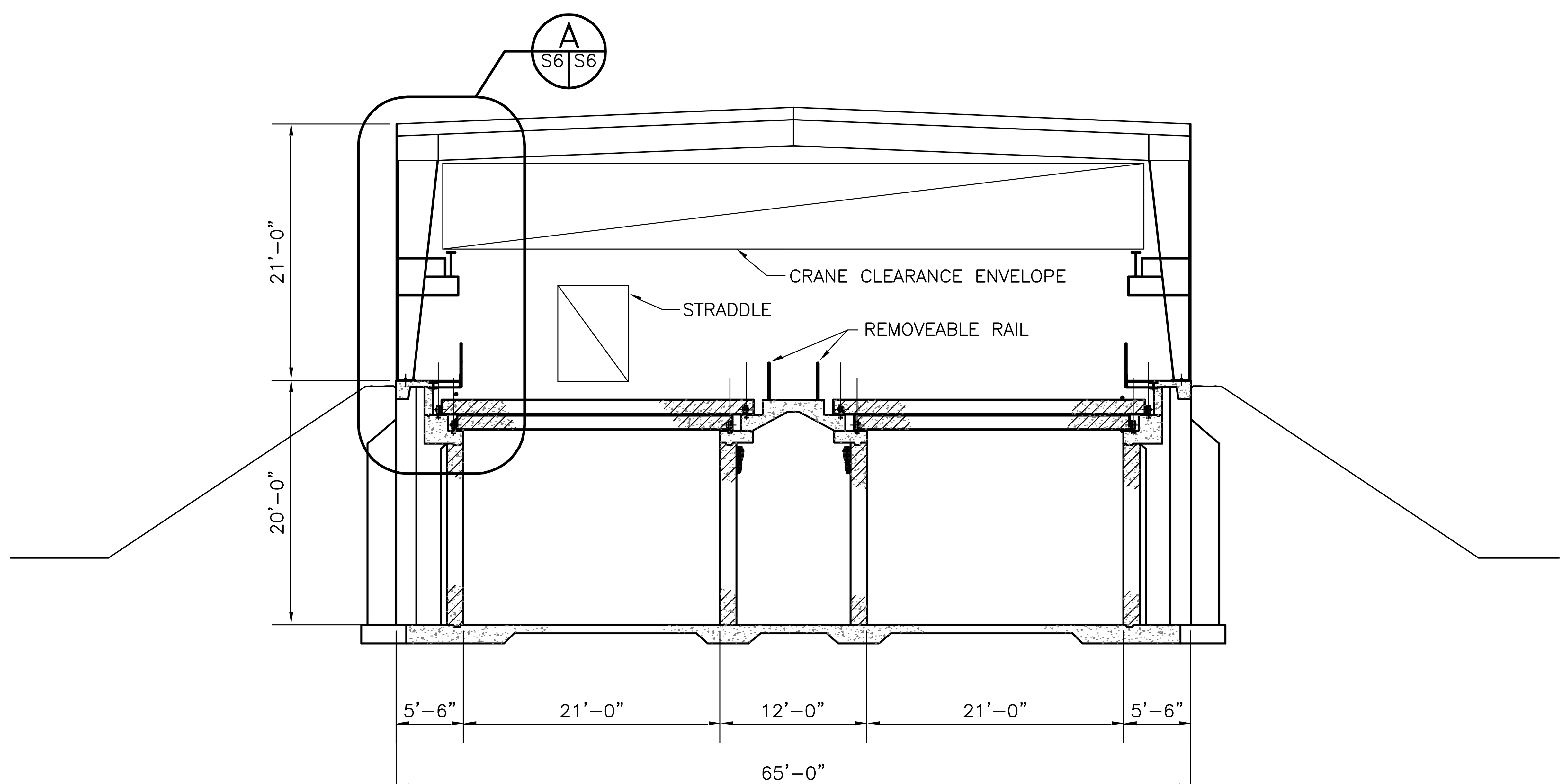
S-5

FILENAME: 7605S005.DWG, UPDATED ON 07/10/01 AT 09:14, XREFS: NONE

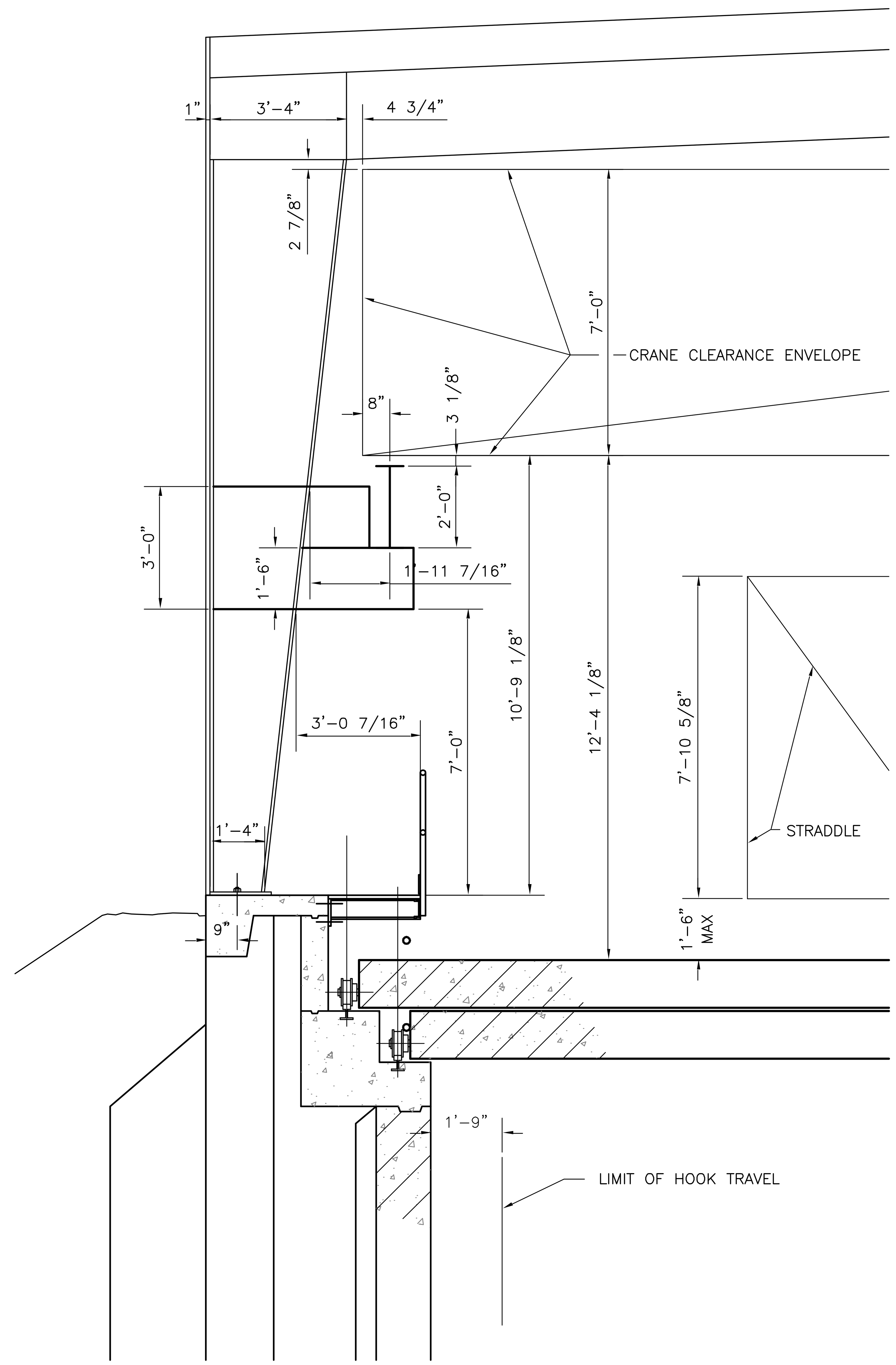
DRAWFORM REVISION 25 SEPT 96



SECTION 1 (S1 | S6)
SCALE: 1/8" = 1'-0"
S2



SECTION 2 (S1 | S6)
SCALE: 1/8" = 1'-0"
S2



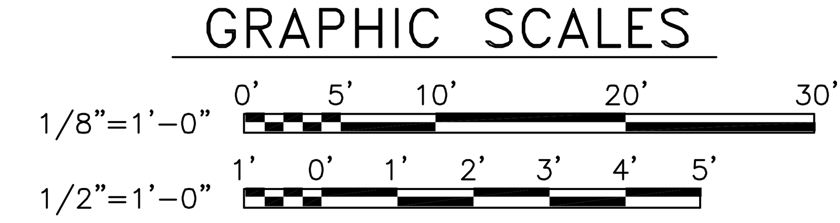
DETAIL A (S6 | S6)
SCALE: 1/2" = 1'-0"

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALES



REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

DESIGN OLH
DRAWN OLH
REVIEW OLH
CHIEF ARCH./ENGR.
PROJECT MANAGER
FIRE PROTECTION
QUALITY CONTROL
BRANCH MANAGER
DESIGN DIRECTOR

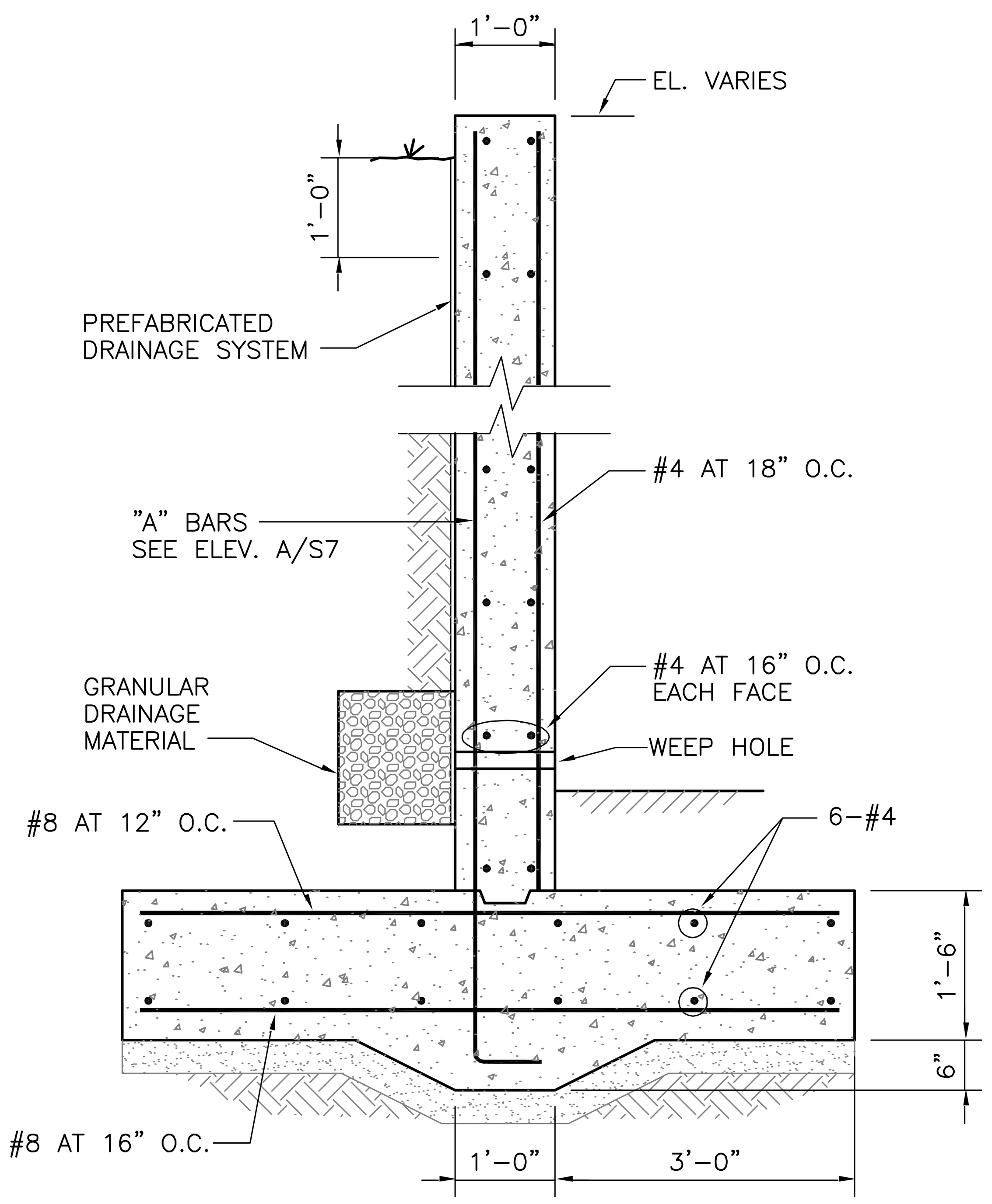
APPROVED
ACTIVITY – SATISFACTORY TO
APPROVED
FOR EFD FOR COMMANDER NAVFAC
SEAL

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

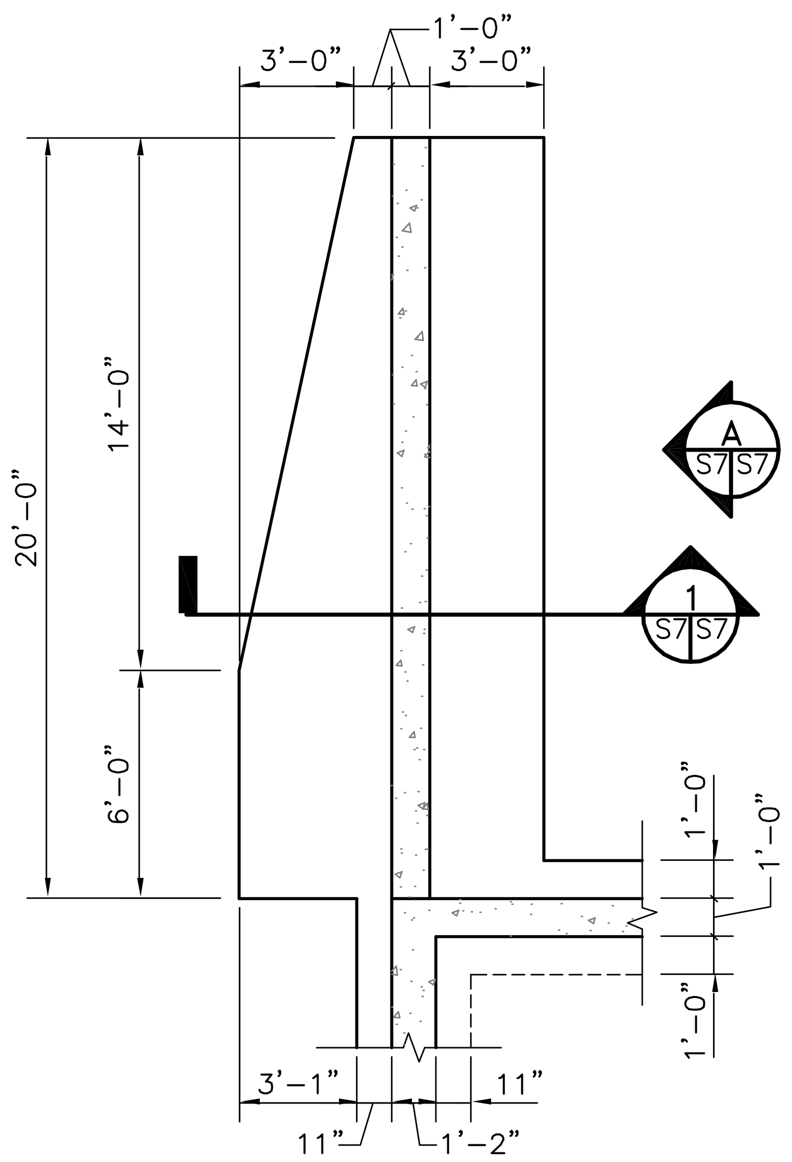
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
BUILDING SECTIONS

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET OF
S-6

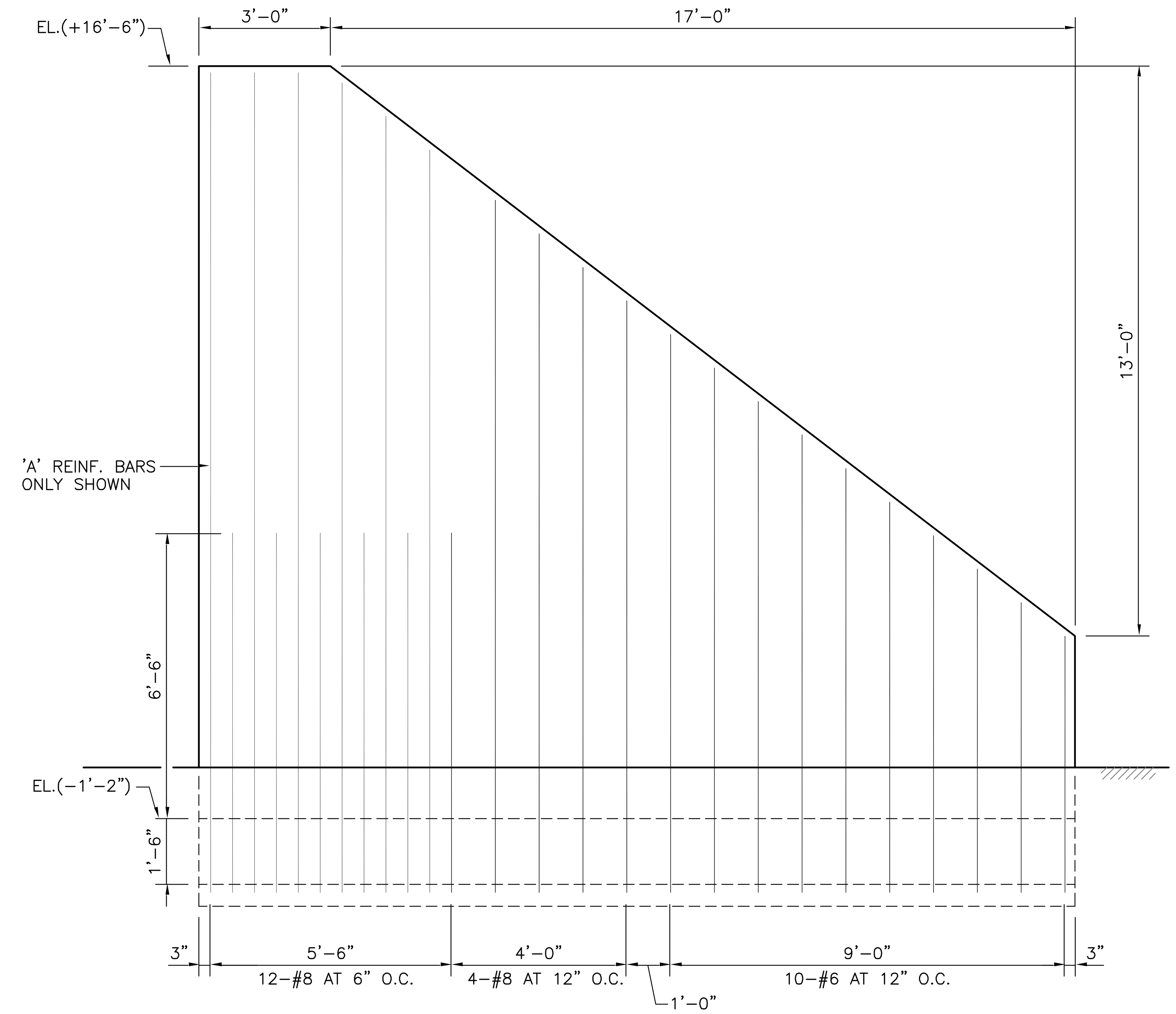
FILENAME: 7605S006.DWG, UPDATED ON 07/10/01 AT 10:53, XREFS: NONE



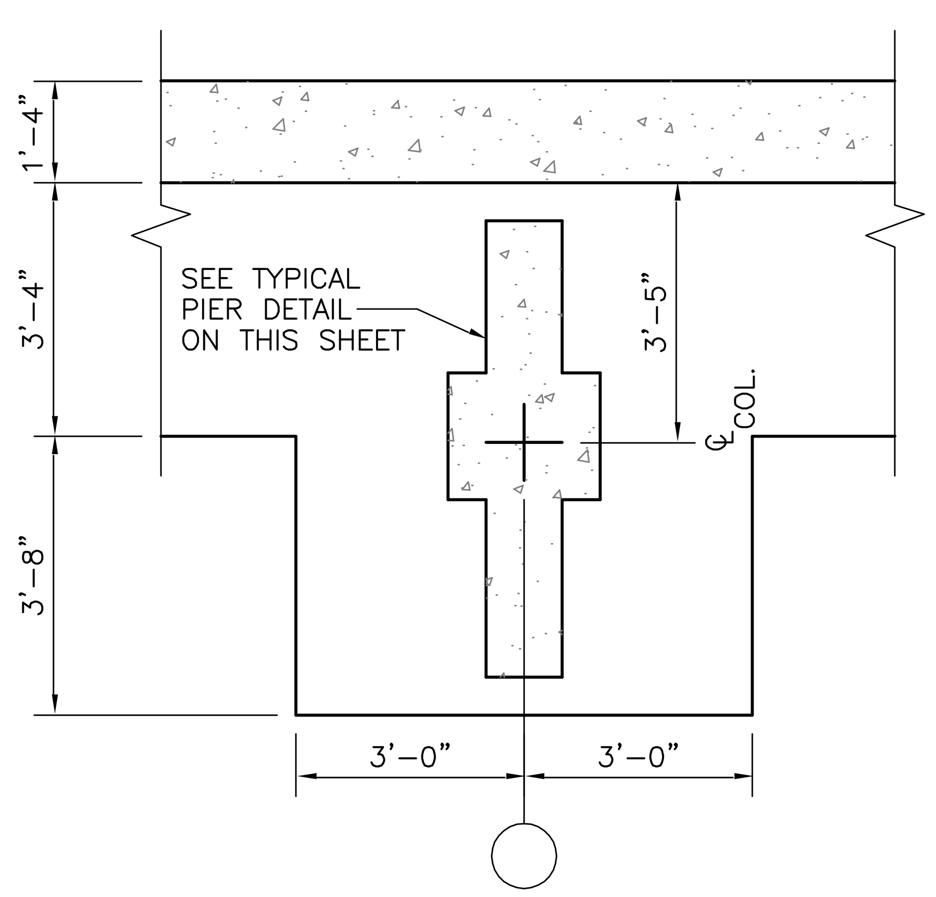
SECTION (1 S7/S7)
SCALE: 3/4" = 1'-0"



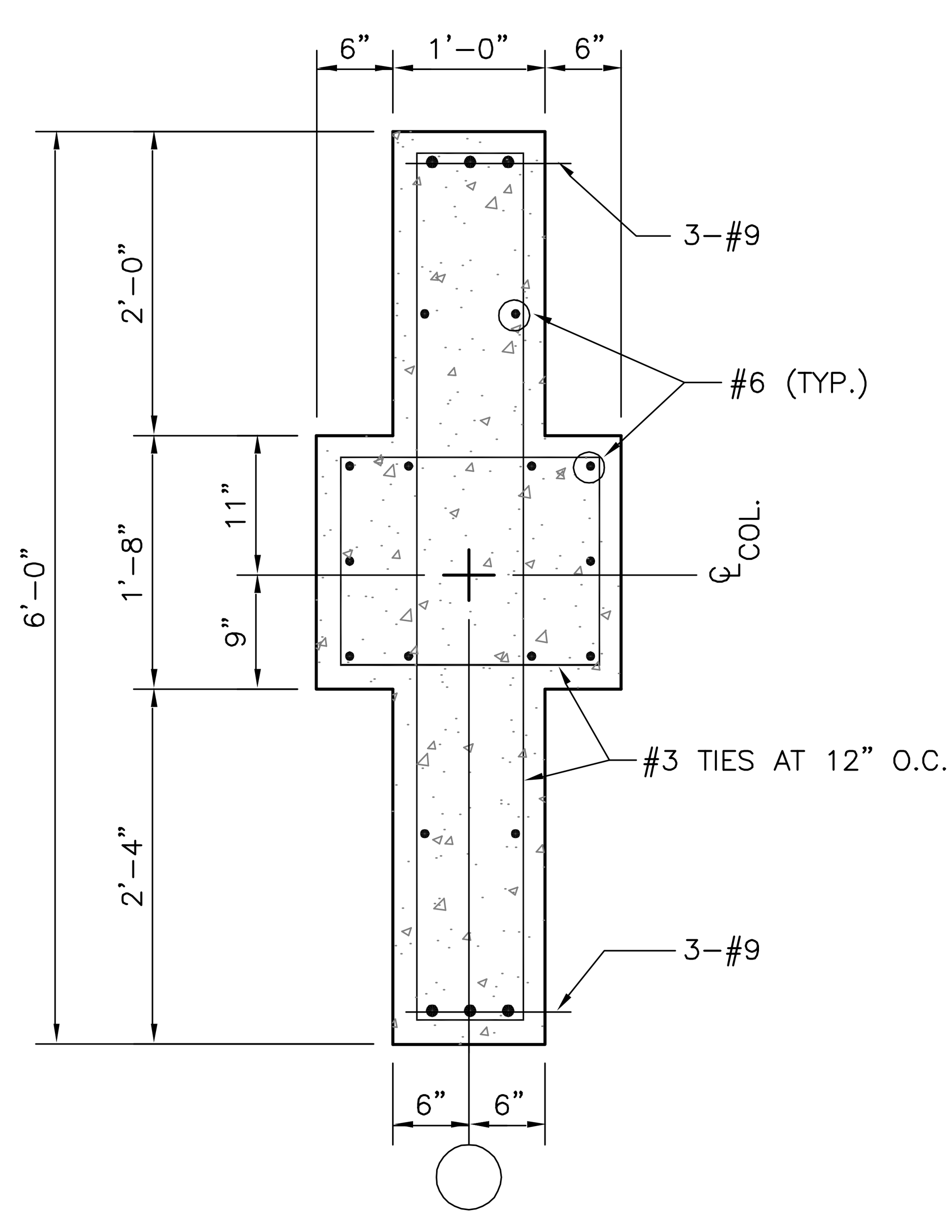
DETAIL (A S1/S7)
SCALE: 1/4" = 1'-0"



ELEVATION (A S7/S7)
SCALE: 1/2" = 1'-0"



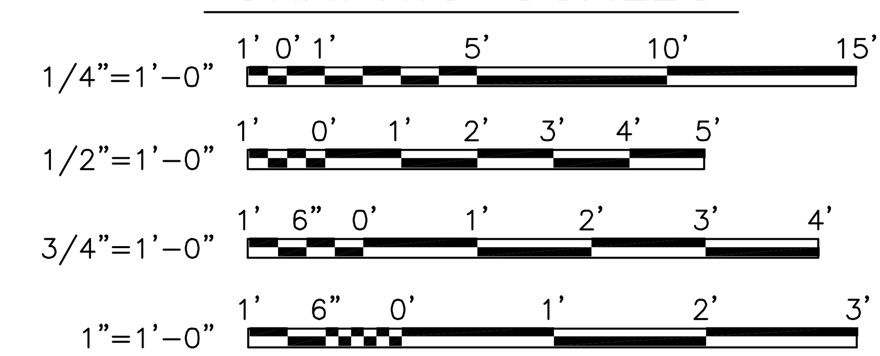
DETAIL (B S1/S7)
SCALE: 1/2" = 1'-0"



TYPICAL PIER DETAIL
SCALE: 1" = 1'-0"

DETAIL (C S1/S7)
SCALE: 1/2" = 1'-0"

GRAPHIC SCALES



REVISIONS
SYM. | DESCRIPTION | DATE | APPROVED

A/E: DESIGN OLH; DRAWN OLH; REVIEW OLH; QC; CHIEF ARCH./ENGR.; PROJECT MANAGER; FIRE PROTECTION; BRANCH MANAGER; DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND
APPROVED / DATE
ACTIVITY — SATISFACTORY TO / DATE
APPROVED / FOR EFD FOR COMMANDER NAVFAC
SEAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION — NORFOLK, VIRGINIA

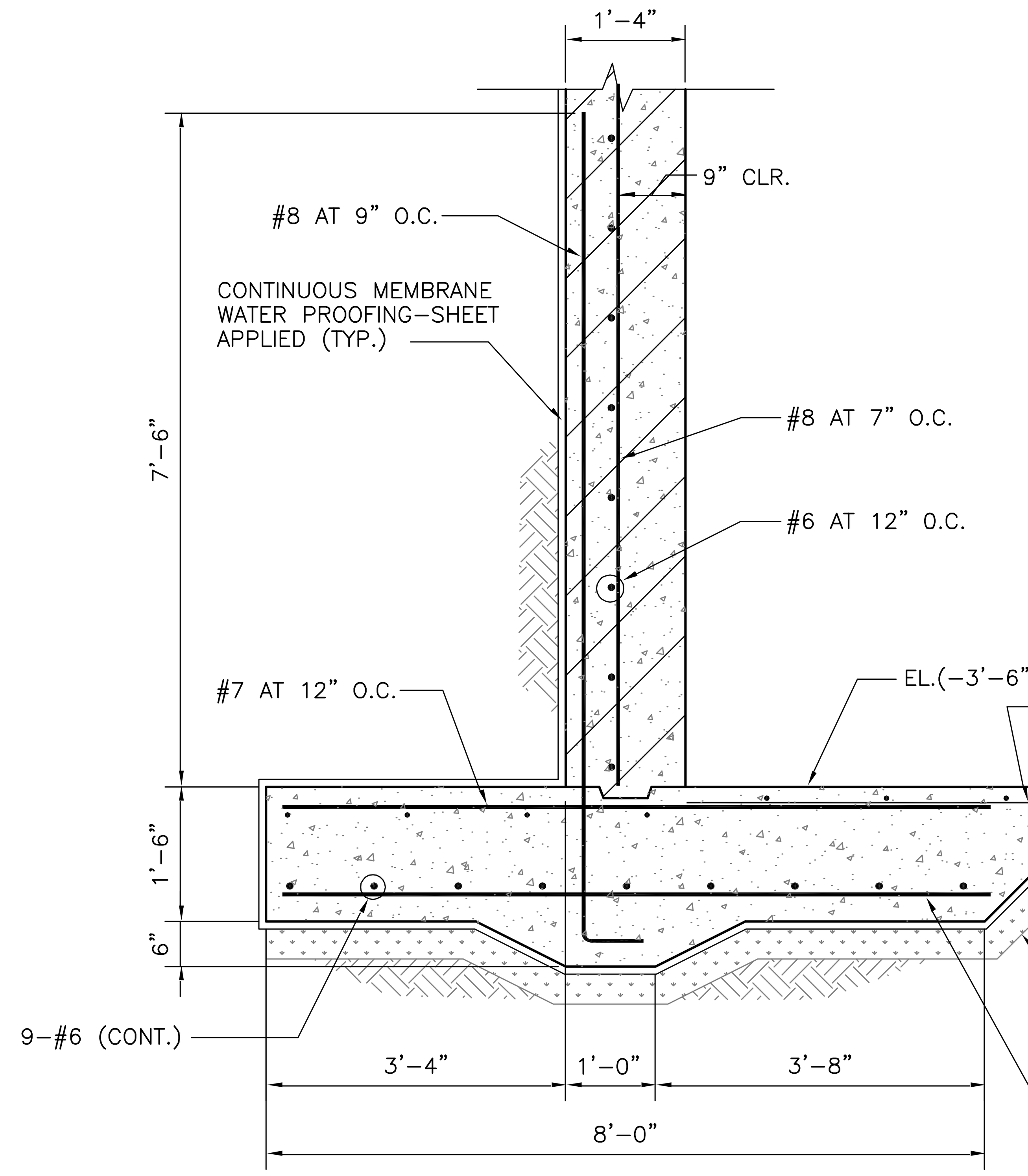
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
FOUNDATION SECTIONS AND DETAILS

CODE ID. NO. 80091 | SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO. 05-97-7605
CONSTR. CONTR. NO. N62470-97-B-7605
NAVFAC DRAWING NO.
SHEET OF
S-7

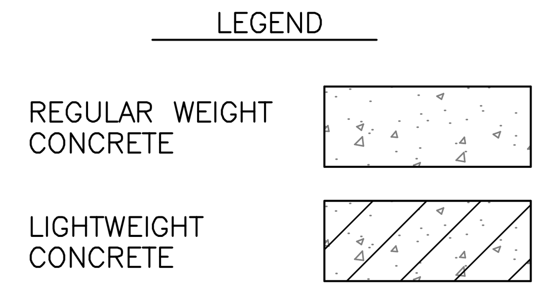
D C B A
8 7 6 5 4 3 2 1

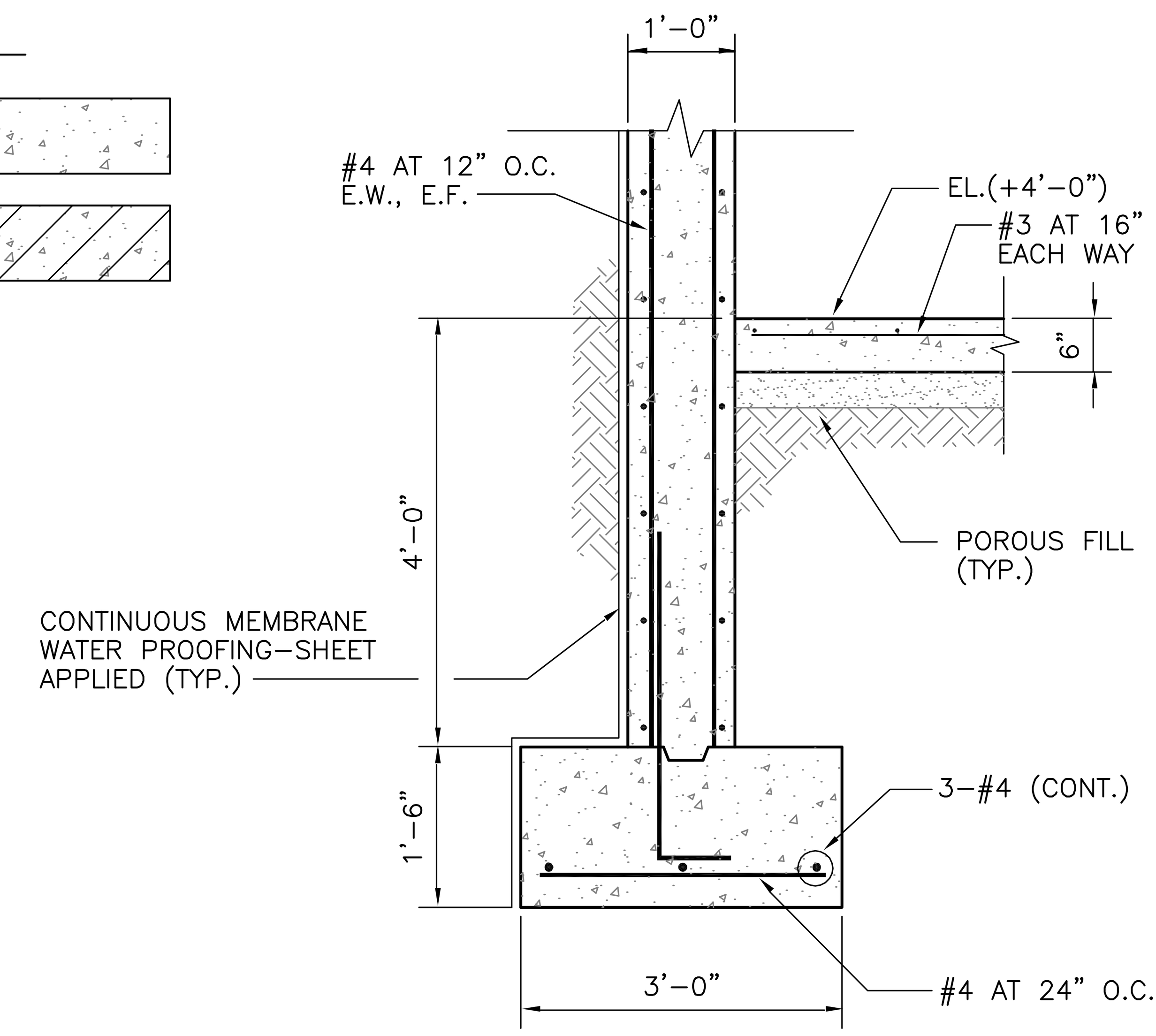
DRAWFORM REVISION 25 SEPT 96

FILENAME: 7605S007.DWG, UPDATED ON 07/03/01 AT 13:42, XREFS: NONE

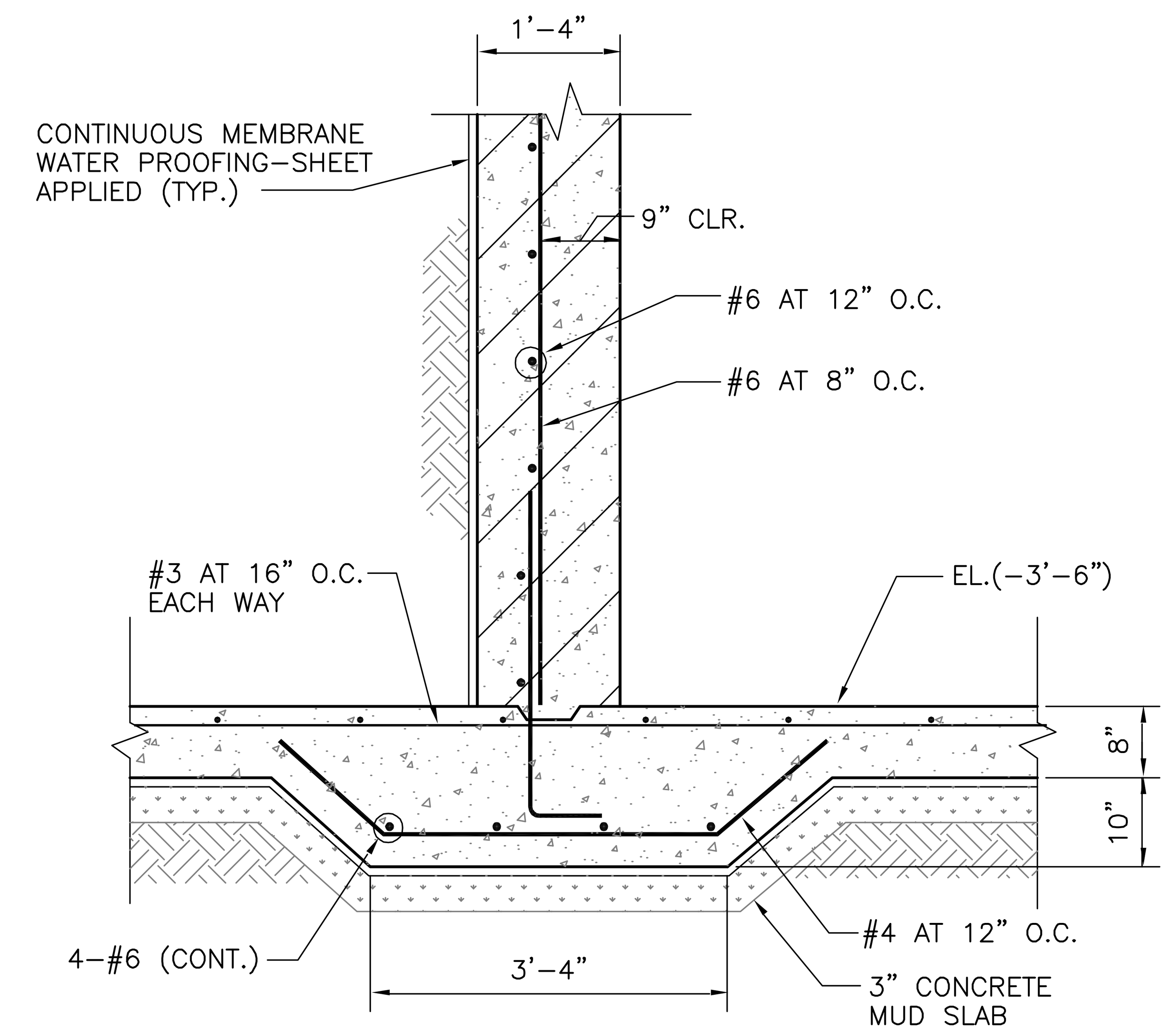


SECTION 1 (S1 | S8)
SCALE: 3/4" = 1'-0"

