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UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT MAINTENANCE HANGARS: TYPE I, TYPE II AND TYPE III

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UNIFIED FACILITIES CRITERIA (UFC)
AIRCRAFT MAINTENANCE HANGARS: TYPE I, TYPE II AND TYPE III

U.S. ARMY CORPS OF ENGINEERS
NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)
AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
Change 1	1 June 2006	Additional Fabric Door criteria and reference edits added throughout.
Change 2	03 Aug 2007	Corrected foreword
Change 3	16 Dec 2009	Document reformatted, requirements language incorporated. Added new hangar type. Incorporated ITG FY05-01

This UFC supersedes (in part) Military Handbook 1028/1C, dated 1 April 1999.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-211-01N with Change 3

Superseding: UFC 4-211-01N with Change 2 and ITG FY 05-01

Description of Changes: The UFC was reformatted to reflect current practice in UFC organization. The material was revised to reflect the current state of the practice of hangar design utilizing lessons learned from recent hangar construction as well as site visits and hangar occupant interviews. This included updated material regarding new hangar design principles, hardware, construction practices as well as new military aircraft entering service. The language of the UFC was also rewritten in a mandatory style suitable for reference by design-build Requests for Proposals for new hangar construction. The content was also streamlined to reflect updated design discipline UFC documents. Requirements from ITG FY05-01, Design Criteria for the Fire Protection of Navy and Marine Corps Aircraft, were also incorporated.

Reasons for Changes: The primary purpose of this revision was to provide a document suitable for use, with design mandates, as a reference for design-build contracts. Additionally, the UFC was more closely integrated with the standard hangar design-build RFP template and other Government publications governing military construction.

Impact: The result of these changes is a document which can more practically be used as part of a construction contract and is more easily understood by the users, more relevant to current practice and is properly coordinated with other Government requirements documents.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

1-1 SCOPE.

This UFC provides guidelines for evaluating, planning, programming, and designing Aircraft Maintenance Hangars. The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). Alteration and renovation projects shall update existing facilities to meet the guidance and criteria contained in this UFC within budgetary constraints. This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

For planning, design and construction of Type I hangars intended to support F35 B or C aircraft see ITG FY2010-01, *Maintenance Hangar Design and Planning Guidance for F35 B and C*. The ITG is available at:
http://www.wbdg.org/ccb/browse_cat.php?o=30&c=212

1-2 USERS OF THIS UFC.

This UFC is intended as a source of basic architectural and engineering information for all individuals involved in the planning, design, or evaluation of Aircraft Maintenance Hangars.

Specific users of the UFC include the following:

1-2.1 Architects and Engineers.

Architects and Engineers (A/Es) who will provide design services under the direction of the individual Service design agencies.

1-2.2 Planning Personnel.

Planning personnel will use this UFC for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing Aircraft Maintenance Hangar in order to achieve the standard established herein.

1-2.3 Additional Users.

Additional users include the following:

- Headquarters Staff and Field Operating Agencies,
- Major Command Staff/Regions,
- Base Commanders,
- Installation Facilities Management,
- Installation Technical Proponents.

1-3 SCOPE OF THE FACILITY.

This UFC contains criteria for the design of Navy and Marine Corps aircraft maintenance hangars for organizational ("O") and intermediate ("I") level maintenance to support the Naval Aviation Maintenance Program in accordance with Chief of Naval Operations (OPNAV), OPNAVINST 4790.2, *Naval Aviation Maintenance Program (NAMP).* Major aircraft overhaul is normally done at a Fleet Readiness Center.

1-4 TYPES OF HANGARS.

1-4.1 General.

Aircraft hangars are comprised of 3 distinct areas; the hangar bay (OH space), the Shop/Maintenance Area (O1 level); and the Squadron Administration and Operations area (O2 level). The levels are designations from shipboard levels and are not specific to the hangar design.

The hangar bay provides "O" level maintenance to aircraft within the hangar bay. O level maintenance includes removing engines, changing tires, etc. Layout of this space is determined by the planning documents for the module configuration identified. The net area of the hangar bay is defined in the module layout and is considered a fixed area. The hangar bay may not be increased in size nor shall the dimensions be modified.

Hangar configurations, including heights are provided to allow for maximum flexibility in accommodating all of the existing and proposed aircraft in the Naval Aviation Fleet. Modifications shall not be made to any hangar bay module without approval from Naval Facilities Engineering Command Atlantic, Capital Improvements Criteria and Programs Office (CIENG), Naval Air Systems Command (NAVAIR) or Commander Naval Installations (CNI). Additionally, Marine Corps hangar bay configurations may be modified by Headquarters, USMC (LF).

1-4.1.1 Type I Hangar.

A Type I maintenance hangar is primarily designed for carrier aircraft, but is adaptable to meet requirements for rotary wing and various types of smaller aircraft. The O1 and O2 level spaces in this type of hangar are configured for a typical strike fighter squadron, two carrier airborne early warning squadrons, or a helicopter antisubmarine warfare squadron.

The Type I hangar bay module is 210' (64.01 meters) wide by 95' (28.96 meters) deep. Clear heights and other specific hangar bay requirements are indicated on Appendix E.

All Type I hangars shall have one bridge crane per module.

1-4.1.2 Type II Hangar.

A Type II hangar is primarily provided for US Marine Corps Aviation. The hangar is designed to accommodate CH-53 Helicopters, V-22 Ospreys and C-130 Hercules aircraft. This type of hangar may also accommodate Navy versions of the C-130, V-22 and H-53 aircraft. The type II hangar bay module is 119 feet (36.27 meters) deep by 325 feet (99.06 meters) wide. Clear heights are as indicated in Appendix E
All Type II hangars shall have one bridge crane per module.

1-4.1.3 Type III Hangar.

A Type III maintenance hangar is principally designed for land based patrol and large transport aircraft. The Type III hangar module is 165 feet (50.29 meters) deep by 165 feet (50.29 meters) wide. Clear heights are as indicated in Appendix E.
Type III hangars are not authorized to have a bridge crane.

1-4.2 Hangar Bays.

See Appendix E for specific hangar bay requirements. Selection of hangar type shall be based on aircraft characteristics.

See Appendix C for aircraft characteristics. Additional data may be obtained from the Aircraft Characteristics Database at http://www.uscost.net/aircraftcharacteristics/.

1-4.3 Other Aircraft Facilities.

Criteria for the design of paint and corrosion control hangars and other aircraft facilities are contained in UFC 4-211-02N.

1-4.4 Other Services' Hangar Facilities.

For **Army** or **Air Force** hangars, use UFC 3-260-01, *Airfield and Heliport Planning and Design,* and specific direction provided by the respective headquarters command.

1-4.5 General Building Requirements.

General building requirements can be found in UFC 1-200-01, *General Building Requirements*.

CHAPTER 2: PLANNING AND LAYOUT

2-1 GENERAL.

2-1.1 Conflicts in Criteria.

Where the general discipline criteria contained on the NAVFAC Design Build Master (NDBM) website conflicts with criteria contained herein for hangars, this UFC controls.

2-1.2 Supplemental Design Criteria.

Refer to DoD page at WBDG website (http://dod.wbdg.org) for supporting and general discipline criteria that also applies to hangar design.

2-1.3 Design Constraints at Airfields.

During the planning and design of hangars, the effect that the new facility will have on any existing facilities must be investigated. It is imperative that the new hangar does not obstruct the sightline of the Air Traffic Control Tower to the runways or taxiways. Furthermore, planners and designers must be aware of the various imaginary surfaces around the airfield which may constrain the height and/or location of any new facility. Planners and designers must also be aware that airfield constraints will impact construction activities. Temporary waivers for construction equipment and activity are generally available on a short term basis, such as for the lifetime of a construction project, there is the potential for significant impacts to a project, both in cost and schedule, and should be thoroughly researched in advance.

2-1.4 Specific Building Requirements.

Closely consult aircraft maintenance officers of shore activities from project definition through the entire design effort of any project related to the construction, repair, or modernization of aircraft organizational and intermediate facilities (refer to Volume 1 of OPNAVINST 4790.2). This ensures that technical requirements for specific aircraft maintenance and testing procedures as outlined in Naval Air (NAVAIR) technical manuals receive proper consideration in the design of these facilities. Specific aircraft data can be obtained from the Aircraft Characteristics Database at http://www.uscost.net/aircraftcharacteristics/.

2-2 PLANNING CRITERIA.

Naval aviation is a highly dynamic field and maintenance concepts depend increasingly on state-of-the-art computer technology. Planning factors in UFC 2-000-05N, *Facility Planning Criteria for Navy and Marine Corps Shore Installations*, and design criteria included in NAVFAC and DoD criteria manuals are guides that must be used with specific weapons system Facilities Requirement Documents (FRD) to design a fully

usable aviation facility. NAVAIR Facilities Management Division, Fleet Support Branch, works with the weapons systems developers to identify unique aviation facility requirements. NAVAIR engineering personnel are available during design and construction to provide specialized expertise to NAVFAC or to arrange for weapons system manufacturers' representatives to attend design reviews if requested by NAVFAC Engineering Field Divisions (EFDs), NAVFAC Engineering Field Activities (EFAs) or aviation facility users.

2-3 DESIGN GUIDANCE.

2-3.1 Adapting the Design.

Squadron Operations vary significantly based on airframe or mission. While all squadrons may have similar shops, they may vary in size based on the requirements of each aircraft. For example, a fighter aircraft may have a need for a shop to work on ejection seats while a helicopter has no such requirement. Flight crews vary with the aircraft so flight gear lockers spaces will vary.

Based on the need to meet specific requirements for each type of squadron and each type of aircraft the O1 and O2 levels must be based on specific input from the squadrons. OH spaces are fixed and are required to comply with Chart C.1

Sample configurations and Functional Relationship Diagrams are provided in this Appendix F.

2-3.2 O1 Shops and Maintenance Administration.

These areas shall be located on the ground floor. Their functions are to provide the maintenance of the aircraft and the administration of the maintenance activity.

Helicopter, fighter and other fixed-wing aircraft have different missions and their aircraft have different maintenance needs. Helicopters have more parts so they generally have larger requirements for tool rooms. Fighter squadrons have need for a specific shop to handle ejection seats. Some squadrons are operated with small detachments and thus have their own individual shops. Some squadrons have a “Line Shop” while others do not. Discuss the operations of the squadron prior to starting design.

The maintenance administration areas generally consist of offices that provide for the administration of the squadrons maintenance activities.

Shops shall be provided to perform the specific requirements for the various needs of each aircraft. All shops shall be co-located and shall be located off of a service corridor. The service corridor should be the only access into the hangar bay from the shop area.

Other spaces such as heads, showers, locker rooms, and utility rooms shall be located on the ground floor.

2-3.2.1 Representative Typical Spaces.

Spaces are typical but are not all inclusive. Marine Corp designations may vary from descriptions below

Shops:

- Aviation Ordnance
- Power Plant
- Phase/Corrosion
- Air Frame
- Composite
- Aviation Technology
- Aviation Electronics
- Tools
- Flight Line
- Parachute (AME)
- Training shops
- Detachment shops – for hangars supporting detachment aircraft

Administration:

- Maintenance Control
- Material Control
- Maintenance Administration
- Quality Assurance
- Division Officers
- CPO Office
- Quarter Deck
- Various private offices

Support Spaces:

- Locker Rooms
- Toilets (Heads)
- Corridors
- Building Systems Spaces
- Vending Area or Break Room
- Communications Room
- Storage Rooms

2-3.3 O2 Squadron Administration and Operations.

Generally, the squadron administration and operations are located on the second floor. Most squadrons have the same functional requirements and most spaces are typical from squadron to squadron. Squadrons performing combat type operations may require additional spaces such as secure briefing spaces, vaults, SCIFS, and other related spaces.

The organization of the squadron may determine the layout of the second level. Consider grouping the operation spaces and the administration spaces. Single module hangars with 2 squadrons will share some common spaces such as heads, lockers, and showers. Double module hangars may share heads, lockers, showers and training rooms to provide for more useable space for each squadron. As with the O1 level, discuss the operations of the squadron prior to starting design.

Various support spaces such as toilets, locker rooms, and utility rooms shall be provided.

Early in the design stage, determine the security and operation requirements for the squadron. Many squadrons require a “secure office” for the incorporation of the secure internet (SIPRNET).

Verify the need or requirements for Sensitive Compartmented Information Facility (SCIF).

2-3.3.1 Representative Typical Spaces.

Administration:

- Personnel Administration
- Command Suite (CO, XO, CMC, etc.)
- Offices, such as Legal, OIC, DAPR, Career Counseling, Medical, etc.
- First Lt. Office
- Reserve Administration

Operations:

- Operations
- Training
- Intel or Tactics
- Briefing Rooms
- Conference Rooms
- Safety / NATOPS
- Ready Room with duty station

Support Spaces:

- Locker Rooms
- Toilets (Heads)
- Corridors
- Building Systems Spaces
- Vending Area or Break Room
- Communications Room
- Duty Rooms
- Classrooms

2-3.3.2 Space Data.

Gross Area shall be as determined by the Planning documents and specifically provided for in the Form 1391. Modifications may be permitted to allocate O1 and O2 spaces as needed by the squadron. For example, if the squadron may wish to move some functions from the second floor to the first floor, it may be acceptable. If the squadron would prefer to reallocate administrative space to shop space, that would be permissible. There is no statutory requirement for the O1 level and O2 level to be the same square footage.

2-3.3.3 Layout and Adjacencies.

Refer to diagrams in Appendix F.

2-4 PLANNING AND DESIGN ISSUES.

A list of issues in questionnaire format is attached as Appendix D to provide assistance to the A/E and the Activity in the planning and design of the hangar.

CHAPTER 3: GENERAL DESIGN CRITERIA

3-1 GENERAL.

Use UFC 1-200-01, *General Building Requirements,* for guidance on the use of model building codes for design and construction of DoD facilities.

3-2 FOUNDATIONS.

The hangar shall be founded upon either deep or shallow foundations as appropriate for the geology of the site.

If the hangar bay (OH) and the office and shop (O1/O2) area are separate structures sharing a common foundation, the movement of the OH framing shall not be perceptible to occupants in the O1/O2 area. This applies to motion caused by wind, cranes, door operations, aircraft movement or similar loads with the exception of seismic forces.

3-2.1 Ground Floors.

Ground floors shall be either concrete slab-on-grade or pile supported reinforced concrete.

Slab-on-grade systems for the offices and shop spaces of the facility shall be designed in accordance with the American Concrete Institute ACI 360R, *Design of Slabs on Grade*. Slab-on-grade systems for the hangar bay, and any other area of the building subjected aircraft loads, shall be designed in accordance with UFC 3-260-02, *Pavement Design for Airfields*. Fiber reinforced concrete systems shall not be used inside the building.

The hangar floor shall slope a minimum of 1/16” per foot from the rear of the hangar towards the flightline door. Additional cross-slopes may be necessary to meet other drainage requirements. The hangar floor slopes shall comply with NFPA 409, *Standard on Aircraft Hangars*. The hangar floor shall be above the exterior grade and the floor slope shall project beyond the face of the building to meet the exterior flightline grade. The finished floor elevation of remainder of the facility shall be above the highest floor elevation of the hangar bay.

3-2.2 Trench Drains.

Trench drains primarily serve to remove hazardous fuels and AFFF fire suppression system discharge from the hangar floor, and to convey fire suppression system piping to the AFFF system discharge devices. Trench drains may also be used to convey compressed air and water service lines to support other operational functions of the maintenance hangar.

3-2.2.1 Design.

3-2.2.1.1 Trench drains shall be sized to account for the flow of the sprinkler system, AFFF system discharge, and hose stream allowance. The design shall also consider the volume of the piping within the trenches, turning radius of the fittings, and shall allow sufficient space for maintenance.

3-2.2.1.2 Drainage trench inverts shall slope at a minimum 1/16" per foot towards and empty into the door trench. Provide drainage from the door trench.

3-2.2.1.3 Trench covers shall be ductile iron or steel, manufactured to withstand a minimum proof-load of 100,000 pounds from a tire with a 250 psi pressure.

3-2-2-2 Location and spacing.

3-2.2.2.1 Provide a trench drain just inside and parallel to the hangar bay doors to collect AFFF discharge and to intercept wind driven rain that may enter through the hangar doors.

3-2.2.2.2 Where hangars have doors on one side of the hangar bay, provide additional trench drains perpendicular to the hangar bay door trench drain spaced no greater than 50 ft (15.2m) center-to-center. The first and last trench drain (at either end of the hangar bay) must be in line with the edge of the door opening.

3-2.2.2.3 Where hangars have doors at opposite ends of the hangar bay, provide additional trench drains parallel to the door trench drains and spaced no greater than 50 ft (15.2 m) center-to-center.

3-3 SUPERSTRUCTURE.

The superstructure of the hangar bay (OH) shall be a steel frame. If constructed as an isolated structure, the office and shops area (O1/O2) may be a bearing wall or frame system of concrete, steel or reinforced masonry. If constructed as an integral part of the OH structure, the O1/O2 shall be a steel frame conforming to the International Building Code. Pre-Engineered Metal Building systems shall conform in all respects to the standards applicable to traditional steel framing, including adherence to all requirements of the American Institute of Steel Construction specifications.

If constructed as an independent structure, the OH area framing shall be treated as an occupied, single story building for the considerations of UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*. If constructed as an integral portion of the O1/O2 area, the entire structure shall meet the requirements of UFC 4-010-01.

The framing system selected for the hangar bay shall provide a completely column free hangar bay and flightline. The hangar door head supporting structure shall meet AISC

steel erection tolerances and limit live or wind load deflection to less than that required for proper operation of the hangar doors. Regardless of the door requirements, the deflection at the door head shall be less than the span/240. Field cutting and welding of members to achieve the required erection tolerances will not be permitted. The design shall consider provisions for field adjustments which do not require field cutting and welding.

Structural bracing shall be located so as not to impair functionality of shop areas. Exposed structural bracing shall not be permitted in any administrative spaces or anywhere on the O2 level.

Single points of failure are undesirable in any facility but are historically not uncommon in long span-steel structures. Where a single connection failure could result in catastrophic collapse or failure of a large portion of the facility, secondary or back up load paths shall be provided.

3-3.1 Main Structural Framing Materials.

3-3.1.1 Weathering Steel.

Weathering steel shall not be used.

3-3.1.2 Hollow Structural Sections.

HSS members shall be sealed to keep water from entering the section and animals from nesting inside.

3-3.1.3 Exposed Structural Steel.

Hangars are often located near corrosive and/or abrasive environments. Exposed steel shapes shall be selected to minimize their surface area. All exposed steel connections shall be designed to shed water. Exposed steel shall be designed to permit the complete inspection of all fasteners and welds.

All exposed structural steel shall be coated with a high performance coating system consisting of an epoxy primer, a high solids polyurethane intermediate coat and a high solids polyurethane top coat.

3-3.2 Secondary Structural Systems.

3-3.2.1 Wall Systems.

The walls and partitions of the hangar bay shall be non-load bearing and shall not be considered as elements of the lateral load resisting system. The walls of the O1/O2 portion of the facility may be designed as load bearing if structurally isolated from the

hangar structure. The designer shall consider the relative stiffness of all wall and partition systems and the main framing and provide for structural isolation as required.

3-3.2.1.1 Interior Partitions.

The designer shall consider the connectivity between rigid wall elements and flexible steel frames.

3-3.2.2 Roof Systems.

Roof systems shall be metal deck on either open web steel joists or structural steel.

Metal decks shall not be used as part of the principle load resisting system of hangar bay roofs. Metal decks may be used to provide stability bracing provided that the designer of record can show that there is deflection compatibility between the deck acting as a brace and the main lateral force resisting system. Metal decks used in this fashion shall have a positive load path to the structural system which does not rely on the joist seats to transfer lateral loads.

3-3.3 Strength and Serviceability Requirements.

In addition to the loads described in or incorporated by reference by UFC 1-200-01, the design shall account for all loads imposed by bridge cranes, personal fall arrest systems or other specialty equipment supported by the structure.

The structural framing shall be designed to accommodate 125% of the loading from overhead bridge cranes. The designer shall consider the effect of pattern loads resulting from multiple loaded hooks. All crane hardware and lifted loads shall be treated as live loads in the load combinations defined in chapter 16 of the IBC, except for patented tracks, tracks, supports, sway braces and similar elements which are immobile and may be defined as dead loads.

3-3.3.1 Gravity Loads.

In determining design load combinations for structures in which the dead load of one portion of the building serves as stability enhancing function for another portion of the building (i.e. cantilevered construction), the following cases shall be considered in addition to the basic load cases

3-3.3.2 Factored Load Combinations.

If the dead load of any portion of the facility, including a structurally isolated administration and shop structure sharing a common foundation, is used to resist uplift forces, it shall be factored by 0.9 in strength design analysis and by 0.6 in stress design analysis if it favorably contributes to the performance of the system.

3-3.3.3 Wind Loads.

Unless the hangar is being designed for a squadron with a specific disaster recovery role, is to be designated as an emergency shelter, will have an occupancy load in excess of 500 people or there is some similar extenuating circumstance, the design Occupancy Category shall be II for wind analysis. Wind loads shall not be calculated using the Method 1 “Simplified Procedure” of ASCE 7. The design shall consider the torsional effect that the eccentricity between center of wind pressure and the center of structural rigidity have on the strength and stiffness of the structure. Wind load on main building wind force resisting system shall be determined based on the following conditions:

- Hangar doors closed for winds at the maximum design velocity. The structural forces shall be calculated based upon the assumption of a “partially enclosed building.” It is permissible to use the large volume reduction factor of ASCE 7 in determining the design wind pressures. It shall be assumed that a 1 inch strip around the perimeter of all hangar door panels is an opening and this shall be combined with the area of all unshielded fenestration.

- Hangar doors open to the maximum extent possible with a wind velocity of 60 mph. The structural forces shall be calculated upon the assumption of a “partially enclosed building.” Use the total open door area in the large volume reduction factor calculation.

3-3.3.4 Seismic Loads.

Unless the hangar is being designed for a squadron with a specific disaster recovery role, is to be designated as an emergency shelter, will have an occupancy load in excess of 500 people or there is some similar extenuating circumstance, the design Seismic Use Group shall be I for seismic analysis.

3-3.3.5 Snow Loads.

Unless the hangar is being designed for a squadron with a specific disaster recovery role, is to be designated as an emergency shelter, will have an occupancy load in excess of 500 people or there is some similar extenuating circumstance, the design Occupancy Category shall be II for snow analysis.

3-3.3.6 Thermal Loads.

In addition to the thermal loads of the IBC, the designer shall account for anticipated differential thermal effects from solar heating (e.g., on long sun-exposed exterior steel compared to shaded steel such as roof trusses, joists or decking) or inside/outside differences (particularly an “attic” effect in the hangar bay). Consider the local climate conditions when selecting the final differential temperature range, as a minimum, a temperature differential of 50°F (28°C) shall be used for design. The deflections caused by differential thermal effects shall be investigated by the engineer of record. Some

architectural fascia elements and weather seals around hangar doors are particularly vulnerable to detrimental deflections. The differential thermal effects are a serviceability concern and shall be investigated using unfactored loads.

The design shall also control deflections to within the limits imposed by section 1604 of the IBC unless stricter control is necessary to support equipment, fascia or other appurtenances. The hangar bay roof shall meet the requirements of a structure "supporting a non-plaster ceiling" and the walls shall meet the requirements of a "partition with flexible finishes." The O1/O2 area shall meet the deflection requirements appropriate to finish type. If the OH and O1/O2 area framing is constructed as a single frame, the combined structure shall meet the most stringent requirements described above.

3-3.3.7 Deflection and Drift.

The deflection of structural elements, evaluated under service level loads, shall provide for the serviceability of the structure and all of its components, including but not limited to exterior walls and cladding, partition walls, hangar doors, bridge cranes, utilities and other appurtenances. However, in no instance shall the deflection of any structural element exceed the limits of the IBC. The lateral drift (sidesway) of the structure as a whole, evaluated under service level loads, shall provide for the serviceability of the structure and all of its components, including but not limited to exterior walls and cladding, partition walls, hangar doors, bridge cranes, utilities and other appurtenances. However, in no instance shall the drift of the structure exceed the mean roof height divided by 320. If the structure has multiple roof elevations, this requirement shall be independently met at each roof level.

3-3.4 Basic Seismic Force Resisting Systems.

The hangar frame shall be designed as a "Structural Steel Systems not Specifically Detailed for Seismic Resistance" as described in the IBC Table 1617.6.2 Section 8 or using one of the following force-resisting systems, referenced in ANSI/AISC 341:

- (EBF) Eccentrically Braced Frames (Part 1, Sec 15)
- (SCBF) Special Concentrically Braced Frames (Part 1, Sec 13)
- (OCBF) Ordinary Concentrically Braced Frames (Part 1, Sec 14)
- (STMF) Special Truss Moment Frame (Part 1, Sec 12)
- (IMF) Intermediate Moment Frame (Part 1, Sec 10)
- (OMF) Ordinary Truss Moment Frame (Part 1, Sec 11)

3-3.5 Design and Construction Documentation.

The construction documents shall clearly and fully disclose all relevant design loading and stability assumptions. The documents for indeterminate structures shall indicate the load state, including thermal effects, at which the connections resulting in indeterminacy may be made.

Elements which function as stability bracing shall be clearly noted and the members which are braced shall be noted as being laterally unstable until such time as the bracing is installed. All instances where the installation of multiple secondary elements is required for the proper stability of a primary element or when a bracing element in turn requires bracing shall be clearly noted.

3-4 EXTERIOR DESIGN.

Exterior walls of the hangar bay shall be of a construction suitable to the building type, be compatible with the design of the adjacent buildings, and be protected from abuse, both interior and exterior. Exterior walls shall be compatible with the Basewide Exterior Architectural Plan (BEAP) or other written documents. For Design/Build projects, coordinate any specific requirements for materials prior to issuing the RFP.

3-4.1 Surface Treatment.

The chemical properties of materials and finishes for exterior surfaces shall have the highest possible resistance to the effects of weather and salt-corrosive atmosphere.

3-4.1.1 Specular Reflectance.

To prevent mirror-like reflections from building surfaces to aircraft in flight, roofs and other external surfaces shall have a specular reflectance compatible with the location of the building on the airfield.

3-4.1.2 Operational Hazard Glare.

If the building is located so that glare may be an operational hazard, the critical surfaces of the building shall have a light reflectance of not more than 10, measured at an angle of 85 degrees in accordance with ASTM D 523, *Specular Gloss*.

3-4.2 Roofing Systems.

3-4.2.1 The roofing system, due to large surface area and proximity to operating aircraft, shall be carefully selected. Only smooth surface roofing systems or metal roofing systems may be utilized. Membrane type roofing, when used shall not have any gravel or other type of loose particles that can be carried off of the roof surface due to high winds or drainage. The color of roof surfaces shall be as described in this section. Provide gutter and outrigger downspouts at the rear (street side) of the hangar. Provide snow guards in areas subject to heavy snowfall. Built-up roofing, insulation, and

moisture protection shall conform to the applicable guide specifications listed at the Whole Building Design Guide DoD page (http://dod.wbdg.org/.)

