US Army Corps of Engineers®

JAPAN DISTRICT DESIGN GUIDE

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PREFACE

In February of 2017, the first version of the Japan District Design Guide (JDDG) was put forth with a vision that it would “be a valued and often used desk reference for practicing professionals….” We are very pleased with the success of the guide and have continued our efforts to hereby put forth JDDG Version 3.0.

The intended purpose of this updated version is to add clarity and accuracy to the existing guide, and to expand our guidance into other areas not previously covered in the prior version. As the District’s Military Construction (MILCON) program continues to move forward with priority and urgency, this guide will continue to be a valued desk reference for practicing professionals whom are performing work for the District.

Practical use of the guide will not only help clarify the District’s expectations of designs and their respective submittals, but more importantly, your efforts to use the guide will have an immediate effect and will help us in raising the standard of our quality.

Our design partners have our full support! As you prepare designs, we urge you to reference the guide—examine, highlight, and mark it up—and when errors or omissions are observed, we want to hear about it. Please send us your comments via email at JDDG@usace.army.mil.

Together with our design partners, we will build and deliver a world-class program!

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Change log for Japan District Design Guide Version 4.0

2.6.1. Added 18. Cybersecurity (Requirement: Refer to Chapter 19 of JED Design Guide for requirements.)

3.4.5 Paragraph revised from LOCAL JAPANESE STANDARDS AND METHODS to JAPAN EDITED SPECIFICATIONS (JES)

5.2 Added UFC 1-200-01 DoD Building Code. Added US Pacific Command Instruction 0536.2 April 6, 2018 (FOUO) Engineering and Construction Bulletin No. 2019-1 Marine Corps Installations Pacific-MCB Camp Butler Policy Letter 3-19 (See Appendix) Air Force Instruction 10-245 June 25, 2015.

5.9.2 Revised paragraph to Standard window geometries (i.e. height, width, number of sashes, and height of sill) are described in Appendix A of the PDC-TR 12-08. Deleted Figure 1: USACE Protective Design Center approved Window Geometry.

5.9.4 Replaced “allowed” with “biddable.”

5.10 Revised sentence to Alternate Design options are described in Appendix C of the PDC-TR 12-08. Deleted Figure 2: Entrance Doors in Direct Alignment of Main Entry.

5.10.1 Deleted Figure 3: Entrance Doors Offset of Main Entry.

5.10.2 Deleted Figure 4: Entrance Doors Offset of Main Entry.

6.2 Deleted the 2016 date in reference to MILITARY SURFACE DEPLOYMENT AND DISTRIBUTION COMMAND TRANSPORTATION ENGINEERING AGENCY (SDDCTEA) SDDCTEA Pamphlet 55-17: Better Military Traffic Engineering

6.3.2.2 CHARRETTE DESIGN sentence revisions.

6.3.4.2 DESIGN ANALYSIS inserted new bullet.

6.3.6.1 DRAWINGS DEMOLITION PLAN sentence revisions.

6.6.14 TREES, SHRUBS AND LANDSCAPING MATERIAL revised 1” to 25mm.

6.7.2 SITE ACCESS AND CIRCULATION sentence revision.

6.7.3.1 PRIVATELY-OWNED VEHICLE (POV) PARKING paragraph revision.

7.2 Added JIS R 3109 Glass in Building – Destructive Windstorm - Resistant Security Glazing – Test Method. ASTM A29 Standard Specification for General Requirements for Steel Bars, Carbon Alloy, Hot-Wrought. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. ASTM E1886 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Missile(s) and exposed to Cyclic Pressure Differentials. Revised Japanese Industrial Standard (JIS) to Japanese Standards Association (JSA). JIS A5373 Precast Pre-Stressed Concrete Products. JIS A7201 Standard practice for execution of spun concrete piles. JIS B1186 deleted Headed Studs. Added JIS B 1198 Headed Studs JIS G 3536 Steel-wires and Strand for Pre-Stressed Concrete. JIS G 3538 Hard Drawn Steel Wire for Pre-Stressed Concrete. JIS Z3021 Welding and Allied Processes - Symbolic Representation. JIS Z3211

Covered Electrodes for Mild Steel, High Tensile Strength Steel and Low Temperature Service Steel". Japanese Welding Engineering Society (JWES) WES B107 Standard for Certification of Welding Practitioners. Deleted ASTM A446 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by Hot Dip Process. Structural (Physical) Quality.

7.3.6 Deleted (Missles A & D except for essential facilities) 2007 (Missles A & C except for essential facilities).

7.3.7 Revised UFC 3-310-04 to UFC 3-301-01.

7.5.1 DEEP FOUNDATIONS paragraph revised. Attached Table PHC Piles.

7.6.3.1 Added foot note underneath Table 9

7.6.4 Added Concrete Anchors. Anchor such as adhesive or wedge type shall be as indicated on the drawings. Provide the following minimum data: tensile strength, shear strength, anchor bolt diameter, embedment depth and number of test required after installation. Japanese anchors shall be certified by the “Japan Construction Anchor Association (JCAA).”

7.6.7 Added 7.6.7 NON-SHRINK GROUTÐon-shrink grout shall conform to ASTM C1107/C1107M. The following Japanese products are compliant:. Denka Pretascon Type-1R. Taiheiyo Pre U-Lox. Tokuyama Grout Mix JHS-312.

7.8.1 Replaced Table 10 with Table 11 and added new paragraph. Added Table 12.

7.8.4 Added Shop and field welding shall be performed by welders certified per JIS Z 3801 and WES B107-Standard for Certification of Welding Practitioners" by Japan

Welding Engineer Society. Welding electrodes are in accordance with JIS Z3211, E49, 400MPa(58 ksi). Welds not indicated shall be 5mm minimum fillets. Base metal pre-heating shall follow the requirements of JASS 6 of AWS D1.1. Weld symbols per JIS JIS Z 3021 (Equivalent to AWS).

7.10 Revised ASTM A446 with ASTM A653

7.12.3.2 Revised paragraph.

7.12.3.3 Revised paragraph.

8.11 Added Seismic Bracing of Non-Structural Components & Special Inspections Table

10.12 Added SEISMIC DESIGN REQUIREMENTS (OF ARCHITECTURAL SYSTEMS)

11.1 Deleted Unified Facilities Guide; Replaced Conservative with Conserving

11.2 Sentence revision regarding UFC 3-401-01

11.3 Sentence revision regarding Design Considerations

11.3.1 Revised Outdoor Design Conditions to Design Conditions

11.3.5 Equipment Anchoring revised from Vibration Isolation/Equipment Pads

11.3.6 Deleted DCID 1/21 and HEMP. Added UFC 4-010-05 SENSITIVE COMPARTMENTED INFORMATION FACILITIES PLANNING, DESIGN, AND CONSTRUCTION

11.3.7 Deleted Provide a portable meter, with appropriate range, for each type of flow measuring device installed.

11.3.9 Deleted REDUNDANCY

11.3.10 Deleted SPARE PARTS

11.4.1 Deleted DETERMINATION OF EXISTING HEAT DISTRIBUTION SYSTEMS

11.4.2 Deleted SELECTION OF HEAT DISTRIBUTION SYSTEMS

11.4.2.1 Deleted ABOVEGROUND SYSTEMS

11.4.2.2 Deleted CONCRETE SHALLOW TRENCH (CST) SYSTEMS

11.4.2.3 Deleted BURIED CONDUIT (PRE-APPROVED TYPE)

11.4.2.4 Deleted BURIED CONDUIT (NOT PRE-APPROVED TYPE)

11.4.3 Deleted DESIGN OF HEAT DISTRIBUTION SYSTEMS

11.4.3.1 Deleted EXISTING SYSTEM CAPACITY

11.4.3.2 Deleted GENERAL DESIGN CONSIDERATION

11.4.3.3 Deleted SPECIFIC DESIGN CONSIDERATIONS

11.5.1 Deleted HAZARDOUS FACILITIES

11.5.2 Deleted SPECIAL OCCUPANCY STRUCTURES

11.5.3 Deleted STANDARD OCCUPANCY STRUCTURES

11.5.4 Deleted DUCTWORK IN BUILDING

11.5.5 Deleted MISCELLANEOUS EQUIPMENT

11.5.6 Deleted SEISMIC DESIGN REQUIREMENTS

11.6 Revised paragraph to only include: Insulation of installed systems should meet the requirements of the Unified Facilities Guide Specifications.

11.6.1 Deleted paragraph

11.6.2 Deleted PUMPS

11.6.3 Deleted INSULATION COVERS

11.7 Revised paragraph to only include: Compressed air systems will be designed in accordance with the requirements of UFC 3-420-02FA Compressed Air.

11.7.1 Deleted COMPRESSOR SELECTION

11.7.1.1 Deleted ANALYSIS

11.7.2 Deleted COMPRESSOR CAPACITY

11.7.3 Deleted COMPRESSOR LOCATION

11.7.4 Deleted FOUNDATION

11.7.5 Deleted MAKE-UP AIR

11.7.6 Deleted PIPING

11.7.6.1 Deleted UNDERGROUND PIPING

11.7.6.2 Deleted PIPE SIZING

11.7.7 Deleted COMPRESSED AIR OUTLETS

11.8.1 Deleted Unified Facilities Guide

11.14.2 Paragraph revision to include VRF Systems

11.14.3 Sentence revision concerning R-32 refrigerant acceptable use.

11.14.5 Deleted UFGS

11.15.7 Deleted ECONOMIZER CYCLE

11.15.9 Deleted VARIABLE AIR VOLUME SYSTEMS

11.16.1 Deleted last sentence of paragraph.

11.17.9 Added A Fire Protection room with pipes subject to freezing shall be protected in accordance with NFPA requirements.

11.17.14 Deleted TIA-569-B-1 added TIA-569-E and deleted TIA-569-B, 5.5.2.2.5.

11.20 Deleted Unified Facilities Guide

11.20.1.2 Added For all projects on mainland Japan, ensure proper freeze protection sequences are developed. The preferred method is to open the chilled water valves to 100% and turn on the pumps to keep water circulating. Chillers should operate via the own internal freeze protection features.

11.20.1.3 Deleted Unified Facilities Guide

11.23.1.3 Added: Document the decision of which systems will be included in the life cycle cost analysis.

11.23.2.3 Added: Life Cycle Cost Analysis including first cost estimates, annual energy costs assumption, annual maintenance cost assumptions, and BLCC reports. Deleted Electrical Load Summary.

11.25 Added SEISMIC DESIGN REQUIREMENTS (OF HVAC SYSTEMS)

12.4 Deleted SEISMIC DESIGN REQUIREMENTS

12.5.20 Deleted SEISMIC DESIGN CONSIDERATIONS

12.7 Added SEISMIC DESIGN REQUIREMENTS (OF PLUMBING SYSTEMS)

13.8.10 Deleted paragraph in its entirety.

13.11 Added SEISMIC DESIGN REQUIREMENTS (OF ELECTRICAL SYSTEMS)

14.7.6 Deleted paragraph in its entirety.

13.9.7.4 Deleted Premium Grade, Low Energy

18.2 paragraph revision, replaced Office with Section.

18.3 Deleted ‘on Okinawa’

18.4 Sentence revision concerning Abatement of Lead-Based Paint

18.8 Paragraph revision concerning Radon

18.10 Paragraph revision concerning Protection of Natural Resources

18.11 Paragraph revision concerning Federal Actions and Environmental Effects Abroad

18.12 Paragraph revision concerning Contamination Remediation Outside the U.S.

Chapter 19 CYBERSECURITY New addition to Version 4.0 of the JDDG

CHAPTER 1 - GENERAL INSTRUCTIONS

1.1 PURPOSE

The purpose of the Design Guide is to provide guidance that assists designers in preparing engineering deliverables for the U.S. Army Corps of Engineers (USACE), Japan District (henceforth referred to as the Japan District). Designers include the Architect-Engineer firms under contract with the Japan District, the Japan District project delivery teams producing in-house designs, and other USACE districts providing reach back support to the Japan District.

1.1.1 SCOPE

The Design Guide covers technical requirements for plans and design analysis submittals, specifications preparation, and quality control requirements for U.S. funded design and construction projects to include Military Construction (MILCON); Sustainment, Restoration and Modernization (SRM); Non-Appropriated Funds (NAF); and Operations & Maintenance (O&M).

The Design Guide contents focus on quality and technical design requirements. The Design Guide does not cover subjects such as scopes of work, project management, progress milestones and scheduling, value engineering, handling of sensitive information, and other procedural/managerial types of instructions and requirements.

1.1.2 APPLICATION

This Design Guide applies to all engineering deliverables produced for the U.S. Army Corps of Engineers, Japan District.

1.1.3 AUTHORITATIVE DOCUMENT

This Design Guide forms the standard for the Japan District to the extent specified herein. Every attempt should be made to comply with the guide, but exceptions may exist. These exceptions will be addressed on a case-by-case basis. All exceptions should be raised through the project Technical Leads.

1.2 DESIGN POLICY

The Unified Facilities Criteria (UFC) and the Unified Facilities Guide Specifications (UFGS) should be used to the greatest extent practical by all the Department of Defense (DoD) Components for planning, design, and construction (restoration and modernization) of facilities, regardless of funding source per DoD Directive Number 4270.5 paragraph 4.7, dated 12 February 2005.

The UFCs require compliance, as applicable, with Host Nation agreements and the Status of Forces Agreement.

1.3 DESIGN CRITERIA, REGULATIONS, MANUALS AND STANDARDS

The designer should use criteria established in the UFCs. The designer is responsible for determining the applicability of these design criteria to each project and incorporating

any applicable Service Component criteria in order to comply with all necessary design requirements. This Design Guide provides guidance on implementation of these agreements.

The UFCs and Service Component specific Technical Manuals, Engineer Manuals, Engineering Instructions, Technical Instructions, Engineering Technical Letters, and Military Handbooks are available electronically at the Whole Building Design Guide website (https://www.wbdg.org/ffc/dod).

Engineering criteria related to Host Nation agreements in Japan are referenced in the discipline specific chapters. The *Japan Environmental Governing Standards* (JEGS) issued by U.S. Forces Japan applies to all U.S. Installations located within Japan.

1.4 METRIC POLICY

Japan District policy is to use the metric system of measurement (International System of Units, SI) in planning and design criteria, Unified Facilities Guide Specifications (UFGS), and construction contract documents.

1.4.1 SI DEFINITIONS

1.4.1.1 HARD METRIC

A hard metric measurement indicates a non-interchangeable International System of Units (SI) value and is based on SI values that change in size and properties from Inch-Pound (IP) values. Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

1.4.1.2 SOFT METRIC

A soft metric measurement is a non-mathematical, industry related conversion. Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other controlling factor. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products.

1.4.1.3 NEUTRAL

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

1.4.2 GENERAL POLICY

1.4.2.1 PRODUCTS

All products should be specified in hard metric unless such products are unavailable or uneconomical. The DOR is responsible for making the determination on whether or not to use the metric system of measurement on a project-by-project basis. However,

decisions to not use the metric system should be approved by the Japan District and should be justifiable and documented in permanent project files.

1.4.2.2 WEIGHTS AND MEASUREMENTS

All dimensions should be specified in hard metric units of weights and measurements and should comply with Federal Standard 376B Preferred Metric Units for General Use by the Federal Government.

1.4.2.3 CONVERSION OF VALUES

The practice of converting US Units (to include Customary, Empirical, and English units) into SI units is highly problematic. Practitioners preparing and/or providing construction contract documents should eliminate the practice of converting units of weights and measurements. In circumstances that may require the use of US Units, the AE should coordinate the use of such units with the project Technical Lead and Project Manager, and be approved by the Japan District.

1.4.2.4 METRIC PROJECT DEFINITION

The Japan District considers a project to be metric when such applications intended for use in engineering studies, analyses, plans, and/or construction contract documents are performed using the SI unit system as described above. All designs should be initiated with SI units of weights and measurements as referenced above as Hard Metric.

1.4.2.5 DUAL DIMENSIONING

The practice of dual-dimensioning is prohibited. This practice adds confusion, not clarity, and is not approved for use in construction contract documents unless approved by the Japan District.

1.5 COST ESTIMATES

The *Japan District Cost Estimating Guide*, issued upon a Task Order (FOUO), is a separate but vital document required to accomplish design projects at the Japan District. The guide is available from the Japan District Cost Engineering Section.

1.6 JAPANESE MATERIALS AND PRODUCTS

The design should incorporate Japanese materials, products and construction methods to the maximum extent possible. The use of Japanese materials, products and construction methods ensures that the project is biddable and constructible, and the facility can be maintained with local materials/supplies by the local workforce.

There are several important exceptions when Japanese materials and products should not be used. The exceptions include, but are not limited to, fire and life safety devices and elevator items that do not meet U.S. code and criteria. Refer to discipline specific chapters for further details. All items that are to be purchased from the United States should be documented in the design analysis.

The POJ Engineering Division is the Authority Having Jurisdiction (AHJ) regarding the use of Japanese materials, products and construction methods when U.S. and Japanese standards are not equivalent and require subjective analysis to determine

acceptability. The A-E is not expected to provide proof of equivalency between US and Japanese standards through testing or other laboratory analysis unless specifically stated. All POJ approvals for the use of Acceptable Alternative Japanese Standards should be documented by the DOR in the Design Analysis. Refer to paragraph 3.4.5 LOCAL JAPANESE STANDARDS AND METHODS for more information.

1.7 JAPANESE PREFECTURAL DIFFERENCES

The designer should account for differences in prefectural infrastructure based on project location. For example, power requirements are different between Okinawa, Yamaguchi and Kanagawa.

CHAPTER 2 - SUBMITTAL REQUIREMENTS

2.1 GENERAL

This chapter covers requirements for each design submittal phase.

2.1.1 PROJECT AUTHORIZATION DELIVERY CODES

Design Deliverable Codes should be issued to the DOR by the Government. Design is typically accomplished in the following phases:

Table 1: Design Submittal Phases

Design Phase Name	Design Percent Complete	Code Number
Programming Charrette	0%	Code 0
Parametric Design	15%	Code 3
Concept Design	35%	Code 2
Intermediate Design	65%	Code 6
Final Design	100%	Code 6
Backcheck	100%	Code 6
Biddability, Constructability, Operability, Environmental, Sustainability (BCOES)	100%	Code 6
Ready to Advertise (RTA)	100%	Code 6
Amendments, as Required	100%	Code 6

The technical content of drawings, design analysis, and specifications for each Design Phase should be prepared in accordance with the relevant chapters of this guide.

2.1.2 BUILDING GROSS AREA CALCULATION METHODS

For vertical construction, facilities are limited in gross area to that identified on the project DD Form 1391. Facilities should also meet gross area and travel distance requirements contained in the building and fire codes. These two requirements are performed separately and require the designer to calculate gross area differently. It is

critical to understand and apply the correct method and criteria for the purpose intended.

2.1.2.1 BUILDING GROSS AREA CALCULATION FOR SCOPE AND 1391 COMPLIANCE

Calculations are based on DOD mandated methods, and are used to validate congressional statutory compliance. The facility Gross Area calculations should be as stated in 1-200-01 General Building Requirements. This calculation method recognizes the relationship of building area and construction cost. Facility type “Unit Costs” are based on this calculation method. This evaluation recognizes different cost factors apply to roofs, overhangs, stairs, etc. Thus, these areas are given a different value than enclosed/conditioned space. Exclusively use this calculation method when performing facility scope and square meter analysis of the project scope and area limitations.

2.1.2.2 GROSS AREA CALCULATION FOR BUILDING AND LIFE SAFETY CODE COMPLIANCE:

Calculations are based on latest version of the International Building Code (IBC), Chapter 5. Gross area begins at the interior face of exterior walls and firewalls. It excludes vents, shafts, and courts. The same definition is used in the NFPA 101, The Life Safety Code. This method is used to calculate the area limitations for construction types, occupancy types, and exit distances when completing the Fire Protection/Life Safety Code compliance worksheet

2.2 DESIGN DEVELOPMENT

The development of engineering design analysis, drawings, and specifications are based on the following documents:

- ER 1110-1-8155 Specifications
- ER 1110-345-700 Design Analysis, Drawings and Specifications
- CEPOD-C526 POD Regional In-House Design
- ERDC/ITL TR-12-1 A/E/C Graphic Standard
- ERDC/ITL TR-12-6 A/E/C CAD Standard

2.3 DESIGNER RESPONSIBILITY

The designer is responsible for providing a high quality, integrated design.

The Integrated Design approach is defined by UFC 1-200-02 Section 2-2. The UFC cites *ASHRAE 189.1 Informative Appendix F* for integrated design principles and *ASHRAE 189.1 Section H1.1.1* for the charrette process. Ensure that each project has implemented an integrated design approach that meets the requirements of UFC 1-200-02 and ASHRAE 189.1.

Identify the integrated approach with the Design Quality Management Plan (DQMP).

2.4 GENERAL DRAWING REQUIREMENTS

Drawings should comply with the most recent A/E/C CAD Standards, except as follows:

- Life Safety Sheets will be located after the Cover Sheet and Schedule of Drawings, and before the General Drawing sheets.
- Sections and details should be designated by a number (e.g. Detail 1/A-501) instead of the relative grid location (e.g. Detail E5/A-501). This allows the DOR to rearrange sections and details within a sheet without the issue of updating references from other sheets.
- The cover sheet should have a vicinity map and a location map. The vicinity map should show the relative project location with respect to the country of Japan. The location map should show the project's location relative to the installation, with the project location, streets, and major landmarks identified. This can be a raster image from Google maps or a layout from CADD files.

Electronic files created by the designer and files modified from existing source material should be supplied to the Japan District upon request. All electronic files should be compatible with the Japan District's existing CAD system. Verify CAD system requirements with the Japan District Technical Services Section.

2.5 PARAMETRIC DESIGN REQUIREMENTS

Follow the requirements of the Scope of Work for parametric design requirements. Follow the DoDEA Facilities Management Guide Parametric Design for DoDEA school projects.

2.6 CONCEPT DESIGN REQUIREMENTS

The designer should prepare the concept design based on the discussions and decisions made at the design charrette.

The concept design goal is to demonstrate that the designer has a thorough understanding of the scope of the project and the owner's requirements, as discussed at the design charrette. At the concept design stage, the designer should confirm all CAD requirements (i.e., sheet numbering, sheet size, A/E/C CAD & USACE standards) with the Japan District Technical Services Section.

Concept design submittal typically consist of the following:

2.6.1 CONCEPT DESIGN ANALYSIS

The design analysis will be in compliance with ER 1110-345-700. The design analysis will address the following major design discipline subjects in the narrative:

Table 2: Design Analysis Outline

ITEM #	DISCIPLINE	REQUIREMENT
1.	GENERAL	General Description: Purpose Authorization Project Description Criteria
2.	GENERAL	Include a discussion of: Existing conditions Project goals Design assumptions
3.	ALL	Design Calculations Referenced criteria Include placeholder sections for topics not required in the concept submittal, but needed for intermediate submittal Economic Summary; Life Cycle Cost Analysis Description of materials and methods of construction to be used. Identify sole source items that require a Justification & Approval (J&A) through the Contracting Officer.
4.	CIVIL	Site analysis that discusses the opportunities and constraints of the site and include the recommendations from the Installation's Master Plan, Design Guide and Appearance Plan Preliminary erosion control analysis Preliminary grading narrative Site specific traffic analysis Site specific drainage analysis of existing and proposed conditions Narrative descriptions of water and wastewater systems, including existing condition and capacity.
5.	LANDSCAPING	Preliminary plant material analysis that reflects the selection of plant material native to the project area, if required.

ITEM #	DISCIPLINE	REQUIREMENT
6.	ENVIRONMENTAL	Hazard analysis (lead based paint, asbestos, radon, etc., if required) Natural and/or Archeological Site Survey, as applicable
7.	FIRE PROTECTION/ LIFE SAFETY	Life Safety and Fire protection analysis in accordance with (IAW) UFC 3-600-01 Life Safety Egress Floor Plans
8.	STRUCTURAL	List all design loads and assumptions Provide design calculations for all load derivations. General description of the foundation system General description of the lateral load resisting system. Name of computer programs used for analysis. Preliminary calculations to size structural members including, but not limited to columns, beams, joists, girders, lateral force resisting system.
9.	ANTITERRORISM (AT)	Narrative that describes the approach used and basis for AT measures, and narrative that describes compliance with IAW UFC 4-010-01. Provide purpose of facility. Provide maximum number of personnel that routinely occupy the facility and level of protection. Provide AT calculations which establish the standoff distances. Identify areas where alternative design for exterior doors are required. PROGRESSIVE COLLAPSE ANALYSIS (PCA) Determine PCA method per UFC 4-023-03 when facility is three stories or taller Name of 3D computer program to be used. General description of how PCA is being applied to the structure. Provide preliminary PCA calculations.

ITEM #	DISCIPLINE	REQUIREMENT
10.	ARCHITECTURE	Identify the purpose, functions, capacities and facility's hours of operation. The desired architectural compatibility or visual appearance to include the design of the exterior and interiors of the building. Number of civilian, military and visiting personnel to use the project. Types of activities, equipment and vehicles involved. Anticipated life of the functions to be accommodated. Type and method of construction; either permanent, temporary or relocatable. Functional areas, occupant capacities and space allowances Exterior and interior finish materials, to include textures, colors and damage resistance Water and moisture proofing Accessibility requirements Calculations
11.	MECHANICAL /PLUMBING	Exterior envelope U-factors (walls, glazing, roof, etc.) Ventilation/exhaust rate calculations Equipment requirements and calculations Cooling/heating plant sizing summary Radon mitigation requirements analysis, as applicable
12.	ELECTRICAL	Design Analysis Narrative explaining the electrical scope, existing electrical conditions and proposed design approaches. Design Analysis Appendix showcasing datasheets of proposed electrical equipment/items to be used in the project, and any pertinent analysis/calculations for early evaluation such as a Lightning Protection Risk Analysis, Grounding, Life Cycle Cost Analysis (LCCA) and Preliminary Load Analysis for Transformer sizing.

ITEM #	DISCIPLINE	REQUIREMENT
13.	TELECOMMUNICATIONS	Design Analysis Narrative explaining the telecommunications scope, existing conditions and proposed design approaches. Design Analysis Appendix showcasing datasheets of proposed telecommunications equipment/items to be used in the project.
14.	SUSTAINABLE DESIGN	Preliminary UFC 1-200-02 compliance checklist including a narrative describing how each requirement will be met (not required for projects seeking GPC certification) Preliminary Energy Compliance Analysis (UFC 1-200-02) Third Party Certification checklist (i.e., LEED, CASBEE, or Guiding Principles Compliance) including a narrative for each proposed credit identifying how that credit will be fulfilled
15.	COMISSIONING	Establish the Owner Project Requirements (OPR) utilizing the POJ Japan District template.
16.	APPENDIX	Include the DD Form 1391
17.	RENOVATIONS	Verification of implementation triggers for Seismic (UFC 3-310-04) and Antiterrorism (UFC 4-010-01) requirements based on Property Replacement Values versus renovation costs of the existing building(s).
18.	CYBERSECURITY	(Requirement: Refer to Chapter 19 of JED Design Guide for requirements.)

2.6.2 CONCEPT DESIGN DRAWINGS

Below is a list of the design drawings that are required at the Concept Design Phase.