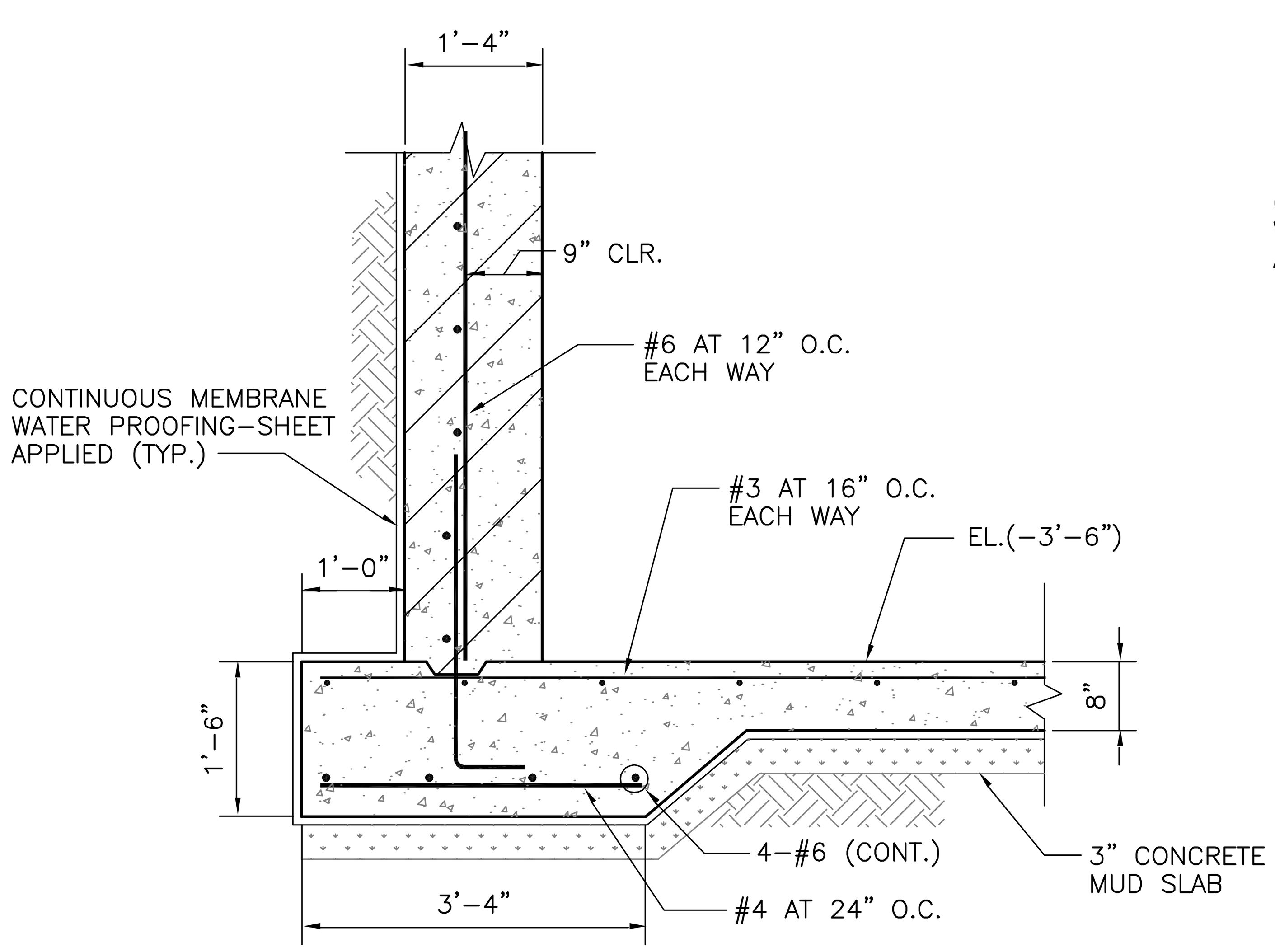




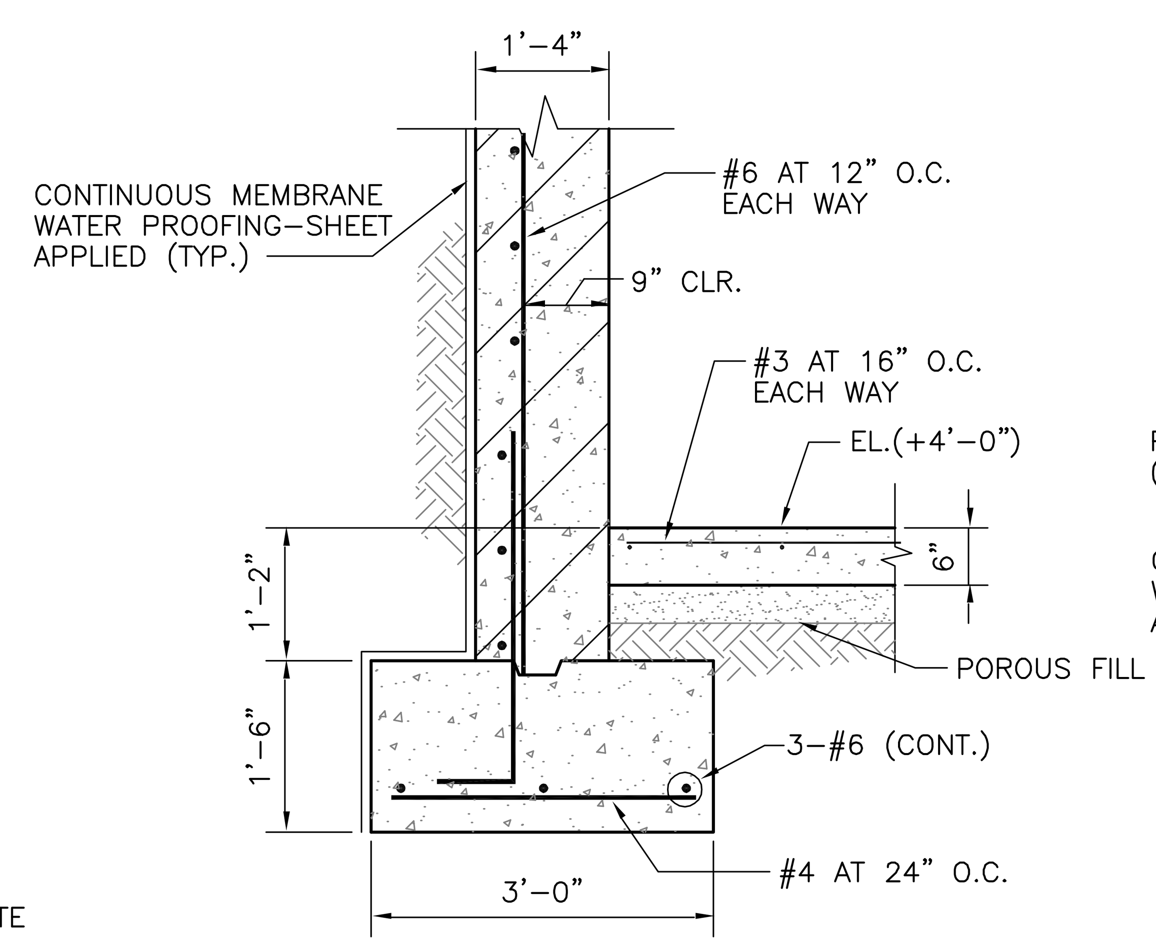
SECTION 2 (S1 | S8)
SCALE: 3/4" = 1'-0"



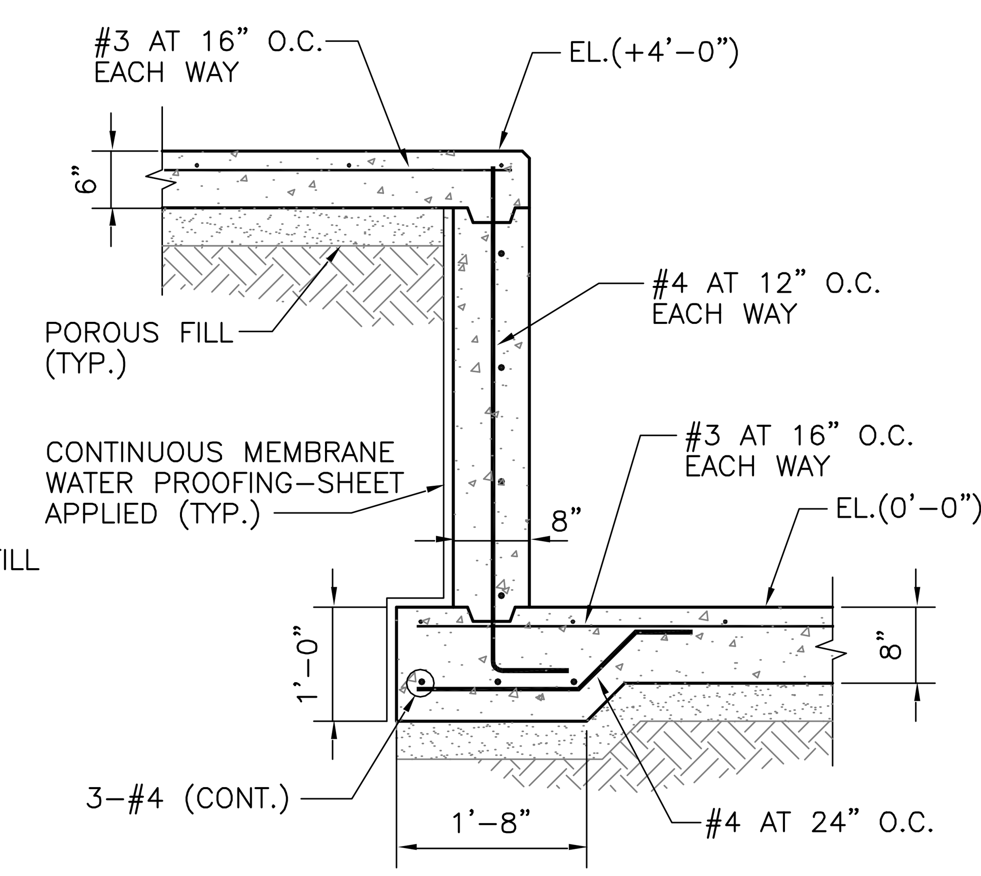
SECTION 3 (S1 | S8)
SCALE: 3/4" = 1'-0"



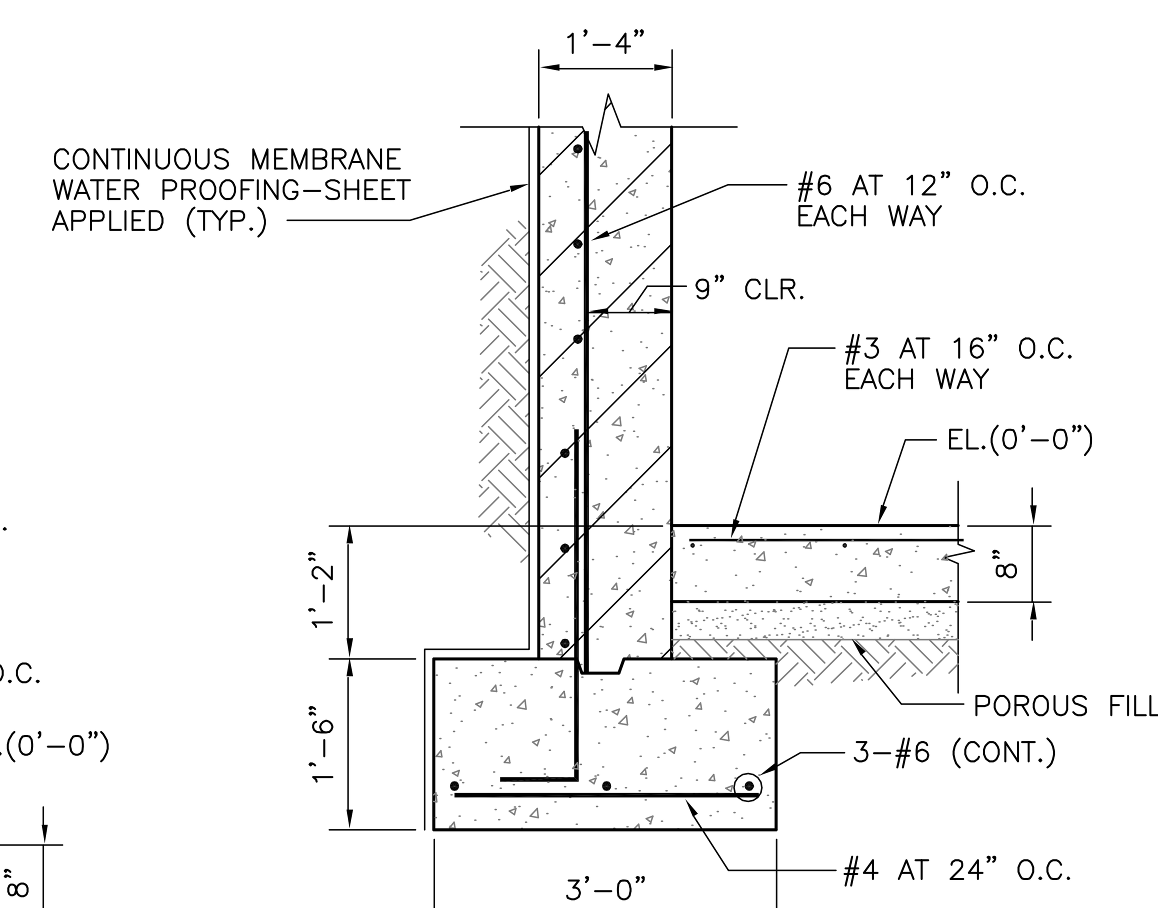
SECTION 4 (S1 | S8)
SCALE: 3/4" = 1'-0"



SECTION 5 (S1 | S8)
SCALE: 3/4" = 1'-0"

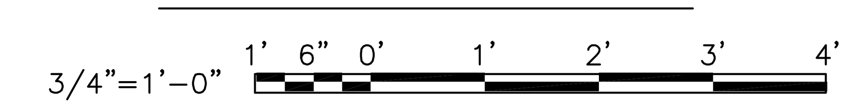


SECTION 6 (S1 | S8)
SCALE: 3/4" = 1'-0"



SECTION 7 (S1 | S8)
SCALE: 3/4" = 1'-0"

GRAPHIC SCALE



REVISIONS

SYM. DESCRIPTION DATE APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN OLH
DRAWN OLH
REVIEW OLH

APPROVED ACTIVITY - SATISFACTORY TO DATE
APPROVED FOR EFD FOR COMMANDER NAVFAC DATE

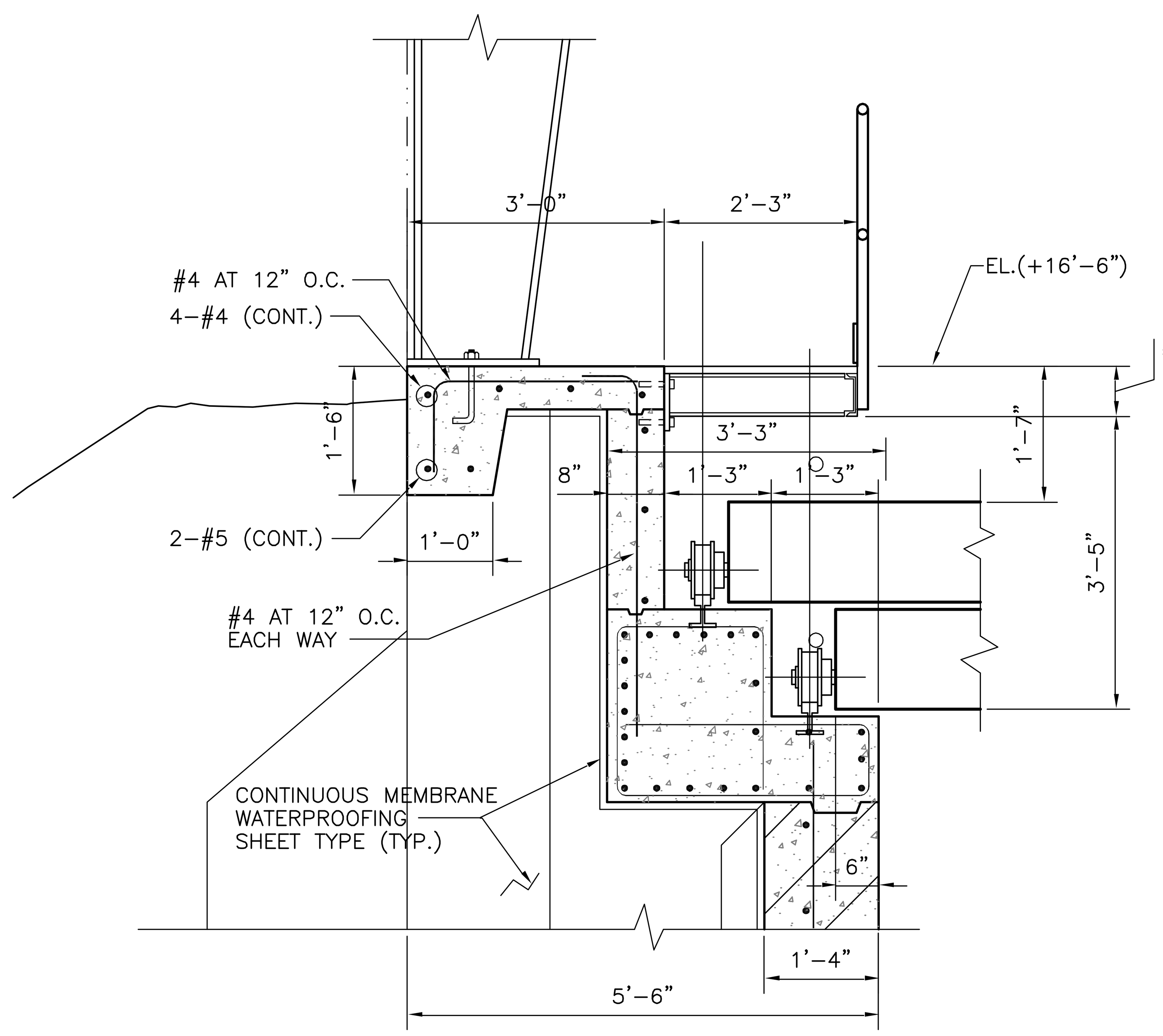
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION NORFOLK, VIRGINIA
NAVAL STATION

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
FOUNDATION SECTIONS

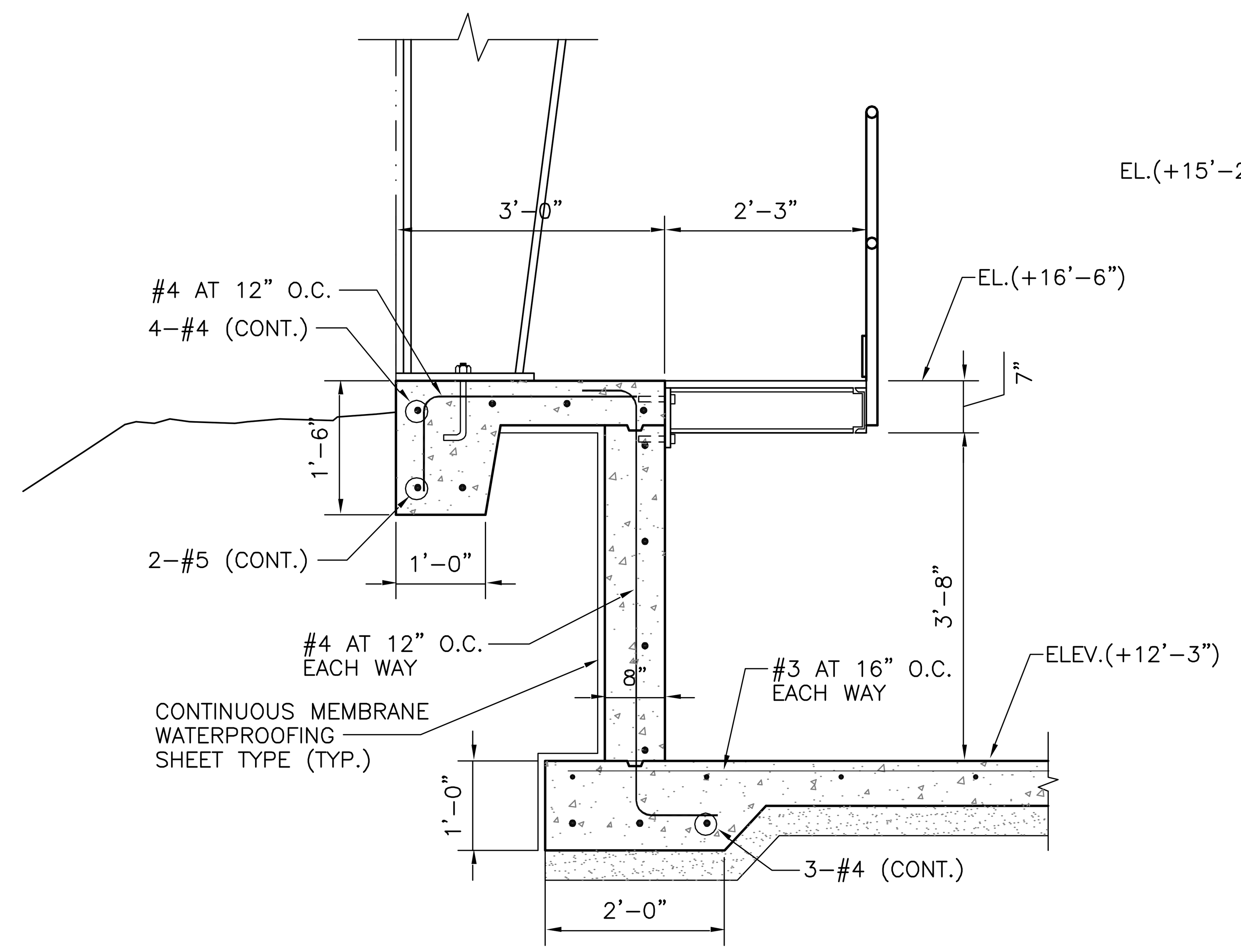
CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO. 05-97-7605
CONSTR. CONTR. NO. N62470-97-B-7605
NAVFAC DRAWING NO.
SHEET OF
S-8

FILENAME: 7605S008.DWG, UPDATED ON 07/03/01 AT 14:00, XREFS: NONE

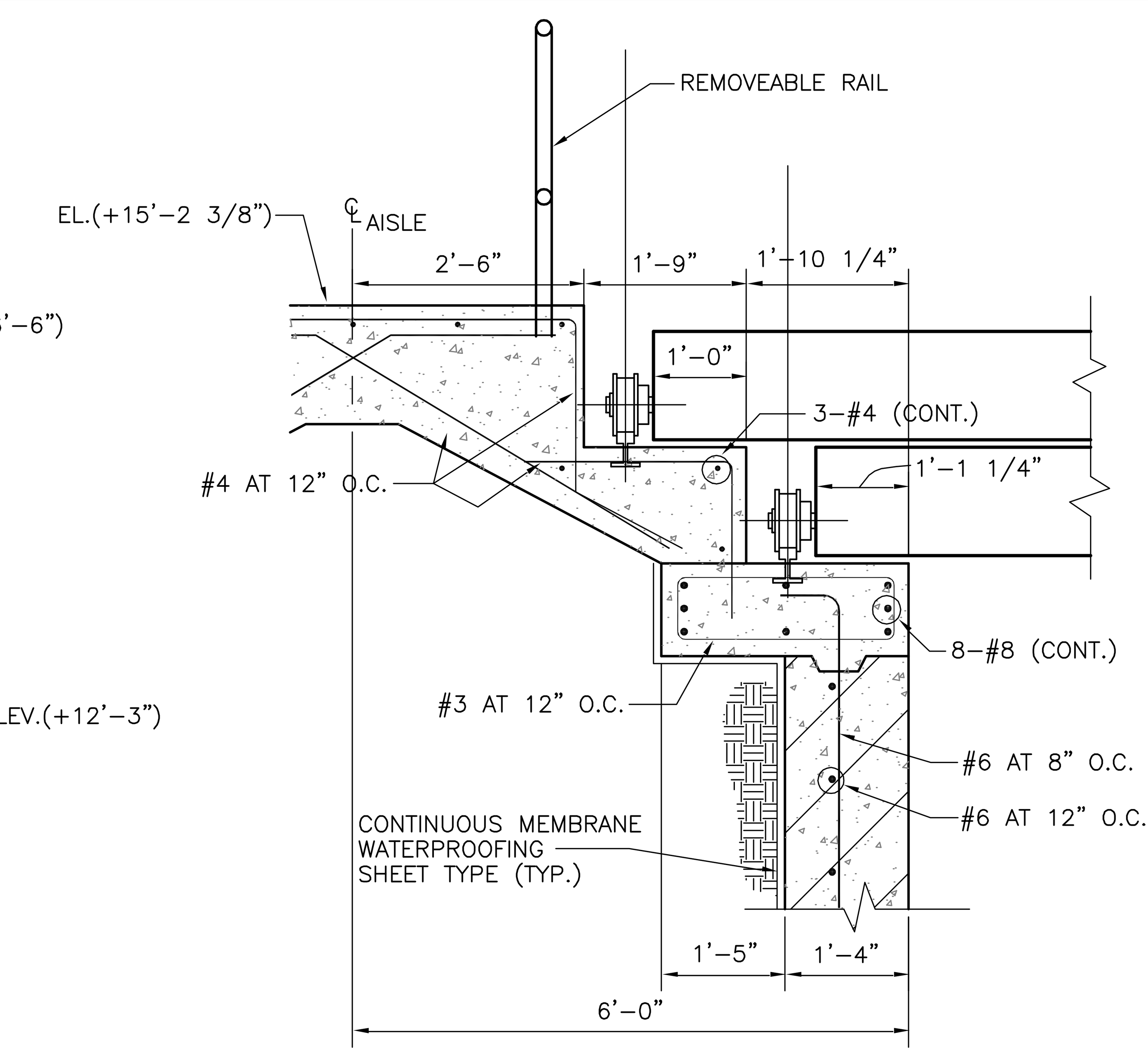
DRAWFORM REVISION 25 SEPT 96



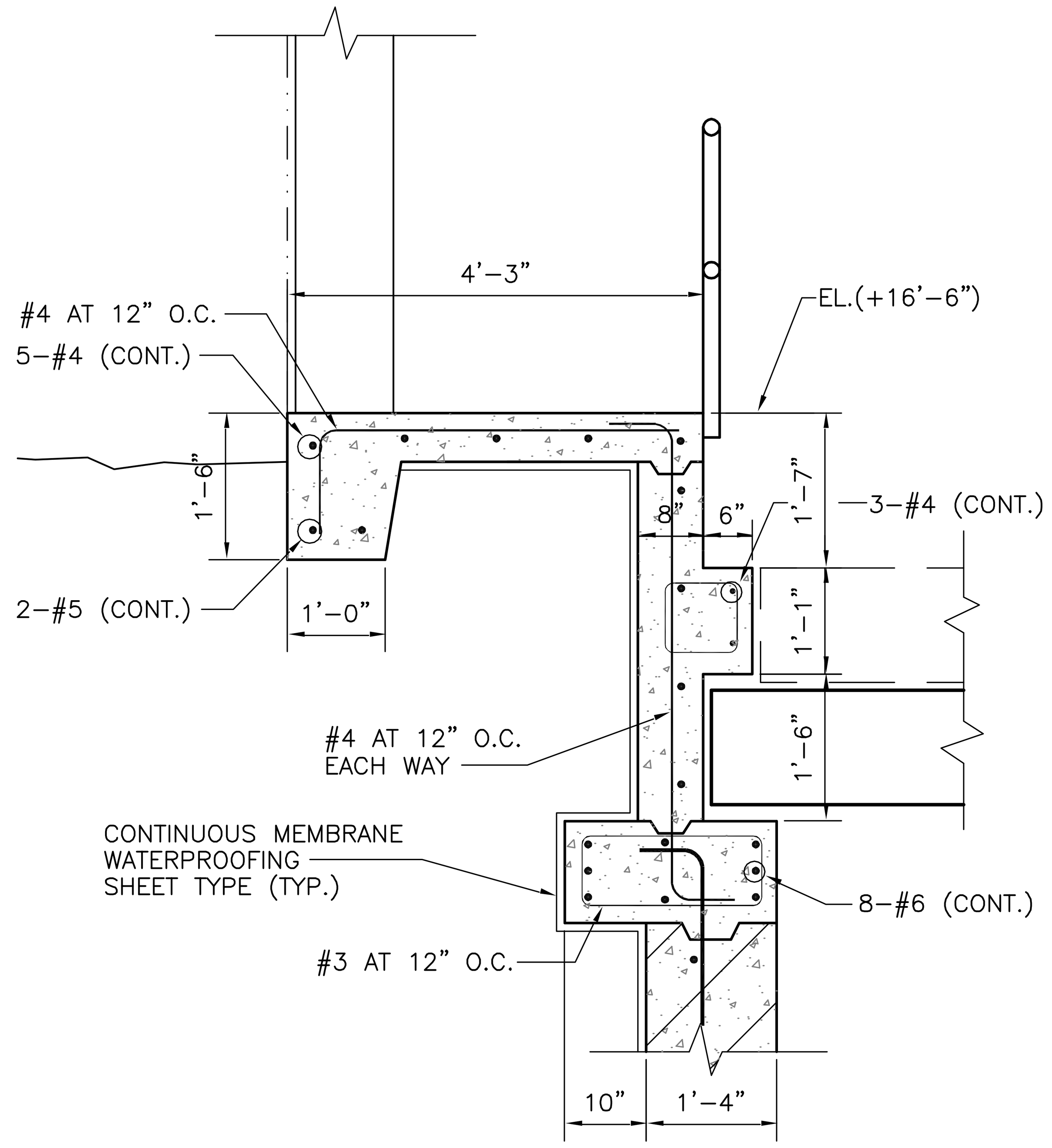
SECTION 1 (S2 | S9)
SCALE: 3/4" = 1'-0"
S3,S4



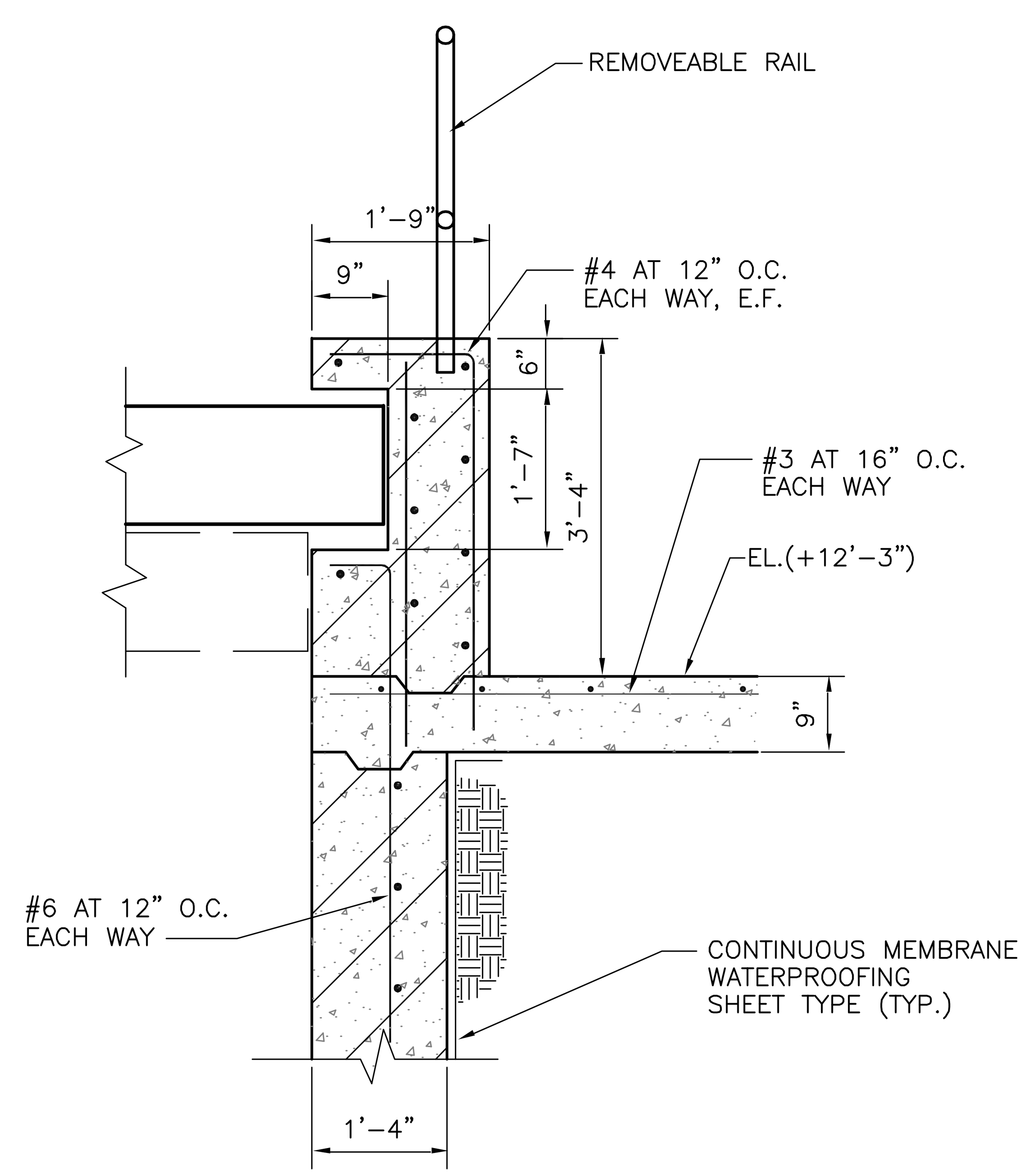
SECTION 2 (S2 | S9)
SCALE: 3/4" = 1'-0"



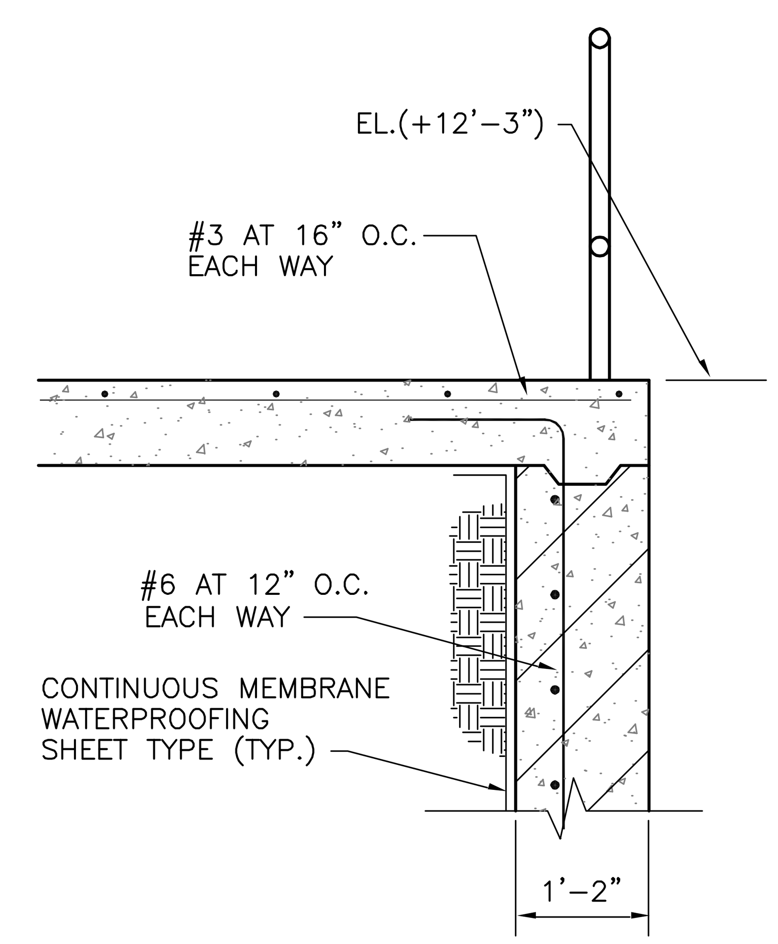
SECTION 3 (S2 | S9)
SCALE: 3/4" = 1'-0"
S4



SECTION 4 (S2 | S9)
SCALE: 3/4" = 1'-0"
S4



SECTION 5 (S2 | S9)
SCALE: 3/4" = 1'-0"
S4



SECTION 6 (S2 | S9)
SCALE: 3/4" = 1'-0"

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALE

3/4"=1'-0" 1' 6" 0' 1' 2' 3' 4'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

A/E DESIGN OLH DRAWN OLH REVIEW OLH

CHIEF ARCH./ENGR.
PROJECT MANAGER
FIRE PROTECTION
BRANCH MANAGER
DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY — SATISFACTORY TO DATE

APPROVED FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

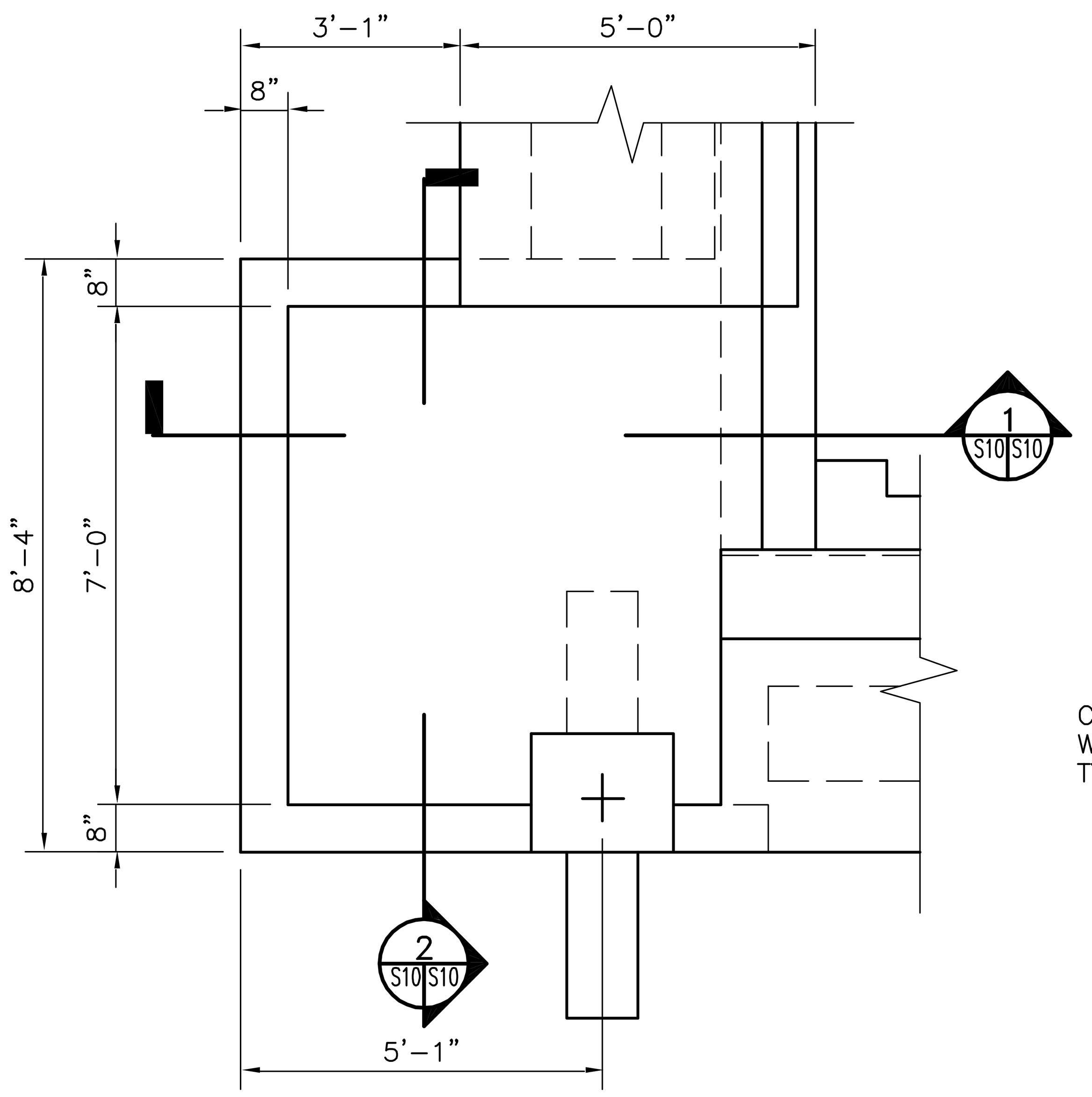
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
SECTIONS

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO. 05-97-7605
CONSTR. CONTR. NO. N62470-97-B-7605
NAVFAC DRAWING NO.
SHEET OF
S-9

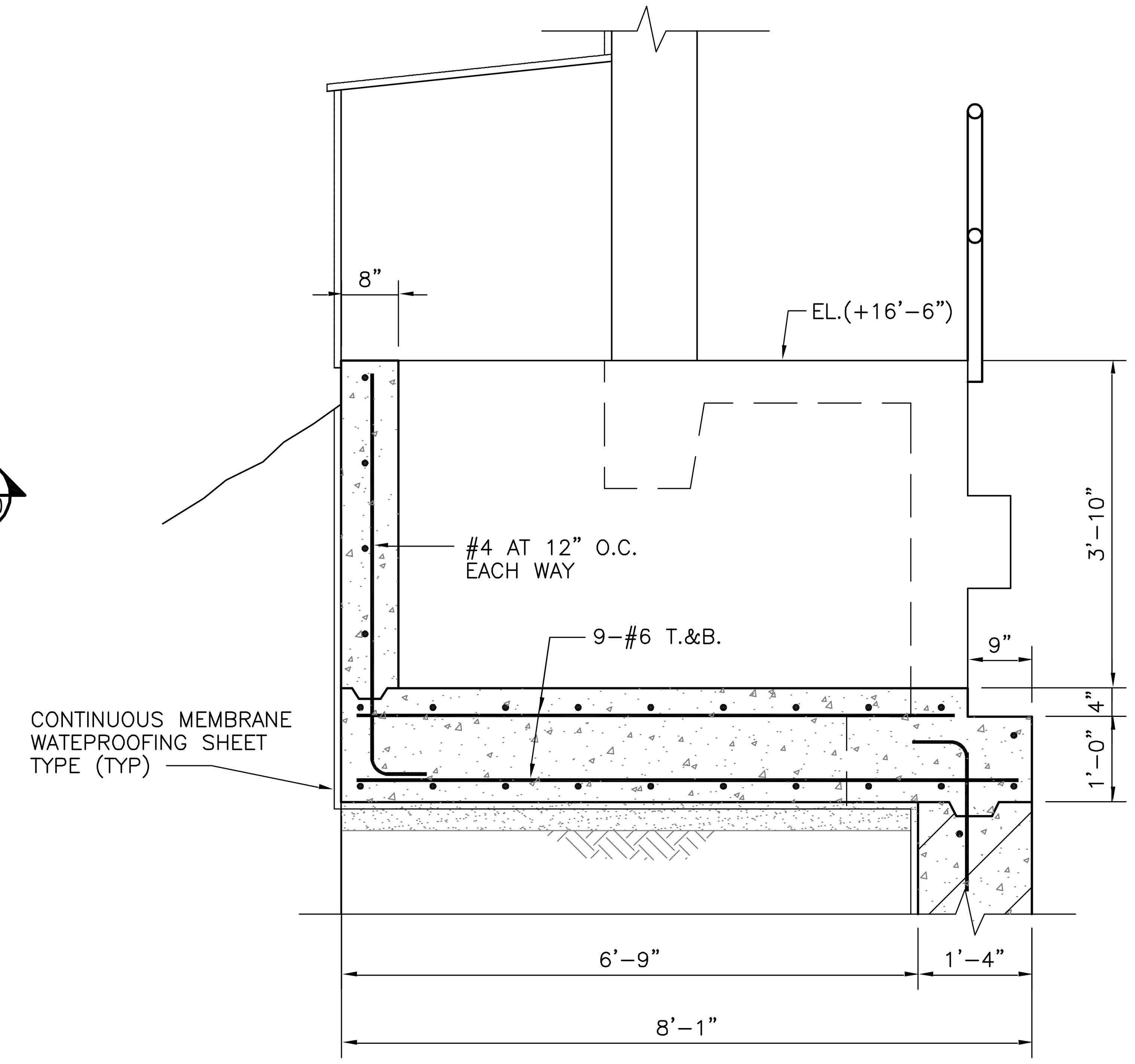
FILENAME: 7605S009.DWG, UPDATED ON 07/10/01 AT 11:29, XREFS: NONE