3-4.2.2 Provide access from O2 level spaces to the low roof over the O1 and O2 spaces and exterior access to the high roof over the OH space through a secured access panel or hatch, to prohibit unauthorized passage.

3-4.2.3 Penetrations in roofing system must have pre-manufactured sleeves or pre-manufactured flashings. Use of pitch pockets is prohibited. Use of field manufactured flashings for cantilevered roof structures is prohibited.

3-4.2.4 Roofs shall only slope to the rear of the hangar and not towards the flightline.

3-4.3 Hangar Doors.

Choose one of the following types:

Provide a Vertical Lift Fabric Door System or Horizontal Sliding Doors. The Vertical Lift Fabric Door System is the preferred door system for all Type I, Type II and Type III hangars.

The fabric door provides greater flexibility in aircraft movement, seals the hangar better against wind, rain and bird intrusion and more efficiently uses the hangar maintenance space.

Proposed selection of Horizontal Sliding doors shall be determined prior to issuance of the RFP.

The hangar doors shall be able to completely open the doorway, either by lifting the doors over the door head line or by sliding into provided pocket spaces to the side of the hangar.

Hangar doors shall be designed to the same standards and criteria as the main force resisting system, including all provisions of UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, except for the requirements that they be outward swinging and fully seated in perimeter jambs when closed. Hangar doors shall be designed to resist the components and cladding wind pressures determined in accordance with UFC 1-200-01. Consider the full operating range of the roof structure and wind uplift to design door guide system.

3-4.3.1 Vertical Lift Fabric Doors.

The hangar doors shall be of a composite system from a single source manufacturer for the purpose of closing a hangar bay space. The doors are supported from the structure above and the structural engineer of record shall consider the different load

combinations imposed by open and closed door panels resulting in eccentric wind loads or mechanical loads from the door and mullion hoisting equipment. The mullions of the door system connect to pits at grade which serve to restrain the mullions from motion perpendicular to the face of the doors. These pits must be designed to resist the high mullion loads and the pits must be provided with a means to drain water.

Hangar doors shall be individually operated, upward acting lightweight frame system with polyvinyl fabric facings. Design doors in sections with lifting mullions between door sections. Design features include electric operation, personnel exit doors, and translucent lighting. Door speed will be a minimum of 4 inches (100 millimeters) per second.

Design the doors so that in case of a power outage, the doors shall be operated by a generator. The generator shall be sized to allow operation of one door panel at a time or in multiple module hangars operation of 1 door panel per module is required.

The door arrangement, proposed in UFGS 08 34 16.20, *Vertical Lift Fabric Door*s, permits egress of aircraft through adjacent panel openings in the event of operational failure. For hangar openings wider than 150 feet (45.72 meters), a personnel exit door will be provided in the center of the bay for a fire exit as required by NFPA 409, *Aircraft Hangars.*

Provide fabric doors with a wind lock to secure the door prior to hurricane conditions and to prevent door uplift. The wind lock shall be provided with a proximity switch to show proper engagement of the wind lock for the operator's benefit. Fabric door systems allow the user flexibility to partially raise selected door sections to enhance hangar bay ventilation.

Provide a catwalk for accessing the motors and other serviceable items of the fabric door. Provide access to maintain vertical lift fabric door equipment, motors and limit switches and other serviceable parts. Ensure all safety requirements are met; see UFGS 01 35 26, *Governmental Safety Requirements*. The access shall be from inside the hangar.

3-4.3.2 Horizontal Sliding Hangar Doors.

Hangar doors shall be a series of insulated, horizontal sliding leaves with protected, preformed (corrugated) metal or sheet-steel siding. Each sliding door leaf shall be supported on hardened wheels rolling on recessed rails with guide rails at the top of the door. Hangar door rail support system shall provide for surface drainage. Intermittent drainage to hangar trench drains shall be at 10 ft (3.05 meters) maximum. In cold climates, the doors shall include a deicing system. The doors will also include a system to ensure that the tracks remain free of obstructions.

The hangar doors shall be of steel framed construction, built to the same standards as the main hangar frame. The door shall be supported at grade by a concrete

foundation. The foundation shall be compatible with the building foundation and the potential for differential settlement shall be considered. The doors shall include a system for draining the sill tracks.

Hangar door panels shall be individually operated and controlled. Use of telescoping bi-parting doors shall not be permitted.

Doors will be located within the footprint of the hangar or within door pockets. Doors may not be unenclosed such as in open door pockets. The door pockets are not included in the gross area calculation of the hangar bay indicated in Appendix E Hangar Bay Dimensions, but the gross area calculations must show the area of the door pockets. Optionally, the doors may be stacked within the open area of the hangar bay, if permitted by the activity. The door opening shall not be reduced more than 25% of the entire opening to accommodate non pocketed doors.

Design thresholds to minimize dirt accumulation or ice buildup at rails. Leaves of the door shall be insulated and shall be provided with waterproof weather stripping and emergency personnel exits as required by NFPA 409*, Standard on Aircraft Hangars* and NFPA 101, *Life Safety Code*. The hangar doors shall be electric motor operated. For electric motor operation, drives shall operate leaves independently. Each drive unit shall have a release mechanism, and the doors shall be provided with a means of movement in the event of power failure. The normal mode of operation is an electric drive and the minimum speed of door travel shall be 60 feet (18.29 meters)per minute.

Control of the doors shall be by momentary contact type push buttons located near the leading edge of the door and limit switches on each door leaf. Safety devices shall be installed to prevent injury to personnel and damage to equipment by moving door sections. If personnel access doors are provided in the hangar door leaves, an interlock shall be installed that will prevent operation of the hangar door leaves when the personnel access doors are open and will halt the hangar door leaves in the event a personnel access door is opened while the hangar door leaves are in operation. An alarm shall sound in conjunction with safety warning beacons when doors are in motion. Sliding steel hangar doors shall be in accordance with UFGS 08 34 16.10, *Steel Sliding Hangar Doors*.

Configure horizontal sliding hangar doors such that they are operable during power outages, by either manual or electrical means. See paragraph 3-11.1.3.

3-4.4 Windows.

Use windows meeting AAMA Type HC60 window specifications (AAMA WSG.1, *Window Selection Guide*). Windows must be thermally broken pre-finished aluminum with tinted, low –e glass. Use laminated glazing and comply with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings* in portions of the building that qualify as “inhabited”, including “inside” windows exposed by the hangar bay. Both panes shall have laminated glazing.

3-4.5 Doors and Hardware.

Exterior doors with closers shall be Level 4, physical performance Level A doors complying with SDA 250.8. Frames shall match door level. Exterior door frames shall be welded type.

Provide Grade 1 hardware typical. Locksets shall be mortise type, Series 1000 as defined by ANSI 156.13 for O1 level doors. Hinges for doors with closers shall be full mortise continuous aluminum hinges. Closers shall be the best and highest grade available from each manufacturer. Exterior doors shall have overhead rain drips and door drips.

3.5 INTERIOR DESIGN.

Durability is extremely important when specifying materials for interior construction and finishes. Aircraft Maintenance Hangars are generally occupied 24 hours per day, seven days a week and heavy equipment is regularly handled throughout the facility. All finishes and components shall be selected based on the operations performed in the hangar bay and shop spaces. These conditions will lead to greater interior damage being incurred compared to many other facility types.

3-5.1 OH Hangar Bay.

The hangar bay shall be provided with durable finishes. The exterior walls shall have as a minimum, a protective panel along the exterior walls that will prevent damage to the exterior finish system. Generally, a hangar bay will be comprised of metal wall panels and protection must be provided from the interior of the hangar bay. The minimum protection can be provided by a non-insulated metal panel attached to the wall panel girts. The protective panel shall extend to at least 7 feet (2.13 meters) above the hangar floor. Alternatively, a masonry panel may be provided.

3-5.1.1 Floor.

Provide a Thin Film Flooring System that complies with MPI (Master Painters Institute) Specification 212. This coating consists of a primer, a mid coat and a top coat. Application of the top coat shall be in accordance with Specification Section UFGS 09 67 23.15 Fuel Resistive Resinous Flooring, 3-Coat System, but in no case may the application be less than recommended by the manufacturer.

USMC standard color is light gray. Verify color requirements in RFP prior to issuing a Design Build RFP.

3-5.1.2 Walls.

There are not any specific requirements for wall finishes. All unfinished items shall be painted. A wall base is not required in the hangar bay.

3-5.1.3 Ceilings.

Paint all structural steel, deck and other non prefinished items.

3-5.2 O1 Level (Shops and Maintenance Administration).

This section identifies requirements for materials and finishes associated with the O1 level functions.

3-5.2.1 General.

Partitions on the O1 level shall be painted concrete masonry with exceptions as noted below. Partitions shall extend to the floor or roof construction above unless allowed in the following sections.

3-5.2.2 Shops and Storage Rooms.

Walls shall be painted concrete masonry units or concrete around shop spaces. For shops in “Universal Shop Layouts”, partitions separating shops may be impact resistant gypsum wall board on metal studs. The type of gypsum board shall be composed of gypsum panels with a backing of “Lexan” or composed of an integrated fiber mesh. Consult the following UFGS sections for specific requirements: 09 22 00 *Supports for Plaster and Gypsum Board*, 09 22 36 *Lath*, 09 23 00 *Gypsum Plastering* and 09 23 82 *Fireproof Gypsum Plastering*. Use of this type of partition shall be determined prior to the issuance of the RFP and shall not be an option of the design builder. Masonry or Concrete walls may be required around the perimeter of the shop space. For shops without ceilings, partitions shall extend to floor construction above.

Floor finish shall be an epoxy floor coating compliant with MPI 212 or sealed concrete.

Generally, shops shall not have suspended ceilings. All exposed piping, structure, deck, ductwork, etc shall be painted.

3-5.2.3 Administration Areas.

Partitions separating administrative spaces may be gypsum board construction. Partitions may extend to above the ceiling for similar office types and spaces where noise between offices is not an acoustical issue. Rooms with Siprnet are required to have full height partitions. Paint all unfinished materials.

Floor finishes shall be durable and cleanable. The minimum requirement is resilient tile. Do not provide carpet for administrative spaces on the O1 level.

Provide suspended acoustical ceilings in all administrative spaces.

3-5.2.4 Toilet and Locker Rooms.

Provide CMU partitions around toilet and locker rooms. Partitions around perimeter of space shall extend to floor or roof construction above. Provide ceramic tile wainscot and ceramic base. Provide ceramic tile wall finishes to the ceiling on all walls in showers. Floor finishes shall be ceramic tile.

Ceilings in toilets and locker rooms shall be suspended acoustical ceilings with a water resistant membrane. Ceilings in showers shall be water resistant gypsum board. Do not use plaster.

3-5.2.5 Corridors and Stairs.

Partitions in corridors and stairs shall be painted masonry or painted gypsum board. Gypsum board shall be impact resistant type to 8 feet (2.44 meters) above the floor or stair level. Corridor partitions and rooms without ceilings shall extend to the deck above. Floor finishes for these spaces shall be as determined by the designer but minimum finish shall be a resilient flooring system.

Corridors shall have a suspended acoustical ceiling, typical.

3-5.2.6 Support Spaces.

Partitions in corridors, around mechanical, electrical, and similar type spaces shall be painted masonry. Corridor partitions and rooms without ceilings shall extend to the deck above.

All exposed piping, structure, deck, ductwork, etc shall be painted.

3-5.3 O2 (Squadron Administration and Operations).

This section identifies requirements for materials and finishes associated with the O2 level functions. In General, these spaces and areas are commercial office type construction and finishes shall reflect that type of environment.

3-5.3.1 Administration and Office Spaces.

Wall between O2 level and hangar bay shall be concrete masonry construction. Other partitions shall be gypsum board on metal studs. Partitions shall extend to the roof construction above for the following areas:

- Commanding Officers Office
- Executive Officers Office
- Conference or Briefing Rooms
- Classrooms or Training Rooms
- Rooms or offices with Siprnet Drops
- Corridors
- Perimeter of Toilet and locker room areas

- Offices where privacy issues are of significant concern.

See the section on Acoustics for additional requirements.

Specific requirements for Secure Briefing Rooms, Siprnet Head-in, SCIF spaces have specific construction requirements. Verify all requirements for these spaces prior to issuing and RFP.

Floor finishes shall be standard type finishes expected based on the expected usage of the spaces. Provide a wall base in all spaces.

Provide suspended acoustical ceilings in all administrative spaces.

3-5.3.2 Toilet and Locker Rooms.

Provide gypsum board partitions around toilet and locker rooms. Partitions around perimeter of space shall extend to floor or roof construction above. Provide ceramic tile wainscot and ceramic base. Provide ceramic tile wall finishes to the ceiling on all walls in showers. Shower stalls or similar “wet” spaces shall have cementitious backer board behind the ceramic tile finish.
Floor finishes shall be ceramic tile.

Ceilings in toilets and locker rooms shall be suspended acoustical ceilings with a water resistant membrane. Ceilings in showers shall be water resistant gypsum board. Do not use plaster.

3-5.4 Miscellaneous Requirements.

Provide a wall base on all walls with an applied floor finish.

Doors shall be metal with metal frames. Doors on the O2 level may be solid core wood. Doors and hardware are addressed in a separate section.

3-5.4.1 Doors.

Interior doors with closers shall be Level 4, physical performance Level A doors complying with SDA 250.8. Frames shall match door performance level. Interior door frames for level 4 doors shall be welded type.

Other O1 level doors shall be Level 3 minimum.

O2 level doors shall be Level 2 minimum.

3-5.4.2 Hardware.

Provide Grade 1 hardware typical. Locksets shall be mortise type, Series 1000 as defined by ANSI 156.13. Locksets for administrative spaces may be Series 4000 as

defined by ANSI 156.2. Hinges for doors with closers shall be full mortise continuous aluminum hinges. Closers shall be the best and highest grade available from each manufacturer.

Panic devices are required on rooms containing explosives (paraloft, flight gear, Ordnance).

3-5.4.3 Lockers.

Provide personnel lockers in dedicated locker rooms. The number of personnel lockers shall be identified in the RFP. Lockers are provided for personnel to keep personal items or clothing during their work shift. Provide lockers with solid sides and louvered doors.

On the O1 level, lockers shall be 9” x 18” x 36” (229mm x 457mm x 914mm) high and shall be double tier type.

On the O2 level, lockers shall be 9” x 21” x 72” (229mm x 533mm x 1829mm) high and shall be single tier type.

Provide flight gear lockers as required by number of flight crew. Lockers shall be sized to accommodate a personnel flight gear. Flight gear may vary with type of aircraft. Flight gear lockers must be constructed of wire mesh or other open material to allow for ventilation. RFP preparer shall establish locker sizes prior to issuance of RFP.

All lockers shall be metal and shall have capability to receive padlocks.

3-5.4.4 Elevators and Lifts.

Elevators are not required but may be needed if required for ADA/UFAS compliance or the activity specifically requests an elevator. Generally, Navy hangars provide an access point located on the wall separating the hangar bay from the O2 level for moving in and out of the hangar.

See the section on Accessibility for further clarification.

Size elevator based on activity requirements. For Design Build Projects, elevator(s) will be sized by the preparer of the RFP.

3-5.4.5 Casework.

Counters, casework, and cabinets shall be of high-quality and durable construction.

3-6 ACOUSTICS.

Design the facility to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate. Provide acoustical design to prevent sound from noisy spaces such as corridors, toilets, elevator machine rooms, and mechanical rooms from having negative impact on the adjacent spaces.

At a minimum, provide the required sound transmission coefficient (STC) ratings identified in Chapter 4, Functional Data Sheets, for individual spaces. Use the "Suggested Design Values" STC ratings in UFC 3-450-01, *Noise and Vibration Control,* as the basis for the sound design of partition, door and window assemblies for the facility. Utilize gypsum board wall "Improvements" to increase the STC of gypsum board "Stud Type" partitions to achieve the project sound requirements. Unless noted otherwise extend partitions and seal to the structure above around rooms that have a noise source such as but not limited to corridors, toilets, elevator machine rooms, gymnasiums, classrooms, training rooms, maintenance rooms, activity rooms, and mechanical rooms. Unless indicated in Chapter 4, STC ratings do not need to be field verified.

Do not provide any special acoustical conditions in the project unless specifically recommended by an acoustical study.

3-7 CONVEYING SYSTEMS.

3-7.1 Overhead Bridge Cranes.

Provide 5 ton (4.5 metric ton) overhead bridge cranes in Type I hangars and 7 ton (6.5 metric ton) bridge cranes in Type II hangars. Cranes are not permitted in Type III hangars. All cranes shall be Duty Service Class C. All bridge cranes shall be supported from patented track systems designed by the crane manufacturer.

All overhead bridge cranes shall be under running, double girder electric cranes.

Provide all cranes in accordance with UFC 3-320-07N, *Weight Handling Equipment*, and the American National Standards Institute ANSI MH27.1, *Specifications for Underhung Cranes and Monorail Systems*, and relevant portions of the Crane Manufacturing Association of America CMAA 70, *Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes,* and the Crane Manufacturing Association of America CMAA 74, *Specification for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist*.

3-7.1.1 Hook Height.

The minimum hook clearance height, (measured from the finished floor elevation to the bottom of the hook at full elevation) shall be as tabulated in Appendix E.

3-7.1.2 Hook Coverage.

The bridge crane shall provide loaded hook coverage to within 12 feet (3.66 m) of the inside face of all walls and to within 15 feet (4.57 m) of the inside face of the hangar doors except for Type II hangars. See diagrams in Appendix F for Type II crane requirements. Where multiple cranes are provided, fully loaded hooks shall be capable of locating within 15 feet (4.57 m) of each other.

3-7.1.3 Travel Speeds.

Overhead bridge cranes shall have electric motorized bridge, trolley and hoist. One crane shall be used per hangar module, with the bridge designed to travel the full width of the module. Trolley and bridge shall be capable of operating at a slow speed of 15 to 20 ft/min (0.07 to 0.1 m/s) for positioning loads and at a high speed for moving loads of 60 ft/min (0.3 m/s); the hoist shall be capable of operating at a slow speed of 3 to 4 ft/min (0.01 to 0.02 m/s) and at a high speed of 12 ft/min (0.06 m/s). Refer to UFGS 41 22 13.13 *Bridge Cranes .*

3-7.1.4 Motor and Controls.

Bridge, trolley and hoist controls shall provide for two-speed reversing of a two-speed, squirrel-cage motor. The controls shall be equipped with reduced voltage starting for the motors. Controls shall be operable from the floor.

Provide service catwalks or platforms to maintain overhead bridge cranes. Ensure all safety requirements are met; see UFGS 01 35 26, *Governmental Safety Requirements*. The access shall be from inside the hangar.

3-7.2 Personal Fall Arrest Systems.

All personal fall arrest systems shall have their supports to the main frame designed with a 1.5 factor of safety on any design loads. This factor is in addition to any factor required by the design methodology. The design loads of personal fall arrest systems shall be neglected in load combinations in which the forces contribute to the stability of other structural elements. The personal fall arrest system hardware shall be treated as live loads in the load combinations defined in chapter 16 of IBC, except for patented tracks, tracks, supports, sway braces and similar elements which are immobile and may be considered dead loads.

3-8 PLUMBING.

3-8.1 General.

Provide plumbing in accordance with UFC 3-420-01, *Plumbing Systems* and the International Plumbing Code.

3-8.1.1 Provide trench drains with sufficient laterals for aeration and easy cleanout of oil or other residue. Provide an oil/water separator. Storm drains shall be located a minimum of 12 in. (305 mm) from the hangar door rails.

3-8.1.2 Provide emergency shower/eyewash fixtures and floor drains.

3-8.1.3 Since hazardous materials are used in the aircraft maintenance process, provide floor drains in the OH space and shop spaces tied to either the station industrial sewer or to a collection system that will capture and hold these materials for proper disposal. The design must comply with all applicable environmental codes.

3-8.2 Compressed Air.

Provide compressed air for all O1 level shop spaces and for hangar (OH) space in accordance with UFC 4-121-10N, *Design: Aircraft Fixed Point Utility Systems* for hangar service points.

3-9 HVAC.

3-9.1 General.

Provide HVAC in accordance with Unified Facilities Criteria and the International Mechanical Code.

3-9.2 Heating.

Provide heating in accordance with UFC 3-410-02N, *Heating, Ventilating, Air Conditioning and Dehumidifying Systems* and as follows:

3-9.2.1 Infiltration Rate.

Design for an infiltration rate of two air changes per hour in the OH area. This rate is dependent upon the installation of nylon brush insulation seals on the hangar sliding doors.

3-9.2.2 Overhead Radiant Heat Systems.

When using overhead radiant heat systems, natural gas-fired tube heaters must be provided for the aircraft servicing area. Tube type heaters that shield the heating element or flame from the atmosphere are required to prevent activation of optical flame detectors and accidental release of the fire suppression system.

3-9.2.3 Under Floor Heating System.

Investigate the use of an under floor heating system for the OH area when outside design temperature is below -10°F (–23°C).

3-9.2.4 Cold Jet Destratifiers.

Consider the installation of Naval Facilities Engineering Service Center (NFESC) cold jet destratifiers based on an economic analysis.

3-9.2.5 Space Thermometer.

A switch activated by opening the hangar doors should override the space thermostat to stop the heating equipment in the OH area. Provide a minimum temperature thermostat field set at 34°F (1°C) to override the heating deactivation switch during door-open periods of subfreezing ambient temperatures. After the doors are closed, the room thermostat should assume control. Heating system recovery time should be 60 minutes after the doors are closed.

3-9.2.6 Snow-Melting System.

A snow-melting system at the hangar door tracks, when rolling hangar doors are used, must be installed when outside design temperature is +25°F (-4°C) or lower and historical snow accumulation data supports the requirement.

3-9.2.7 Automatic Thermostatic Control.

The automatic thermostatic control must meet the requirements of UFC 3-410-02N, *Heating, Ventilating, Air Conditioning and Dehumidifying Systems.*

3-9.2.8 Heating Zones.

Each module in the OH area must be a separate heating zone.

3-9.3 Ventilation.

Provide ventilation in accordance with UFC 3-410-02N, *Heating, Ventilating, Air Conditioning and Dehumidifying Systems, and* UFC 3-410-04N, *Industrial Ventilation* and as follows:

3-9.3.1 Toxic Fumes.

Toxic fumes and combustible vapor that generate in work areas must be exhausted directly to the outside. The Airframes, Corrosion Control and Electric Shops are likely producers of toxic fumes. These shops must always be provided with exhaust ventilation to the outside.

3-9.3.2 Fuel.

If fuel systems maintenance is performed in the OH spaces, provide a system for purging the fuel line and the tanks. Also provide a fuel low level vapor exhaust system and a fuel cell vapor exhaust system.

3-9.4 Air Conditioning.

Air conditioning is not required in the general OH space.

3-9.5 Mechanical Equipment Requirements.

3-9.5.1 Corrosion Protection.

Provide special finish coatings on the interior and the exterior surfaces of HVAC equipment exposed to the weather, including all coil surfaces and interior equipment surfaces belonging to the first HVAC equipment (excluding louvers) in the supply ductwork system that is subjected to outside supply air. The coating must not act as an insulating barrier to the HVAC heat exchange capability.

3-9.6 Force Protection.

Building systems shall meet the requirements of UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

3-9.7 Noise and Vibration Control.

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01, *Noise and Vibration Control.*

3-10 FIRE PROTECTION.

3-10.1 General.

3-10.1.1 NFPA 409.

The requirements of NFPA 409 shall apply in their entirety to all hangars, except as modified by this UFC.

3-10.1.2 Hangar Classifications.

All hangars shall be classified as Group I hangars for the purpose of determining the requirements from NFPA 409.

3-10.1.3 Construction Requirements.

The type of construction, clear space distance requirements around hangars, floors, doors, and other features shall comply with the requirements of Group I hangars in NFPA 409.

3-10.1.4 Internal Separations.

NFPA 409 requirements for Internal Separations are replaced by the following.

3-10.1.4.1 Internal fire barriers separating other hangar bay, office and shop areas from the hangar bay shall be minimum one hour fire resistance rated. Openings shall be protected by listed assemblies with a minimum fire resistance rating of 45-minutes.

3-10.1.5 Column Protection.

Columns within the hangar bay shall be 1-hr fire resistance rated to a height of 20 ft (6.10 m) above the finished floor. Fire resistance may be accomplished with appropriately designed masonry walls or high density cementitious spray-applied fire proofing suitable for exterior exposure and heavy abuse, or a combination thereof.

3-10.1.6 Draft Curtains.

Draft curtains shall be provided. Draft curtain design, construction, and area shall be as specified in NFPA 409.

3-10.1.7 Hand Hose Systems.

Hand hose systems shall not be provided.

3-10.2 Water Supply.

3-10.2.1 Water Supply.

Provide a water supply that will support the combined demand of the aircraft storage and servicing area ceiling sprinkler system, low-level fire suppression system, and the outside hose stream allowance. The water supply shall be evaluated to determine if surge suppressors will be necessary to prevent damage from water hammer.

3-10.2.2 Backflow Preventer.

For connections between potable water systems and systems containing foam, provide a reduced-pressure backflow preventer.

3-10.2.3 Hydraulic Calculations.

Hydraulic calculations must include a minimum pressure drop across backflow preventers of 12 psi (83 kPa), or the listed pressure drop, whichever is greater, regardless of type or size.

Hydraulic calculations must include a minimum pressure drop across flow control valves of 20 psi (138 kPA), or the listed pressure drop, whichever is greater.

3-10.2.4 Piping Below Concrete Slabs.

Do not install any piping below, or embedded in a concrete slab. If piping must be located below the floor line, use concrete trenching with steel grating.

3-10.2.5 Riser Manifolds.

Where multiple risers are fed from a common manifold, locate AFFF system risers downstream of any wet-pipe sprinkler risers. Provide an isolation valve, check valve and strainer in the manifold piping ahead of the AFFF system risers.

3-10.2.6 Strainers for AFFF System.

Provide wye-type strainers with isolation valve to facilitate servicing. Strainer baskets shall be stainless steel with a mesh size no greater than $^{1}/_{16}$-in (1.59 mm).

3-10.3 Closed Head Water Sprinkler System for Aircraft Storage and Servicing Areas.

3-10.3.1 Hangar Bay Sprinkler System.

The hangar aircraft storage and servicing area shall be protected with a closed-head water only sprinkler system. The closed-head water only sprinkler system may be either wet pipe or preaction sprinkler system. The selection of wet pipe or preaction sprinkler system will depend on the climate conditions. Where provided, preaction sprinkler systems protecting hangar bays shall be “non-interlock type” as defined by NFPA 13.

3-10.3.2 Hydraulic Design Area.

Hydraulically design the system to provide 6.9 L/min/m² (0.17 gpm/ft²) over the hydraulically most demanding 697 m^2 (7,500 ft^2) of floor area as defined in NFPA 13. Do not increase design area when the ceiling slopes exceed 2 in 12.