Table 3: Concept Design Drawings

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
1.	GENERAL	Title Sheet and general sheets with preliminary haul route	General Sheets to include project index

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
2.	GENERAL	Project Site Plan and Area Plan	
3.	GENERAL	Construction Notes and legend pages, phases (as required)	
4.	LIFE SAFETY/CODE ANALYSIS	Plans	
5.	CIVIL	Project site plan	Including AT standoff setbacks for EWI, EWII and ESQD arc if applicable
		Area Site Plan	
		Preliminary Exterior Utility Plans	
		Complete subsurface investigation and analysis	
6.	ARCHITECTURE	Plans	Functional relationships and analysis Work area usage Security requirements Traffic flow patterns Roof plan illustrating stormwater flow and control
		Building Code Analysis	
		Exterior Building Elevations	Showing principal shapes, fenestrations and finishes
		Building Section	
		Interior Finish Selection	General concepts presented
7.	STRUCTURAL	Structural Notes 1) Design Loads 2) Special Inspections	Including but not limited to: Risk Category AT classification

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		3) Geotechnical Information 4) Materials	Identify lateral force resisting system Specify Japanese materials or provide justification and include cost for US materials
		Foundation Plan	Dimensions including but not limited to: Footings, piles, pile caps, tie beams, grade beams, etc.
		Floor Plan(s)	Including but not limited to: Column size and locations, beam size and locations, floor slab thickness, openings coordinated with architecture, and location of floor drains as applicable, and lateral force resisting system location
		Roof Plan	Including but not limited to: Column size and locations, joist, girder, and truss dimensions and locations, openings coordinated with architecture, lateral force resisting system location, and roof deck
		Building Sections	
8.	MECHANICAL	Preliminary HVAC layout	Including equipment capacities and sizes
		Preliminary DDC controls schematics and sequences of operation	Clearly indicate HVAC zones
9.	PLUMBING	Preliminary plumbing layout	Including equipment capacities and sizes
10.	ELECTRICAL	Electrical Legend, General Notes, Abbreviations	

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		Preliminary electrical layout: Existing/Demo Site Plan(s) New Power/Lighting Site Plan(s) General Interior Power Plan(s) General Interior Lighting Plan(s)	See Chapter 13 for descriptions of Electrical Design Submittal Requirements
		Typical Details	
		Riser and/or One-line Diagram	
11.	TELECOM	Telecom Legend, General Notes, Abbreviations	
		Preliminary telecom layout: Existing/Demo Site Plan(s) New Telecom Site Plan(s) General Interior Telecom Plan(s)	See Chapter 14 for descriptions of Telecom Design Submittal Requirements
		Typical Details	
		Riser Diagram	
12.	FIRE PROTECTION	Preliminary Fire Protection Floor Plans Fire Alarm And Mass Notification System Plan Fire Suppression System Plan	
13.	ENVIRONMENTAL		

2.6.3 CONCEPT SPECIFICATIONS

Include a list of Technical Specification (Divisions 02 through 49) sections in PDF format, including section numbers and title, proposed for the project.

2.6.4 CONCEPT COST ESTIMATE

Provide a current working estimate. Refer to the *Japan District Cost Estimating Guide*.

2.6.5 CONCEPT QUALITY CONTROL

The designer should conduct thorough Quality Control of all documents to be submitted to the Government for review.

2.7 INTERMEDIATE DESIGN REQUIREMENTS

Prepare the intermediate design and technical specifications based on concept design, project criteria and general instructions. At this stage the building and site design should be finalized with the User, Installation and Japan District.

The intermediate design effort should be a continuation of the concept design. The intermediate design goals are to show the project is on schedule and at an acceptable level of quality and completeness. It should also demonstrate that the designer's quality control (QC) process is functioning properly. The designer should conduct a full QC review prior to the submittal of the intermediate design. The designer QC review should consist of a full Detail Check and Independent Technical Review. Complete coordination amongst design disciplines should be conducted to review and resolve design conflicts.

Intermediate design typically consists of the concept design in addition to the following items listed below:

2.7.1 INTERMEDIATE DESIGN ANALYSIS

The design analysis will be in compliance with ER 1110-345-700. The design analysis will build upon the concept submittal and address the following major design discipline subjects in the narrative.

Table 4: Intermediate Design Analysis

ITEM #	DISCIPLINE	REQUIREMENT
1.	GENERAL	General description: Purpose Authorization Project Description Criteria

ITEM #	DISCIPLINE	REQUIREMENT
2.	GENERAL	Include a discussion of: Existing conditions Project goals Design assumptions
3.	ALL	Design Calculations and presuppositions Referenced criteria Include placeholder sections for topics not required in the intermediate submittal, but needed for the final submittal Economic Summary; Life Cycle Cost Analysis and Value Engineering Summary Description of materials and methods of construction to be used
4.	CIVIL	Site analysis that discusses the opportunities and constraints of the site and include the recommendations from the IDG / Installation Master Plan Erosion control analysis Grading narrative Site specific traffic analysis. Threat scenario analysis for Entry Control Facilities and Access Control Points Site specific drainage analysis of existing and proposed conditions and calculations justifying proposed finished floor elevations Narrative descriptions of water and wastewater systems, including existing conditions and capacity Complete subsurface investigation and analysis
5.	LANDSCAPING	Preliminary plant material analysis that reflects the selection of plant material native to the project area, if required
6.	ENVIRONMENTAL	Hazard analysis (lead based paint, asbestos, radon, etc., if required) Natural and/or Archeological Site Survey, as applicable
7.	FIRE PROTECTION/ LIFE SAFETY	Life Safety and Fire protection analysis IAW UFC 3-600-01

ITEM #	DISCIPLINE	REQUIREMENT
8.	STRUCTURAL	List all design loads and assumptions Provide design calculations for all load derivations Provide design calculations for the foundation system Provide design calculations for the lateral load resisting system, diaphragm, chord and collector elements Calculations to size structural members including, but not limited to columns, beams, joists, girders, lateral force resisting system Provide design calculations for non-structural components, supports and attachments
9.	ANTITERRORISM (AT)	Narrative that describes the approach used and basis for AT measures, and narrative that describes compliance with IAW UFC 4-010-01. Specifically address all 21 Standards Provide blast resistant window calculations Provide performance requirements for exterior blast doors, if required
10.	PROGRESSIVE COLLAPSE ANALYSIS (PCA)	Determine PCA method per UFC 4-023-03 Name of 3D computer program to be used General description of how PCA is being applied to the structure Provide preliminary PCA calculations

ITEM #	DISCIPLINE	REQUIREMENT
11.	ARCHITECTURE	Identify the purpose, functions, capacities and facility's hours of operation The desired architectural compatibility or visual appearance to include the design of the exterior and interiors of the building Number of civilian, military and visiting personnel to use the project Types of activities, equipment and vehicles involved Anticipated life of the functions to be accommodated Type and method of construction; either permanent, temporary or relocatable Functional areas, occupant capacities and space allowances Exterior and interior finish materials, to include textures, colors and damage resistance Water and moisture proofing Accessibility requirements Calculations
12.	MECHANICAL / PLUMBING	Designed HVAC systems types, capacities, and controls, including a description of the selected system Pressure loss calculations for all air fans and hydronic pumps Designed plumbing system types, including description of the selected system Compressed air system type, capacity, and controls Designed Petroleum, Oil, and Lubricants (POL) system types, including a description of the selected system (as required) Energy modeling assumptions, climate zone classifications, building envelope requirements and results of the energy modeling and design energy use calculations Commissioning requirements Radon survey data with mitigation system, as applicable

ITEM #	DISCIPLINE	REQUIREMENT
13.	ELECTRICAL	Design Analysis Narrative explaining the electrical scope, existing electrical conditions and proposed design approaches Design Analysis Appendix showcasing datasheets of proposed electrical equipment/items to be used in the project Design Analysis Calculations detailing all pertinent electrical design calculations such as Lighting Calculations, Short Circuit Analysis, and Voltage Drop Calculations; as well as parametric and concept design calculations/analysis and any updates to them
14.	TELECOM	Design Analysis Narrative explaining the telecommunications scope, existing electrical conditions and proposed design approaches Design Analysis Appendix showcasing datasheets of proposed telecommunications equipment/items to be used in the project Design Analysis Calculations detailing all pertinent telecommunications design calculations as described in this document
15.	SUSTAINABLE DESIGN	Updated UFC 1-200-02 compliance checklist including a narrative describing how each requirement will be met (not required for projects seeking GPC certification) Updated Energy Compliance Analysis (UFC 1-200-02) Updated Third Party Certification checklist (i.e., LEED, CASBEE, or Guiding Principles Compliance) including a narrative for each proposed credit identifying how that credit will be fulfilled
16.	COMMISSIONING	Update the OPR Provide all related TPC required documentation in preparation for construction
17.	APPENDIX	Include the DD Form 1391 Life Cycle Cost Analysis Whole Building Energy Simulations Owner Project Requirements

ITEM #	DISCIPLINE	REQUIREMENT
18.	RENOVATIONS	Verification of implementation triggers for Seismic (UFC 3-310-04) and Antiterrorism (UFC 4-010-01) requirements based on Property Replacement Values versus renovation costs of the existing building(s)

2.7.2 INTERMEDIATE DESIGN DRAWINGS

Table 5: Intermediate Design Drawings Outline

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
1.	LIFE SAFETY/CODE ANALYSIS	Building Life Safety Code Analysis	Including Egress Floor Plans and code analysis Building Life Safety Code & Fire Protection Plans including Building Code and Occupancy Analysis
2.	CIVIL	Project site plan	Including standoff setbacks for EWI (Explosive Weight I), EWII and ESQD arc if applicable
		Area Site Plan	
		Preliminary Exterior Utility Plans	
		Existing conditions (topography)	
		Demolition plan	
		Grading plan	
		Road sections, plans and profiles	
		Utility plans and profiles	
		Civil and site details	
		Geotechnical boring logs	

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
3.	ARCHITECTURE	Plans: Floor Plans Reflected Ceiling Plans Roof Plans Enlarged Floor Plans Furniture & Equipment Plans Signage Plans Interior Finish Floor Plans Life Safety Egress Floor Plans	Functional relationships and analysis Work area use Security requirements Traffic flow patterns Roof plan to illustrate stormwater flow and control
		Air Barrier	Identify the extent of the Air Barrier on the A-000 series, and indicate through the entire set how the air Barrier is applied, in accordance with UFC 3-101-01
		Building Code	
		Exterior Building Elevations	Showing fenestration, finishes and coordination between disciplines
		Interior Elevations	Showing coordination between finishes, interdisciplinary and features of the buildings
		Building Section	Sections indicating the major conditions through the building
		Wall Sections	
		Schedules: Wall Types Door Window Louver Exterior Finishes Room Finish Interior Finish Legend	Include AT requirements for exterior windows
		Details	Preliminary details indicating the method and approach of the design intent

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
4.	STRUCTURAL	Structural Notes Update Structural Notes from Concept Submittal	
		Foundation Plan	Update the Foundation Plan from the Concept Submittal to include but not limited to: Coordination with architecture, mechanical, electrical, and plumbing for openings, slab recesses, control joints, seismic joints, etc. Coordinate footing and pier locations with new and existing utilities
		Floor Plans	Update the Floor Plan from the Concept Submittal to include but not limited to: Horizontal diaphragms, shear transfer, collector elements, lateral bracing and openings Coordination with architecture, mechanical, electrical, and plumbing for floor openings
		Roof Plan	Update the Roof Plan from the Concept Submittal to include but not limited to: Horizontal diaphragms, shear transfer, collector elements, lateral bracing and openings Coordination with architecture, mechanical, electrical, and plumbing for roof openings
		Foundation Schedule and Details	Details include foundation sections showing connections to walls, slab, grade beams, etc.
		Wall Sections and Details	Details to include shear transfer, opening details, boundary elements, etc.

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		Column Schedules and Details	
		Beam/Girder Schedules and Details	
		Slab Schedules and Details	
		Building Sections	
		Shear Wall and Building Frame Elevations as applicable	
		Non-Structural Components, Supports and Attachments	See ASCE 7 Chapter 13 for design requirements
5.	MECHANICAL	Mechanical Legend, General Notes, Abbreviations	
		Plans: Site HVAC Piping Compressed Air	
		Sections	Mechanical room plans should be supplemented by at least one section; at least two sections for more complex, congested applications Provide ample building sections in congested areas for coordination with arch/structural
		DDC points List	Points of Control for the DDC for the utility monitoring system. Identify the installation monitoring system and the compatibility of the proposed installed system

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		Equipment Schedules Air Handling Units Exhaust Fans Heat Recovery Units Chillers Compressor, Dryer, Accumulator Tank *Any other HVAC Design	
		Isometrics	Refrigerant, Chilled, and Hot Water piping diagrams
		Riser diagrams	
		DDC Schematics and Equipment Control Sequences	
		Details	Preliminary details indicating the method and approach of the design intent. Preliminary one line diagrams
6.	PLUMBING	Plumbing Legend, General Notes, Abbreviations	
		Plans: Site Plumbing	Include sub-pipe system layout for radon mitigation requirements, as applicable Show condensate drain lines from all cooling coils. Indicate required depth of water trap. Show slope from drain pan
		Sections	
		Equipment Control Sequences	
		Schedules Plumbing Fixtures Plumbing Equipment	
		Isometric/Riser Diagrams	
		Details	

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
7.	ELECTRICAL	Electrical Legend, General Notes, Abbreviations	
		Plans: Site Plan(s) Demolition Plan(s) Lighting Plan(s) Power Plan(s) Mech. Connections Plan(s) Lightning Protection Plan(s) Grounding Plan(s) Cathodic Protection Plan(s)	See Chapter 13 for descriptions of Electrical Design Submittal Requirements
		Schedules Lighting Fixture Schedule Mech. Connections Schedule Panel Schedules	
		Electrical Riser and/or One-line Diagram	
		Electrical Details	
8.	TELECOM	Telecom Legend, General Notes, Abbreviations	
		Plans: Demolition Plan(s) New Telecom Site Plan(s) Building Telecommunications Plan	See Chapter 14 for descriptions of Telecom Design Submittal Requirements
		Telecom Riser Diagram	
		Telecom Details	
9.	FIRE PROTECTION	Fire Suppression Legend, General Notes, Abbreviations	
		Fire Alarm & Mass Notification Legend, General Notes, Abbreviations	

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		Plans Fire Alarm & Mass Notification System Plan Fire Suppression System Plan Site Plans Life Safety	
		Code Analysis	
		Details	Riser Layout to be included
		Fire Alarm Matrix	
10	FOOD SERVICE (as required)	Food Service Legend, General Notes, Abbreviations	
		Plans Equipment Plans	
		Schedules Equipment Schedule	
		Details	
11	AUDIO / VIDEO (as required)	AV Plans	
		Schedules	
		Details	
15.	ENVIRONMENTAL	Project Site Plan	
		Area Site Plan	
		Preliminary Exterior Utility Plans	
		Existing Conditions	
		Demolition Plan	
		Grading Plan	
		Road Sections, Plans and Profiles	
		Utility Plans and Profiles	
		Civil and Site Details	

ITEM #	DISCIPLINE	DRAWING TYPE	ADDITIONAL REQUIREMENTS
		Geotechnical Boring Logs	

2.7.3 INTERMEDIATE DESIGN SPECIFICATIONS

Specifications for intermediate design typically consist of:

- Technical (Divisions 02 through 49) specifications in SpecsIntact (.sec) format, with changes from Unified Facilities Guide Specifications shown by enabling tracked changes.
- Division 01 design-related attachments (e.g. Draft DD1354).

Coordination and input is required with Japan District Technical Services Section prior to intermediate design submittal regarding design elements within Division 01 specifications.

2.7.4 INTERMEDIATE COST ESTIMATE

See the Japan District Cost Guide for information on Cost Estimates.

2.7.5 INTERMEDIATE QUALITY CONTROL

The designer should conduct a thorough Quality Control of all documents to be submitted to the Government for review. Quality control requirements are covered in Chapter 4.

2.8 FINAL DESIGN REQUIREMENTS

The designer should prepare the final design and technical specifications based on the intermediate design and review comments received from the intermediate design review.

The final submittal should be complete with all information necessary for bidding and complete construction and should be ready for advertising from the government perspective. The drawings should show the name of the reviewer and signature of the Designer of Record or Principal of the A/E Firm responsible for the design as testimony that this submittal has been reviewed and found to be suitable for bidding. The submittal should incorporate all previous review comments. The designer should provide a response indicating the reason for not incorporating any non-concurred comments. The designer should submit a complete response to all previous review comments in Dr. Checks with the submission.

2.8.1 FINAL DESIGN ANALYSIS

The completed design analysis should incorporate all comments and revisions from the previous submission.

Sustainability needs to be fully documented. This includes a completed UFC 1-200-02 compliance checklist and narrative, Final TPC checklist and narrative, and the completed agency specific HPSB Compliance checklist.

For renovation projects, include a narrative on the renovation costs compared to the replacement values of the existing building(s) and associated implementation triggers for seismic (UFC 3-310-04) and Antiterrorism (UFC 4-010-01) requirements.

2.8.2 FINAL DESIGN DRAWINGS

Design drawings should be complete with all information necessary for bidding and complete construction.

2.8.3 FINAL SPECIFICATIONS

A completed set of technical (Division 02 through 49) specifications shall be developed in SpecsIntact (.sec) format. Technical specifications should incorporate all comments and revisions from the previous submission by enabling tracked changes. All errors from verification reports (address, bracket, duplicate reference, unresolved reference, section, submittal, and title) generated by SpecsIntact shall be resolved. Submit updated Division 01 design-related attachments (e.g. Draft DD1354). Continuing coordination and input is required with Japan District Technical Services Section prior to final design submittal regarding design elements within Division 01 specifications.

2.8.4 FINAL COST ESTIMATE

Complete final working cost estimate ready to advertise that includes estimate narratives, quantity take-off documentations and calculations, vendor quotes and all supporting cost data and final construction schedule.

2.8.5 FINAL QUALITY CONTROL

The designer should conduct a thorough Quality Control of all documents to be submitted to the government for review. Submit Detailed Checks and Reviews (DCR) and Independent Technical Review (ITR) documents to include: Completed DCR checklists; completed ITR annotated comment sheets; and the project Scope of Work.

2.9 BACKCHECK DESIGN REQUIREMENTS

The designer should prepare the backcheck design and technical specifications based on the final design, project criteria, and general instructions.

The backcheck submittal should be complete in every respect and should be ready for advertising. The drawings should show the name of the reviewer and signature and professional seal of the Principal of the firm responsible for the design as testimony that the submittal was reviewed and found to be suitable for bidding. The submittal typically incorporates all previous review comments; and Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) review comments made during the concept and final design phases. All comments should have been addressed, validated, and closed. The designer should provide a response indicating the reason for not incorporating any non-concurred comments. The designer should submit a complete response to all previous review comments in Dr. Checks with the submission.

Backcheck design typically consists of, but is not limited to, the following:

- Complete backcheck Design Construction Drawings ready to advertise.
- Complete set of backcheck Technical Specifications ready to advertise.

- Complete backcheck Design Analysis.
- Complete backcheck working cost estimate ready to advertise to include estimate narratives, quantity take-off documentations and calculations, vendor quotes, and all supporting cost data and final construction schedule.

The designer should conduct a thorough Quality Control of all documents to be submitted to the government for review. Submit Detailed Checks and Reviews (DCR) and Independent Technical Review (ITR) certifications.

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CHAPTER 3 - SPECIFICATIONS

3.1 GENERAL

Architect-Engineer (A-E) firms and personnel performing design for Japan District shall be responsible for Division 02-49 specification sections, with Japan District Technical Services Section coordination effort required for design aspects of Division 01 specification sections (e.g. Draft DD1354, Scope of Work, Section 01 45 35 SPECIAL INSPECTIONS, Attachment 01 11 00.00 10-A ACCEPTABLE ALTERNATIVES FOR JAPANESE STANDARDS, Commissioning, etc.).

3.2 DESIGN CRITERIA

ENGINEERING REGULATIONS

- ER 415-1-10. Construction Contractor Submittal Procedures.
- ER 1110-1-8155. Engineering & Design: Specifications.
- ER 1110-345-700. Engineering & Design: Design Analysis, Drawings and Specifications.

ENGINEERING MANUALS

- EM 385-1-1 Corps of Engineers Safety and Health Requirements.

3.3 GUIDE SPECIFICATIONS

Guide specifications referenced throughout the Japan District Design Guide refer to the Unified Facility Guide Specifications (UFGS), and should be used in writing specifications. The UFGS is available at the Whole Building Design Guide website (http://www.wbdg.org), and can be modified using the free SpecsIntact software (available at https://specsintact.ksc.nasa.gov/). Designers are required to use UFGS and SpecsIntact. Guide specifications shall be edited for each particular project by making suitable modifications and alterations thereto.

In the course of editing specifications, all inapplicable portions of the guide specifications should be deleted, and additional information should be included in the proper part of each section. Those sections required in the Technical Provisions where no guide specifications are available should be prepared and submitted by the designer in accordance with the MasterFormat and UFGS guidelines. Where various choices (indicated as “brackets”) are provided in the guide specifications, the proper choice for the specific design should be selected and other choices deleted. Where guide specifications allow use of optional materials or methods, options should be included in the completed specifications to the extent that such material and methods are suitable and available for construction in Japan.

3.4 PREPARATION OF PROJECT SPECIFICATIONS

Specifications should be furnished to Japan District in the native SpecsIntact (.sec) file format.

3.4.1 CONTENT

The technical specifications should be in sufficient detail so that when used with the project drawings, estimates or bids can be furnished by contractors, material suppliers, or manufacturers on a fair and competitive basis; and construction can be completed without additional specifications except as necessary to deal with unforeseen conditions or to accomplish changes made during construction. Sections should be prepared in a manner to supplement the project drawings only to the extent necessary. The use of trade names, proprietary items, and the drafting of a specification by adopting a manufacturer's description is not allowed, except for instances as indicated in Paragraph MATERIAL DESCRIPTIONS below. To the extent possible, the specifications should refer to recognized standards and organizations such as ASTM, ANSI, AWWA, etc. Specifications should include at a minimum the following items if appropriate:

- Size or capacity.
- Materials of construction.
- Detailed description of equipment construction and function.

3.4.2 SPECSINTACT

3.4.2.1 DESIGN-BID-BUILD PROJECTS (D-B-B)

For D-B-B projects, the A-E's Division 02-49 SpecsIntact (.sec) files should be submitted with the design review PDF submittals. Japan District Tech Services section requires the .sec files for review as well as for the submittal records. Two weeks prior to each A-E submittal, the A-E should contact the assigned Japan District Tech Services section POC and request Division 01 .sec for their incorporation into hard copies for said submittal. For the CONCEPT (35%) submittal, the A-E will only need to provide the table of contents of Div. 02-49 spec sections, and Japan District Tech Services section will not be providing the A-E with Div. 01 specs.

For the RTA package, the A-E will provide their final version of Division 02-49 .sec files, along with PDFs of any Division 02-49 attachments, to Japan District Tech Services section. The A-E is also responsible for making changes to the .sec files during amendment phase, in conformance with QMS US.360-SOP ProjNet Bidder Inquiry Process.

3.4.2.2 DESIGN-BUILD PROJECTS (D-B)

For D-B projects, two weeks prior to each A-E submittal, the A-E should contact the assigned Japan District Tech Services section POC and request Division 01 .sec files for their incorporation into hard copies for said submittal. A-E should coordinate with Japan District Tech Services section on the labeling on the SOW/Design Criteria as Section 01 11 00 attachments.

For the RTA package, the A-E will provide the SOW/Design Criteria attachments (Word and PDF versions) to Japan District Tech Services section. The A-E is also responsible for making changes to the SOW/Design Criteria attachments during the amendment phase, in conformance with QMS US.360-SOP ProjNet Bidder Inquiry Process.

3.4.3 PRIORITIES OF PUBLICATIONS REFERENCES

References known to nationally recognized industry and technical society specifications should be used. References should be by specific issue; the revision letter, date, or other specific identification should be included. Availability of publications (where to purchase) is contained in UFG Section 01 42 00 entitled: SOURCES FOR REFERENCE PUBLICATIONS, available on the Whole Building Design Guide website at: http://www.wbdg.org.

3.4.4 MATERIAL DESCRIPTIONS

Except for unique spare parts that are inherently sole source, trade or brand names will only be used as a last resort and only with acceptance of a Justification and Approval (J&A) routed by the Project Manager (PM) through the appropriate offices of Japan District. The naming of a particular commercial product with the words "or approved equal", or adopting verbatim a manufacturer's description of a particular commercial article is not allowed, unless approved by the Contracting Officer. If approved for use, no less than three (3) manufacturers with complete address, telephone number, fax number, e-mail address, and Point-of-Contact (POC) if known, should be included within the specifications. The specifier should describe the needs of the design, or the Government, with sufficient clarity to appraise prospective bidders of the specific requirements. Every effort should be made to describe properly in the specifications (and supplement by drawing details, where applicable), the physical, chemical, or performance characteristics of materials, products, or construction methods in a manner to ensure full and free competition. This concept also applies to non-unique spare parts where competitive, equivalent items are available (belts, filters, hoses, valves, bearings, lamps, etc.).

3.4.5 JAPANESE EDITED SPECIFICATIONS (JES)

A limited set of modified UFGS incorporating previously identified and accepted Japanese standards and methods (also known as Japan Edited Specifications, or JES) will be provided to the A-E to assist the A-E in the design. The A-E shall incorporate applicable JES into the project specifications, and edit the JES accordingly for the project.

- Technical specification section
- U.S. Standard specified in the technical specification section
- Proposed Japanese alternative standard or method
- Synopsis providing the justification of the proposed alternative

Japan District will review the request, and provide a response (acceptance or rejection) in an expedited manner. The A-E shall track each request and the corresponding JED decision (acceptance or rejection) in the Design Analysis. These requests shall be discussed at each OBR."

3.4.6 AMBIGUITIES

Ambiguities should be avoided in the preparation of specifications. Specific instructions should be included in the specifications in lieu of the expression "as directed (approved) by the Contracting Officer". Designer should contact Technical Services Section - Japan District, to obtain specific information to avoid the necessity for indefinite specification requirements. For example, when material is to be salvaged and stored, the specifications should state the disposition of such material, e.g. "to be stored in Building 210" or "in the Base Salvage Yard", rather than "where directed by the Contracting Officer". When ultimate disposition of excess excavated materials, broken concrete, etc., is impossible to determine at the time of the writing of the specifications, the specification should state that the haul will not exceed a stated distance when such material can be disposed of on Government controlled property. When waste material is to be disposed of by the Contractor off the Government property, the specifications should state, "Waste material shall be disposed of off the Government premises by and at the expense of the Contractor." Where necessary to demolish or move structures, Japan District should be contacted for disposition of material, equipment or the structure in order that detailed instructions may be given in the Technical Specifications or Contract Clauses.

3.4.7 PROJECT TABLE OF CONTENTS

A Table of Contents for the project specifications should be prepared in Microsoft Word format (.doc or .docx), with attachments and appendices indicated. A template of the Table of Contents can be obtained upon request from Technical Services Section, Japan District.

3.4.8 GUIDE SPECIFICATIONS

When editing guide specifications, intent should be clearly defined and the guide specifications should be revised accordingly. Specifications should not be written which leave the burden of intent (interpretation) on the bidders, contractor, or construction personnel administering the contract in the field.

3.5 AMENDMENTS

During the time period a project is being advertised for bids/proposals, revisions to drawings and/or specifications due to a prospective offeror’s Request for Information (RFI) may become necessary. When directed by the Contracting Officer and/or the Contracting Officer’s Representative, the designer should prepare the necessary revisions to the drawings and/or specifications in response to the RFIs as part of an amendment.

3.5.1 SCHEDULING OF AMENDMENTS

Amendment revisions should be prepared and submitted under a strict time schedule in order that revisions can be issued to bidders at the appropriate time during the advertising period. Close coordination with the Japan District Technical Lead, Project Manager, and Technical Services Section is required at this time.

3.5.2 PREPARATION OF AMENDMENTS

The following rules typically apply when editing specifications for amendments:

- To delete words: Overstrike Appearance should be used, so a reviewer is able to read what was deleted.
- New text should appear bold and underscored.

Paragraphs should not be renumbered when making deletions by amendment. For example, if a paragraph is deleted, the paragraph number should remain and should be noted as "NOT USED". New paragraphs or subparagraphs should always be inserted at the most logical chronological place between existing paragraphs or subparagraphs. Submit the revised specification sections to Japan District in native SpecsIntact (.sec) file format.

3.6 SPECIAL REQUIREMENTS

3.6.1 GOVERNMENT FURNISHED PROPERTY

When Government-furnished, Contractor-installed (GFCI) materials or equipment are involved, such Government-furnished items should be listed separately and submitted along with specifications at the Final and RTA submittals. The list should contain the quantity, item description including manufacturer's make and model number if available, dimensions, cube weight, and power source if applicable, e.g. gas, electric, steam, 120V, 220V, 240V, etc.

3.6.2 REMOVAL OF EQUIPMENT OR MATERIALS (EXISTING FACILITIES)

Equipment or materials to be removed should be identified in the scope of work and should include any special disposal instructions such as store for re-use or return to Stakeholder.