DRAWFORM REVISION 25 SEPT 96

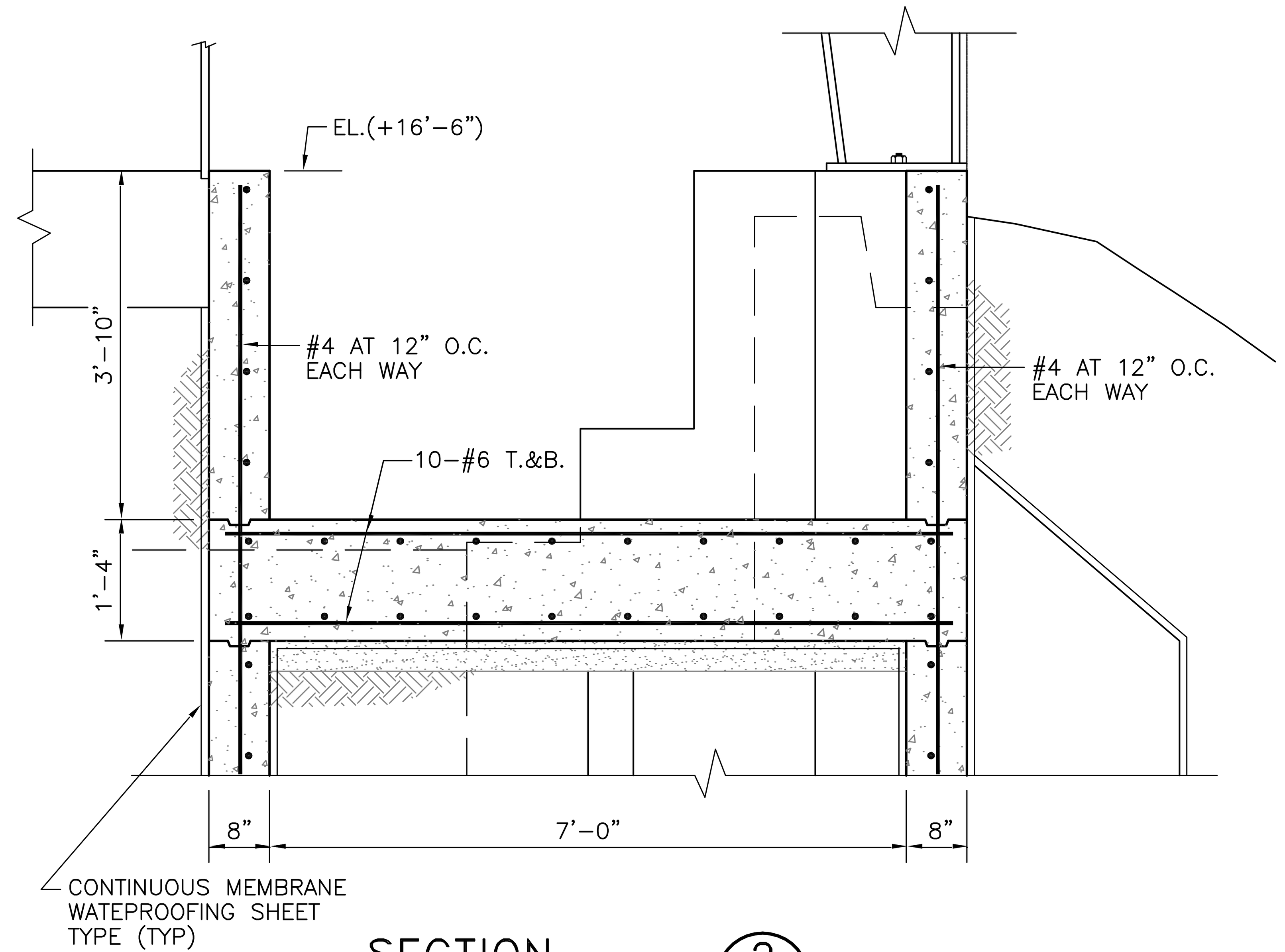
8 7 6 5 4 3 2 1
D C B A



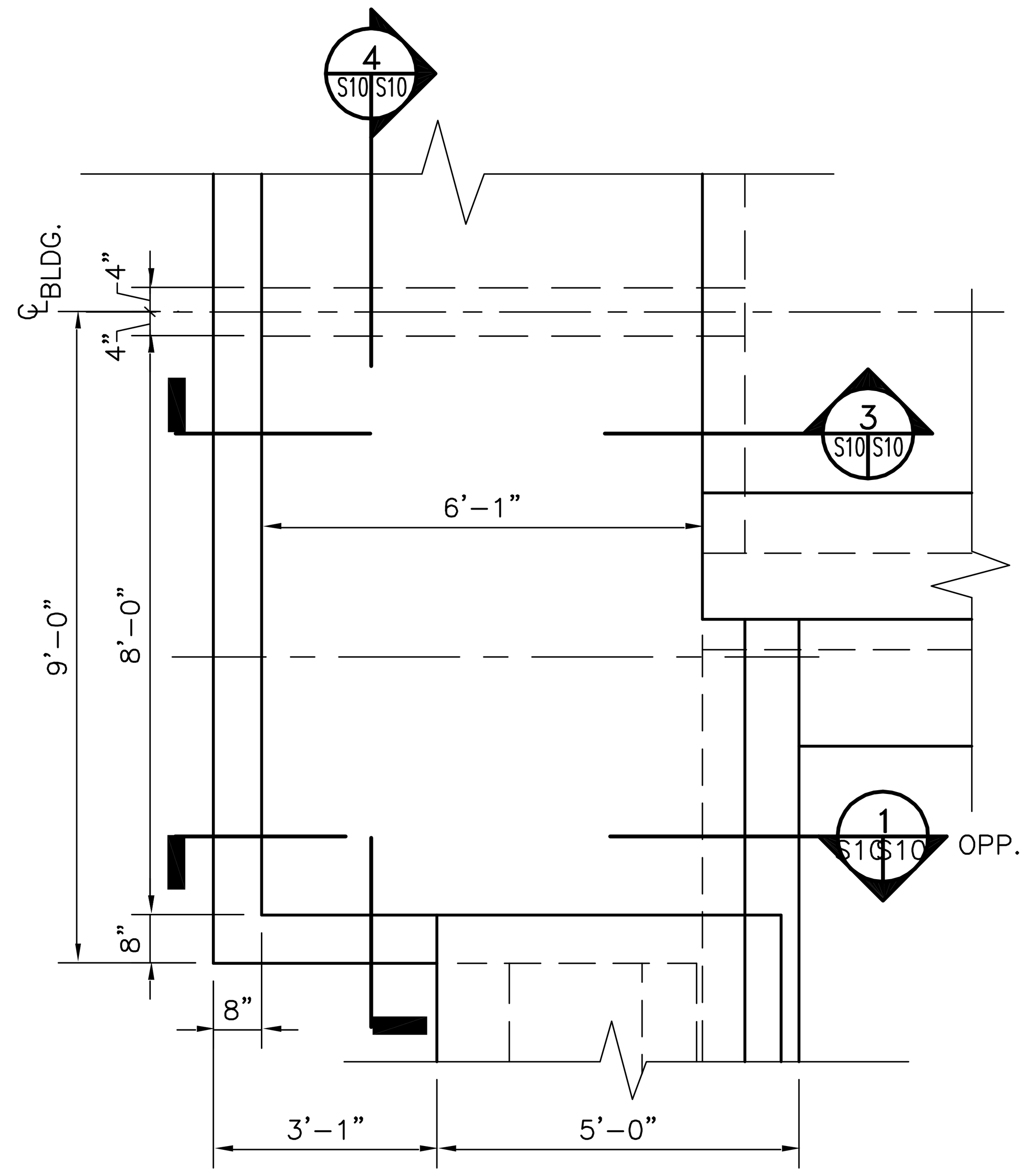
DETAIL A
SCALE: 1/2" = 1'-0"
S2 S10



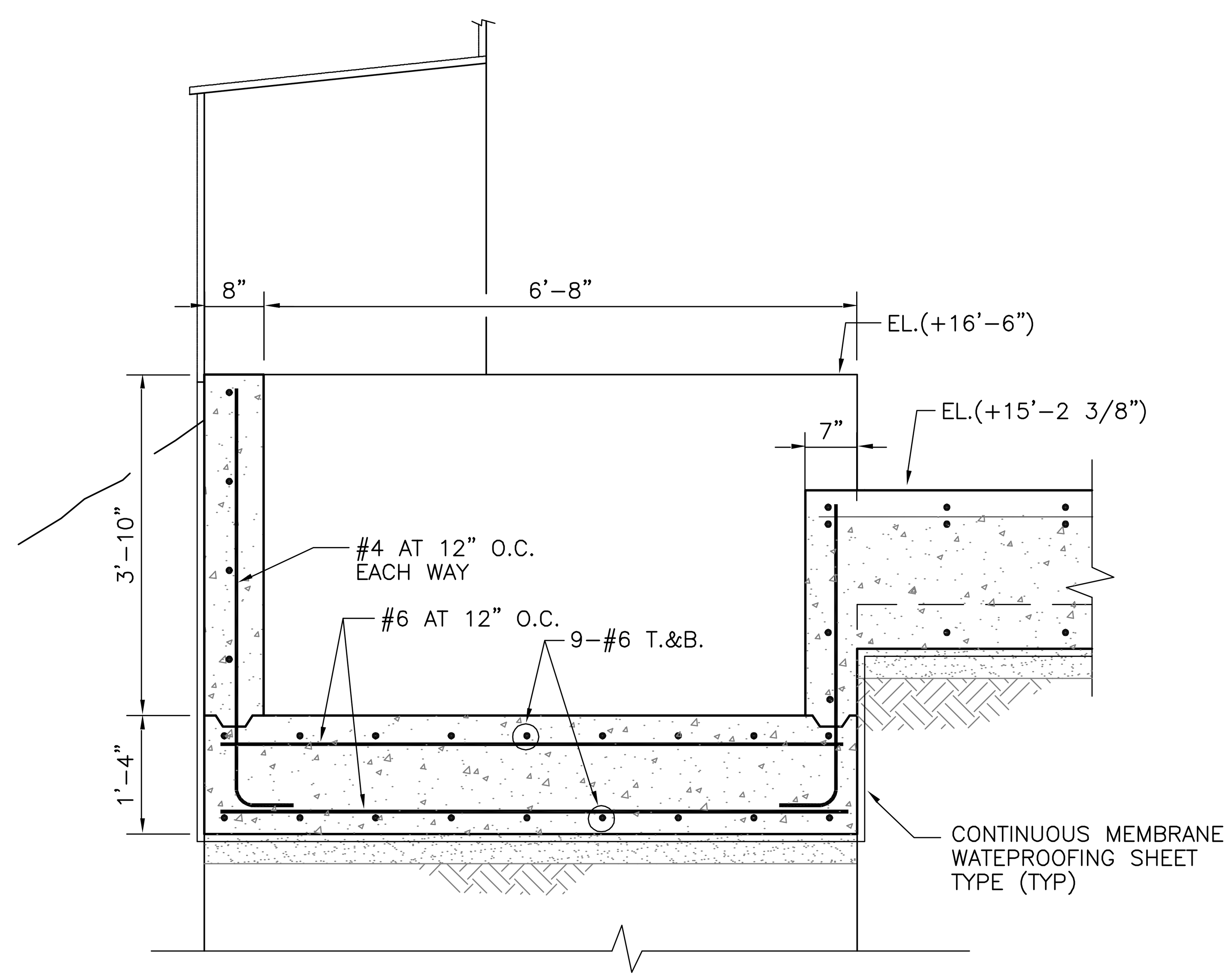
SECTION 1
SCALE: 3/4" = 1'-0"
S10 S10



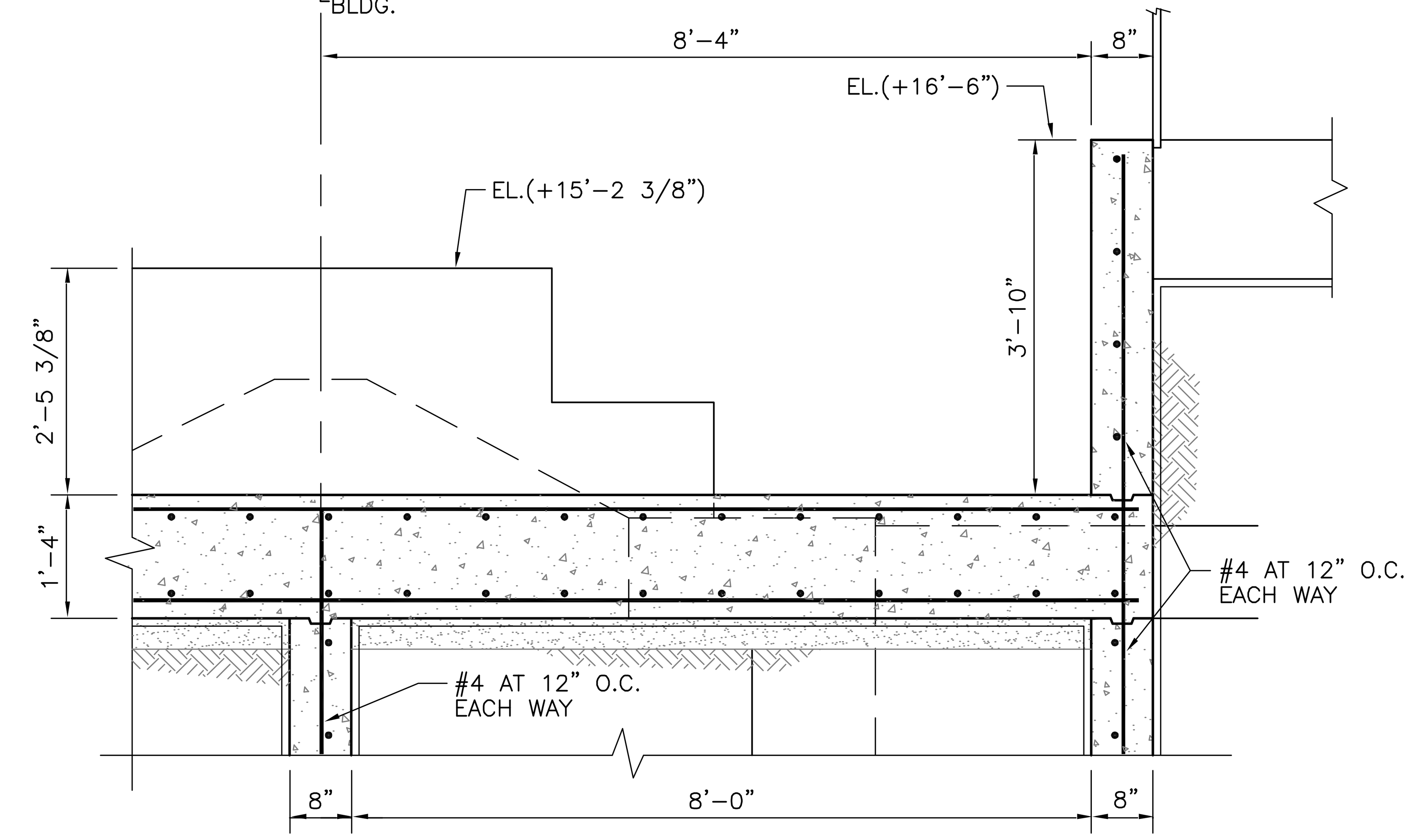
SECTION 2
SCALE: 3/4" = 1'-0"
S10 S10



DETAIL B
SCALE: 1/2" = 1'-0"
S2 S10



SECTION 3
SCALE: 3/4" = 1'-0"
S10 S10



SECTION 4
SCALE: 3/4" = 1'-0"
S10 S10

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALES

1/2"=1'-0" 1' 0' 1' 2' 3' 4' 5'

3/4"=1'-0" 1' 6" 0' 1' 2' 3' 4'

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN OLH DRAWN OLH REVIEW OLH

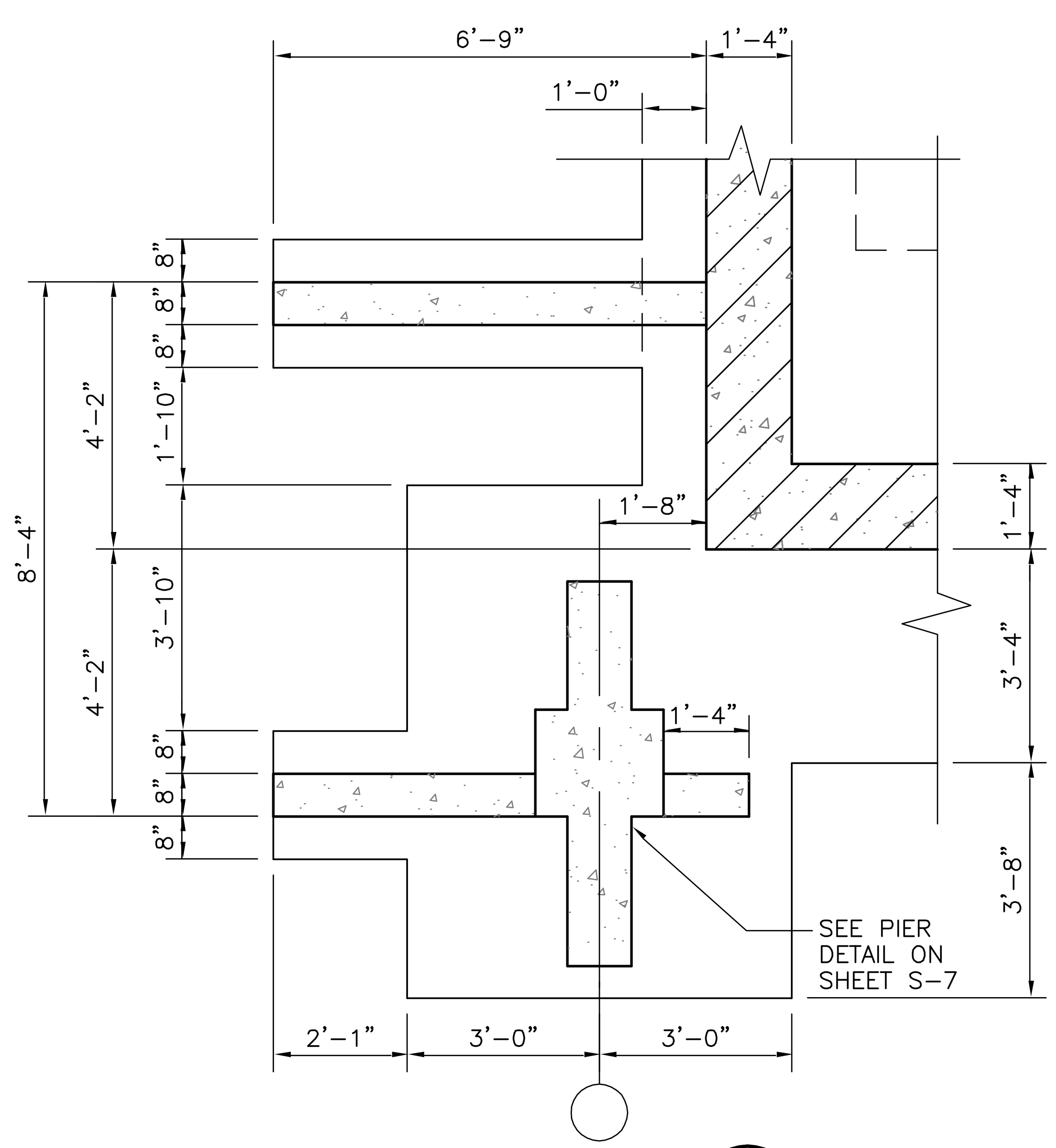
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION NORFOLK, VIRGINIA
NAVAL STATION

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
SECTIONS AND DETAILS

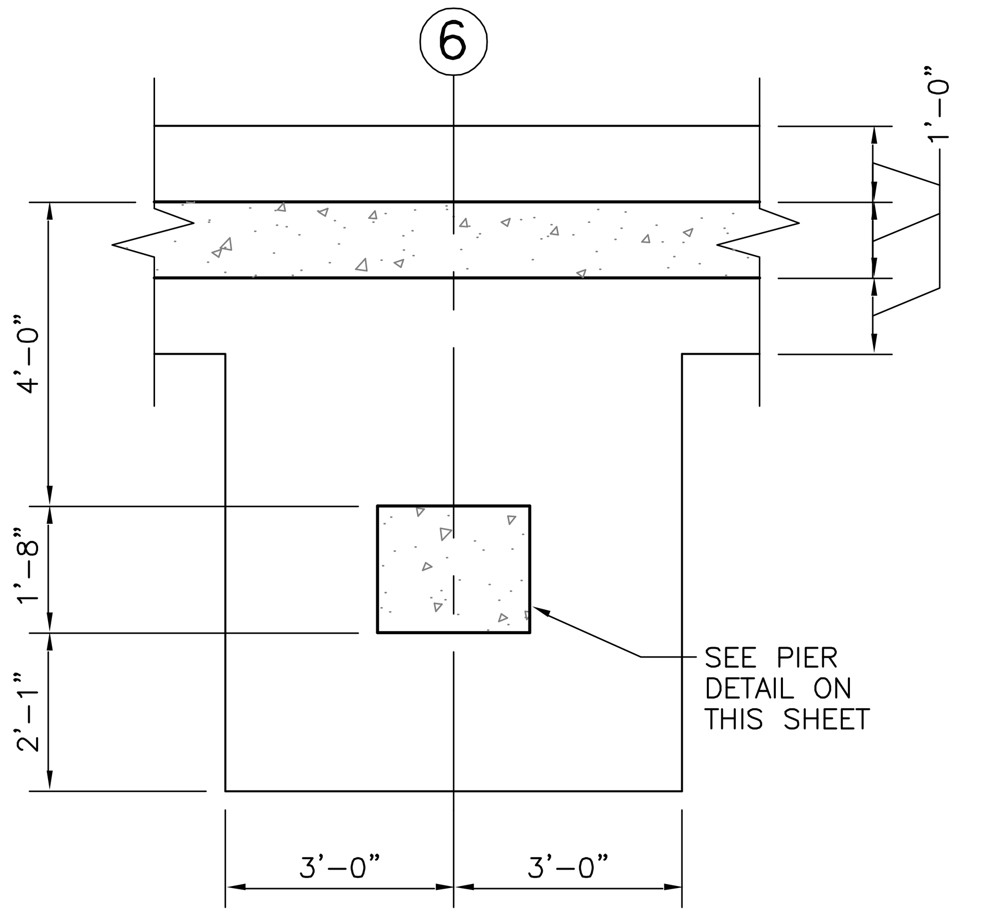
CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
SPEC. NO. 05-97-7605
CONSTR. CONTR. NO. N62470-97-B-7605
SHEET S-10

FILENAME: 7605S010.DWG, UPDATED ON 07/03/01 AT 14:05, XREFS: NONE

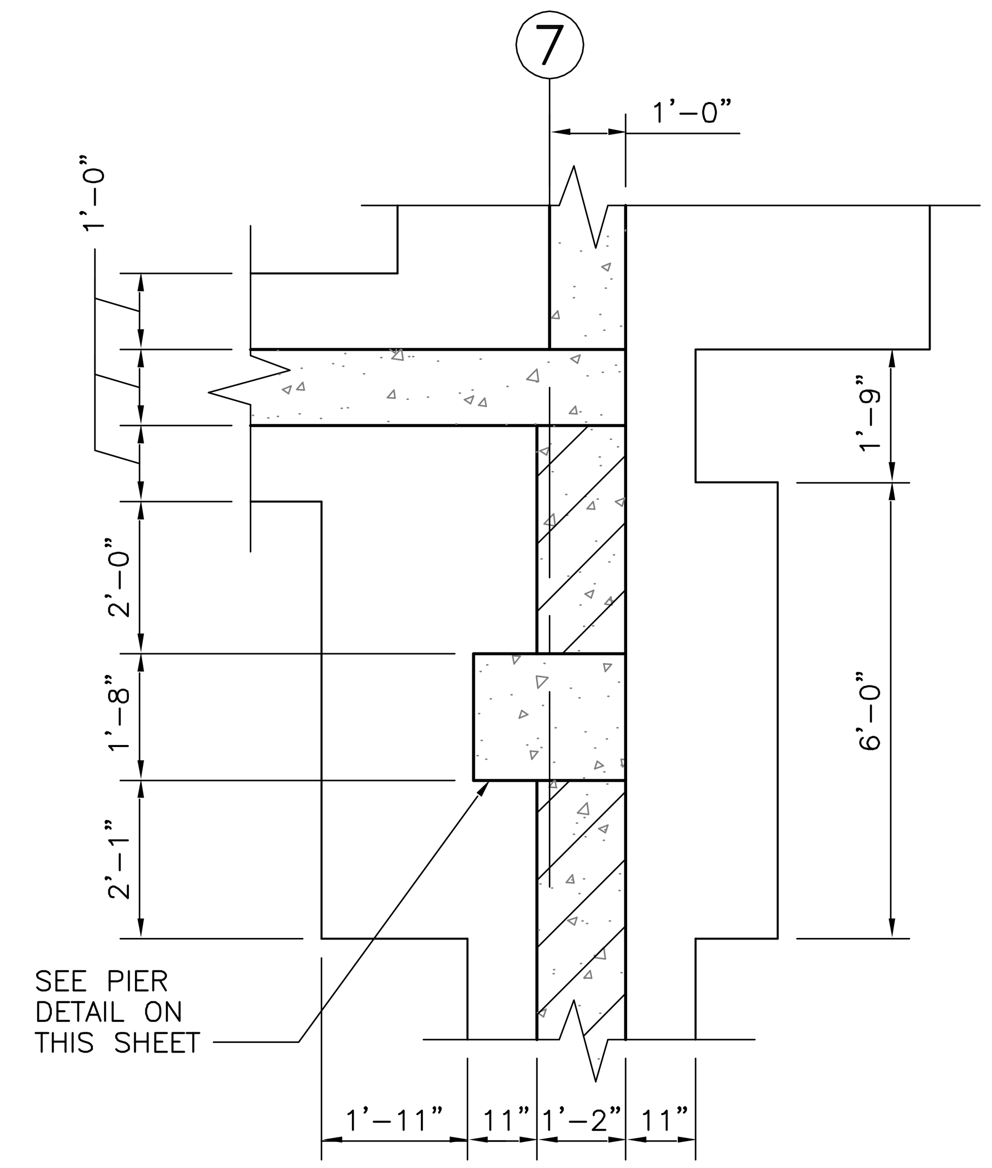
DRAWFORM REVISION 25 SEPT 96



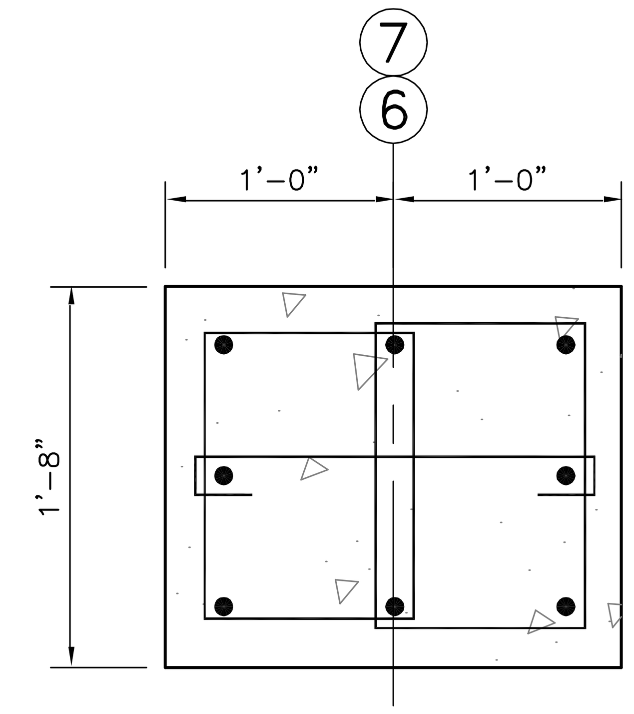
DETAIL A S1 S11
SCALE: 1/2" = 1'-0"



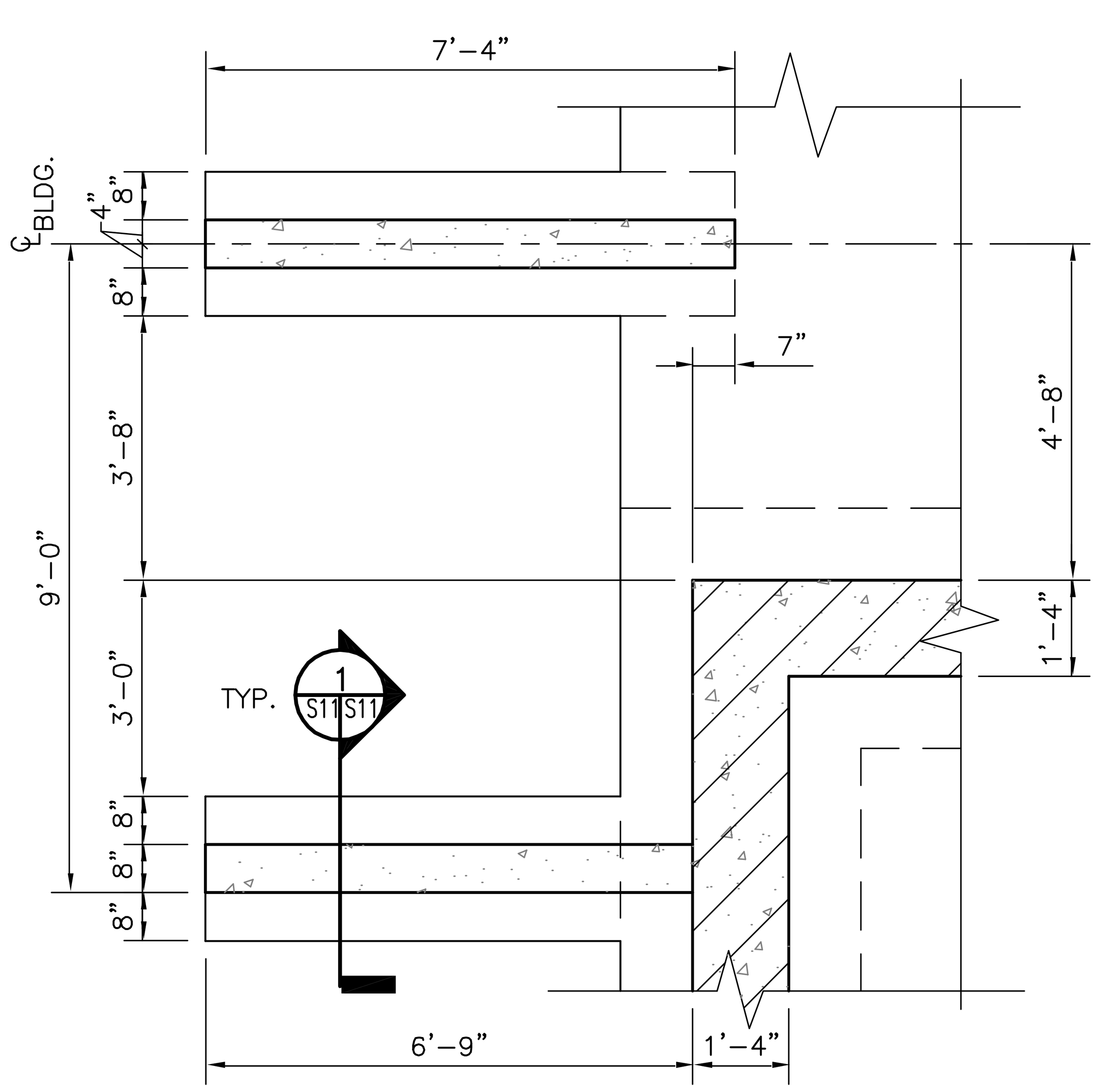
DETAIL C S1 S11
SCALE: 1/2" = 1'-0"



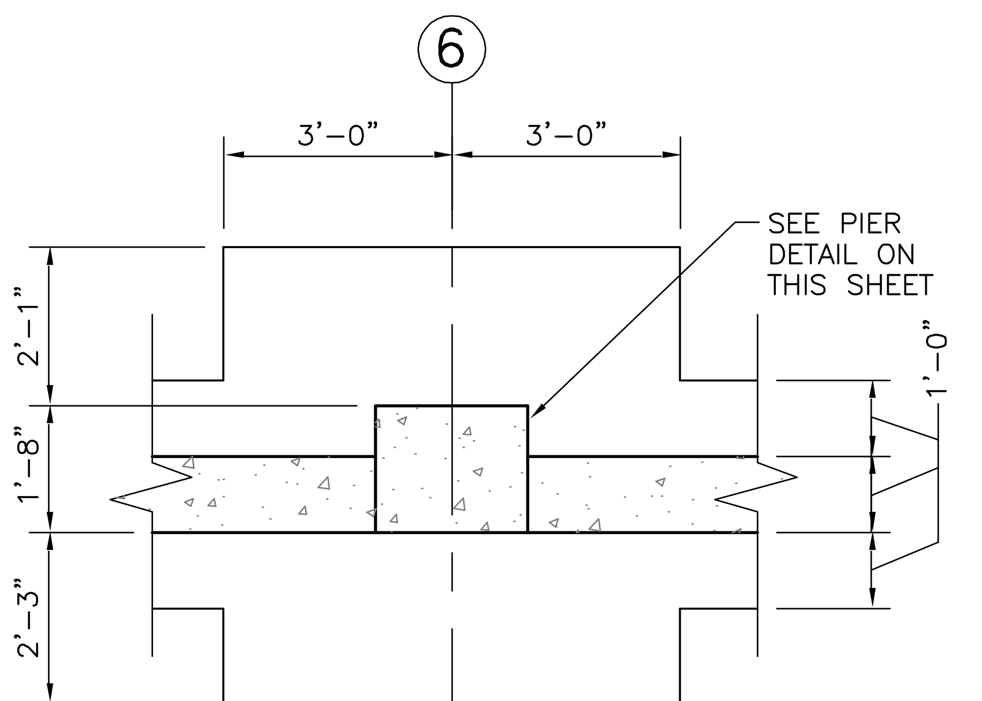
DETAIL D S1 S11
SCALE: 1/2" = 1'-0"



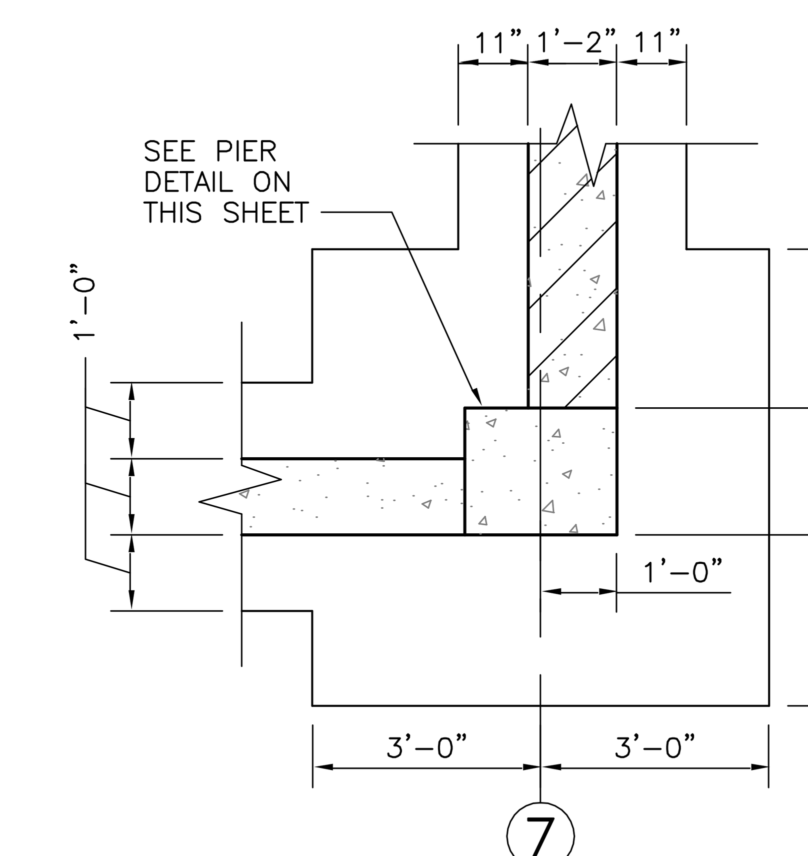
PIER DETAIL
SCALE: 1 1/2" = 1'-0"



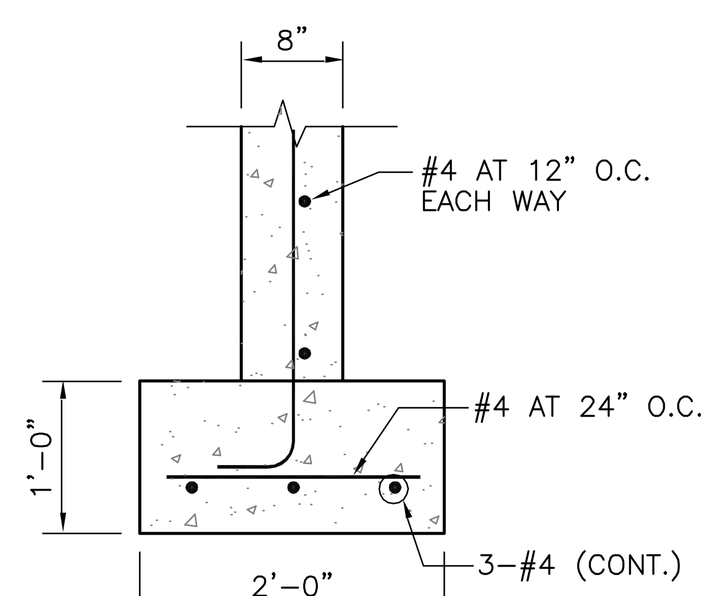
DETAIL B S1 S11
SCALE: 1/2" = 1'-0"



DETAIL E S1 S11
SCALE: 1/2" = 1'-0"



DETAIL F S1 S11
SCALE: 1/2" = 1'-0"



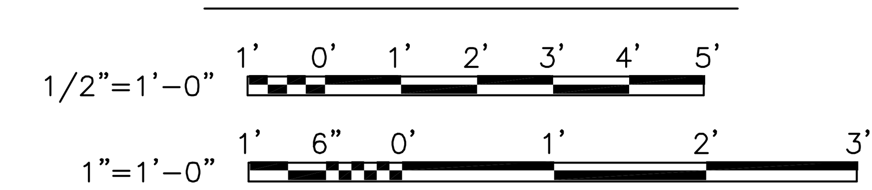
SECTION 1 S11 S11
SCALE: 1" = 1'-0"

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALES



REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

A/E — EFD
DESIGN OLH
DRAWN OLH
REVIEW OLH
QC
CHIEF ARCH./ ENGR.
PROJECT MANAGER
FIRE PROTECTION
BRANCH MANAGER
DESIGN DIRECTOR

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE
ACTIVITY – SATISFACTORY TO
APPROVED DATE
FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

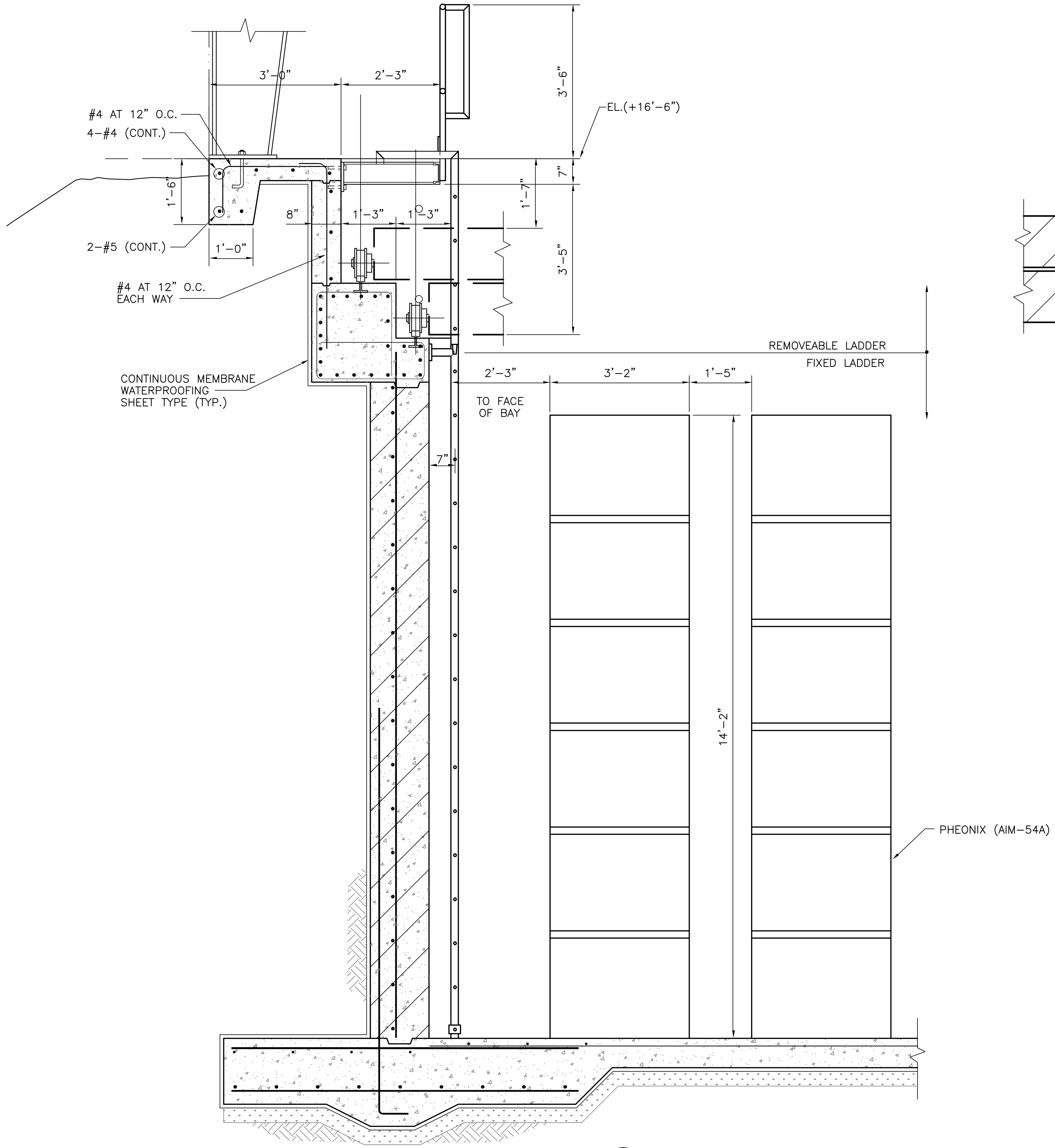
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

SECTIONS AND DETAILS

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO. 05–97–7605
CONSTR. CONTR. NO. N62470–97–B–7605
NAVFAC DRAWING NO.
SHEET OF
S–11

FILENAME: 7605S011.DWG, UPDATED ON 07/03/01 AT 14:06, XREFS: NONE

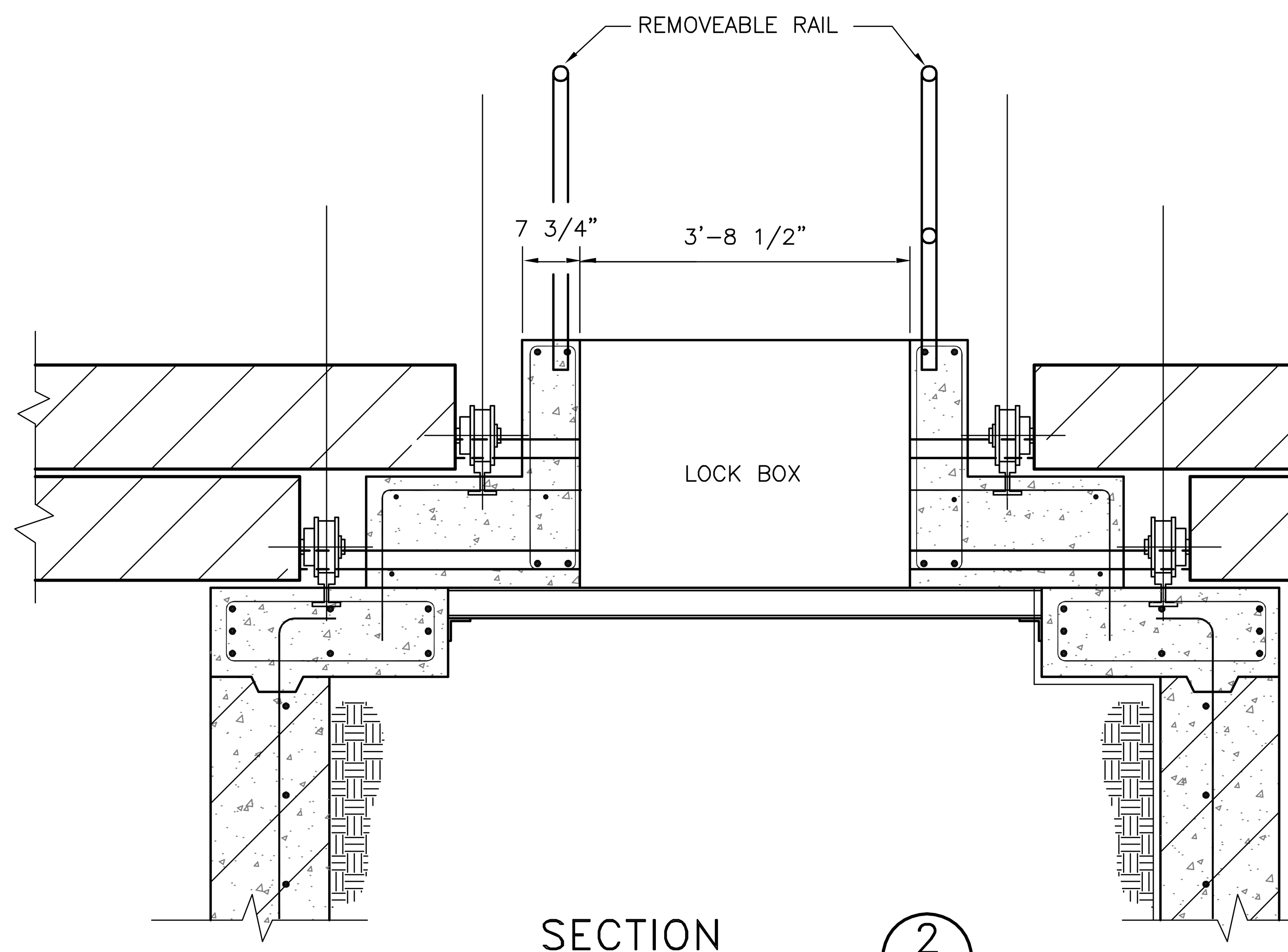
DRAWFORM REVISION 25 SEPT 96



SECTION 1 S1/S12

SCALE: 3/4" = 1'-0"