3-10.3.3 Expansion Chamber.

Provide a listed expansion chamber of appropriate size and pre-charged air pressure to compensate for thermal expansion in the automatic wet pipe sprinkler system in aircraft storage and servicing areas.

3-10.4 Low-Level Low Expansion Foam Systems.

3-10.4.1 Low-Level AFFF Discharge Devices.

Provide a low-level AFFF system utilizing the Viking Grate Nozzle™, Models GN 200/360, 200/180, or 200/090.

3-10.4.1.1 Nozzle spacing within trenches must be no closer than 7.6m (25 ft) and not exceed 8.2m (27 ft).

3-10.4.1.2 Model GH 200/360 type nozzles must be located no closer than 7.6 m (25 ft) to interior walls. Utilize Model GN 200/180 or 200/90 type nozzles along hangar doors and sidewalls.

3-10.4.1.3 AFFF floor nozzles and supporting framework embedded in trench drain grating shall be designed for a 36,000 pound wheel load distributed over the area of the nozzle surface.

3-10.4.2 AFFF Delivery Time.

The time from actuation of an AFFF system to discharge of AFFF at the most remote nozzle must not exceed 30 seconds.

3-10.4.3 Water and Foam Flow Control Valves.

The use of flow control valves for the low-level AFFF system is required.

3-10.4.3.1 Valves shall be equipped with an automatic re-closing feature, speed control settings, and a pressure reducing trim component.

3-10.4.3.2 Valve trim settings must be such that low-level nozzle pressures are maintained between 275 kPa (40 psig) and 310 kPa (45 psig) for all nozzles.

3-10.4.4 AFFF Concentrate Proportioning Systems.

Foam proportioning shall be by a single foam inductor taking suction from a tank located beneath or adjacent to the inductor (per flow control valve or zone). Inductor shall, through a venturi, take concentrate and proportion such concentrate into the flow steam reliably at the designed system flow rate. Inductor shall be specifically tuned for the system flow rate, inlet pressure, back pressure, and concentrate lift height (at the near empty tank level). Inductor shall be fitted with a low loss bronze or brass check valve assembly by the manufacturer that is included in the device's hydraulic design. Product from a European Common Union country is acceptable for this product only.

Proportioning by other means (ILBP pumps or bladder tank) must receive approval by the NAVFAC Chief Fire Protection Engineer.

3-10.4.4.1 Systems must be design such that the inductor outlet pressure is between 55 and 58 percent of the inductor inlet pressure (while flowing).

3-10.4.4.2 Foam inductors shall be manufactured to provide a nominal 3.3 percent foam injection rate (percent concentration).

3-10.4.4.3 Shop drawings shall indicate the K-factor of each inductor in the project.

3-10.4.5 Installation.

Provide a minimum of 10 diameters of straight pipe on both sides of the inductor.

3-10.4.5.1 The flow control valve shall be located a minimum of 20 pipe diameters upstream of the inductor.

3-10.4.5.2 Locate the inductor in the horizontal position over the top of the concentrate tank to minimize concentrate pipe length. Where multiple inductors are supplied by a single tank, provide dedicated concentrate supply to each inductor.

3-10.4.5.3 Locate the inductor above the maximum fill level of the concentrate tank. The use of automatic control valves in the concentrate line is prohibited.

3-10.4.5.4 Provide a brass, bronze, or stainless steel full bore quarter turn ball valve in the concentrate line and surrogate test agent line. The valve provided in the concentrate line shall be provided with a manufacturer installed (integral) electric tamper switch.

3-10.4.5.5 The surrogate test connection shall be provided with tight sealing cap to close off this line at all times except when testing.

3-10.4.5.6 Provide valve gauge cocks three feet before and after the inductor to monitor pressures while setting up the system.

3-10.4.6 Fire Protection Equipment Rooms.

Foam concentrate tanks, pumping equipment and sprinkler control valves must be located rooms separated from the aircraft servicing and other areas by a minimum of 1-hour fire resistive construction Equipment rooms must be sized to provide access for inspection, maintenance, and repair of all equipment. Configure equipment to permit removal of tanks, valves, pumps, and motors without the removal of other components. Doors shall be sized to accommodate removal of equipment and foam tanks.

3-10.4.6.1 Fire Pump Rooms.

Fire pump rooms must be located on an exterior wall with doors providing direct access to the exterior of the structure.

3-10.4.6.2 AFFF System Foam Equipment Rooms.

Provide multiple foam equipment rooms as necessary to facilitate the hydraulic design of the foam proportioning equipment. Foam rooms shall share a common wall with the hangar bay and shall be located interior to the structure as necessary. Locate doors to provide direct access to the exterior of the structure or to the hangar bay.

3-10.4.7 AFFF Concentrate Supply.

3-10.4.7.1 Provide a supply of 3% AFFF concentrate meeting Military Specification MIL-F-24385F, *Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater*, to support a 10-mintue discharge at the design water flow rate based on the supply calculation method at a 3.9 percent induction rate to conservatively account for inductor performance variations.

3-10.4.7.2 Provide a horizontal, closed cell polyethylene storage tank listed by the manufacturer as being compatible with the provided concentrate. Tank shall have either a translucent shell or clear vertical window to indicate fill level with permanent capacity markings at least every 50 gallons. There shall be no taps in the bottom or sides of the tank. Inductor dip tube shall enter through the top of the tank. Provide a closeable fill opening and vent assembly.

3-10.4.8 Piping.

3-10.4.8.1 Foam Concentrate Piping.

The foam concentrate piping must use stainless steel pipe with rolled grooved fittings, welded joints and fittings, or flanged joints and fittings. Other materials may be considered subject to approval by the NAVFAC FPE.

3-10.4.8.2 Foam Solution Piping.

All pipe, fittings, fasteners, hangars, and stands downstream of the flow control valve shall be hot dip galvanized and a minimum schedule 40 wall thickness. Do not roll grove galvanized pipe. Any cut groves, threaded ends, and areas where the zinc coating has been damaged shall be cleaned of cutting oils and debris, dried, and painted with two full coats of a cold galvanizing primer containing a minimum of 95% zinc. Main drain from the flow control valve shall be piping into the retention trench. No piping shall be run atop the floor. Provide seismic bracing of all piping regardless of geographic location.

3-10.4.9 Reserve AFFF Concentrate Tank.

A second foam concentrate tank is not required.

3-10.4.10 Protection of Multiple Aircraft Hangar Facilities.

Independent concentrate storage and proportioning systems must be provided for each aircraft hangar facility.

3-10.4.11 Spill Containment.

The AFFF concentrate tank(s) shall be provided with spill containment i.e., provide berm to contain any spill or leak. Containment area shall be capable of containing 100 percent of the foam concentrate stored. Do not provide floor drains inside the berm area.

3-10.5 Fire Alarm Reporting System.

The Fire Alarm Control Panel (FACP) must transmit a separate and distinctive fire signal to the fire department upon activation of any portion of an AFFF system. Where the base reporting system consists of a telegraphic loop, provide a separate masterbox for AFFF system activation.

3-10.6 Building Fire Alarm Systems.

3-10.6.1 Provide a single Fire Alarm Control Panel (FACP) for all detection and alarm functions in the facility that are not required as part of the fire suppression systems release.

3-10.6.2 The FACP shall monitor fire suppression releasing panel(s) for alarm, supervisory and trouble conditions.

3-10.6.3 Locate fire alarm system manual pull stations within the hangar bay in accordance with NFPA 101. Colored portions of the tamper covers for manual pull stations shall be red. Activation of these manual pull stations shall ***not*** activate the low level foam system.

3-10.6.4 The flow/pressure switch(s) for the overhead sprinkler systems in the aircraft storage and service area shall be part of the building fire alarm system. Activation of a sprinkler flow/pressure switch shall ***not*** cause the low-level fire suppression system to activate.

3-10.6.5 All fire alarm and fire suppression system supervisory devices shall be part of the building fire alarm system. (Valve tamper switches, high/low air pressure switches, fire and concentrate pump, etc., shall ***not*** be monitored by fire suppression releasing panels.

3-10.7 Control and Release of Fire Suppression Systems.

3-10.7.1 AFFF System Operation.

3-10.7.1.1 Manual Release Station Activation.

Activation of any manual AFFF release station shall activate the low-level AFFF fire suppression system, preaction sprinkler system if provided, and the building fire alarm system. A separate and distinctive fire signal shall be transmitted to the fire department indicating the AFFF system has been activated.

3-10.7.1.2 Optical Flame Detection Operation.

(a) First Detector - Alarm. Upon activation of any one flame detector, the releasing panel shall send a signal to the FACP. The building FACP in turn shall sound a general building alarm, and transmit a building fire alarm signal over the base wide fire reporting system.

(b) Second Detector - Activation. Upon activation of a second flame detector the releasing panel shall activate the low-level AFFF fire suppression system and send a foam system activation signal to the building fire alarm panel. The FACP in turn will transmit the separate and distinctive fire signal to the fire department indicating the AFFF system has been activated.

3-10.7.1.3 Low-level AFFF Abort Station Operation.

(a) Operation. Once depressed, and so long as the button is held down, the abort station will prevent/stop discharge from the low-level AFFF system regardless of whether or not the AFFF system was activated automatically or manually and whether or not the activation occurs prior to or after the abort station is pressed and held.

(b) Automatic Reset. Unless the releasing FACP has been reset and all activation alarms (manual and automatic) have been cleared; when the push button is released, the abort station shall instantaneously restore system operation and AFFF discharge.

3-10.7.2 Releasing Control Panels.

3-10.7.2.1 Provide a separate fire alarm control panel, independent of the building fire alarm system panel, for fire suppression systems requiring control and release.

3-10.7.2.2 A common releasing panel may control multiple systems or agents.

3-10.7.2.3 Electronic solenoids used for release of the suppression system must be indicated in the FM Approved Guide, under “Automatic Water Control Valves” as compatible with solenoids operating the control valve.

3-10.7.2.4 A switch must be provided within the lockable control panel to disable the releasing functions of the panel while leaving all detection and other functions of the panel operational. Separate switches shall be provided for disabling the AFFF and preaction systems when these systems utilize a common panel. Activation of this switch must transmit a non-latching supervisory alarm signal to the building fire alarm control panel.

3-10.7.2.5 The foam system manual releasing stations, abort stations, and triple IR detectors, and all associated wiring shall be connected to and supervised by the releasing FACP.

3-10.7.3 Low-Level Manual Release Stations.

3-10.7.3.1 Type.

Manual release stations must be the locking type that, when activated, require a key to be reset.

3-10.7.3.2 Color and Marking.

Manual release stations must be yellow, distinctively different from the manual fire alarm stations, and must have distinctive signage at each device. Colored portions of the tamper covers specified in Section 3-10.8 must be yellow and any lettering on the cover must be “FOAM”; the words “fire” or “alarm” must not appear on the cover.

3-10.7.4 Low-Level Abort Stations.

3-10.7.4.1 Type.

Provide abort stations of the "dead-man" type. The abort stations must be used in conjunction with valves and equipment that will prohibit or stop the discharge of foam or water from the low-level foam suppression system.

3-10.7.4.2 Color and Marking.

Abort stations shall be blue in color and the face of the station shall include the word “STOP”. The mushroom type push button shall be red and include the word “PUSH”. The words “fire” or “alarm” shall not appear on AFFF system abort stations. The stations must have distinctive signage at each device. Colored portions of tamper covers specified in Section 3-10.8 must be blue and any lettering on the cover must be “FOAM”; the words “fire” or “alarm” must not appear on the cover.

3-10.7.5 Location of Low-Level Manual Release and Abort Stations.

3-10.7.5.1 Location within Hangar Bay. Manual AFFF release and abort stations shall be installed within the hangar bay so they are unobstructed, readily accessible, and located in the natural exit access path near each required exit from the area.

3-10.7.5.2 The distance between station locations shall not exceed 200 linear feet (61 meters).

3-10.7.5.3 AFFF system abort stations shall be provided at each AFFF manual release station.

3-10.7.5.4 Manual AFFF release (and abort) stations are not required outside the hangar bay.

3-10.7.5.5 Separation.

Maintain a minimum separation distance of 5 ft (1.5 m) between building fire alarm system manual pull stations and the low-level system manual releasing and abort stations.

3-10.7.6 Signage for Low-Level Manual Release and Abort Stations.

3-10.7.6.1 Single Sign Mounting Option.

Permanently mount both the manual activation station and the abort station onto a single 24 inch (610 mm) high by 18 inch (457 mm) wide metal sign with a yellow or lime-yellow background. The upper half of the sign shall have the words “FOAM SYSTEM” in red block lettering not less than 3 inches (76 millimeters) high. The words “fire” or “alarm” shall not appear on this sign. The activation and abort stations, along with their tamper covers, shall be located on the lower half of the sign as indicated. Above the activation station the word “START” shall be stenciled in 1inch (25.4 mm) green block lettering. Above the abort station the word “STOP” shall be stenciled in 1 inch (25.4 mm) red lettering.

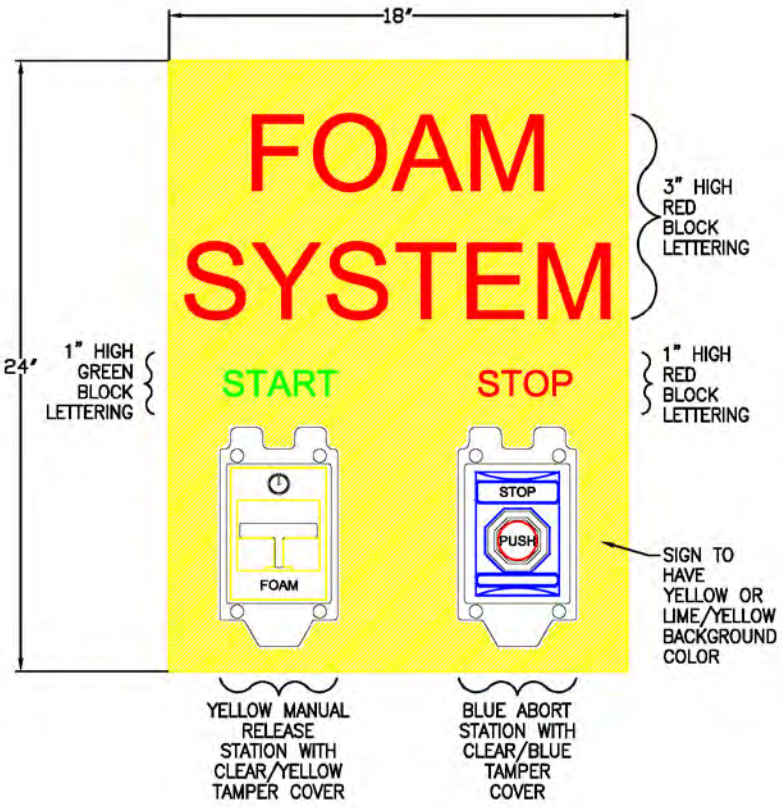


Figure 3-10.7.6(a): Single Sign Option

3-10.7.6.2 Two Sign Mounting Option.

Provide two separate but adjacent 24 inch (610 mm) high by 18 inch (457 mm) wide metal signs. There shall be no more than 12 inches of separation between the two signs. The words “fire” or “alarm” shall not appear on these signs. The sign for the manual AFFF release station shall have a yellow or lime-yellow background with “START FOAM SYSTEM” in red lettering not less than 3 inches (76 millimeters) high. The release stations with tamper covers shall be located on the lower center portion of the sign. The word “START” shall be written in minimum 1 inch (25.4 mm) high green lettering placed directly above the activation station. The sign for the AFFF system abort station shall have a white background with a minimum ½ inch wide blue boarder with “ABORT FOAM SYSTEM” in blue lettering not less than 3 inches (76 millimeters) high. The abort station with tamper cover shall be located on the lower center portion of the sign and be protected with a clear plastic tamper cover. The word “STOP” shall be written in minimum 1 inch (25.4 mm) high red lettering placed directly above the activation station.

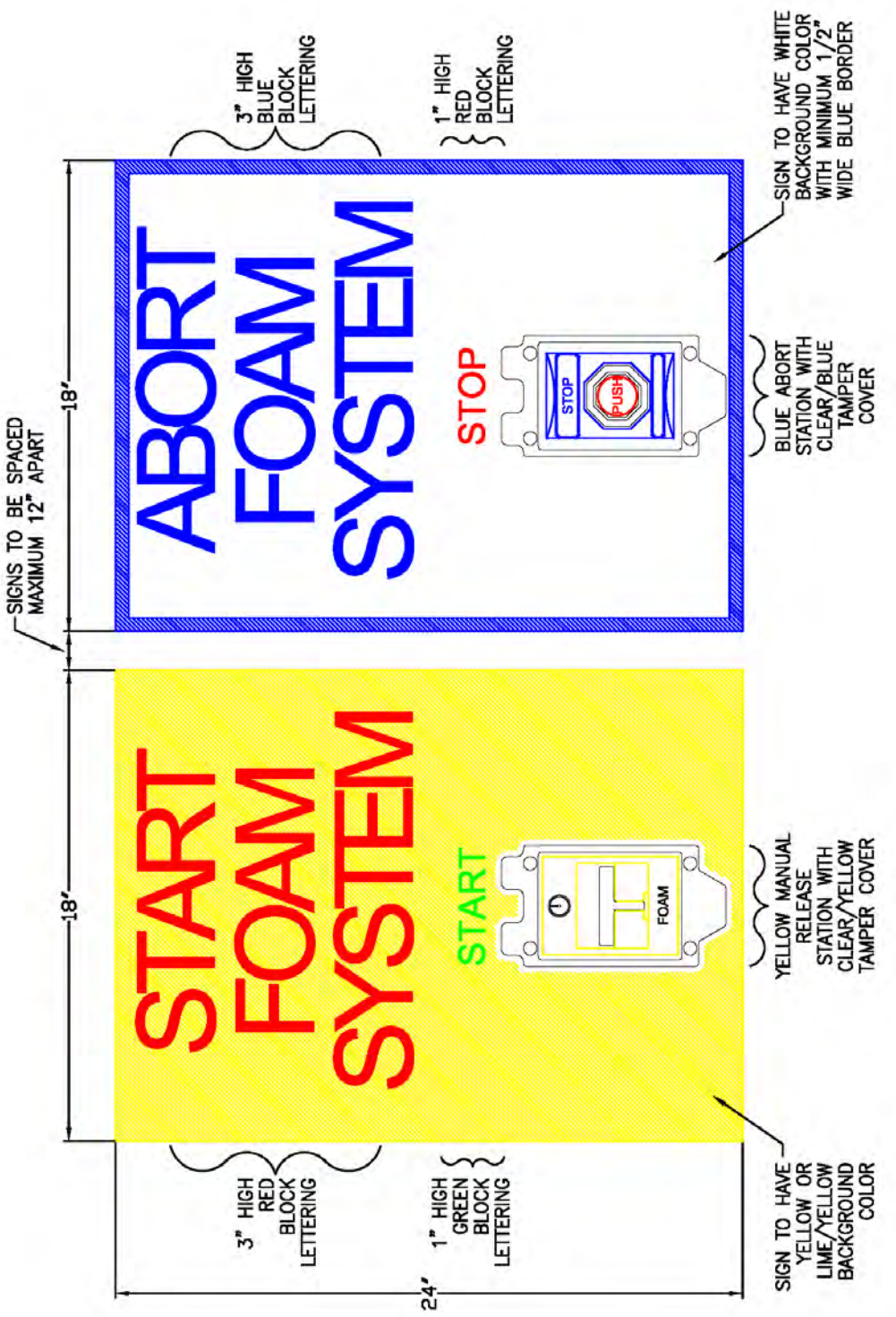


Figure 3-10.7.6(b) Two Sign Option

3-10.7.7 Optical Flame Detection System.

3-10.7.7.1 Detector Type.

Provide optical flame detection utilizing triple infrared (IR) flame detectors that are manufactured by Det-Tronics (X3301 Multispectrum IR Flame Detector). The detectors must be immune to radar and radio frequency emissions.

3-10.7.7.2 Mounting.

Detectors must be mounted in accordance with their listing approximately 8 ft (2.4 m) above the finished floor of the hangar. The specifics for each design must take into account facility construction, type of aircraft, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area, and all other relevant factors.

3-10.7.7.3 Flexible Conduit.

The optical flame detectors shall be installed with 5 ft (1.5 m) of flexible conduit to allow for any minor adjustments during testing or changes in mission of the hangar.

3-10.7.7.4 Coverage Areas.

Provide a sufficient number of detectors such that a fire at any position will be within the range and cone-of-vision of at least three detectors.

3-10.7.7.5 Shielding.

Provide shielding for the detectors from radio frequency interference.

3-10.7.8 Thermal Detectors for Preaction Systems.

3-10.7.8.1 Detection System.

Automatic thermal fire detection systems must be provided to activate any pre-action sprinkler systems. The detectors must be located at the underside of the roof or suspended ceiling (if provided) of the aircraft servicing area.

3-10.7.8.2 Detector Type.

The system must consist of rate-compensated heat detectors having a temperature rating between 160°F (71 °C) and 170°F (76 °C).

3-10.7.8.3 Coverage Area.

The spacing between detectors must not exceed 40 feet (12.2 m) regardless of ceiling height, but shall not exceed their list spacing (for 10 foot (3.1 m) ceiling) without consideration for reduction in spacing. The area covered by the fire detection system must correspond with the affiliated roof-level sprinkler system bound by draft curtains. The activation of any heat detection device in the sprinkler zone will activate the appropriate pre-action valve for the floor area covered by the detection system.

3-10.8 Protection of Fire Alarm Panels and Equipment.

3-10.8.1 Panel Location.

Locate the Fire Alarm Control Panel (FACP), supplemental control panels, and releasing control panels in a year-round conditioned space within the building that complies with the manufacturer's requirements.

3-10.8.2 Panel Protection.

Provide panel in the manufacturer's NEMA 4 enclosure for panels subject to water spray/runoff under normal operating conditions and/or located in damp/dirty locations or, relocate to a suitable dry location at the direction of the Contracting Officer. Conduit must not enter the top of a control panel cabinet for enclosures requiring a NEMA 4 designation.

3-10.8.3 Surge Suppression.

Transient Voltage Surge Suppression (TVSS) must be provided in accordance with UFC 3-580-01, *Telecommunications Building Cabling Systems Planning and Design*, and UFC 3-500-10, *Design: Electrical Engineering*.

3-10.8.4 Manual Activation and Abort Stations.

Manual stations located in the aircraft servicing area used for activation of the building general fire alarm system or control (activation or abort) of the AFFF fire suppression system must be protected from accidental activation caused by mechanical damage or water infiltration. The stations must be housed within a weatherproof, clear plastic tamper cover that must be lifted prior to actuating the station. Colored portions of the tamper covers shall be as specified in Section 3-10.7. Provide watertight connections with conduit runs entering the station backbox from the bottom.

3-10.9 Required Features for System Testing.

3-10.9.1 Trench Piping.

The piping in the trench shall have end caps that are tapped with a valve to allow for attaching a pressure gage for testing purposes, and draining the piping after the system has been activated.

3-10.9.2 System Testing.

For testing purposes, the foam system shall be equipped with fittings to accommodate an auxiliary tank of alternate test liquid to determine foam solution flow and foam solution concentration.

3-10.10 AFFF Containment Systems.

A system to contain discharge from an inadvertent activation of the AFFF system must be provided. The capacity of the AFFF containment system must accommodate a minimum 10 minute discharge of the low-level AFFF system. Refer to Section 3-16, Civil, for AFFF Containment System requirements.

3-11 ELECTRICAL.

Provide site electrical utilities, interior distribution systems, and communications and security according to UFC 3-500-10, Electrical Engineering, and the latest installation design requirements.

- Site Electrical Utilities includes equipment, overhead power distribution, underground electrical systems, grounding, metering, and exterior site lighting.

- Interior distribution systems includes service entrance and distribution equipment, TVSS, wiring devices, raceways, conductors, interior lighting systems, lightning protection systems, and hazardous locations.

- Communications and security includes telecommunications systems and electronic security systems.

In addition to the criteria identified above, comply with the following hangar specific design requirements.

3-11.1 Power.

Provide separate dedicated panel boards to serve each separate user area. (All of the space identified to be associated with a particular squadron shall be considered a separate user area.)

3-11.1.1 O1/O2 Level Spaces.

Serve shop spaces by distinct panels dedicated to shop and equipment loads only. Do not supply office spaces from shop circuits or panels. Except as specifically noted otherwise, feed loads located in the O1 space from panel boards located in the O1 space; feed loads located in the O2 space from panel boards located in the O2 space.

3-11.1.2 Hangar (OH) Space.

Except as specifically noted otherwise supply loads in the OH space from panelboards located in the OH space. Additionally, meet the criteria set forth below:

3-11.1.2.1 Electrical Equipment.

Electrical equipment mounted in the OH space at an elevation lower than 5' below the ceiling/roof support structure must be provided in a NEMA Type 4 (minimum rating) enclosure in order to prevent equipment damage in the event of testing or accidental discharge of the fire suppression system, or in the event of aircraft wash-downs.

3-11.1.2.2 Power Service Points.

UFC 4-121-10N, *Design: Aircraft Fixed Point Utility Systems,* identifies the various types, the capacity, and the location and installation requirements of electrical power to be provided at the power service points. Aircraft power service points should be positioned as required to provide adequate connections to aircraft to be maintained in the hangar. Recent developments in aircraft power requirements are leading to providing individual power units for each aircraft power connection. Coordinate all requirements with using activity and aircraft manufacturer and dedicate adequate wall space for all equipment. The power service points will provide:

- Three phase, 115/200V, 4-wire, 400 Hz, (kVA ratings as required by aircraft type). Refer to UFC 3-555-01N, *400-Hertz Medium-Voltage Conversion/Distribution and Low-Voltage Utilization Systems,* for 400 Hz power requirements and to criteria for OH space power and grounding requirements for aircraft maintenance. Spiral wrapped, six around one, flexible cables, designed specifically for 400-hertz systems should be used. The cable shall consist of six power conductors, two per phase, helically laid around one central neutral conductor. The conductors size based on the KVA rating of the aircraft type. The cable shall also contain a minimum of six control conductors, minimum size # 18 AWG.

- Three phase, 100 Amp, 480 V, 4-wire, 60 Hz, with (Class L) receptacles for ground support equipment (GSE.). This receptacle, referenced in UFC 3-555-01N, is built by very few manufacturers and must be identified by part number. Coordinate required outlet requirements with the using activity.

- Single phase, 120 V, 60 Hz, ground fault interrupt duplex utility outlets.

- 28 V direct current (kVA ratings as required by aircraft type) Coordinate with the activity.

- External aircraft power provided by the power service points must be

within the voltage and frequency tolerances specified for aircraft type. The flexible power cable to the aircraft must be adequately sized to meet the specified aircraft loading (amperage) requirements.

3.11.1.3 Emergency Power.

Coordinate and provide emergency power as dictated by the mission. At a minimum, hangar doors shall be operable in the event of utility power failure by means of a generator.

3-12 LIGHTING.