3.6.3 SHOP DRAWINGS AND SUBMITTALS

The designer should identify all required submittals and shop drawings and categorize them for review or for information only (FIO) per ER 415-1-10. The designer should use SpecsIntact's "submittal tags" feature to identify all submittals so that SpecsIntact will automatically compile a list of all required submittals and shop drawings for the projects and create the ENG Form 4288 for the project.

3.6.4 SERVICES OF MANUFACTURER'S TECHNICAL REPS

The designer should include information regarding services of manufacturer's technical reps in contract requirements for projects and equipment when required to ensure proper installation, start-up and/or training of operation and maintenance personnel. The requirements for these services should be added in the Technical Specifications only upon approval and coordination with Japan District.

3.6.5 SPECIAL INSPECTION

Designer shall utilize the Japan District templates for the Statement of Special Inspections and the Schedule of Special Inspections that are attachments to UFGS

Section 01 45 35 Special Inspections. The templates are provided in the JDDG Appendix. UFGS Section 01 78 23 shall include the following requirement in paragraph 1.3: Designated Seismic Systems certification shall be maintained by the Special Inspector of Record (SIOR) in a file identified as "Equipment Certification Documentation" and submitted as part of the O&M Manual.

CHAPTER 4 - QUALITY CONTROL REQUIREMENTS

4.1 CRITERIA

ENGINEERING REGULATIONS

ER 1110-1-12	Quality Management
ER 5-1-11	U.S. Army Corps of Engineers (USACE) Business Process
ER 415-1-11	Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) Reviews

4.2 DEFINITIONS

4.2.1 QUALITY

Quality is the totality of features and characteristics of a product or service that bear on its ability to meet the stated or implied needs and expectations of the project. There should be consensus on expectations for quality among the PDT members (includes Japan District). The expectations for quality should be reflected in the Quality Control Plan.

4.2.2 QUALITY ASSURANCE

Quality assurance (QA) is the Government oversight of the Designer of Record (DOR) quality control process to ensure their effectiveness in the production of quality products. ER 5-1-11 defines QA as an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed to meet project requirements defined in the Quality Control Plan (QCP). Typical QA activities may include:

- Reviewing and approving the QCP prepared by the designer
- Ensuring that activities described in QCP have been/are being performed
- Verifying that Designer of Record (DOR), Detailed Checks and Reviews (DCR) and Independent Technical Review (ITR) members are the same members as identified in the QCP
- Ensuring that an ITR is conducted per ER 1110-1-12 with emphasis on determining that the ITR was appropriate to the level of risk and complexity inherent in the project; that the ITR verified compliance with established policy principles and procedures; utilized justified and valid assumptions; and reviewed methods, procedures, alternatives, and reasonableness of results, including whether the product meets Stakeholder's needs
- Verifying that appropriate staff signed Quality Control certifications
- Ensuring that all review comments have been adequately resolved
- Verifying that the product received satisfies contract requirements
- Engaging in frequent dialogue with the Designer of Record to ensure that the project will satisfy Japan District requirements and avoid lost effort

4.2.3 QUALITY CONTROL

Quality Control (QC) is the process that ensures the performance of tasks meets the agreed upon requirements of the Stakeholder, appropriate laws, regulations, policies, and technical criteria, schedule, and budget. ER 5-1-11 defines QC as the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established in the QCP; operational techniques and activities that are used to fulfill requirements for quality. QC is the responsibility of the Designer of Record (DOR). The Government should not be reviewing the design package for quality control issues.

4.3 QUALITY CONTROL PLAN

The designer should submit a draft project specific QCP with the original fee proposal. The draft QCP should contain, at minimum, the features listed below. Within two weeks after the project start, the designer should provide a completed project specific QCP that should address all quality control features listed below. The Government should accept the QCP before the designer proceeds with any further work. The QCP should be a living document and should be updated as required throughout all stages of the design.

The QC process will be enforced throughout the design process and into the Contract Award phase. The Designer of Record should conduct QC measures during the Bid Solicitation period, which will include Detailed Checks and Reviews and Independent Technical Review of documents revised during the Bid Solicitation period.

4.3.1 ROLES AND RESPONSIBILITIES

- Identify the entire Design Team to include the Designer of Record (DOR) for each discipline, Detailed Checks and Reviews (DCR) Team and the Independent Technical Review (ITR) Team.
- Provide qualifications of major designers that will be part of the Design Team. The DOR for each discipline should consist of licensed engineers and architects.
- The Detailed Checks and Reviews team member should be the designer's principal or senior designer that is not involved with the project on a day-to-day basis.
- The Independent Technical Review team members should be designers that are not involved in the project and should conduct a thorough independent technical review.
- The DOR, DCR and ITR members should not be the same.
- The designer should notify Japan District in writing of any revision to the DOR, DCR team, and ITR team members as indicated in the QCP during the design process.

4.3.2 COORDINATION PROCEDURES

Describe Designer of Record interdisciplinary coordination procedures:

- Clearly identify step-by-step the QC coordination process between design disciplines, including the DCR and ITR processes, comment sheets, and certifications.
- Provide a flowchart illustrating key QC activities and their order of execution for each deliverable stage.
- Identify Centers of Standardization (COS) and describe how the COS standard designs will be verified for standard design compliance.
- The designer should conduct a final Quality Control review of all printed submittal documents prior to submitting the documents to the Government. This is to check for any last minute spelling, printing, and coordination errors. Errors should be corrected and documents re-printed prior to submitting to the Government.
- QC is the responsibility of the design team. The Government does not review the design package for quality issues.
- The Detail Check and Independent Technical Review should be conducted by the design team prior to submittal to the Government.
- Submittals will be considered incomplete and rejected by the Government if completed DCR and ITR documentation are not provided. Re-submittal shall be at the cost of the designer.

4.3.3 DRAFTING COMPLIANCE

Identify how the CADD/BIM requirements have been met in accordance with the Submittal Requirements chapter of the Design Guide.

Provide the documentation required in the Submittal Requirements chapter and identify any software programs used, describe the process by which the input and output will be checked and validated.

4.3.4 SUSTAINABILITY COMPLIANCE

Identify how the project will meet the sustainability requirements and the quality control procedures that will be conducted through each design phase.

4.3.5 LESSONS LEARNED

Provide a description and list of applicable Lessons Learned from similar projects. List Lessons Learned in the following format:

- Project:
- Lessons Learned Statement:
- Discussion:
- Recommended Solution:

4.3.6 RISK ANALYSIS

Provide a design risk analysis to include probable risks and risk mitigating strategies for undesirable project outcomes. Mitigating strategies include ways the designer can overcome less than ideal schedules, missing design information, etc.

4.3.7 DETAILED CHECKS AND REVIEWS

Detailed Checks and Reviews (DCR), which is referred to as Quality Checks and Reviews in ER 1110-1-12, is the DOR's own Quality Control effort and refers to quality checks, technical checks, and reviews of design documents occurring as routine management practice during the project development process.

- The DCR is not the Independent Technical Review (ITR) and is typically completed before the ITR.
- The DCR should be performed by each discipline's supervisor or senior Architect/Engineer.
- The DCR should document review comments. The DOR should work with the DCR reviewer to incorporate all resolutions/corrections in to the design package prior to the printing of the submittal (or electronic submittal) package to the Government.
- If the DOR chooses to annotate DCR comments with "will incorporate in the next submittal", they will be responsible to follow through with the changes and comments will not be closed until the changes can be verified in the next submittal.

The DCR serves to:

- confirm that calculations are correct (a complete math check);
- confirm that appropriate formula(s) from reference manuals are used correctly;
- confirm that input to design software is reasonable;
- confirm that results of calculations and investigations are correctly displayed on the contract documents (plans and specifications);
- confirm that contract documents are technically complete and correct and
- ensure that intent and delineation of design documents are clear to all parties. Confirms that all typos, spelling, and drawing coordination is complete.

4.3.8 INDEPENDENT TECHNICAL REVIEW (ITR)

Independent Technical Review (ITR) is a holistic, comprehensive review of the project design. The ITR process acts as the DOR's "Dr. Check's" review prior to submission to the Government.

- The ITR is to be completed prior to the printing (or electronic) of the submittal package at each deliverable design phase to the Government.
- ITR review should be accomplished by an independent technical review team composed of experts in the disciplines involved in the development of the design product.
- The ITR team is technically knowledgeable with U.S. codes, laws, regulations and requirements, and Japanese Design and Construction Methods & Materials.
- Reviewers should be experienced and be capable of focusing on potential problem areas of the design and identifying conflicts between discipline designs.
- The ITR is intended to ensure that a technically competent design has been produced but does not relieve the DOR of responsibility for the design.

- The ITR should document review comments and the DOR should work with the ITR reviewer(s) to incorporate all resolutions/corrections in to the design package prior to the printing of the submittal (or electronic submittal) package to the Government.
- This process should be repeated as required until all ITR comments have been resolved/corrected and incorporated in the design package.
- If the DOR chooses to annotate DCR comments with “will incorporate in the next submittal”, they will be responsible to follow through with the changes and comments will not be closed until the changes can be verified in the next submittal.
- Completed ITR annotated comments, marked up drawings/specifications/design analysis should be included at each deliverable design phase submittal.
- At each design submittal to the Government, the DOR should provide a signed certification by the ITR reviewer, team leader, Project Manager, and Principal certifying that an ITR was accomplished and all comments resulting from the ITR have been incorporated into the design documents (a sample certification template is available from the Japan District upon request).

The ITR serves to verify:

- the project meets the Stakeholder’s scope, intent and quality objectives;
- the formulation and evaluation of alternatives are consistent with applicable regulations and guidance;
- the concepts and project costs are consistent with expectations and market trends;
- the recommended alternative is feasible and will be safe, functional, constructible, environmentally sustainable, economically justified, and within the U.S. Government interest;
- the relevant engineering and scientific disciplines have been effectively integrated and coordinated without conflict;
- there is consistency within the contract documents among disciplines;
- the appropriate computer models and methods of analysis were used and basic assumptions are valid;
- the source, amount, and level of detail of the data used in the analysis are appropriate for the complexity of the project;
- the project complies with accepted industry practices and materials; construction methods and materials are appropriate for local (Japanese) implementation and
- the content and documentation are sufficiently complete for the current phase of the project and provide an adequate basis for future development efforts.

4.3.9 QUALITY ASSURANCE REVIEW

The Japan District will perform a quality assurance review of all designer work to confirm that quality control processes were followed during the project design process. During the quality assurance review, Japan District performs a technical review to determine whether the designer met quality requirements and utilized quality control processes. Japan District review of the designer-developed quality control documentation (QCP, ITR and DC comments and responses) is part of the quality assurance review process. The designer is solely responsible for conducting a thorough QC review in accordance with their QCP and for completing a quality design product that complies with Japan District's BCOES process.

CHAPTER 5 - ANTITERRORISM

5.1 GENERAL

Design for antiterrorism refers specifically to UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings. This UFC seeks effective ways to minimize the likelihood of mass casualties from terrorist attacks against DoD personnel in the buildings in which they work and live.

This chapter provides guidance for applying Appendix B and C of UFC 4-010-01, when applicable. The Installation Antiterrorism Officer's Design Basis Threat analysis will determine whether Appendix B and C are applicable to the project. It is the Installation's responsibility to determine the level of protection and the additional protective measures required for a project by using the process in UFC 4-020-01 DoD Security Engineering Facilities Planning Manual. Physical Security, Force Protection, and Access Control Points/Entry Control Facilities are separate design considerations not covered in this Chapter.

5.2 DESIGN CRITERIA

ASTM INTERNATIONAL (ASTM)

ASTM E1300	Standard Practice for Determining Load Resistance of Glass in Building
ASTM F2247	Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Load Method)
ASTM F2248	Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
ASTM F2927	Standard Test Method for Door Systems Subject to Airblast Loadings

DEPARTMENT OF DEFENSE

UFC 1-200-01	DoD Building Code
UFC 4-010-01	DoD Minimum Antiterrorism Standards for Buildings

US Pacific Command Instruction 0536.2 April 6, 2018 (FOUO)

Engineering and Construction Bulletin No. 2019-1

Marine Corps Installations Pacific-MCB Camp Butler Policy Letter 3-19 (See Appendix)

Air Force Instruction 10-245 June 25, 2015

US ARMY CORPS OF ENGINEERS PROTECTIVE DESIGN CENTER

PDC TR 06-08	Antiterrorism Response Limits

PDC TR 10-02	Blast Resistant Design Methodology for Window Systems Designed Statically and Dynamically
PDC TR 12-08	Protective Design Center Technical Report, Standoff Distances for Japanese Conventional Construction (See Appendix)

5.3 DEFINITIONS

- CCSD – Conventional Construction Standoff
- Glazed Door- Door that has any amount of glazing
- IGU – Insulated Glazing Unit
- PVB – Polyvinyl Butyl Interlayers
- SBEDS_W Single degree of freedom Blast Effects Design Spreadsheet for Windows
- SBEDS_5 Single degree of freedom Blast Effects Design Spreadsheet for Building Elements

5.4 BLAST ANALYSIS

The designer should coordinate with Installation AT Officer to verify Blast Analysis assumptions. The designer should apply provisions necessary to mitigate the effects of explosives at the achievable standoff distance to the appropriate level of protection, as defined in UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings. The blast analysis should be conducted by an engineer experienced in blast-resistant design and is to be based on the structural design of the building. Building elements to be analyzed include, windows, doors, and roof where applicable per UFC. Blast Analysis should be included in the Design Analysis.

5.5 STRUCTURAL COMPONENTS

Structural components that do not conform to Table C-5 of the UFC 4-010-01 and Table 1 of the PDC TR 12-08 should be analyzed dynamically using SBEDS_5.

5.6 STANDOFF DISTANCES

Standoff distance for buildings (not including windows and doors) can be determined by using Appendix B and C of UFC 4-010-01. Standoff is based on applicable charge weight and building construction parameters

5.7 PROGRESSIVE COLLAPSE RESISTANCE

All new buildings, three stories or more should comply with UFC 4-023-03 *Design of Buildings to Resist Progressive Collapse*. All existing building 3 stories or more, where the renovation cost is greater than 50% of the replacement cost, should comply. Penthouse or floors below grade will be considered a story if any portion is designated for human occupancy. If penthouse or floors below grade are not occupied, they will be eliminated from the calculation of the number of stories.

Progressive collapse resistant buildings on US Installations in Japan are predominantly cast-in-place reinforced concrete buildings. Buildings composed of precast concrete

elements will only be allowed with approval from Protective Design Center (PDC) in Omaha.

Progressive Collapse design requirements employ three different types of design/analysis approaches: Tie Force Method, Alternate Path and Enhanced Local Resistance. The selection of design requirements are based on “Occupancy Category” in Table 2-1 and Table 2-2 of UFC 4-023-03.

- Tie Force method is a prescriptive way of enhancing the buildings structural integrity only used for Occupancy Category II. This method applies to framed and two way load bearing wall structures with four or more bays in both directions. One way load bearing wall structures should have four or more bays in the one way span direction.
- Alternate Path analysis should be three dimensional computer model, two dimensional models are not permitted. Within Alternate Path there are three different analysis procedures: Linear Static (LSP), Non-linear Static (NSP) and Non-linear Dynamic (NDP). In order of usage, LSP is used most often, NDP is used when analyzing irregular structures and NSP is hardly used. NDP requires more advanced computer software. LSP is permitted for irregular structures if Demand Capacity Ratio (DCR) for the components are less than 2.0.

As much as possible avoid irregular structures per UFC 4-023-03. Alternate Path model should be entirely load bearing wall or entirely space frame. Space frame may include shear walls. When a building has access control, only exterior columns are removed.

5.8 STRUCTURAL ISOLATION

“Inhabited” building classification applies to the entire building envelope, although portions of the above buildings may be “low occupancy” if they are structurally isolated. For example, a “low occupancy” hangar may be structurally isolated from the “inhabited” administration areas. Note that isolated adjacent structures should have the same risk category. The most stringent risk category should be used.

5.9 WINDOWS AND SKYLIGHTS

UFC 4-010-01 allows for three different window design methods: dynamic, testing and static (ASTM F2248 and ASTM E1300). PDC TR 12-08 is a design guide for locally available windows in Japan. PDC TR 12-08 does not apply to skylights.

Japanese Architects/Engineers and Window Manufacturers are generally not familiar with blast design. U.S. window designs showing blast pressures and impulse will need to be imported from the U.S. Japan District goal is to use Japanese products to the furthest extent possible. Testing of windows by Japanese manufacturers is not likely. Static method used by some U.S. manufacturers is uncommon for Japanese Architects/ Engineers to apply. Also, static method is more conservative than dynamic analysis. Through experience, dynamic analysis is the recommended method of window design. Windows described in the PDC TR 12-08 are based on dynamic analysis.

5.9.1 PDC TR 12-08

In window design the first step is to check with the PDC TR 12-08, if available sizes may be used on the project. Glazing was designed dynamically using the SBEDS_W program. Frame I_{min} for blast was based on deflection criterion L/60 at 2 x STP (Static Test Pressure). Window frame manufacturer should check wind loads based on allowable stress with a deflection criterion of L/175. Frame minimum section properties should be based on the governing condition between blast and wind.

Windows that do not conform to the parameters of PDC TR 12-08 may be designed in accordance with Dynamic Analysis Section 5.10.3.

5.9.2 STANDARD WINDOW GEOMETRY

Standard window geometries (i.e. height, width, number of sashes, and height of sill) are described in Appendix A of the PDC-TR 12-08.

5.9.3 DYNAMIC ANALYSIS

Dynamic analysis guidance is presented in PDC TR 10-02. Any of the glazing, framing members, connections, and supporting structural elements should be designed using dynamic analysis. Use SBEDS_W to analyze window glazing and mullions dynamically. Provide performance equivalent to or better than the applicable level of protection. Design load for dynamic analyses will be the appropriate pressures and impulses from the applicable explosive weights at the actual standoff distances at which the windows are sited.

Design loading should be applied over the areas tributary to the element being analyzed.

5.9.4 BLAST REQUIREMENTS - WINDOWS

Windows and other glazing required to comply with Antiterrorism requirements should be designed such that the specific design requirements (e.g. laminated glazing material and thickness, PVB interlayer thickness, bite depth, air gap width (for IGUs), minimum frame section properties, etc.) are specified on the design documents. Performance blast requirements other than for anchorage and frame-to-frame connections will not be biddable. Frame minimum section properties should be based on the governing condition between blast or wind pressure; I_{min} for blast is based on PDC TR 06-8 response limits; wind is based on deflection criterion L/175. Prescriptive design of windows is to ensure that Japanese materials are incorporated into the design to the greatest extent practical, that the project will be biddable and constructible, and the facility can be maintained locally. The following minimum design information is required for bidding and manufacturing of windows by Japanese manufacturers to meet Antiterrorism requirements:

5.9.4.1 SINGLE PANE-LAMINATED

- Glass Type – Annealed, Heat Strengthened, or Fully Tempered
- Glass Thickness
- PVB Interlayer Thickness (24 MPa)
- Bite Depth

- Silicone Strength (1.0 or 1.7 MPa)

5.9.4.2 IGU-MONOLITHIC OUTER PANE AND LAMINATED INNER PANE

- Glass Type – Annealed, Heat Strengthened, or Fully Tempered
- Glass Thickness
- PVB Interlayer Thickness (24 MPa)
- Bite Depth
- Air Gap Width
- Silicone Strength (1.0 or 1.7 MPa)

5.9.4.3 FRAME – PROVIDE I_{MIN}

- Jamb Member
- Head/Sill Member
- Transom Member
- Mullion Member
- Confirm with local window manufacturer that sections with I_{min} are available

5.9.4.4 ANCHORS

Requirements in PDC-TR 12-08: minimum of two anchors at jamb, head, and sill; maximum anchor spacing of 400mm and frame-to-frame connections

- Provide out of plane blast line loads for jamb, head, and sill for anchorage.
- Provide out of plane end blast reactions for mullion or transom for frame to frame connections.

5.9.5 DRAWING REQUIREMENTS

Antiterrorism (Blast) Window requirements should be indicated in the Architectural set of the design drawings. NOTE: Based on Japanese construction practices, Japanese contractors consider window design work to be part of the Architectural drawing set, not the Structural drawing set.

5.10 BLAST EXTERIOR DOORS

Blast resistant doors should be tested accordingly:

- Unglazed Doors –ASTM F2247 or ASTM F2927
- Glazed Doors – ASTM 2927

Avoid using blast resistant doors, which are very expensive. Alternative Design, as described in UFC 4-010-01, should be the first option. Alternate Design options are described in Appendix C of the PDC-TR 12-08.

CHAPTER 6 - CIVIL

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

6.1 GENERAL

This chapter provides guidance and instructions for the civil design submittals (paragraphs 6.2 through 6.5) and for the design of facilities and infrastructure (paragraph 6.6). Items covered in this section include site layout, pavements, grading, drainage, water supply and distribution systems, sanitary sewage systems, topographic survey and geotechnical report requirements, and landscaping.

6.2 DESIGN CRITERIA

The following are commonly used design criteria documents not included on the Whole Building Design Guide (WBDG) website:

ACCESSIBILITY STANDARDS

DoD Policy Memorandum 31 October 2008, Subject: Access for People with Disabilities

Architectural Barriers Act Standard for Department of Defense Facilities (ABA)

MILITARY SURFACE DEPLOYMENT AND DISTRIBUTION COMMAND TRANSPORTATION ENGINEERING AGENCY (SDDCTEA)

SDDCTEA Pamphlet 55-17: Better Military Traffic Engineering

MARINE CORPS

MCO 5530.14A Marine Corps Physical Security Program Manual

DEFENSE FACILITIES ADMINISTRATION AGENCY

Structures Standardized Design Criteria for Civil Engineering Under the Facilities Improvement Projects (Civil DDD)

The Civil Definitive Design Drawings (DDD) provide standard Japanese construction details for site, utilities, and landscaping, and is available upon request from the Japan District Civil/Structural Section.

6.3 DESIGN SUBMITTAL REQUIREMENTS

6.3.1 PROGRAMMING CHARRETTE

The programming charrette is a meeting to gather information and prepare programming documents. The designer should provide a preliminary site plan showing

the project site and approximate location of the new site work for inclusion with the programming documents.

6.3.2 PRE-DESIGN MEETING

6.3.2.1 PRE-DESIGN CONFERENCE

The purpose of the conference is to provide an opportunity for the designer to gather project information and requirements. A site visit is performed, and base mapping, utility and other pertinent site data is gathered during the conference. Site information and requirements compiled during the meeting should be included in the meeting minutes that are prepared by the designer upon completion of the conference.

6.3.2.2 CHARRETTE DESIGN

The charrette is a meeting to exchange design ideas and present requests and requirements. A charrette may be performed to initiate design of the project. The charrette should typically be held at the project's Installation with representatives from the base, their command headquarters, Japan District, and the designers attending. The designer should coordinate with all of the representatives and strive to incorporate ideas, requests, and requirements into the site design while maintaining project scope. Base mapping and utility infrastructure studied, master plans and other pertinent site data should be gathered during or prior to the charrette.

Typically a site visit is performed on the first day of the charrette. A Site Study of existing manmade, environmental, and natural conditions should be made prior to initial site concepts to determine whether existing site parameters such as storm drainage limits and slopes, transportation patterns, soil types, wind direction, solar exposure, etc., will affect the site and building design.

During the charrette several schemes for the site layout should be presented for consideration and commented on by attendees. The Site Plan resulting from the attendees' combined efforts, suitable for presentation to high-ranking officers on the base, should be presented during a formal out brief on the last day of the charrette. A copy of the Site Plan and a narrative of the site requirements should be included in the charrette document, or meeting minutes, that are prepared by the designer upon completion of the charrette.

6.3.3 PARAMETRIC DESIGN

6.3.3.1 DRAWINGS

VICINITY MAP AND LOCATION PLAN

The Vicinity Map is a small-scale drawing showing the location of the installation, area, or community in relationship to surrounding cities and roads, similar to a road map. The Location Plan should show the project's location, access routes, and staging areas on the installation or within the area or community.

DEMOLITION PLAN

The Demolition Plan should show the existing site before construction and deconstruction for accurate Contractor bidding and project construction. This plan

should include the field survey (or designer's developed CADD file if the survey has not been completed) to show all above and below ground utilities, buildings, roads, parking, sidewalks, trees, turf, walls, storage tanks, foundations, athletic facilities, and existing contours. Label, dimension, and hatch all items that require deconstruction, removal, relocation, or modification.

SITE PLAN

The Site Plan should show the basic site layout and existing site features and structures to remain on the project site. Proposed fencing, pavements, and structures should be labeled to indicate material types. Plan sheets should clearly differentiate between new and existing pavements and different pavement types (concrete, bituminous, or gravel). Key dimensions should be shown. Proposed work will be clearly evident from existing features. The plan should incorporate applicable regulations and restrictions for clearances and setbacks; i.e., antiterrorism, airfield and explosive clearance zones, etc., Drawing orientation should generally be with north pointing to the top (or to the left) of the sheet.

UTILITY PLAN

The Utility Plan should show the site layout including all existing utilities (i.e. water, storm, sewer, gas, electrical, etc.) with sizes. All proposed utilities should be shown at proposed locations with tentative sizes. Utilities should be shown from their tie-in point with existing infrastructure up to a point 1.5 meters from the building envelope. All potential interferences with utility routings including any existing infrastructure should be depicted and noted.

DRAINAGE PLAN

The Drainage Plan should include a conceptual layout design of the storm drainage system. The plan should be based on an existing condition and proposed condition drainage analysis. All proposed drainage systems should be indicated at their locations and include tentative sizes.

DESIGN ANALYSIS

Give the basis and reasons for design, i.e., goals, objectives and priorities. Clearly explain the recommended site development concept. The DA typically includes:

- The general geology of the project site, its history, and whether hazardous and toxic waste contamination may be present.
- Any available and relevant existing subsurface data at the site and whether additional subsurface investigation is required for the design of the project.
- The status of any ongoing subsurface investigation.
- The entities responsible for providing any required additional subsurface investigation, the Geotechnical Report, and the geotechnical specifications.
- Criteria used to design utilities systems, and/or components thereof.
- Adequacy of water distribution system. Should the information prove unobtainable, the designer should promptly contact the Japan District Technical Lead.

- The capacity of the existing wastewater and storm drain system to accept additional flow generated by the proposed project.
- Whether concrete curb and gutter will be used.
- Pipe size that will be used for the cost estimate and a rough estimate of earthwork quantities.
- If borrow material is available on site.
- Approximate amount of fill under buildings and roads.
- Minimum and/or maximum grades (% slope).
- Energy conservation measures.
- Pollution prevention measures and other environmental constraints identified in the environmental documentation.
- A separate section on unresolved items or criteria required to complete the final design.

6.3.4 CONCEPT DESIGN

6.3.4.1 DRAWINGS

VICINITY MAP, LOCATION PLAN, DEMOLITION, AND SITE PLAN

Include Vicinity Map, Location Plan, Demolition Plan, and Site Plan requirements from previous submittal with review comments incorporated.

UTILITY PLAN

Include Utility Plan requirements from previous submittal and include locations of proposed valves (including PIV's), lift stations, manholes, new fire hydrants, and fire department connection (FDC) on the building.

For water supply lines, trunk or outfall sewers, and force mains:

- Provide separate layout sheet showing new routing with tentative sizes;
- Existing utilities and aboveground features which could affect construction;
- Right-of-way for off-base portions; and locations of manholes, relief valves, blowoffs, isolation valves, etc.
- For pumping stations:
  - Provide site plan showing structure location and exterior piping;
  - Coordinate with Architecture and Plumbing for point of connection of single line piping with tentative sizes;
  - One drawing section through showing pertinent elevations.

For water and wastewater treatment plans:

- Provide site plan showing major unit treatment items including their relationship to existing facilities and exterior yard piping;
- Schematic flow diagrams for process flow, solids handling, chemical feed, and service water;
- Hydraulic profile flow rates per scope of services;
- Coordinate with Architecture and Plumbing for point of connection of single line piping with tentative sizes;

One section through structure showing pertinent elevations.

GRADING AND DRAINAGE PLAN

The Grading and Drainage Plan should show the basic site layout including all existing utilities to remain and existing contours. The plans should be prepared in accordance with paragraphs 6.5.3 through 6.5.5. Tentative finished floor elevations of new buildings should be shown. Uniform grades should be labeled using slope arrows. New culverts, storm drains, and sub drains should be labeled with tentative sizes. The designer should edit the following notes accordingly and add to the Grading and Drainage Plan.