S2



SECTION 2 S2/S12

SCALE: 3/4" = 1'-0"

LEGEND

REGULAR WEIGHT CONCRETE

LIGHTWEIGHT CONCRETE

GRAPHIC SCALE

3/4"=1'-0" 1' 6" 0' 1' 2' 3' 4'

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN OLH DRAWN OLH REVIEW OLH

ACTIVITY - SATISFACTORY TO

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

SECTIONS

CODE ID. NO. 80091 SIZE D

SCALE: AS NOTED

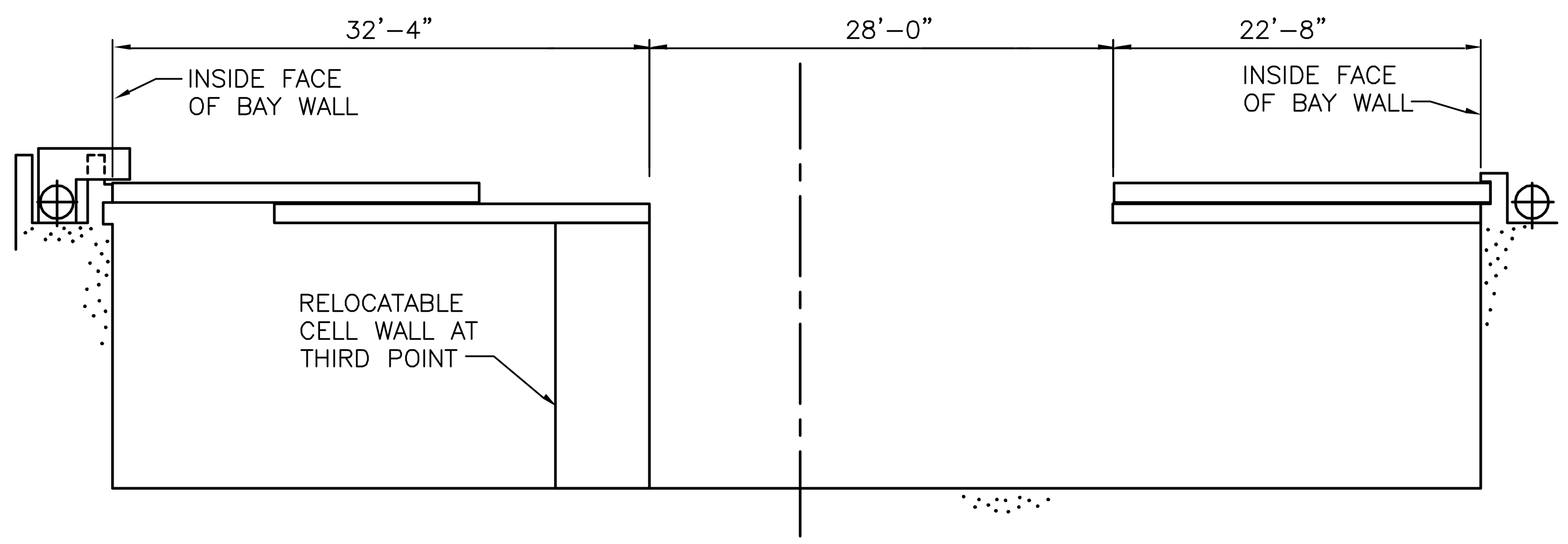
SPEC. NO. 05-97-7605

CONSTR. CONTR. NO. N62470-97-B-7605

SHEET S-12

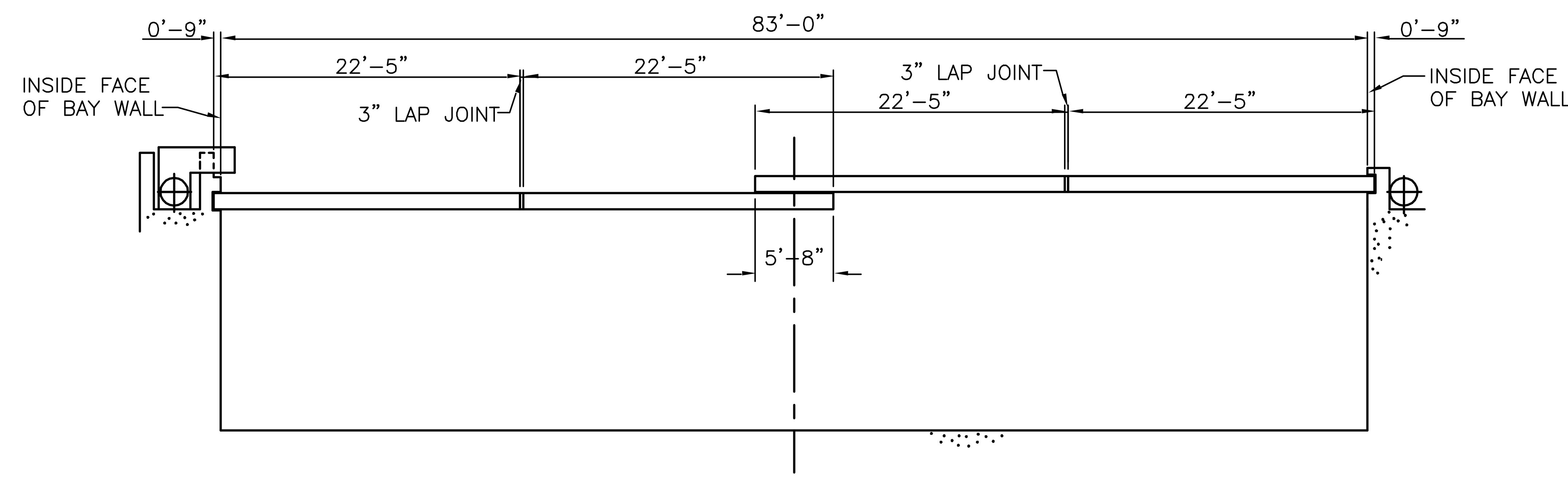
FILENAME: 7605S012.DWG, UPDATED ON 07/10/01 AT 11:11, XREFS: NONE

DRAWFORM REVISION 25 SEPT 96



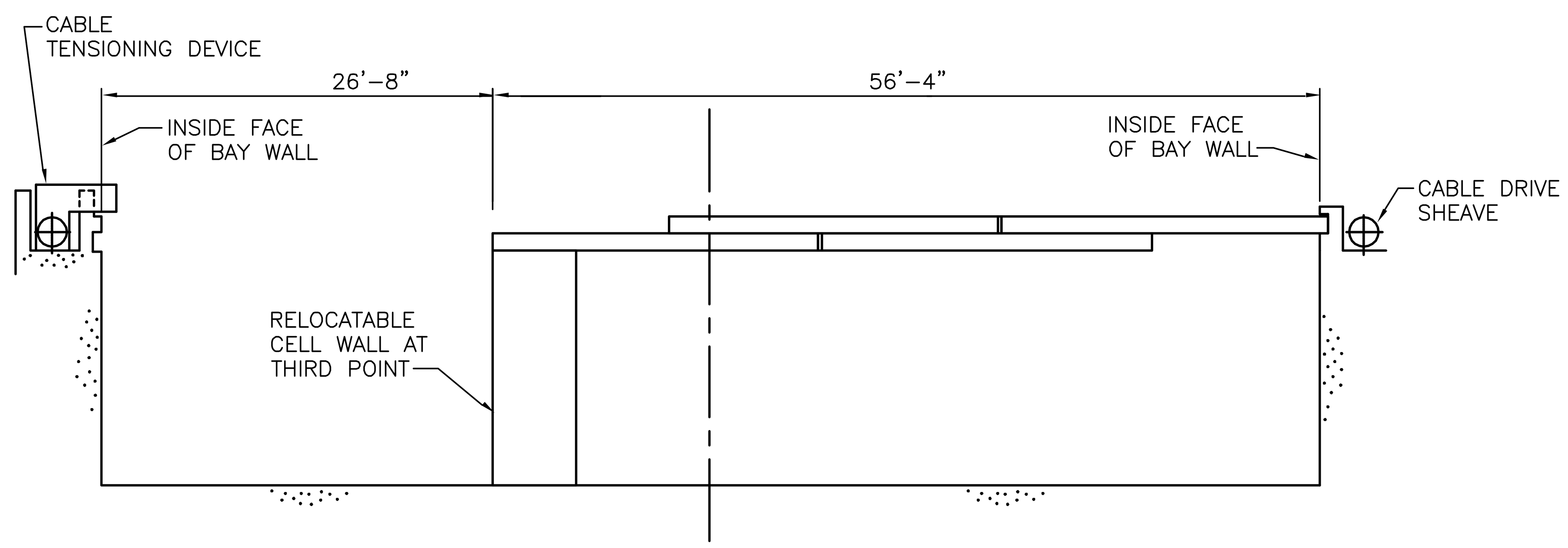
CENTER THIRD OPEN

SCALE:1/8"=1'-0"



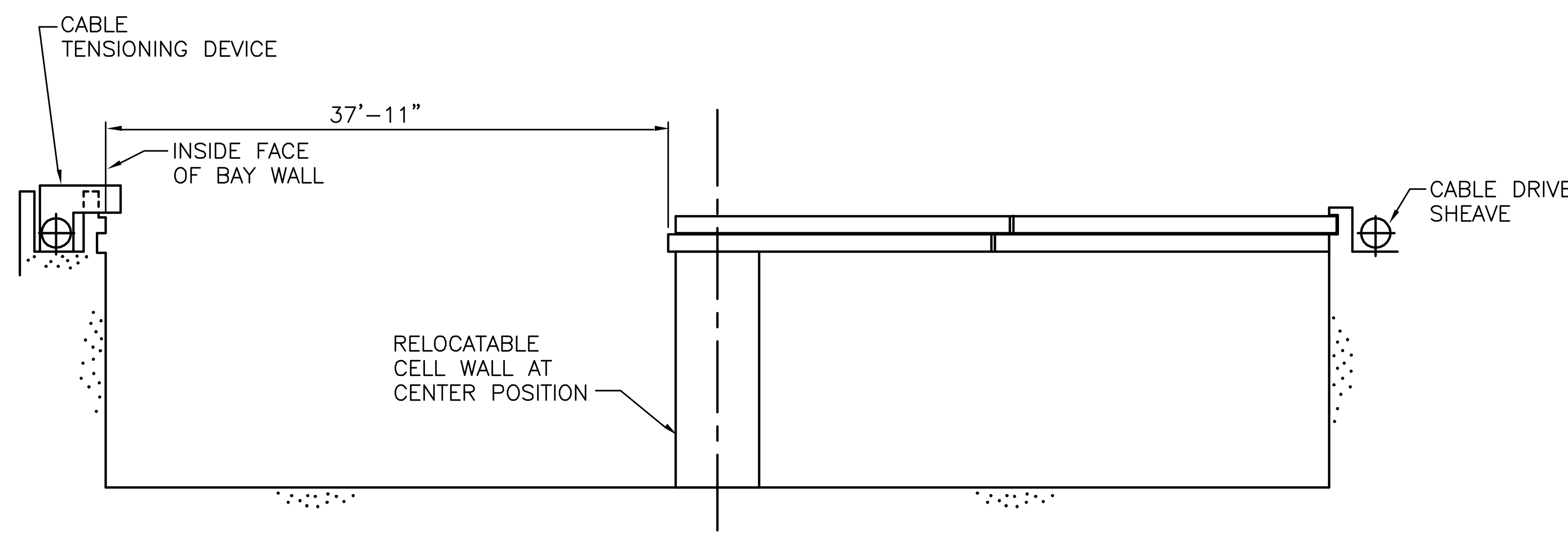
BAY CLOSED

SCALE:1/8"=1'-0"



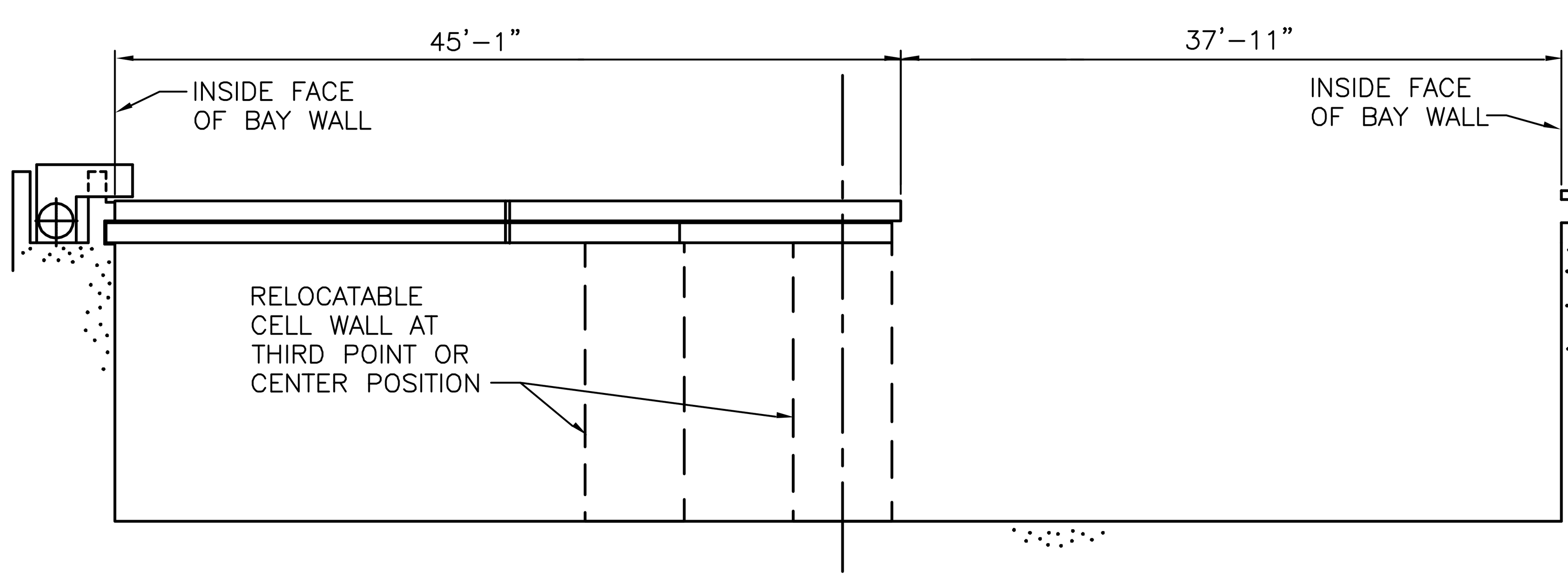
LEFT THIRD OPEN

SCALE:1/8"=1'-0"



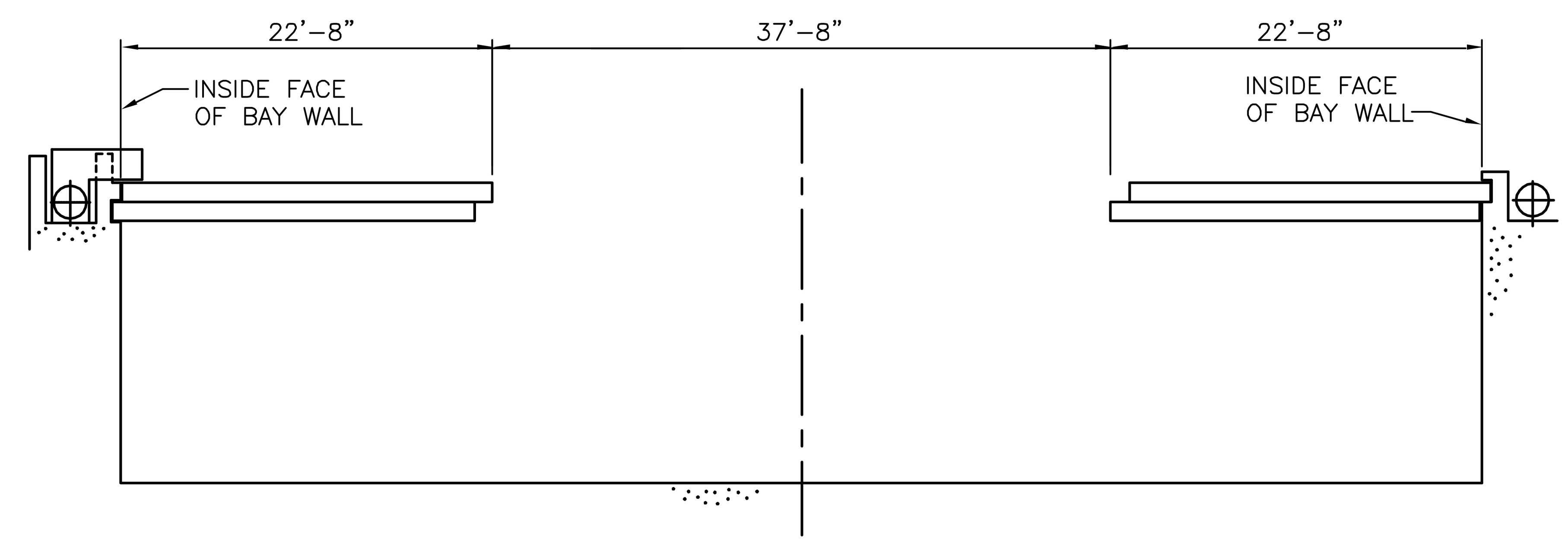
LEFT HALF OPEN

SCALE:1/8"=1'-0"



RIGHT HALF OPEN

SCALE:1/8"=1'-0"



CENTER HALF OPEN

SCALE:1/8"=1'-0"

REVISIONS

SYM. DESCRIPTION DATE APPROVED

A/E EFD DESIGN DRAWN REVIEW QC CHIEF ARCH./ENGR. PROJECT MANAGER FIRE PROTECTION BRANCH MANAGER DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY - SATISFACTORY TO DATE

APPROVED FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

BAY COVER CONFIGURATIONS

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

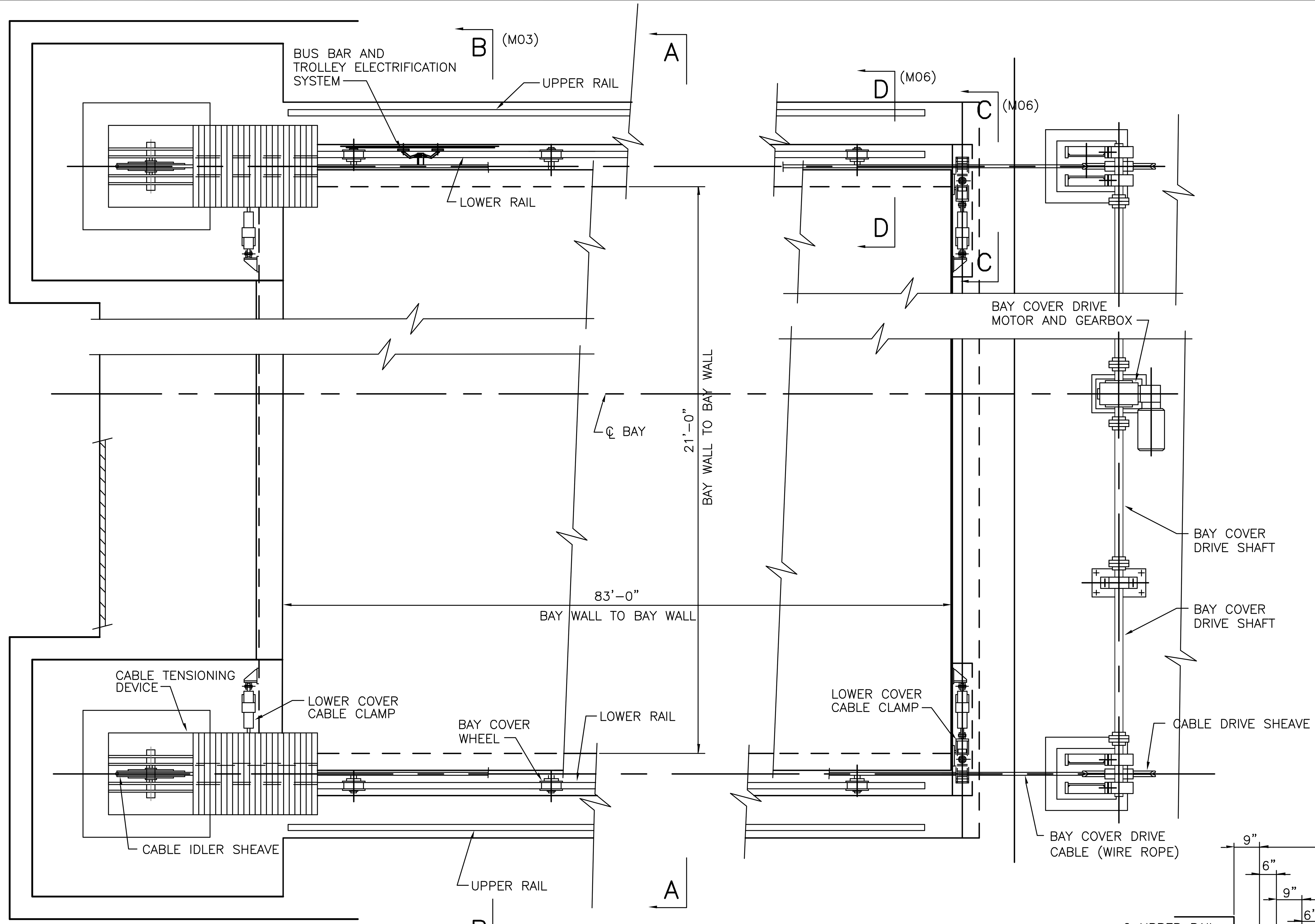
CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

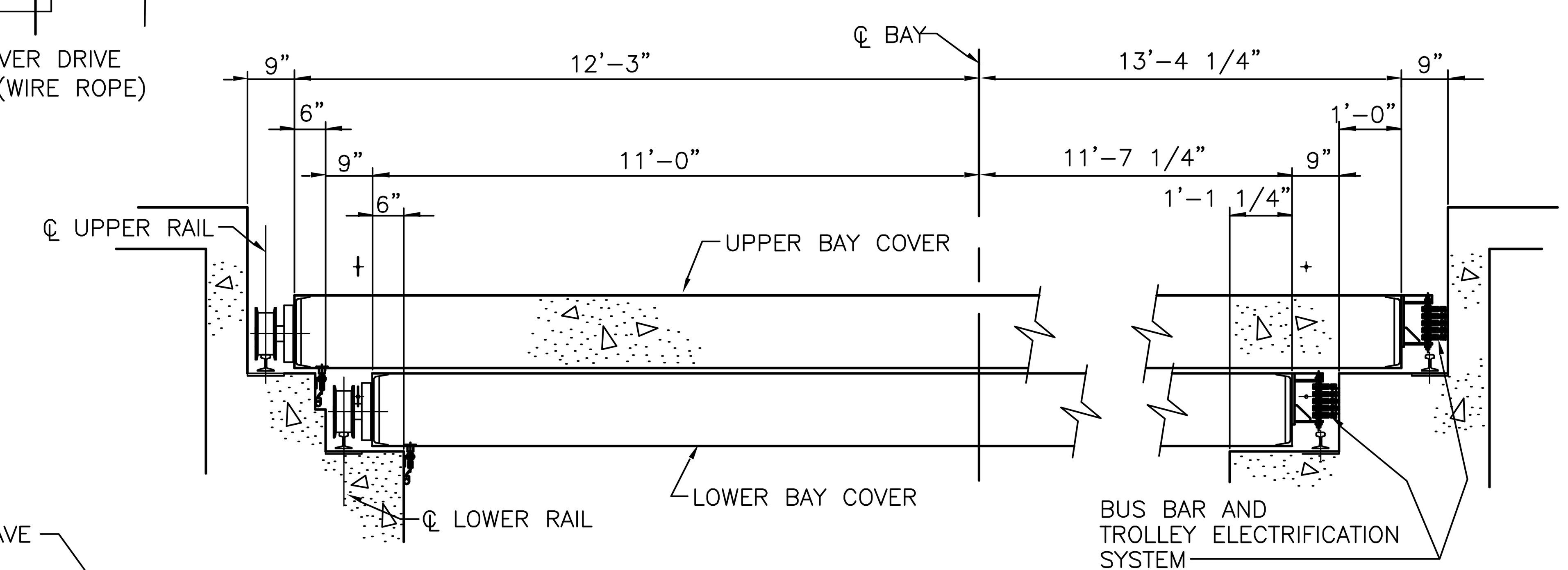
SHEET OF

FIGURE M01

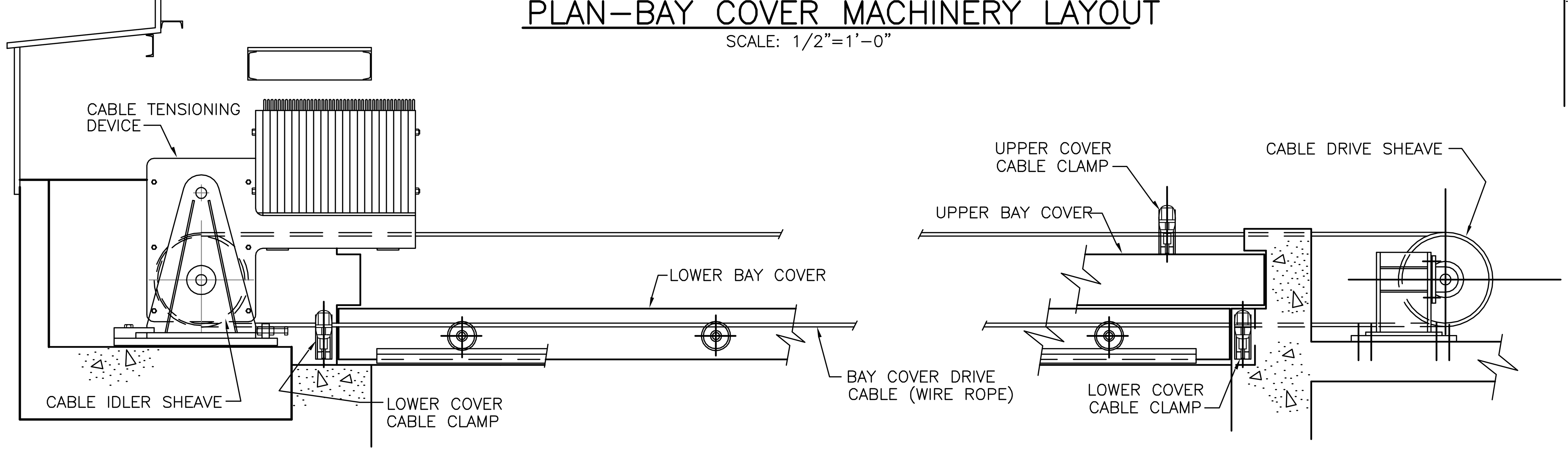
N:\013936\SSS\3011S011.DWG



PLAN–BAY COVER MACHINERY LAYOUT
SCALE: 1/2"=1'-0"



SECTION A–A
SCALE: 1/2"=1'-0"



ELEVATION–BAY COVER MACHINERY LAYOUT
SCALE: 1/2"=1'-0"

REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

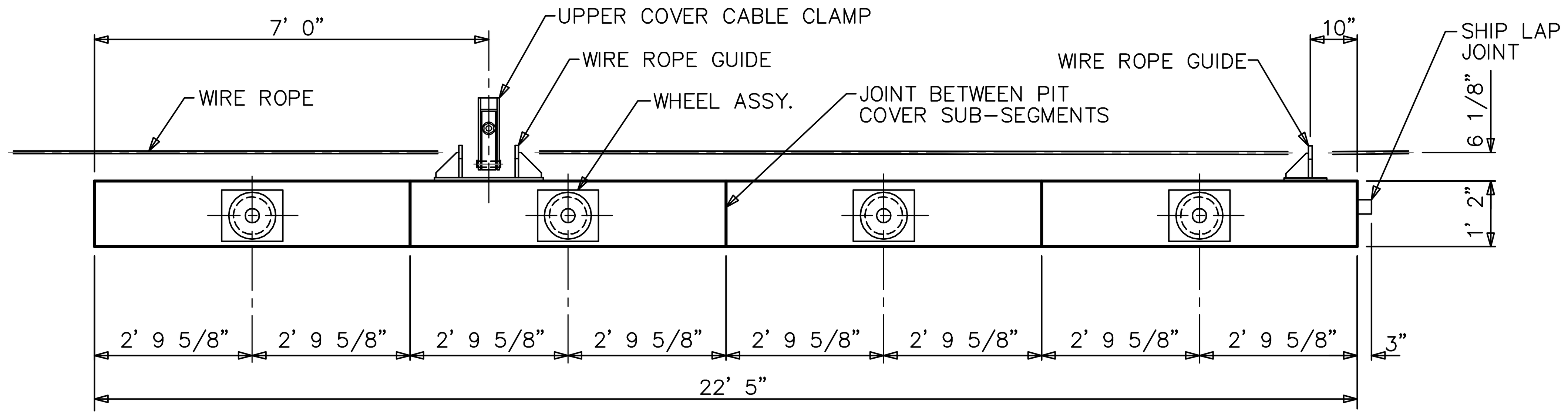
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
MACHINERY LAYOUT

CODE ID. NO. 80091 SIZE D

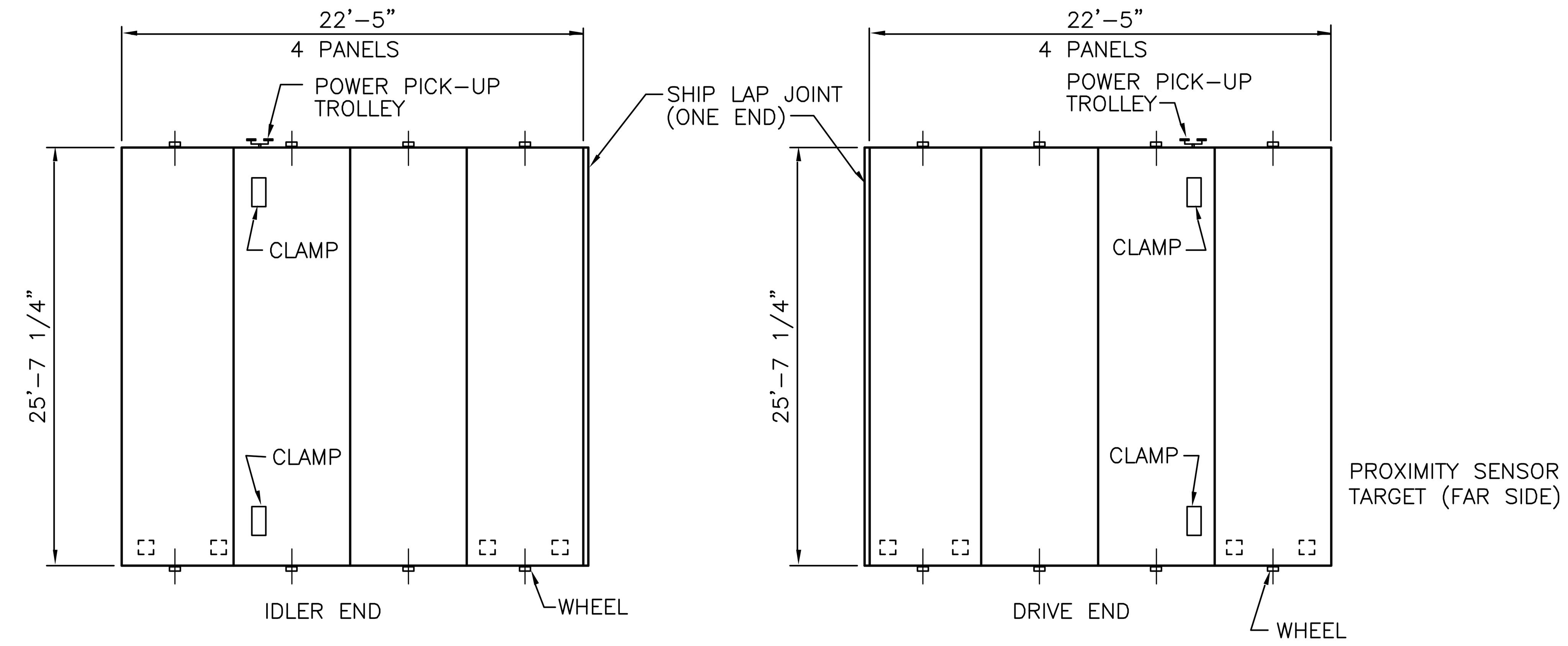
FIGURE M02

N:\013936\SSS\3011S012.DWG



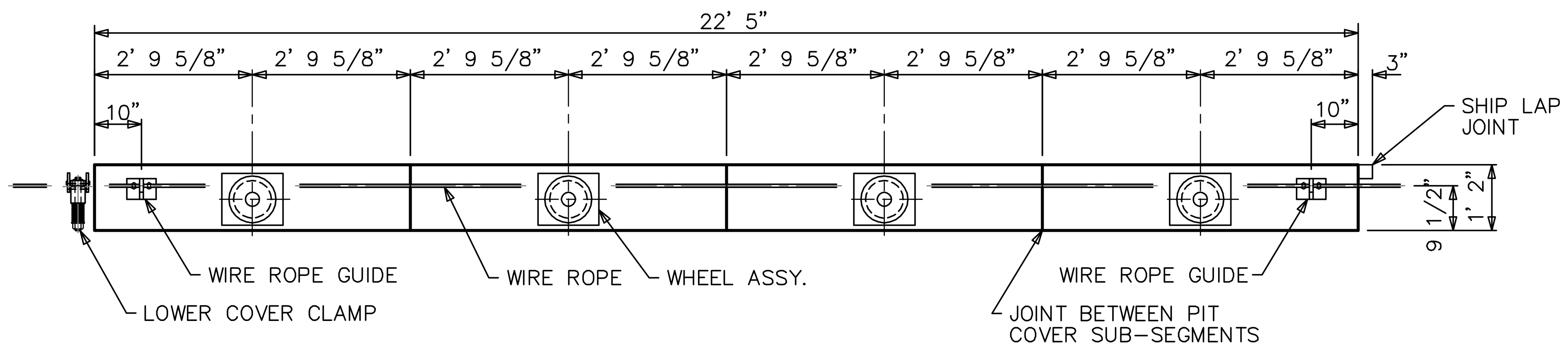
SIDE ELEVATION—UPPER BAY COVER

SCALE: 1/2"=1'-0"



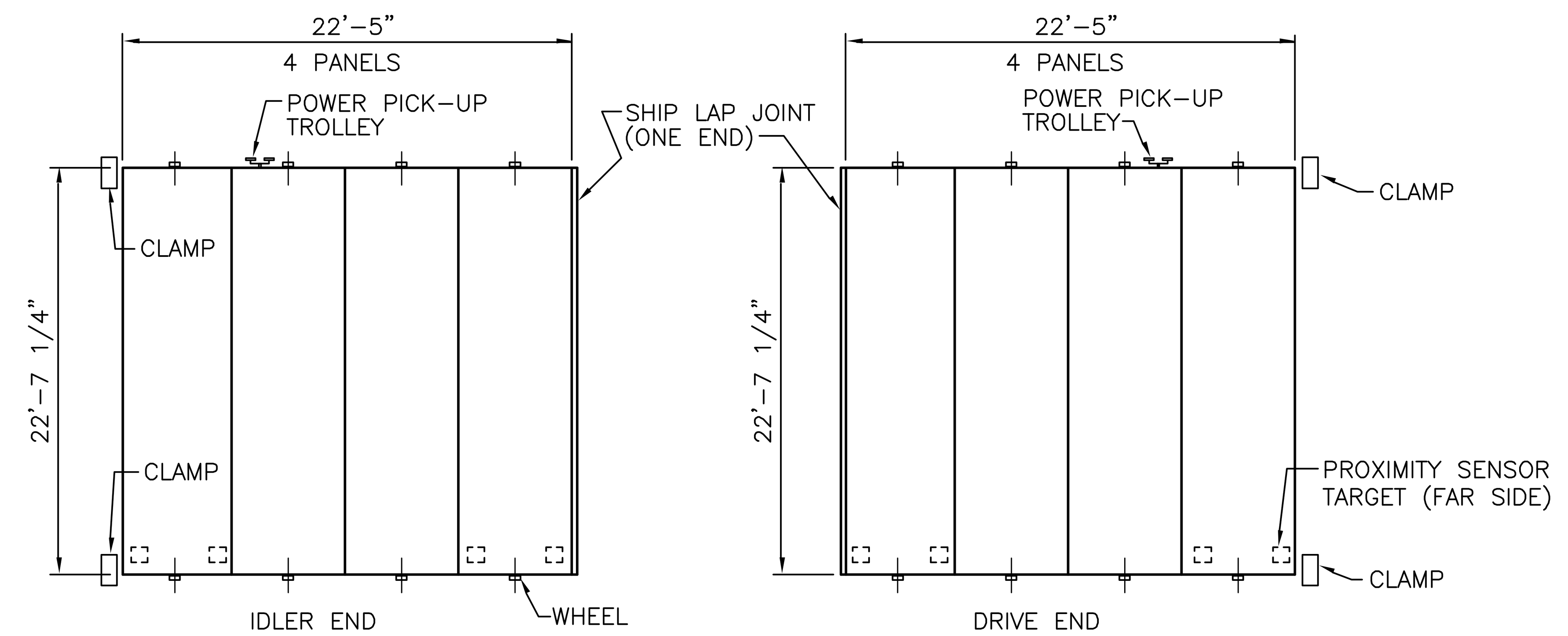
PLAN—UPPER BAY COVERS

POWER TROLLEYS AND PROXIMITY SENSOR TARGETS NOT SHOWN.