3-12.1 Interior Lighting.

3-12.1.1 Under Aircraft Lighting.

Provide connections for task lighting under shadow of aircraft.

3-12.1.2 Workstation Task Lighting.

Provide all individual workstations with task lighting to supplement the ambient light of the office space.

3-12.2 Exterior Lighting.

Orient exterior fixture to minimize glare on ramps and taxiways. Refer to UFC 3-260-01, *Airfield and Heliport Planning and Design*, for clearance requirements, obstruction lighting requirements, and airfield utility lighting information

3-13 GROUNDING.

3-13.1 Hangar (OH) Grounding.

Provide the maintenance hangar with a ground grid of No. 1/0 AWG (minimum) bare copper conductors arranged horizontally (east-west) and vertically (north-south), a maximum of 25 foot (7.6 m) apart encompassing the entire Hangar Bay (OH) space (spacing is adjustable to avoid floor trenches and concrete joints).

Each horizontal and vertical conductor shall be continuous along its entire length and each grid intersection shall be bonded using exothermic weld or hydraulic compression connection.

Provide flush-mounted, floor power ground receptacles mounted on a ¾-inch (19 mm) x 10’ (3.24 m) copper clad ground rod (also oriented in a grid encompassing the entire OH space and spaced a maximum of 25 foot (7.6 m) in each direction (horizontal and vertical) connected to the ground grid with a No. 1/0 AWG bare copper conductor. See Figure 3-1 for typical power grounding details.

Resistance to ground for power ground must not exceed 10 ohms maximum in accordance with MIL-HDBK-274 (AS), *Electrical Grounding for Aircraft Safety* and with NAVSEA OP5, *Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping*.

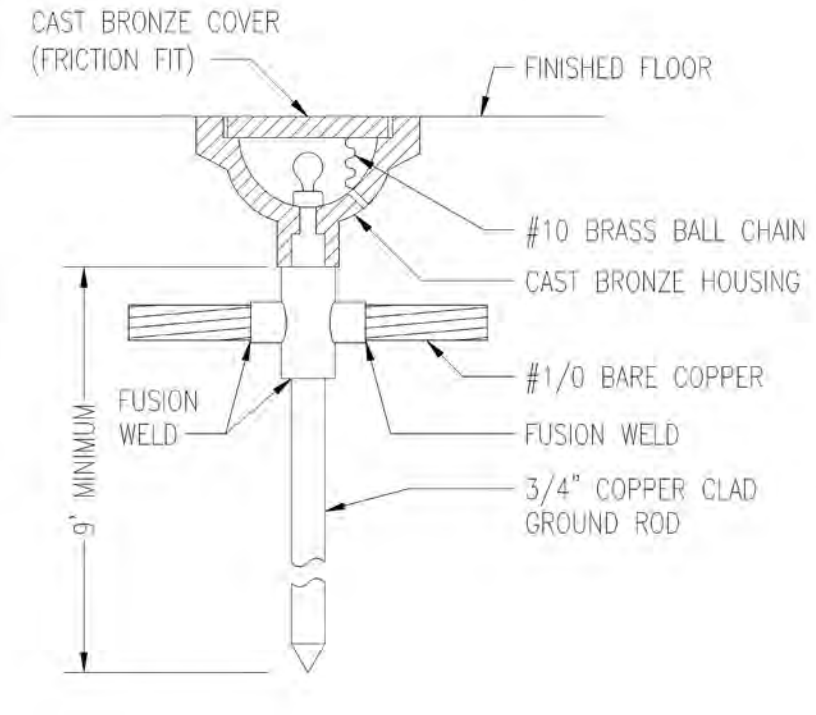


Figure 3-1 Power Grounding Details

3-13.2 Shops.

In electronic, aviation, seat and ordnance shops, as required by the user, provide 2” x ¼” thick x length as required bare copper grounding bus around the perimeter of the entire shop. The grounding bus shall be bonded to the grounding grid below the hangar space, and to the counterpoise surrounding the hangar.

3-14 LIGHTNING PROTECTION.

Provide in accordance with NFPA 780, UL 96A, and MIL-HDBK 1004/6 *Lightning Protection*.

3-15 ORGANIZATIONAL COMMUNICATIONS.

For Design Build projects, the RFP preparer shall investigate the needs and requirements of the squadron and include all necessary components into the communications systems.

3-15.1 3M Communications (Maintenance and Material Management).

Provide an independent, stand-alone, Type 1, Direct Connected Keyed, intercommunications system, for use by aircraft maintenance and material operations only. This system should provide two-way communications from line shacks to and between all rooms in the O1 level space except passages, locker and toilet rooms, and mechanical equipment rooms. Provide the necessary raceway in new building construction with provisions, when required, for interconnection with other buildings.

3-15.2 Intercommunication System.

Provide an inter-communications system, integral to the telephone system, to allow two-way communications between:

- Rooms in the O1 and O2 level space, except passages, locker and toilet rooms, and storage rooms;
- Department heads and the commanding officer and executive officers of the squadron;
- Officers' ready room and maintenance control;
- Administration office and maintenance administration.

3-15.3 Public Address System.

Provide a public address system, integral to the telephone system, to reach interior and exterior work areas. Provide a separate handset-type microphone in the hangar (OH) space that will broadcast only to the hangar (OH) spaces.

3-15.4 Telecommunications Service Requirements for Voice, Data and Video.

For telecommunication, refer to UFC 3-580-01, *Telecommunications Building Cabling Systems Planning and Design.* Requirements must also be in accordance with UFC 3-580-10, *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices*, when NMCI will be providing connectivity. Provide additional communications outlets as required by mission. Additional required communications systems may include:

- Base Radio System drops
- SCI Outlet
- JWIC Outlets
- STU Outlets
- Naval Aviation Logistics command Management Information System

(NALCOMIS)

- SIPRNET (Secure Internet Protocol Network)
- CATV SYSTEM, additional outlets may be required for training systems
- GPS systems in the (OH) space
- Closed-circuit television (CCTV) (security)

3-15.5 Electronic Security Systems.

Coordinate the requirements for the following optional systems with the requirements of the mission.

- Intrusion Detection System
- GPS Systems in the (OH) space
- Access Control

If the building has a SCIF (Sensitive Compartmentalized Information Facility) refer to Government publication DCID 6/9 for requirements including PDS (Protected Distribution System) regulations.

3-16 CIVIL.

3-16.1 Siting.

3-16.1.1 General.

When sitting the hangar, place emphasis on operation, function, energy efficiency and safety. Provide efficient access to the flight line. Other factors to consider include topography, vegetative cover, existing construction, weather elements, wind direction, soil conditions, flood hazards, natural and man-made obstructions, adjacent land use, availability of usable airspace, accessibility of utilities, taxiway and runway clearances and future expansion capability. Vehicular parking, pedestrian access and traffic flow must also be given careful consideration.

3-16.1.2 Anti-Terrorism/Force Protection.

Use standoff criteria in UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

3-16.1.3 Hangar Safety Clearance.

Orient hangar such that it is in compliance with all runway safety zones and imaginary surface criteria of UFC 2-000-05N, *Facility Planning Criteria for Navy/Marine Corps Shore Installations,* and UFC 3-260-01, *Airfield and Heliport Planning and Design*.

3-16.2 Restrictions.

Land use restrictions dealing with runway clearances, helipad planning, aircraft noise, and use of airspace are to be applied to the site location with MIL-HDBK-1190, *Facility Planning and Design Guide*.

3-16.2.1 Construction in Floodplains or on Wetlands.

The construction of facilities in floodplains and wetlands is not recommended but is permitted provided the provisions of MIL-HDBK-1190, *Facility Planning and Design Guide*; DOD Directive 4165.61, *Intergovernmental Coordination of DoD Federal Development Programs and Activities*; Executive Order 12372, *Intergovernmental Review of Federal Programs*; Executive Order 11988, *Floodplain Management*; Executive Order 11990, *Protection of Wetlands*; 43 FR 6030, *Floodplain Management Guidelines*; Title 44, CRF 59-79, *National Flood insurance Programs*; Executive Order 11514, *Protection and Enhancement of Environmental Quality*; Public Law 91-190, *National Environmental Policy Act of 1969*; and State Law are all met. Coordinate all similar requirements as directed by the authority having jurisdiction.

3-16.3 Accessibility for the Disabled.

All exterior routes to the facility must be accessible to the disabled in accordance with the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG). See Appendix B, Section 11 for additional discussion concerning accessibility requirements.

3-16.4 Soil and Groundwater Conditions.

Investigate soil and foundation conditions to assure suitability for economical excavation, site preparation, building foundations, utility lines, grading, and planting. Test the bearing capacity for the design of stable and economical facility foundations. Check groundwater elevations to assure economic methods of construction on subsurface foundations and utilities. Investigate the potential of contaminated soils and groundwater within the site to determine if remediation will be required.

3-16.5 Vehicular and Pedestrian Circulation.

3-16.5.1 Street System.

Coordinate design of the street system with the overall traffic circulation plans for the installation as well as the adjacent road system. Provide convenient and safe vehicular access and circulation for essential services, such as deliveries, trash and garbage

collection, fire protection, and maintenance and repair. Through traffic should be kept to a minimum. Design in accordance with applicable criteria set forth in UFC 4-010-01, *DoD Minimum Antiterrorism Standard for Buildings and* UFC 3-200-10N, *Civil Engineering*.

3-16.5.2 Sidewalks.

Design sidewalks to provide convenient and safe pedestrian access and necessary circulation. Base the width of walks on pedestrian traffic volume and accessible route criteria set forth in the current versions of the UFAS and the ADAAG.

3-16.6 Airfield Pavements.

3-16.6.1 Airfield Pavements.

Geometric design of airfield pavements shall be in accordance with UFC 3-260-01, *Airfield and Heliport Planning and Design* and P-80.3, *Facility Planning Factor Criteria for Navy and Marine Corps Installations, Appendix E, Airfield Safety Clearances*.

Design airfield pavement sections in accordance with UFC 3-260-02, *Pavement Design for Airfields*. Minimum thickness design of airfield pavement sections shall be in accordance with the latest version of *Pavement-Transportation Computer Assisted Structural Engineering (PCASE)* software.

All airfield pavement designs must be sealed by a registered professional engineer who is experienced in airfield pavement design, so that safe, high quality and geometrically correct airfield surfaces conforming to concurrent applicable airfield criteria are maintained.

Porous pavements are not allowed in airfield design. Airfield pavements include any pavements supporting vehicles trafficking the airfield pavement.

3-16.6.2 Airfield Pavement Markings.

Airfield pavement markings for Navy and Marine Corps facilities must conform to NAVAIR 51-50AAA-2, *General Requirements for Shorebased Airfield Marking and Lighting*. Assault Landing Zone markings and heliport markings shall conform to TM 5-923-4, *Marking of Army Airfield Heliport Facilities*.

3-16.7 Utilities.

Design utilities in accordance with UFC 3-200-10N, *Civil Engineering*.

3-16.7.1 Security.

The design, location, visibility and access to utility systems should be considered for protective construction measures to reduce vulnerability to action or sabotage.

3-16.7.2 Storm Drainage.

Design the storm drainage system, including gutters, drains, inlets and culverts, to carry the anticipated runoff for the appropriate level design storm event, including runoff from melting snow. Provide inlets where necessary to intercept surface flow.

3-16.7.3 Water Service.

Provide water service loop with proper valving to maximize reliability. Provide appropriate backflow prevention devices on water service and fire protection lines.

3-16.7.4 Sanitary Sewer.

Coordinate hangar elevations with the existing sanitary sewer elevation to avoid the need for ejection pumps where feasible. Capture oily wastewater contaminants from the hangar bay trench system with oil/water separators, or as directed by the department overseeing environmental policy for the installation.

3-16.7.5 AFFF Containment.

Runoff from the hangar bay (OH space) trenches during activation of the AFFF system shall be automatically routed to a containment system.

3-16.7.5.1 Environmental Regulations.

The local environmental regulations must be considered to determine the control measures for the discharge of the AFFF. Discharge overflow from the containment system to either the sanitary sewer system or the storm drain system as directed by the department overseeing environmental policy for the installation. The disposal of spent AFFF is dependent upon the water treatment facilities that would treat the effluent from the discharge site. Conditions for disposal will depend upon the capability and location of the facility that would treat the effluent from the discharge site. Verify AFFF containment discharge requirements with the appropriate NAVFAC environmental engineer.

3-16.7.5.2 Capacity.

The capacity of the AFFF containment system must accommodate a minimum 10 minute discharge of the low-level AFFF system. The containment system shall accommodate the entire 10 minute discharge volume; the trenches, piping to containment, etc, shall not be assumed to contain any of the required volume. No allowance is required for the water only sprinkler systems or hose streams.

3-16.7.5.3 AFFF Containment System Monitoring.

Provide AFFF containment system with remote capacity monitoring panel. Monitoring panel shall be provided with audible and visual (yellow strobe or beacon) alarms. Audible and visual alarm shall automatically actuate when capacity level exceeds 5%. Provide a silence switch for the audible alarm. Visual alarm shall remain illuminated, and shall automatically extinguish when level condition is returned to normal. Locate containment system monitoring panel in hangar space on exterior wall.

3-16.7.5.4 Diverter Valve Reset and Monitoring.

AFFF containment system diverter valves shall be automatically actuated with electronic (remote) manual reset capability and valve position monitoring. Locate reset/monitor panel in hangar space on exterior wall adjacent to AFFF Containment System Monitoring Panel. Panel shall include a "Valve Position Restore" button and a visual confirmation of valve position. Panel shall also be provided with a visual alarm (yellow strobe or beacon) which shall automatically illuminate when valve position is "off normal" and remain illuminated until valve is restored to full normal position.

CHAPTER 4: SPECIFIC DESIGN CRITERIA

This chapter identifies the specific design needs for each functional area as outlined in the space program.

The Space or Room Types Functional Data sheets are provided as a guide only as each squadron occupying a hangar has different requirements based on the size of the squadron, the type of aircraft; the type of hangar; the type of squadron (training, reserve, etc.) and various other issues. The data sheets can only serve as a guide to provide basic information to the designer, planner or RFP preparer to provide consistency in the design of common spaces. The items indicated for each space shall be the minimum requirements.

Support spaces such as mechanical, pump rooms, electrical rooms shall be provided as required and are not listed in the Functional Data Sheets. These spaces shall be as determined by the requirements of the project.

Variations

Type I - Hangar for Carrier Based Aircraft
Type II - Standard Hangar for US Marine Corps and non- carrier based US Navy aircraft
Type III – Land Based Patrol and Multi Mission Aircraft.

All spaces represented in the following charts may not be applicable to a particular hangar type. For example, Aviation Ordnance will not be provided in a hangar where the aircraft do not have weapons or ejection seats. The designer or the RFP preparer will coordinate all requirements with the squadron for each specific project.

US Marine Corps has different designations for similar activities. Coordinate USMC requirements with the squadron.

Space or Room Type		Lobby
Description / Usage		This space is located at the main personnel entrance to the hangar. The space may include the quarterdeck. Verify requirement for quarterdeck as not all squadrons have personnel available for manning.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted CMU with resilient base.
	Floors	Provide durable floor finish such as ceramic tile.
	Ceiling	Suspended Acoustical Ceiling with hold down clips if direct access to exterior
Built in Equipment or casework		Building Directory, counter for quarterdeck if required.
Furnishings		Furniture for quarterdeck personnel if required
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets for Quarterdeck
Lighting		Fluorescent
Communication		Telephone Outlet
Special Requirements		Some activities may require a control window with communication device to permit communication with a visitor. The quarterdeck may have visual control of the access to the flightline.
Acoustics		No special requirements

Space or Room Type		Maintenance Administration
Description / Usage		This space provides for administration of maintenance activities. This space is a general office area.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Carpet shall not be used.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Transaction Counter in Material Control Service
Furnishings		Desks and Chairs, bookcases, lateral files, copy machine, fax machine, shredder, printer
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation and Convenience Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		No Special Requirements

Space or Room Type		Quarterdeck
Description / Usage		This space is located at the main personnel entrance to the hangar. The space may be separate from the lobby or open to the lobby as determined. Generally, this space is occupied by one person.
Minimum Ceiling Height		8 ft (2.44 M)
Finishes	Walls	Painted CMU with resilient base.
	Floors	Resilient Tile and Base minimum
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Built in counter Marker Board
Furnishings		Chair for work counter.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience and Workstation Outlets
Lighting		Fluorescent
Communication		Workstation Outlet, CATV Outlet
Special Requirements		This space cannot be open to the exit. If it is part of the lobby, the adjacent stair must have a separate exit door and not provide exit access through the lobby. It is preferable for this space to have a view to the exterior to see anyone that approaches the entrance when the building is closed.
Acoustics		No special requirements

Space or Room Type		Maintenance Administration - Private Offices (if required)
Description / Usage		Provides for separate or combined office for the Maintenance Officer and the Assistant Maintenance Officer (AMO)
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Do not use carpet
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		
Furnishings		Desks and Chairs, bookcases, lateral files,
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation and Convenience Outlets
Lighting		Fluorescent
Communication		Secure (SIPRNet) Outlets (verify with squadron), CATV Outlet, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Verify requirement for Siprnet drops. Construct room(s) in accordance with Protected Distribution System (Requirements)
Acoustics		Partition and door construction shall have a minimum STC rating of 45

Space or Room Type		Material Control
Description / Usage		This space provides for maintenance record storage. This activity also provides for receipt and documentation of deliveries.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Transaction Counter in Material Control. Size to allow for 2 people at counter
Furnishings		Desks and Chairs, bookcases, lateral files, copy machine, fax machine, printer
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation and Convenience Outlets
Lighting		Fluorescent
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Activity may request that space is combined with Maintenance Control. Activity may request access to the exterior be provided to receive parts and components.
Acoustics		No special requirements

Space or Room Type		Maintenance Control Private office (if required)
Description / Usage		Provides private office for the Maintenance Control OIC.
Minimum Ceiling Height		8 ft (2.44 M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		
Furnishings		Desk and Chair, side chair, bookcases, file cabinet.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation and Convenience Outlets
Lighting		Fluorescent
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		Partition and door construction shall have a minimum STC rating of 45

Space or Room Type		Maintenance Control
Description / Usage		This space provides for administration of squadron maintenance. The space also provides flight crews to access the maintenance records and flight data. This space may also be used for briefing of maintenance personnel prior to beginning of work day.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum on office side; sealed concrete, epoxy coating on the customer side. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Service Counter to provide for maintenance personnel to receive daily assignments. The counter shall be a bi-level counter. Work Counter to provide a work space for review of records. Counter for flight crew to enter flight records. Record entry is by computer. Marker Board
Furnishings		Desks and Chairs, bookcases, lateral files, copy machine, fax machine, printer
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation and Convenience Outlets, Dedicated Equipment Outlets
Lighting		Fluorescent
Communication		Conduits to Roof Mounted Antenna Farm Platform, Base Radio Outlet, CATV Outlet, Workstation Outlets, Telephone Only Outlet
Intercommunications Systems		Master Control Station
Special Requirements		Activity may request that this space be combined with Material Control. Sometimes access to the exterior is provided if it is part of Material control. CCTV monitoring and PTZ control of hangar and apron cameras. This space may have direct visual access to the hangar bay. Windows shall be fixed with fire rated glass.
Acoustics		No special requirements

Space or Room Type		Shop – Power Plant
Description / Usage		Maintains Aircraft Engines
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) required. Exhaust directly outdoors.
Fire Protection		Required
Power		Dedicated Equipment Connections. Convenience Outlets, Workstation Outlets
Lighting		HID, Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door shall be provided in lieu of double doors opening onto the hangar bay. Door shall be at least 5 feet (1.52M0 wide and 6’-8” (2.03M0 high. If a 4’ (1.22M) wide opening is adequate, provide a single 4’ (1.22M) wide personnel door in lieu of double doors. Podium Junction Box (if combined with Conference Space)
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Tool Room
Description / Usage		Tool Storage and Issue
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Tool issue counter located within the tool room. Provide a service counter with overhead rolling service counter door if requested by the activity. Marker Boards Peg Board
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench Emergency eye and face wash
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Dedicated Equipment Connections, Workstation Outlets
Lighting		Fluorescent, HID
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door shall be at least 5 feet (1.52M0 wide and 6'-8" (2.03M0 high. If a 4' (1.22M) wide opening is adequate, provide a single 4' (1.22M) wide personnel door in lieu of double doors. Consider using modular rolling storage shelving units for large tool rooms.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Avionics
Description / Usage		Maintains Aircraft electrical systems. This shop also provides storage for specialized communication equipment and may require special secure storage areas. Consider providing a vault within the shop as opposed to making the entire shop a secure space.
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench Emergency Eyewash
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) required. Exhaust directly outdoors.
Fire Protection		Required
Power		Required
Grounding Systems		Shop Ground Bus
Electrical Special Systems and Devices		400 Hz Frequency Converter, 400 Hz Panelboard, Convenience Outlets, Dedicated Equipment Connections, 400 Hz Bench Connections, Test Bench Connections
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door shall be at least 5 feet (1.52M0 wide and 6'-8" (2.03M0 high. If a 4' (1.22M) wide opening is adequate, provide a single 4' (1.22M) wide personnel door in lieu of double doors. Sometimes this space may require a vault or secure file cabinets. Coordinate requirement with squadron.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Air Frames
Description / Usage		Maintains Air Frames
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench
HVAC		Heating, ventilation and cooling required. Requires special industrial exhaust system that goes directly to the outside.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets, Dedicated Equipment Connections
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door shall be at least 5 feet (1.52M0 wide and 6'-8" (2.03M0 high. If a 4' (1.22M) wide opening is adequate, provide a single 4' (1.22M) wide personnel door in lieu of double doors.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Corrosion Control
Description / Usage		Provides maintenance shop for corrosion control
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) required. Exhaust directly outdoors.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay Door shall be at least 5 feet (1.52M0 wide and 6’-8” (2.03M0 high. If a 4’ (1.22M) wide opening is adequate, provide a single 4’ (1.22M) wide personnel door in lieu of double doors.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Phase Crew
Description / Usage		Provides planned maintenance on aircraft parts
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) may be required. Exhaust directly outdoors.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay Door shall be at least 5 feet (1.52M0 wide and 6'-8" (2.03M0 high. If a 4' (1.22M) wide opening is adequate, provide a single 4' (1.22M) wide personnel door in lieu of double doors.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Aviation Ordnance
Description / Usage		Maintains aircraft weapons systems including weapons cleaning and storage
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Service Sink Compressed air drop at workbench
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) required. Exhaust directly outdoors. Thermostat/humidistat. Separately controlled zone. Humidifier/Dehumidifier may be required due to the presence of ordnance. Explosion-proof fan motors may be required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets, 400 Hz Panelboard, 400 Hz Bench Connection, Test Bench Connections, Ground Bus Bar
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Aviation Ordnance Shop must have direct access to the exterior. Provide panic devices on all doors from the shop. May require a vault. Coordinate with the squadron. Special solvents may be used for cleaning – provide special exhaust if required. Coordinate explosive classification requirements with the activity.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Division Office
Description / Usage		This space provides office space for the squadron division office.
Minimum Ceiling Height		9 ft (2.74 M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board
Furnishings		Desks and Chairs, side chairs, bookcases, file cabinets.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets, Secure (SIPRNet) Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		Partition and door construction shall have a minimum STC rating of 39

Space or Room Type		Quality Assurance
Description / Usage		This space provides office space and study space for quality assurance activities. This space also provides for storage of aircraft manuals. Manuals may be provided on CD.
Minimum Ceiling Height		9 ft (2.74 M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum on office side; sealed concrete on the customer side.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board
Furnishings		Desks and Chairs, side chairs, bookcases, file cabinets, copy machine.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets, Dedicated Equipment Outlets
Lighting		Fluorescent
Communication		Workstation Outlets, Workstation and Ceiling Mounted Projector Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Coordinate bookcase requirements with squadron.
Acoustics		Partition and door construction shall have a minimum STC rating of 39

Space or Room Type		1st Lieutenant
Description / Usage		This space provides for the storage of building maintenance supplies and office space for the 1st Lieutenant.
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted CMU with resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient Tile, minimum. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board
Furnishings		Desks and Chairs, side chairs, bookcases, file cabinets.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Some squadrons may place this function on the O2 level.
Acoustics		No special requirements

Space or Room Type		Shop – Paraloft Also may be part of AME shop or Flight Equipment
Description / Usage		This space is used to repair flight gear. It also provides the storage area for flight gear.
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards Flight Gear Lockers – coordinate requirements with squadron. Generally, lockers are open style with mesh sides. Due to the storage of combustible materials (flares), doors are not desirable on the locker fronts. Lockers must be sized to accommodate helmets and the particular gear associated with the aircraft type. Work table – provide large worktable to provide workspace for working on flight gear. Consider Rolling Storage units in lieu of fixed lockers to save space.
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		Washer hook up
HVAC		Heating, ventilation and cooling required. Dryer vent required. Specialized exhaust system(s) required. Exhaust directly outdoors. Explosion-proof fan motors may be required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets, Dryer hookup.
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		2 exits are required from this space. Doors shall swing out and have panic devices. Verify quantity of Class C/D1.4G explosive material within the space. Provide protective construction if the allowable quantities of explosive material are exceeded. Space may need to be classified as a “Hazardous Occupancy” based on types and quantity of pyrotechnical devices stored in the space. Verify quantity (pounds) of material prior to establishing a special occupancy separation.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Seat Shop
Description / Usage		Shop and storage area for seats and other components that are part of reconfigurable aircraft.
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) may be required. Exhaust directly outdoors.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets, grounding bar
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door should be at least 5 feet (1.52M) wide and 6'-8" (2.03M) high. If direct access to the hangar bay is not provided, provide an exterior double door.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Shop – Detachment
Description / Usage		Standard shop for Squadrons employing deployed aircraft. This is generally a workspace without any specific requirements. Coordinate requirements with a squadron configured for detachment components.
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Shops shall have exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		Marker Boards
Furnishings		Desks and Chairs, bookcases, vertical file cabinets, work benches. Coordinate the quantities of furniture with the squadron. Other types of furniture may be required based on squadron and airframe type utilizing the hangar.
Plumbing		
HVAC		Heating, ventilation and cooling required. Specialized exhaust system(s) may be required. Exhaust directly outdoors.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Night Vision Gear (NVG) storage
Description / Usage		This space provides for storage of night vision gear.
Minimum Ceiling Height		8 ft (2.44 M)
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Shelving
Furnishings		
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlet, Convenience Outlets
Lighting		Fluorescent
Communication		
Special Requirements		Provide metal door with a combination lock and deadbolt.
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Vending (Geedunk)
Description / Usage		Provides space for vending machines and snack bar operations. Coordinate specific requirements with the squadron.
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Counter with glass top and front for display Base cabinet with countertop
Furnishings		Cash register Coffee Maker Coolers, vertical
Plumbing		Kitchen Sink
HVAC		Heating, ventilation and cooling required. Exhaust fan may be required.
Fire Protection		Required
Power		Dedicated Equipment Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		Workstation Outlet, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Allow space for 3 vending machines
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Janitor Closet Also known as CG (cleaning gear)
Description / Usage		Provides for cleaning supply storage
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc. Provide suspended gypsum board ceiling as an option
Built in Equipment or casework		Mop Rack Shelving
Furnishings		
Plumbing		Service Sink, Mop Sink, Clinic Service Sink
HVAC		Ventilation required.
Fire Protection		Required
Power		
Lighting		
Communication		
Special Requirements		
Acoustics		No special requirements above the STC provided by full height masonry walls

Space or Room Type		Men's Head (Toilet) – O1 Level
Description / Usage		Toilet facilities, locker and shower rooms.
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Ceramic Tile wainscot and Base. Walls in showers shall be full height ceramic tile and may be full height in other areas if selected by RFP preparer or Designer of record.
	Floors	Ceramic Tile
	Ceiling	Suspended Acoustical Ceiling with moisture resistant finish. Shower shall have a painted water resistant gypsum board suspended ceiling.
Built in Equipment or casework		Counter tops at lavatories, toilet partitions, urinal screens, personnel lockers with benches. Provide wall mounted lavatories in 1st floor heads. Provide toilet accessories including mirrors, hooks, and related items.
Furnishings		
Plumbing		Flush Valve Waterclosets, Flush Valve urinals, Countertop lavatories, wall mounted lavatories, showers, Room Floor Drain
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlet
Lighting		Fluorescent
Communication		
Intercommunications Systems		Volume Control Station
Special Requirements		Number of fixtures will be determined by the RFP preparer for design build projects or shall provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide 2 tier-1/2 height lockers on concrete base. RFP preparer shall determine the number of lockers required. Lockers shall be sized based on activity requirements. Provide accessible fixtures if, required
Acoustics		Partitions shall have an STC rating of 50 for partitions separating head area from other occupied spaces. Doors shall be a standard steel door or solid core wood door without any special sealants or strips. Internal partitions within the confines of the space may extend to above the ceiling line.