- Existing contours were interpolated from a topographic survey made (Give Date). Survey horizontal datum is (Give Datum) and vertical datum is (Give Datum).

Benchmark (Give location, description, and elevation).

PLAN AND PROFILES

Provide profiles of new roadway alignments. Profiles should show all new and existing utilities. Horizontal curve information should be shown on plans and vertical curve information should be shown on profiles.

GRADING SECTIONS

Provide a minimum of two grading sections through each building, embankment, or road showing existing and finished grade lines.

6.3.4.2 DESIGN ANALYSIS

The design analysis typically includes the following:

- List of design criteria
- The goals, objectives and priorities. Clearly explain the recommended site development.
- Narrative describing minimum finished floor elevations.
- Composition and volume of anticipated traffic.
- Pavement design calculations and results using soil data provided in the soils report.
- For water systems provide narrative description (including operation and controls), available flow and residual pressures, peak and average demands, allowable pipe materials, and calculations to support pipe sizing, tank sizing, flow demands, etc. If applicable, provide well capacities, chemical analyses and treatment requirements, storage availability and requirements, storage tank type and size, pump types, sizes, electric and control requirements, and insulation and/or heating requirements.
- For wastewater systems, provide narrative description (including operation and controls), capacity of existing system, design flow rates, allowable pipe materials, and all calculations necessary to support pipe sizing, tank sizing, flow demands, etc. If applicable, provide pump types, sizes, and electric and control requirements with pertinent information, pumping rates, hydraulic transient (surge) analysis, wastewater effluent analysis, and any special requirements of

industrial wastewater systems. Address energy conservation measures taken in the site design. Document pollution prevention measures and other environmental considerations made during design.

- Provide landscape design considerations for site conditions, climate, soils, water, erosion, in selection of materials.

6.3.5 INTERMEDIATE DESIGN

6.3.5.1 DRAWINGS

VICINITY MAP, LOCATION PLAN, DEMOLITION, AND SITE PLAN

Include Vicinity Map, Location Plan, Demolition Plan, and Site Plan requirements from previous submittal with review comments incorporated.

UTILITY DRAWINGS

Generally, the corrected and approved concept plans may be used as the basis for the intermediate plans; however, all details necessary for completion should be included.

- Provide preliminary profiles of all gravity sewers, waterlines, and sewer force mains.
- Profiles may be omitted for short waterline unless necessary to assure adequate cover or avoid interference with other underground facilities.
- Indicate existing pipe material where new lines connect.
- Indicate type of connection and elevation.
- Provide location of all valves, fire hydrants, and similar appurtenances.
- For pavement crossings, indicate installation method (open cut, boring, jacking, etc.). Where lift stations are required, provide appropriate details showing piping required, pumps, valves, and accessories. Include at least one section showing all required elevations.
- For water supply lines, outfall sewers, and force mains, include survey ties and/or bearings, stationing in both plan and profiles, contours in plan, and appropriate notes, etc. for pavement crossings.
- For water and wastewater treatment plants provide preliminary equipment layout showing all required piping, valves, meters, pumps, etc.
- Provide preliminary equipment schedules showing capacity, head, etc. for major items of equipment.

GRADING AND DRAINAGE PLAN

New grading contours should be provided on the grading and drainage plan. New spot elevations should be provided at the corners of buildings and entrances, tops of drainage, sewage, and other utility structures, parking areas, changes in grade (high and low points in grading scheme), top and bottom of retaining walls and curbs, etc.. Utilize abbreviations next to spot elevations when the elevation pertains to a specific feature (i.e. FF-finished floor, TC/BC-top/bottom of curb). New slope arrows with percentages (%) or slope ratios (H: V) (Horizontal: Vertical) should be provided at locations not covered by typical sections or as needed.

PLAN AND PROFILES

Profiles of new roads, streets, and railroads may be provided on separate drawings or on Plan and Profiles drawings. Plan and profile drawings should show new and existing contours.

GRADING SECTIONS

Grading sections through new buildings and parking areas should show finished and existing grades, new and existing utilities, pavement sections in detail, spot elevations, dimensions, slope percentage, ditches, etc.

SITE DETAILS

Provide detailed drawings of site furnishings; accessories; handicapped parking and provisions; water and sewer details; and specific construction techniques, applications, and finishes when graphical clarification is necessary for design interpretation or construction quality. Provide pavement details showing interface between new and existing pavements and new pavements of different sections. Use standard detail drawings from the Civil DDD where applicable.

6.3.5.2 SPECIFICATIONS

Draft specifications should be submitted for review in redlined form. Special sections should be prepared to cover those subjects for which no pattern guide specifications are available.

6.3.5.3 DESIGN ANALYSIS

It is recommended that the DA also include a summary of the basic information and conclusions presented in the previous submittal. In addition to water and wastewater items required in the concept preliminary design provide, if applicable, narrative and calculations for ultimate disposal to wastewater facilities, pilot testing for treatment facilities, and hydraulic transient (surge) analysis for pumping stations for potable and fire water systems. If the project utilizes non-government facilities for water supply and/or wastewater treatment, provide documentation showing coordination. Provide drainage area map showing the boundaries of specific drainage areas tributary to their respective drain inlets or culverts. Include storm runoff calculations for each drainage area. Provide preliminary pipe sizing calculations. Provide preliminary earthwork quantity calculations with a discussion of the earthwork balancing. Provide copies of pertinent correspondence and conversation summaries.

6.3.6 FINAL DESIGN

The Final Design documents should include all information for bidding and construction of the project. Specific requirements for plans, specifications and design analysis are as follows:

6.3.6.1 DRAWINGS

The corrected and approved plans from previous submittals (with review comments incorporated) may be used as the basis for the final plans. All details necessary for bidding and complete construction should be included. The following information is

required (when applicable) in addition to the previously stated requirements for drawings.

LOCATION PLAN

The Location Plan should show:

- **Contractor's Access and Haul Routes:** Show access and haul routes with any load limits. Coordinate requirements with local engineering and construction offices.
- **Waste and Borrow Sites/Areas:** The designer should determine the waste and/or borrow sites for all non-hazardous/toxic/radioactive waste (HTRW) materials for the project. Waste and/or borrow areas should be clearly identified on the Location Plan showing the material acceptable for borrow or waste. Areas selected should meet all existing regulations for pollution control and environmental quality as established by the city, county, state, and federal governmental agencies. The designer should check waste areas for types of materials which may, or may not, be disposed of.
- **Contractor's Staging Area and Parking:** Show areas for contractor storage, temporary fencing, sheds, and parking for subcontractors and their employees. Coordinate requirements with the engineering and construction offices.

BORING LOGS

The designer should provide soil boring logs on the Final Design drawings. Soil boring or test pit locations should also be shown on the Final Design drawings, preferably on the site plan where exploration locations may be referenced to structural features of the project. Elevations of the top of borings and the water table, if encountered, should be shown on the drawings if they are known. If not known they should be referenced to the existing ground surface. If feasible, a schematic sketch of new structures with foundation depths noted should be shown on the boring logs; thus indicating required cut and fill and soil strata on which foundation elements will bear. Do not include the narrative portion of the Geotechnical Report or any sections or profiles containing interpretations of subsurface data in contract drawings or specifications.

DEMOLITION PLAN

The Demolition Plan should show the existing site before construction and the demolition required by construction of this project. This Plan should include the field survey to show all above and below ground utilities, buildings, roads, parking, walks, trees, turf, walls, storage tanks, foundations, athletic facilities and existing contours. Demolition required by all aspects of the design have been fully coordinated at final design and are shown on the Demolition Plan. All items to be removed, relocated or modified should be appropriately labeled and hatched. The extents or limits of demolition should be clearly marked. Dimension all items that require demolition.

SITE PLAN

The Site Plan should be fully dimensioned and labeled as necessary to field locate each item to be constructed. The Site Plan will show all existing physical features within and

adjacent to the work site that will remain after the proposed construction has been completed. New work will be clearly evident from existing features. Applicable regulations and restrictions for clearances and setbacks should be met.

Utility Drawings

The Utility Plan should be fully stationed and labeled as necessary to field locate each item to be constructed. New work will be clearly evident from existing features. Provide finalized profiles and sufficient sections and details to permit construction.

Grading And Drainage Plan

New grading contours should be provided on the grading and drainage plan. New spot elevations should be provided at the corners of buildings and parking areas, changes in grade, etc. New slope arrows with percentages (%) or slope ratios (H: V) (Horizontal: Vertical) should be provided at locations not covered by typical sections or as needed.

Erosion And Sediment Control Plans

Provide Erosion and Sediment Control Plans for projects which disturb more than one acre. Show the location of permanent and temporary best management practices required to minimize erosion and retain sediment within the boundaries of the site. This Plan should show methods of controlling erosion and sediment control during and after construction. When this Plan is not required, temporary erosion and sediment controls should be the responsibility of the construction contractor unless otherwise indicated.

Indicate on the erosion control plan the location of the applied erosion control item and indicate this item as “temporary.” In details that show erosion control items, indicate these items as “temporary” in nature as well.

Plan And Profiles

Provide profiles of new roads on separate drawings or on Plan and Profiles drawings. Plan and profile drawings should show new and existing contours. Profiles should show all new and existing utilities. New grade elevations should be provided at the beginning and end stations and at 15 meter minimum intervals along profiles for roads, and streets.

Storm Drains, Culverts, And Subdrains

Profiles of all new storm drains, subdrains, and culverts should include new and existing grades, new and existing utilities, pavement sections in detail, pipe diameters and lengths, pipe slopes, invert elevations, etc. Class, gauge, etc. of all storm drain, subdrain, and culvert pipes should be indicated. This information may also be included in the Storm Drain and Subdrain Schedule drawings.

Site Grading Sections

Grading sections through new buildings and parking areas should show finished and existing grades, new and existing utilities, pavement sections in detail, spot elevations, dimensions, slope percentage, ditches, etc.

Road Sections

Provide grading sections at 15 meter intervals along major roads, and streets.

PAVEMENT JOINT LAYOUT PLANS

Provide pavement joint layout plans with spot elevations at joint intersections for all new concrete roads and parking areas. Each type of joint should be shown with a different symbol and a joint legend provided. Pavement joint layout plan should not be combined with any other plans.

SITE DETAILS

Provide detailed drawings of site furnishings, accessories, handicapped parking and provisions, appropriate water and sewer details, concrete pavement joint details, chain-link fence details, and specific construction techniques, applications, and finishes when graphical clarification is necessary for design interpretation and construction quality. Provide pavement details showing interface between new and existing pavements and new pavements of different sections. Use standard detail drawings from Civil DDD where applicable.

LANDSCAPE PLAN

The landscape plan should show plants and sodding.

- **Plants:** The Landscape Plan should show all trees, shrubs, plant beds, landscape-related furnishings, landscape edging. Show beds or areas that are to receive decorative mulches. The Landscape Plan should include a plant materials list. The list should include: botanical names; common names; the appropriate size in caliper, height or size of container, i.e., 3 meter high or 20 liter container; the method of transplanting, balled and burlapped, container grown; and special comments such as 1-year old seedlings, or "symmetrical form with branching at 2 meter height minimum". This Plan should also show any wetlands plantings or any other re-vegetation requirements necessary for the project.
- **Sodding:** Show all unsurfaced ground areas disturbed by construction to be sodded on the Landscape Plan. When a landscape design is not being provided with a project, unsurfaced ground areas to receive sodding or erosion control will be shown on the Site Plan. Seeding is not common practice in Japanese construction.

LANDSCAPE DETAILS

Provide details for installing plants and constructing plant beds, landscaping furnishings and accessories. The Civil DDD standard landscape details should be used where applicable. The Designer should verify the methods of planting to meet the project site requirements and modify the generic landscape details as local practices dictate. The Designer should provide all additional designs and details as necessary for furnishings and accessories not included in the standard details.

SPECIFICATIONS

The specifications should be complete, accurate and fully coordinated with the plans and details.

DESIGN ANALYSIS

The Design Analysis should include the information presented in the previous submittal, corrected to reflect changes.

GEOTECHNICAL REPORT

Incorporate recommendations stated in the Geotechnical Report into the design. Provide geotechnical design calculations using parameters outlined in the Report and include a copy of the Report in the design analysis as an appendix. Include laboratory test data as an appendix. Identify and resolve any conflicts between the Geotechnical Report and the design. Contact the author of the Geotechnical Report for assistance in resolving such conflicts if needed or if the Geotechnical Report needs to be modified.

DRAINAGE AND STORMWATER MANAGEMENT

Provide tabulation of capacities of new storm drains and culverts including: diameter and slope of storm drain pipes, design storm discharge and velocity for each storm drain pipe, maximum discharge capacity of each storm drain pipe, erosion control at each outlet if required, headwater depth of each culvert during design storm discharge. Provide hydraulic capacity calculations for each new curb and area inlet. Include anticipated service life of all allowable storm drain pipe materials. Include discussion of watertight joint requirements for storm drains. The Designer should determine whether watertight joints are required for new storm drains. Include discussion of any permanent stormwater best management practices (BMP's) incorporated into the project such as detention basins, bioretention areas, etc. Provide discussion of any temporary or permanent erosion and sediment controls incorporated into the project.

6.3.7 RTA DESIGN

6.3.7.1 GENERAL REQUIREMENTS

Plans, specifications, and design analysis should have all comments incorporated.

6.4 DRAWING COMPOSITION

6.4.1 PREPARATION

Drawings of the project site should be prepared by assembling a CAD file specifically for the purpose of plotting. The file should reference the survey file; removal plan, site layout file, as applicable; and a border file. CAD file naming conventions and drafting standards should be followed. Scales between 1:250 and 1:400 meters (1 inch = 20' and 1 inch = 30') are acceptable drawing scales for site drawings. Other drawing scales should be approved by the Japan District. CAD files of actual field survey data should be used design.

6.4.2 COMBINING PLANS

Some combinations of plans on a drawing sheet may be made when plans have relatively small amounts of data that can be legibly combined with another plan. The Location Plan and Vicinity Map may be combined on the cover sheet with the index, or placed on the same sheet as the Site Plan. The Site Plan and the Utilities Plan may be combined as one plan with the approval of the Japan District, or they may appear as

separate plans on the same sheet of drawings. Under no circumstances should the Site Plan be combined as one plan with the Grading and Drainage Plan, although they may appear on the same sheet of drawings. Projects having little or no existing facilities to be removed may not require a separate removal plan, and the small amount of removals may be shown on the Site Plan.

6.4.3 NOT-IN-CONTRACT

Any work (construction, relocation and/or removal) shown on the drawings, that is to be performed by others should be identified on the Site Plan, Removal, Utilities and/or Grading and Drainage Plans as "N.I.C." (for "Not in Contract"). Note on each Plan that there is information on the Plans for work that is not in the contract.

6.5 GEOTECHNICAL INVESTIGATION AND REPORT

The designer should plan and perform such geotechnical subsurface investigation at the project site as required, and provide to the design team a comprehensive Geotechnical Report as early in the design as practicable but not later than the Intermediate Design submittal. For projects on Air Force installations, ensure soil resistivity testing is performed. See 6.7.11.4 for additional information. The designer should be responsible for obtaining all utility clearances and a digging permit prior to subsurface work. The Geotechnical Report should be prepared and provided in accordance with UFC 3-220-01 at a minimum for all contracts unless otherwise directed by the Japan District. All computations, studies, analyses, and recommendations should be included in the report. For larger structures, alternative foundation systems should be presented if more than one system will economically perform the task especially in the case where deep foundations are required to bypass weak and/or compressible layers of soil.

6.6 TOPOGRAPHIC SURVEYS

A topographic survey should be furnished by the designer for all projects that require grading and utility work. The survey should incorporate the basic criteria of EM 1110-1-1005 Table 6-1.

6.6.1 TOPOGRAPHIC MAPPING

Topographic mapping typically conforms to A/E/C Standards.

6.6.2 ANNOTATION AND SYMBOLOGY

General annotation typically includes street names, building numbers, feature descriptions, and surface types.

6.6.3 TYPICAL SCALES

Typical scales for engineering design site surveys is 1:250.

6.6.4 CONTOUR INTERVAL

Contour interval will be typically 0.250 meter. Each fourth contour will be bolder than others.

6.6.5 SPOT ELEVATIONS

Spot elevations are to be displayed to the nearest 0.001m.

6.6.6 SURVEY LIMITS

Extend survey limits a minimum 10m beyond project limits for clarification of existing drainage patterns.

6.6.7 UTILITIES

Show the source of utility information in the legend area of mapping. Above and below ground utilities will be located and shown on the final mapping. Underground utility information to be shown includes but is not limited to: sanitary sewers, storm sewers, electrical, communications (including fiber optic), cathodic protection, gas, and water. Utility lines extending outside the indicated mapping area should be shown to logical conclusions (adjacent manhole or potential connecting point) even if that end point is outside the mapping area. All underground information will be shown at proper elevations in the 3D CAD files and thoroughly annotated.

6.6.8 ABOVE AND BELOW GROUND UTILITIES (ELECTRIC)

Utilities include, but are not limited to, power lines and communication lines, street light poles, guy wires, vaults (including handholes and manholes), transformers and substations.

6.6.9 ABOVE AND BELOW GROUND UTILITIES (WATER, GAS, ETC.)

Locate all water, gas and other above and below ground pressure pipes. Locate all fire hydrants, hose bibs, valve meter, regulators, etc., within the limits of the area to be surveyed. Include location of pressure pipes on the topo map. Use sketched inserts where needed for detail and clarity. Utility lines extending outside the indicated mapping area should be shown to logical conclusions (adjacent manhole or potential connecting point) even if that end point is outside the mapping area. Open all manholes even if they are locked. If the facility will not assist, notify a POC immediately.

6.6.10 WASTERWATER SEWERS AND STORM DRAINS

Locate sanitary and industrial sewer manholes and storm drainage structures, such as culverts, headwalls, inlets, cleanouts, and manholes. Always obtain an elevation at the manhole rim and at the flow line at the bottom of all the pipes connected to a manhole culvert or inlet (invert elevations). Clearly identify the size, direction of flow and type of each pipe. Obtain the pipe invert elevation upstream and downstream of all manholes and inlets even if beyond the limits of the required topo. Provide sketches where needed for detail and clarity.

6.6.11 ROADS, DRIVES, PARKING LOTS, WALKS AND TRAILS

All roads should have spot elevations at 10 meter intervals along the centerline and each edge of road. The top-back of curbs and gutter flow lines should be collected for elevation purposes. The back of curb should be shown in plan view without gutter lines for this mapping. Dimensions of curb height and width should be annotated on each

respective detail. Centerlines will be shown on two-lane roads or wider. The surface type and road name will be shown by text.

6.6.12 BUILDINGS AND STRUCTURES

All permanent and temporary buildings, foundations, and structures will be identified. Structures higher than ground elevation should be collected from their roof lines and shown at zero elevation. This outline will be used to define an obscure zone for eliminating contour display. All buildings and similar structures will have ground elevations determined adjacent to them using the minimum number of points defining the structure's footprint. Elevations should be collected photogrammetrically where possible. These elevations should be 3D line strings to be used as break lines when developing the TIN (triangulated irregular network) for contour processing.

6.6.13 FENCES

All fences, walls and other similar obstructions should be shown. Chain link fences should be shown with a double X, rather than a single X as indicated in the CADD standards.

6.6.14 TREES, SHRUBS AND LANDSCAPING MATERIAL

Show all landscape materials, shrubs, shrub beds, trees over 25mm caliper, and types (evergreen or deciduous), how limits of turf types (field or lawn), also show irrigation systems. Show all wetlands, wet or marshy areas. If the trees are so dense (obscured) as to prevent adequate contouring, then tree lines will be treated exactly as buildings and structures.

6.6.15 DITCHES, STREAMS, CANALS, PONDS AND SCOUR HOLES

Show water's edge if visible. Water should be considered an obscured area and treated as buildings and structures with the exception that water's edge should be at proper elevation and should be collected as visible break lines. Areas with active erosion should be noted.

6.6.16 OTHER VISIBLE SURFACE FEATURES

Locate any storage tanks, radio antennas, or other surface structures visible and located within the area to be mapped.

6.7 SITE LAYOUT

6.7.1 BUILDING LOCATION

Consider the dimensional, environmental, orientation, and visual determinants, as discussed in UFC 3-201-01, when determining the building location.

6.7.2 SITE ACCESS AND CIRCULATION

The design should provide for the safe, efficient movement of pedestrians and vehicles. Consider travel routes and areas of pedestrian concentration when planning walks. UFC 3-201-01 provides guidance on the geometric design of walks. Follow the ABA for accessibility requirements. Follow Antiterrorism (AT) Standards when drop-off lanes and

loading docks are included in the project scope. Access drives should be designed to accommodate the full range of vehicles using the site. Service drives should be designed to accommodate only the particular vehicle(s) using the drive. Setbacks between roads, drives, installation perimeter, and buildings as required by the AT Standards should be met. Entrances to and from access drives should have a minimum turning radii for the largest vehicle expected to use the drive. Throat widths and lengths should accommodate incoming and outgoing traffic. A minimum of 30.4 meters (100 feet) of unobstructed sight distance for turns from parking lots and service drives onto the access drive should be provided.

6.7.3 PARKING

See Section 8.6.5 SOLAR REFLECTANCE INDEX for information on pavement coatings.

6.7.3.1 PRIVATELY-OWNED VEHICLE (POV) PARKING

Off street parking facilities should be located near the facilities served. Setbacks required by the AT Standards should be met. The design vehicle used in Japan is the mid-size vehicle with a parking stall size of 2.5 meters wide by 5.0 meters long.

Table 6 lists the standard parking lot dimensions based on Japanese design vehicle sizes.

Table 6: Japanese POV Parking Lot Dimensions

FEATURE	SIZE (mm) W x H
Parking Stall - 90°	2500 x 5000
Parking Stall - 60°	2900 x 5000
Parking Aisle - 90°	6000 W
Parking Aisle - 60°	4800 W
Two Way Driveway	6000 W
Turning Radius (Driveway)	5000
Turning Radius (Parking)	1500
Separation between Parking	1540

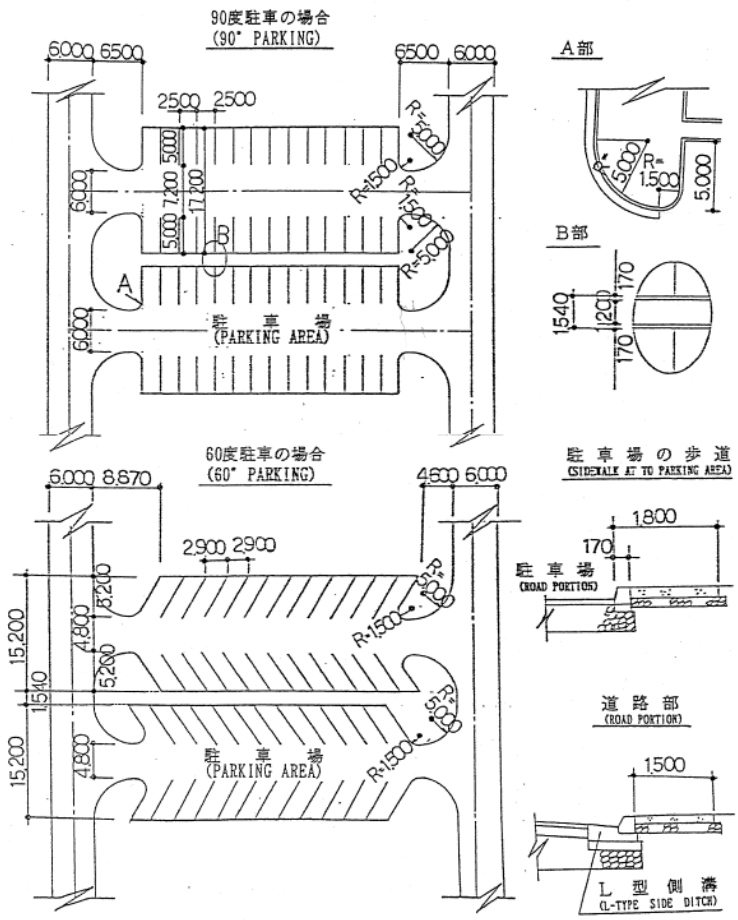


Figure 1: POV Parking Lot Figure

6.7.3.2 SIZE AND LAYOUT OF FACILITIES

Most POV parking should be designed with 90-degree stalls. Angled parking may be used when it is the only practical method, or is requested by the User. See UFC 3-201-01 for parking stall sizes for 90-degree and angled parking layouts. Pending data from Installation's traffic study and approval from each Installation's engineering division, parking stalls may be sized to match Japanese POV design vehicles (2.5m x 5.0m). Adjust end islands as shown in the UFC to allow for a 4.5-meter (15-foot) inside turning radius by vehicles. Provide for more than one entrance and exit in parking lots with more than 100 parking spaces. Follow the ABA for the design of accessible parking stalls. Provide motorcycle parking and bike racks on concrete paving.

6.7.3.3 CRITERIA FOR QUANTITY OF PARKING

Criteria for determining the appropriate number of parking stalls for POV authorized vehicles is either given in the Project DD Form 1391, Government furnished project documents or can be found in UFC 3- 201-01. The quantity of handicapped stalls should be as determined by the ABA.

6.7.3.4 GOVERNMENT VEHICLES (GOV) VEHICLE PARKING

Space allowances for design of GOV parking should be determined by the size of the vehicles and their maneuvering capabilities. Vehicle types and sizes are normally available from the User. See UFC 3-201-01 for some general guidelines on vehicle sizes and minimum turning requirements. Additional vehicles are listed in AASHTO. The designer will document vehicle parking design considerations in the Design Analysis.

6.7.4 DUMPSTER ENCLOSURE

If the facility user requires a dumpster on site, a concrete dumpster pad and sanitation vehicle access pad will be provided. The chosen location should consider the aesthetics of the building, accessibility by maintenance personnel, and the maneuverability of the servicing vehicle. Dumpsters may be screened with walls, landscaping and/or berms, as requested by the User. Typical practice in Japan is to have poured in place concrete walls on three sides, with a swing gate for access. Minimum setbacks as required by the AT Standards should be met.

6.7.5 ROADS

Pavement design for roads and parking areas should be the responsibility of the designer. Both flexible and rigid pavement designs should be considered and the most economical section chosen. Pavement for roads and parking areas should be designed using Pavement Transportation Computer Assisted Structural Engineering (PCASE). Determine appropriate design vehicle size and loading from Installation's traffic study. A particular type of pavement may be required based on anticipated types of vehicular traffic or other considerations. In general, POV parking areas and access roads should have flexible pavement.

See Section 8.6.5 SOLAR REFLECTANCE INDEX for information on pavement coatings.

6.7.5.1 GEOMETRY

OCONUS Installation streets and roads are considered an extension of the host country's road system, and should use traffic control device standards and criteria of the host standard. UFC 3-201-01 Section 2-5.2 references SDDCTEA Pamphlet 55-17 for design of vehicle circulation and parking systems. SDDCTEA Pamphlet 55-17 Section 4.9 states that for OCONUS installations, host country standards should be followed for traffic control devices and geometric design of roads and parking systems. However, following host nation standards does not preclude conforming to any applicable antiterrorism and ABA accessibility requirements.

6.7.5.2 ROADWAY SAFETY

Roadside safety should be considered in design of new roads and streets. Clear zone distances should be determined based on traffic volumes and speeds, and on roadside geometry in accordance with the AASHTO Roadside Design Guide. Warrants, selection, and placement of roadside barriers, such as guardrails, crash cushions, etc., should be in accordance with the AASHTO Roadside Design Guide.

6.7.5.3 SIGNAGE AND STRIPING

Traffic signage and striping should be provided for all new roads and streets. The designer should address traffic signage with the Installation at the predesign conference. Regulatory signage and striping should be designed in accordance with the Japanese regulations and law. Refer to the Manual of Uniform Traffic Control Devices for signage not covered in Japanese requirements. When replacing pavement due to resurfacing, utility excavations, etc., ensure that roadway markers are replaced.