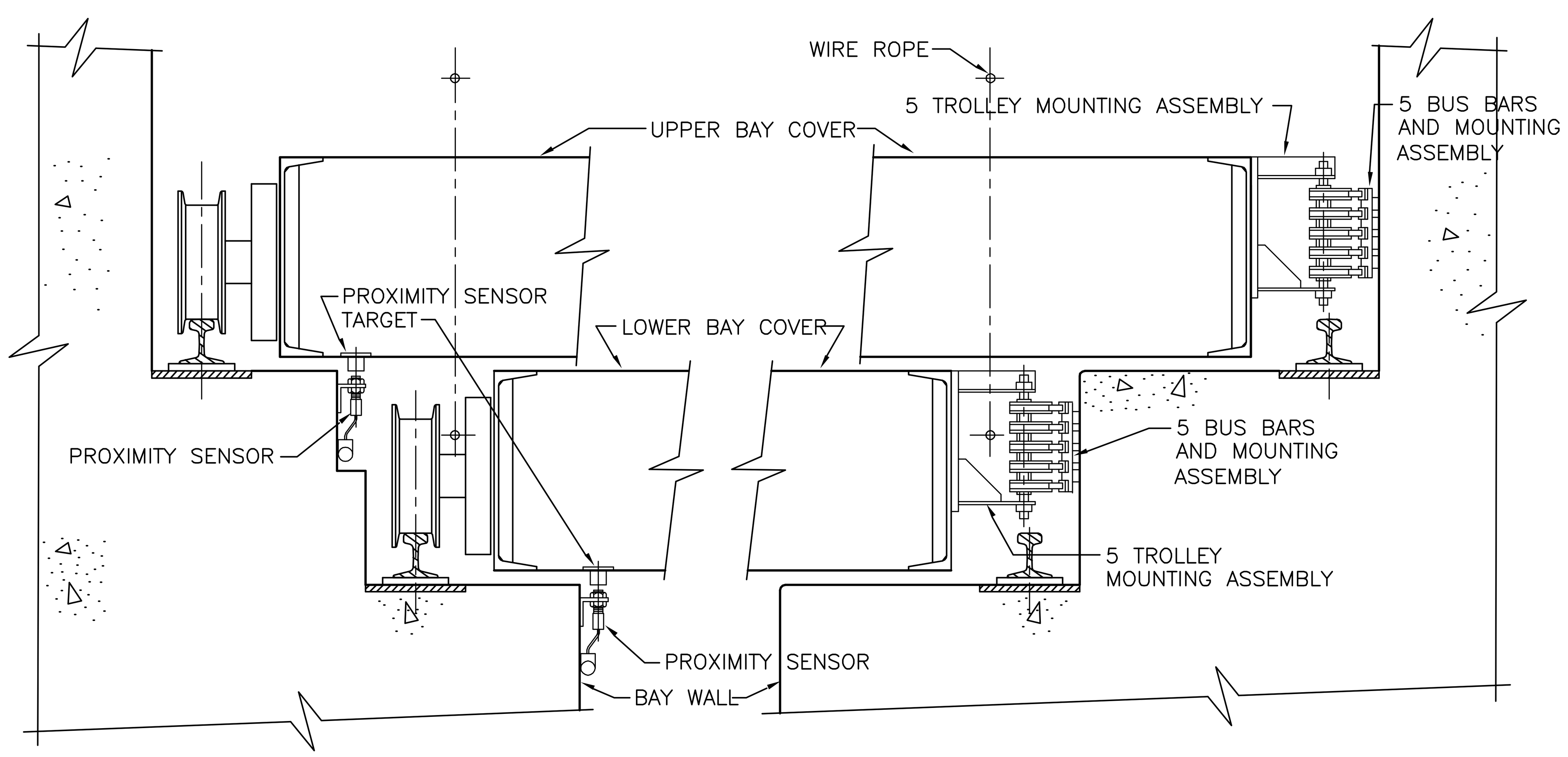


SIDE ELEVATION—LOWER BAY COVER

SCALE: 1/2"=1'-0"



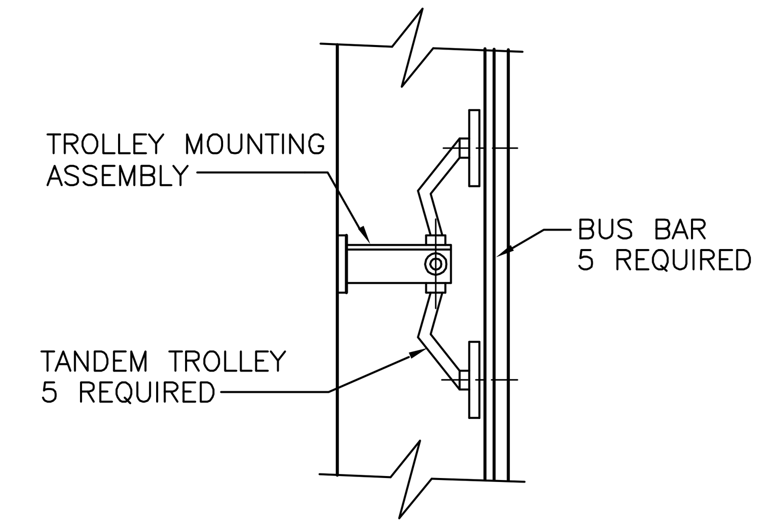
PLAN—LOWER BAY COVERS



BUS BAR AND PROXIMITY SENSOR DETAIL

SECTION B–B (M02)

SCALE: 1 1/2"=1'-0"



PLAN

REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

ACTIVITY - SATISFACTORY TO

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

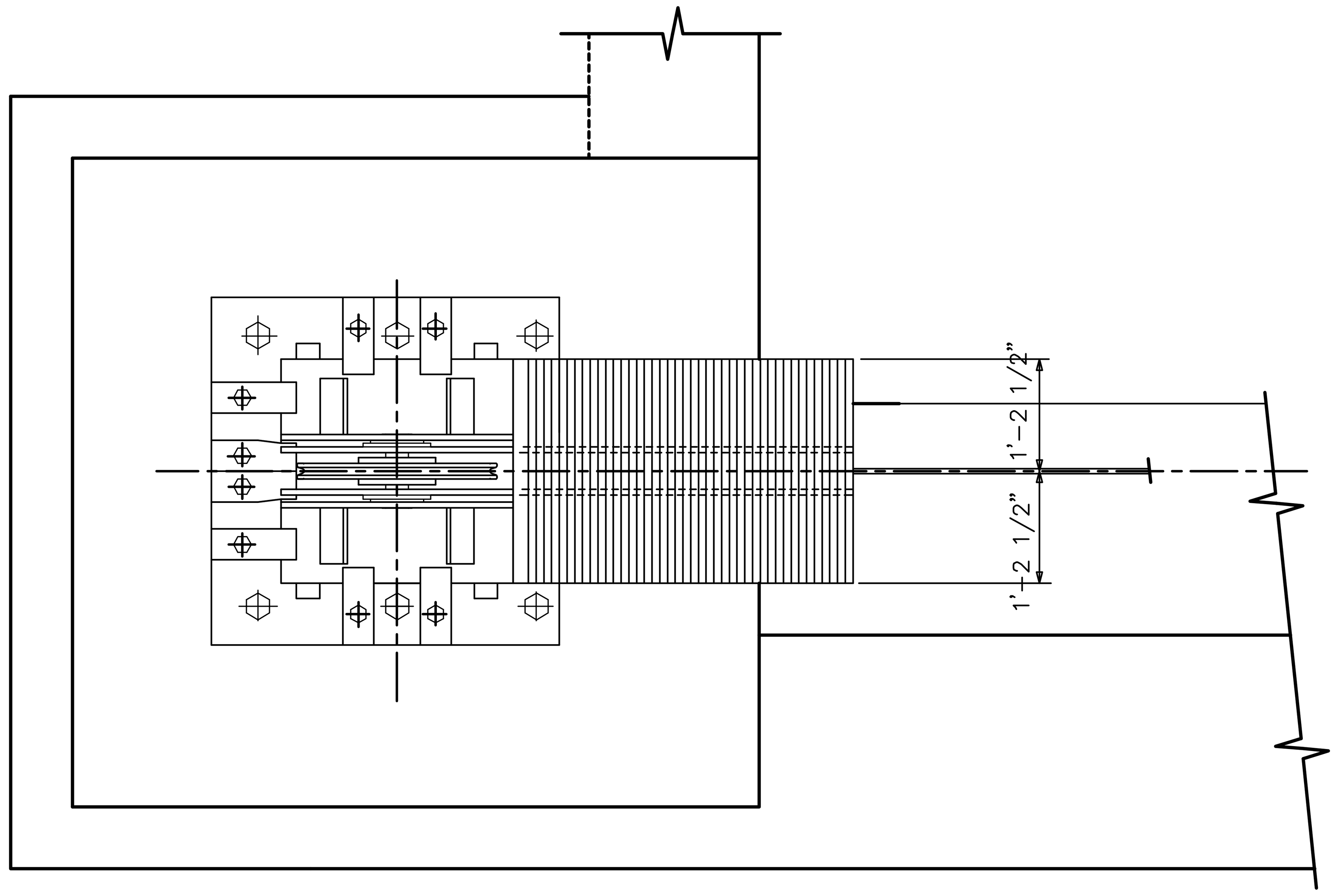
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

BAY COVERS—PLANS AND ELEVATIONS

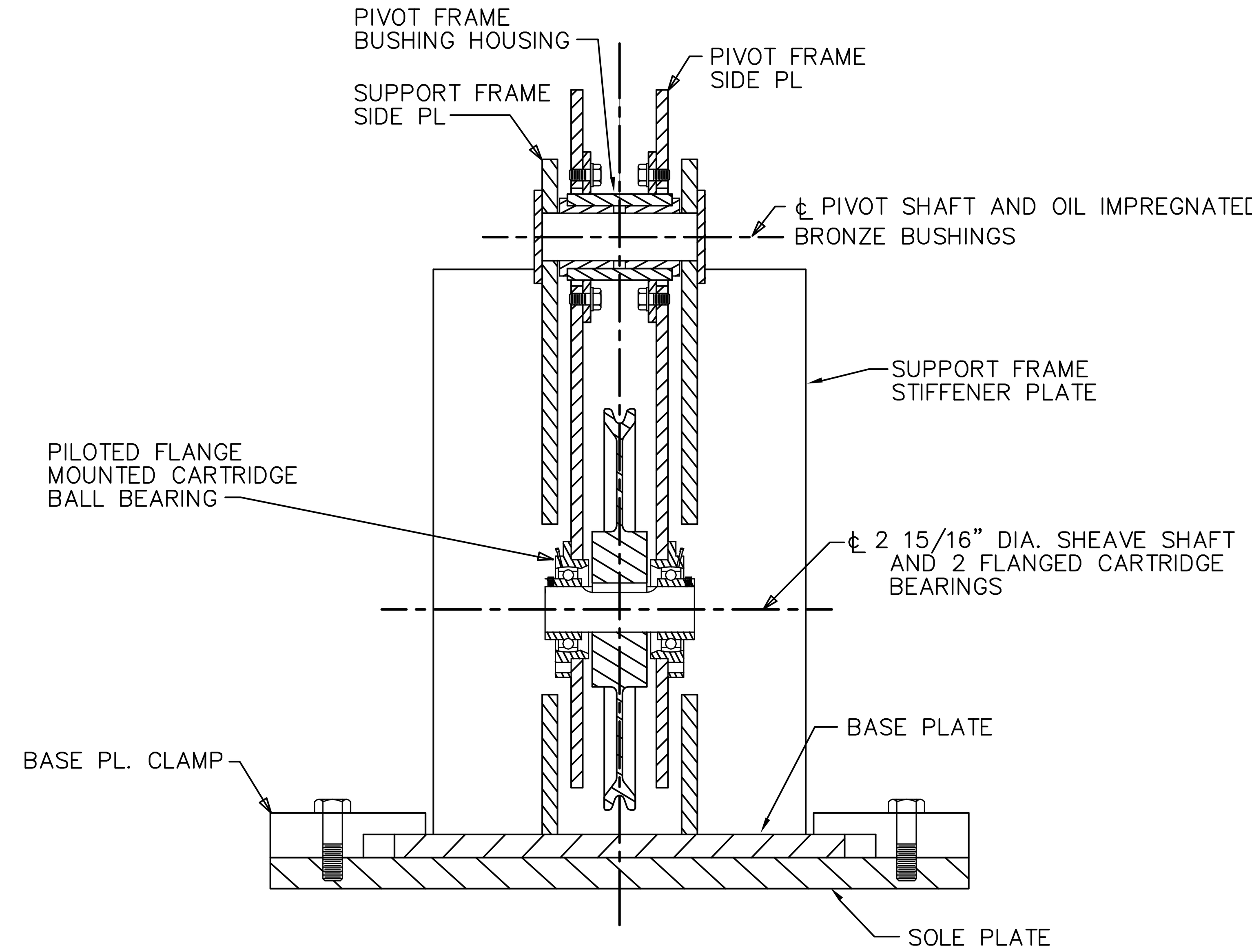
CODE ID. NO. 80091 SIZE D

FIGURE M03

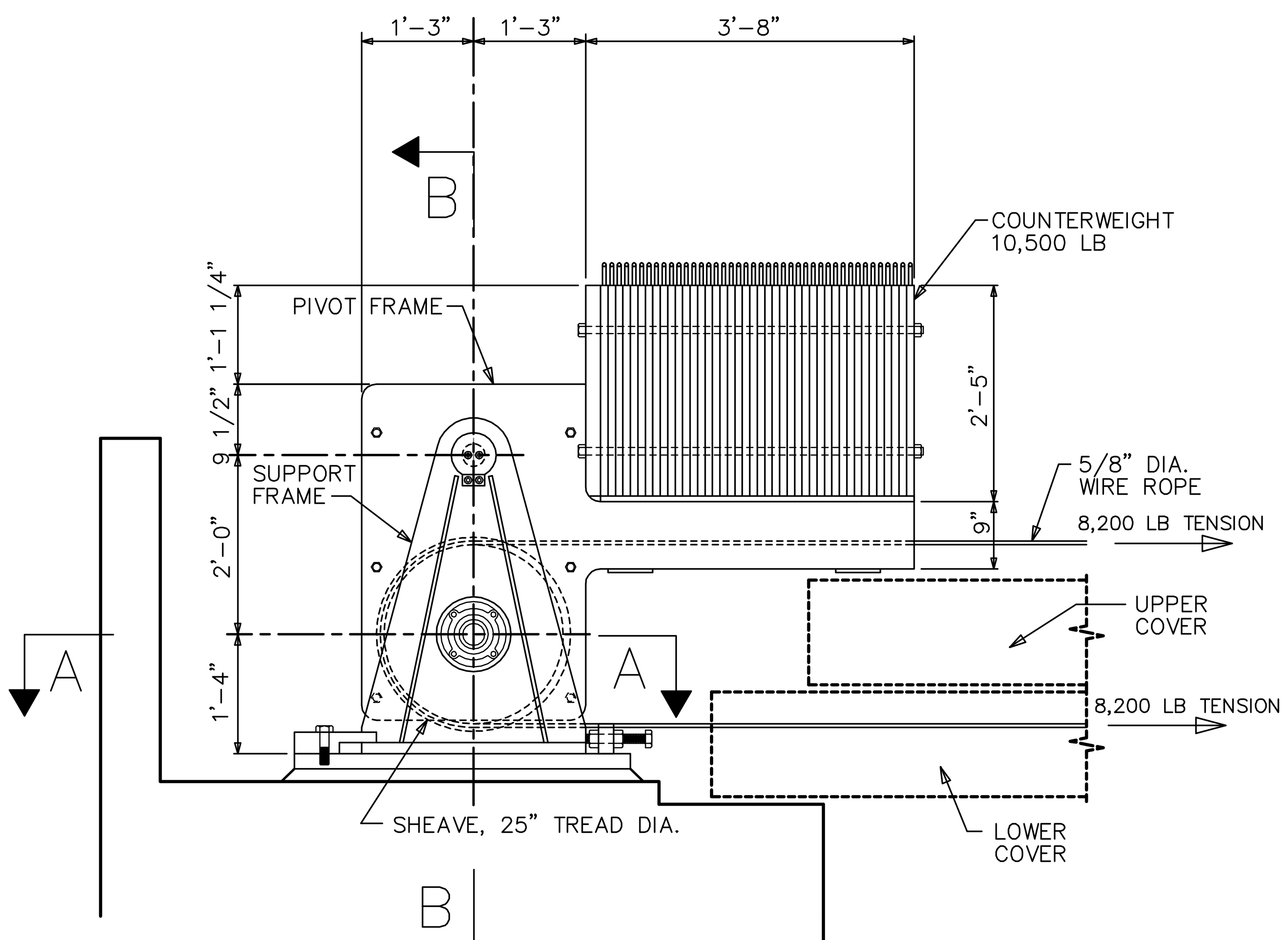
N:\01393G\SSS\3011S017.DWG



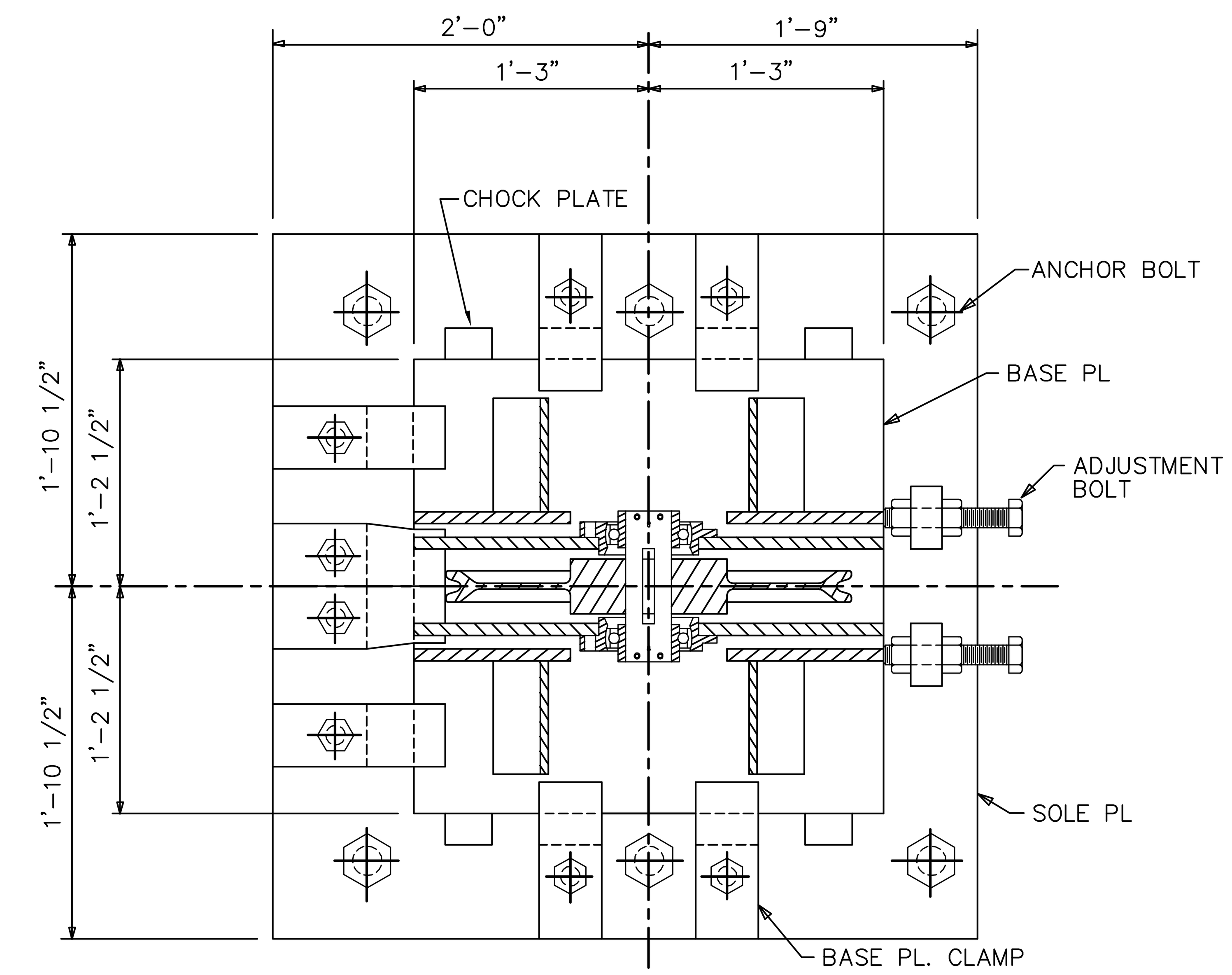
PLAN
SCALE: 3/4"=1'-0"



SECTION B–B
SCALE: 1 1/2"=1'-0"



CABLE TENSIONING DEVICE ARRANGEMENT
SCALE: 3/4"=1'-0"



SECTION A–A
SCALE: 1 1/2"=1'-0"

REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

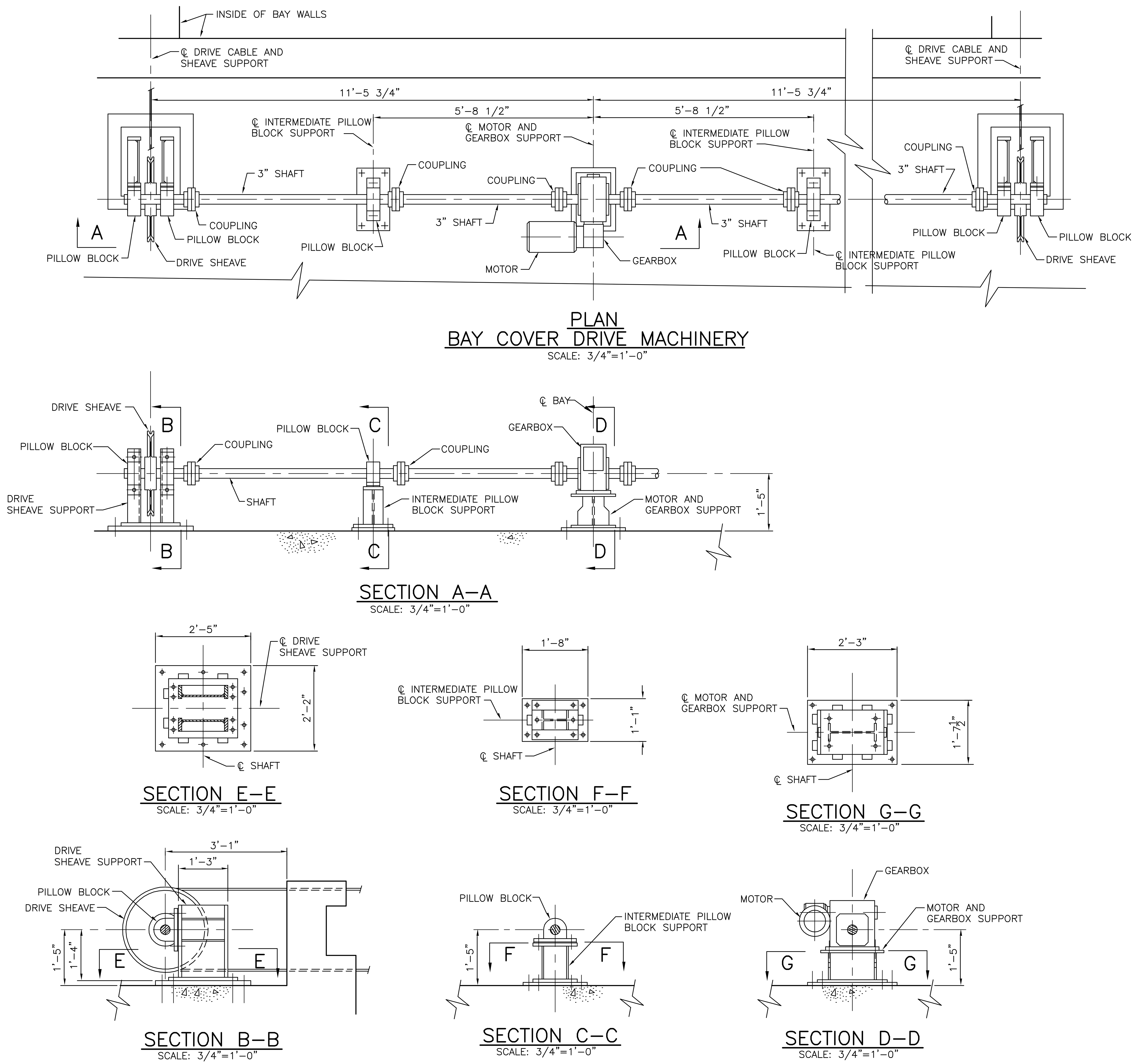
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA
NAVAL STATION

HIGH PERFORMANCE MAGAZINE
STANDARD DESIGN
CABLE TENSIONING DEVICE

CODE ID. NO. 80091 SIZE D

FIGURE M04

N:\013936\SSS\3011S015.DWG



SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

ACTIVITY — SATISFACTORY TO

APPROVED — FOR EFD FOR COMMANDER NAVFAC

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION — NORFOLK, VIRGINIA

NAVAL STATION

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

BAY COVER DRIVE MACHINERY

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

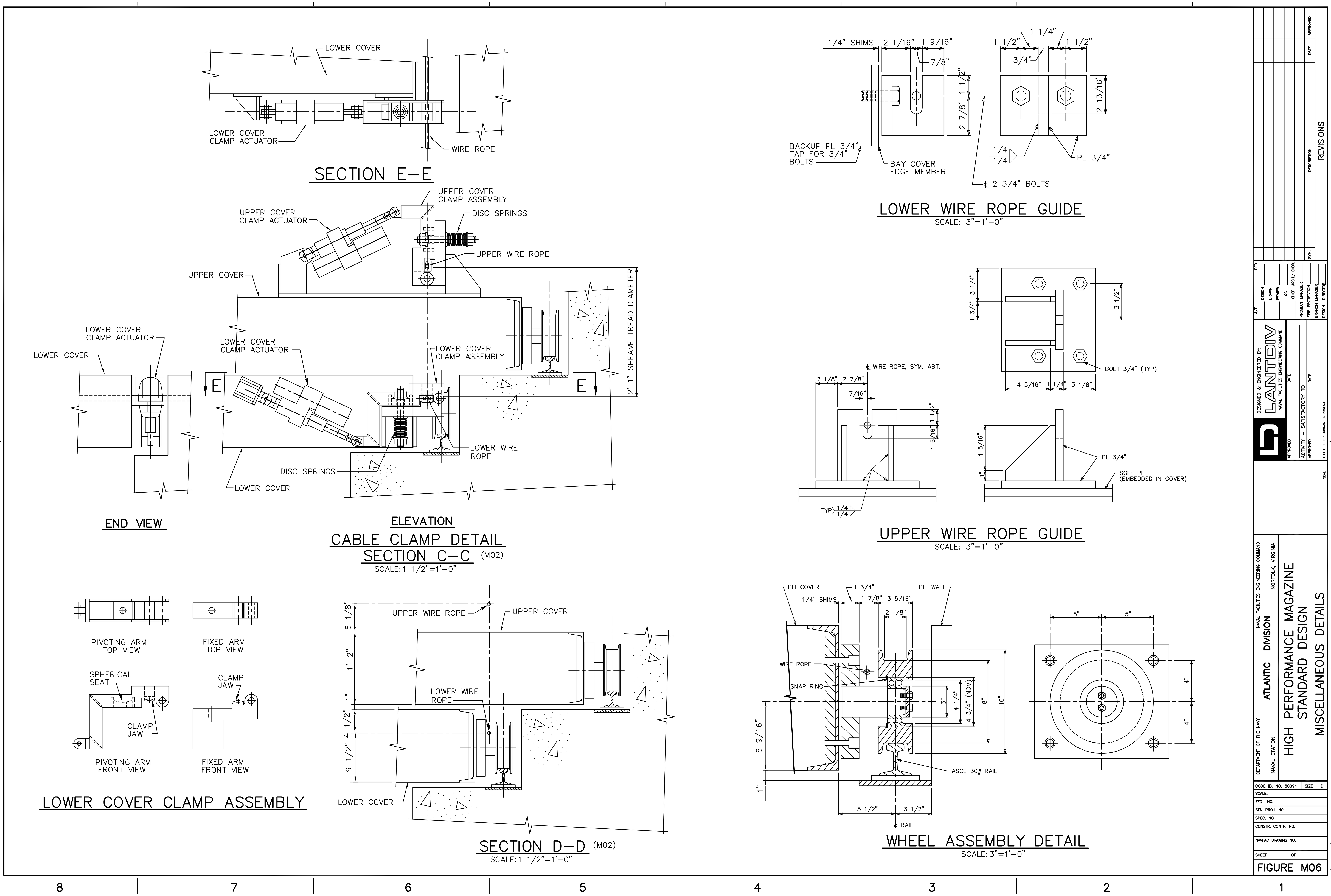
CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

SHEET OF

FIGURE M05

N:\013936\SSS\3011S016.DWG

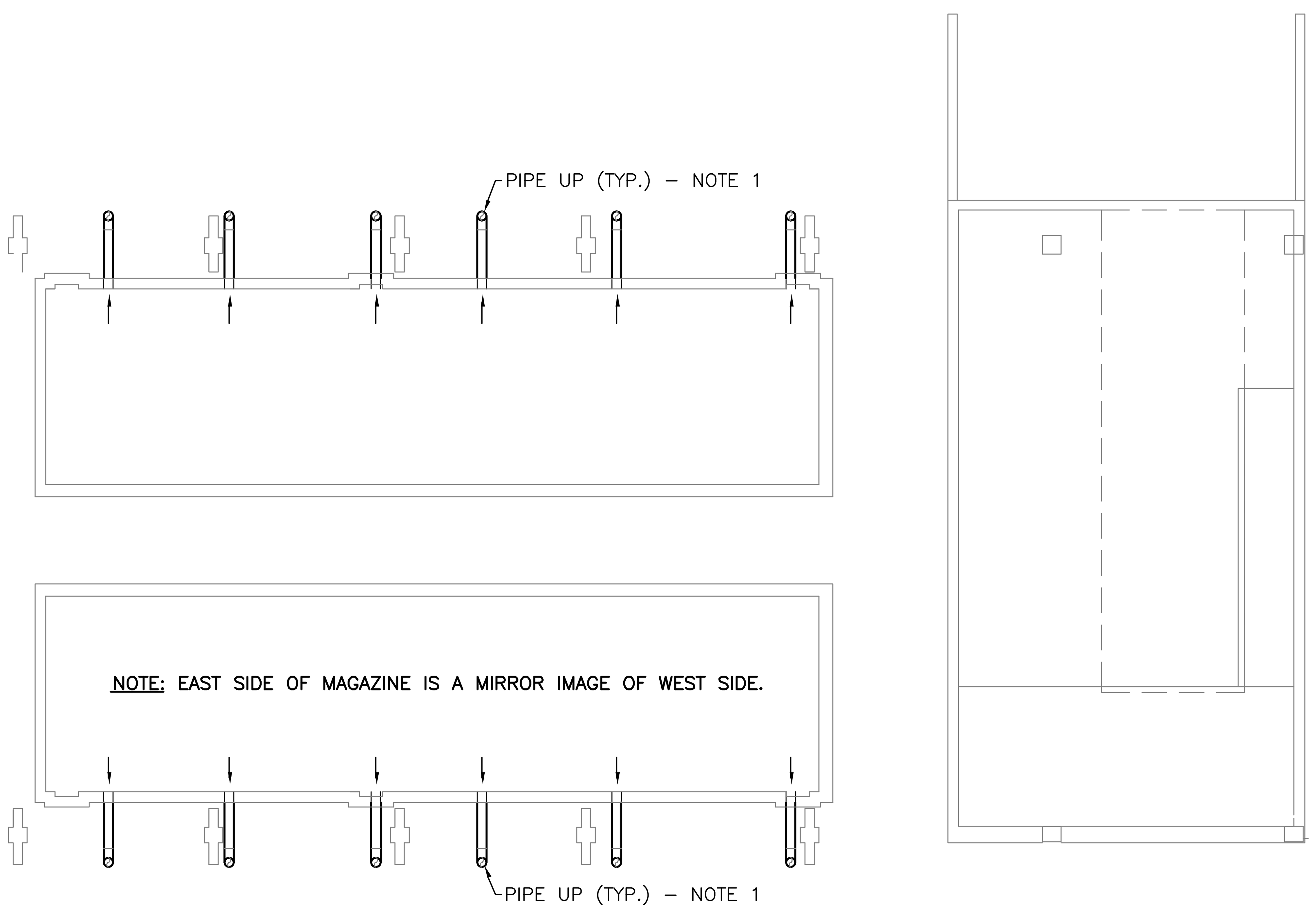

LOWER COVER
LOWER COVER CLAMP ACTUATOR
WIRE ROPE
SECTION E–E
UPPER COVER CLAMP ASSEMBLY
UPPER COVER CLAMP ACTUATOR
DISC SPRINGS
UPPER WIRE ROPE
UPPER COVER
2' 1" SHEAVE TREAD DIAMETER
LOWER COVER CLAMP ACTUATOR
LOWER COVER
LOWER COVER CLAMP ASSEMBLY
LOWER WIRE ROPE
DISC SPRINGS
LOWER COVER
E
E
END VIEW
ELEVATION
CABLE CLAMP DETAIL
SECTION C–C (M02)
SCALE: 1 1/2"=1'-0"
PIVOTING ARM TOP VIEW
FIXED ARM TOP VIEW
SPHERICAL SEAT
CLAMP JAW
CLAMP JAW
PIVOTING ARM FRONT VIEW
FIXED ARM FRONT VIEW
LOWER COVER CLAMP ASSEMBLY
UPPER WIRE ROPE
UPPER COVER
LOWER WIRE ROPE
LOWER COVER
6 1/8"
1'-2"
1"
4 1/2"
9 1/2"
SECTION D–D (M02)
SCALE: 1 1/2"=1'-0"
1/4" SHIMS
2 1/16"
1 9/16"
7/8"
1 1/2"
2 7/8"
1 1/4"
1 1/2"
3/4"
1 1/2"
2 13/16"
BACKUP PL 3/4" TAP FOR 3/4" BOLTS
BAY COVER EDGE MEMBER
1/4
PL 3/4"
℄ 2 3/4" BOLTS
LOWER WIRE ROPE GUIDE
SCALE: 3"=1'-0"
3 1/4"
1 3/4"
3 1/2"
BOLT 3/4" (TYP)
4 5/16"
1 1/4"
3 1/8"
℄ WIRE ROPE, SYM. ABT.
2 1/8"
2 7/8"
7/16"
1 1/2"
1 5/16"
4 5/16"
1"
PL 3/4"
SOLE PL (EMBEDDED IN COVER)
TYP 1/4
UPPER WIRE ROPE GUIDE
SCALE: 3"=1'-0"
PIT COVER
1 3/4"
PIT WALL
1/4" SHIMS
1 7/8"
3 5/16"
2 1/8"
WIRE ROPE
SNAP RING
3"
4 1/4"
4 3/4" (NOM)
8"
10"
6 9/16"
1"
ASCE 30# RAIL
5 1/2"
3 1/2"
℄ RAIL
5"
5"
4"
4"
WHEEL ASSEMBLY DETAIL
SCALE: 3"=1'-0"
REVISIONS
SYM.
DESCRIPTION
DATE
APPROVED
DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND
ACTIVITY – SATISFACTORY TO
APPROVED
DATE
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA
NAVAL STATION
HIGH PERFORMANCE MAGAZINE
STANDARD DESIGN
MISCELLANEOUS DETAILS
CODE ID. NO. 80091
SIZE D
SCALE:
EFD NO.
STA. PROJ. NO.
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET
OF
FIGURE M06
N:\013936\SSS\3011S013.DWG
8
7
6
5
4
3
2
1

UPPER LEVEL & ROOF PLAN
SCALE: 3/32"=1'–0"

N (REF)

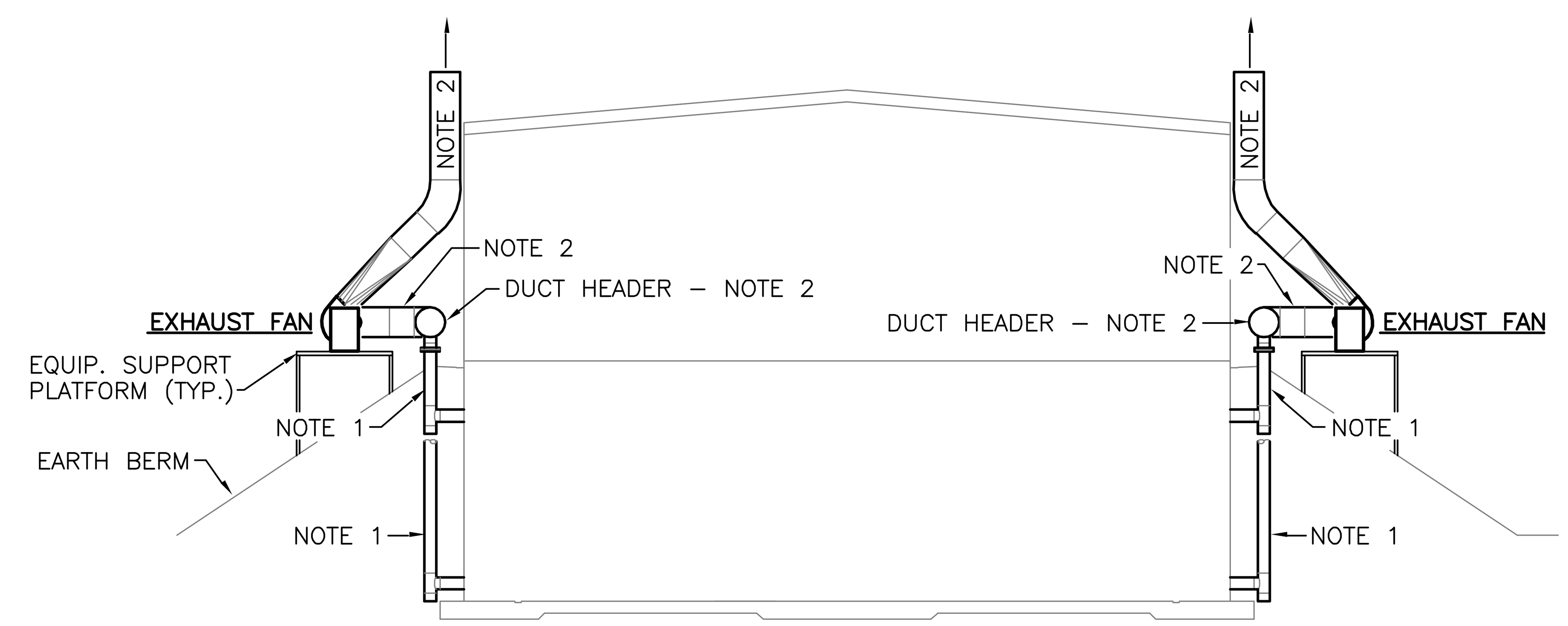
NOTES

1. FOR 12 AIR CHANGES PER HOUR USE 12ø SIZE @ 900 CFM EACH.
2. FOR 12 AIR CHANGES PER HOUR USE 24ø SIZE.
3. L–1 MOTORIZED OUTSIDE AIR STORM PROOF LOUVER FOR 12 AIR CHANGES, 5400 CFM, 2 @ 72"x72". LOUVER WILL BE ELECTRICALLY INTERLOCKED WITH EXHAUST FAN.
4. COOLING AND HEATING OF THE UPPER LEVEL IS NOT SHOWN SINCE IT IS NOT A CRITERIA REQUIREMENT. COOLING AND HEATING OF THE UPPER LEVEL WILL DEPEND UPON SITE SPECIFIC CONSIDERATIONS.



PARTIAL LOWER LEVEL PLAN
SCALE: 3/32"=1'–0"

N (REF)



WEST END ELEVATION
SCALE: 3/32"=1'–0"

REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

ACTIVITY – SATISFACTORY TO

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
VENTILATED MAGAZINE (12 AIR CHANGES)

CODE ID. NO. 80091 SIZE D

M–1

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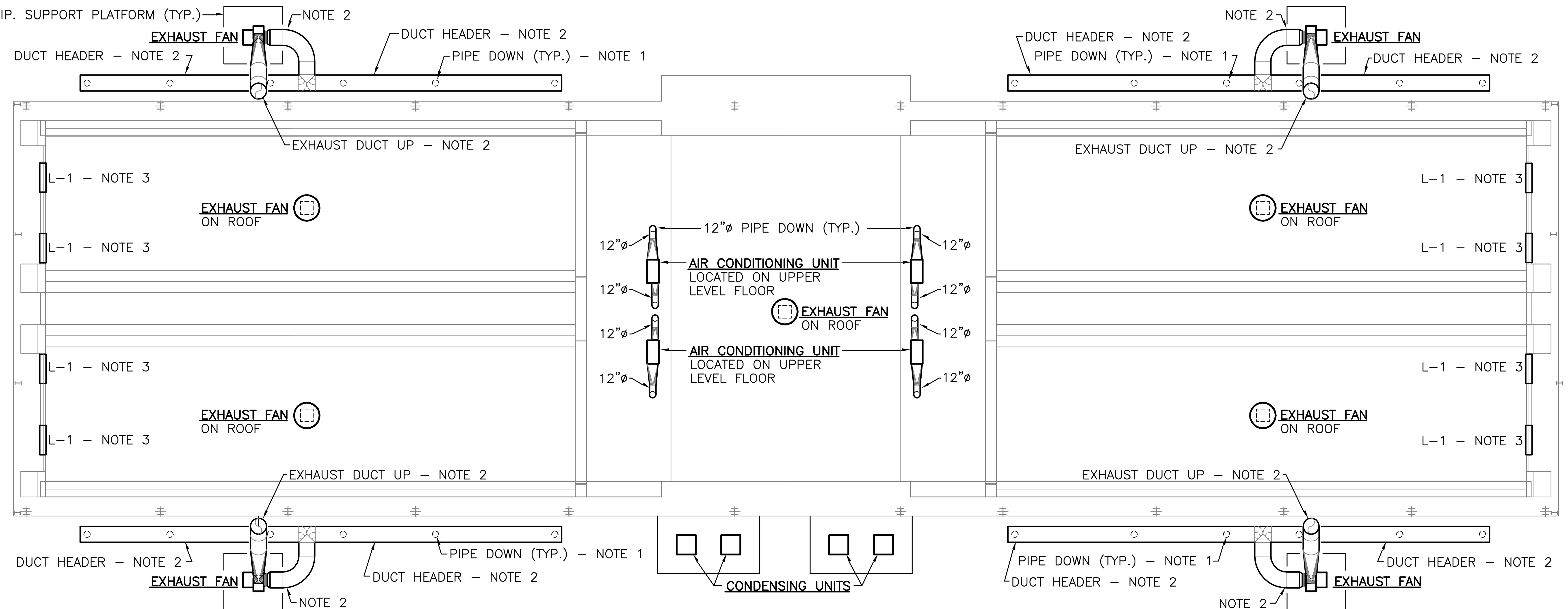
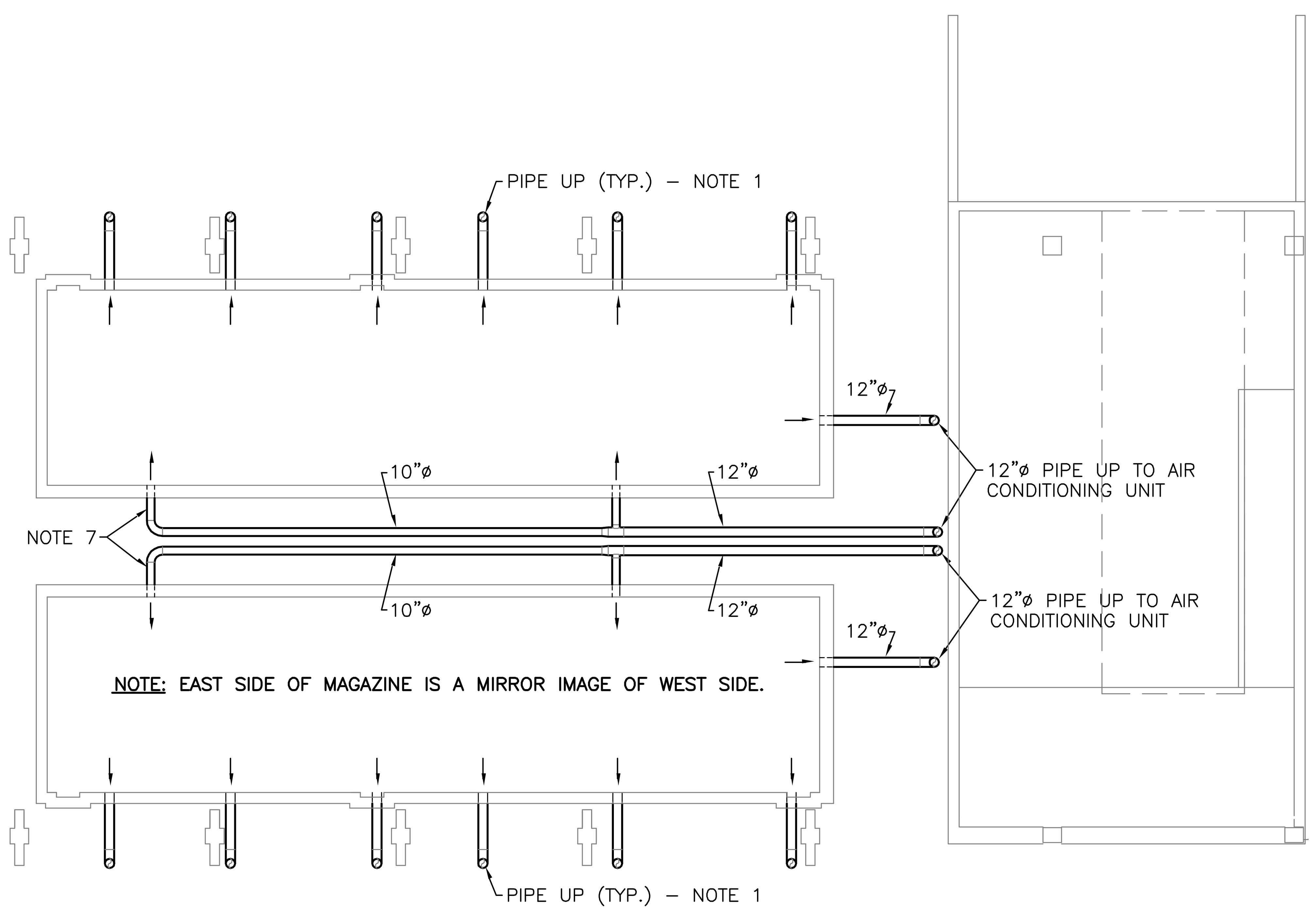
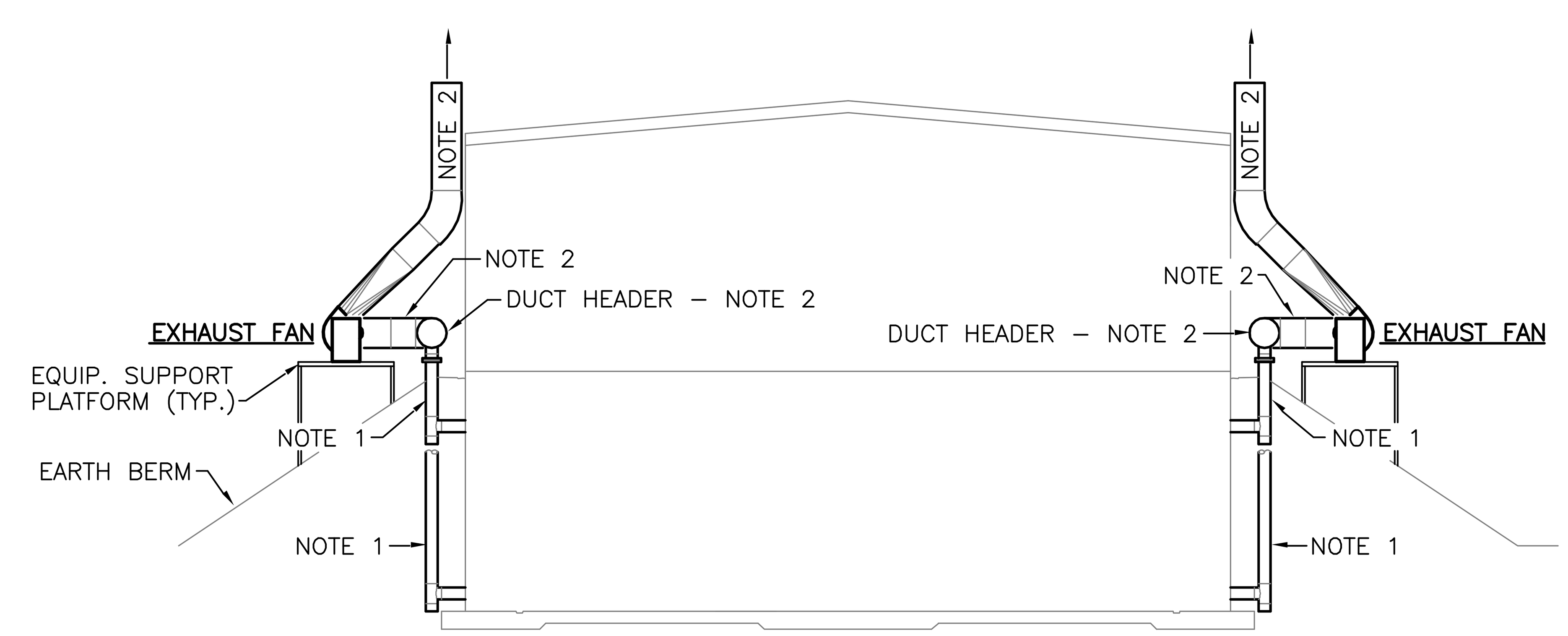


UPPER LEVEL & ROOF PLAN
SCALE: 3/32"=1'-0"
N (REF)



PARTIAL LOWER LEVEL PLAN
SCALE: 3/32"=1'-0"
N (REF)



WEST END ELEVATION
SCALE: 3/32"=1'-0"

NOTES

1. FOR 12 AIR CHANGES PER HOUR USE 12ø SIZE @ 900 CFM EACH.
2. FOR 12 AIR CHANGES PER HOUR USE 24ø SIZE.
3. L-1 MOTORIZED OUTSIDE AIR STORM PROOF LOUVER FOR 12 AIR CHANGES, 5400 CFM, 2 @ 72"x72". LOUVER WILL BE ELECTRICALLY INTERLOCKED WITH EXHAUST FAN.
4. COOLING AND HEATING OF THE UPPER LEVEL IS NOT SHOWN SINCE IT IS NOT A CRITERIA REQUIREMENT. COOLING AND HEATING OF THE UPPER LEVEL WILL DEPEND ON SITE SPECIFIC CONSIDERATIONS.
5. AIR CONDITIONING SHOWN IS FOR ENVIRONMENTAL CONTROL OF PIT CONDITIONS.
6. BELOW GROUND DUCTWORK SHALL BE SCHEDULE 80 PVC.
7. SUPPLY CONDITIONED AIR LOW IN STORAGE PITS.