Space or Room Type		Women's Head (Toilet) – O1 Level
Description / Usage		Toilet facilities, locker and shower rooms.
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Ceramic Tile wainscot and Base. Walls in showers shall be full height ceramic tile and may be full height in other areas if selected by RFP preparer or Designer of record.
	Floors	Ceramic Tile
	Ceiling	Suspended Acoustical Ceiling with moisture resistant finish. Shower shall have a painted water resistant gypsum board suspended ceiling.
Built in Equipment or casework		Counter tops at lavatories, toilet partitions, personnel lockers with benches. Provide toilet accessories including mirrors, hooks, and related items.
Furnishings		
Plumbing		Flush Valve Waterclosets, Countertop lavatories, wall mounted lavatories, showers, Room Floor Drain. Provide wall mounted lavatories in 1st floor heads.
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		
Intercommunications Systems		Volume Control Station
Special Requirements		Number of fixtures will be determined by the RFP preparer for design build projects or shall provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide 2 tier-1/2 height lockers on concrete base. RFP preparer shall determine the number of lockers required. Lockers shall be sized based on activity requirements. Provide accessible fixtures if, required
Acoustics		Partitions shall have an STC rating of 50 for partitions separating head area from other occupied spaces. Doors shall be a standard steel door or solid core wood door without any special sealants or strips. Internal partitions within the confines of the space may extend to above the ceiling line.

Space or Room Type		Communications Room
Description / Usage		Provides space for NMCI head-in equipment
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc. Provide suspended gypsum board ceiling as an option
Built in Equipment or casework		
Furnishings		
Plumbing		Not required
HVAC		Heating, ventilation and cooling required. Dedicated unit required.
Fire Protection		Required
Power		Dedicated Equipment Outlets, Equipment Connection, Convenience Outlets
Lighting		Fluorescent
Communication		Rack Mount Equipment and Racks
Special Requirements		Verify requirements for distance between communications rooms.
Acoustics		No special requirements

Space or Room Type		Stairs
Description / Usage		Provides for vertical circulation
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above. 2nd floor partitions may be gypsum board on metal studs.
	Floors	Resilient tile is the minimum. Treads shall be heavy duty resilient with thickened nosings.
	Ceiling	Suspended acoustical ceiling.
Built in Equipment or casework		
Furnishings		
Plumbing		Not required
HVAC		Heating only. Provide unit heater when climate makes it necessary.
Fire Protection		Required. Provide rated wall assemblies as required.
Power		
Lighting		Fluorescent
Communication		
Special Requirements		If gypsum board partitions are used in stairways, provide impact resistant gypsum board up to 8 feet above the floor line or above the projected stringer line. For circulating stairs width shall be 5 feet wide. For exit only stairs, width shall be 4 feet.
Acoustics		Gypsum board partitions separating the stairs from an occupied space shall have an STC rating of 56 minimum. Full height masonry partitions do not need any additional acoustical enhancements. Doors opening into corridors do not need any special acoustical properties

Space or Room Type		Corridors – O1 level
Description / Usage		Provides for horizontal circulation
Minimum Ceiling Height		8 feet (2.44M)
Finishes	Walls	Painted CMU with resilient base. Partitions shall extend to the construction above.
	Floors	In Shop Areas – sealed concrete, minimum In Administrative areas – resilient tile, minimum
	Ceiling	Suspended acoustical ceiling.
Built in Equipment or casework		
Furnishings		
Plumbing		Provide drinking fountains
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		
Special Requirements		Separate administrative corridors from shop corridors.
Acoustics		Corridors shall be separated by full height masonry partitions without any additional acoustical enhancements. Corridor doors shall be standard steel doors or solid core wood doors without any special acoustical seals or strips.

Space or Room Type		General Office (open) Such as: Reserve Administration, Safety/Natops
Description / Usage		General office space used for squadron administration.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board with resilient base.
	Floors	Resilient Tile and Base minimum
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Provide service counters or include as furnishings
Furnishings		Provide workstations utilizing systems furniture.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets, Secure (SIPRNet) Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		Gypsum board partitions and doors separating the different functional areas shall have an STC rating of 39 minimum.

Space or Room Type		Personnel Office
Description / Usage		General office space used for squadron administration.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board with resilient base.
	Floors	Resilient Tile and Base minimum
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Provide service counters or include as furnishings Mail slots (some squadrons may require a separate mail room)
Furnishings		Provide workstations utilizing systems furniture. Book cases, counter chairs, side chairs, vertical file cabinets, lateral file cabinets Printers, copier, fax machine
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		CATV Office, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		Gypsum board partitions and doors separating the different functional areas shall have an STC rating of 39 minimum.

Space or Room Type		Private Office - Commanding officer; Executive Officer These offices are generally adjacent to each other and are often interconnected either by direct access or by a vestibule. They may share a toilet with shower if requested. Generally, the spaces are associated with a waiting area and/or clerk's office. They may be a part of a "command suite" that includes the Command Master Chief.
Description / Usage		Private offices
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base. Partitions separating the CO, XO and CMC shall extend to the roof construction above.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		None
Furnishings		Provide executive office type furniture. Include a small conference table if space allows.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlets
Lighting		Fluorescent
Communication		CATV Outlet, SIPRNet Outlet, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		These offices may contain Siprnet drops so special door hardware is required. Provide acoustically enhanced partitions and doors providing for an STC of 49.

Space or Room Type		CO/XO Head
Description / Usage		Private Toilet for CO/XO
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Ceramic Tile and Base
	Floors	Ceramic Tile
	Ceiling	Suspended Acoustical Ceiling with moisture resistant finish. Shower shall have a painted water resistant gypsum board suspended ceiling.
Built in Equipment or casework		Counter tops at lavatories Toilet accessories as required
Furnishings		
Plumbing		Watercloset, lavatory, shower
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlet
Lighting		Fluorescent
Communication		
Special Requirements		
Acoustics		Provide full height partitions

Space or Room Type		Private Office – General This type of office is provided for various administrative functions on the O2 level. Offices include: DAPA, Command Master Chief, Admin Officer, CPO, OIC, CCD, CCO, SAFTO, NATO, Legal. Coordinate the number of occupants.
Description / Usage		Private offices
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted Gypsum Board and resilient base. Provide partitions to roof construction above for Legal and Medical offices.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		None
Furnishings		Provide standard office type furniture including desks and chair; side chair, vertical 3 drawer file cabinet; book case.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlet, Convenience Outlet
Lighting		Fluorescent
Communication		Coordinate with squadron for SIPRNet requirements, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		None
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 49. Except as indicated above, partitions may extend to above the ceiling.

Space or Room Type		Duty Station
Description / Usage		Bunk Room
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted Gypsum Board and resilient base. Provide partitions to roof construction.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		None
Furnishings		Bunk Bed, small desk, chair
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlet
Lighting		Fluorescent
Communication		Provide Telecom Outlets, CATV Outlets in accordance with squadron requirements
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Coordinate requirement for a bunk room with squadron.
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 49.

Space or Room Type		Exam Room
Description / Usage		Provides exam space for medical officer
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Sheet vinyl
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board
Furnishings		Exam Table Side chair
Plumbing		sink
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlet, Dedicated Equipment Outlet
Lighting		Fluorescent, Exam
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		None
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 49. Extend partitions to roof deck above.

Space or Room Type		Conference Room
Description / Usage		*Provides space for meetings and conferences*
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board Smart Board
Furnishings		Conference table and chairs
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlet, Dedicated Equipment Outlets
Lighting		Fluorescent – Incandescent Dimmed
Communication		Workstation and Ceiling Mounted Projector Outlets, Video Teleconferencing (VTC) Outlet, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		This space may be associated with the Command Suite and will generally be close to the CO/XO office area.
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 45. Except as indicated above, partitions may extend to above the ceiling.

Space or Room Type		Chief's Mess
Description / Usage		Provides meeting space for CPO's Coordinate requirement with squadron.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Base cabinets and countertops TV support bracket
Furnishings		Provide a conference type table with chairs, workstations, refrigerator and microwave,
Plumbing		Full size countertop kitchen sink
HVAC		Heating, ventilation and cooling required. Exhaust fan may be required.
Fire Protection		Required
Power		Convenience Outlets, Dedicated Equipment Outlets, Equipment Connection
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 39. Except as indicated above, partitions may extend to above the ceiling.

Space or Room Type		Training Room
Description / Usage		This space provides for training of personnel
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Resilient Tile, Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		None
Furnishings		Desks and Chairs; Book cases; file cabinets; testing carrels with chairs; marker board
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Provide partition with an STC of 45 Possible user network configuration for telecom jacks (coordinate with squadron)
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 45.

Space or Room Type		Classroom
Description / Usage		This space provides for training of personnel
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Resilient Tile, Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		None
Furnishings		Desks and Chairs; Book cases; file cabinets; testing carrels with chairs; marker board
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Provide operable folding partitions if required by squadron. Possible user network configuration for telecom jacks (coordinate with squadron)
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 45.

Space or Room Type		Men's Head (Toilet) – O2 Level
Description / Usage		Toilet facilities, locker and shower rooms.
Minimum Ceiling Height		8 ft 2.44M)
Finishes	Walls	Ceramic Tile wainscot and Base. Walls in showers shall be full height ceramic tile and may be full height in other areas if selected by RFP preparer or Designer of record.
	Floors	Ceramic Tile
	Ceiling	Suspended Acoustical Ceiling with moisture resistant finish. Shower shall have a painted water resistant gypsum board suspended ceiling.
Built in Equipment or casework		Counter tops at lavatories, toilet partitions, personnel lockers with benches.
Furnishings		
Plumbing		Water closets, urinals, lavatories, showers
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		
Special Requirements		Number of fixtures will be determined by the RFP preparer for design build projects or shall provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide single tier- full height lockers on concrete base. RFP preparer shall determine the number of lockers required. Lockers shall be sized based on activity requirements. Provide accessible fixtures if, required
Acoustics		Partitions shall have an STC rating of 50 for partitions separating head area from other occupied spaces. Doors shall be a standard steel door or solid core wood door without any special sealants or strips. Internal partitions within the confines of the space may extend to above the ceiling line.

Space or Room Type		Women's Head (Toilet) – O2 Level
Description / Usage		Toilet facilities, locker and shower rooms.
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Ceramic Tile wainscot and Base. Walls in showers shall be full height ceramic tile and may be full height in other areas if selected by RFP preparer or Designer of record.
	Floors	Ceramic Tile
	Ceiling	Suspended Acoustical Ceiling with moisture resistant finish. Shower shall have a painted water resistant gypsum board suspended ceiling.
Built in Equipment or casework		Counter tops at lavatories, toilet partitions, personnel lockers with benches.
Furnishings		
Plumbing		Water closets, lavatories, showers
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		
Special Requirements		Number of fixtures will be determined by the RFP preparer for design build projects or shall provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide single tier- full height lockers on concrete base. RFP preparer shall determine the number of lockers required. Lockers shall be sized based on activity requirements. Provide accessible fixtures if, required
		Partitions shall have an STC rating of 50 for partitions separating head area from other occupied spaces. Doors shall be a standard steel door or solid core wood door without any special sealants or strips. Internal partitions within the confines of the space may extend to above the ceiling line.

Space or Room Type		Ward Room (Ready Room)
Description / Usage		Ready room for pilots and flight crew.
Minimum Ceiling Height		9 ft (2.74M) minimum
Finishes	Walls	Painted Gypsum Board and resilient base. Partitions shall extend to roof construction above.
	Floors	Commercial Carpet or Carpet Tile
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Counter with base cabinets, wall cabinets and Duty Station countertop Marker Boards Overhead projector supports Projector screen, motorized.
Furnishings		Conference Room Table and Chairs, chair for duty station.
Plumbing		Countertop sink
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets, Dedicated Outlets
Lighting		Fluorescent (may require dimmable)
Communication		Workstation and Ceiling Mounted Projector Outlets, Video Teleconferencing (VTC) Outlet, Secure (SIPRNet) Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Partitions shall have an STC rating of 50.
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 49.

Space or Room Type		Briefing Room
Description / Usage		This spaces provides for operational briefings associated with flight operations
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board and resilient base. Partitions shall extend to roof construction above.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Projection screen(s) Folding Partition (if part of program)
Furnishings		chairs
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets, Dedicated Outlets
Lighting		Fluorescent (may require dimmable)
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		If combined with Conference Room Space – Podium Junction Box, Ceiling Projector Telecom Outlet, Floor Box under Table
Acoustics		Provide acoustically enhanced partitions and doors providing for an STC of 49.

Space or Room Type		Operations Offices This may include other offices such as Intel or Tactics
Description / Usage		Office serves as the operations center for all squadron flight operations.
Minimum Ceiling Height		9 ft (2.74M)
Finishes	Walls	Painted Gypsum Board with resilient base.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Provide service counters or include as furnishings
Furnishings		Provide workstations utilizing systems furniture.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Workstation Outlets, Convenience Outlet
Lighting		Fluorescent
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		This area is a secured area and requires controlled access hardware. If Siprnet is required, meet requirements for a Protected Distribution System (PDS).
Acoustics		Partitions shall extend to the roof construction above and shall have an STC rating of 45. Doors shall have an STC rating of 45

Space or Room Type		Secure Office
Description / Usage		Provides head-in space for Siprnet
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted Gypsum Board with resilient base. Partitions shall be constructed in accordance with the UFC for Protected Distribution Systems.
	Floors	Resilient Tile, minimum
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		
Furnishings		Provide workstation if required by squadron.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required. Dedicated unit required.
Fire Protection		Required
Power		Convenience Outlet, Workstation Outlet
Lighting		Fluorescent
Communication		Rack Mounted Equipment and Racks, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		This area is a secured area and requires controlled access hardware. Partitions shall extend to the roof construction above Provide combination lock as required by Protected Distribution System requirements

Space or Room Type		Chart Room
Description / Usage		Provides space for flight planning operations
Minimum Ceiling Height		8 ft (2.44M)
Finishes	Walls	Painted Gypsum Board and resilient base.
	Floors	Commercial Carpet or Carpet Tiles
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		Marker Board Built in Chart Table
Furnishings		Stools Book cases Flat Files for chart storage
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets
Lighting		Fluorescent
Communication		Workstation Outlets, CATV Outlet, Secure (SIPRNet) Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		This space is generally associated with Operations
Acoustics		No special requirements

Space or Room Type		Sensitive Compartmented Information Facility (SCIF)
Description / Usage		Operational spaces requiring high level of security. Other spaces such as Operations, Briefing, etc. may be combined into a SCIF.
Minimum Ceiling Height		As required by requirements but 9 ft (2.74M), minimum
Finishes	Walls	Painted Gypsum Board with resilient base. Partitions shall be constructed in accordance with the written requirements for a SCIF
	Floors	Resilient Tile, minimum
	Ceiling	Suspended Acoustical Ceiling
Built in Equipment or casework		
Furnishings		Provide workstation if required by squadron.
Plumbing		Not required
HVAC		Heating, ventilation and cooling required. Dedicated unit required.
Fire Protection		Required
Power		Convenience Outlet, Workstation Outlet
Lighting		Fluorescent
Communication		Rack Mounted Equipment and Racks, Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		This area is a secured area and requires controlled access hardware. Partitions shall extend to the roof construction above Provide combination lock as required SCIF construction requirements
Acoustics		Provide acoustically enhance ratings as required by SCIF requirements. If no specific requirements are indicated, provide full height partitions with an STC rating of 45. Provide doors with an STC rating of 45.

Space or Room Type		Corridors – O2 level
Description / Usage		Provides for horizontal circulation
Minimum Ceiling Height		8 feet (2.44M)
Finishes	Walls	Gypsum Board Partitions shall extend to the construction above.
	Floors	Resilient Tile, Minimum
	Ceiling	Suspended acoustical ceiling.
Built in Equipment or casework		
Furnishings		
Plumbing		Not required
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent
Communication		
Special Requirements		Corridor finishes around the Command Suite may be upgraded.
Acoustics		Corridors shall be separated by full height partitions with and STC of 39, minimum. Corridor doors shall be standard steel doors or solid core wood doors with an STC rating of 39

Space or Room Type		OH – Hangar Bay
Description / Usage		Maintenance Hangar area
Minimum Ceiling Height		See mandatory height requirements based on hangar type.
Finishes	Walls	Painted CMU between O1/O2 and hangar bay Exterior walls shall have a protective panel system or masonry partition to 7' above the hangar floor Fire protection on columns shall be provided to a height of 20' above floor line.
	Floors	Thin Film Flooring System
	Ceiling	Exposed construction. Paint exposed structure, deck, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		An approved Avian Intrusion Prevention System shall be incorporated in the hangar bay. Do not use bird netting.
Furnishings		
Plumbing		Emergency Shower and Eyewash per NAVOSH requirements
HVAC		Heating and ventilation required. Specialized exhaust system(s) required. Exhaust directly outdoors. Thermostatic control switch required. May require overhead radiant heating. May require snow-melting system at hangar door tracks in colder climates.
Fire Protection		Required. Provide Draft Curtains, Low-Level AFFF system, and fire separation between office and shop areas.
Power		400 Hz Converter, Ground Power Equipment Connection, Dedicated Equipment Connections, Convenience Outlets, Classified Area up to 18" AFF
Lighting		Fluorescent, HID
Communication		Workstation Outlets, SCI Communications Outlets
Intercommunications Systems		Microphone and Auxiliary Jacks, Paging Speaker System (Neoplanar Emitters), GPS Repeater Systems
Electrical Special Systems and Devices		400 Hz Frequency Converters Security – CCTV Cameras, Access Control (if required by Government)
Special Requirements		Provide Vertical Lift Fabric or Horizontal Sliding Doors with personnel doors as discussed in the UFC Provide catwalks and ladders to provide service for Vertical Lift Fabric Doors Provide platforms and ladders to provide service of bridge crane(s)
Acoustics		No Special requirements above the full height CMU wall separating the O1/O2 area from the hangar bay. Doors between the O2 level and the hangar bay, if required, shall have acoustical seals including automatic door bottoms and perimeter seals

Space or Room Type		Hangar Storage
Description / Usage		Storage area adjacent to hangar bay.
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		
Furnishings		
Plumbing		
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets
Lighting		Fluorescent, HID
Communication		
Special Requirements		Due to the potentially large pieces of equipment brought into this space, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door should be at least 8 feet (2.44M) wide and 8 feet (2.44M) high. Door shall be motorized. Provide 1 door to the hangar bay and one door to the exterior.
Acoustics		No special requirements

Space or Room Type		Line Shack
Description / Usage		Flightline personnel waiting area and storage area
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		
Furnishings		Provide furniture or built in seating for personnel
Plumbing		
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		Convenience Outlets, Workstation Outlets
Lighting		Fluorescent
Communication		CATV Outlet, Workstation Outlets, Workstation Outlets, Base Radio Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		No special requirements

Space or Room Type		Shop – Flight Line Office
Description / Usage		Flight line personnel shop
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		
Furnishings		
Plumbing		Service Sink Emergency eyewash
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		
Lighting		
Communication		Workstation Outlets, CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Due to the potentially large pieces of equipment brought into this space, a rolling service door should be provided in lieu of double doors opening onto the hangar bay. Door should be at least 8 feet (2.44 M)wide and 8 feet (2.44M)high. Door shall be motorized. Provide 1 door to the hangar bay and one door to the exterior.
Acoustics		No special requirements

Space or Room Type		Flight Line Office
Description / Usage		Office for flight line shop
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU with resilient base. Partitions extend to the floor or roof deck above.
	Floors	Sealed concrete is the minimum. Epoxy or Thin Film Flooring Systems shall be provided if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		
Furnishings		Provide standard office type furniture including desks and chair; side chair, vertical 3 drawer file cabinet; book case.
Plumbing		
HVAC		Heating, ventilation and cooling required.
Fire Protection		Required
Power		
Lighting		
Communication		Workstation Outlets
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		
Acoustics		No special requirements

Space or Room Type		Mechanical, Fire Protection, Electrical Rooms
Description / Usage		Provides space for building systems
Minimum Ceiling Height		-
Finishes	Walls	Painted CMU. Partitions shall extend to the construction above.
	Floors	Sealed concrete is the minimum.
	Ceiling	Exposed construction. Paint exposed structure, ductwork, conduit, piping, devices, etc.
Built in Equipment or casework		
Furnishings		
Plumbing		As required
HVAC		As required
Fire Protection		Required
Power		As required
Lighting		Fluorescent
Communication		
Special Requirements		Provide a dedicated fire pump room located on an exterior wall. Provide dedicated rooms for AFFF equipment as necessary to facilitate the hydraulic design of the foam proportioning equipment. AFFF equipment rooms shall be located interior to the structure as necessary with doors that provide direct access to the exterior or to the hangar bay.
Acoustics		Corridors shall be separated by full height partitions with and STC of 52, minimum. Corridor doors, if provided shall be standard steel doors with an STC rating of 52

APPENDIX A: REFERENCES

GOVERNMENT PUBLICATIONS

1. Department of Defense (DoD)

Washington Headquarters Service Communications and Directives Directorate www.whs.pentagon.mil	DoD Directive 4165.61, Intergovernmental Coordination of DoD Federal Development Programs and Activities, 9 August 1983
Military Specifications http://assist.daps.dla.mil/online/start/	MIL-F-24385F, Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater
Unified Facilities Criteria http://dod.wbdg.org	UFC 1-200-01, General Building Requirements
	UFC 2-000-05N, (P-80) Facility Planning Criteria for Navy/Marine Corps Shore Installations
	UFC 3-200-10N, Civil Engineering (Draft)
	UFC 3-240-02N, Wastewater Treatment Systems Augmenting Handbook
	UFC 3-260-01, Airfield and Heliport Planning and Design
	UFC 3-260-02, Pavement Design for Airfields
	UFC 3-310-04, Seismic Design for Buildings
	UFC 3-320-07N, Weight Handling Equipment

UFC 3-400-02, Design: Engineering Weather Data

UFC 3-410-02N, Heating, Ventilating, Air Conditioning and Dehumidifying Systems

UFC 3-410-04N, Industrial Ventilation

UFC 3-420-01, Plumbing Systems

UFC 3-450-01, Noise and Vibration Control

UFC 3-500-10N, Design: Electrical Engineering (DRAFT)

UFC 3-520-01, Interior Electrical Systems

UFC 3-530-01, Design: Interior and Exterior Lighting and Controls

UFC 3-555-01N, 400 Hertz Medium Voltage Conversion/Distribution and Low Voltage Utilization Systems

UFC 3-580-01, Telecommunications Building Cabling Systems Planning and Design

UFC 3-580-10, Navy and Marine Corps Intranet (NMCI) Standard Construction Practices

UFC 3-600-01, Fire Protection Engineering for Facilities

UFC 4-010-01, DoD Minimum Antiterrorism Standard for

	Buildings
	UFC 4-121-10N, Design: Aircraft Fixed Point Utility Systems
	UFC 4-832-01N, Design: Industrial and Oily Wastewater Control
Unified Facilities Guide Specifications http://dod.wbdg.org	UFGS 07 41 13, Non-Structural Metal Roofing
	UFGS 07 42 13, Metal Wall Panels
	UFGS 08 34 16.10, Steel Sliding Hangar Doors
	UFGS 08 34 16.20, Vertical Lift Fabric Doors
	UFGS 41 22 13.13 Bridge Cranes
2. Government Printing Office Washington, DC 866-512-1800 202-512-2104 (fax) http://www.gpoaccess.gov/index.html	43 FR 6030, Floodplain Management Guidelines, 10 Feb 1978
	44 CFR 59-79, National Flood Insurance Program.
3. U.S. National Archives and Records Administration College Park, MD 866-272-6272 http://www.archives.gov/federal-register/codification/	Executive Order 11514, Protection and Enhancement of Environmental Quality, 5 March 1970
	Executive Order 11988, Floodplain Management, 24 May 1977
	Executive Order 11900, Protection of Wetlands, 24 May 1977

	Executive Order 12372, Intergovernmental Review of Federal Programs, 14 July 1982
4. U.S. Fish and Wildlife Service Washington, DC http://www.fws.gov/laws/lawsdigest/resourcelaws.htm	Public Law 91-190, National Environmental Policy Act of 1969, 1 January 1970
5. US Access Board 1331 F Street, Suite 1000 Washington, DC 20004-1111 202-272-0080 202-272-0081 (fax) http://www.access-board.gov	Uniform Federal Accessibility Standards (UFAS) Americans with Disabilities Act Accessibility Guidelines (ADAAG)
6. Department of the Navy (DON) SECNAV/OPNAV Directives Control Office N09B15 Washington Navy Yard, Bldg 36 720 Kennon Street, SE, Room 203 Washington Navy Yard, DC 20374-5074 (202) 433-4934/5/6 (202) 433-2693 (fax)	OPNAVINST 4790.2, Naval Aviation Maintenance Program (NAMP)
7. Naval Facilities Engineering Command Engineering Criteria and Programs Office 6506 Hampton Boulevard Norfolk, VA 23508 757-322-4200 757-322-4416 (fax) www.navfac.navy.mil	P-80.3, Facility Planning Factor Criteria for Navy/Marine Corps Shore Installations Safety Clearance MIL-HDBK-1004/6, Lightning Protection MIL-HDBK-1190, Facility Planning and Design Guide, 1 September 1987
8. Naval Air Systems Command (NAVAIR) NAVAIRSYSCOMHQ 47123 Buse Rd	MIL-HDBK-274, Electrical Grounding for Aircraft Safety

B2272 Unit IPT, Suite 075 Patuxent River, MD 20670-1547 301-757-1487 navairpao@navair.navy.mil www.navair.navy.mil	NAVAIR 51-50AAA-2, General Requirements for Shore Based Airfield Marking and Lighting
9. Naval Sea Systems Command 1333 Isaac Hull Avenue S. E. Washington Navy Yard, D.C. 20376 Phone: (202) 781-0000 http://www.navsea.navy.mil/	NAVSEA OP-5, Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping
10. Federal Emergency Management Agency 500 C Street, SW Washington, D.C. 20472 Phone: (202) 566-1600 www.fema.gov	FEMA 368, NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, Part 1 – Provisions, 2000 Edition FEMA 369, NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, Part 2 – Commentary, 2000 Edition.
11. Cognizant Security Authority / Agency	Joint Air Force – Army – Navy JAFAN 6/9 Manual; Physical Security Standards for Special Access Facilities; 23 March 2004

NON-GOVERNMENT PUBLICATIONS

1. National Fire Protection Association (NFPA)
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101
(617) 770-3000
(617) 770-0700 (fax)
www.nfpa.org

NFPA 20, Standard for the Installation of Stationary Fire Pumps for Fire Protection

NFPA 70, National Electrical Code

NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems

NFPA 101, Life Safety Code

NFPA 409, Standard on Aircraft Hangars

NFPA 780, Standard for the Installation of Lightning Protection Systems

2. ASTM International
100 Barr Harbor Drive,
PO Box C700
West Conshohocken, PA 19428-2959
(610) 832-9585
(610) 832-9555 (fax)
www.astm.org

ASTM C 90, Standard Specification for Loadbearing Concrete Masonry Units

ASTM D 523, Standard Test Method for Specular Gloss

3. International Code Council
5203 Leesburg Pike, Suite 600
Falls Church, VA 22041
703-931-4533
Fax: 703-379-1546
www.iccsafe.org

International Mechanical Code

4. American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601 (312) 670-2400 (312) 670-5403 (fax) www.aisc.org	ANSI/AISC 341, Seismic Provisions for Structural Steel Buildings, amended 10 November 2000.
5. American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191-4400 1-800-548-2723 toll free (703) 295-6222 fax www.asce.org	ASCE 7, Minimum Design Loads for Buildings and Other Structures
6. American Concrete Institute (ACI) PO Box 9094, Farmington Hills, MI 48333 (248) 848-3700 www.aci-int.org	ACI 360R, Design of Slabs on Ground
7. Master Painters Institute 4090 Graveley St. Burnaby, BC Canada V5C 3T6 (888)674-8937 toll free www.paintinfo.com/	MPI 212, Floor Coating, Thin Film, for Aircraft Maintenance Facilities
8. American Architectural Manufacturer's Association (AAMA) 1827 Walden Office Square, Suite 550 Schaumburg, Illinois 60173-4268 (847) 303-5664 http://www.aamanet.org/	WSG.1, Window Selection Guide

APPENDIX B: BEST PRACTICES

B-1 GENERAL.