6.7.5.4 SIDEWALKS

Provide a minimum drop of 150 mm (6 inches) at all personnel doors. Sidewalks leading to main building entrances should be designed with slopes meeting ABA requirements. Limit the use of separate ramps. The use of steps in walks will be avoided whenever possible. The use of single riser steps is especially discouraged. When steps are unavoidable, they should have at least three risers and will be provided with handrails. Special attention should be given to sidewalks that are on the north (shaded) side of buildings. These walks should be designed to ensure a freeze/thaw cycle does not result in the formation of ice on the walk. Expansion joint sealant should be a cold-applied type. Typically, Japanese construction practice only uses reinforcement in concrete sidewalks for odd-shaped slabs. Provide underlay paper in accordance with JIS P3401 for concrete sidewalks as shown in Civil DDD concrete sidewalk detail.

CURB RAMPS

For curb ramps along ABA accessible paths, ABA standards should govern. The change is level from asphalt to concrete curb ramp is 20mm in the Civil DDD. ABA standards require a 6.4mm maximum vertical change in level, or 13mm maximum change in level for beveled edges. Additionally, for Curb Ramp Detail on R-15 of Civil DDD, 1800mm length (3 curb blocks) should be used in lieu of 1200mm length (2 curb blocks) for lower slope during the 150mm drop.

6.7.6 GRADING

Table 3.1 in UFC 3-201-01 provides minimum and maximum requirements and best practices for various surfaces. Positive drainage should be provided for all areas and existing drainage ways should be utilized to the extent possible. It is desirable to direct drainage away from buildings to curb and gutter or road ditches. Swales between buildings and parking areas or roads should be avoided, if possible. Parking areas should be graded such that storm water is directed off to the sides, with curbs and gutter to control drainage, and not down the center of the parking area, where possible. Required excavation and embankment quantities should be balanced to the extent possible without compromising the design. Include hydraulic calculations justifying building finished floor elevations.

6.7.6.1 PARKING AREA GRADES

Follow Table 3.1 in UFC 3-201-01 and ABA requirements for ABA accessible stalls and paths.

6.7.6.2 RAMP GRADES

The maximum desirable grade for ramps is 7 percent. The absolute maximum ramp grade should be 10 percent and for short distances only.

6.7.6.3 GUTTER GRADES

The minimum desirable gutter grade should be 0.8 percent. The absolute minimum gutter grade should be 0.5 percent.

6.7.6.4 LONGITUDINAL SIDEWALK GRADES

The maximum longitudinal sidewalk grade adjacent to the roadway should be less than or equal to the adjacent roadway grade. Sidewalks without railings should have a maximum grade not exceeding 5 percent. Sidewalks with handrails and landings should have a maximum slope of 8.333 percent (1V:12H) slope with 1.5 m (5 feet) level landings at 9.1 m (30 feet) maximum spacing and at the top and bottom of the slope. See ABA Standards for additional requirements. Requirement listed here are per AASHTO Guide for Planning, Design and Operation of Pedestrian Facilities.

6.7.6.5 GRADES AWAY FROM BUILDING

The grade within 3 m (10 feet) of buildings should have a desirable minimum slope of 5 percent and a desirable maximum slope of 10 percent. The grade around the perimeter of buildings should have desirable minimum drop of 150 mm (6 inches) from the finished floor.

6.7.6.6 DITCHES

Ditches should have a minimum slope of 0.3 percent. Trapezoidal ditches should have a minimum width of 1.25 m (4 feet). The bottom of ditches should be a minimum of 0.1 m (0.3 feet) below the bottom of adjacent pavement courses.

6.7.7 STORM DRAINAGE

Design of storm drainage facilities should conform to the requirements in UFC 3-201-01.

Sizing of storm drainage systems for developed portions of military installations such as administrative, industrial, and housing areas as well as roadway culverts should be based on rainfall of 10-year frequency. Protection of military installations against flood flow originating from areas exterior to the installation will normally be based on 25-year or greater rainfall, depending on operational requirements, cost-benefit considerations, and nature and consequences of flood damage resulting from the failure of protective works. Potential damage or operational requirements may warrant a more severe criterion. In addition to the storm events described above, provisions should be made to prevent major property damage and loss of life for the storm runoff expected to have a one percent chance of occurring in any single year.

6.7.7.1 DETERMINATION OF STORM RUNOFF

Determination of peak discharges for smaller drainage areas may be accomplished using the Rational Method described in UFC 3-201-01. The Rational Method is commonly used in Japan for drainage areas greater than 80 hectares. For large

drainage areas, verify the Rational Method results used in the existing storm drain system are comparable to results using TR-55.

For areas where detailed consideration of ponding is required, computation should be by unit-hydrograph and flow-routing procedures.

6.7.7.2 STORM DRAINAGE SYSTEM LAYOUT

The storm drainage system should be designed so as to minimize the number of drainage structures required. Structures should be located at all vertical and horizontal changes in direction of storm drain lines, at the intersection of two or more storm drain lines, and where required to intercept rainfall runoff. The distance between drainage structures should not be more than approximately 90 m (300 feet) for conduits with a minimum dimension smaller than 750 mm (30 inches) but in no case further than 150 m (500 feet). Storm drain lines should be located outside of paved areas to the extent possible. Under no circumstance should storm drain lines be located beneath buildings. Existing storm drain lines located beneath new building sites should be relocated around the building. Curb inlets should be spaced along roadways with curbs and gutters so that the width of flooded areas does not exceed half the outside lane width. Where possible, a minimum drop of 0.05 m (0.2 feet) between inverts of equal diameter storm drain pipes should be provided at the centerline of drainage structures. Where storm drain pipes are of different diameters, the pipe crown elevations should be matched at the drainage structure.

6.7.7.3 MINIMUM COVER UNDER PAVEMENTS

The minimum cover for storm drains and culverts beneath road and airfield pavements should be in accordance with UFC 3-201-01.

6.7.8 FENCING

Provide wire sizes in mm diameter common to Japanese construction for chain-link fencing. Design security fences in accordance with UFC 4-022-03 Security Fences and Gates. Bolts/nuts used for security fencing can be easily removed, which presents a security risk. Provide spot welding of gate hinge pins and bolts attaching the fence fabric to the fence support posts for physical security.

6.7.9 SPECIAL SITE SECURITY REQUIREMENTS

The Designer should coordinate with the Installation to determine any special site security or screening requirements. All special security requirements that will impact the construction contractor should be included in the contract specifications.

6.7.10 LANDSCAPE

Provide a design that is both commensurate with the building's function and complementary to the architecture. Place emphasis on using plantings that require minimum maintenance. Plantings should supplement the energy efficiency of the building through wind control, temperature modification, and glare and reflection reduction, and, also reduce noise and control erosion. The designer should specify types of plant materials that are locally grown, commercially available and acclimated to

the project environment. Large, dense trees and shrubs should be planted outside of the facility's antiterrorism unobstructed space.

Refer to the Installation's design guide for site specific landscape requirements.

6.7.11 UTILITIES

6.7.11.1 SEWERS

The designer should verify with the Installation to determine if sewers in the area are overloaded. Verify system capacity if sewers are known to be overloaded or if large sewage flows will be generated by the new facility. Do not route wastewater, other than domestic sewage, to the sanitary sewage system without adequate pretreatment and/or verification of compatibility with the existing treatment system. Shut-off valves for raw sewage or sludge should not be gate valves. Small lift stations (100 gpm to 300 gpm) should be of the submersible pump type with plug and check valves in a separate valve manhole. Where flows indicate pump capacities substantially below 100 gpm, consideration should be given to use of a submersible, grinder-type pump station (duplex) with shut-off and check valves located in the wet well. Force mains for grinder pump stations should be 50 mm through 75 mm diameter. Wet wells and valve manholes should be precast concrete based on vehicle loading.

6.7.11.2 WATERLINE AND FORCE MAINS

For design of waterlines and force mains, use maximum Hazen-Williams "C" value of 130 for plastic pipe and 120 for other pipe materials.

6.7.11.3 WATER PRESSURE AT CFAS SASEBO

At CFAS Sasebo, waterline pressures are typically above average. Designer should take this into account for any new or repair work affecting the water system. For example, the Civil DDD thrust block details are not rated for such pressures and thus may not be used as shown.

6.7.11.4 CORROSION PROTECTION FOR AIR FORCE PROJECTS

For projects on Air Force installations, specify a bonded coating for corrosion protection of underground pipes. AFI 32-1054 prohibits use of unbonded coatings, such as loose polyethylene wraps, for protection of underground pipes without prior approval by AFCEC/COS. Polyethylene encasement is acceptable if soil resistivity exceeds 10,000 ohm-centimeters and AFCEC/COS approves. Ensure the geotechnical investigation includes field resistivity test for soils if seeking this exception.

CHAPTER 7 - STRUCTURAL

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

7.1 GENERAL

The instructions in this chapter provide guidance for the structural design criteria to be used and for the scope and content of the structural portion of the design documents required for each phase of the design. The structural design, including the resulting design documents, should conform to the applicable criteria and instructions set forth below.

7.2 DESIGN CRITERIA

The designer is responsible for determining the applicability of design criteria to each project and incorporating any appropriate Service Component criteria in order to comply with all necessary design requirements.

The Unified Facilities Criteria (UFC) and Service Component specific Technical Manuals, Engineer Manuals, Engineering Instructions, Technical Instructions, Engineering Technical Letters, and Military Handbooks are available electronically at the Whole Building Design Guide (WBDG) website at http://www.wbdg.org.

Commonly used criteria documents required for design and not included at the WBDG website include the following:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	Building Code Requirements for Structural Concrete
ACI530	Building Code Requirements for Masonry Structures
ACI 350	Environmental Engineering Concrete Structures.
ACI 360R	Guide to Design of Slabs-on-Ground
ACI SP-66	Detailing Manual

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) PUBLICATION

Steel Construction Manual

Seismic Provisions for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE) PUBLICATION

ASCE 7	Minimum Design Loads for Buildings and other Structures

ASCE 41	Seismic Evaluation and Retrofit of Existing Buildings

AMERICAN WATER WORKS ASSOCIATION (AWWA) PUBLICATION

AWWA D100	Welded Carbon Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS) PUBLICATION

AWS D1.1	Structural Welding Code
AWS D1.4	Structural Welding Code – Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A29	Standard Specification for General Requirements for Steel Bars, Carbon Alloy, Hot-Wrought
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000psi Tensile Strength
ASTM A325	Standard Specification for High-Strength Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563A	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM E1886	Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems

	Impacted by Missile(s) and exposed to cyclic Pressure Differentials
ASTM E1996	Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impacted by Windborne Debris in Hurricanes
ASTM F436	Standard Specification for Hardened Steel Washers
ASTM F844	Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

INTERNATIONAL CODE COUNCIL (ICC) PUBLICATION

International Building Code (IBC)

International Existing Building Code (IEBC)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) PUBLICATION

ISO 16932	Glass in Building – Destructive – Windstorm – Resistant Security Glazing – Test and Classification

JAPANESE ARCHITECTURAL STANDARD SPECIFICATION (JASS)

JASS 5	Reinforced Concrete Work
JASS 6	Steel Work

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS A5005	Concrete Aggregate
JIS A5308	Ready Mixed Concrete
JIS A5373	Precast Pre-Stressed Concrete Products
JIS A6204	Air Admixture
JIS A6514	Components for Metal Roof Decks
JIS A6517	Steel Furrings for Wall and Ceiling
JIS A7201	Standard practice for execution of spun concrete piles
JIS B1180	Hexagon Head Bolts and Hexagon Head Screws
JIS B1181	Hexagon Bolt
JIS B1186	Tests of High Strength Hexagon Bolt, Hex Nut and Plain Washers for Friction Grip Joints
JIS B1220	Set of Anchor Bolt for Structures
JIS B1256	Plain Washer
JIS B 1198	Headed Studs

JIS G3101	Rolled Steels for General Structures
JIS G3112	Steel Bars for Concrete Reinforcement
JIS G3136	Rolled Steels for Building Structures
JIS G3444	Carbon Steel Tubes for General Structure
JIS G3466	Carbon Steel Square and Rectangular Tubes for General Structure
JIS G3350	Light Gauge Steel Sections for General Structures
JIS G3352	Steel Decks
JIS G 3536	Steel-wires and Strand for Pre-Stressed Concrete
JIS G 3538	Hard Drawn Steel Wire for Pre-Stressed Concrete
JIS G3551	Welded Wire Mesh and Rebar Grid
JIS R 3109	Glass in Building – Destructive Windstorm-Resistant Security Glazing – Test Method
JIS R5210/5211	Portland Cement
JIS Z2201	Test Pieces for Tensile Test for Metallic Materials
JIS Z2241	Metallic Materials-Tensile Testing-Method of Test at Room Temperature
JIS Z3021	Welding and Allied Processes – Symbolic Representation
JIS Z3120	Method and Acceptance Criteria of Test for Gas Pressure
	Welded Joint of Steel Bars for Concrete Reinforcement
JIS Z3211	Covered Electrodes for Mild Steel, High Tensile Strength Steel and Low Temperature Service Steel
JIS Z3410	Welding Coordination- Tasks and Responsibilities
JIS Z3801	Standard Qualification Procedure for Manual Welding Technique
JIS Z3841	Standard Qualification Procedure for Semi-Automatic Welding Technique
JIS Z3881	Standard Qualification Procedure for Gas Pressure Welding Technique of Steel Bars for Concrete Reinforcement

JAPANESE REINFORCING BAR JOINTS INSTITUTE (JRJI)

JRJI	Japan Reinforcing Bar Joints Institute precast/Prestressed Concrete Institute (PCI) Publication

Japanese Welding Engineering Society (JWES)

WES B107 Standard for Certification of Welding Practitioners

PCI Design Handbook, Precast and Prestressed Concrete

MNL-116	Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
MNL -117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products

7.3 STRUCTURAL LOADINGS

Structural loadings should be developed for each building and structure using the site and project specific criteria and following the procedures indicated in the criteria sources referenced below.

7.3.1 DEAD LOADS

Dead loads should be selected in accordance with ASCE 7, as applicable.

7.3.2 FLOOR LIVE LOADS

Design live loads for floor areas should be as indicated in Scope of Services. Where floor loads are not provided, uniformly distributed floor live loads for common building usage should be obtained from UFC 3-301-01 and ASCE-7. Unusual loads and loads for usage not listed in that publication can be obtained from other recognized sources.

7.3.3 VEHICULAR LOADS

For vehicles exceeding 4536 kg (10,000 lbs) design in accordance with UFC 3-301-01 and AASHTO Bridge Design Specification.

7.3.4 HANGARS

See design requirements in UFC 3-301-01.

7.3.5 SNOW LOADS

Snow loads should be calculated in accordance with the procedures outlined in ASCE 7. Ground snow load, and other pertinent snow load criteria, should be obtained from the UFC 3-301-01.

7.3.6 WIND LOADS

Wind loads should be calculated in accordance with the procedures outlined in ASCE 7. Wind speed should be obtained from the UFC 3-301-01.

In “Wind Borne Debris Region (Ultimate Design Wind speed greater than 225 km/h)” glazing should be impact resistant per UFC 3-301-01. Glazing in windows and storefronts should be impact resistant meeting the requirements of JIS R 3109 or ASTM E 1886 and ASTM E 1996 or ISO 16932.

7.3.6.1 INTERIOR PARTITIONS

Interior partitions in structures that are defined as "partially enclosed" for wind loads by ASCE 7 should be designed for 10 psf lateral pressure. Interior partitions in structures that are defined as "enclosed" for wind loads by ASCE 7 should be designed for 5 psf

lateral pressure. Interior partitions around mechanical room spaces should be designed for 10 psf lateral pressure regardless of whether the structure is classified as "enclosed" or "partially enclosed". The deflection of interior partitions under wind load should be not more than 1/360 the span of wall for walls with brittle finishes and 1/240 for walls with flexible finishes.

7.3.7 SEISMIC LOADS

All facilities should be designed to withstand seismic loading in accordance with UFC 3-301-01 and ASCE 7. Spectral response accelerations should be obtained from UFC 3-301-01.

7.3.7.1 SEISMIC SCREENING AND EVALUATION OF EXISTING BUILDINGS

The evaluation of existing buildings and the design of the mitigation of structural deficiencies should be in accordance with ASCE 41 and IEBC. Seismic evaluation and retrofit are required for buildings assigned to Seismic Design Category C where renovation costs total more than 50% of the replacement value of the building. Seismic evaluation and retrofit are required for buildings assigned to Seismic Design Category D, E, or F where renovation costs total more than 30% of the replacement value of the building.

7.3.7.2 SEISMIC ANALYSIS

Calculations should include horizontal and vertical building irregularity checks in accordance with ASCE 7-10 tables 12.3-1 and 12.3-1 and 12.3-2. For seismic design categories C-F, apply the orthogonal combination procedure in accordance with ASCE 7-10 section 12.5.

7.3.8 ANTITERRORISM (AT) STANDARDS

The structural design should incorporate the minimum requirements for Antiterrorism (AT) as given in UFC 4-010-01 DOD Minimum Antiterrorism Standards for Buildings. Progressive collapse design should be in accordance with UFC 4-023-03 Design of Buildings to Resist Progressive Collapse. For additional requirements regarding window blast calculations, see Chapter 5 Antiterrorism.

7.4 BUILDING CONSTRUCTION

Buildings on US Military Installations in Japan are predominantly constructed of cast-in-place reinforced concrete. Hangars and warehouses are typically steel construction. Buildings constructed of precast/prestressed concrete elements (solid planks, hollow core, tritrees) and masonry are uncommon in Japan, except for piles. Precast piles are common in Japan.

7.5 FOUNDATION DESIGN

The designer will perform the subsurface investigation and the foundation analysis. The foundation analysis includes but is not limited to the recommended type of foundation and design depths, allowable soil bearing pressure, equivalent fluid density and lateral earth pressure coefficients, frost depth, modules of sub grade reaction, depth of

effective bearing layer, seismic site class determination and evaluation of liquefaction potential.

For new construction in close proximity to an existing structure, involving activities that could impact the existing structure (i.e., excavations and pile installations), the condition of the existing structure should be inspected and documented prior to the work as a baseline for any future claims of damage. When excavation near existing foundations is required, an assessment should be conducted in accordance with the IBC.

Designer should include all pertinent soils information in the contract documents. The geotechnical report should not be provided to the Contractor.

7.5.1 DEEP FOUNDATIONS

Precast pre-stressed high strength concrete (PHC) pile is the most common pile in Japan.

Table 7: PHC Piles

Description	**Japanese Std.**	**Concrete Strength Min.**	**Yield Strength Min.**	**Tensile Strength Min.**
Design	JIS A5373			
	JIS A7201			
Precast Concrete Pile	JASS 5			
Type A		80Mpa		
Type B		85MPa		
Type C		85MPa		
Prestressing Strand	JIS G3536	1275 Mpa	1275 Mpa	1420 Mpa
Spiral Reinforcing	JIS G3538		295 MPa	440 Mpa

PHC Piles are installed by pre-drilling to the bearing layer with two options for installing the remainder of the pile:

1. Driving Option – Driving the remaining 1 to 1-1/2 meters into firm bearing layer. When using larger diameter piles verify if hammers are readily available. Also give consideration to noise/vibration mitigation.

2. Cement Milk Option – Drilling the remaining length of pile into the firm bearing layer and vibrating the pile into place by using cement milk. Majority of Japanese contractors employ cement milk method of installation. Cement milk method compared to driven method is 10-50% more expensive and results in a bearing capacity of 30% less.

Due to transportation concerns, pile segment length shall be limited to 12m.

Provide a pile testing, location and quantity per geotechnical recommendations. Lateral and uplift testing is not common in Japan. Dynamic testing is usually acceptable for compression testing.

Other common types of piles are helical piles, steel pipe piles and drilled piers. Helical piles may be used where there are space constraints, time constraints, liquefaction issues, inclined bedrock, or soil contamination. Helical piles, although are more expensive, can provide larger axial capacities and therefore require less piles. For marine structures, steel pipe piles are typical. Drilled piers are used for large structures with large loads which are not common in US military installations in Japan.

Batter piles in building construction are not permitted.

7.5.2 SHALLOW FOUNDATIONS

Soil Cement Slurry (SCS) is a soil improvement method in Japan which strengthens the existing soil to minimize earthwork and soil disposal cost. This method can be used when the firm bearing layer is less than 4 m from the bottom of the footing and the soil bearing capacity of less than 80 MPa.

Soil Cement Columns (SCC) can be used when soil bearing is located at 3 meter to 6 meter depth from the bottom of the footing.

Verify the required design soil bearing capacity for shallow foundations with JGS (Japanese Geotechnical Society) 1521 Load Plate Test.

7.6 CONCRETE DESIGN

Concrete design should be in accordance with JASS 5, UFC 3-301-01, UFC 3-320-06FA, and current ACI publications that are applicable to the design. The water cement ratios at JIS certified plants are typically over 0.50 and have historically met performance requirements. Ensure specifications incorporate standard water cement ratios from JIS certified plants, or provide justification for using non-standard mix design and incorporate additional costs into the cost estimate. The following detailed design instructions also apply.

7.6.1 TYPICAL JAPANESE CONCRETE STRENGTHS AND USAGES

Table 8: Concrete Strengths and Usages

28-DAY STRENGTH	USE AND APPLICATION
24MPa (3481 psi) Compressive Strength*(water cement ratio 0.57)	Most reinforced concrete structures not exposed to freezing-and-thawing cycles, such as slabs, beams, girders, columns, exposed walls, footings, foundations, and sidewalks. For slabs-on-grade not subjected to heavy vehicular or stationary loads.
30MPa (4351 psi) Compressive Strength (water cement ratio 0.48)	Most water reservoirs and tanks for sulfate resistant structures not exposed to freezing-and thawing cycles. For other structures where economy consistent with good practice will result.
33 MPa (4786 psi) Compressive Strength	Minimum strength requirement for concrete exposed to freezing-and-thawing cycles
36 MPa (5221 psi) Compressive Strength	For precast concrete members, except 6000 psi compressive strength may be permitted if rigid control is exercised over plant and production.
3.85 to 4.48 MPa (560 to 650 psi)Flexural Strength **	Heavy-duty slabs-on-grade, i.e., slabs subjected to heavy loads.

* Minimum compressive strength used for Okinawa projects.

** Available flexural strength depends upon the concrete materials specific to the geographical location of the project involved.

7.6.2 OTHER AVAILABLE CONCRETE STRENGTHS

Other most commonly used concrete strengths are 18 MPa (2610 psi) (water cement ratio of 0.65), 21 MPa (3046 psi) (water cement ratio of 0.61), and 27 MPa (3916 psi) (water cement ratio of 0.52).

7.6.3 REINFORCING BARS

7.6.3.1 JAPANESE REINFORCING BARS

Table 9: Japanese Reinforcing Bars

BAR SIZE DESIGNATION	**NOMINAL AREA** (cm^2)	**NOMINAL WEIGHT** (kg/m)	**NOMINAL DIAMETER** (mm)
D10 (#3)	0.713	0.56	9.5
D13 (#4)	1.267	0.995	12.7
D16 (#5)	1.986	1.56	15.9
D19 (#6)	2.865	2.25	19.1
D22 (#7)	3.871	3.04	22.2

D25 (#8)	5.067	3.98	25.4
D29 (#9)	6.424	5.04	28.6
D32 (#10)	7.942	6.23	31.8
D35 (#11)	9.566	7.51	34.9

Note: “Designation are Japanese sizes and may differ with sizes in ACI 318M”

7.6.3.2 REBAR AVAILABILITY

For concrete design, the following reinforcing are locally available in Japan:

Table 10: Rebar Availability

BAR SIZE DESIGNATION	ASTM	JIS	STRENGTH
D16 & Smaller	ASTM A615/ASTM A706	JIS G3112 SD295A	295 MPa (43 ksi)
D19 & Larger	ASTM A615/ASTM A706	JIS G3112 SD345	345 MPa (50 ksi)
D29 & Larger	ASTM A615/ASTM A706	JIS G3112 SD390	390 MPa (56.5 ksi)

Reinforcing strength 390 MPa (71 ksi) listed in the table above is the minimum requirement for accidental explosion resistance and can only be procured by special order. SD390 should be used for longitudinal bars of special moment frames. Reinforcing strength 420 MPa (60 ksi), not listed in the table, does not exist in Japan. All other reinforcing not shown in the above table can only be procured by special order.

7.6.3.3 USAGE LIMITATIONS

Except for stirrups, ties and bars used in slabs-on-grade, the minimum reinforcing bar size should be D13. Nosing bars should not be used in exterior concrete stairs.

7.6.3.4 SPLICES

The three methods of splicing in Japan are lap, mechanical and welded splices. Lap and welded splices are the most common. Gas Pressure Welded Splice is the name of the welded splice method and is unique to Japan. Gas pressure welding is typically applied to the splicing of rebar D19 and larger. Welders are required to be qualified in accordance with JIS Z3801, JIS Z3841, and JIS Z3881. Gas pressure welding should be carried out in accordance with JASS 5 and JRJI. Weld should develop 125% of the minimum yield tensile strength of the spliced bar. Perform mechanical testing of steel in accordance with ASTM A370 or JIS Z2201 and JIS Z2241.

7.6.4 CONCRETE ANCHORS

Anchor such as adhesive or wedge type shall be as indicated on the drawings. Provide the following minimum data: tensile strength, shear strength, anchor bolt diameter,

embedment depth and number of test required after installation. Japanese anchors shall be certified by the “Japan Construction Anchor Association (JCAA).”

7.6.5 BUILDING SLABS-ON-GRADE

Design of slabs should be in accordance with UFC 3-301-01 and the following detailed instructions. Floor slabs to be subjected to heavy loads should be designed in accordance with UFC 3-320-06FA.

Slabs should be designed as floating slabs without rigid edge support and unrestrained lateral and vertical movement, or where structural slabs are required for soil/site conditions. Where compressible filler is used as a cushion, its thickness should not be less than 50 mm (2 inches). An isolation joint consisting of 13.6kg (30 lb.) felt or a 13mm (1/2-inch) expansion joint material is required where slabs abut vertical surfaces. All interior slabs should be designed and constructed in accordance with ACI 360R. The requirement and location of vapor barriers should be determined per figure 4.7 of ACI 360R. If a vapor barrier is required, the minimum thickness should not be less than 10 mil. A 150mm (6-inch) thick compacted capillary water barrier should be on compacted subgrade. Crack control measures should be incorporated in the slab design. Control joint spacing and details should be as delineated in UFC 3-301-01and UFC 3-320-06FA, as applicable.

7.6.5.1 SLABS SUBJECT TO HEAVY LOADS

Slabs subject to heavy loads are typically used in warehouses, vehicle maintenance shops, hangars, industrial plants, and similar buildings with heavy stationary or wheel loads. Slab thickness should be determined in accordance with the Portland Cement Association (PCA) Slab Thickness Design for Industrial Concrete Floors on Grade and UFC 3-320-06FA. The "k" factor should be furnished by the foundation analysis and adjusted for the type of soil and saturated conditions without frost.

7.6.5.2 SLABS-ON-GRADE IN FREEZER AREAS

Slabs in freezer areas should be designed with special measures to prevent sub-grade freezing. Such measures include insulation, vent pipes, heat coils, or heat pipes placed beneath slabs in these areas.

7.6.5.3 STRUCTURAL CONCRETE STOOPS

Exterior doorways require structural stoops where exterior slabs are susceptible to frost heave, and slab movement could render outward-swinging doors inoperable. Stoops should have foundation walls and footings to frost depth, should be rigidly attached to foundation walls, and have 300mm of uncompacted fill under the slab.

7.6.5.4 EXTERIOR SLABS FOR RAMPS, DOCKS & APRONS AT VEHICULAR DOORS

Where movement of the floor slab with respect to a door can cause operating difficulties, preventive measures should be taken. Such measures would include making the floor a structural slab supported on a foundation that extends below frost line, depressing the foundation wall at door openings and doweling the interior and exterior slabs together, or depressing the foundation wall at door openings and thickening the

edges of interior and exterior slabs at their interface. The thickened edge should be 1.25 times the slab thickness and should begin 10 times the slab thickness from the edge of the slab.

7.6.5.5 CONCRETE FLOOR SLAB FINISHES

Concrete floor slab finishes should comply with those indicated in Unified Facility Guide Specification (UFGS) 03 30 00 CAST-IN-PLACE CONCRETE.