REVISIONS

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

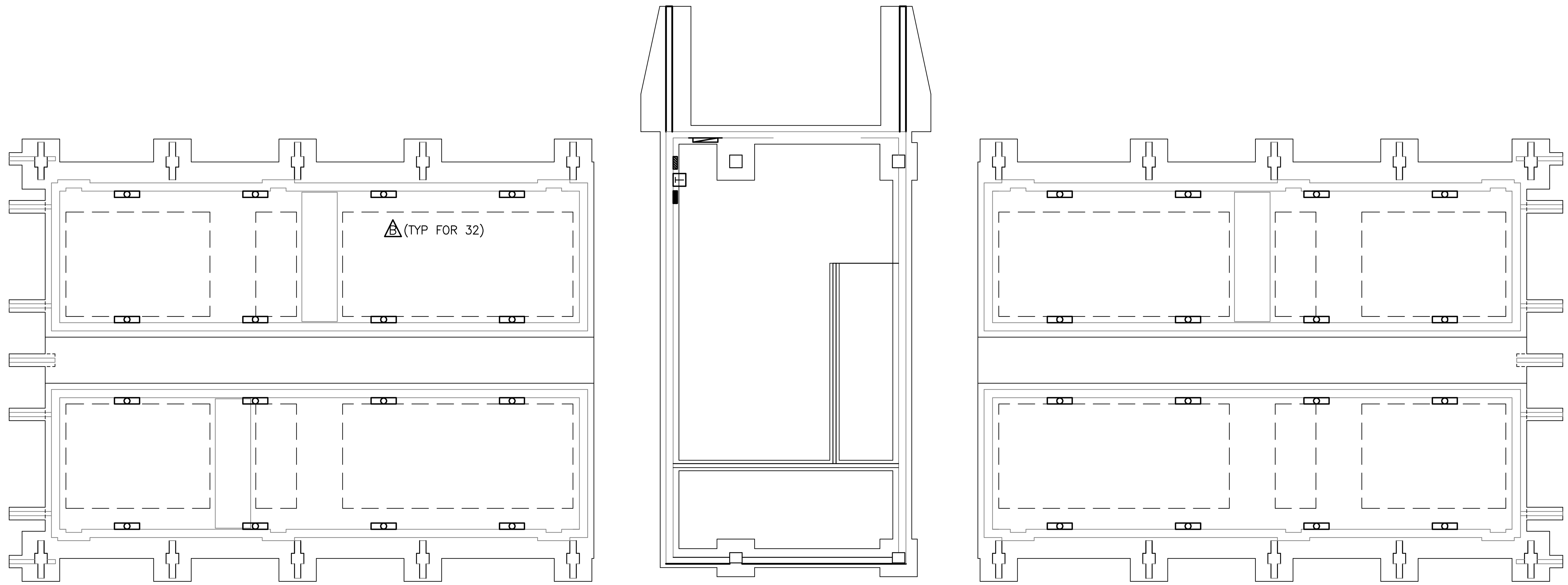
HIGH PERFORMANCE MAGAZINE
STANDARD DESIGN
AIR CONDITIONED MAGAZINE (12 AIR CHANGES)

CODE ID. NO. 80091 SIZE D

SHEET M-2

FILENAME: 7605X02R.DWG, UPDATED ON 07/05/01 AT 12:33, XREFS: NONE

DRAWFORM REVISION 25 SEPT 96



LIGHTING PLAN – FIRST LEVEL
SCALE: 3/32" = 1'-0"

HAZARDOUS LOCATION NOTE
MAGAZINE INTERIOR IS A CLASS 1 DIVISION 2 GROUP D AND CLASS 2 DIVISION 2 HAZARDOUS LOCATION BELOW THE BAY COVER ONLY.

LIGHTING FIXTURE SCHEDULE

FIXTURE SYMBOL	SKETCH NO. & TYPE	NUMBER AND TYPE OF LAMPS	VOLTAGE	MOUNTING	NOTES
A	NL-49, TYPE D	1-250W MH	277	PENDANT MOUNT 6" ABOVE CRANE CLEAR.	②
B	NL-60	2-F60/T12 HO	277	WALL RECESSED 8' ABOVE BOTTOM OF PIT	①③
C	NL-25	1-150W HPS	277	WALL MOUNT 15' ABOVE TOP OF BERM	
D	NL-51	2-12W HALOGEN	277	WALL MOUNT 6' ABOVE TRANSFER AISLE	
E					
F					

① LUMINAIRE RATED FOR CLASS 1, DIVISION 1, GROUP D ATMOSPHERE

② PROVIDE GLOBE GUARD.

③ SEE SHEET E-__ FOR MOUNTING DETAIL.

GRAPHIC SCALE
3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

A/E / EFD: DESIGN RST, DRAWN RST, REVIEW, QC, CHIEF ARCH / ENGR, PROJECT MANAGER, FIRE PROTECTION, BRANCH MANAGER, DESIGN DIRECTOR

APPROVED DATE

ACTIVITY – SATISFACTORY TO DATE

APPROVED FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION — NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN
LIGHTING PLAN – FIRST LEVEL

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
EFD NO.
STA. PROJ. NO.
SPEC. NO. 05-99-7605
CONSTR. CONTR. NO. N62470-99-B-7605
NAVFAC DRAWING NO.
SHEET OF
E-1

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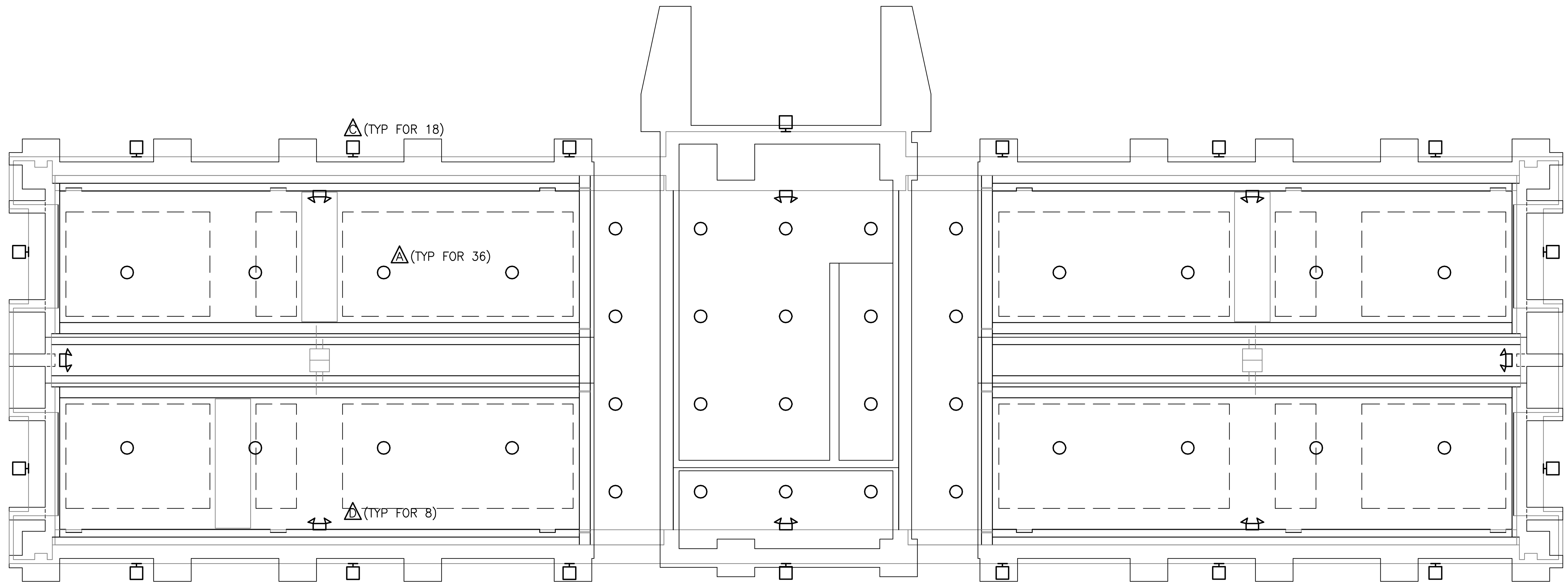
DRAWFORM REVISION 25 SEPT 96



LIGHTING PLAN – SECOND LEVEL

SCALE: 3/32" = 1'-0"

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

A/E | EFD
DESIGN RST
DRAWN RST
REVIEW
QC
CHIEF ARCH./ ENGR.
PROJECT MANAGER
FIRE PROTECTION
BRANCH MANAGER
DESIGN DIRECTOR

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND
DATE
APPROVED
ACTIVITY – SATISFACTORY TO
DATE
APPROVED
FOR EFD FOR COMMANDER NAVFAC

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

LIGHTING PLAN – SECOND LEVEL

CODE ID. NO. 80091	SIZE D
SCALE: AS NOTED	
EFD NO.	
STA. PROJ. NO.	
SPEC. NO. 05-99-7605	
CONSTR. CONTR. NO. N62470-99-B-7605	
NAVFAC DRAWING NO.	
SHEET	OF

E-2

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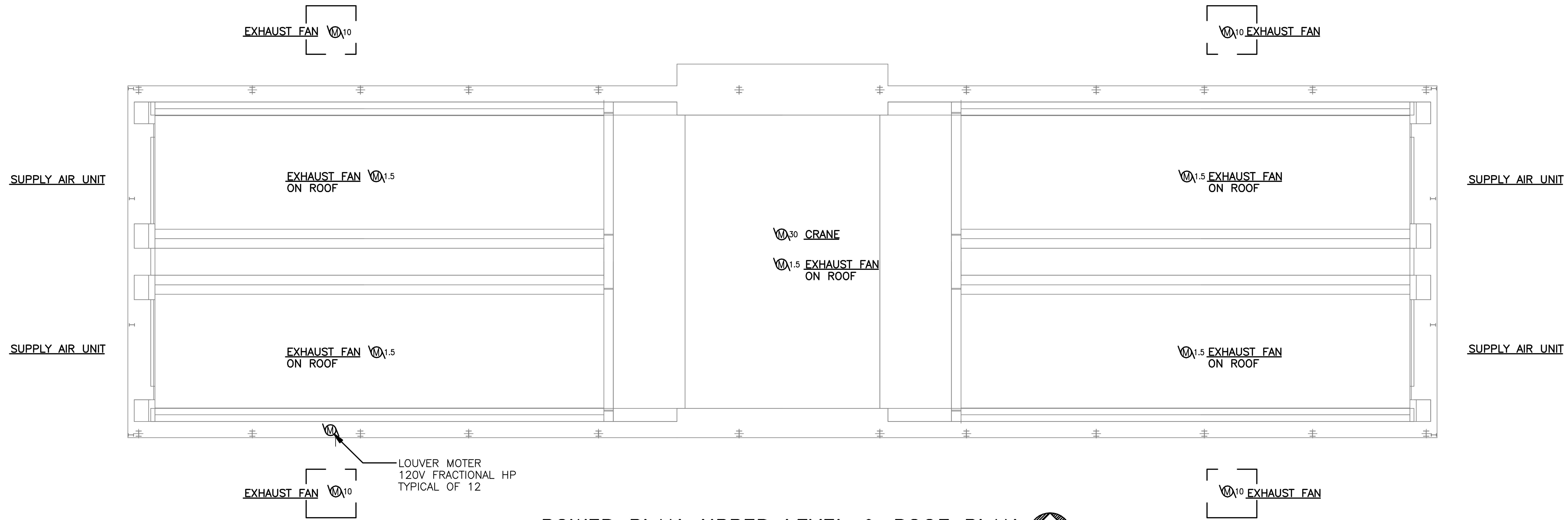
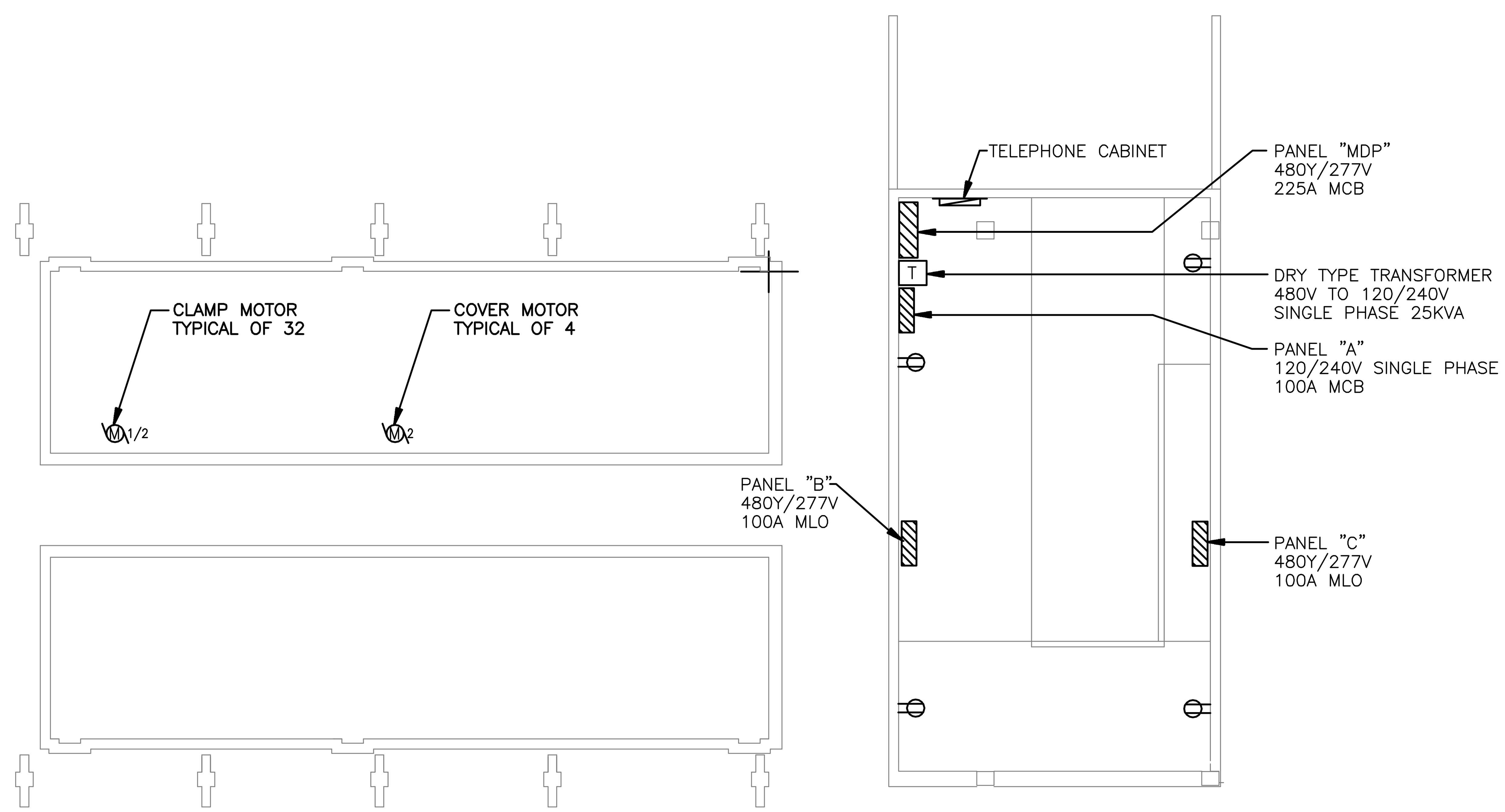
DRAWFORM REVISION 25 SEPT 96



POWER PLAN–UPPER LEVEL & ROOF PLAN

SCALE: 3/32"=1'–0"

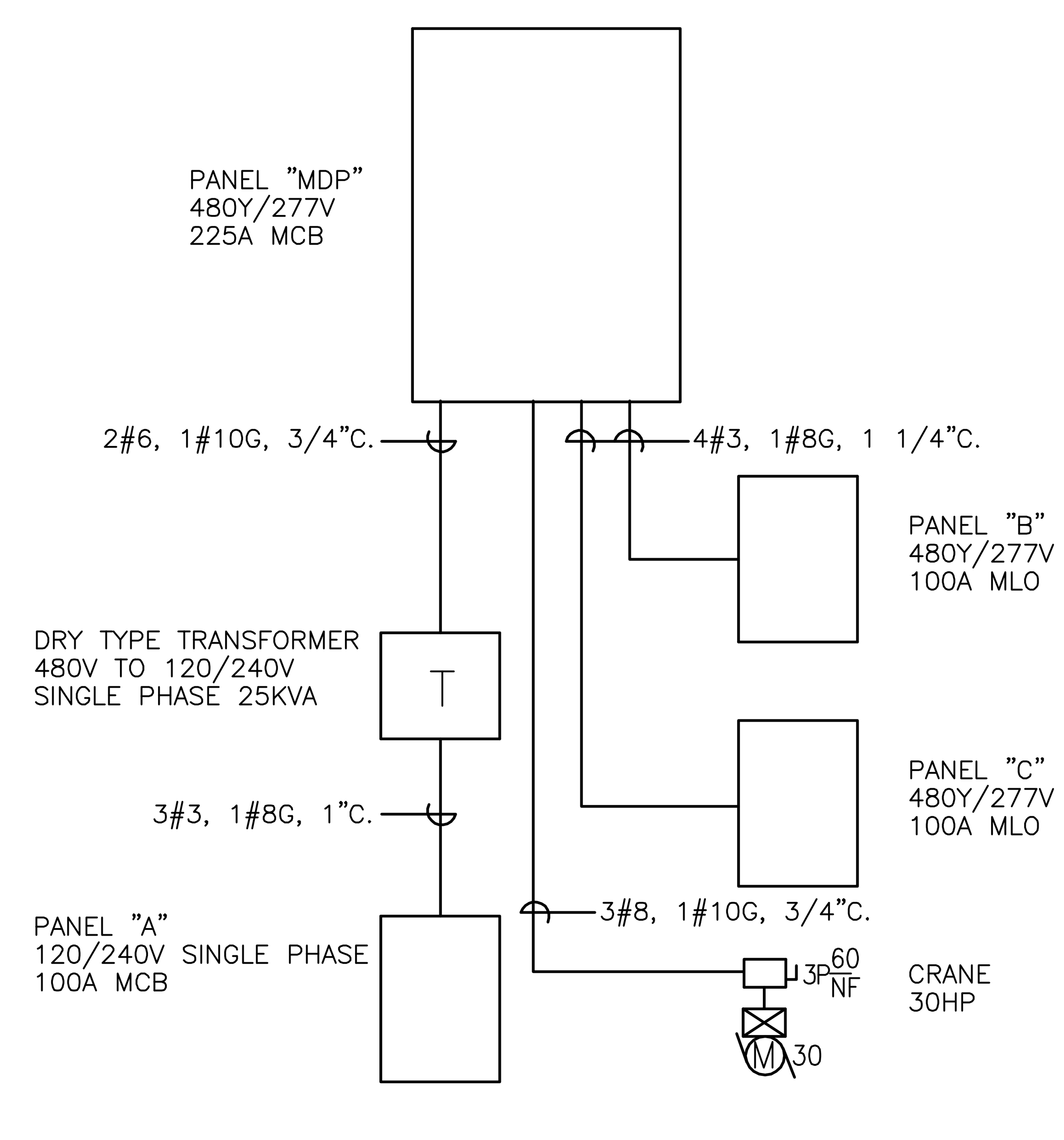
N (REF)



POWER PLAN–PARTIAL LOWER LEVEL PLAN

SCALE: 3/32"=1'–0"

N (REF)



POWER RISER DIAGRAM

NTS

GRAPHIC SCALE

3/32"=1'–0" 0' 10' 20' 30' 40'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGN GCB
DRAWN LDS
REVIEW
QC
CHIEF ARCH / ENGR
PROJECT MANAGER
FIRE PROTECTION
BRANCH MANAGER
DESIGN DIRECTOR

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY – SATISFACTORY TO DATE

APPROVED FOR EFD FOR COMMANDER NAVFAC

SEAL

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

VENTILATED MAGAZINE

CODE ID. NO. 80091 SIZE D
SCALE:
EFD NO.
STA. PROJ. NO.
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET OF

E–3

DRAWFORM REVISION 25 SEPT 96

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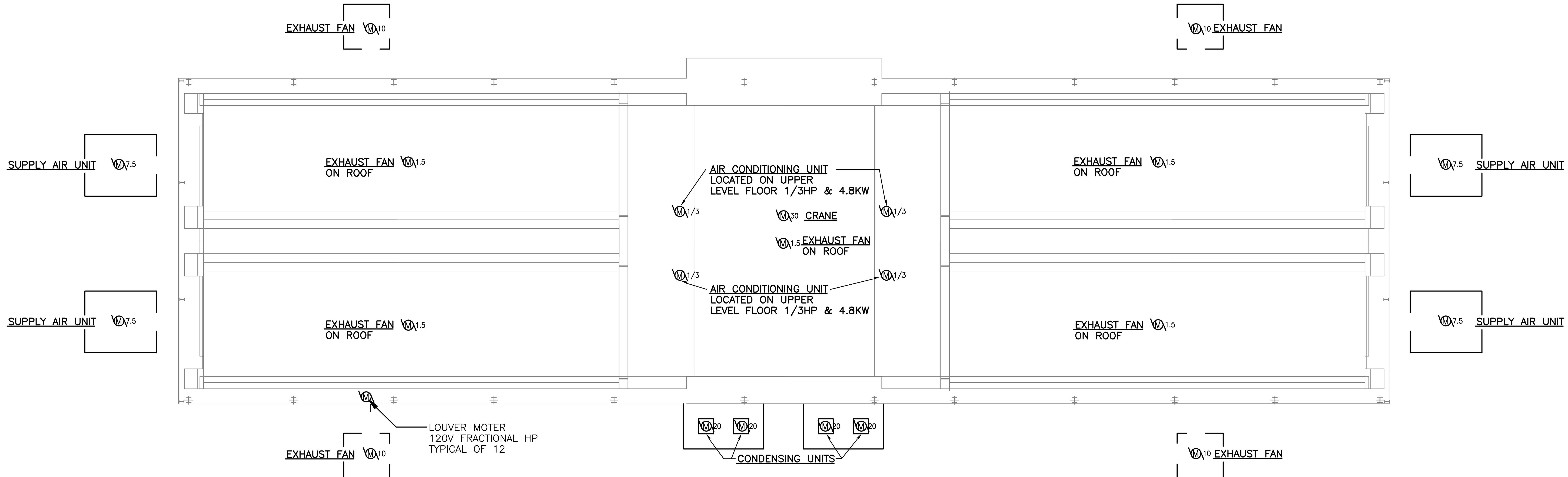
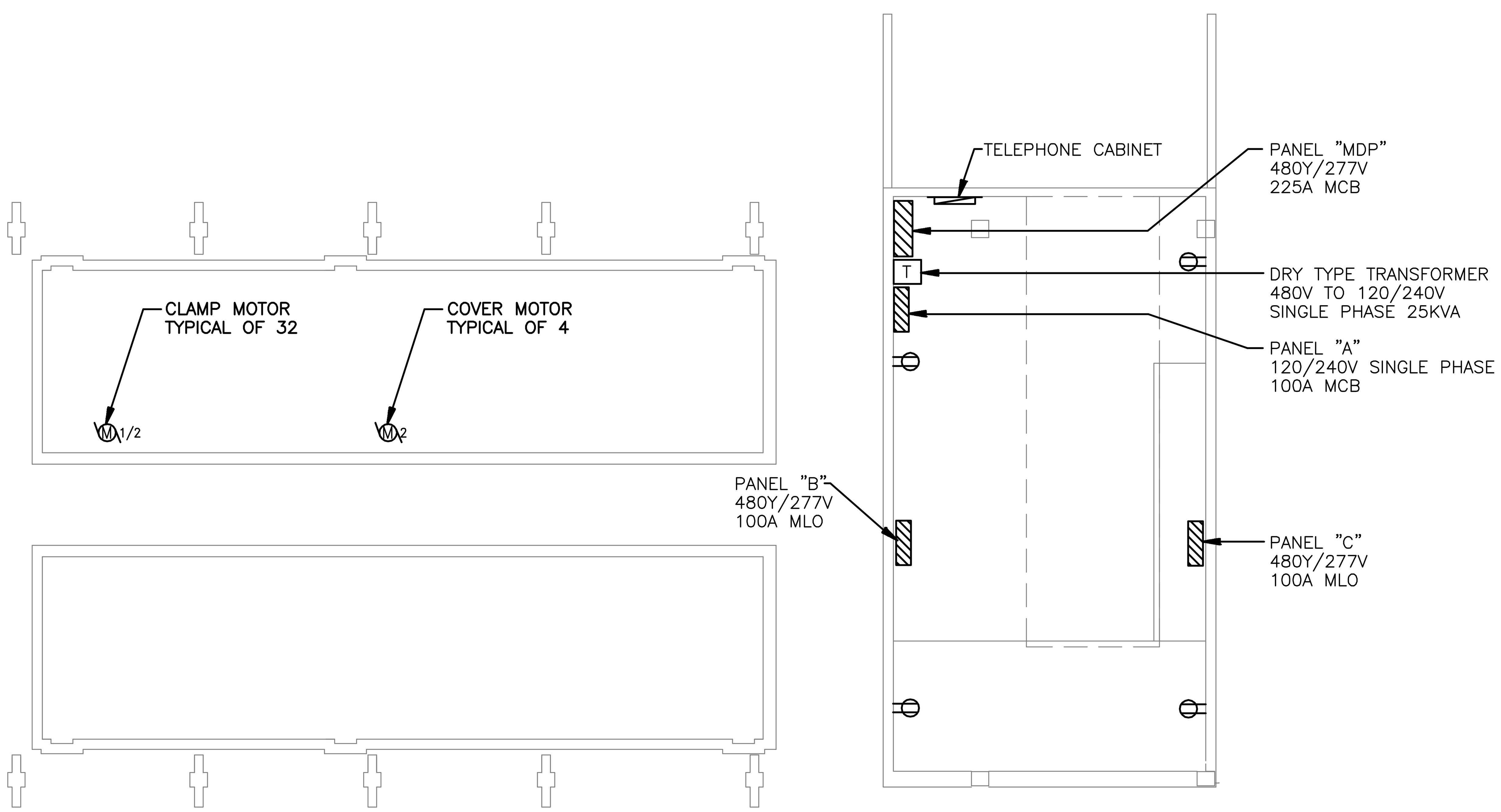


POWER PLAN–UPPER LEVEL & ROOF PLAN

SCALE: 3/32"=1'-0"

N (REF)



POWER PLAN–PARTIAL LOWER LEVEL PLAN

SCALE: 3/32"=1'-0"

N (REF)

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

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ACTIVITY – SATISFACTORY TO

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

AIR CONDITIONED MAGAZINE

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

CONSTR. CONTR. NO.

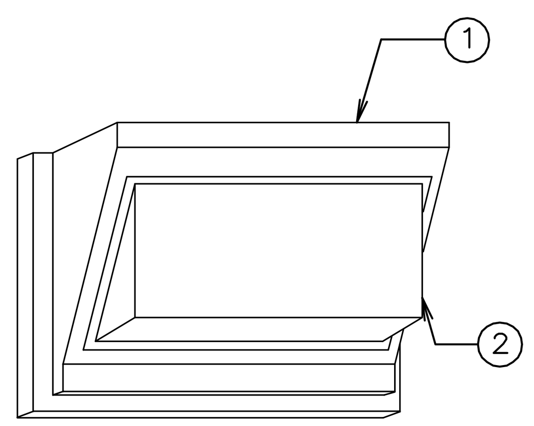
NAVFAC DRAWING NO.

SHEET OF

E-4

FILENAME: 7605E004.DWG, UPDATED ON 07/10/01 AT 09:34, XREFS: NONE

DRAWFORM REVISION 25 SEPT 96



TYPE A – 70W HIGH PRESSURE SODIUM
TYPE B – 100W HIGH PRESSURE SODIUM
TYPE C – 150W HIGH PRESSURE SODIUM
TYPE D – 175W METAL HALIDE
TYPE E – 35W LOW PRESSURE SODIUM

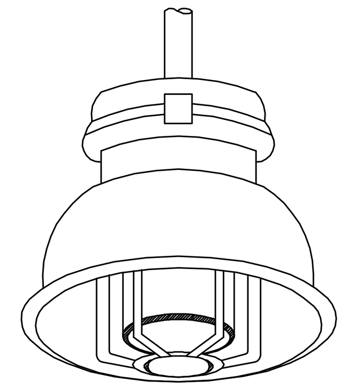
LUMINAIRE REQUIREMENTS

1. HOUSING–DIECAST ALUMINUM, SEALED AND GASKETED. UL LISTED FOR WET LOCATIONS. PROVIDE INTERNAL GREEN GROUNDING SCREW. (DIMENSIONS: APPROXIMATELY 16"L X 10"H X 11"D)
2. REFRACTOR–BOROSILICATE PRISMATIC GLASS. PROVIDE ALUMINUM REFLECTOR.
3. BALLAST–HIGH POWER FACTOR ($\geq$ .9) ENCASED AND POTTED MULTI–VOLTAGE.
4. FINISH–DARK BRONZE, UNLESS OTHERWISE NOTED.
5. LAMP SOCKET SHALL BE ADJUSTABLE.
6. PROVIDE INTEGRAL PHOTOCELL WHEN INDICATED.

EXTERIOR COMMERCIAL WALL MOUNT H.I.D.

SKETCH DATE	NOVEMBER 1995	STYLE	NL–25

C



TYPES B & D
(SHOWN WITH DOME REFLECTOR)

TYPE A – 2–F9/T4 TWIN TUBE COMPACT FLUORESCENT LUMINAIRES RATED FOR CLASS 1 DIVISION 1 GROUP D ATMOSPHERE.

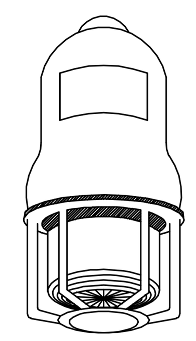
TYPE B – 2–F9/T4 TWIN TUBE COMPACT FLUORESCENT LUMINAIRES RATED FOR CLASS 1 DIVISION 2 GROUP D ATMOSPHERE.

TYPE C – 70–250 WATT HPS OR 175–400 WATT METAL HALIDE LUMINAIRE RATED FOR CLASS 1 DIVISION 1 GROUP D ATMOSPHERE.

TYPE D – 70–250 WATT HPS OR 175–400 WATT METAL HALIDE LUMINAIRE RATED FOR CLASS 1 DIVISION 2 GROUP D ATMOSPHERE.

LUMINAIRE REQUIREMENTS

1. LUMINAIRE SHALL MEET UL 844 OR FACTORY MUTUAL (FM) STANDARD FOR HAZARDOUS LOCATIONS.
2. HOUSING SHALL BE COPPER FREE CAST ALUMINUM WITH LACQUER, EPOXY OR POLYESTER POWDER FINISH.
3. ALL JOINTS SHALL BE OF THE THREADED TYPE (TYPES A & C).
4. HEAT AND IMPACT RESISTANT PRESTRESSED GLASS GLOBE.
5. PROVIDE WHITE PORCELAIN ENAMEL STEEL, FIBERGLASS REINFORCED POLYESTER OR GLASS COATED DOME REFLECTOR.
6. PROVIDE GLOBE GUARD WHEN INDICATED.
7. PROVIDE LAMPS AS INDICATED.
8. MOUNTING AS INDICATED.
9. PROVIDE INTERNAL GREEN GROUNDING SCREW.
10. PROVIDE HIGH POWER FACTOR ($\geq$ .9) ELECTROMAGNETIC BALLAST FOR TYPES A & B LUMINAIRES.
11. PROVIDE HIGH POWER FACTOR ($\geq$ .9) CORE AND COIL BALLAST FOR TYPES C & D LUMINAIRES.

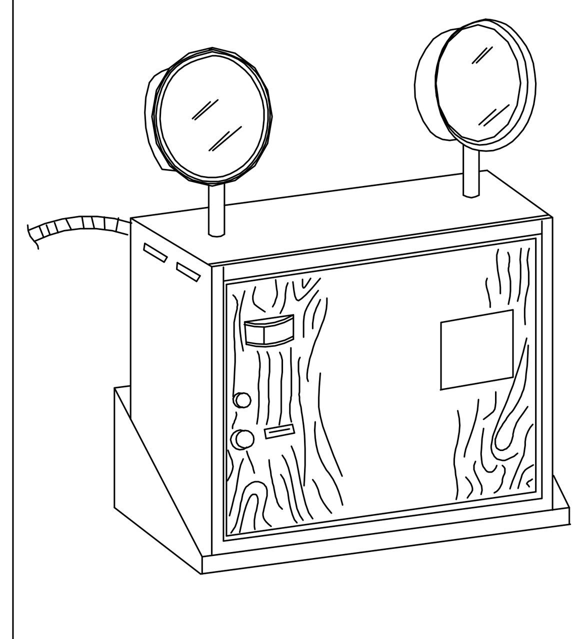


TYPES A & C

EXPLOSION–PROOF LUMINAIRE

SKETCH DATE	FEBRUARY 1996	STYLE	NL–49

A



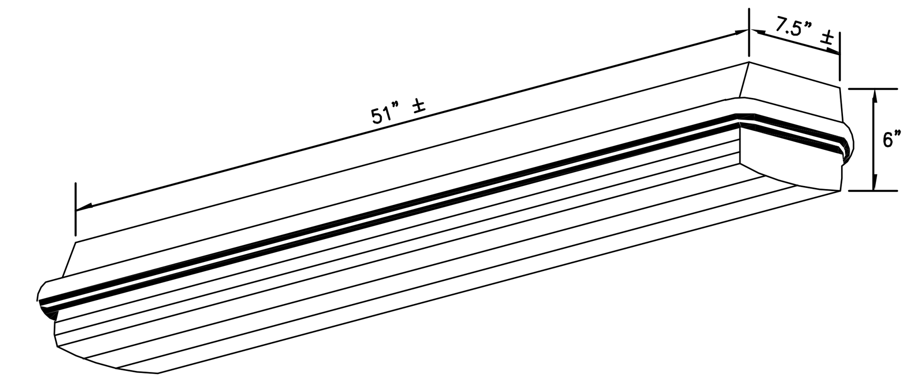
LUMINAIRE REQUIREMENTS

1. SEALED BATTERY, SPECIFICALLY DESIGN FOR EMERGENCY LIGHTING, SOLID STATE FULLY AUTOMATIC – THREE RATE CHARGER FOR NICKEL CADMIUM BATTERY AND TWO RATE HIGH/LOW CHARGER FOR LEAD CALCIUM OR LEAD ACID SEALED BATTERIES.
2. MINIMUM 0.032" THICK STEEL HOUSING WITH BAKED ENAMEL PAINTED FINISH (BROWN OR BEIGE), OR NONMETALLIC PLASTIC HOUSING.
3. TEST SWITCH
4. "AC ON" PILOT LIGHT.
5. AUTOMATIC OVERLOAD PROTECTION – FUSE OR CIRCUIT BREAKER.
6. HEADS SHALL BE FULLY ADJUSTABLE VERTICALLY AND HORIZONTALLY.
7. SEALED BEAM HALOGEN PAR–36 LAMPS, MINIMUM 12 WATT OR 20 WATT AS INDICATED.
8. INPUT VOLTAGE AS INDICATED.
9. VOLTMETER.
10. 3/C #16, SO CORD SET – (HARD WIRE TO CIRCUIT)
11. PROVIDE MINIMUM 0.032" THICK STEEL WALL MOUNTING SHELF, OR MOUNTING BRACKETS OR HOLES IN HOUSING FOR MOUNTING UNIT ON WALL.
12. LOW VOLTAGE, DEEP DISCHARGE DISCONNECT.
13. PROVIDE INTERNAL GREEN GROUNDING SCREW.

EMERGENCY LIGHTING UNIT

SKETCH DATE	SEPTEMBER 1997	STYLE	NL–51

D



LUMINAIRE REQUIREMENTS

1. LUMINAIRE SHALL MEET U.L. 595 AND U.L. 844.
2. LUMINAIRE SHALL BE SUITABLE FOR CLASS I, DIVISION 2, GROUPS A, B, C, AND D LOCATIONS, AND U.L. LISTED FOR DAMP AND WET LOCATIONS.
3. HOUSING – COPPER FREE ALUMINUM, STAINLESS STEEL, OR HEAT AND IMPACT RESISTANT FIBERGLASS REINFORCED POLYESTER.
4. HEAT AND IMPACT RESISTANT CLEAR ACRYLIC LENS OR ULTRA–VIOLET RESISTANT CLEAR POLYCARBONATE LENS.
5. BALLAST SHALL BE HIGH POWER FACTOR ($\geq$ .95) INSTANT START CLASS P ELECTRONIC BALLAST WITH A SOUND RATING OF "A".
6. PROVIDE 2 F32/T8 LAMPS.
7. LUMINAIRE SHALL BE COMPLETELY PREWIRED.
8. PROVIDE INTERNAL GREEN GROUNDING SCREW.
9. LUMINAIRE SHALL BE SUITABLE FOR PENDANT OR SURFACE MOUNTING.
10. LUMINAIRE SHALL HAVE SPRING LOADED SOCKETS.

"CLASS I, DIVISION 2 LUMINAIRE"

INDUSTRIAL FLUORESCENT – HAZARDOUS LOCATION

SKETCH DATE	NOVEMBER 1995	STYLE	NL–60

B

REVISIONS

SYM. | DESCRIPTION | DATE | APPROVED

A/E | EFD
DESIGN RST
DRAWN RST
REVIEW
QC
CHIEF ARCH./ ENGR.
PROJECT MANAGER
FIRE PROTECTION
BRANCH MANAGER
DESIGN DIRECTOR

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND
APPROVED | DATE
ACTIVITY – SATISFACTORY TO | DATE
APPROVED
FOR EFD FOR COMMANDER NAVFAC
SEAL

DEPARTMENT OF THE NAVY | NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION | NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

LIGHTING PLATES

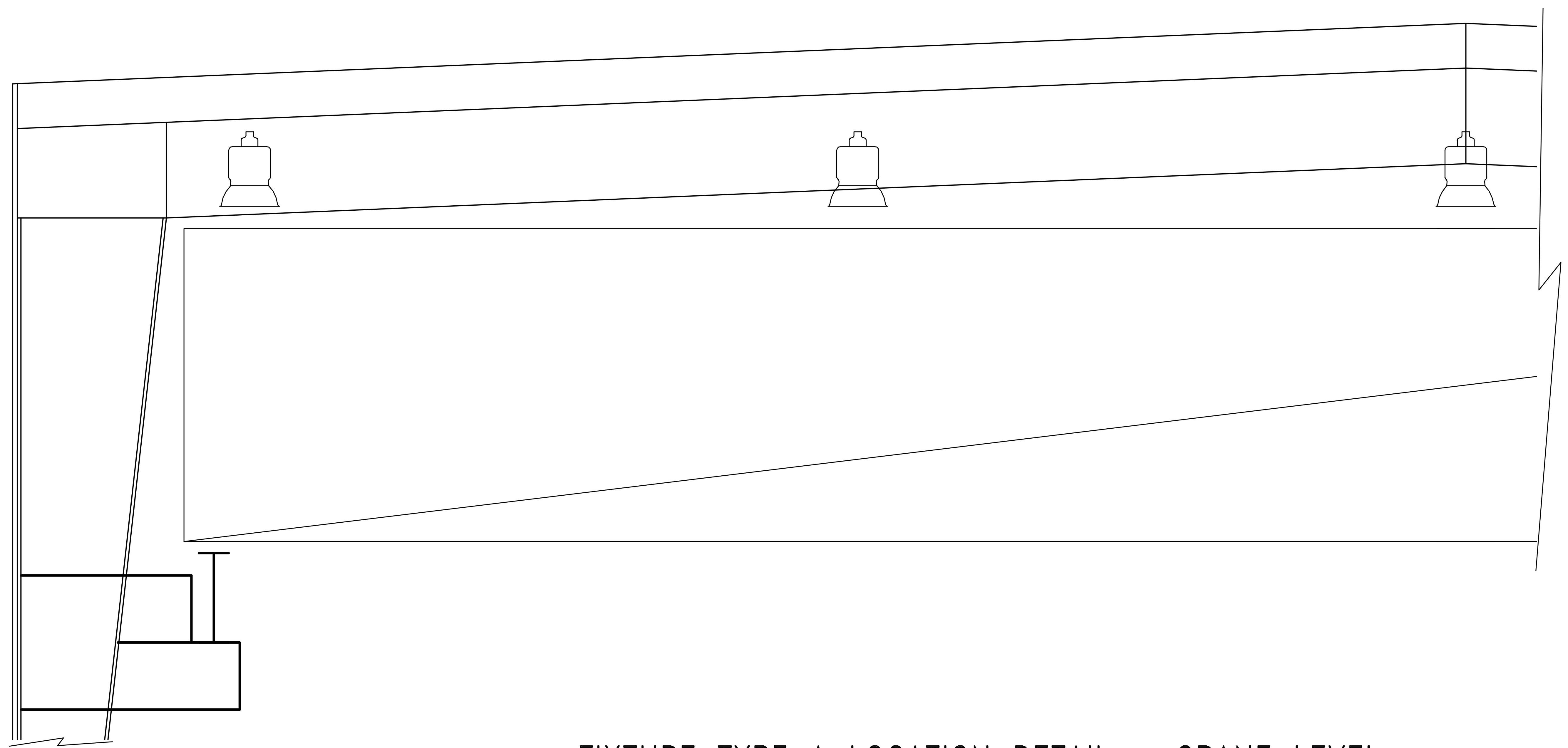
CODE ID. NO. 80091	SIZE D
SCALE: NONE	
EFD NO.	
STA. PROJ. NO.	
SPEC. NO. 05–99–7605	
CONSTR. CONTR. NO. N62470–99–B–7605	
NAVFAC DRAWING NO.	
SHEET OF	
E–5	

8 7 6 5 4 3 2 1

D C B A

DRAWFORM REVISION 25 SEPT 96

FILENAME: 7605E00C.DWG, UPDATED ON 07/03/01 AT 15:47, XREFS: NONE



FIXTURE TYPE A LOCATION DETAIL – CRANE LEVEL

SCALE: 1/2" = 1'-0"

GRAPHIC SCALE

1/2"=1'-0" 1' 0' 1' 2' 3' 4' 5'

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

DETAILS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

APPROVED DATE

ACTIVITY – SATISFACTORY TO DATE

APPROVED

FOR EFD FOR COMMANDER NAVFAC

SEAL

A/E EFD

DESIGN RST

DRAWN RST

REVIEW

QC

CHIEF ARCH./ENGR.