Best practices in Navy hangar design are contained in this appendix. Hangar design must meet all applicable requirements found in the following:

UFC 1-200-01, General Requirements;
UFC 4-010-01, DoD Minimum Antiterrorism Standard for Buildings;
UFC 3-600-01, Fire Protection Engineering for Facilities, supplemented by Chapter 6 of this UFC.
NFPA 101, Life Safety; and
NFPA 409, Aircraft Hangars.

B-2 ENVIRONMENTAL CONCERNS.

The maintenance facilities must meet applicable pollution abatement criteria. For applicable discharge criteria, consult NAVFAC Atlantic CI ENG. Refer to UFC 3-240-02N, *Wastewater Treatment System Augmenting Handbook* and UFC 4-832-01N, *Design: Industrial and Oily Wastewater Control*.

It is essential that, as part of the preliminary studies, consideration be given to water conservation and source control, including the possibility of substantial alteration of the process or plant operation to reduce pollutant loading. The greater the volume of wastewater to be treated and the greater the amount of contaminant to be removed or destroyed, the higher the capital, labor, and material costs required. As a result, it is often economical to eliminate or reduce the quantity of waste at its source prior to treatment or in place of treatment. Several possible techniques exist including process change, material recovery, segregation, and water reuse. Sometimes, with only partial purification, spent water can be reused, once or several times, in the industrial process. Water unsuitable for direct reuse may be serviceable for a different purpose, in which quality requirements are less restrictive.

Often, there are a number of alternatives that can achieve the desired result. Therefore, a major objective of the preliminary studies should be to determine what combinations of actions are the most cost effective and technically and operationally feasible.

B-3 ANTI-TERRORISM/FORCE PROTECTION (ATFP).

Incorporate ATFP issues at the initial phase of the design. Formulate the basis for design on UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*. Coordinate all protection features with the current standards and any additional requirements in place at the time of the design. Ascertain the exact requirements for protection based on a site-specific survey, or lacking one, provide the minimum protection standards outlined in the standards. Coordinate all ATFP issues with the

base that may be a part of another project or impact adjacent facilities such as security fencing, parking etc.

B-4 PLANNING.

O level maintenance hangars have been modified since the 1940's. The old style hangar was generally, a barrel vaulted hangar with the O1 level (shops) and O2 level (Operations and Administration) on the sides. This design allowed for the hangar to be open on both ends of the hangar bay. This design was replaced in the 1970's with a single opening hangar facing the flightline. The O1/O2 shops were located at the rear of the hangar. Generally, the O1/O2 wing was a box providing the same area on the ground floor as on the second floor. As hangars got wider, the O1/O2 wing got narrower as it followed the width of the hangar bay.

In the late 1990's the some hangars were being developed to provide for a more functional layout that allowed the squadron to assign O1/O2 functions as needed by the individual squadrons. If more space was needed in shop areas, space could be reallocated from the O2 level to the O1 level. This allowed the needed space to be allocated as required by the particular aircraft of each squadron. This also allowed space that was being used for circulation to be captured and applied to usable space.

Another problem encountered with the older hangars was the number of doors accessing the hangar bay. Each shop had a door that opened to the hangar bay and one to the interior corridor. The 2 sets of doors reduced the usable area of the shop. Also, the doors opening into the hangar bay were fire rated and the double doors were often damaged. Fire marshal inspections would force the shops to close until the doors were repaired. In order to alleviate this concern, the "universal shop" was developed. The universal shop provides for a shop area that contains all of the shop spaces. The shops are sized to represent the specific airframe utilized. The key to this design is that the shops are accessed by a service corridor off of the hangar bay. Only shops that must have direct access to the hangar bay are provided with an overhead door to allow movement of large aircraft parts. The benefits to this design allow for better operational conditions within the shop area. The benefits include:

- Doors to shops do not have to have closers so doors can remain open.
- The shop area is more easily air conditioned as the only access to the hangar bay is closed most of the time.
- Reconfiguration of shop spaces can be easily accomplished as all shops are in one area.
- Management of shop activities is easier as all shops are centrally located.
- Storage space for equipment, deployment items and reconfigurable items should be addressed during project planning. Warehouse space exists on many bases that may be suitable. In some cases, portions hangar bay have been used for storage, which is an inefficient of this high value space. Category Code 211

storage space can be planned with hangar projects, when it can be shown that use of offsite storage would adversely impact squadron operations.

B-5 FOUNDATIONS.

Geotechnical Investigations. A thorough geotechnical investigation shall be conducted. The large column free hangar space results in highly concentrated foundation loads in remote portions of the building footprint. Areas of particular concern include towers or columns support long span trusses, cross-braced bays along the perimeter of the building, towers supporting cantilevered roof trusses and the tension anchorages for such trusses. The geotechnical investigation shall pay particular care to these points of load concentration.

Combined Foundation Systems.

While structural framing between the O1/O2 and OH areas of the facility are distinct and separate, it is often useful to consider the dead weight of the O1/O2 structure in resisting the overturning forces of cantilevered framing. This approach can lead to significant savings in the foundation design. The designer is cautioned that the foundation system must be designed for proper load paths if this option is exercised. If a shallow foundation is being used, the designer should consider differential settlement and the resulting forces in grade beams and ties. This is of particular concern in cantilevered roof framing systems.

B-6 SUPERSTRUCTURE.

Cantilevered OH Framing System.

A cantilevered system supports all of the gravity loads from the rear wall of the hangar bay. Lateral loads are resisted by the structural framing around the perimeter of the structure. The roof framing system should be designed with a means to correct out of tolerance construction without resorting to field modifications of any member. Cantilevered roof systems are generally statically determinate in all phases of construction.

Advantages.

The system is advantageous in that it provides a column-free building face towards the aircraft flightline. This maximizes the usable flightline frontage while decreasing the number of obstructions to aircraft movements and provides for the maximum flexibility to service future aircraft which may enter the inventory long after the hangar was designed. The system provides the maximum flexibility for structural expansion to either side of the hangar. However, if future expansion is anticipated, other disciplines must consider such expansion in their design development. Additionally, the highest point of the structure is generally towards the rear wall of the hangar, which may be

advantageous when the hangar is located near a runway and must remain below a glide or transition slope.

Disadvantages.

A cantilevered system is an inefficient method for supporting loads; is prone to larger deflections than other systems; and is more difficult to erect. Thermal cycles are also more likely to result in larger deflections affecting door operation, but will not result in thermal stresses unless the system is restrained in some unconventional manner. Additionally, the landward side of the facility must have some provision for tension anchorage of the rear of each cantilever. This anchorage may be in the form of massive dead-load or tension earth anchorages (typically tension piles). A cantilevered system also requires a more elaborate foundation. The tension anchorages, for both the above and below grade structures, require more elaborate coordination with the O1/O2 structure. The tension anchorages are also typically located outside of the building footprint and require greater coordinate with the civil site design.

Considerations.

Design documents for a cantilever system need to carefully consider the effect of erection sequencing, actual versus predicted dead load deflection and environmental conditions during the fabrication and erection. Additionally, the possibility of load reversal on the main supporting elements as a result of high uplift forces must be considered.

Header Truss OH Framing System.

A header truss system spans the entire flightline face of the building and either rests upon columns or towers at each flightline corner of the building or is continuous to the foundation. The remaining walls of the hangar are conventionally framed. Lateral support is provided through the framing in the perimeter walls. The truss is typically supported against lateral loads through dedicated horizontal truss system. The truss should be designed to maintain a slight upward camber after all dead loads have been placed. The truss may be fabricated on shoring towers in the air or on the ground and lifted as a single unit. The truss may be designed as statically determinate, indeterminate or initially determinate but becoming indeterminate at some point during the erection sequence. The design should consider the effect of erection methodology and sequence, in conjunction with determinacy of the system. Additionally, thermal effects on statically determinate header trusses are particularly significant and the designer of record should carefully evaluate these effects.

Advantages.

The header truss is an efficient system to span intermediate lengths and provides a relatively simple erection system, provided that the issues of static indeterminacy are dealt with.

Disadvantages.

The structural efficiency and stiffness decrease exponentially as the span of the truss increases. This may be offset by increasing the depth of the truss. However, the practical limits of transporting the fabricated hardware, erecting the assembled truss and lateral bracing of the system and its individual components limit the truss depth to something on the order of 25 foot (7.5 m) A header truss virtually precludes the use of expansion joints; therefore the hangar door span may be limited by the thermal response of non-structural components. However, a three-hinged arch system allows an expansion joint along the centerline of the hangar bay and extends the practical thermal expansion limit. The header truss system also requires that flightline frontage be dedicated to structural supports. Finally, the potential expansion of the hangar is constrained by the presence of towers and lateral load resisting systems.

Considerations.

Construction documents for a header truss system must clearly indicate the camber requirements as well as supply the necessary information for the fabricator and erector to predict the truss's response at various states of construction, handling and loading.

The header truss may be designed as fixed, pinned or partially restrained at its supports in order to balance the strength and deflection characteristics of the header truss with the complexity of detailing and erection. The designer of a statically indeterminate truss must carefully consider the influence that temperature, erection sequence and erection rigging will have on the difficulty of completing connections as well as final camber and this complexity must be communicated on the design documents.

Static Determinacy.

While the structural engineer is typically advised to avoid interfering with the means and methods of the construction professionals, he should have an understanding of the consequences that accompany any chosen erection method. The design documents should indicate if and when the structure is statically indeterminate. The designer of record should consider the effect which various erection approaches may have on the loads in an indeterminate structure and the documents shall clearly indicate any restrictions required on the erection to ensure a safe, serviceable building.

Construction and Erection.

Hangar construction involves the creation of a long-span, column-free space. These requirements complicate the erection of the building and make the steel erection contractor a much more important partner in the process than is typical of most government construction. Two general approaches are applicable to the erection of large hangar bays, ground assembly with heavy lift and aerial assembly with shoring towers.

Ground Assembly with Heavy Lift.

While not unique to hangars, lifts of pre-positioned, pre-assembled hardware weighing 30 to 50 tons (27,000 to 45,000 kg) are uncommon in most construction but typical of hangar construction. Ground construction is typically the most common means selected by contractors. Large cribbing is set immediately adjacent to the lift location and leveled. Shims are set to adjust for elevation differences and to establish the proper camber. The structural element is then constructed on top of the cribbing. Once completed, the entire element is lifted into place and the final support connections made. Fabricating on the ground allows for enhanced safety for the bulk of the work as well as greater control of quality and ease of access for inspectors. The drawbacks of the approach include the cost associated with mobilizing a crane or cranes that can lift the assembly. Tight quality control is essential to ensure that the final fit is made.

Some issues for the designer to be aware of include: The rigging and lift may impose loads on a structural assembly that were not anticipated by the designer. Even if the assembly is not damaged by the lift, it may undergo unexpected deformations that may then be locked into the final structure once the last connections are made. The heavy lift may place the large, overhead elements into place prior to the remainder of the facility's framing being completed. This is often a physical requirement given the necessity of getting equipment adjacent to the lift operations. The designer should give some consideration early in the design as to the lateral stability of the building components that support the major roof elements.

Aerial Assembly with Shoring Towers.

This approach is becoming increasingly uncommon with the general availability of large cranes and the increased emphasis on avoiding fall injuries on the work site. The approach involves the fabrication of temporary towers to support the piece-by-piece fabrication of the major components in their final place. The temporary shoring tower's location will determine the actual deflected shape of the structure resulting from the dead load of the structural steel only.

Advantages and Disadvantages.

The advantage of aerial assembly is that it avoids the necessity of having a large capacity crane and fabrication errors may be discovered and corrected without postponing a single milestone-lifting event. The disadvantage of the aerial assembly is the loss of productivity and potential for accidents related to high work. This approach also introduces the risk that unexpected loads may be introduced in the structural framing system by poorly designed shoring towers or long term settlement of the shoring towers. Additionally, the manner in which the temporary towers are removed may also introduce unexpected, albeit temporary, loads in the main structure.

STRENGTH AND SERVICABILITY REQUIREMENTS

The necessity of a large open, column free space will result in the lateral load resisting system being located along the perimeter of the building. Widely separated lateral load resisting elements may lead to high thermal stresses being developed. The designer is cautioned to balance the needs of other disciplines as to the location of cross-bracing and the desire to produce a more torsionally resistant design against the potential for developing high thermal stresses.

Wind Loads.

Hangars are prone to large eccentricities between centers of wind pressure and centers of rigidity (especially cantilevered hangars). Even unfactored loads resulting from this eccentricity may be significant. The designer should consider this eccentricity while laying out the lateral load resisting system to locate the center of rigidity as near to the center of applied force as practical.

Seismic Loads.

Seismic design criteria may impose significant constraints upon the structural frame, not only in the loads applied but also in the fundamental choice of framing system. For instance, an STMF system (per AISC) is limited to a span of 65 feet (20 m). A combination of site condition, design approach and structural layout will determine the AISC criteria. A poor selection of framing, arrangement of bracing or large asymmetries may result in expensive connection fabrication and testing requirements or outright prohibition of the fundamental design. The facility designer's should investigate the seismic issues early in the design phase and plan the building's geometry and structure accordingly.

Hangars are prone to large eccentricities between centers of mass and centers of rigidity. This is especially true for hangars with cantilevered roof framing systems. Regardless of the structural system, the unfactored loads from this eccentricity may be significant. For general information about structural loads, see UFC 1-200-01. For detailed information, see UFC 3-310-04, *Seismic Design for Buildings* and ANSI/AISC 341, *Seismic Provisions for Structural Steel Buildings*.

MAIN STRUCTURAL FRAMING MATERIALS.

Hollow Steel Sections.

There may be additional benefits derived from efficiency in steel use and minimization of exposed steel surfaces. The bi-axial strength characteristics provide for enhanced erectibility and greater resistance to progressive collapse resulting from localized damage. However, HSS connections are more challenging to design and often more difficult to fabricate. The engineer of record should consider and clearly represent in the contract drawings the difficulty of the HSS connections. Additionally, a greater reliance on shop connections is the norm in HSS practice. The designer is encouraged to consider the complications of transporting large, built-up elements to the site. HSS

connections may involve the use of welds that are not pre-approved and/or more extensive weld testing than normally found on hot rolled steel construction.

SECONDARY STRUCTURAL SYSTEMS.

Roof Systems.

Historically, it has been difficult to maintain the necessary level of quality control required to weld decks at side laps and at supports. Mechanical fasteners are the desired option. Additionally, there may be significant economy in erection by allowing pneumatic and powder actuated fastening systems. Most pneumatic and powder actuated systems are proprietary in nature and not covered by the Uniform Guide Specifications UFGS 05 30 00, Steel Decks.

Coordinating the Structure with the Hangar Doors.

Hangar door guide systems are normally sized to allow total roof truss live load deflection not to exceed 200 mm (8 inches). The designer of record is responsible for coordinating the total anticipated roof deflection with the door guide manufacturer to ensure that the design stroke of the hangar door guides is not exceeded. For cantilever roof systems, the hangar door guide system should have adjustment capability to allow for final leveling after all loads are in place. The construction documents shall indicate the expected maximum deflection, both upward and downward, as well as the allowable deflection of the hangar door guide system.

Diaphragms.

Given the difficulty in providing lateral load resistance for the large open spans associated with hangar bay structures, it often appears desirable to incorporate the roof deck into the lateral load system as a flexible diaphragm. However, these same large spans involved in hangar structures often require large deflections in the frame before the deck produces the desired resisting forces. Designers are therefore prevented from relying on a steel deck as a diaphragm in the hangar bay and required to provide a dedicated secondary horizontal lateral load. The deck may, however, be assumed to provide local support to elements, such as top chord/flange support to joists/beams.

Wall Systems.

Generally bearing or shear wall systems of masonry or concrete are much stiffer that the steel frame used in the hangar bay. Designers are cautioned to carefully consider the differential movement likely to occur between the O1/O2 structure and the OH structure when designing the interface.

Floors.

Ground floors are typically slabs on grade. In some circumstances with particularly poor geotechnical properties and schedules which do not allow for remediation, pile supported slabs may be desirable. Given that naval shore facilities are often located near the coast on sites with soils displaying poor load performance, careful consideration of long-term settlement is required. It is not atypical for the main structural frame to be built on deep foundations while the ground floor slabs are soil supported. In this circumstance, differential settlement is a potential risk to the serviceability of the facility. The designer may consider careful detailing between the floor slabs and the surrounding structure or, in the most severe circumstances, pile supporting the floor slab.

B-7 EXTERIOR DESIGN.

Horizontal Rolling Hangar Doors.

Horizontal rolling hangar doors typically support their own gravity load and only impart lateral (wind, seismic) loads to the main structural system through a track system at the door head. The door head track is generally the responsibility of the hangar door manufacturer. The designer of the hangar is cautioned to carefully consider the manner in which the door head track is supported to provide proper coordination.

Vertical Lift Fabric Doors.

Vertical lift fabric doors are lighter than rolling doors, but the entire weight is carried by the superstructure. Additionally, beyond a practical limit of about 60 foot (19 m) multiple door leaves are required. A complicated swinging mullion with additional overhead equipment is required for every vertical lift fabric door beyond the first. However, vertical lifting fabric doors do not require door pockets to entirely clear the hangar opening nor do they require extensive support at grade.

The main load collecting members for a vertical lift fabric door panel generally span horizontally, from mullion to mullion. As such, the mullions serve as load collectors for a very large tributary area which is then delivered to the main framing system as a concentrated force. At a basic, conceptual level, the structural engineer is cautioned to consider how these forces will be collected and distributed back to earth. To the maximum extent practical, the principle framing of the hangar structure should align with the mullion locations.

B-8 INTERIOR DESIGN.

Interior furnishings should be “heavy duty” for shop spaces. In addition, shops must be easily reconfigurable so systems furniture should be avoided. Systems furniture that cannot be easily configured by the squadron should not be used. Powered systems requiring an electrician to modify or relocate should not be used.

In Design Bid Build projects, coordinate the systems furniture electrical requirements. Provide power poles, floor outlets as determined. Interior designer may want to limit the use of power poles and this should be identified in the RFP.

Coordinate all miscellaneous items that may be required by the activity. In some cases items that can be considered to be furnishings may also be built in. For example, mail racks or slots may be a casework item or a purchased item. RFP preparer should note any special considerations for these types of items. Counters may either be case work or furniture. RFP preparer should identify as to what is preferred. Generally, furniture may be relocated while casework cannot.

Shop Floor Finishes. There are several acceptable floor finishes for shops: a sealed concrete, an epoxy coating, or a thin film flooring system. The RFP preparer or Designer should thoroughly evaluate the requirements before selecting a finish. A sealed concrete finish may be the most cost effective but may not provide the appearance expected. A thin film flooring system may provide a good finish with a good appearance but may not provide the impact resistance expected in a shop space. A trowelled epoxy system may provide the best performance but can be extremely expensive. Evaluation of the cost of the systems should be considered prior to making a final selection.

B-9 ACOUSTICS.

Acoustics around operational airfields pose significant questions about what to provide in the way of acoustical enhancements on a hangar. The type of aircraft and the projects proximity to the runways play a significant role in what might be expected on the envelope of the project. At jet bases or other locations employing aircraft with extremely high noise levels, it is important to consult with an acoustical consultant to determine proper noise reduction requirements within various areas of the hangar. The designer should carefully investigate the implications of providing specific acoustical requirements for the envelope of the facility. In Design Build projects the RFP preparer shall determine the requirements and provide adequate data to allow the Design Builder to adequately determine the cost for any acoustical requirements.

Interior acoustical requirements should be limited to what is specifically needed by the functional requirements. Most shop spaces do not have high noise level equipment so it is not necessary to provide ratings in excess of what will be provided by the standard partition recommended in the UFC.

Office and other similar type of administrative spaces should comply with commercial standards for similar type of spaces.

Do not specify special acoustical requirements if there is not an operational or functional reason to do so.

B-10 CONVEYING SYSTEMS.

Overhead Bridge Cranes.

Overhead cranes are often located close to overhead radiant heat systems. The two systems must be coordinated to avoid heat damage to the crane equipment. Common approaches include automatic switching which deactivates the heaters located near the crane or, in instances where the concentrated heat is not as high, locally shielding the vulnerable elements of the crane.

Personal Fall Arrest Systems (PFAS).

Aircraft maintenance workers are often required to work on top of aircraft, well above the floor surface. It is common practice in similar circumstances, for workers to be protected against falls through the provision of a Personal Fall Arrest System. However, hangars with bridge cranes represent a special challenge in that the cranes and PFAS compete for access to same work space and workers protected from falls by the safety system are now at risk of having their lanyards struck by a moving crane. It is important for the designers of aircraft hangars to understand the conflicts between the two systems and the means by which they can coexist. Additionally, PFAS systems may experience the same coordination issues with overhead radiant heat systems as do overhead cranes. The designer should consult the discussion on cranes above.

Description of Horizontal Lifeline (HLL) System.

The HLL system consists of a flexible line such as a rail, wire or synthetic cable (usually a stainless steel cable) that is installed in a horizontal or nearly horizontal plane between two or more anchorages and to which a shock absorbing lanyard, self-retracting lanyard (SRL) or vertical lifeline is attached. The lanyard has an integral locking snap hook at the end that attaches to the dorsal D ring of the person’s full body harness. The HLL system should be installed above the crane. Both the crane and HLL are usually installed at higher elevations. In order to perform work more efficiently on an aircraft, a network of HLL systems is generally required. The HLLs should be laid out in a system which accounts for the location of the aircraft and maximizes the freedom of movement of the users. Additionally, trans-fasteners are used to have an added mobility to move between intermediate anchorages with 100% tie-off.

Description of Self-Retracting Lanyard (SRL) Systems.

SRL systems involve single points of attachment for the D ring hooks. SRL systems experience the same conflicts with the bridge cranes as HLLs but the retraction systems are generally simpler to develop. However, SRLs restrict the movement of users to a small radius around the SRL location and require that the users detach and reattach to move about.

Quality Control.

HLL systems are typical proprietary in nature. The manufacturer should provide calculations and drawings showing that the system is appropriate for the application. The manufacturer should also be responsible for the proper installation and testing of the system and the training of the facility users in its use prior to Government acceptance.

Issues and Conflicts between Crane Operation and PFAS.

The following are few of the conflicts that will occur between the HLL system(s) and the crane(s):

If the HLL is installed above the Crane:

During the movement and operation of the crane a conflict will exist when personnel are tied to the HLL systems because the lanyards will be in the path of the crane. A Lockout/Tag out program should be in place which precludes the cranes and PFAS from being used simultaneously in a given area. In this situation, personnel should detach themselves from the HLL systems and the lanyards should be retracted inside the elevation of the crane.

There is some difficulty in developing a system which raises and lowers the snap hooks. There are two methods to lower the snap hooks to personnel's level. The first one is using a power tagline, which is a motorized winch that raises and lowers the lanyards to the users' level, activated by a control panel. The second method is using a lightweight rope that passes thru two pulleys located above the HLL to raise and lower the snap-hook manually by a person on the ground level.

When the HLL is retracted out of the crane's path, there should be a minimum clearance around the crane envelope of 3 inches (75 mm) from the top and 2 inches (50 mm) on either side.

In practice, the automatic system is preferable in that it can be interlocked with the crane controls; however the automatic system involves greater cost and complexity. The manual system is generally simpler but requires greater diligence in use. In any case, a Tagline Management Plan should be developed to ensure that both systems can be safely operated.

If the HLL is installed below the Crane:

If the HLL is installed below the crane rail, there will be interference with the crane operation unless a system to retract the HLL to the sidewalls is provided. Such systems generally come in one of two forms: (1) The HLL is suspended from a bridge beam which is lower than the bridge crane and supported from tracks located outboard of the bridge crane tracks. (2) The HLL is suspended from beams cantilevered off of the side walls, much like a jib crane, which can rotate flush to the side walls. The large open, column-free areas of hangar bays general make these systems impractical in hangar

usage. If the HLL requirements can be narrowed to a smaller portion of the total hangar floor area, these systems may become acceptable.