7.6.6 CONCRETE WALL THICKNESSES

Typical wall thicknesses in Japan are 120mm, 150mm, 180mm, 200mm, 250mm, 300mm, 350mm, 450mm, 500mm, and 600mm. 120mm and 150mm are non-structural walls and structural walls begin from 180mm thick. Walls thicker than 150mm and greater have double layer of reinforcing. 150mm thick walls have a single layer of 100mm spacing vertical and horizontal bars.

7.6.7 NON-SHRINK GROUT

Non-Shrink grout shall conform to ASTM C1107/C1107M. The following Japanese products are compliant: 1.) Denka Pretascon type-1R. 2.) Taiheiyo Pre U-Lox 3.) Tokuyama Grout Mix JHS-312

7.7 MASONRY

Masonry as a structural building element or rainscreen is uncommon in Japan. Due to the seismic conditions, the construction culture uses cast in place concrete as the predominate construction methodology. In Japan, masonry is typically used for property walls, trash enclosure walls and plumbing walls in buildings. Japanese blocks typically have three cells instead of two and are constructed using stack bond.

In the instances where masonry is used, design should be in accordance with ACI 530 (as modified by the International Building Code and UFC 3-301-01. Type S mortar should be specified for all masonry. Reinforcement should be sufficient to satisfy the calculated and prescriptive requirements for strength, shrinkage crack control, and seismic design. Connections between walls and structural steel frames should be designed to allow frame movement with minimum influence on the adjoining walls. Concrete masonry crack control measures comprised of masonry control joints, joint reinforcement, and bond beams should be incorporated in the design of concrete masonry walls and partitions. Masonry control joints should be judiciously located at a spacing no greater than the maximum recommended in UFC 3-301-01. Masonry control joints should not be placed closer than 600mm from openings. Brick expansion joints for brick faced buildings 15m and longer, should be located as recommended by UFC 3-301-01. Masonry control joint (MCJ) locations should be shown on the architectural plan sheets. Brick expansion joint (BEJ) locations should be shown on the architectural exterior wall elevations and floor plans.

7.8 STRUCTURAL STEEL

Structural steel should be designed in accordance with UFC 3-301-01, JASS 6, AISC, and AISC Seismic Provisions for Structural Steel Buildings. All structural steel members

should be designed by the structural engineer to support all applicable loads. Structural drawings should clearly show all structural members and their locations. Types of connections should be consistent with the design assumptions for the basic type of steel construction used. Connections should be designed and detailed to provide adequate capacities for the applied forces and moments. Connection design should be the responsibility of the structural engineer and should not be delegated to the steel fabricator.

7.8.1 STANDARD JAPANESE STRUCTURAL STEEL

On occasion Japanese manufacturing companies produce ASTM products. However, it is rare and still recommended to use Japanese products when available.

Table 11: Standard Japanese Structural Steel

SHAPE	ASTM	Yield Strength	JIS	STRENGTH	REMARKS
H Shape	ASTM A36 ASTM A992	36 ksi 50 ksi	JIS G3101 SS400 JIS G3136 SN400B JIS G3136 SN490B	235MPa (34 ksi) 235MPa (34 ksi) 325 MPa (47ksi)	1
Channels Angles Plates	ASTM A36	36 ksi	JIS G3101 SS400	235MPa (34 ksi)	
Channels Angles Plates	ASTM A992	50 ksi	JIS G3136 SN400B JIS G3136 SN490B	235MPa (34 ksi) 325MPa (47 ksi)	4
Tubes	ASTM A500, Grade B ASTM A500, Grade C	42 ksi 46 ksi	JIS G3466 STKR400 JIS G3466 STKR490	245MPa (35.5 ksi) 325MPa (47 ksi)	
Tubes	ASTM A500, Grade B ASTM A500, Grade C	42 ksi 46ksi	BCP 235 BCR 295 BCP 325	235MPa (34 ksi) 295MPa (43 ksi) 325MPa (47 ksi)	2 2 2

Pipe	ASTM A53, Grade B	35 ksi	JIS G3444 STK400 JIS G3444 STK490	235MPa (34 ksi) 325MPa (47 ksi)	
Pipe	ASTM A53, Grade B	35 ksi	JIS G3475 STKN400B JIS G3475 STKN490B	235MPa (34 ksi) 325 MPa (47ksi)	3 3

1. Used for supporting facilities less than 100 square meters, non-seismic applications and for non-welding member such as purlin, column or beam.

2. No JIS, authorized by MLIT (Ministry of Land, Infrastructure, Transportation)

3. Developed for buildings, but has not become popular as JIS G3444.

4. Used for designs that require seismic applications and welding.

See the following web sites for a catalogue of structural steel shapes:

- Nippon Steel & Sumitomo Metal - http://www.nssmc.com/en/product/index.html
- JFE Steel Corporation - http://www.jfe-steel.co.jp/en/products/index.html
- Kobe Steel Corporation - http://www.kobelco.co.jp/english/products/

* English language information may not reflect commonly available Japanese products. Refer to Japanese language product information as needed.

Table 12: Standard Japanese Bolts/Studs

TYPE	ASTM	YIELD STRENGTH	JIS	YIELD STRENGTH	REMARKS
Bolt	ASTM A307	60 KSI*	JIS B1180	420MPa (60.9 ksi)	*Tensile Strength
				300MPa (43.5 ksi)	
				420MPa (60.9 ksi)	
Nut	ASTM A563A		JIS B1181		
Washer	ASTM F844		JIS B1256		
High Strength Bolt	ASTM A325	92 ksi-1/2”-1”dia.	JIS B1186	640MPa (92.8 ksi)	

(Galvanized)		81 ksi-1-1/8”-1-1/2”dia.			
			F8T Galvanized		
High Strength Bolt	ASTM A490	105 ksi	JIS B1186	900MPa (130.5 ksi)	
(Ungalvanized)			S10T Ungalvanized*		*popular
Nut	ASTM A563DH		JIS B1186		
Washer	ASTM F436		JIS B1186		
Welded Headed Studs	ASTM A29	50 ksi	JIS B1198	350 Mpa (51 ksi)	
Anchor Bolts	ASTM F1554	36 ksi	JIS B1220 SNR400B	235 Mpa (34 ksi)	
Nut	ASTM A563A		JIS B1220		
Washer	ASTM F844		JIS B1220		
Welding Electrodes		70 ksi	JIS Z3211, E49	400 MPa (58 ksi)	

Typ. Bolt Dia: M10, M12, M16, M18, M20, M22, M24, M27, M30
Typ. Welded Headed Stud Dia. M10, M13, M16, M19, M22, M25

7.8.2 JAPANESE STRUCTURAL STEEL DESIGNATION

Table 13: Japanese Structural Steel Designation

SHAPE	DESIGNATION	EXAMPLE
H Shape	H (height) x B (width) x t1 (web) x t2 (flange)	H440x300x11x18
Channels	H (height) x B (width) x t1 (web) x t2 (flange)	C200x90x11x14.5
Angle	A (height) x B (width) x t1 (A) x t2 (B)	L 200x90x9x14
Tube	A (height) x B (width) x t (wall thickness)	Tube 60 x 30 x 1.6
Pipe	D (outside diameter) x t (wall thickness)	Pipe 150 dia. x 10

7.8.3 CONNECTION DESIGN

The structural engineer should provide the connection design. Japanese fabricators do not typically design connections. Japanese fabricators prefer bolted connections for all structures including trusses. Specify galvanized anchor bolts for columns.

7.8.4 WELDING

Japanese fabricators prefer field welding to be minimized. Shop and field welding shall be performed by welders certified per JIS Z 3801 and WES B107-Standard for Certification of Welding Practitioners by Japan Welding Engineer Society. Welding electrodes are in accordance with JIS Z3211, E49, 400MPa (58 ksi). Welds not indicated shall be 5mm minimum fillets. Base metal pre heating shall follow the requirements of JASS 6 of AWS D1.1. Weld symbols per JIS Z 3021 (equivalent to AWS). Perform non-destructive testing of welds in accordance with AWS D1.4 Section 7. Radiographic testing is uncommon in Japan. Ultrasonic testing is the typical method used for welding inspection.

7.9 STEEL JOISTS AND JOIST GIRDERS

Structural steel beams are typically used in lieu of steel joists and joist girders in Japanese construction. In Japan, steel joists are typically used for temporary construction.

7.10 STEEL DECKING

Metal roofing and siding should not be used as a diaphragm. Lateral loads are typically resisted by tension rods. Metal roofs are typically 200mm in depth.

Floor decking is typically 50mm or 75mm depth with a maximum of an additional 100mm concrete topping.

- Metal Roofing ASTM A653 JIS A6514
- Composite Metal Deck ASTM A653 JIS G3352 (345 MPa) or SDP2G (Z27) MLIT Certified

7.11 COLD-FRAMED LOAD BEARING STEEL STUD WALLS

Design and detailing of wall systems using cold-formed steel members as load-bearing systems should be in accordance with the provisions of UFC 3-310-04A. Wall systems should be specified using UFGS 05 40 00 Cold Formed Steel Framing Design assumptions and details should be coordinated with specifications.

Metal stud spacing is typically 450mm and 300mm.

- Studs (Non-structural) ASTM A653 JIS G3350 SSC400 245 MPa (35.5 ksi)
- Studs (Structural) ASTM A36 235 MPa (34 ksi)

7.12 SPECIAL CONSTRUCTION

7.12.1 STANDING SEAM METAL ROOFING SYSTEM

Structural standing seam metal roof systems typically comply with UFGS 07 61 14.00 20 Steel Standing Seam Roofing and UFC 3-320-03A. Drawings should include diagrams of the calculated design wind uplift pressures for the various regions of the building roof(s), as determined from ASCE 7.

7.12.2 ELEVATED WATER TANKS

Elevated water tanks and other structures commonly constructed in accordance with manufacturer's proprietary designs are likely to be contractor designed or redesigned. For such structures the design should include a tabulation of loading criteria (roof live load, wind velocity, seismic design data, allowable soil bearing pressure, minimum foundation depth, coefficients for active and passive lateral soil pressure, etc.) and the load combinations necessary for design or completion of design by the contractor; a statement of the commercial design codes (ACI 318, AISC Specifications, AWWA D100 etc.) which govern the design of the structure, its supporting steel, and foundations; a complete design for the supporting structure and the foundations; and a drawn-to-scale graphical representation of the completed structure, including any dimensional requirements or limitations.

7.12.3 BLAST RESISTANT CONSTRUCTION

7.12.3.1 CONCRETE STRUCTURES

Concrete structures to be used for the manufacture, maintenance, inspection, or storage of explosive materials are typically designed in accordance with UFC 3-340-02. The following information will be required for such designs and will be furnished to the designer by the Japan District: Sketches or drawings defining the configuration and construction of the facility; the category of protection that is required; the amount, type, and location of explosive in each area; the TNT equivalence for each explosive; and the sensitivity of each explosive in terms of a minimum fragment velocity, if required.

Concrete structures located within the Blast ESQD (Explosive Safety Quantity Distance) arc should be designed in accordance with UFC 3-340-02. Blast analysis should be performed by the designer. Hardening requirements for structures, windows, and doors should be incorporated into the design.

7.12.3.2 MUNITIONS STORAGE IGLOOS AND MAGAZINES

When munitions storage igloos and magazine type facilities are included in the project, standard drawings are available for the designer to edit in accordance with the Designer Notes on the drawings. Other revisions may also be required for adaptation of the drawings to the site, climatic, and foundation conditions.

7.12.3.3 STEEL FRAMES AND COLD-FRAMED STEEL COVERINGS

Steel frames, cold-formed steel items, and blast doors shall be designed to be blast resistant as required in accordance with UFC 3-340-02.

7.12.3.4 ARMS STORAGE ROOMS

Criteria for arms storage rooms should be obtained or verified by the Stakeholder's Provost Marshal or Security Office through the Japan District's Project Manager.

7.12.4 WATER STORAGE RESERVOIRS

When the design of concrete water storage reservoirs include construction joints with water stops, the designer may stipulate that the reservoirs be tested for leakage prior to backfilling. When such testing is required, the reservoir structural design should include the loading condition of internal hydraulic head on the reservoir due to filling for testing purposes with no backfill in place.

CHAPTER 8 - ARCHITECTURE

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

8.1 GENERAL

Excellence in architectural design for both the interior and exterior of facilities is the primary goal for all design projects. Reaching this goal requires a commitment to architectural quality and a design that is sensitive to both the surrounding community and to the specific functional needs of the Stakeholder. Careful attention should be given to the Stakeholders' functional requirements; an aesthetic solution compatible with the local environment and the installation design guide or facilities excellence plan; sustainability; antiterrorism/force protection; siting; interior and exterior details; energy efficiency/performance; safety; and economy of design including life cycle cost. New facilities should be creative yet harmonious with those existing facilities that are considered to be architecturally appropriate. It should be recognized that quality design does not imply added expense, and can often provide savings in operating, maintenance, and construction costs. Materials for both interior and exterior of facilities should be selected and used with proper consideration for aesthetics, constructability, sustainability, durability and maintainability. Design decisions and material selections should have the supporting data necessary to justify the design adopted.

8.2 DESIGN CRITERIA

Design criteria will include a wide variety of codes, regulations, standards and other applicable requirements depending on the project type. The designer should coordinate the design closely with the Installation Fire Chief for design requirements particular to the project location. Even if this is an Air Force project, some Army codes and regulations may still be applicable. The designer should be responsible for researching and complying with all necessary design requirements. In cases where two or more design requirements appear to conflict, the designer should notify the Corps of Engineers Project Manager who will coordinate with the appropriate technical discipline for resolution. Most U.S. Army Corps of Engineers technical publications are available electronically at the Whole Building Design Guide website: http://www.wbdg.org/. New documents found at the sites, which are not listed in this design guide but appear to apply should be brought to the attention of the Japan District Architecture Section to verify if they apply.

8.3 DESIGN FOR SAFETY

Applicable provisions of the OSHA Occupational Safety and Health Standards should be incorporated into the design where consistent with Stakeholder design criteria. In cases of conflict, the safety standards established in the Stakeholder design criteria should take precedence. Questions on applicability should be referred to the Japan District Project Manager for resolution.

8.3.1 SPECIAL COORDINATION

The interrelationship between the requirements for Fire Protection, Life Safety, Sensitive Compartmental Information Facility (SCIF) Construction, Sound Control, Blast Control, Antiterrorism-Force Protection, Sustainable Design, Energy saving strategies, and Physical Security should be carefully studied. For example, individual doors that will satisfy more than single design requirements are generally not available. This can often mean that vestibules with multiple doors are necessary to cover any group of differing requirements, and unless they are correctly placed, can in turn interfere with one of the operations.

Japanese contractors do not provide the full set of design drawings and specifications to all of their sub-contractors. It is important to clearly indicate on the design drawings all necessary information for a sub-contractor to construct their component. For instance, on the Architectural Reflected Ceiling Plan, please indicate all symbols on the symbols legend. Do not note to see Electrical drawings for lighting symbols. The sub-contractor who will be installing the ceiling will not receive the Electrical drawings, so there will be questions during construction which can be avoided if all of the information is included on the Reflected Ceiling Plan.

Special coordination is required between the Life Safety Egress Floor Plans and the Architectural Floor Plans. Life Safety Plans should be not considered contractual. Fire Ratings of walls should be indicated on the Architectural Drawings using the standard symbology, which appears on the Life Safety Plans. To avoid conflicts, both Life Safety Plans and Architectural Floor Plans require coordination.

8.4 DESIGN FOR PEOPLE WITH DISABILITIES

Design features to accommodate people with disabilities should be in accordance with the Architectural Barriers Act (ABA) Accessibility Standards for Department of Defense Facilities. In general, all facilities designed, constructed, or funded by DoD that are open to the public or that may be visited by the public in the conduct of normal business, should be designed and constructed to be accessible to people with disabilities. The designer should be sensitive to the special needs of people with disabilities, and should ensure the incorporation of accessible features into the design. The Design Analysis should clearly document the ABA Design Guidelines and/or contain written exemptions.

8.5 BUILDING ENVELOPE REQUIREMENTS

8.5.1 INTRODUCTION

UFC 3-101-01 chapter 3 identifies the basic requirements for building envelope design. This portion of the design guide will provide guidance on how to design to these requirements while maximizing the use of local Japanese construction methods and materials that meet the climate specific needs of the varied environmental conditions of Japan.

This chapter will discuss how to apply the continuity of the barriers regarding the rain screen or water deflection layer, the insulation or thermal barrier, the air barrier, the water drainage plane, and the waterproof barrier.

8.5.2 CLIMATE ZONE DATA

When identifying how ASHRAE or IECC will be applied please reference the climate zone data in Chapter 16 Climate Data.

8.5.3 JAPANESE STANDARD DESIGN DETAILING – MLIT (MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM)

Japan has created a standardized detailing system that allows you to pick from a catalog selection of detailing that will be universally accepted by manufacturers and understood by contractors. While manufacturers in the US pride themselves on the uniqueness of their products, this is not the case in Japan. Standard sizes, materials, and construction methodologies are all pre-defined as a kit-of-parts, making detailing much less of an emphasis on design. It is not uncommon to flip through a set of drawings only to find the same exact details represented from one project to another.

In order to design to maximize construction efficiency and to minimize cost, it is highly recommended to reference the MLIT drawings when designing.

8.5.4 FENESTRATION

When considering designing fenestration in Japan it is important to understand how it is constructed. In the United States a single window manufacturer is used to create a complete glazing unit. In Japan there are two separate manufacturers; one for the frame and one for the glazing. This makes it challenging to determine the whole U value assembly and if it can be achieved when the manufacturers are operating individually. For Exterior Windows, it is recommended to utilize the window sizes that are indicated in the PDC TR 12-08 to the maximum extent possible. The window sizes indicated in the TR 12-08 have been analyzed by the USACE Protective Design Center to meet the minimum requirements of UFC 4-010-01.

8.5.5 OPENINGS

8.5.5.1 GLAZING

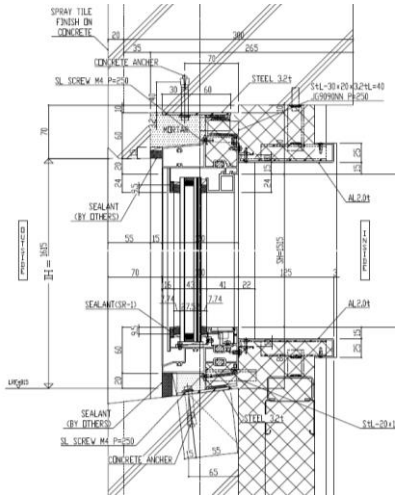
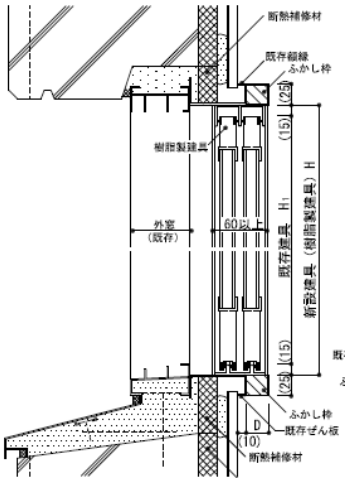
Window and door glazing performance should be selected based on the energy conservation goals established for the project, and should include such factors as appropriate U-value, solar heat gain coefficient, and shading coefficient. Glass sizes

and thickness will be based on the wind load requirements of the specific geographic location and the Antiterrorism blast load requirements of the facility. Each design load should be confirmed by the structural engineer.

When detailing glazing, please note some critical differences within the Japanese construction method to the US construction method. Standard practice in Japan for waterproofing glazing assembly installation, provided by MLIT Specification Chapter 12 is to “perform moisture proofing by coating lacquer enamel and the like on back of frame which is contacting concrete and the like, and has a width of 180mm or more or good finishing degree.” In addition the installation method for the frame includes “Attach wedges using adhesives around frames at intervals of approximately 450mm to hold in place by holding corners down. Perform concrete nailing on concrete walls. Fill with mortar with ratio of 1 part cement to 3 parts sand or concrete around.”

In the United States we would typically provide a shim, and anchor the frame to the structure; whereas, in Japan, they will provide an anchor for securing the frame and then mortar the frame in place. When considering this type of grout filled frame system, it is important to identify how and where the vapor barrier will be placed, and the use of a waterproof; damproof liquid additive to the grout.

Table 7: Window Installation Detailing

Typical U.S. Window Head and Sill Detail	**Typical Japan Window Head and Sill Detail**	**MLIT Drawing**
		
Typical US Window Head and Sill Detail	Japanese window manufacturer shop drawing: Note the grout filled metal frame.	Standard detail provided on Plate 4-54 of MLIT Drawing set.

8.5.5.2 TRANSLUCENT SYSTEMS

Translucent fiberglass systems are typically shipped from the United States due to the fire rating requirements. However, in non-fire rated wall assemblies local material of insulated polycarbonate plate systems is common practice and recent developments have created increased production in sustainable systems for higher isolative values.

8.5.5.3 DOORS

Metal doors and frames are recommended for general use. Wood doors and frames may be used at interior locations where appropriate in family housing construction, to match existing conditions, or in administrative facilities where appearance is important. Aluminum doors and frames or storefront systems are generally recommended for building entrances. Entrance doors, windows and frames should be weather resistant, protected from the weather and of sufficient strength to withstand constant use. Wood entrance doors should be avoided. Service (overhead, etc.) doors in air conditioned facilities should be insulated. Exterior doors should be coordinated to comply with UFC 4-010-01 as required. Blast Loads should be confirmed with the structural engineer.

Standard Japanese Door systems are as provided below.

Table 8: Japanese Typical Door Dimensions

DOOR TYPE	SIZE (MM) W X H
Single Door	900 x 2100
Single Door w/ Half Door	400 (small leaf) 900 (large leaf) x 2100
Double Door	1800 x 2100
Coil Door	900 x 1800
Large Coil Door	2350 x 1940

8.5.6 INSULATION

For U.S. Funded projects, all insulation including thermal (interior, exterior, loose, and rigid types), acoustical, spray-on, plumbing, and HVAC should comply with UFC 3-600-01, paragraph 8-3 Insulation. This means that Japanese products have to be tested and comply with UFC 3-600-01. The designer is responsible for verifying the R-values/U-values.

Tapered rigid insulation is uncommon in Japan. In Japan it is typical construction practice to slope the structure and attach the continuous insulation on top. This differs from the US where it is typical to have a flat structure and slope the insulation.

The total wall assembly R value typically comply with ASHRAE, UFC 3-101-01, UFC 1-200-02 and per each Stakeholder’s requirements.

Clearly designate the unit type that will be utilized on a given project, designate within the construction documentation and specifications the locations with the designation for metric with a (SI) or for imperial (IP) next to the insulation value. Example is provided below.

Example - For Metric Insulation Value: Rigid Insulation, min. R-49 (IP)

Example - For Imperial Insulation Value: Glass wool (32KG), MIN. R-2.5 (SI)

8.5.7 THERMAL BRIDGE MITIGATION

Thermal bridges will be avoided throughout the building envelope; floors/slabs, walls, and roof.

Based on the Japanese MLIT drawings the definition of “Cold” and “Warm” Climates are as follows.

Table 9: Climate Zone Temperature Classification

MLIT CLIMATE TYPE	ASHRAE CLIMATE ZONES
Warm	1A through 5A
Cold	6A+

Japanese Energy Standard has defined the method of mitigating thermal bridges for concrete wall to roof structures by ensuring that continuous insulation overlaps a min. of 300mm. Note the diagram below for application examples.

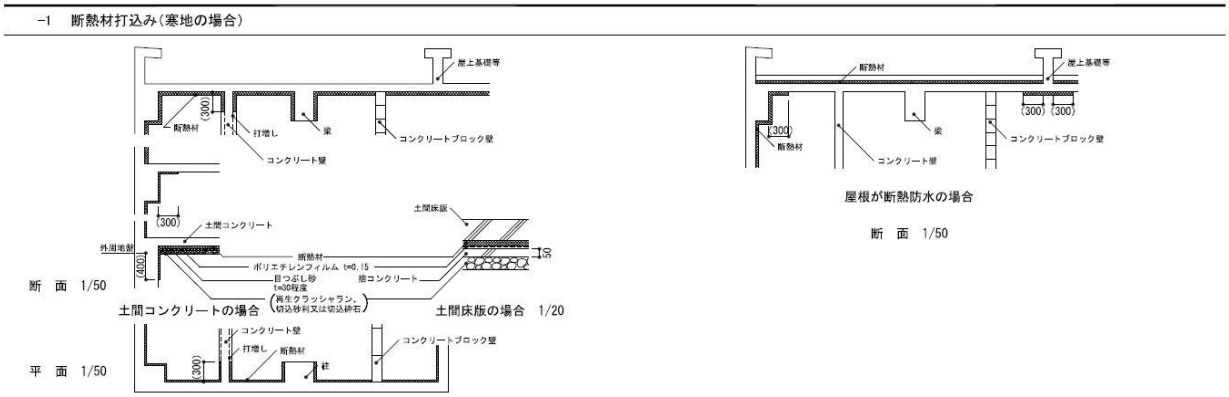


Figure 2: Japanese MLIT Cold Climate Mitigation Diagram; 1 / 7-01

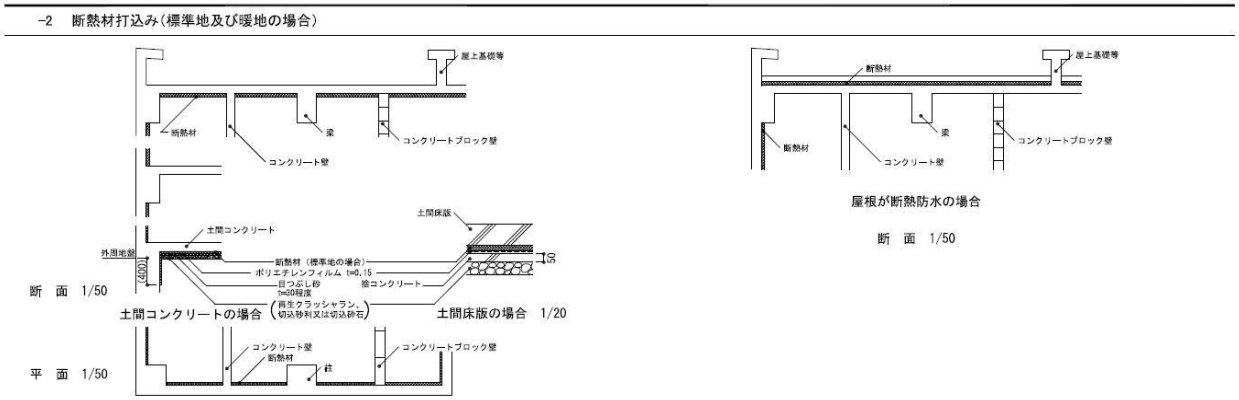


Figure 3: Japanese MLIT Warm Climate Mitigation Diagram; 2 / 7-02

8.5.8 MOISTURE BARRIER

In order to apply the moisture barrier correctly with Japanese materials it is first important to define how and when a vapor barrier/vapor retarder and an air/moisture barrier are applied within a project. The below information is provided by the National Building Science Corporation

The below excerpts are from BSD-106: Understanding Vapor Barriers, Joseph Lstiburek, April 15, 2011.

ASHRAE Fundamentals, Chapter 23 defined the vapor retarder as “the element that is designed and installed in an assembly to retard the movement of water by vapor diffusion.”

The unit of measurement typically used in characterizing the water vapor permeance of materials is the “perm,” with several difference classes of permeance.

Table 10: ASHRAE Vapor Retarder Classification

TYPE	(US) CLASS	(JP) CLASS	PERMANENCE	
Vapor impermeable	Class I Vapor Retarder	Type 3	0.1 per or less	***Vapor Barrier***
Vapor semi-impermeable	Class II Vapor Retarder	Class C	1.0 perm or less and greater than 01 perm	***Vapor Retarder is 1.0 perm or less***
Vapor semi-impermeable	Class III Vapor Retarder	Class A	10 perm or less and greater than 1.0 perm	
Vapor permeable		Class A-3	Greater than 10 perms	

Test procedures for vapor retarders can be found in ASTM E-96 Test Method A (the desiccant method or dry cup method), when providing vapor retarders utilizing Japanese materials it is important to identify to the maximum extent possible how each material complies with these classification types.

Understanding the application of vapor barrier/retarder for the typical wall assembly type for Japan is noted in this example provided by Building Science Corporation.