PROJECT MANAGER

FIRE PROTECTION

BRANCH MANAGER

DESIGN DIRECTOR

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

CODE ID. NO. 80091 SIZE D

SCALE: AS NOTED

EFD NO.

STA. PROJ. NO.

SPEC. NO. 05-99-7605

CONSTR. CONTR. NO. N62470-99-B-7605

NAVFAC DRAWING NO.

SHEET OF

E-6

DRAWFORM REVISION 25 SEPT 96

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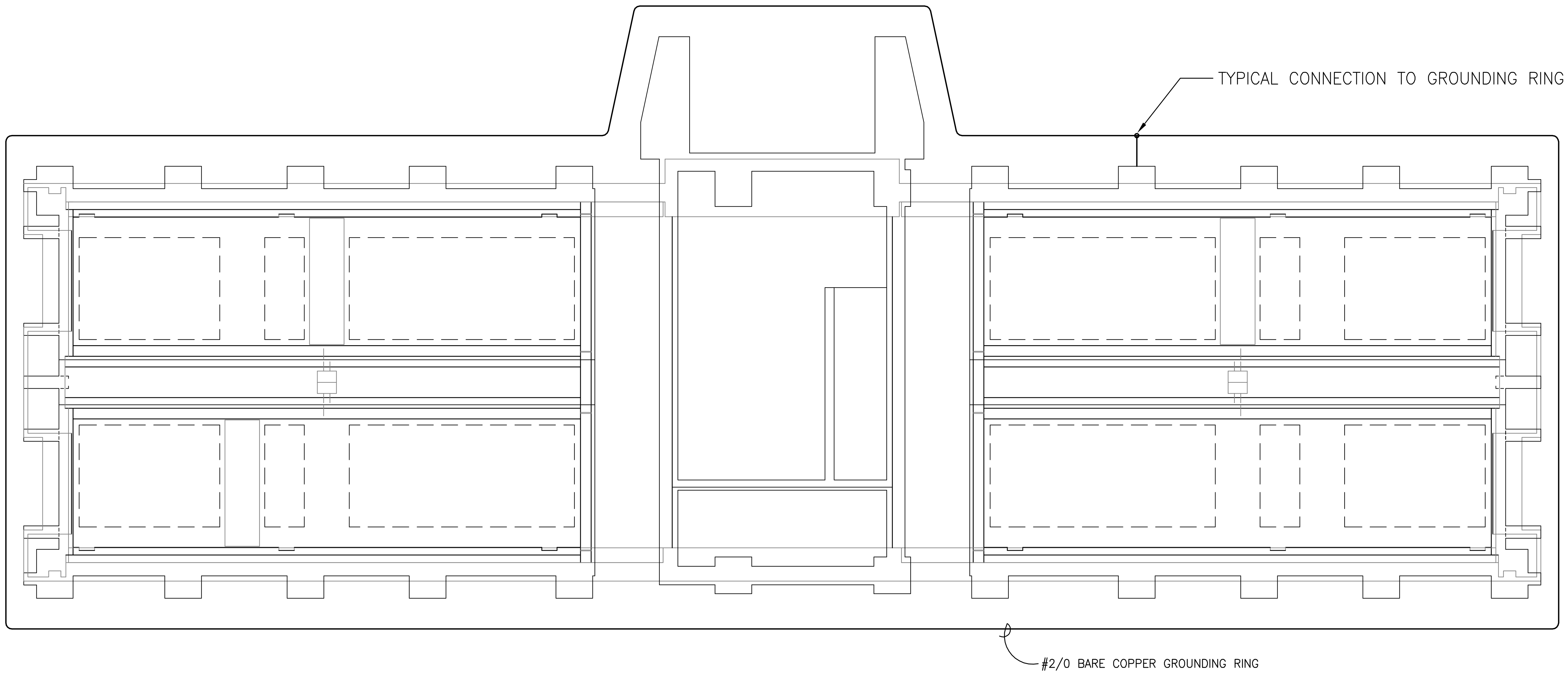


LIGHTING PROTECTION PLAN

SCALE: 3/32" = 1'-0"

PROVIDE THREE (3) ROWS OF 16 – 2' AIR TERMINALS LOCATED ON BUILDING ROOF.
CONNECT EACH AIR TERMINAL TO GROUNDING RING AT NEAREST POINT.

GRAPHIC SCALE

3/32"=1'-0" 0' 10' 20' 30' 40'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DESIGN RST
DRAWN RST

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION — NORFOLK, VIRGINIA
NAVAL STATION

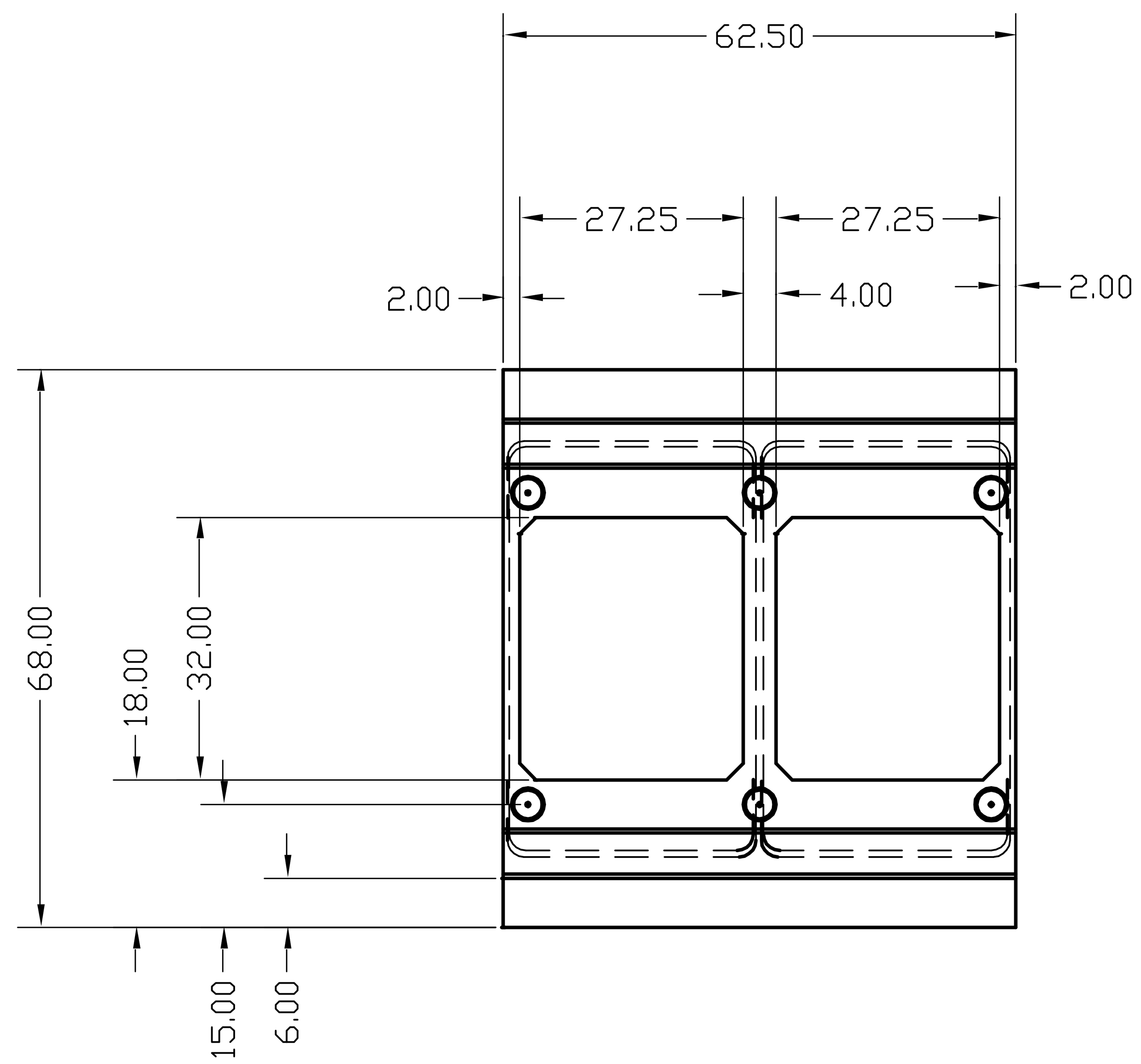
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

LIGHTING PROTECTION PLAN

CODE ID. NO. 80091 SIZE D
SCALE: AS NOTED
SPEC. NO. 05-99-7605
CONSTR. CONTR. NO. N62470-99-B-7605
SHEET E-7

FILENAME: 7605E00E.DWG, UPDATED ON 07/03/01 AT 15:50, XREFS: MODEL-PLAN

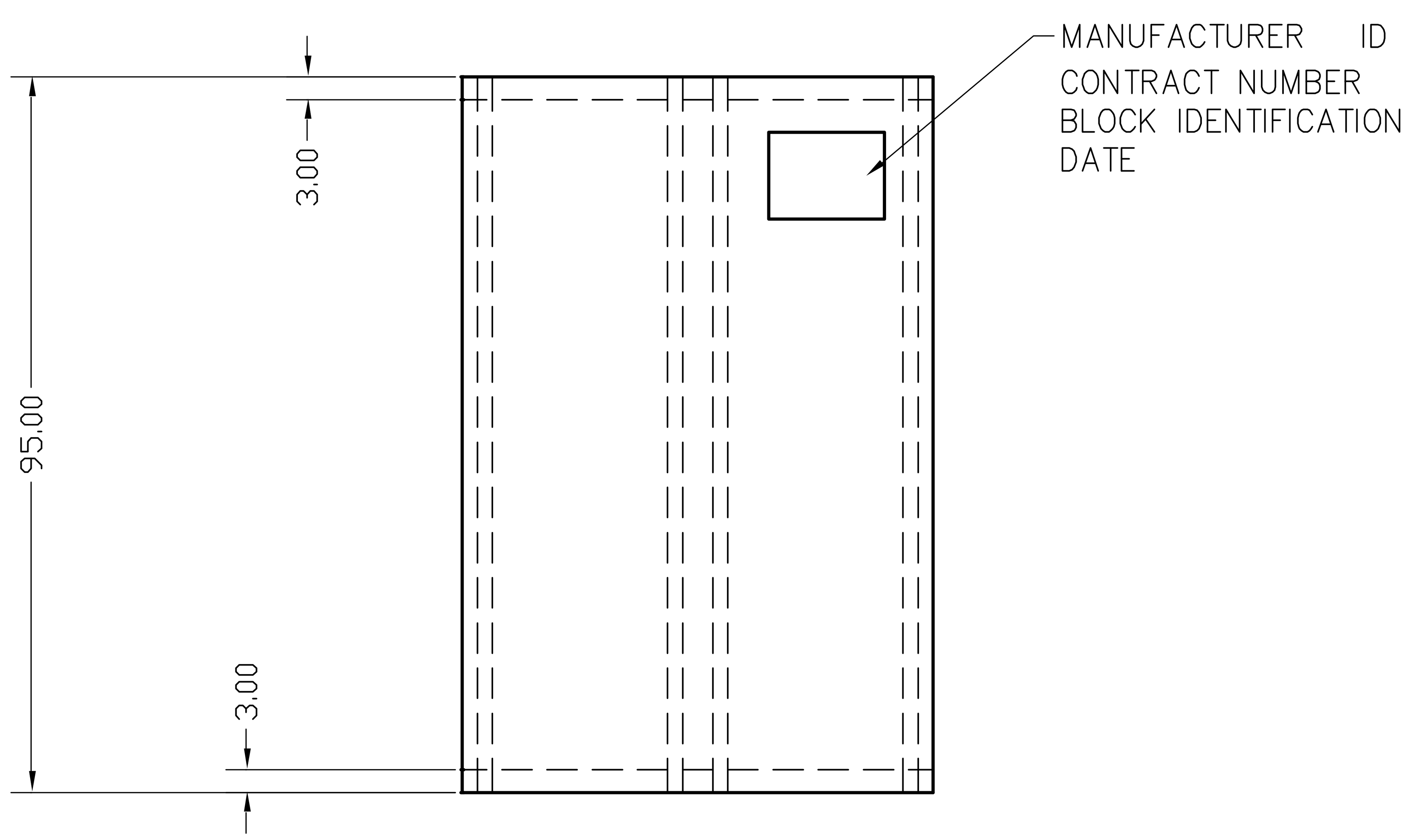
DRAWFORM REVISION 25 SEPT 96

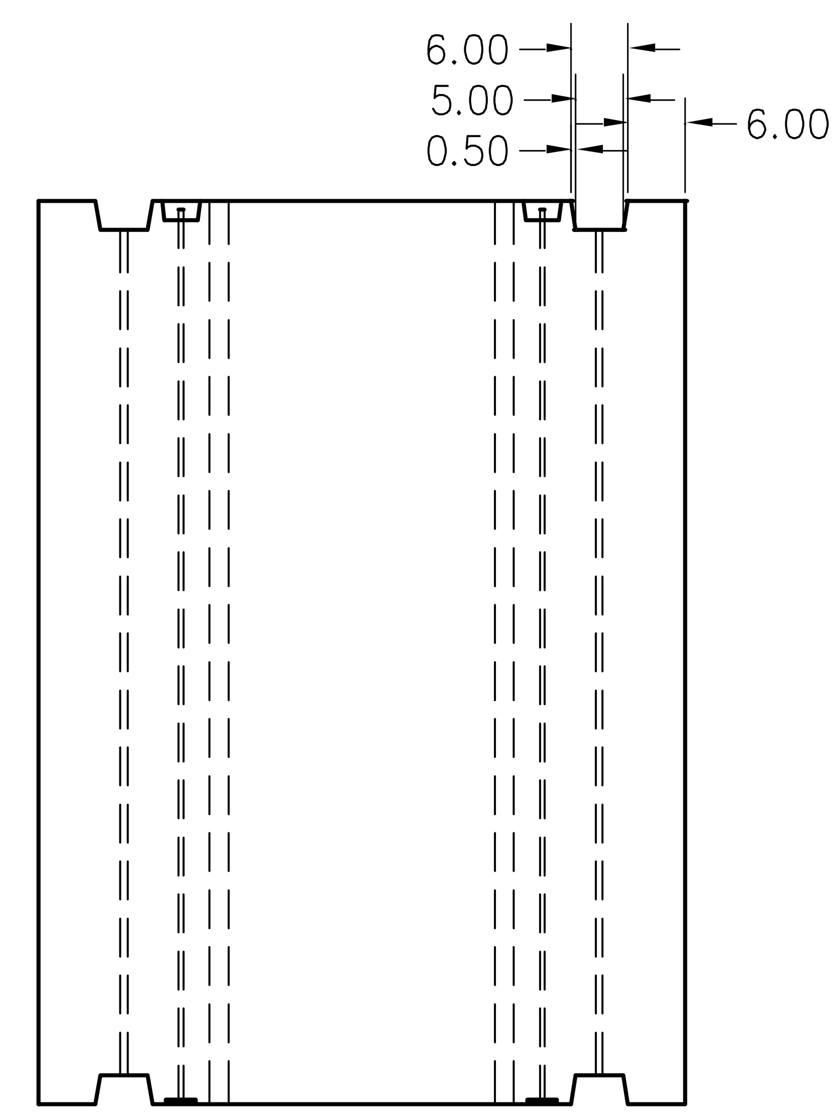


NOTES:
1. MATERIAL TO BE 60 PCF CEMCOM SA-CBC
2. EXPOSED MESH - 10 PLACES MAX
3. MAX 1"ø BUG HOLES 0.5" DEEP ON EXPOSED FACES
4. SURFACE HIARLINE CRACKING - ALLOWED
5. TOLERANCES ±0.5 UNLESS SPECIFIED
6. MAXIMUM BLOCK WIDTH IS TO BE 62.50"

A
B

E
F





REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

ACTIVITY - SATISFACTORY TO

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

CELL WALL BLOCK BASIC UNIT

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

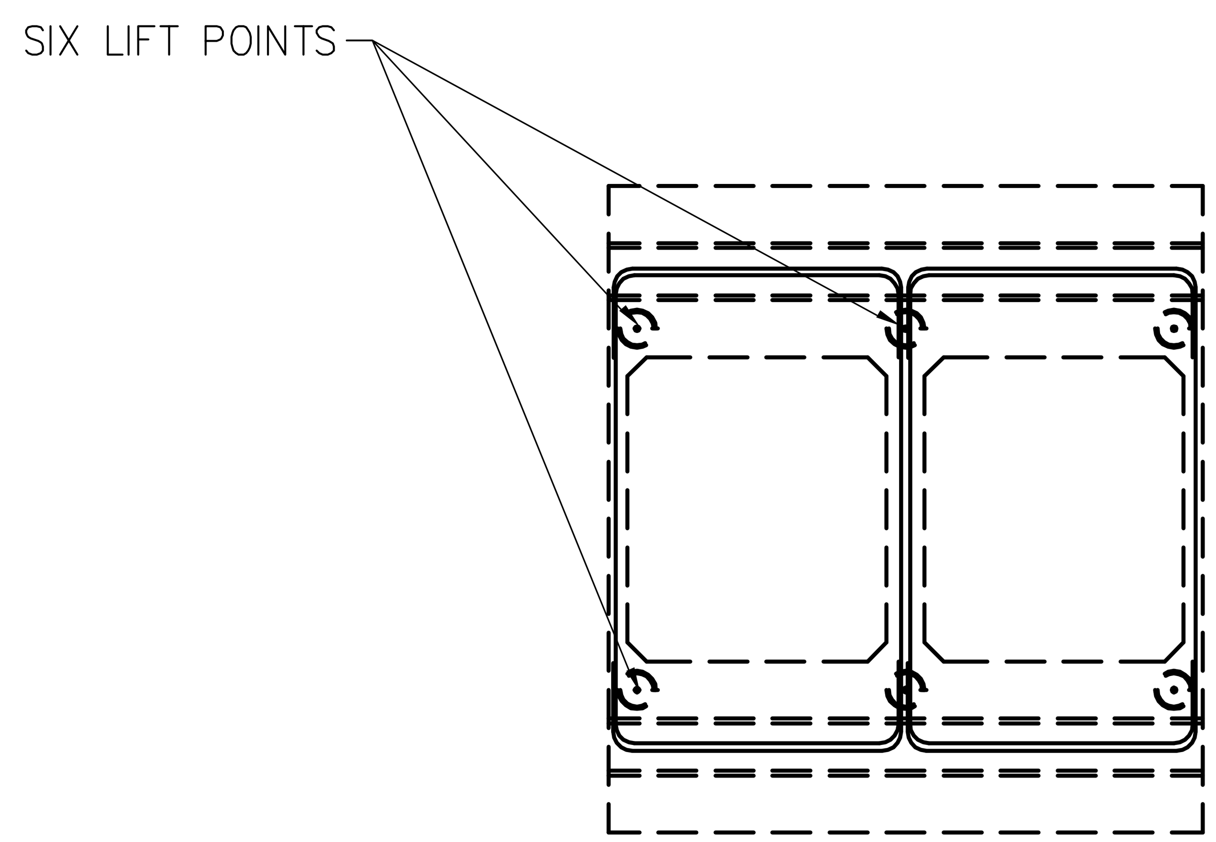
CONSTR. CONTR. NO.

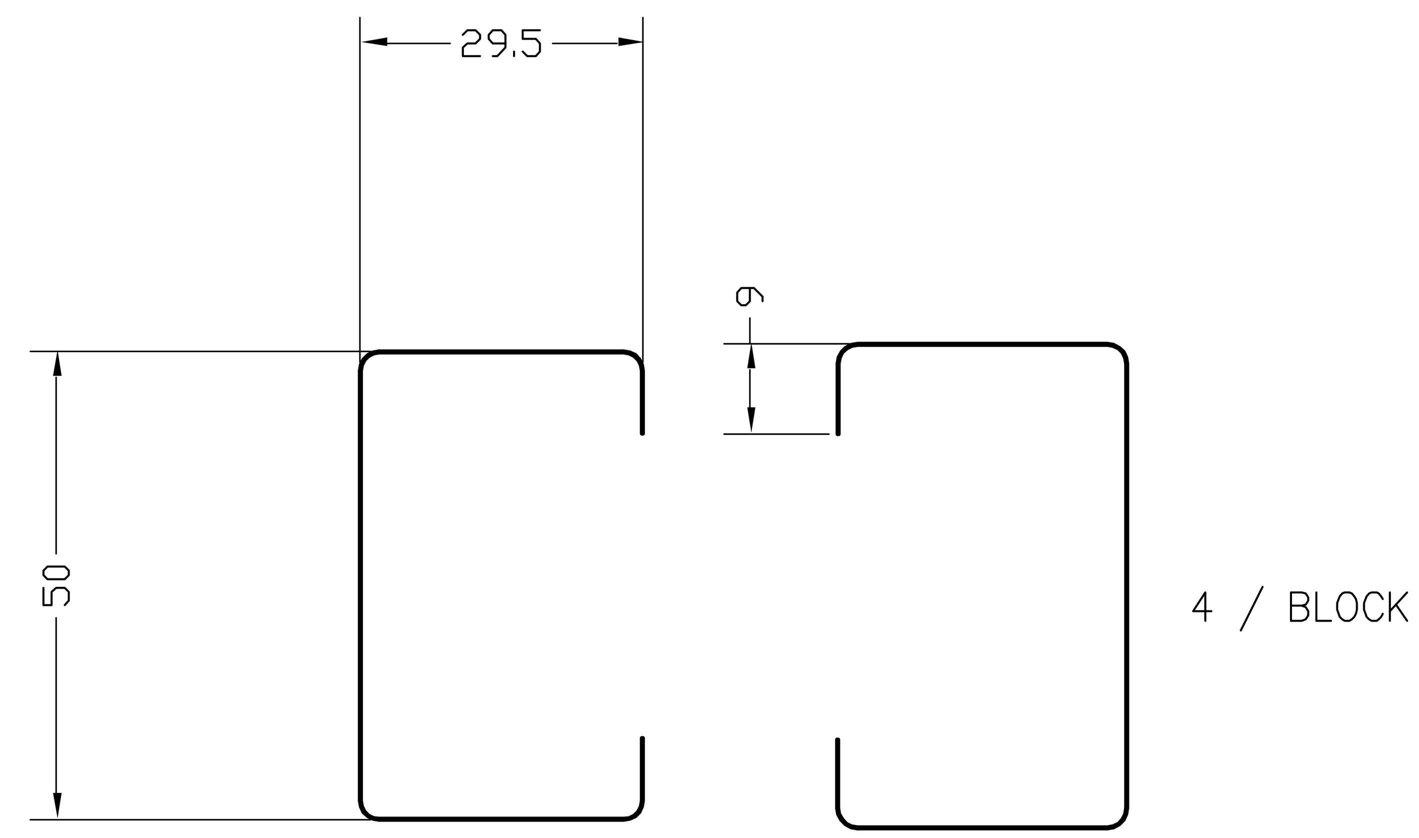
NAVFAC DRAWING NO.

SHEET OF

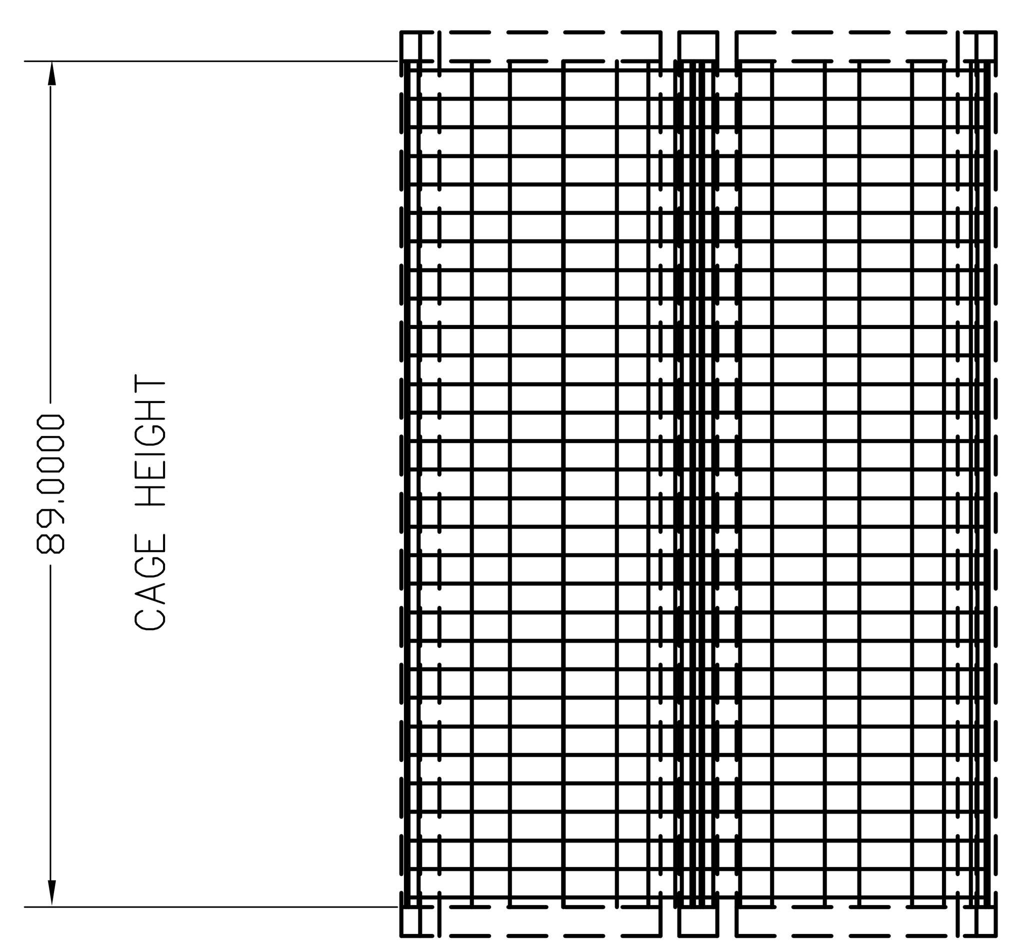
SK-HPM-1

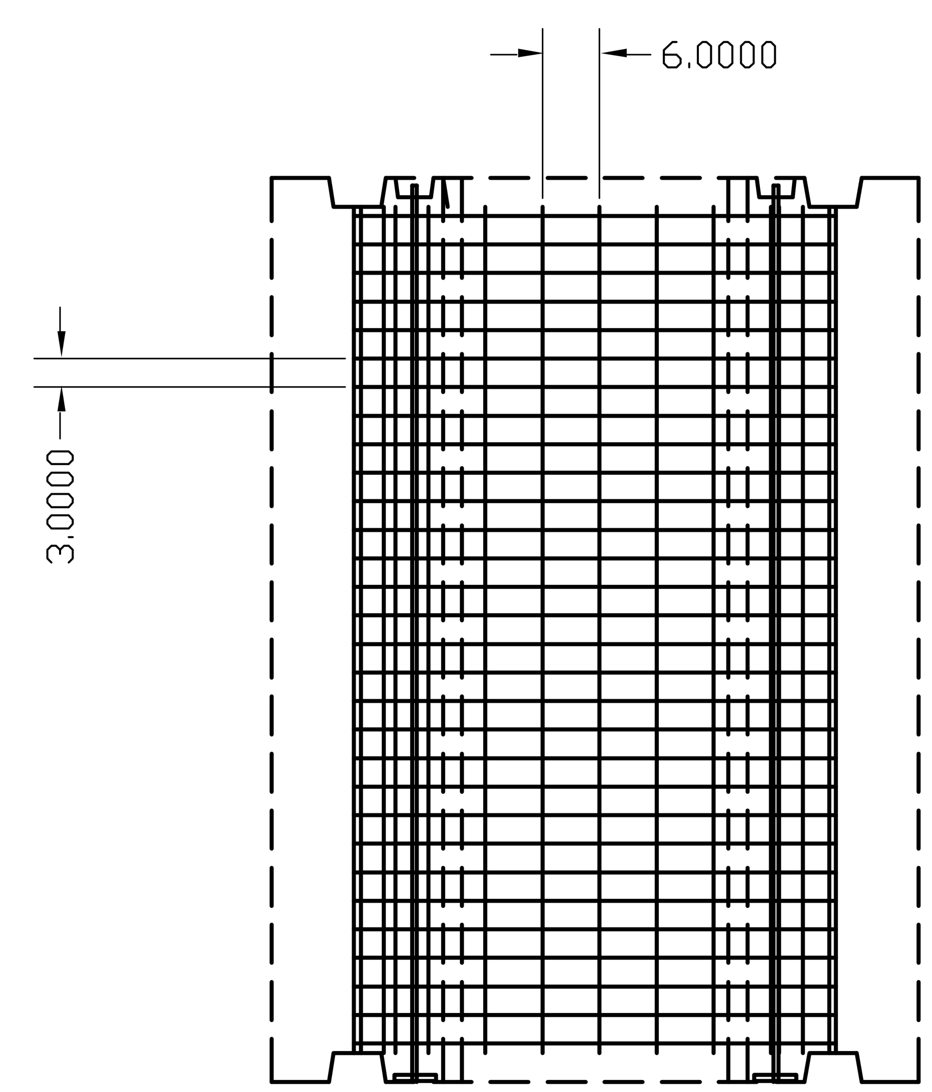
FILENAME: SK-HPM-1.DWG, UPDATED ON 07/03/01 AT 14:18, XREFS: NONE





CAGES FIT INSIDE EACH OTHER





NOTES:
1. MESH REINFORCING TO BE 6"x 3" W4 VERTICAL BAR SPACING 6" HORIZONTAL HORIZONTAL BARS 3" VERTICAL SPACING.
2. VERTICAL LIFT RODS ARE TO BE 1/2" COIL ROD

REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

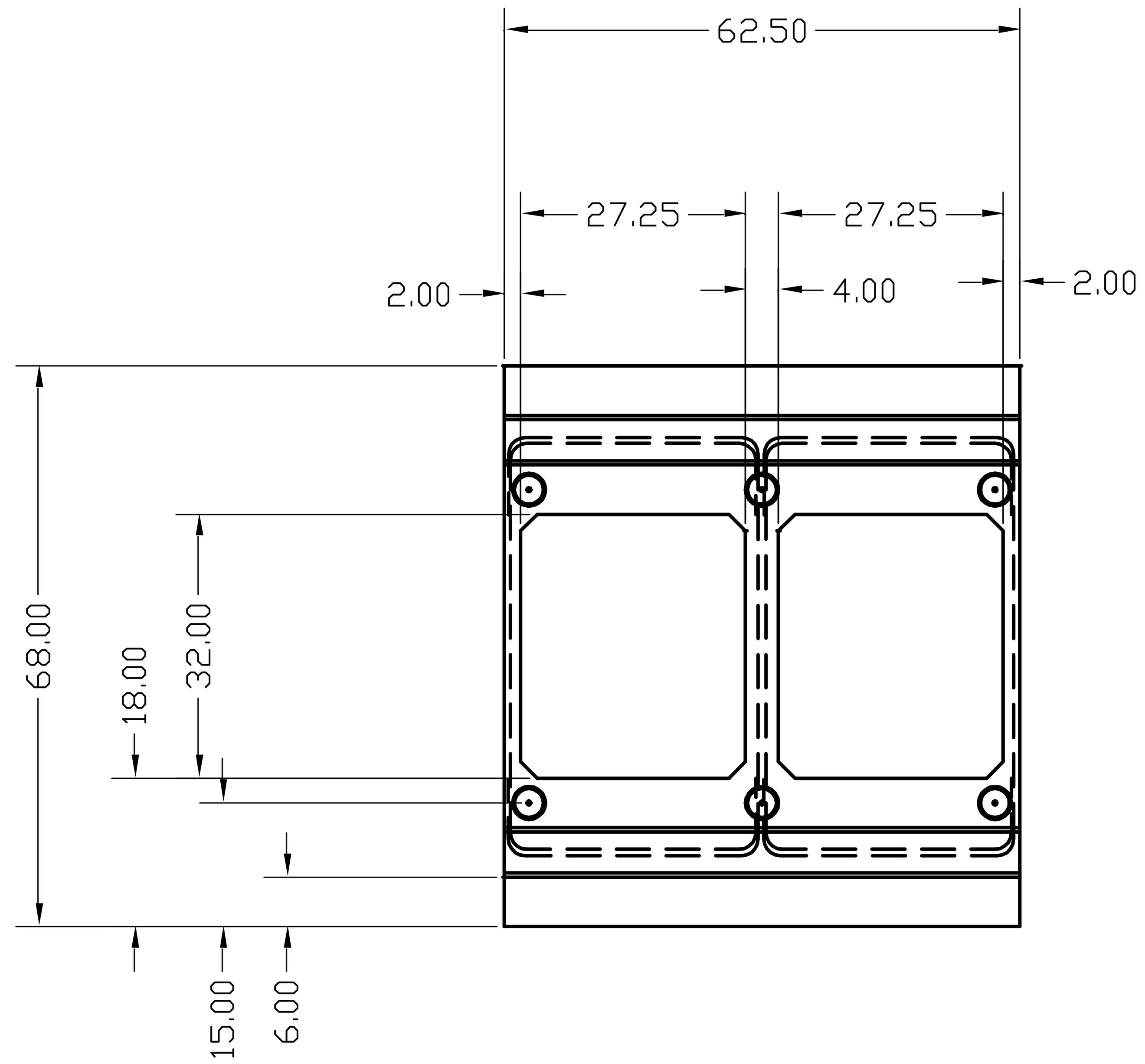
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

CELL WALL BLOCK BASIC UNIT

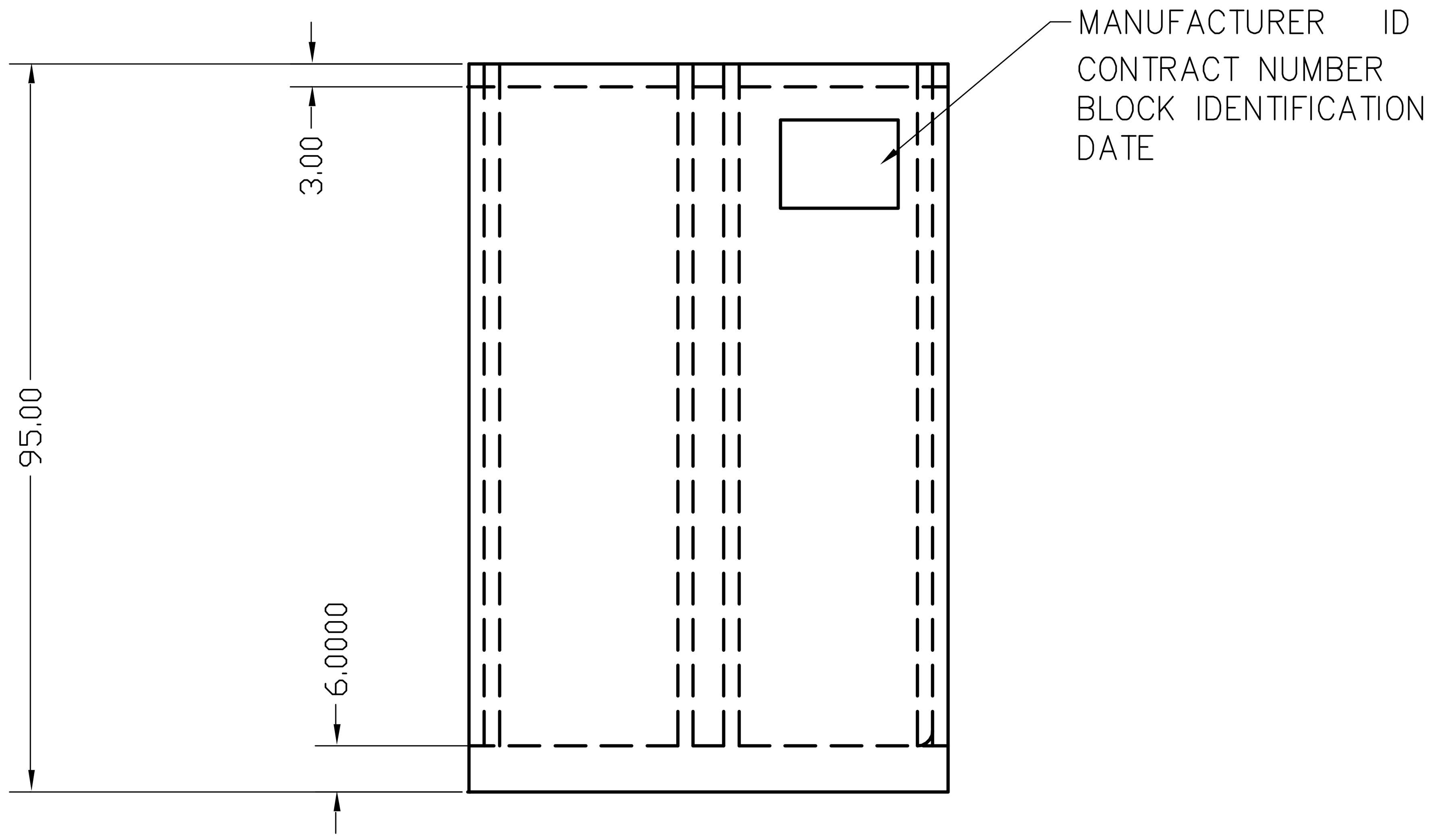
CODE ID. NO. 80091 SIZE D

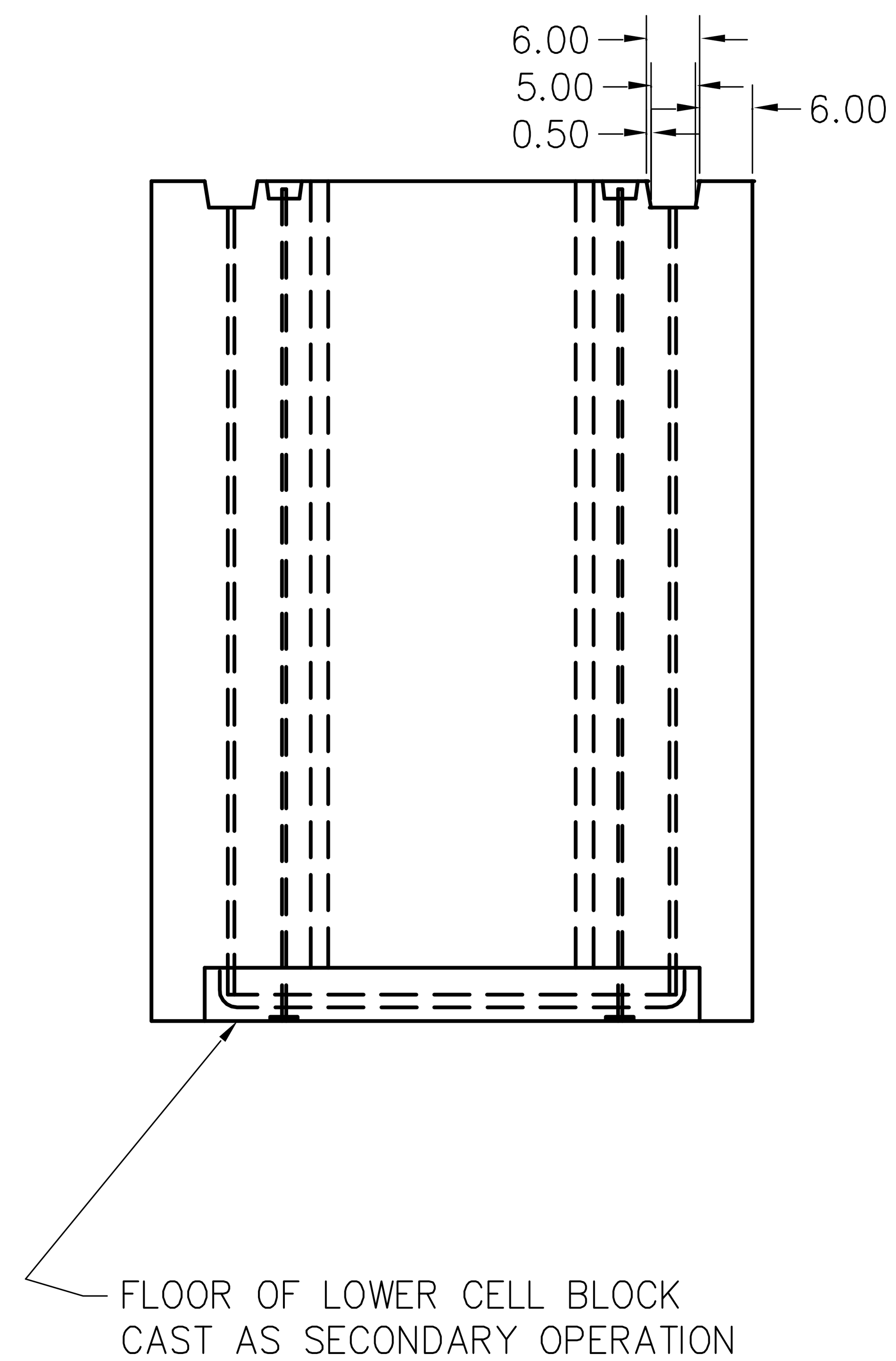
SK-HPM-2

FILENAME: SK-HPM-2.DWG, UPDATED ON 07/03/01 AT 14:19, XREFS: NONE



NOTES:
1. MATERIAL TO BE 60 PCF CEMCOM SA-CBC
2. EXPOSED MESH – 10 PLACES MAX
3. MAX 1"ø BUG HOLES 0.5" DEEP ON EXPOSED FACES
4. SURFACE HIARLINE CRACKING – ALLOWED
5. TOLERANCES ±0.5 UNLESS SPECIFIED
6. MAXIMUM BLOCK WIDTH IS TO BE 62.50"





REVISIONS

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL STATION NORFOLK, VIRGINIA

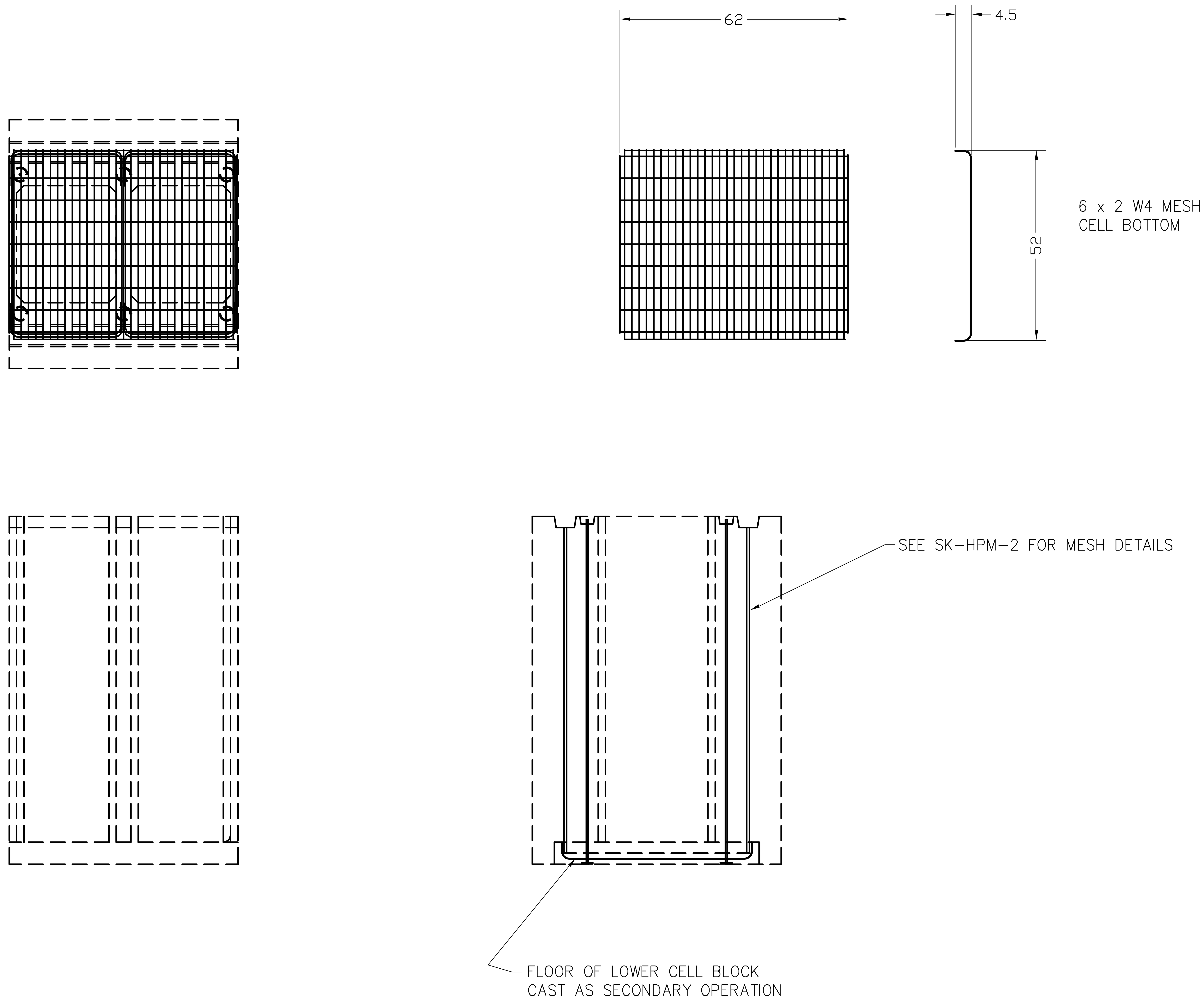
HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

CELL WALL BLOCK BASIC UNIT

CODE ID. NO. 80091 SIZE D

SK-HPM-5

FILENAME: SK-HPM-5.DWG, UPDATED ON 07/03/01 AT 14:20, XREFS: NONE



REVISIONS

DESIGNED & ENGINEERED BY: LANTDIV NAVAL FACILITIES ENGINEERING COMMAND

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

HIGH PERFORMANCE MAGAZINE STANDARD DESIGN

CELL WALL BLOCK BASIC UNIT

CODE ID. NO. 80091 SIZE D

SK-HPM-6

4.0 PRELIMINARY DESIGN SUMMARY PARAMETRIC COST ESTIMATE

4.1 COST ESTIMATE ASSUMPTIONS

General:
- Assumed Bid date April 2002
- Project located on west coast

Sitework:
- Assumed flat and level site
- Assumed finish floor elevation of Shipping and Receiving area 1'-0" above existing grade to provide positive drainage away from magazine
- Berms at 3:2 slope. (Recommend that berm slope be reduced to 2:1 to reduce erosion)
- Bituminous pavement at entrance of magazine except for concrete paving in immediate vicinity of truck door
- Fencing provided around immediate perimeter of magazine
- Sitework considerations beyond fence line including pavement, earthwork, electrical, telephone, and IDS, have not been included in the estimate.
- Assumed allowable site soil bearing capacity of 4500 PSF. No costs have been included for soil enhancements, such as compaction or surcharging, which may be required at specific sites to achieve this bearing capacity. Sites where 4500 PSF is unattainable would require redesign of the foundation with the potential of additional construction costs.