Alternate Methods and Systems:

There are other personal fall arrest systems that can be specified, but these are typically portable systems which can be more appropriately classified as equipment then building systems:

Work Stands: These are costly but safer than the use of PFAS. The work stands should be equipped with guardrails on three sides. Often, work stands must be customized to fit a small range of aircraft types. This then necessitates providing new work stands should the aircraft being serviced in the hangar change.

Portable Fall Arrest Systems: These are typically a single drop eyelet for a D-ring, supported from a jib arm on a portable derrick. The derricks are generally cumbersome, requiring additional equipment to relocate them, and offer only a limited range of movement to the user. These types of systems are generally not appropriate for a maintenance hangar unless the aircraft are expected to be static for long periods of time.

B-11 ELEVATORS.

Historically, US Navy hangars to not have elevators since they are occupied by able bodied military personnel. As most of the aircraft and personnel are deployable and aircraft carriers do not have elevators, the squadrons prefer to have the space required for the elevator and equipment applied to “usable” area.

Typical hangars generally have an access door from the O2 level that opens onto the hangar bay. This door is used to transfer furniture and other equipment that may be taken on deployment. The door is generally located in an accessible area such as a classroom or similar type of space.

Elevators shall be provided if civilian employees or contractors support hangar operations. If the activity requests not to have an elevator, the activity will need to provide a waiver request stating that the facility will be occupied by able bodied military personnel only. The RFP preparer shall obtain the waiver and attach to the RFP. If an elevator is required or desired, the requirement shall be clearly identified by the RFP preparer.

If an elevator is provided, the access door from the O2 level to the hangar bay (OH) may be deleted.

B-12 PLUMBING.

Reserved for future use.

B-13 HVAC.

Reserved for future use

B-14 FIRE PROTECTION.

Water Supply Piping. Avoid locating piping under paved operational surfaces (taxiways and aircraft parking).

Foam Concentrate Piping.

If using welded joints and fittings, consideration must be given to the maintenance of the system and the provision of flanged joints at certain locations to allow for maintenance.

Reserve AFFF Concentrate Supply.

For remote locations, it is recommended that a reserve supply of AFFF be available on base for refill purposes.

Releasing FACP Exception.

If the initiating devices required for the suppression system comprise 75% or more of the entire facility alarm initiating devices, a combined releasing/building fire alarm system panel may be used if approved by the cognizant NAVFAC Fire Protection Engineer.

B-15 ELECTRICAL.

Reserved for future use.

B-16 CIVIL.

APPEARANCE.

Locate HVAC equipment, meters, poles, transformers, vaults, pressure reducing station piping and valving, and other utility items so that they do not detract from the building's appearance. Design should also reduce the negative visual impact of utility items and communication lines.

ENERGY CONCERNS.

Consider the effect of local sun angles and wind conditions on the hangar.

WINDS.

n harsh climates, seacoasts and areas of consistently high or changing winds, design hangar entry points (hangar bay, personnel entrance and windows, intake and exhaust

vents) to compensate for these adverse conditions, including snow. Consider prevailing and seasonal wind conditions as well.

SECURITY FENCING.

Limit the use of fencing to enclose and separate areas within the vicinity of the hangar to those conditions requiring security or the protection of life, separation of a construction site from operational facilities, isolation of a hazardous area, or as stipulated by the Base Security Department.

LANDSCAPE PLANTING.

Make use of low maintenance landscape plants that are indigenous to the area. Existing mature trees and vegetation should be retained whenever practical. Landscape design should avoid planting next to the hangar that would permit concealment in accordance with criteria set forth in UFC 4-010-01,*DoD Minimum Antiterrorism Standards for Buildings*. As hangars are generally in industrial areas, limit landscaping to entrances and other public areas.

UTILITIES.

Consider utilities that are essential to efficient operation and design of adequate size to serve future requirements in the early planning stages. Specifically address the adequacy of existing utilities support and include any additional needs. Plan utility lines to minimize utility easements, capital investments, and maintenance and repair costs.

UNDERGROUND LINES.

Locate underground utilities to minimize the cost and effort of performing maintenance. Normally, utility lines of any type should not be located under hangars, parking lots, sidewalks, and other paved areas. Locate all underground utility lines, mains, and conduits at the minimum depth required in accordance with local code, frost line and water table requirements, and, when possible, in common corridors to allow for ready access and maintenance. Locate utilities to allow for future expansion of the flightline.

STORM DRAINAGE.

The building up of undeveloped areas may have a noticeable effect on installation drainage facilities; major alterations or extensions to storm sewers and drainage channels may be required because of the location and design of new facilities.

APPENDIX C: AIRCRAFT DATA

Specific aircraft data can be obtained from the Aircraft Characteristics Database at http://www.uscost.net/aircraftcharacteristics.

AIRFRAME TYPE, OR MODEL AND SERIES	TYPE HANGAR MODULE	WINGSPAN (MAX)		FUSELAGE LENGTH	MAX HEIGHT	WEIGHT	
		NORMAL	FOLDED			EMPTY	MAX TAKE OFF
		(ft-in)	(ft-in)	(ft-in)	(ft-in)	(LB)	(LB)
A6 AIRFRAME	I	53-0	25-4	54-9	21-11	26600	60400
C2A	I	80-7	35-6	56-8	15-11	31400	55000
H1 AIRFRAME	I	48-2	-	42-5	14-5	10200	14750
H2 AIRFRAME	I	44-0	-	38-4	15-6	6953	13500
H3 AIRFRAME	I	62-0	-	54-9	16-10	13465	21000
H60 AIRFRAME	I	53-8	-	50-0	17-2	13648	21000
T2C	I	38-2	-	38-8	14-10	8115	13179
TAV8B	I	30-4	-	46-4	11-8	14223	31000
F18 AIRFRAME	I	42-10	-	60-3	16-0	-	66000
E2C	I	80-7	29-4	57-7	18-4	39373	53267
C130 AIRFRAME	II	132-7	-	97-9	38-3	79981	175000
CH53 AIRFRAME	II	79-0	-	73-4	29-5	33226	73500
MH53 AIRFRAME	II	79-0	-	73-4	29-5	33226	69750
C40 AIRFRAME	III	112-7	-	129-6	41-2	-	171000
P3 AIRFRAME	III	99-8	-	116-10	33-9	61500	135000
MMA P-8A	III	117-6	-	126-6	41-2	138300	184700
V-22 AIRFRAME	II	84-7	18-6	57-4	22-1		
***CONSULT WITH CNIC, NAVAIR AND NAVFAC CIENG FOR SPECIAL MMA AIRCRAFT HANGAR REQUIREMENTS.							

AIRFRAME TYPE, OR MODEL AND SERIES	TYPE HANGAR MODULE	WINGSPAN (MAX)		FUSELAGE LENGTH	MAX HEIGHT	WEIGHT	
		NORMAL	FOLDED			EMPTY	MAX TAKE OFF
		(m)	(m)	(m)	(m)	(kN)	(kN)
A6 AIRFRAME	I	16.15	7.72	16.69	6.68	118.3	268.7
C2A	I	24.56	10.82	17.27	4.85	139.7	244.7
H1 AIRFRAME	I	14.68	-	12.93	4.40	45.4	65.6
H2 AIRFRAME	I	13.41	-	11.68	4.72	30.9	60.1
H3 AIRFRAME	I	18.90	-	16.69	5.13	59.9	93.4
H60 AIRFRAME	I	16.36	-	15.24	5.23	60.7	93.4
T2C	I	11.63	-	11.79	4.52	36.1	58.6
TAV8B	I	9.25	-	14.12	3.56	63.3	137.9
F18 AIRFRAME	I	13.06	-	18.36	4.88	-	293.6
E2C	I	24.56	8.94	17.55	5.59	175.1	236.9
C130 AIRFRAME	II	40.41	-	29.79	11.66	355.8	778.4
CH53 AIRFRAME	II	24.08	-	22.35	8.97	147.8	326.9
MH53 AIRFRAME	II	24.08	-	22.35	8.97	147.8	310.3
C40 AIRFRAME	III	34.32	-	39.47	12.55	-	760.6
P3 AIRFRAME	III	30.38	-	35.61	10.29	273.6	600.5
MMA P-8A	III	35.81	-	38.56	12.55	615.2	821.6
V-22 AIRFRAME	II	25.78	5.64	17.48	6.74		
***CONSULT WITH CNIC, NAVAIR AND NAVFAC CIENG FOR SPECIAL MMA AIRCRAFT HANGAR REQUIREMENTS.							

APPENDIX D: QUESTIONNAIRE

MAINTENANCE AND OPERATIONS QUESTIONNAIRE FOR NEW HANGAR DESIGN

1. What type of lighting will be required on the parking apron?

2. Will outside public address system be required?

3. How many employees, both direct and indirect, are expected to occupy the hangar per shift?

4. Will a security fence be required around the hangar?

5. What type of lighting will be required in the employee parking lot?

6. Will a guard booth be required at roadway entrance to hangar area?

7. What type of signage is required for exterior of hangar?

8. Will there be parking spaces for executive parking, visitor parking, and handicapped parking close to entrance of hangar? Of so, how many and what locations?

9. Will there be a requirement for special devices to be mounted to hangar roof, such as an antenna, microwave dishes, etc?

10. Will cleaning or paint scaffolds be required?

11. Will stabilized platforms or other overhead suspended scaffolding systems be required?

12. Will “stacker” cranes be used?

13. Will overhead or in-ground utilities be required? Of so, what locations?

14. Will 400HZ be required?

15. Will 400 Hz be solid-state or M/G set?

16. Is 28 VDC required? If so, what spaces will utilize the 28 VDC?

17. Will security systems be required? If so, what types will be required (IDS, CCTV, or access control)?

18. Will breathing compressed air be required?

19. What will be the heaviest cfm drawn from hoses? (Quantity of outlets?)

20. Will standard power be required overhead?

21. Will personal fall arrest systems be required above aircraft? If so, what type?

22. What type and source of lighting will be preferred in the hangar? (Metal Halide, High Pressure Sodium or T8/T5 linear fluorescent?) What lux (foot-candle) levels are required? (Per current UFC handbook.)

23. Will tail docks, wing docks, fuselage docks or nose docks be required? If so, what utilities will be hooked up to them? i.e. 480 volt, 120 volt, compressed air or water?

24. Will door track heating be required?

25. Will door track drainage be required?

26. What type of utilities will be required around the inside perimeter of the hangar? Such as 480 volt, 120 volt, 208 volt, 400-Hz, compressed air, water, etc. Please give location and capacity required.

27. Will a PA system be required? If so, give location and number of microphones.

28. What type of power tooling will be mounted in hangar? Such as drill presses, grinders, shearers, brakes, etc. In what location will this machinery be mounted? What type of utilities will be required for operation?

29. Will there be overhead coiling doors? If so, give location and size. (Will any locations require power for motor operators?)

30. What loads should be served with emergency power?

31. Verify shop requirements.

    a. Type of shops?

    b. Square footage needed for each shop?

    c. The location in the building?

    d. What utilities are required?

    e. Are floor drains needed?

    f. Crane coverage and hook heights?

g. Overhead air and electric reels?

h. Machinery location and utility requirements?

i. Floor coatings required?

j. Number and size of roll-up doors to outside of hangar.

k. Give location and number of telephones.

l. What are the serving requirements for shops? Shipping and receiving docks? Waste disposal?

32. Will there be an inspection area? If so, give square footage, location and utilities required.

33. Will a cleaning shop be required? If so, give square footage, location, utilities required. Also, please note any special or heavy drain items such as salt bath ovens or large ovens. Provide material safety data sheets for all cleaning products including application rates, methods, durations and frequencies.

34. Will there be a lunch/break room? If so, please indicate square footage, location of building, number of employees per shift, if vending machines will be used, what type of floor, and if drop ceilings will be required.

35. Will waste oil drains be required? If so, give locations in hangar for receptacle funnels.

36. Will there be a drum room? If so, how many drums should it hold? What types of chemicals are to be stored?

37. Where are hazardous waste containers to be located?

38. What type of door security devices will be used? How many and what locations?

39. Any fluid discharges that may harm metal piping that would require an acid waste system? (X-ray room, etc.)

40. Will there be any operational requirements for emergency eye wash/shower units? (Locations?)

41. What locations are required for hose reels for water or air? (Overhead, column mounted or shop areas?)

42. Will there be a need for exterior deployment storage space?

43. Is there a need for a dumpster or waste recycling?

44. Is there a need for a pedestrian turnstile gate with a swipe card access system, in the flightline security fence?

45. Will there be a SCIF? Verify the requirements.

APPENDIX E: HANGAR BAY DIMENSIONS

HANGAR BAY DIMENSIONS.

	TYPE I	TYPE II	TYPE III	SEE NOTES
WIDTH	210' 64.01M	325' 99.1M	165' 50.3M	See note 1
DEPTH	95' 28.96M	119' 99.1M	165' 50.3M	see note 2
Net Area	19,975 SF 1855.74 SM	38,675 SF 3593.03 SM	27,225 SF 2529.29 SM	See note 3
Allowed Gross Area	20,974 SF 1948.55 SM	40,609 SF 3772.70 SM	28,586 SF 2655.73 SM	
CLEAR HEIGHT	32.5' 9.91M	42' 13.11M	46' 14.02M	See note 7
HOOK HEIGHT	29.5' 8.99M	34' 10.36M	NONE	See notes 8, 9, 10
DOOR WIDTH	232' min 70.71M	322' min 98.15M	162' min 49.38M	See Note 4
DOOR HEIGHT	25' 7.62M	42' 13.11M	46' 14.02M	See note 6
CLEARANCES				See Note 5
REAR	10' 3.05M	10' 3.05M	20' 6.10M	
SIDES	5' 1.52M	5' 1.52M	5' 1.52M	See Note 11
FRONT WALL (DOOR)	5' 1.52M	5' 1.52M	5' 1.52M	

Notes

1. Width of hangar shall be determined as the dimension to the inside face of the exterior walls at the hangar floor level. This may be the face of a cmu knee wall or the face of the girts.

2. The depth of the hangar bay shall be determined as the dimension between inside face of the rear wall and the face of the interior face of the fabric door. In hangars with steel doors, the distance will be to the face of the innermost door panel.

3. Area allocated to sliding door pockets are not included in the Gross Area Calculations, however area required for depth of staggered door panels are included in the Gross Area Calculation. Allowed gross area is provided to allow for various wall types. Excess area may not be reallocated to 01 or 02 spaces.

4. Hangar door width shall be determined by the structural elements at the edge of the door opening. The width of the opening shall be not less than 3' less than the width of the hangar bay.

5. Clearances are measured from the face of walls and columns or permanent obstructions such as power points, bollards, and similar features. Floor markings will be moved to reflect the clearance requirement.

6. Height of hangar door may be reduced to provide a clearance of 4' above the tail height of the aircraft anticipated to be the hangar bay. Reduction in the height of the door may only with the permission of NAVFAC Atlantic CI ENG.

7. Dimensions for width, depth and height are considered to be "standard". Variations in hangar bay sizes are not permitted without authorization of the NAVFAC Atlantic CI ENG. Additionally, Marine Corps hangar bay configurations may be modified by Headquarters, USMC (LF).

8. Hook height is to the saddle of the hook.

9. For USMC, Type II hangars, the bridge crane coverage must be designed to account for the possibility of servicing a C-130 aircraft. Coordinate crane coverage with the activity.

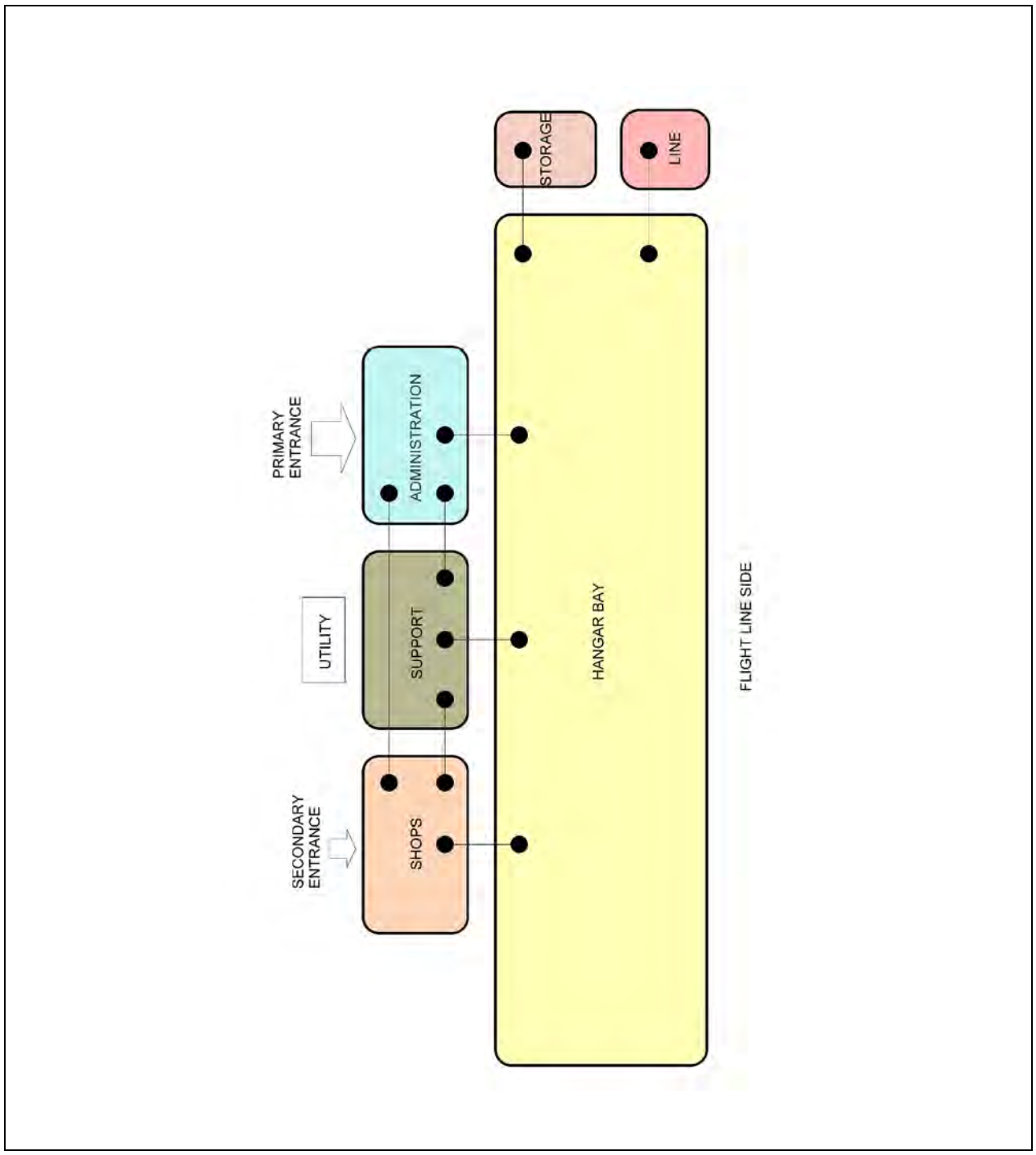
10. See diagrams to clarify hangar crane coverage area for Type II hangars.

11. 7’ side clearance required for V22 Aircraft.

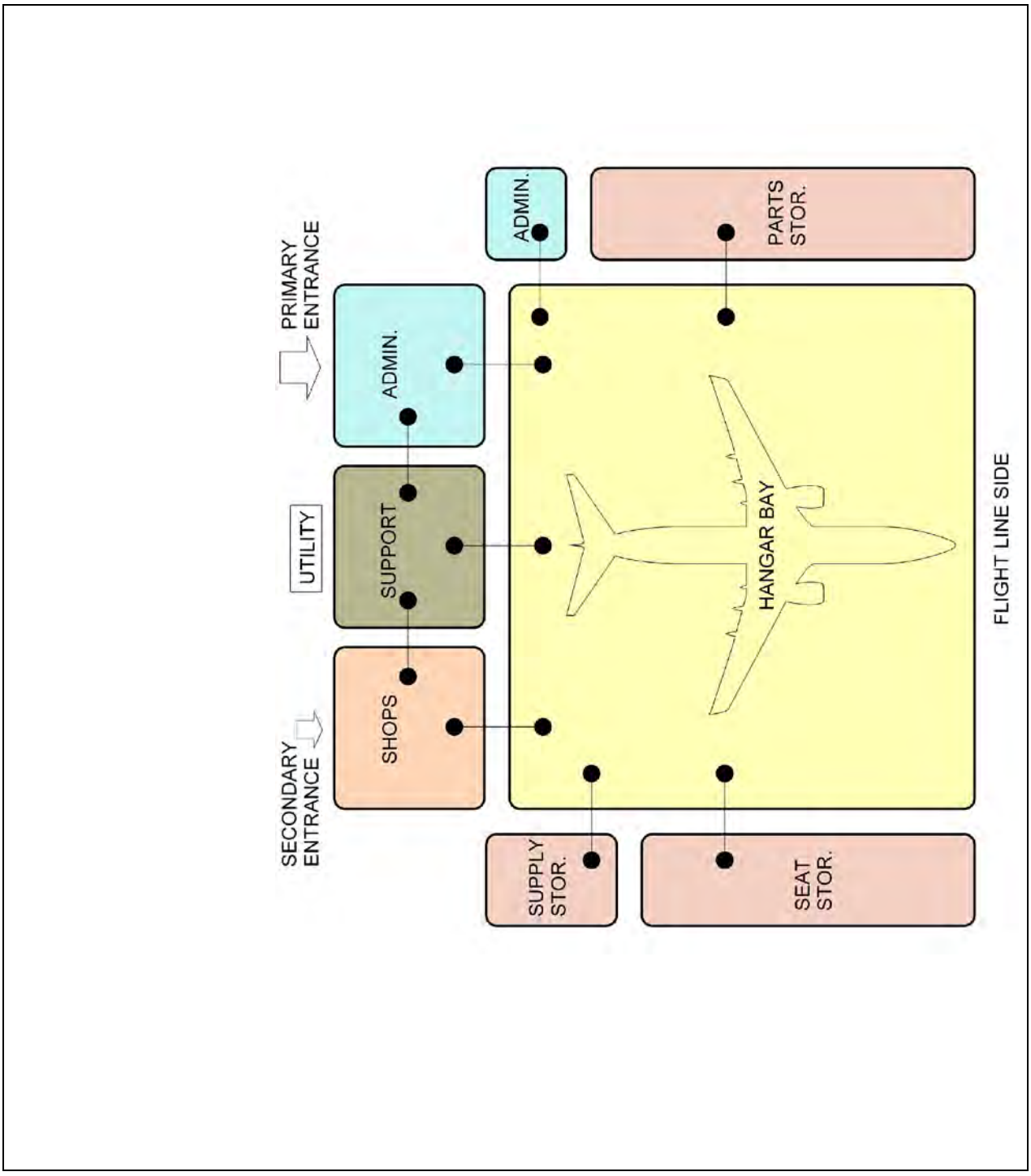
APPENDIX F: DRAWINGS AND SKETCHES

The conceptual floor plans and notional drawings illustrate functional relationships and are not intended for use as standard designs.