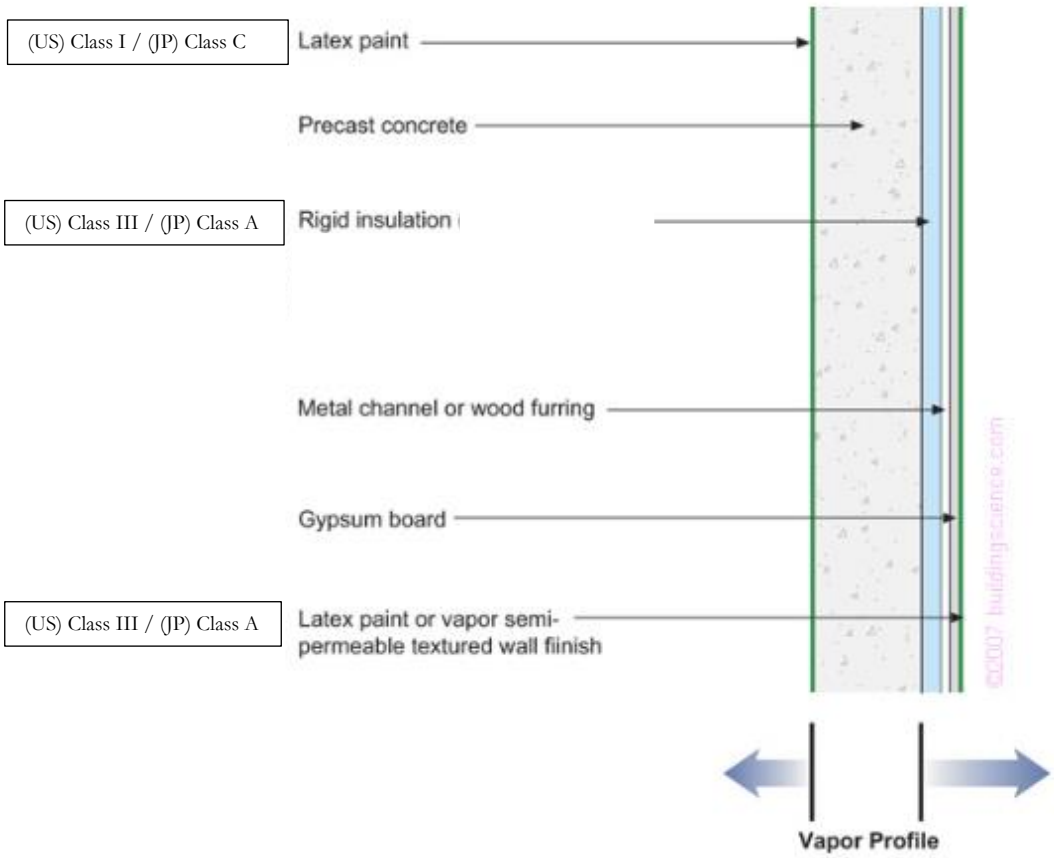


Figure 4: Concrete Structure with interior Frame Wall Cavity Insulation, per Building Science Corporation

This wall assembly is fairly typical for Japan in climate zones classified as 1A-4C, climate zones 5A and above would require different consideration.

8.5.9 DAMPROOFING AND WATERPROOFING

In addition to a foundation drainage system (perforated drain pipe, coarse gravel, filter fabric, etc.), all occupied spaces below grade should have the exterior walls finished with a waterproofing material. The designer should determine which waterproofing material types should be used depending on the severity of below grade water present

and the type of occupied space. In addition to the exterior wall finishing, a more extensive water drainage systems may be required.

8.5.10 WATER VAPOR ANALYSIS

The designer should perform a job specific vapor transmission analysis based on project specific climate and specified wall components and materials. Indicate the temperature and relative humidity for the inside and the outside of the building, a complete listing of building components, their thickness, thermal resistance and permeance, as well as building location and use. Utilize ASHRAE Handbook Fundamentals; Chapters 20, Thermal Insulation and Vapor Retarders – Fundamentals; Chapter 21, Thermal Insulation and Vapor Retarders – Applications; and Chapter 23-Thermal and Moisture Control in Insulated Assemblies as a minimum for the analysis. The use of numerical models, such as Oak Ridge National Laboratory's WUFI-ORNL/IBP or NIST's (National Institute of Standards and Technology) MOIST is preferred.

8.5.11 EXTERIOR WALL AND ROOF ASSEMBLIES

Typical practice in Japan utilizes cast in place concrete for the structural wall, slab and roof assembly. For roof assemblies, the use of poured in place concrete is typical for low-slope roofs. For steep slope roofs or long-span roof assemblies a steel framing system would be typical practice.

The cast in place concrete wall assembly is typical also for the rain screen system, meaning that all insulation, furring etc. is done on the interior of the wall. Keep this in mind when performing initial gross square footage calculations per UFC 3-101-01 section 2-2.

8.6 ROOFS

Consideration of the most appropriate roofing systems materials should occur early in the design process. Designers should consult UFC 3-110-03, Roofing, which provides general guidelines and major considerations for selecting an appropriate roofing system. Specific roofing system design should also be in accordance with UFC 3-110-03, Roofing. Additionally, each Army Post, Marine Camp, and Air Force Base may have special roofing requirements that can involve such things as preferred roofing system types, placement or type of insulation, minimum and maximum slopes, and other features which could impact the appearance and structure of the facility. For example, some Installations prohibit flat (low-slope) roofs. Designers should review Installation Design Guides or Facility Excellence Plans for guidance on acceptable or preferred roofing systems.

8.6.1 JAPANESE ROOF DRAINAGE STANDARDS

Below is the drain pipe diameter and bearable roof area for typical Japanese standard construction. For the table below the pipe diameter and receivable maximum roof area is based on the maximum rainfall of 180mm/hr. For gutter sizing, see 16.4 Rainfall Data.

Table 11: Roof Drainage Standards, provided by Toda

PIPE DIAMETER (nominal diameter) (mm)	MAXIMUM ROOF AREA (m^2)		
	Vertical drain and vertical pipe[2)]	Horizontal drain and horizontal pipe[3)] (slope 1/50)	Horizontal pipe[3)] (slope 1/100)
80[5)]	110	70	50
100	240	160	110
125	430	280	200
150	690	460	330
200	1,500	1,000	700

* Edited by Architectural Institute of Japan, standard specification of construction work/its interpretation JASS 12 Roof construction, Architectural Institute of Japan

Notes:

1. The above table applies when 1 drain is connected to 1 vertical pipe. If multiple drains join a vertical pipe, you should perform flow calculations.
2. If there is a horizontal pipe under a vertical drain + vertical pipe, “3) horizontal pipe” column applies.
3. Columns with the 3) superscript apply if a length of horizontal pipe exceeds 2m. Otherwise, same bearable area as that of vertical pipe.
4. A vent pipe for a sewage drain connected to horizontal pipe should have same diameter as that of horizontal pipe.
5. If there is PVC pipe, 5) is changed to read 75mm.
6. In rainy or low rainfall regions, Maximum Roof area is defined as “Maximum Roof Area = (maximum roof area in the above table x 180)/(maximum rainfall for 10 min in the past x 6)”.
7. In case there is a wall above a roof or eaves, 50% of wall area should be added to roof area.

8.6.2 STANDING SEAM METAL ROOFING SYSTEMS

Standing seam metal roofing systems may be used where desired for architectural aesthetics and/or where high roofing reliability is required. Slopes of 16 percent or greater are preferred, but lower slopes may be permitted. Slopes less than 16 percent should be approved by the District Project Architect prior to the concept design submittal. When a standing seam metal roof is considered, UFGS Section 07 61 14.00 20 (Steel Standing Seam Roofing) should be used to specify the system unless specifically approved by the Japan District Project Architect. To help assure a leak-free standing seam metal roofing system, an ice/water guard membrane underlayment installed on top of the insulation is strongly recommended along the roof edges, including valleys, ridges, and hips which are prone to leaking.

In Japan, structural steel metal decking is uncommon, typically purlins are used. In addition to that, the shape of the standing seam metal roofing material may vary significantly from the United States. Be sure to research local manufacturer's standard profile shapes to confirm that the aesthetic and drainage requirements have been met.

8.6.3 BUILT-UP ROOFING SYSTEMS

In general, roofing systems other than built-up roofing should be considered first. However, where flat (low slope) roofs are permissible by Installation Design Guides or Facilities Excellence Plans and where permitted by the Installation Stakeholder, built-up roofing may be used. The primary roof slope should be 5 percent minimum and the structural roof deck should be sloped to provide the primary roof slope. Secondary slopes in valleys and crickets should also be at least 5 percent. The UFGS Section 07 51 13 (Built-Up Asphalt Roofing) includes a variety of special requirements designed to improve the quality of the installed roofing system, including increased Contractor quality control.

8.6.4 SINGLE-PLY MEMBRANE ROOFING SYSTEMS

Where flat (low-slope) roofs are permissible by Installation Design Guides or Facilities Excellence Plans, single-ply roofing systems such as EPDM or PVC may be considered for use on facilities with low-slope roof designs. The governing criteria for single-ply roof systems should be determined for each individual project. Use a fluid-applied membrane roofing system applied directly to the concrete roof deck for facilities in Okinawa. The Installation Stakeholder may have preferred single-ply systems, so the designer should consult with the District Project Architect prior to the concept design phase. Primary roof slopes should be a minimum of 5 percent and secondary slopes in valleys and crickets should be at least 2 percent.

8.6.5 SOLAR REFLECTANCE INDEX

Japanese products do not typically provide information on solar reflectance index (SRI), when specifying products in order to streamline the construction process indicate within the specifications for the emissivity and reflectance values with the projected SRI values and reference ASTM E1980 that can be used for the calculated method of compliance. The purpose of this is allow contractors to have the tools to utilize the calculated method when submitting local products and/or variances to the design.

8.6.6 WARRANTIES

Specify a comprehensive, single source manufacturer material and watertight warranty for the roofing system selected. The warranty terms, exclusions, and limits should be clearly enumerated in the specifications. In the United States, the length of the warranty is normally for 20 years or more, but could vary depending on the project circumstances. However, in Japan, the warranties are typically 10 years. Good watertight warrantees generally add some additional cost to the project and the Stakeholder should be given the opportunity to weigh the cost vs. benefit ratio for the warranty chosen. See UFC 3-110-03, Roofing for additional information on roofing system warranties.

8.7 NON-STRUCTURAL METAL STUDS

Japanese standard metal stud partitions are significantly smaller and have equally smaller spacing than in the United States. Please note the table below for standard Japanese stud sizes and spacing. Refer to JIS A 6517 (Steel furrings for walls and ceilings in buildings) for wall furring materials.

Table 12: Non-Structural Metal Stud Sizes

STUD NAME	SIZE (mm)	RUNNER	CLASSIFICATION BY HEIGHT OF
WS-50	50 x 45 x 0.8	52 x 45 x 0.8	Height 2.7m or less
WS-65	65 x 45 x 0.8	67 x 45 x 0.8	Height 4.0m or less
WS-90	90 x 45 x 0.8	92 x 45 x 0.8	Height over 4.0m and 4.5m or less
WS-100	100 x 45 x 0.8	102 x 45 x 0.8	Height over 4.5m and 5.0m or less

The runner shall be fixed on floor, under beams, under slabs and the like with drift pins at intervals of approximately 900mm by holding the edges down. However, it shall be fixed with a type of tapping screw or by welding if it is installed on steel, light gauge steel ceiling furrings and the like.

Due to the size of the metal studs in Japan, the spacing becomes dependent on the gypsum board in order to add rigidity to the system. Please note the requirements for metal stud spacing.

Table 13: Non-Structural Metal Stud Spacing

STUD SPACING	LAYER OF GYPSUM BOARD	APPLICATION OF GYPSUM
300mm	Single Layer	Vertical
450mm	Double Layer	First Layer: Horizontal Second Layer: Vertical

Interval of studs shall be approximately 450mm if there is a substrate, and approximately 300mm if finishing materials are applied directly or wall paper or types of basecoats are applied directly.

8.8 GYPSUM BOARD

Japanese gypsum board has a smaller panel size and thickness than in the United States, note the industry standards for gypsum board in Japan:

- Gypsum board Size: 900mm (W) x 1800mm (H)
- Gypsum board thickness: 9mm, 12.5mm (most common) and 15mm

8.8.1 FIRE RATED PARTITION WALLS

The Japan District has reviewed two Japanese wall assemblies that have been tested in accordance with the ASTM E119 Standard Test Methods for Fire Tests for Building Construction and Materials. Based on the test results, the following assemblies are deemed suitable for U.S. Army Corps of Engineers projects in Japan:

- MLIT Certification Numbers FP0606NP-0197/0198 for 2-hour gypsum board fire-rated assemblies. Although the certificate states, “1-Hour Fire Resistant Structures”, this assembly successfully passed endurance and host stream tests for 2-hour fire-rated construction. Copies of the Yoshino Gypsum Co. LTD fire endurance test dated May 11, 1978 and the Japan Gypsum Industry Association hose stream test dated August 29, 1999 are available upon request.
- MLIT Certification Numbers FP0606NP-0174/0175 for 1-hour gypsum board fire-rated assemblies.

The original Japanese Installation Instructions and Certificates for the wall assemblies and the English translated versions are located in the Appendix of the Japan District Design Guide.

These assemblies are offered as options to UL Listed assemblies and should be installed in strict accordance with the MLIT Installation Instructions.

For 2-hour fire-rated wall assemblies such as stair shafts and elevator shafts, it is recommended to design these shafts with 200mm thick reinforced concrete.

8.9 JAPANESE SOUND ATTENUATION

Sounds attenuation testing is different in Japan. Japan does not use the Sound Transmission Class (STC) rating system. The measurement used in Japan is Transmission Loss (TL). Sound Rated Partition design should be coordinated with an acoustical consultant to ensure that the proper sound transmission requirements can be achieved using Japanese materials. If this is unachievable, sound attenuation partition assemblies and other materials should be provided from the U.S. and cost for shipping and handling should be included in the project cost.

Sound insulation of products is usually tested by following testing methods in Japan.

For building materials of wall, floor, door, window, or others:

JIS A 1416, Acoustics - Method for laboratory measurement of airborne sound insulation of building elements

For building equipment, such as ventilation, air intake, or others:

JIS A 1428, Laboratory measurement of airborne sound insulation of small building elements. All tests of the above two are usually performed in specific laboratories.

Evaluation values vary depending on each materials or equipment being tested.

Table 14: Japanese Sound Attenuation Values

SYMBOL	DESCRIPTION
D-XX	Transmission loss, tested at an actual building site, not in a laboratory, by using JIS A 1419, Acoustics - Rating of sound insulation in buildings and of building elements.
R-XX	Is for some wall and ceiling materials. Means “sound reduction index (sound transmission loss)”, and its unit is dB.
R_T-XX	Is for doors and windows. Is a part of R-xx, formally called Rt-xx, and means “sound reduction index (sound transmission loss) for doors and windows”, and its unit is also dB.

Both R-XX and R_T -XX result from testing in a laboratory based on JIS A 1416, and show sound insulation performance of a “single” material, not assembly of partition.

For windows and doors the following conversion is available for specifying a translation between STC and the R_T -XX values.

Table 15: Windows and Doors Sound Reduction Index

STC	R_T -XX Value
STC 25	R_T -1
STC 30	R_T -2
STC 35	R_T -3
STC 40	R_T -4
STC 50	Not Available

When considering local procurement in Japan, it is important to not the above limitations in meeting STC performance values for windows and doors.

When these materials and equipment are produced in Japan and also used in Japan, JIS testing is enough. When manufacturers expects to export them to foreign countries, then, ISO 10140-2 is required for international certification.

However, detailed testing methods of JIS A 1416 and ISO 10140-2 are almost equal, except their indications of evaluation values.

When you would like to find sound insulation of “product” itself, its product performance should be tested by JIS A 1416, JIS A 1428, and/or ISO 10140-2.

8.10 FINISHES

8.10.1 PAINT - JAPAN PAINT MANUFACTURING ASSOCIATION (JPMA)

In Japan, the paint colors are standardized using the JAPAN PAINT MANUFACTURING ASSOCIATION paint guide. Paint colors should be from the JPMA (www.toryo.or.jp/eng/) standard paint colors. Exterior colors should comply with the Installation Exterior Appearance Plan or Installation Design Guide. Color matching process in Japan is different from the U.S. color matching process. Benjamin Moore paints are available in Japan, http://benjaminmoore.co.jp/english/

The paint numbering system changes each time they release a new version and typically starts with a different lettering system. On plans it is recommended to not include the Edition letter. However, refer to Table 21 for some historical and current numbering values.

Table 16: JPMA Edition History

YEAR OF RELEASE	EDITION
2017	J Edition (current)
2015	H Edition
1995	T Edition
1993	S Edition
1991	R Edition

The color swatches are available for purchase only and are not available online. You can purchase the swatches at the following website: http://www.toryo.or.jp/eng/.

Table 17: Standard Installation Exterior Color Palette

LOCATION	PAINT COLOR	JPMA COLOR SAMPLE
Exterior Wall/Façade	J19-80F	
Eave	J09-30D	
Exposed Metal such as (but not limited to) stairs, handrails, guardrails	J09-30D	

LOCATION	PAINT COLOR	JPMA COLOR SAMPLE
Downspouts	J09-30D	
Exterior Doors	J09-30D	

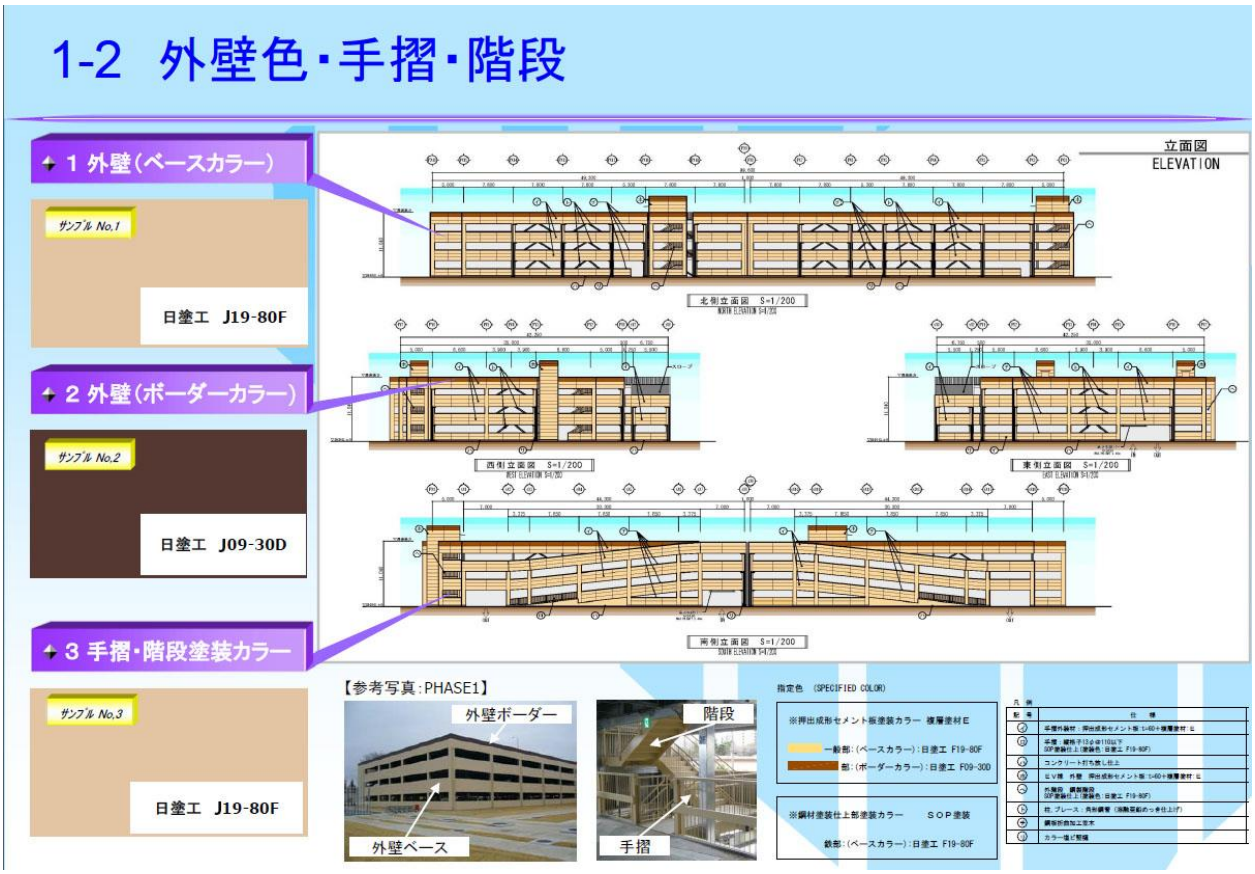


Figure 5: Exterior Color Sample Elevations: Provided by JPMA

8.10.1.1 FINISH SCHEDULES

When calling out finishes on finish schedules, it is typical practice to simply identify the JPMA color guide number and any additional requirements such as sheen, VOC, etc.

8.10.1.2 APPLICATION OF RUST PREVENTIVE PAINTS

This section applies to the application of rust preventive paints on steel surfaces and hot dip galvanized steel surfaces.

The Japanese classification of rust preventative paints on steel surfaces are identified listed in the below table.

Table 18: Classification of Rust Preventative Paints on Steel Surfaces

CLASS	RUST PREVENTIVE PAINTS AND OTHER			Coating Quantity (kg/m²)	Standard Coating Thickness (μm)	Application
	Standard No.	Name of Standard	Type			
Type A	JIS K 5674	Lead-free, Chromium-free anticorrosive paints	Type 1	0.10	30	Outdoor, indoor
Type B	Either of the following shall be applied.			—	—	Indoor
	JASS 18 M－111	Water type anticorrosive paints	—	0.11	30	
	JIS K 5674	Lead-free, Chromium-free anticorrosive paints	Type 2	0.11	30	

(Note)

1. JASS 18 M-111 is the material standard of Architectural Institute of Japan.

2. Type 1 in JIS K 5674 is solvent type and Type 2 in JIS K 5674 is water type.

The method of rust preventative paints on a galvanized steel surface is different from a typical steel surface. The identification is listed below for reference.

Table 19: Classification of Rust Preventative Paints on Galvanized Steel Surfaces

CLASS	RUST PREVENTIVE PAINTS AND OTHER			Coating Quantity (kg/m²)	Standard Coating Thickness (μm)	Application
	Standard No.	Name of Standard	Type			
Type A	JIS K 5629	Calcium plumbate anticorrosive paint	—	0.10	30	Outdoors, indoors
Type B	JASS 18 M－109	Modified epoxy resin primer	Modified epoxy resin primer	0.14	40	Outdoors, indoors
Type C	JASS 18 M－111	Water type anticorrosive paints	—	0.11	30	Indoors

(Note) JASS 18 M-109 and M-111 are the material standards of Architectural Institute of Japan.

8.10.1.3 EXTERIOR CONCRETE COATING

Exterior concrete finish in Japan typically found on installations are a layered coating system that provides an air/moisture barrier this is known in Japan as a Type 3 vapor membrane system.) Refer to JIS A 6909 (Coating materials for textured finishes of buildings) for finish coating material. The finish coating material shall be mixed to the color, gloss and the like as designated by the manufacturer and it shall not be used if it is expired. Additionally, the undercoat, principal and topcoat shall be the products of the same manufacturer to ensure proper bonding between coats.

The coating frequency is designated by the finish coating material manufacturer.

Table 20: Types of Exterior Concrete Coatings

TYPE	NAME	FINISHED SHAPE	CONSTRUCTION APPLICATION	REQUIRED AMOUNT (kg/m²)	COATING FREQUENCY
Multi-layered finish Coating Material	Multi-layered coating material CE Multi-layered coating material Si	Salient treatment Irregular pattern	Spraying	Undercoat 0.1 or more	1
				Principal base layer 0.7 or more	1
				Principal pattern 0.8 or more	1
				Topcoat 0.25 or more	2
	Multi-layered coating material E Multi-layered coating material RE	Yuzu skin-like	Roller coating	Undercoat 0.1 or more	1
				Principal 1.0 or more	1-2
				Topcoat 0.25 or more	2

TYPE	NAME	FINISHED SHAPE	CONSTRUCTION APPLICATION	REQUIRED AMOUNT (kg/m²)	COATING FREQUENCY
Multi-layered finish Coating Material	Flexible multi-layered coating material CE	Salient treatment Irregular pattern	Spraying	Undercoat 0.1 or more	1
				Principal base layer 1.0 or more	1-2
				Principal pattern 0.5 or more	1
				Topcoat 0.25 or more	2
		Yuzu skin-like	Roller coating	Undercoat 0.1 or more	1
				Principal 1.0 or more	1-2(Note)4
				Topcoat 0.25 or more	2

TYPE	NAME	FINISHED SHAPE	CONSTRUCTION APPLICATION	REQUIRED AMOUNT (kg/m²)	COATING FREQUENCY
Multi-layered finish Coating Material	Waterproofing multi-layered coating material CE	Salient treatment Irregular pattern	Spraying	Undercoat 0.1 or more	1
	Waterproofing multi-layered coating material E	Yuzu skin-like	Roller coating	Additional coating material(Note)2 0.9 or more	1
	Waterproofing multi-layered coating material RE			Principal base layer 1.7 or more	2
	Waterproofing multi-layered coating material RS			Principal pattern 0.9 or more	1
				Topcoat 0.25 or more	2
Light weight aggregate finish coating material	Light weight coating material for spraying	Sand wall-like	Spraying	Undercoat 0.1 or more	1
				Principal thickness 5mm or more	1-2
	Light weight coating material for trowel coating	Flat	Trowel coating	Undercoat 0.1 or more	1
				Principal thickness 3mm or more	1-2

The four main textured levels identified in the “Finish Shape” column can be described as the following visual textures.

Table 21: PAINT TEXTURE FINISH TYPES

FINISHED SHAPE	TEXTURE
Salient treatment Irregular pattern	Not Available
Yuzu skin-like	Not Available
Sand wall-like	Not Available
Flat	Not Available

The most common application on installations is the use of the Yuzu skin-like texture, which is commonly referred to as “spray tile.”

8.10.2 CEILINGS

When designing ceilings it is important to take into consideration the seismic requirements within Japan. Due to the increased seismic concerns, the typical practice in Japan is to create a rigid ceiling either out of acoustical ceiling material backed with gypsum board or simply gypsum board with a rigid framing system hung by rods to the structural deck. This limits access to the plenum space and ceiling access hatches are typically installed for convenience.

A light weight steel ceiling furring is typical in Japan, refer to JIS A 6517 (steel furrings for walls and ceilings in buildings) for the materials and ceiling furring. Standard dimensional units for indoor and outdoor applications are defined in the table below.

MEMBER TYPE	TYPE 19 (INDOOR)	TYPE 25 (OUTDOOR)
Single Ceiling Joist	25×19×0.5	25×25×0.5
Double Ceiling Joist	50×19×0.5	50×25×0.5
Ceiling Joist Receiver	38×12×1.2	38×12×1.6
Hanger for Ceiling Joist Receiver	Thickness 2.0 or more	
Clip	Thorough-thickness 0.6 or more	Thorough-thickness 0.8 or more

MEMBER TYPE	TYPE 19 (INDOOR)	TYPE 25 (OUTDOOR)
Hanger Bolt	Rolled threads, screw thread diameter 9.0 (diameter of cylindrical part 8.1 or more)	
Nut	Height 8.0	

8.11 MISCELLANEOUS REQUIREMENTS

8.11.1 CONTROL JOINTS

To prevent cracking, gypsum wallboard and plastered surfaces should be provided with control joints at the corners of openings and at other locations and intervals given in the guide specifications or where shown on the drawings. Control joints in concrete walls should be extended through the applied finish. Control joints should be located on the plans, coordinated with structural drawings, and indicated on elevations. Control joints should be designed, detailed, and placed in unobtrusive locations for gypsum wallboard partitions and ceramic tile surfaces in accordance with criteria and references in the guide specifications.

8.11.2 RADON MITIGATION

Radon mitigation is a common requirement for facilities in Okinawa. Radon mitigation should conform to UFC 3-101-01 paragraph 2-5.1. Sub-pipe system under the slab on grade should be designed by the plumbing engineer. All radon mitigation systems should be designed and constructed to allow easy conversion to an active system in case future testing reveals unacceptable radon levels. This includes conduits and junction boxes positioned for potential fan installation and accommodating the extension of the exterior pipes to the roof.