Pre-engineered Building:
- Building walls and roof insulated
- 10 year warranty to be provided on integrity of wall and roof skin
- Pre-engineered building designed for the following live loads:
  - Loadings indicated in Chapter 2.4.2
  - Maximum bridge crane wheel load of 25,000 lb., with an 8 foot spacing between wheels (Full crane load in combination with maximum 50 mph wind speed)

Mechanical HVAC:
- Base price assumes dehumidification of bay is not required. (Current information indicates that storage of certain munitions will require dehumidification at many locations)
- Specific bay ventilation and air quality monitoring requirements have been provided by Joe Gott Director, Safety and Occupational Health, NAVFAC.

Bridge Crane:
- Quoted price includes rotate hoist, straddle lift and rail

CBC Relocateable walls:
- Pricing includes shipping of CBC modules to west coast from Maryland
  Pricing includes shipping of steel grit to west coast from Michigan

Lightweight Concrete:
- Pricing includes shipping of light weight aggregate to west coast from Alabama.

Standard High Performance Magazine 6/28/2001

"Preliminary Design" Construction Estimate

4.2 SUMMARY COST - HPM COMPONENTS

Supporting Facilities - Limited to Fence line (75 feet beyond building perimeter)	
Site Preparation	
(Excavation, Fill, Compaction)	$161,153
Site Improvements	
(Paving / Fencing & Gates)	$26,298
Electrical Site	
(Fence line to Magazine)	$56,238
	$243,689
Primary Facility	
Pre-engineered Building	
(Incl doors and Louvers)	$440,378
Concrete	
(Bay Covers)	$309,134
(Light Weight Concrete)	$616,999
(Regular Weight Concrete)	$635,301
(Steel Walkway / Handrail)	$134,737
(Waterproofing)	$142,205
	$1,838,376
Electrical	
(Secondary Distribution)	$109,805
(Lighting and Branch Wiring)	$194,300
(Grounding)	$41,828
(P.E.B. Ventilation)	$24,414
(Bay Dehumidification)	$37,791
(Bay Ventilation)	$55,579
	$463,717
Mechanical	
(P.E.B. Ventilation)	$31,580
(Bay dehumidification incl controls)	$377,017
(Bay Ventilation - 12 changes/hour incl controls)	$363,123
Miscellaneous Items	
Bridge Crane	
(Two Cranes - Straddle, Crane rail, Rotating Hoist)	$875,000
(C-Grab)	$55,000
(Post Award Review)	$85,000
	$1,015,000
Bay Cover Operating System	
(Strtuctural / Mechanical)	$480,000
(Electrical / Controls)	$135,000
	$615,000
CBC Relocateable walls	
(Modules installed)	
(1 wall)	$84,000
(2 walls)	$142,000
(4 walls)	$257,000
(Grit nstalled)	
(1 wall)	$70,000
(2 walls)	$140,000
(4 walls)	$210,000
Coordinate Tracking System	$50,000
Physical Security - Locks / IDS / Alarms	
Bay Cover Locks	$42,182
IDS / Alarms	$5,000
	$47,182
Access into Bays	$30,000
Gas monitoring Equipment	$5,000

4.3 SUMMARY COST - BASIC HPM

Basic Facility: (Two bridge cranes, Two CBC walls, Bay ventilation(12 changes/hour), No pit dehumidification, **No sitework or utilities beyond fence,** No forklifts)
(Approx. 1461 Square Meters)

Supporting Facilities:	$243,689	
Primary Facility:	$3,796,565	
Miscellaneous Items:	$1,297,000	(Bridge Crane / Straddle Lift / C-Grab / CBC walls)
	$5,337,254	**Say $5.3 million**

Deductive items:

Eliminate 1 CBC wall	$154,000
Eliminate both CBC walls	$282,000

Addititive items:

Provide bay dehumidification	$414,808	(Requirement will vary according to site)
Add two CBC walls	$185,000	
Add Coordinate Tracking System	$50,000	

4.4 SUMMARY COMPARISON COST - Type 'M' & 'F'

Standard 'M' Magazine

1010 Sq Meter)

Basic Facility: (Two bridge cranes, No CBC walls, no dehumidification,
No sitework or utilities beyond fence)

Supporting Facilities:	$270,000	
Primary Facility:	$1,975,000	
Miscellaneous Items:	$820,000	(Bridge Crane / Straddle Lift)
	$3,065,000	**Say $3.0 million**

Standard 'F' Magazine

(836 Sq Meter)

Basic Facility: (No cranes, No CBC walls, no dehumidification,
No sitework or utilities beyond fence)

Supporting Facilities:	$250,000	
Primary Facility:	$1,335,326	
Miscellaneous Items:	$0	
	$1,585,326	**Say $1.6 million**

5.0 SPECIAL CONSIDERATIONS FOR THE HPM

5.1 GENERAL

The intent of this chapter is to further highlight and describe issues that should be considered prior to and during the planning, design / construction, and operation of a High Performance Magazine.

The HPM is very different from other approved standard magazines in that they can be sited much closer together with similar storage capacities. This is due to the segregation of the stored ordnance in the HPM into individual bays thereby reducing the total potential blast effect resulting from an accidental explosion. The reduced ESQD Intermagazine separation distance allows the storage of a much greater concentration of ordnance within the same encumbered land area than other standard magazines.

The original concept proposed for the HPM was based on a superstructure similar to other standard magazines with a heavy reinforced concrete roof and walls, and with a minimum 2'-0" earth cover. The superstructure was later modified by the NFESC to the current conventionally framed pre-engineered steel framed structure with light gage metal wall and roof sheathing due to the excessive cost of the hardened structure.

5.2 PLANNING & SITING CONSIDERATIONS

(Note: These considerations are pointed out for informational purposes only, and are **not** intended as siting criteria.) The IMD siting relationships for the HPM in terms of explosive Safety Quantity Distance (ESQD), asset protection, and facility protection are described graphically in attachments 1) and 2).

The combination of the increased concentration of ordnance per acre as well the reduced resistance of the superstructure as compared to other standard magazines, significantly increases the impact of the collateral damage to the surrounding ordnance assets and to operational capabilities in the event of an accidental explosion. The probability of an explosive event is very small, however if asset protection or the ability to readily access ordnance in the event of an accidental explosion is important, these factors should be considered.

5.2.1 Asset Protection. The minimum Intermagazine Distance (IMD), expressed as ESQD, is based solely on the prevention of prompt propagation of an explosion of Class/Division 1.1 material. The minimum IMD for the HPM is based on a "K"=1.25 for a side or rear exposure to another standard magazine. Therefore a "full" HPM may be sited 49 feet from another HPM, and 79 feet from a standard Earth Covered Magazine based upon the minimum IMD. The distance required to prevent damage to ordnance in a HPM from an explosion in a standard Earth Covered Magazine is based on a "K"=9 or 567 feet. Based upon information provided by the NFESC, the assets in a HPM would not be damaged from an explosion in an adjacent HPM at a distance of "K"=1.25 or 49 feet.

5.2.2 Facility / Operational Protection. The superstructure of the HPM is a conventionally designed pre-engineered steel framed structure with light gage metal wall and roof sheathing. The bridge crane, required for storage and retrieval of ordnance from the HPM storage bays, is supported from the pre-engineered structure. (The typical current standard magazine used today is a reinforced concrete structure buried under a minimum of 2 feet of soil.) The IMD required to prevent severe damage to the superstructure is based on a "K"=30. The superstructure and crane of a HPM sited less than 1174 feet from a donor HPM would likely be damaged and ordnance will have to be extracted with the use of an external mobile crane.

5.3 DESIGN / CONSTRUCTION CONSIDERATIONS

5.3.1 Lightweight / Low Strength Concrete. The walls and covers of the storage bays must be constructed with lightweight concrete with an air-dry unit weight not exceeding 85 lb/ft^3. This low density is pushing the limits of structural lightweight concrete. ACI 213R defines structural lightweight concrete as concrete with "the air-dried unit weight at 28 days usually in the range of 90 to 115 lb/ft^3 and the compressive strength more than 2500 psi." In addition to the 85 lb/ft^3 maximum density, the 28-day compressive strength of this concrete must not exceed 3000 psi, while the minimum compressive strength of 2500 psi must be attained to achieve the necessary strength of the completed structure. Normal construction practice only requires structural concrete to satisfy minimum design strength and does not typically have maximum strength limitations for concrete.

Thus far, three concrete mixes have been designed and tested by NFESC or CTL that satisfy the strength and density requirements of the HPM lightweight concrete. However, these restrictive characteristics will result in a much greater potential for constructability problems and finished product acceptability issues than normally expected.

To reduce the risk of unacceptable concrete, we are proposing that the acceptability range for the lightweight concrete compressive strength at 28 days be between 2000 and 3000 psi. At 56 days, the concrete compressive strength must be between 2500 and 3500 psi. The concrete must be shored or otherwise supported prior to attaining the minimum compressive strength of 2500 psi.

It is anticipated that the water cement ratio will be much more critical than for normal structural concrete due to the porosity of the extreme lightweight aggregate. This may result in a greater potential for problems associated with achieving adequate strength while maintaining the ability to place and consolidate the concrete. It should be anticipated that the concrete will not be able to be pumped, but will have to be placed directly in the forms.

The small range of acceptable strength as well as the placement concerns and density requirements will require a much higher level of quality control than normally applied. The required concrete parameters must clearly be communicated in the contract documents, with the clear understanding that any deviation will require the removal of the unacceptable concrete. The contractor should be required to construct test panels in order to demonstrate that he can successfully satisfy the requirements prior to beginning construction. Also it is recommended that an expert consultant be on site during the initial concrete pours.

The potential short and long-term deflection characteristics for normal lightweight structural concrete have been well tested and defined. It's questionable however, whether these characteristics are directly applicable to the maximum 85 lb/ft^3 concrete. The deflection characteristics of the lightweight concrete are critical in the HPM design due to the small clearances in the interface between the moveable covers and between the covers and the bay walls. It is recommended that prior to initiating construction of an HPM, an expert consultant perform creep model testing of the proposed concrete mix in order to evaluate the effect of creep and long term deflection. The testing results should then be used to modify the exact design of the plank interface and storage bay walls as required. Adequate adjustability of the plank interface should be accounted for in the final design.

5.3.2 Moveable Storage Bay Covers. As currently configured, there is an upper and a lower set of moveable storage bay covers. The covers are designed to travel independently the full length of the bays into the various potential configurations. Because of physical security requirements as well as for protection against line-of-sight fragmentation, restrictions have been placed on the allowable gaps and clearances between the cover segments and between the covers and the bay side and end walls. These restrictions are described in reference (3).

Extra care must be taken in the design and construction of the cover system to ensure that the covers can achieve a full range of operation without interferences or conflicts, and still satisfy the required clearance restrictions. Adequate adjustability should be built into the system to account for product and construction tolerances as well as the potential effect of creep and long-term deflection. The planks may need to be constructed with an initial camber to accommodate the deflection effects.

5.3.3 Storage Bay Cover Operating System. The design of the operating system for the moveable storage bay covers may vary in configuration from that shown in the preliminary design, however it must satisfy the minimum requirements of reference (3) as well as the physical security requirements of reference (1). Final design must be reviewed and approved by the NFESC and NAVFAC Engineering Innovation & Criteria Office.

The cover operating system chosen for the preliminary design was based on its simplicity and low initial cost. The concept for moving the covers is very similar to the operation of a ski lift, and has proven to be extremely reliable in adverse conditions. The upper and lower cover clamp assembly and clamp actuators however, are unique components and were required to be designed specifically for this application. It is therefore strongly recommended that these components be fabricated and tested prior to final approval.

The movement of the cover segments is controlled through a master programmable logic controller (PLC). Proximity switch sensors and targets are used to monitor cover location with limit switches to provide end of bay travel protection. The final design shall also include a bumper or shock absorbing system at the interface between two abutting covers and also between the covers and the end walls of the bay to prevent damage from the impact resulting from normal cover operation as well as from failure of the system to limit travel of the covers.

The final design must ensure that the individual operational and control components of the cover operating system are compatible and that the total system works as an integrated unit. The programming logic for the full range of cover movement and opening combinations shall be designed as part of the final design package. The controls for the cover operating system shall provide integrated coordination with other components within the magazine including the cover locking devices, storage bay ventilation system, placement of removable handrails, and the automated bridge crane positioning system as required to ensure adequate operational safeguards. Alarm functions of the final software configuration will be defined during the final design.

The final design should be carefully structured to ensure that the HPM construction contractor has the capability and experience to design and construct the cover operating system, and retains ultimate responsibility to provide a cover system that operates as intended and in a reliable manner.

Following the construction of the initial HPM, it is strongly recommended that the design of the cover operating system, including the individual components and the programming logic be incorporated into future HPM projects to ensure uniformity and compatibility. This may require the cover operating system of subsequent HPMs to be proprietary.

5.3.4 Re-locatable Modular Walls. The hollow Chemically Bonded Ceramic (CBC) block unit that was tested and approved for the relocateable non-propagation walls in the HPM is a patented product developed and designed by CEMCOM Research Assoc. under U.S. Navy contract for the NFESC. Other materials and designs may be considered, however they must be analyzed and approved by the NFESC for explosive safety prior to approval. With no other proven acceptable material, these units may have to be proprietary, however due to this unique application, justification for proprietary procurement should not be difficult.

5.3.5 Overhead Bridge Crane. The Naval Crane Center (NCC) has the responsibility to procure all bridge cranes for ordnance handling facilities. The two overhead bridge cranes shall be provided as part of the total HPM construction contract utilizing a minimal performance based requirements specification. The intent is to provide cranes that are essentially industry standard based on the Crane Manufacturer's Association of America (CMAA) guidelines, with only minor unique features to enhance reliability. The NCC will review and certify the cranes based solely on satisfaction of the performance-based criteria. Reference (6) includes the design performance specification for the cranes.

The crane / straddle carrier control and video monitor system shall be provided by the crane supplier. The crane, including the control and monitor system, must be designed and manufactured to ensure compatibility with the operation of the straddle carrier and C-Grab. A quick connect coupler shall be provided between the crane and the straddle or C-Grab to energize the carriers and transfer the images from the cameras mounted on the straddle to the monitor in the crane control system.

5.3.6 Universal Straddle & C-Grab Carriers. The Universal Straddle and C-Grab carriers are devices that have been developed by the Naval PHST Center. If construction drawings are available at the time of the design of a new HPM, they shall be included in the construction documents for the HPM. If the construction drawings are not available, or if modifications are required to the existing drawings, the HPM construction contractor may be required to provide some design related services. The Naval PHST Center shall be responsible for approval and certification of both the USC and C-Grab.

Three to four cameras will be mounted on each side of the straddle carrier to assist in the stowage and retrieval of ordnance. The cameras will be oriented to ensure that the straddle tines are aligned properly into the pockets of the containers, the mating ends of the containers are properly engaged, and that the carrier is adequately opened or closed during maneuvering of ordnance.

Following the initial HPM design, the drawings for the construction of the USC and C-Grab shall be incorporated into future HPM projects to ensure uniformity and compatibility between magazines.

5.3.7 Automated Bridge Crane Positioning System. The bridge crane positioning system is an optional feature designed to automate and speed up the operation of the overhead bridge cranes. At the time that the preliminary design was developed, there was only one acceptable positioning system available from an overseas source. If an activity determined that the automated positioning system was desirable, justification for proprietary procurement and demonstration of compliance with Buy-American regulations may have to be addressed unless other acceptable suppliers are developed.

5.3.8 Air Quality Monitoring Provisions. Suitable testing equipment must be available for ensuring that the air quality in the storage bays of the HPM is acceptable prior to and during occupancy. Also training and certification is required for the operators of the testing equipment. The final design of a site specific HPM, shall verify whether the construction contract is to provide the testing equipment and training, or whether other sources will provide them. The testing equipment shall be suitable to detect and measure oxygen content, explosive limit, and the potential organic vapors identified in reference (b), and be approved by the National Institute for Occupational Safety and Health (NIOSH), Mine Safety and Health Administration (MSHA), or other nationally recognized testing laboratory recognized by OSHA.

The Confined Space Program Manager (CSPM) at the HPM site location shall be responsible for ensuring the adequacy of the testing equipment as well as the training and certification of the operators in its proper use, maintenance and calibration.

5.3.9 Ordnance Storage Ventilation System. The built in ventilation system for the storage bays shall be designed to optimize the ability to refresh the air within the bay and flush any potential toxic vapors. The supply and exhaust ducts shall be sized and located to preclude "dead" spots within the bay with consideration for the potential ordnance storage arrangements demonstrated by references (1) and (2).

5.3.10 Temperature / Humidity Control. Temperature and humidity controls may be required within the storage bays for the storage of certain ordnance. The specific humidity and temperature requirements for the specific ordnance to be stored shall be determined prior to final design. These requirements coupled with the site-specific environmental characteristics shall determine the need for an HVAC system within the bays. If an HVAC system is required, a life cycle energy evaluation shall be performed to determine the optimum design.

5.3.11 Building Enclosure. The Preliminary design of the pre-engineered building and the foundations was based on the design loading described in paragraph 2.4.2. Design of the building or foundation to resist the effects of an accidental explosion is not required. The design of the building and the supporting foundations may be modified based upon prevailing conditions at the project site.

5.3.12 Physical Security. The overall design and approval for the physical security system for the HPM is the responsibility of the NFESC, code ESC66 (Security Engineering Division).

A detailed design for hardening the storage bays from intrusion and for a mechanism to lock the covers in their closed position has been developed by the NFESC. This design is described in references (4) and (5). The final design may vary in configuration from that shown, however it must satisfy the physical security requirements described in references (1) and (2). Final design must be reviewed and approved by the NFESC code ESC66. A high security lock, to secure the covers in the closed position, shall be provided as government furnished equipment for the HPM.

An intrusion detection system (IDS) shall be installed inside of the upper level of the HPM in accordance with the requirements of references (1) and (5).

5.4 RECOMMENDED PROCUREMENT STRATEGY

It is highly recommended that a single construction contract to be used to procure all of the components of the HPM in order to facilitate a coordinated project with a clear line of responsibility and to ensure that all of the individual components can be constructed and work together in a coordinated way. Due to the unusual number of individual complex components that make up the HPM, it is recommended that a two-step Best Value Source Selection procurement strategy be employed to maximize the control over the capabilities of the chosen construction team in each of the critical components.

5.5 OPERATIONAL CONSIDERATIONS

5.5.1 Personnel Safety Within the Storage Bays. The HPM concept requires storage of ordnance in covered underground bays with no means of egress other than by vertical ladders. Personnel access into the bays may be required to occasionally assist in the movement of the ordnance and to perform routine maintenance on the ordnance stored. By definition, the bays qualify as confined spaces. In order to operate the HPM as a non-permitted confined space, and to ensure that the bays are safe for personnel to enter and occupy, the air quality must be measured to ensure that the oxygen content is acceptable and that no harmful substances are present. A ventilation system is required to refresh the air within the bay prior to entry, and to continue to circulate the air while occupied. Whenever an individual enters the bay, he must wear a full body harness. An attendant will be required to maintain sight and voice contact with the person in the bay at all times. In the event of an emergency requiring a worker to be assisted from the storage bay, a lanyard attached to the hoist of the overhead bridge crane will serve as a secondary means of egress.

It is essential that each HPM facility develop well defined operational guidelines and assign clear responsibility for ensuring that all ordnance handling personnel are adequately trained in the required safety procedures.

5.5.2 Bay Egress. Access into the bays is required to be by a vertical aluminum ladder extending approximately 20 feet from the platform above. A removable ladder extension section must be added to the top of the fixed ladder to access the lower ladder section from the platform above. Since the removable ladder section must be installed after the covers are opened, the installer must wear a safety harness and be tied off to prevent a falling hazard. A removable rail section on the upper level platform would be in place when the removable upper ladder extension was not in place. This means of egress will be difficult and requires the full use of both legs an hands. The bridge crane will have to be used to extract an injured worker. Other egress options have been eliminated due to explosive mitigation concerns and the impact on ordnance storage capacity.

5.5.3 Ordnance Stowage and Retrieval. A crane/straddle operator positioned on the walkway along the building exterior wall, and located above the tops of the storage bay covers will control typical ordnance stowage and retrieval. The configuration of the ordnance stacks, as shown in references (1) and (2), allows the stowage of most containers into stacks up to approximately 14 to 15 foot high. The aisle spacing and orientation of the stacks with respect to the crane operator will in many cases not allow a direct line of sight between the operator and the containers. The images from six to eight cameras positioned on the straddle carrier will be fed to a monitor that is built into the control panel for the bridge crane / straddle carrier. This camera / monitor system was originally intended to provide adequate information to the crane operator to allow the stowage and retrieval of ordnance.

Some of the containers within the ordnance inventory require relatively precise positioning to ensure that the mating parts align properly when stacked. It has been demonstrated that some containers cannot be reliably stacked with only the use of the cameras located on the straddle lift. Spotters are required to guide or “nudge” these containers into the proper stowed position. Reference (7) identifies several of the containers that require tag line assistance for stowage. Line handlers may need to be positioned along the center transfer aisle wall, the upper walkway, and on top of the bay covers to assist the crane operator in the stacking operation. Safety concerns associated with lowering the containers by crane prevent personnel in the constricted aisle spaces of the bay below when the containers are being stacked greater than two high.

Depending on the position of the particular ordnance being stowed, and the configuration of the other ordnance within the bay, the use of tag lines from the aisles above will in some instances be extremely difficult due to interferences and restricted line of sight, and will require multiple line handlers.

Removable railing along the transfer aisle walls and along the edges of the bay covers will be provided for the protection of the tag line spotters. The removable railing sections that interfere with the transport of the ordnance through the magazine cannot be put in place prior to positioning the ordnance over the designated stacking location. Depending on the stowage operation, portions of the removable rail sections may have to be installed and removed with the movement of each individual container. Also the bay covers may require multiple configurations to ensure that the rails are not required to be placed or removed at the edge of an open bay for safety reasons.

The automated bridge crane positioning system can be used to automate the positioning of the bridge crane. Precise positioning may reduce the need to use tag lines to final position the mating parts of the containers. However, due to the variability of the containers in the inventory, the precision with which the tines of the straddle must be positioned within the pocket of the containers to successfully mate many containers, and the lack of 100% operational reliability, this system will not eliminate the need for tag line assistance for stowage of many containers.

5.5.4 Stowage Capacity. Due to the extreme difficulty to load and unload some of the maximum capacity storage plans, operational load storage plans with reduced storage capacity have been developed by the PHSTC to illustrate efficiency and space requirements for comparison with the maximum efficiency plans. The HPM ordnance handling and storage operations and the development of storage load plans is discussed further in reference (7).

The access ladder into the bays has been inset into the bay wall in order to accommodate the ordnance stowage plans shown in references (1) and (2). All of the stowage arrangements have been accommodated except for the tomahawk (VLS-SUB). One or more stacks of this missile would have to be eliminated due to the clearance requirements of the access ladder.

5.5.5 Reliability / Maintenance. The HPM has a much greater reliance on technically and / or mechanically complex components than other standard ordnance magazines. The only viable means to stow and retrieve ordnance in the HPM is with the overhead bridge crane. Other components of the HPM that are **required** for ordnance stowage include the straddle lift, cover operating system, gas monitors, and bay ventilation system. Back-up and redundancy measures that have been included to improve the reliability of the critical components including:

- a second bridge crane to serve as a back-up in the event the failure of the first,
- provisions for an emergency power generator to be brought on site to power critical components, and
- provisions for manual movement of the bay covers.

Spare parts for critical components of the crane, straddle lift, C-Grab, air testing equipment, bay ventilation system, cameras and video monitors, automated positioning system, and the cover operating system should be stockpiled in order to facilitate recovery from an outage. In addition, the technically and mechanically complex systems must be maintained on a regular schedule to improve reliability.

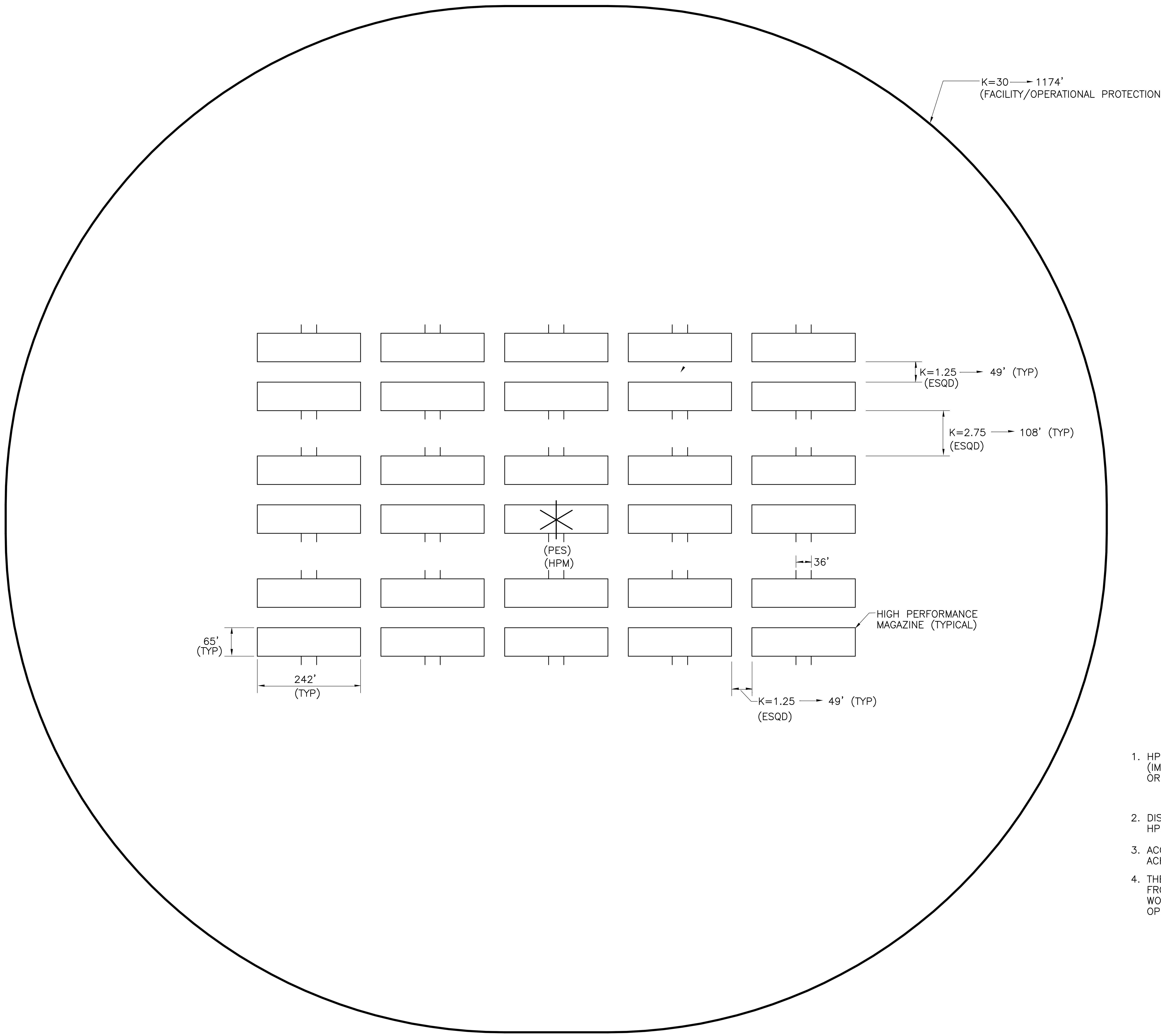
6.0 REFERENCES

1. Naval Facilities Engineering Services Center, Technical Report TR-2084-SHR REV (3): “Basis of Design for the High Performance Magazine”, by J.E. Tancreto and Kevin Hager, March 2000.
2. Naval Facilities Engineering Services Center, Special Publication SP-2053-SHR REV (1): “High Performance Magazine Concept of Operations, Operating Hazards Analysis and Mitigation”, by Preston Springston, James Tancreto, Kevin Hager, and Daniel Zarate, September 1999.
3. Naval Facilities Engineering Services Center, “Definitive Drawings Explosives Safety Requirements for High Performance Magazine”, NFESC Drawing nos. 99220001 – 992299912, March 2000.
4. Naval Facilities Engineering Services Center, “HPM-ILD Lock Box Envelope/Installation”, Contractor’s Drawing nos. 620100 - 620138.
5. Security Design Sciences, “Security Requirements for he High Performance Magazine, Report 99-1, February 2, 2000.
6. Naval Crane Center, Specification, 04-HP-MAG, “Two 8-ton OET Cranes for High Performance Magazine.
7. Naval Packaging, Handling, Storage, and Transportation Center, Technical Report SRB001, “High Performance Magazine Evaluation of Ordnance Handling and Storage Operations and Development of Magazine Storage Load Plans” 2 April 2001.

7.0 ATTACHMENTS

1) HPM Siting Relationships (HPM as PES) - IMD for ESQD and Operational Protection

2) HPM Siting Relationships (ECM as PES) - IMD for ESQD, Asset Protection, and Operational Protection



ABBREVIATIONS

PES: POTENTIAL EXPLOSION SITE

ES : EXPOSED SITE

HPM: HIGH PERFORMANCE MAGAZINE

IMD: INTERMAGAZINE DISTANCE

ESQD: EXPLOSIVE SAFETY QUANTITY DISTANCE

K : FACTOR DESCRIBING RELATIONSHIP BETWEEN DISTANCE AND CHARGE WEIGHT:
$D=KW^{1/3}$

D: SEPERATION DISTANCE (FEET)

W: NET EQUIVALENT EXPLOSIVE WEIGHT (LB)

NEW: NET EQUIVALENT WEIGHT

NOTES

1. HPM AS DRAWN ARE SITED FOR MINIMUM ESQD REQUIREMENTS. (IMD BASED UPON PREVENTION OF PROMPT PROPRGATION OF ORDNANCE IN AN ES RESULTING FROM AN EXPLOSIAN IN A PES)
   K=1.25 (SIDE AND REAR EXPOSURE TO PES)
   K=2.25 (FRONT EXPOSURE TO PES)
2. DISTANCES ARE BASED ON A NEW OF 60,000 LB WITH THE HPM AS THE PES.
3. ACCORDING TO NFESC, NEARLY COMPLETE ASSET PROTECTION IS ACHIEVED WHEN THE HPM IS SITED AT THE ESQD.
4. THE ARC LABELED K=30 REPRESENTS THE DISTANCE FROM A PES WHERE THE SUPERSTRUCTURE OF A HPM WOULD BE DAMAGED BEYOND THE ABILITY TO MAINTAIN OPERATIONAL CAPABILITY.

ATTACHMENT (1)

DESIGNED & ENGINEERED BY: LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
NORFOLK, VIRGINIA

HPM SITING RELATIONSHIPS (HPM AS PES)

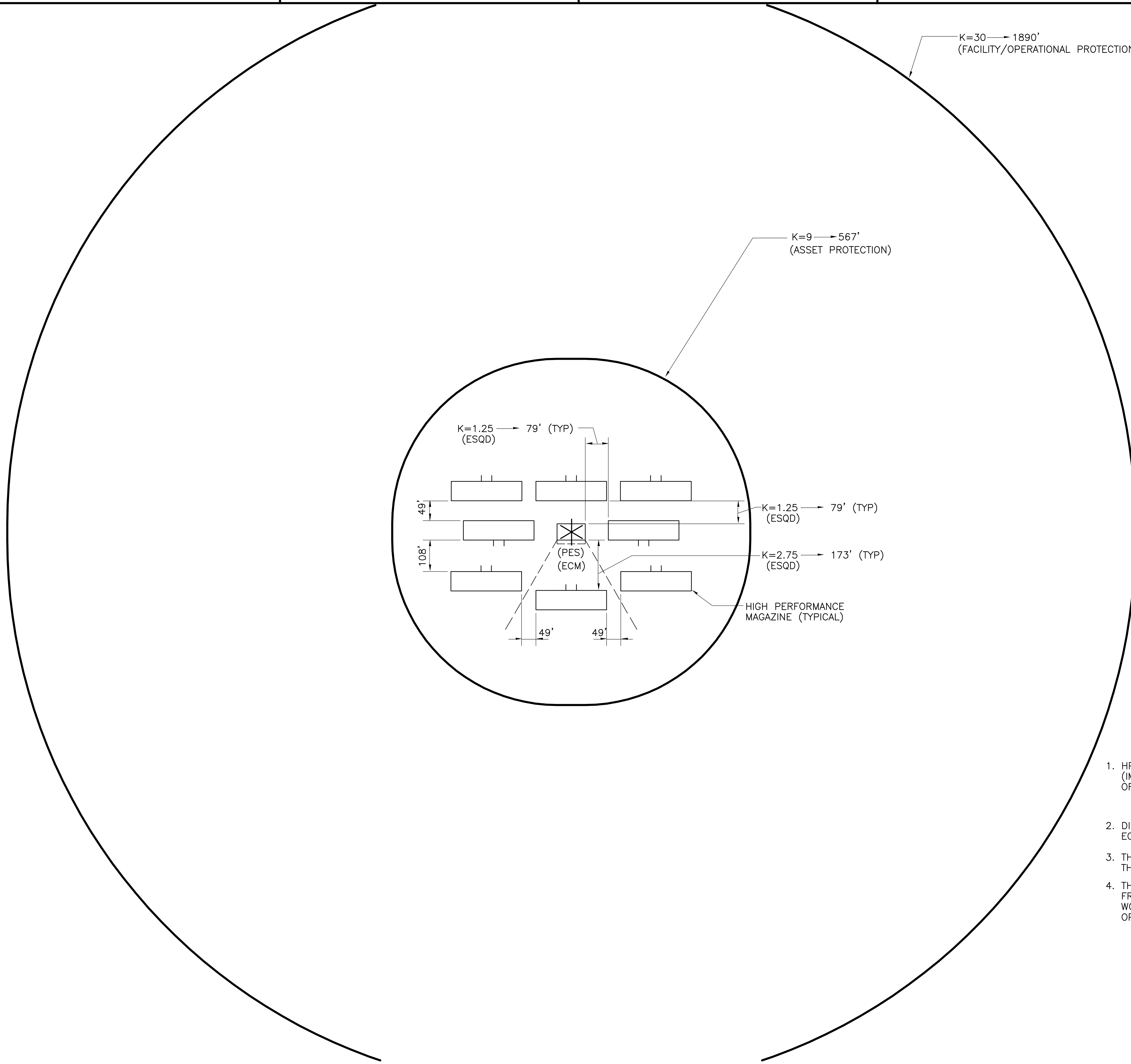
IMD FOR ESQD AND OPERATIONAL PROTECTION

CODE ID. NO. 80091 SIZE D

SHEET 7-2

DRAWFORM REVISION MAY 2000

FILENAME: MAGIZ.DWG, UPDATED ON 07/10/01 AT 13:08, XREFS: NONE



ABBREVIATIONS

PES: POTENTIAL EXPLOSION SITE

ES : EXPOSED SITE

HPM: HIGH PERFORMANCE MAGAZINE

ECM: STANDARD EARTH COVERED MAGAZINE

IMD: INTERMAGAZINE DISTANCE

ESQD: EXPLOSIVE SAFETY QUANTITY DISTANCE

K : FACTOR DESCRIBING RELATIONSHIP BETWEEN DISTANCE AND CHARGE WEIGHT:
$D=KW^{1/3}$

D: SEPERATION DISTANCE (FEET)

W: NET EQUIVALENT EXPLOSIVE WEIGHT (LB)

NEW: NET EQUIVALENT WEIGHT

NOTES

1. HPM AS DRAWN ARE SITED FOR MINIMUM ESQD REQUIREMENTS. (IMD BASED UPON PREVENTION OF PROMPT PROPRGATION OF ORDNANCE IN AN ES RESULTING FROM AN EXPLOSIAN IN A PES)
   K=1.25 (SIDE AND REAR EXPOSURE TO PES)
   K=2.25 (FRONT EXPOSURE TO PES)
2. DISTANCES ARE BASED ON A NEW OF 250,000 LB WITH AN ECM AS THE PES.
3. THE ARC LABELED K=9 REPRESENTS THE DISTANCE FROM THE PES WHERE ORDNANCE IN A HPM WOULD BE DAMAGED.
4. THE ARC LABELED K=30 REPRESENTS THE DISTANCE FROM A PES WHERE THE SUPERSTRUCTURE OF A HPM WOULD BE DAMAGED BEYOND THE ABILITY TO MAINTAIN OPERATIONAL CAPABILITY.

AHACHMENT (2)

SYM. DESCRIPTION DATE APPR

DESIGNED & ENGINEERED BY:
LANTDIV
NAVAL FACILITIES ENGINEERING COMMAND

SEAL

APPROVED

ACTIVITY - SATISFACTORY TO

DATE

APPROVED

FOR EFD FOR COMMANDER NAVFAC

DATE

A/E EFD

DESIGN

DRAWN

REVIEW

QC

CHIEF ARCH./ ENGR.

PROJECT MANAGER

FIRE PROTECTION

BRANCH MANAGER

DESIGN DIRECTOR

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION NORFOLK, VIRGINIA

HPM SITING RELATIONSHIPS (ECM AS PES)

IMD FOR ESQD, ASSET PROTECTION, AND OPERATIONAL PROTECTION

CODE ID. NO. 80091 SIZE D

SCALE:

EFD NO.

STA. PROJ. NO.

SPEC. NO.

CONSTR. CONTR. NO.

NAVFAC DRAWING NO.

SHEET OF

7-3

DRAWFORM REVISION MAY 2000

FILENAME: MAGIZ2.DWG, UPDATED ON 07/10/01 AT 13:09, XREFS: NONE