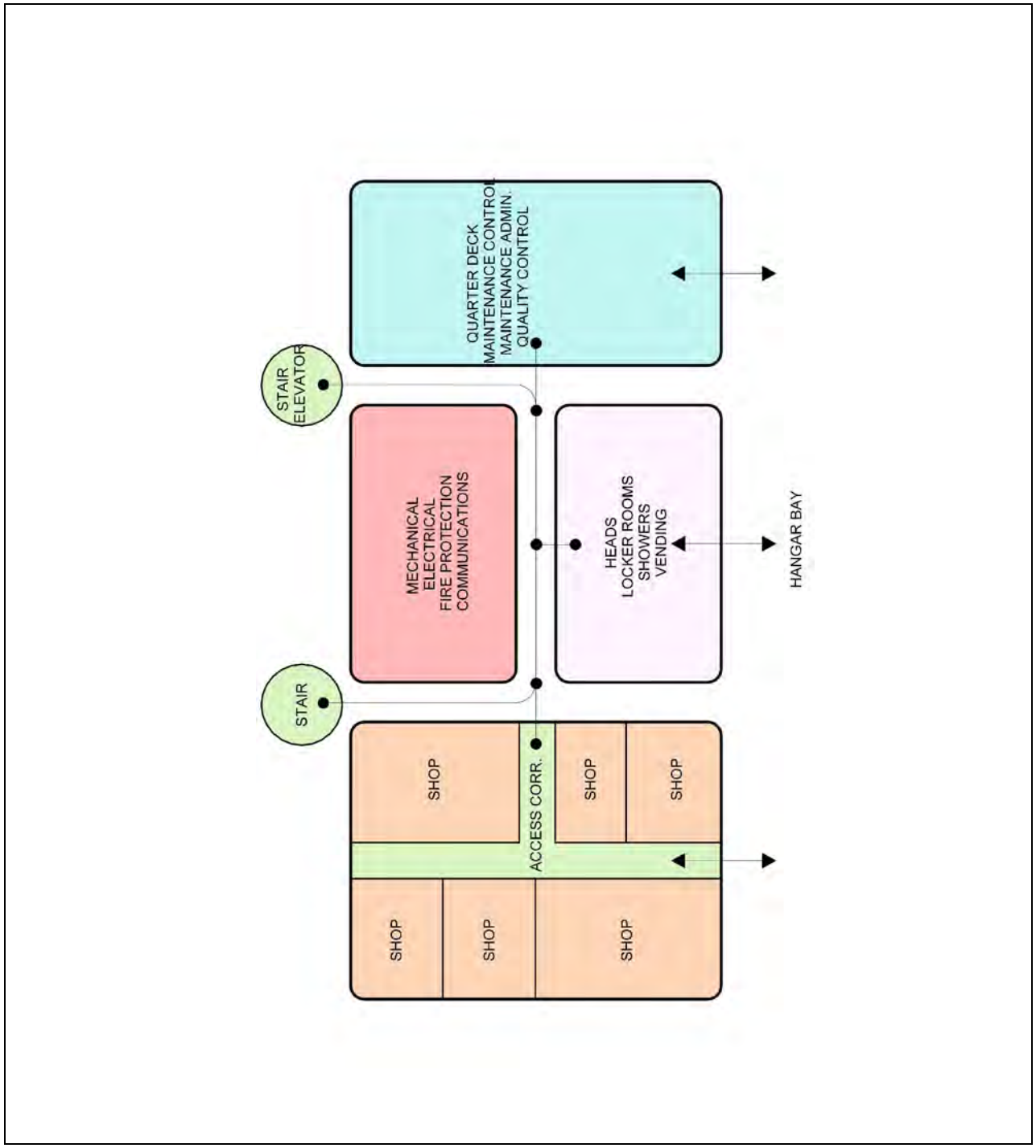
Index to drawings and diagrams



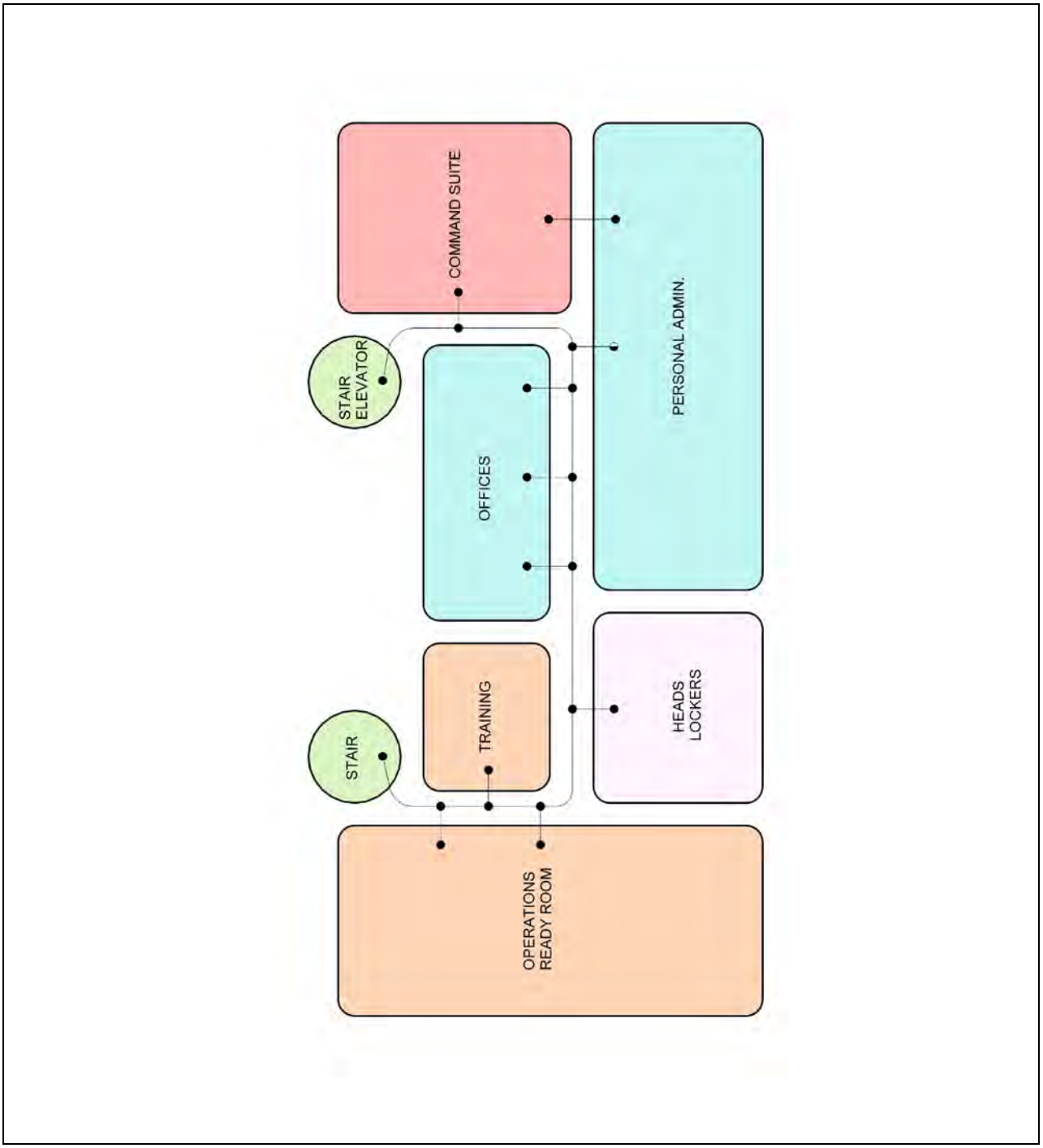
TYPE I AND TYPE II HANGAR DIAGRAM



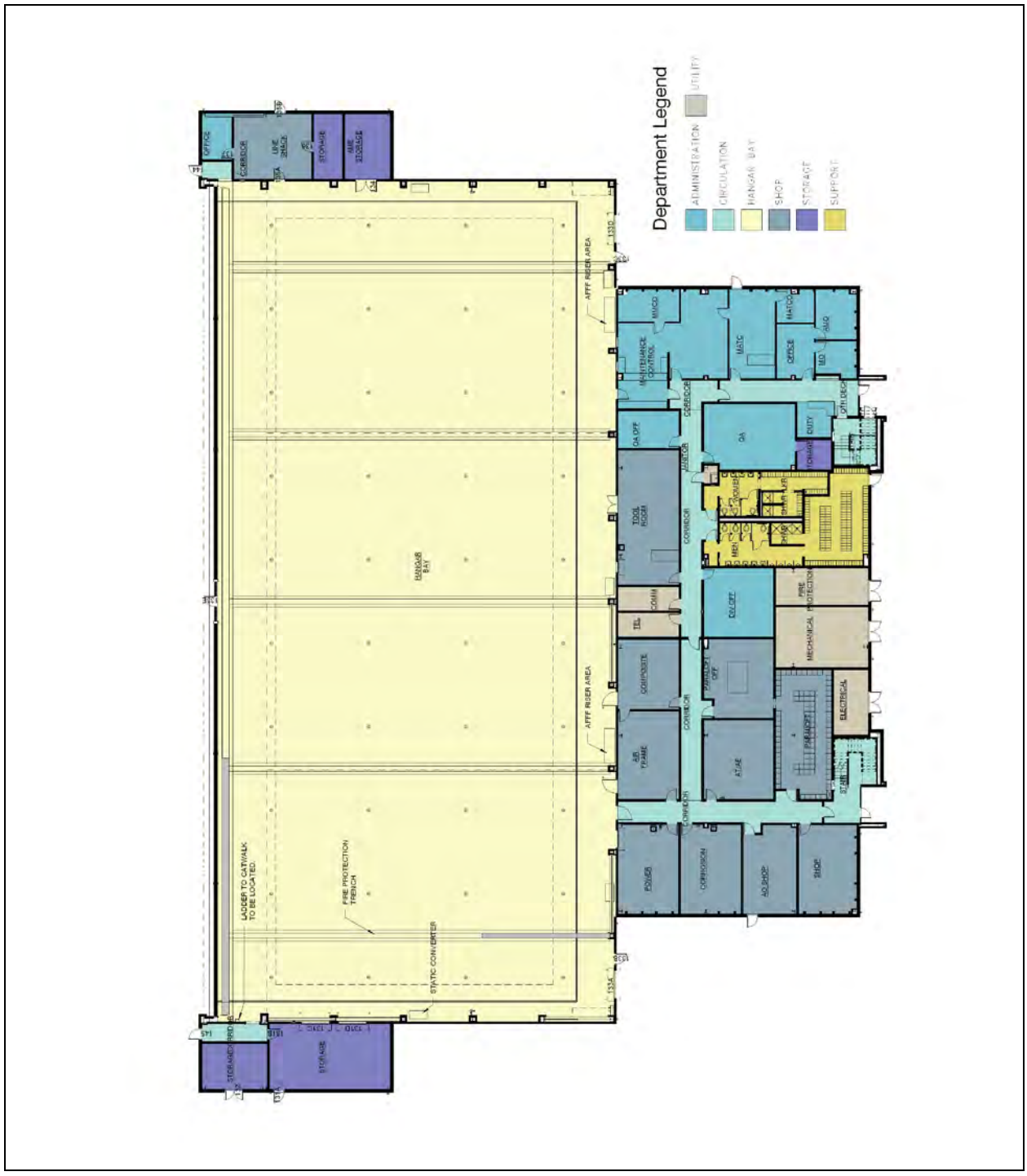
TYPE III HANGAR DIAGRAM



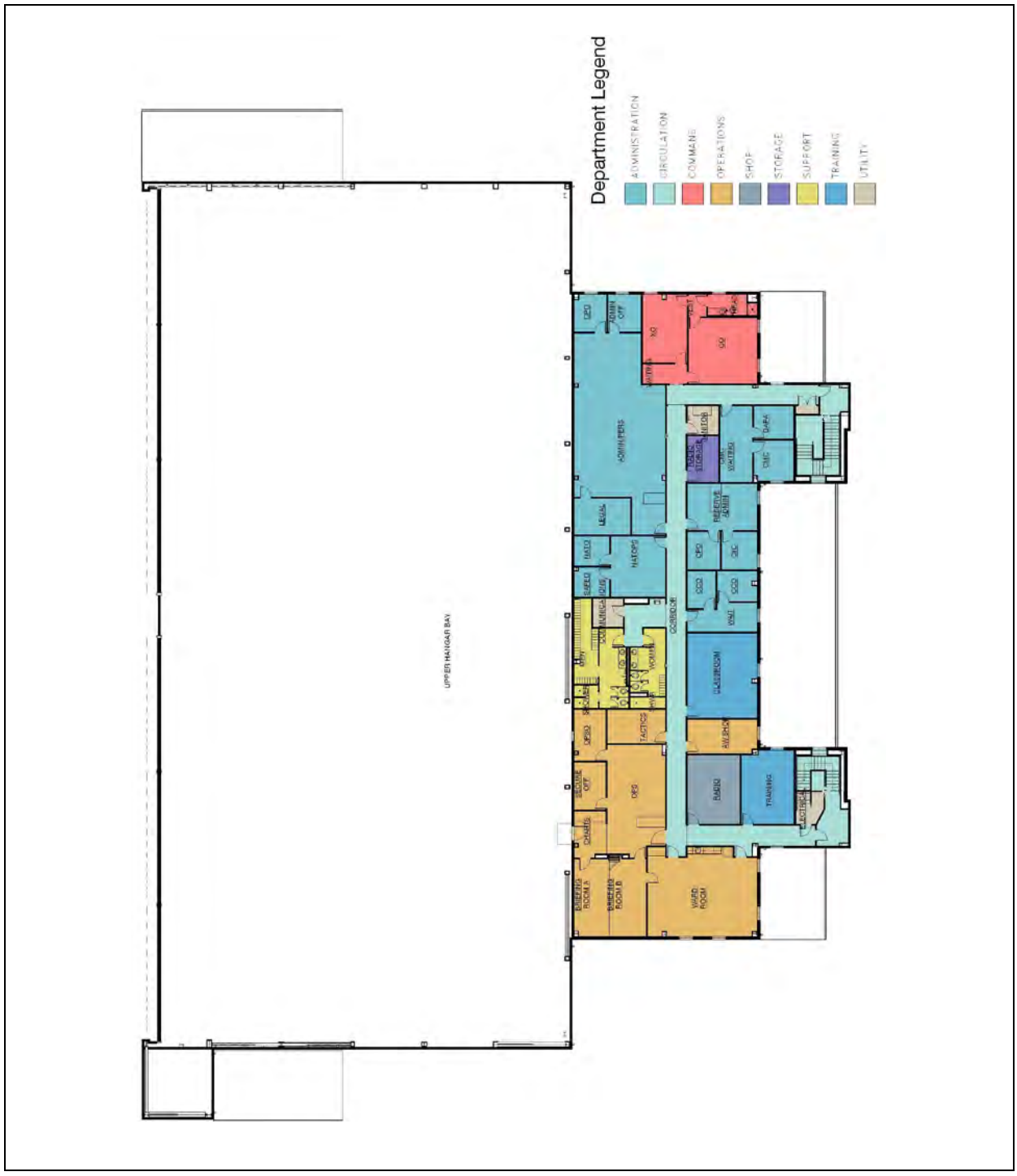
O1 LEVEL DIAGRAM



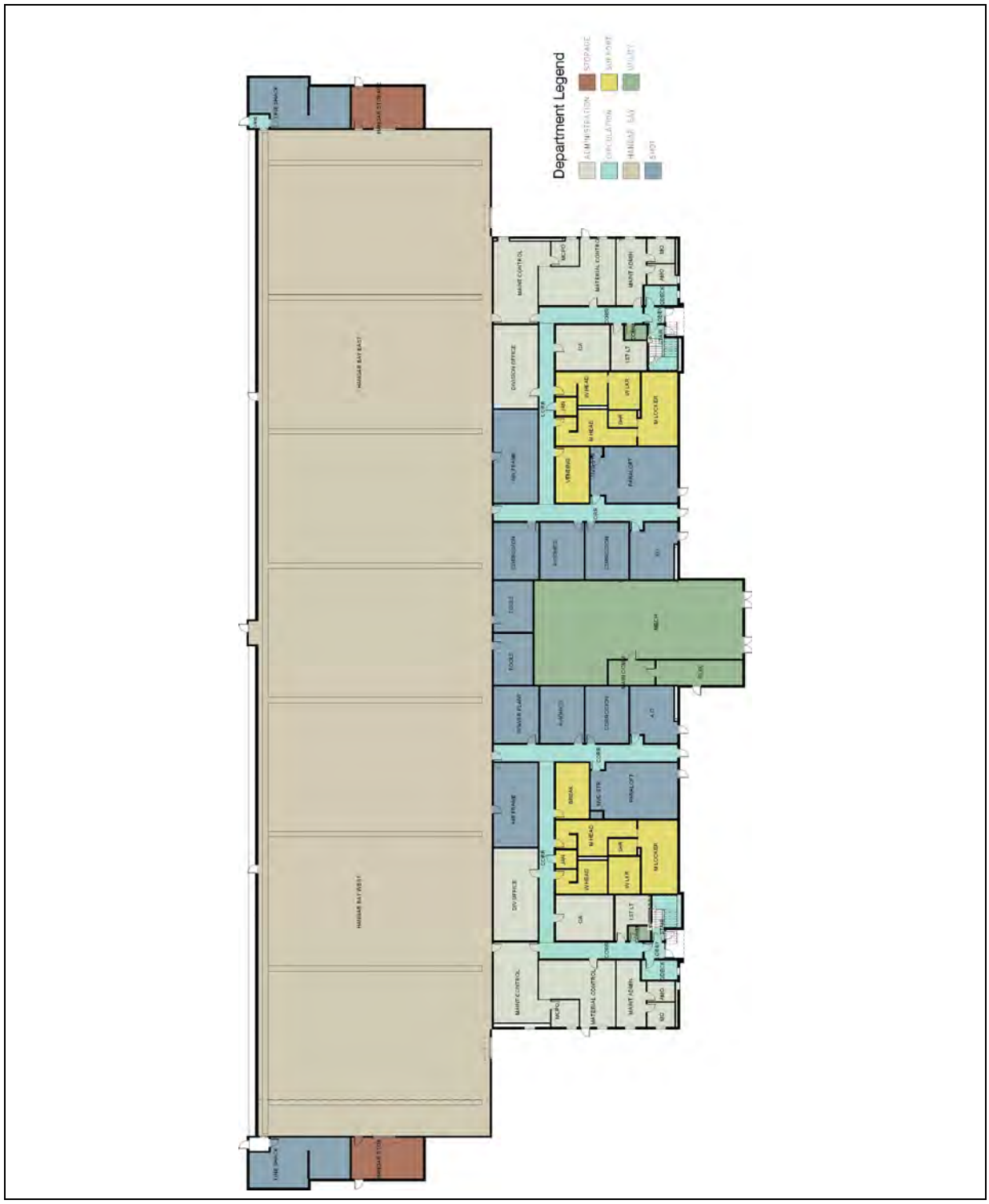
O2 LEVEL DIAGRAM



SINGLE MODULE HANGAR 0H/01

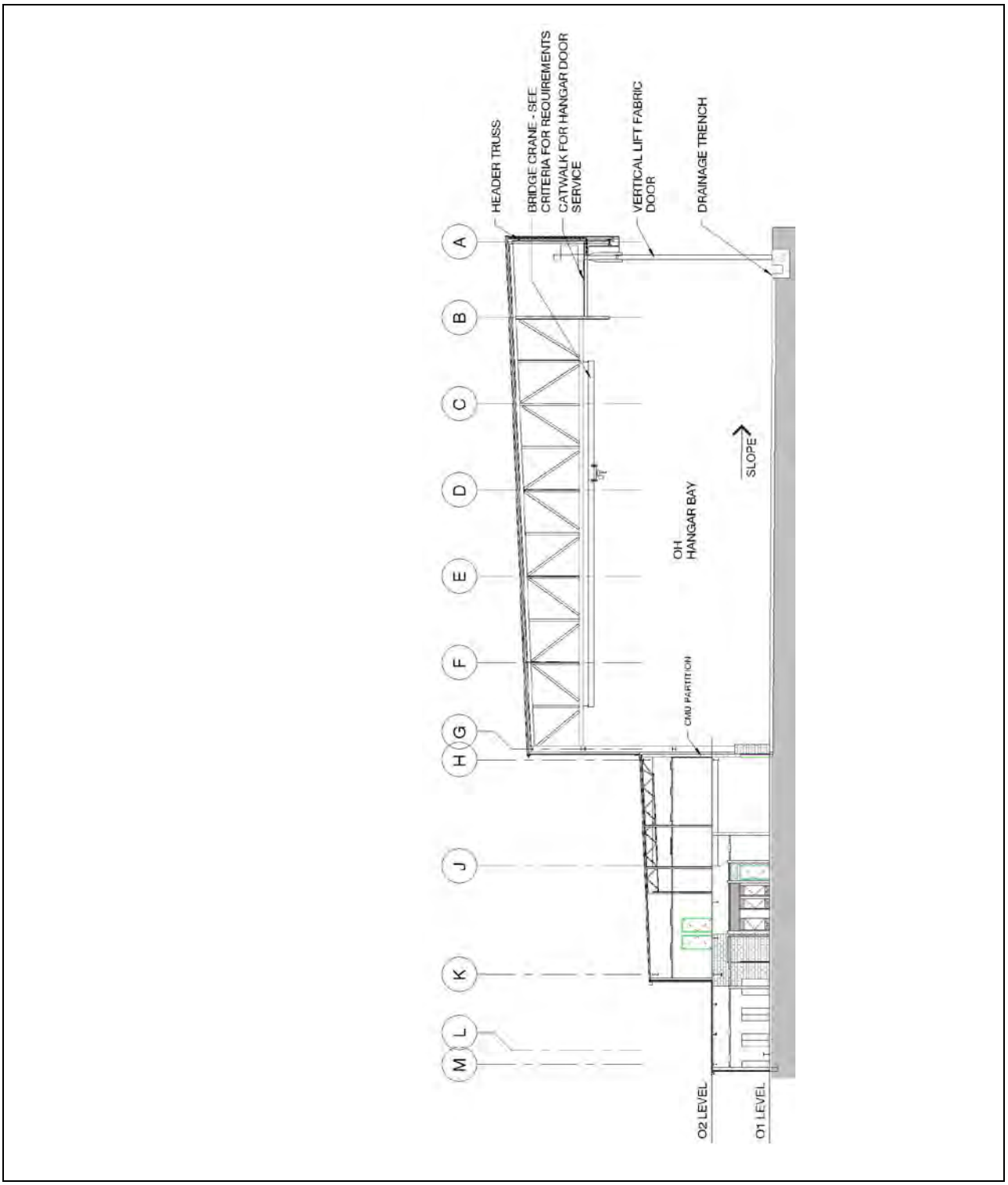


SINGLE MODULE HANGAR – O2

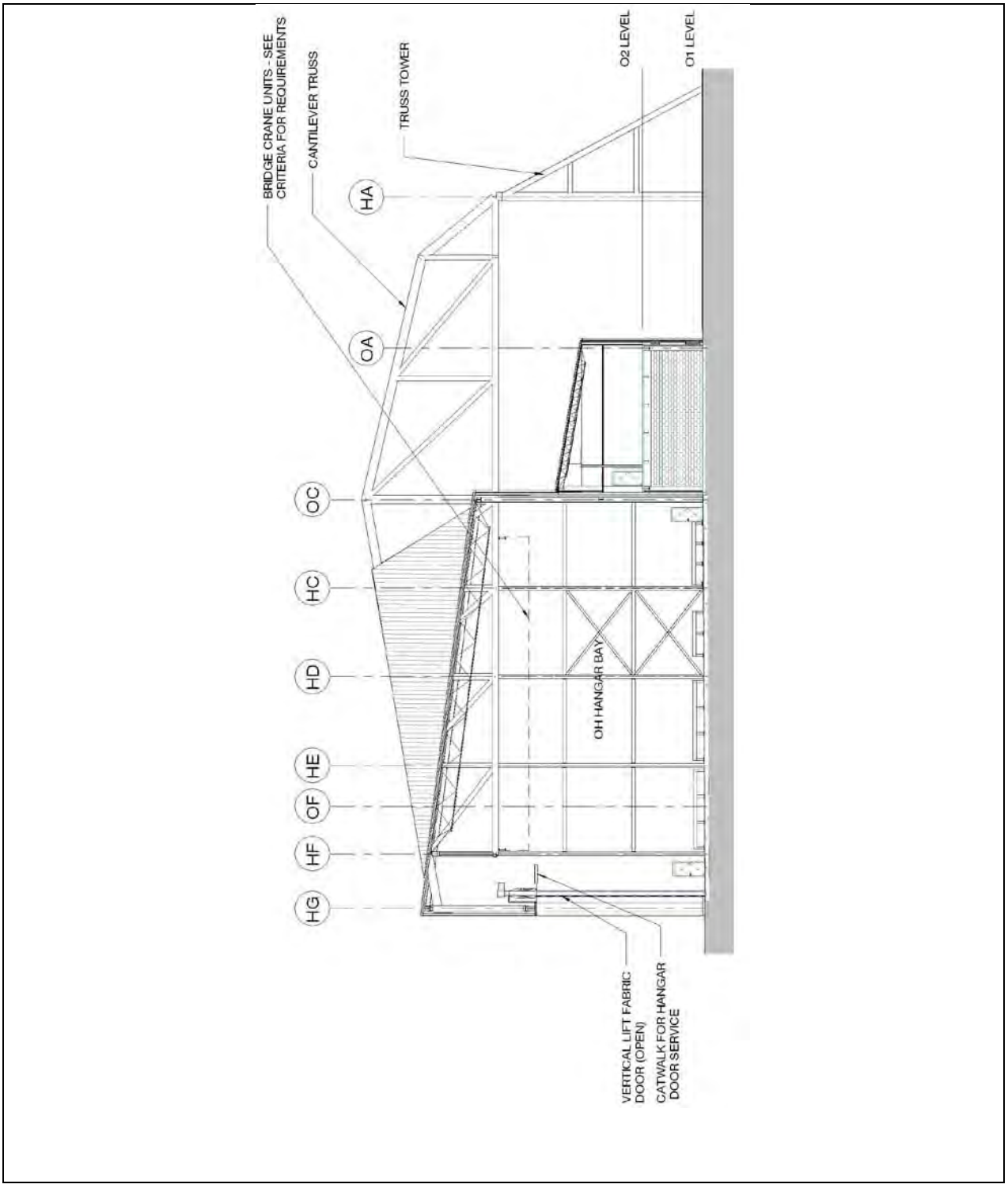


DOUBLE MODULE HANGAR – OH/O1

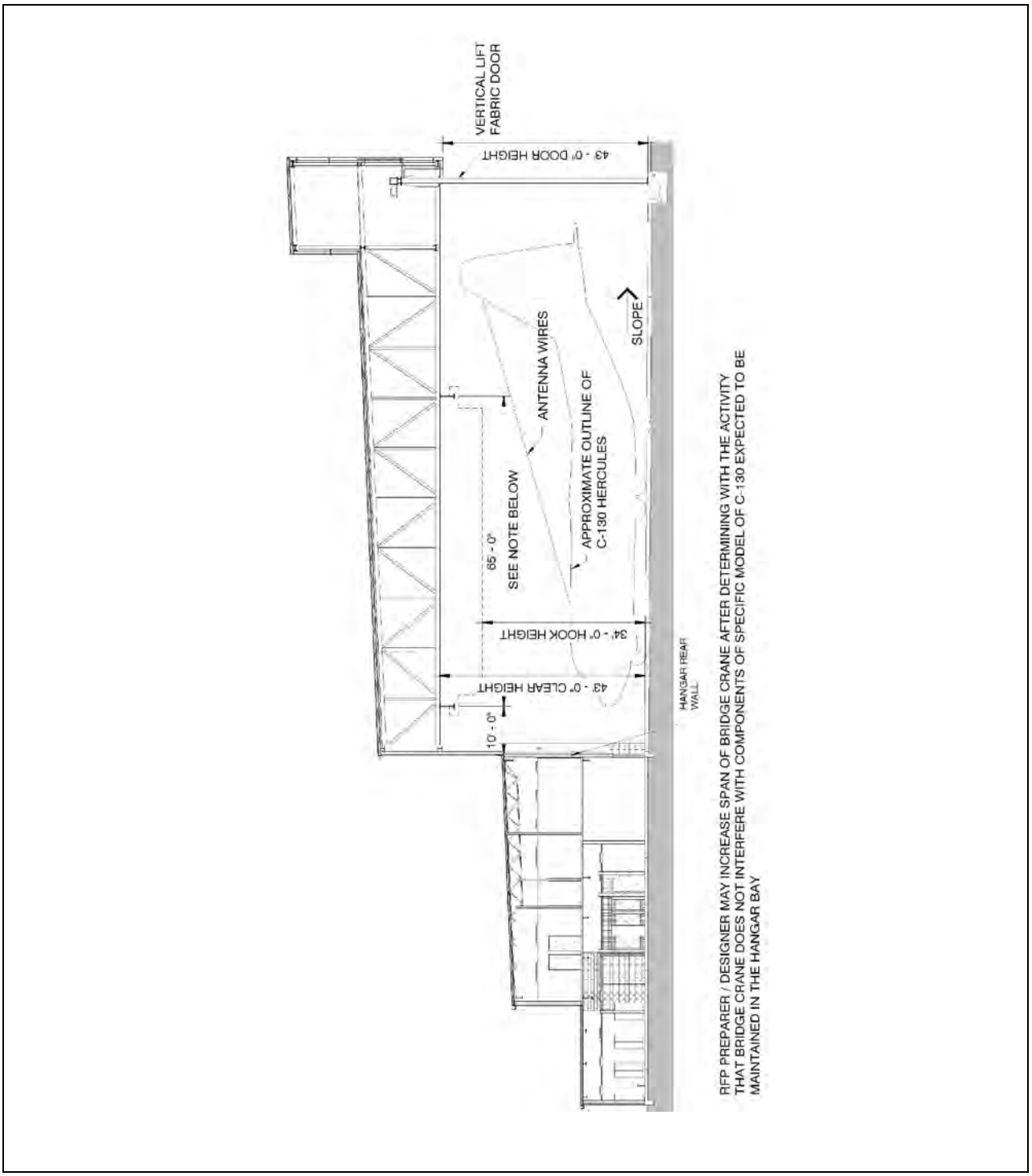
DOUBLE MODULE HANGAR– O2



SECTION SHOWING HEADER TRUSS



SECTION SHOWING CANTILEVER TRUSS



SECTION THROUGH TYPE II HANGAR SHOWING CRANE CONFIGURATION