8.11.3 ELECTRIC TRACTION PASSENGER ELEVATORS

UFGS Section 14 21 23 Electric Traction Passenger Elevators paragraph 1.2.3 shall be edited to include the following:

- Elevator equipment and controller supports and attachments shall be designed to meet the force and displacement requirements of ASCE 7-10 Sections 13.3.1 and 13.3.2, per ASCE 7-10 Section 13.6.10 Elevator and Escalator Design Requirements.

- Elevators operating with a speed of 46m/min or greater shall be provided with seismic switches per ASCE 7-10 Section 13.6.10.3 Seismic Controls for Elevators. Install seismic switches in accordance with Section 8.4.10.1.2 of ASME A17.1/CSA B44.

- Provide a nameplate for each Designated Seismic Systems (DSS) component. Refer to Section 01 45 35 Statement of Special Inspections for the list of DSS. The nameplate shall:

    - Be mechanically attached to or adjacent to the DSS component.
    - Be not less than 125 mm X175 mm with red letters 25 mm in height on a white background stating "Certified Equipment".
    - Include the statement "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file."
    - Contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

8.12 SEISMIC DESIGN REQUIREMENTS (OF ARCHITECTURAL SYSTEMS)

The following provides information on the fundamentals on the subject, and highlights various frequently overlooked aspects. (Code and Criteria references are included in parenthesis.)

Key information for Designated Seismic Systems can be found in ASCE 7, 13.1.3 and UFC 3-310-04, 2-13.6.10.3.

<u>Acceptable Alternatives:</u>

- Japanese components and technical criteria shall meet the functional intent of ASCE 7-10, and UFC 3-310-01. DoR shall identify all Acceptable Alternatives in the Design Analysis.

<u>Special inspections of Non-Structural</u> *(IBC 2015, 1705.12.4)*

- DoR shall identify components of Designated Seismic Systems in the 01 45 35 Statement of Special Inspections. Identify corresponding special inspection in the 01 45 35 Schedule of Special Inspections.
- The Design of Record shall provide bracing details for bracing of Designated Seismic System components.
- Spray Applied Fire-Resistant Materials
- Mastic and Intumescent Fire-Resistant Coatings.
- Access Floors
- Cabinets, greater than 8’.

<u>Elevators:</u>

- Elevators are Designated Seismic Systems and part of Risk Category I, II, III, and IV structures.
- DoR shall specify certifications of component. *(ASCE 7, 13.2.2, and UFC 3-310-04, 2-13.2.2.1.)*

- DoR shall specify name plate. Name plate to be located on or adjacent to equipment. *(UFC 3-310-04, 2-13.2.2.2.)*
- identify this component as a Designated Seismic System, with an Ip = 1.5 *(UFC 3-310-04, 2-13.6.10.3)*
- Trigger level for seismic switch shall be set to 50% of the acceleration of gravity along both orthogonal horizontal axes.
- Locate seismic switch in control room adjacent to vertical load bearing wall or column *(ASME A 17.1, 8.4.10.1.2 and ASCE 7-10, 13.6.10.3)*

<u>Acoustical Ceilings:</u>

With perimeter clip by manufacturer:

- Provide shake table certification for Seismic Design Category E.
- Conduct Special Inspection per Manufacturer ESR. *(IBC 2015, 1705.1.1 and ASCE 7, 11A.1.3.9)*
- Include Acoustical Ceilings in 01 45 35 Special Inspections of Non-Structural
- Install acoustical ceiling system per ASTM E580

With 2 in. wall angle:

- Install per ASTM E580.

<u>Ceilings:</u>

- Ceiling areas greater than 1,000 sq. ft. requires lateral bracing *(ASTM E580, 5.2.8.1)*
- Ceiling areas greater than 2,500 sq. ft. requires a bulkhead. *(ASCE 7, 13.5.6.2)*
- Change in ceiling plane elevation shall have independent positive bracing. (ASTM E580, 5.2.8.6)
- Gypsum Board Ceilings: Lateral brace walls to structure where gypsum board is on one level, surrounded by and connected to walls (ASCE 7, 13.5.6).
- Install Japanese ceilings per JIS A65167.
- Wires shall not attach to or bend around interfering material or equipment. Consider the interaction between the ceiling and mechanical and electrical components (ASTM E580, 5.2.7.4).

<u>Partition bracing:</u>

- Brace partitions per ASCE 7-10, 13.5.8.1
- Bracing tops of walls to the structure will normally resist out-of-plane forces *(UFC 3-310-04, B-2.3.7)*

<u>Power actuated fasteners</u> *(ASCE 7, 13.4.5)*

- Fasteners approved for seismic loading. Power actuated fasteners in concrete used for support of acoustical tile or lay-in panel suspended ceiling application and distributed systems where the service load on any individual fastener does not exceed 90 lb. (400N).

<u>Cabinets:</u>

- Seismic brace all cabinets 8 ft. and greater. *(ASCE 7, Table 13.5-1)*

<u>Louvers:</u>

- Positively attach louver to wall with approved seismic rated anchor. *(ASCE 7, 13.6.7)*

Glass Partitions:

- Glass in glazed curtain walls, glazed storefronts and glazed partitions shall be designed and installed in accordance with ASCE 7, 13.5.9.

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CHAPTER 9 - INTERIOR

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

9.1 GENERAL

This chapter provides general guidance and outlines technical requirements that apply to both building-related and furniture-related interior design projects, new construction and renovation projects. The information provided in this chapter will be used by interior designers and architects and will serve as the minimum interior design requirements.

The Comprehensive Interior Design (CID) is a combination of two elements, the Structural Interior Design (SID) and the Furniture, Fixtures and Equipment (FF&E) specification and procurement package. The SID is the selection and specification of all building related finishes and products. Included in the SID is paint, carpet, laminates, flooring, vinyl base, signage, etc. The FF&E package is the document that dictates the item selection, procurement, provision and installation of all furniture, fixtures, and equipment needed for the installation.

Sometimes the term is used to denote just the FF&E package. Clarify with the PDT which effort is really required for the project. If an SID is to be provided as well as an FF&E package (a true CID), the designer should coordinate with the project architect to provide all necessary building finish selections, schedules, and color boards to fully explain the color schemes. In all cases, the designer should fully coordinate the SID package with the FF&E package so that the project is unified and cohesive.

The FF&E may sometimes be abbreviated as FFE in the plans and specification. The meaning will be the same for both FF&E and FFE in this document. FF&E is the preferred abbreviation.

9.2 INTERIOR DESIGNER QUALIFICATIONS

All work should be performed by a professional interior designer with qualifications based on education, experience and examination. Designers should have completed a recognized program of academic training in interior design, will have significant interior design experience, and be NCIDQ certified or state registered, licensed, or certified.

9.3 DESIGN CRITERIA

The design of buildings is typically in accordance with the instructions contained in this chapter and in other applicable chapters of the Japan District Design Guide. Additional

applicable design criteria include Unified Facilities Guide Specifications, Using Service and Command criteria publications, and design criteria documents. Applicable requirements are usually incorporated from recognized national standards including the National Fire Codes, Life Safety Code, Architectural Barriers Act(ABA) Accessibility Guidelines for Buildings and Facilities, Occupational Safety and Health Standards (OSHA), and the International Building Code.

TECHNICAL INSTRUCTIONS

(TI) – Design Criteria TI 800-01

UNIFIED FACILITY GUIDE SPECIFICATIONS (UFGS)

UFC 1-200-01 General Building Requirements

This chapter provides general guidance and outlines technical requirements that apply to both

UFC 3-600-01 Fire Protection Engineering for Facilities

UFC 3-100-01 Architecture

UFC 3-120-10 Interior Design

UFC 4-021-01 Design and O&M: Mass Notification Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

INTERNATIONAL BUILDING CODE (IBC)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) STANDARDS

AIR FORCE MANUALS AND ENGINEERING TECHNICAL LETTERS (ETLS)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR- CONDITIONING ENGINEERS (ASHRAE) -HANDBOOK OF FUNDAMENTALS

9.4 OVERVIEW OF MILITARY INTERIOR DESIGN

Interior design may be required on new building construction and renovation projects regardless of funding source or type of project. A Comprehensive Interior Design (CID) will be provided, unless otherwise directed, and will include the Structural Interior Design (SID) and the Furniture, Fixtures and Equipment (FF&E) Design. The two types of services cover different aspects of the interior environment and are funded through different sources.

9.4.1 STRUCTURAL INTERIOR DESIGN (SID)

The Structural Interior Design includes building related design elements and components that are generally part of the building itself, such as walls, ceilings, floor coverings and built in casework. The interior designer’s knowledge and involvement in the project from the programming stage forward affords maximum success in accomplishing the user’s goals and requirements. The interior designer should be involved with the programming and space planning to help achieve the client’s goals for space utilization, and with determining the desired interior finish materials and their

respective aesthetic, durability and maintenance qualities or characteristics. In addition, the interior designer should provide a furniture footprint based on the project program. The SID will be performed by a qualified interior designer.

9.4.2 FURNITURE, FIXTURES & EQUIPMENT (FF&E)

The Furniture, Fixtures & Equipment is the selection, layout, specification and documentation of workstations, seating, storage, filing, visual display items, accessories, window treatments, and artwork including contract documentation to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the SID portion of the interior design. Items such as marker boards, bulletin boards and some window treatments may be specified in either the SID or the FF&E.

9.5 FINISH, COLOR, AND FURNISHING SELECTION

All work should comply with UFC 3-120-10 Interior Design. Careful consideration should be given to the aesthetics, function, maintainability, and quality of all design selections.

9.5.1 SAFETY AND ANSI COLOR REQUIREMENTS

In addition to aesthetics, two safety color codes are currently being used by professionals in the design field: those of the Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI). Both share some of the same conventions, such as the use of the color red for indicating fire protection equipment. For detailed specifics regarding the application of either system, the designer should refer directly to an OSHA or ANSI guidebook.

9.6 BUILDING RELATED INTERIOR DESIGN

This includes the coordination of interior and exterior materials and coordination and specification of finish materials, and specialties, including color, texture, pattern and quality which is consistent with the design theme.

9.6.1 CARPET

Locally procured carpets typically do not comply with NFPA 101 Chapter 10 – Interior Finish, Contents and Furnishings and the flame spread rating in paragraph 10.2.7 – Interior Floor Finish Testing and Classification. Carpet and carpet like interior floor finishes shall comply with ASTM D 2859, Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials. Carpet used in projects for Japan should comply with these requirements.

9.7 FURNITURE, FIXTURES AND EQUIPMENT (FF&E)

FF&E is the selection, layout, specification and documentation of furniture which includes, but is not limited to, workstations, seating, tables, storage, shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the SID portion of the interior design. The FF&E package should ideally be developed concurrently with the building design to ensure that there is coordination between the electrical outlets,

switches, J-boxes, communication outlets and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and, unless otherwise noted, do not attach furniture including furniture systems to the building. If project has classified data and/or non-classified networks, the furniture layout should be coordinated with the proper separation requirements. Verify that all separation requirements for classified systems have been incorporated in the design.

9.7.1 FURNITURE PRESENTATION REQUIREMENTS

Where required by the project SOW, the interior designer for the project should prepare a FF&E package necessary for client approval of the interior design scheme. The FF&E package should consist of the selection of all freestanding furniture, furnishings, equipment, accessories and pre-wired workstation components.

9.7.2 DESIGN NARRATIVE

Include a detailed description of the design intent.

9.7.3 ITEM CODE LEGEND

Provide a spreadsheet indicating each item code ID with a brief item description, quantity and item location.

9.7.4 SPECIFICATION

Provide a technical and aesthetic specification for each item for open market procurements.

9.7.5 FURNITURE ILLUSTRATIONS AND FINISH SAMPLES

A furniture illustration sheet should be provided for each item of FF&E and should consist of a picture of the item and a fabric and/or finish color sample. Fabric and finish colors should be selected to coordinate with the building room finish colors.

9.7.6 PRE-WIRED WORKSTATION LAYOUTS

If pre-wired workstations are required for the project, an enlarged layout of each different type of workstation should be provided. Additionally, a perspective or a complete set of elevations should be drawn for each workstation typical. Panel layout plans should be provided as needed.

9.7.7 MANUFACTURER’S SUMMARY LIST

The manufacturer’s summary list should include the name of each manufacturer with the address, telephone number and point of contact.

9.7.8 COLOR BOARDS

9.7.8.1 COLOR BOARDS FOR FF&E PACKAGES

Provide color boards to show area color fabric and finish schemes. Samples should be large enough to show texture and patterns in the selected finishes.

9.7.8.2 COLOR BOARDS FOR SID PACKAGES

Three sets of color boards depicting the building related materials and finishes should be provided. Display samples should indicate true pattern, color and texture and should be labeled to identify color, pattern, and style. Color boards should be prepared as part of the SID regardless of whether a CID is part of the project scope.

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CHAPTER 10 - LIFE SAFTEY & FIRE PROTECTION

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

10.1 GENERAL

This chapter provides instructions for the preparation of fire protection and life safety construction documents and design analysis. Fire protection construction documents and design analysis should be prepared by a Qualified Fire Protection Engineer as defined by UFC 3-600-01, Fire Protection Engineering for Facilities fire protection, paragraph 2-1.15.

10.2 DESIGN CRITERIA

The design publications listed below should be used as sources of criteria for fire protection design. The criteria from these sources may be supplemented by applicable criteria contained in nationally recognized codes, standards, and specifications. Government engineering publications are located in the Whole Building Design Guide website at http://www.wbdg.org.

UNIFIED FACILITY CRITERIA (UFC)

UFC 3-600-01 Fire Protection Engineering for Facilities, Most Recent Edition

UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)

See the Whole Building Design Guide website for the most current UFGS fire protection specification sections.

INTERNATIONAL CODE COUNCIL (ICC)

International Building Code (IBC), Most Recent Edition

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

Most Recent Editions

10.3 FIRE PROTECTION RELATED ITEMS THAT SHALL BE U.S. PRODUCTS

The following fire protection related items shall be U.S. products with U.S. testing labels as required. These items CANNOT be substituted with Japanese manufactured products:

- Fire Suppression System including valves, alarm valves, sprinkler heads (pipes and fittings of Japanese manufacturer may meet the functional requirements)

- Fire Pumps including motors, controllers, drives, and valves
- Fire Alarm and Mass Notification Systems including panels, initiating devices, notification appliances, smoke alarms (conductors and conduits of Japanese manufacturers may meet the functional requirements)
- Engineering Technician requirements for development of fire suppression systems and alarm shop drawings, calculations, and material submittals
- Fire doors and frame assemblies
- Fire Dampers and Smoke Dampers
- Interior Finishes with Flame Spread and Smoke Development ratings
- Insulation with Flame Spread and Smoke Development ratings
- Plenum rated cables

This list should be included in the Life Safety Fire Protection drawings and in the project specifications.

10.4 FIRE SUPPRESSION SYSTEMS

Fire suppression systems shall be provided for facilities in accordance with UFC 3-600-01 and applicable NFPA criteria. System designs should be the performance based type with detailed shop drawings, materials submittals, and hydraulic calculations prepared by qualified technicians. Installation of as required by UFC Standpipe and Hose Systems and NFPA standards Installation of Sprinkler Systems.

Tailor the sprinkler design criteria (occupancy, design area, density, hose demand, etc.) specifically for each building.

Identify all of the performance criteria for the warehouses and hangars. The criteria should be specific. For the warehouse, simply stating ESFR is not enough. The drawings should identify the storage arrangement, storage height, clearance, commodity being stored, K-factor, number of heads operating, minimum pressure, hose demand, etc. such that the Government or Contractor does not have search NFPA 13 for the criteria or argue about the commodity, maximum storage height, etc.

Show the incoming water supply line location and risers. The riser has to be fully detailed complete with identifying all valves, switches, and piping. The conceptual design begins downstream of the riser and not at the pump. Important items need to be shown pictorially to indicate the design intent. The detail callouts on the plan need to match detail sheets. Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler cross mains. The contract drawings should include a detailed sprinkler riser diagram. Show location and size of service mains, interior feed mains, control valves, sprinkler risers, drain lines, sectional valves, and inspector's test valves and switches on the drawings. Specify water flow data including hydrant flow results, including the location where the hydrant flow test was conducted, on the drawings. Indicate the location and size of existing mains and new water supply lines that will serve the sprinkler system (including all supervisory valves), and the location and size of all risers on the plans. Highlight or clearly indicate the area(s) to be protected by sprinklers on the drawings. Specify waterflow requirements including the design density, design area, the hose stream demand (including location

of the hose stream demand), the duration of supply, and sprinkler spacing and area of coverage on the drawings. Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings.

When connecting to an existing water distribution system, waterflow tests will be conducted in accordance with UFC 3-600-01 to determine available water supply for the sprinkler system. The Designer of Record should either perform or witness the waterflow test. The waterflow test results (including date test is performed) should be included in be included in the design documents no later than the concept submission. Note that the availability of the Designer to participate or witness the waterflow test will be necessary.

Provide hydraulic calculations and sketches complete with nodes, pipes, sprinklers, etc. The hydraulic calculations to follow the format of NFPA 13 to support the conceptual design and submitted in the Basis of Design. The designer (a fire protection engineer) must provide hydraulic calculations demonstrating that the design will provide an adequate water supply for the fire extinguishing system. Hydraulic calculations must be submitted before the first submittal. The A/E needs to provide hydraulic calculations based on a conceptual layout. Not rough conceptual calculations.

10.5 FIRE ALARM, DETECTION, AND MASS NOTIFICATION SYSTEMS

Fire alarm, detection and mass notification systems shall be provided in accordance with UFC 3-600-01. System designs should be the performance based type with detailed shop drawings, materials submittals, and hydraulic calculations prepared by qualified National Institute for Certification in Engineering Technologies technicians.

Do not show "conceptual locations" for the fire alarm control panels. The A/E needs to locate the panels. The panels need to be accessible to the fire department and in an air conditioned space. The power to the panel needs to be coordinated with the electrical design drawings. The Contractor cannot be allowed to move the panels because it is a "conceptual" drawing and we have to argue later to move it back during the acceptance testing. The conceptual layout begins at the panel.

Show all fire alarm initiating devices and notification appliances. For hangar projects, show manual foam releasing stations, foam stop stations, optical detectors complete with coverage cones and ensure 3 detectors can “see” each area of the hangar floor. Show all monitor modules for tamper switches and control modules for system controls such as elevator shunt-trips, water flow switches, and tamper switches. Show location of control panel, batteries and charger (if remotely mounted), transmitter, annunciator, primary power supply, remote trouble device, remote annunciator, detectors, notification appliances, and each alarm initiating device including fire extinguishing system switches. Show single-line fire alarm/mass notification systems riser diagram, device and zone schedules. Each device on the riser should be identified by type and location. Indicate connection of equipment by circuit runs, or conduit/cable runs. Show a fire alarm operating matrix/mass notification system be placed on the drawings. Show actions of detectors, manual initiators, water flow contacts, etc. on one axis and bells,

door releases, smoke control fans, elevator relays, etc. on the other. Entries which require descriptions, explanation of processes, sequences, interfaces, etc. can be flagged by symbols keyed to supplementary notes. Show all devices to indicate a complete and functional conceptual design.

10.6 LIFE SAFETY

Refer to UFC 3-600-01 for requirements.

10.7 HANGAR SUPPRESSION SYSTEMS

Specify all the foam system performance design criteria. The drawings need to clearly specify the discharge criteria and simultaneous operation of the overhead system. For Air Force projects, provide equipment schedules, such as a foam generator schedule complete with a list of the salient design features so the Contractor can design the system. The design needs to indicate a minimum number of generators and a provable conceptual system to avoid Contractors supplying two when five are required. Provide calculations/catalog data showing how the sizes and locations were selected including the minimum operating pressure for the generator.

Show the incoming water location, risers, and main piping. The riser must be fully detailed complete with identifying all valves, switches, surge suppressors, strainers and piping. The conceptual design begins downstream of the riser and not at the pump. The riser diagrams were not complete. For Air Force projects, the foam generator detail needs to show the incoming solution piping, strainer, pressure gage, clearances around the generator, bird screen, bracing call out to the structural drawings and other devices recommended by the manufacturer. The foam tank size and interconnection to the flow control valve needs to be shown. The Contractors here in Japan rely on diagrams and equipment on the drawing. Notes describing the equipment and system requirements are difficult for the Contractor to understand. Important items need to be shown pictorially to indicate the design intent. The detail callouts on the plan need to match detail sheets.

Show location and detail of each foam system supply riser, deluge, or pre-action valve, water motor alarm, fire department inlet connection, foam hydrant, hand hose station, monitor nozzle, air compressor(s), and associated electrical connections. Indicate point of connection to the existing water distribution system. Show location of foam system control valves and post indicator valves. Indicate areas of foam system coverage, with zone designations (if multiple zones). Show location and design of draft curtains as required by NFPA 409 for aircraft hangar. For pipe larger than 12 inches, detail methods of anchoring pipe including pipe clamps and tie rods. Show location of foam proportioning equipment and storage tank. Show locations of control panel, annunciator(s), alarm devices, manual actuation stations, point of connection to the building fire evacuation alarm system, remote trouble device, point of connection to the incoming power supply and fusible safety switch. Do not show conduit sizes or number of conductors for DC circuits. Do not show locations of detectors. Show single line riser diagram for all detection, activation, and alarm circuits. Connection of equipment should be indicated by circuit runs and not conduit runs. Do not indicate number and size of

conductors for interconnection of fire alarm components. Show the conceptual locations of the optical detectors and indicate a complete working conceptual design.

Provide detailed hydraulic calculations for the foam system. The general spreadsheet calculations are only estimates. Calculations should include the foam generators operating simultaneously with the overhead sprinkler system activation. Provide hydraulic calculations and sketches complete with nodes, pipes, sprinklers, etc. The hydraulic calculations to follow the format of NFPA 13 to support the conceptual design should be submitted in the Basis of Design.

10.8 MISCELLANEOUS FIRE PROTECTION ISSUES

The UFGS specifications need to be project specific. The specifications must match the UFGS format with Part 1 general requirements, Part 2 products, and Part 3 execution. Specifications have been submitted with all three sections in Part 1.

The A-E is required to use and modify the Unified Facilities Guide Specifications as provided in the Whole Building Design Guide website (http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs), consistent with the Section Format organizational structure as described in Construction Specifications Institute's (CSI) Project Resource Manual. Additionally, specifications will need to be written and edited in SpecsIntact (.sec) format. Standards/codes/criteria should be properly referenced (not copied verbatim into the specifications) as indicated in the SpecsIntact guide (page 33). This allows proper verification of references, saves the total paper count of the specifications package, and eliminates conflicts between specs and standards/codes/criteria. Tech Services section is available to anyone who needs guidance/assistance in implementing and following these processes.

For hangar projects, coordinate with the Activity to provide vestibule/cut-off rooms to separate the hangar and the adjacent areas to minimize large Class I Division 2 areas in accordance with UFC 4-211-01, 3-7.1. It is not practical for the Activity to have large rooms where electrical equipment cannot be placed at or near the floor especially in areas where there are work stations complete with desks and chairs. The service members unknowingly may expose themselves to a hazardous/explosive environment simply by placing a power strip on the ground near their work station, installing a small refrigerator or creating a coffee mess. Careful coordination can minimize the classified areas with small changes to the floor plans or impact to the use of the facility.

For hangar projects, ensure plans show exit doors at maximum spacing of 150 feet around the entire perimeter of the hangar bay in accordance with UFC 4-211-01, 3-3.1.9. Also provide exit doors within 20 feet of each end of the hangar bay door.

For hangar projects, show door swings from the hangar bay into adjacent areas such that the door swings in the direction of travel to comply with UFC 4-211-01, 3-3.1.9. Provide fire exit hardware on rated doors exiting through the buildings. Doors terminating directly to the outside are permitted to have panic hardware.

For hangar project, provide exit doors directly to the outside for rooms exceeding 100 sf in accordance with UFC 4-211-01, 3-3.1.9.

For hangar projects, add a note to require all fire alarm circuiting in the hangar bay should be in watertight conduit with watertight connections. Provide NEMA 4 junction boxes, back boxes and enclosures. Initiating devices such as Start Stations, Stop Stations, and Flame Detectors require the conduit to enter the bottom of the back box, and the low point of the conduit be provided with a drain in accordance. These are commonly missed items that have caused false alarms and accidental activations.

Show the control valve, water flow switch and test valve for the elevator hoist way and machine room sprinklers. The architect may need to provide an access panel on their drawings.

For buildings with smoke exhaust systems, provide calculations for the smoke exhaust system and makeup air to show the means of egress doors forces to release the latch and set the leaf in motion do not exceed the requirements in NFPA 101, 7.2.1.4.5.

Fire extinguishers are not required in buildings with sprinkler protection and fire alarm systems (except Medical Facilities) in accordance with UFC 3-600-01, 9-17.1. If the extinguishers are determined necessary by the Activity, document the name of the individual requiring the extinguishers in the analysis. The Air Force directive is to not provide fire extinguishers as the extinguishers are an unnecessary recurring maintenance cost.

10.9 WATER SUPPLY

The water supply for water based fire suppression systems typically complies with UFC 3-600-01. The Qualified Fire Protection Engineer (A-E) shall perform fire hydrant flow tests at the start of the design phase to determine the available water supply. Fire pumps and/or water tanks should be provided as required if the fire sprinkler and hose stream demands exceed the available water supply.

10.10 HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) SYSTEMS

All ventilation systems shall be designed to conform to the requirements of NFPA 90A Installation of Air-Conditioning and Ventilating Systems, NFPA 90B Installation of Warm Air Heating and Air-Conditioning Systems, and NFPA 91 Exhaust Systems fir Air Conveying Gases, etc.

In general, HVAC ducts penetrating 2-hour fire rated wall or floor assemblies shall be provided with fire-dampers. HVAC transfer ducts penetrating 1-hour fire rated walls shall be provided with fire dampers. The type and location of these fire protection devices should be coordinated with the mechanical engineer and shown on the contract documents.

10.11 INSULATION FOR U.S. FUNDED PROJECTS

All insulation to include Thermal (interior, exterior, loose, and rigid types), Acoustical, Spray-on, Plumbing, and HVAC typically comply with UFC 3-600-01, paragraph 8-3 insulation.

10.12 SEISMIC DESIGN REQUIREMENTS (OF FIRE AND LIFE SAFETY SYSTEMS)

The following provides information on the fundamentals on the subject, and highlights various frequently overlooked aspects. (Code and Criteria references are included in parenthesis.)

Key information for Designated Seismic Systems can be found in ASCE 7, 13.1.3 and UFC 3-310-04, 2-13.6.10.3.

In Risk Category I, II, III and IV structures, the following are Designated Seismic Systems:

- 21 13 13.00 10 Wet Pipe Sprinkler System shall be a Designated Seismic System with an Ip = 1.5 (ASCE 7-10, 13.1.3)
- 21 30 00 Fire Pumps shall be a Designated Seismic System, with an Ip = 1.5 (ASCE 7-10, 13.1.3)
- 28 31 76 Interior Fire Alarm and Mass Notification shall be a Designated Seismic System, with an Ip = 1.5 (ASCE 7-10, 13.1.3)

Special Inspections are required for Designated Seismic Systems per IBC 2018, 1705.12.4.
Identify Designated Seismic Systems in the 01 45 35 Statement of Special Inspections.
Identify corresponding Special Inspection in the 01 45 35 Schedule of Special Inspections.

CHAPTER 11 - MECHANICAL

11.1 GENERAL

The design of all mechanical systems should meet the instructions and requirements contained herein, the other government furnished criteria, and the requirements of the Japan Edited Specifications. Where conflicts between the above documents exist, these instructions should take precedence.

Mechanical designs should be economical, maintainable, sustainable and energy conserving with full consideration given to the functional requirements and planned life of the facility. Mechanical design should also consider life cycle operability, maintenance and repair of the facility, and real property installed equipment components and systems.

11.2 DESIGN CRITERIA

UFC 3-401-01 is the main reference for all mechanical work. Follow design criteria as reference in the UFCs.

11.3 DESIGN CONSIDERATIONS

Weather conditions used in designing the mechanical systems should be obtained from UFC 3-400-02 or ASHRAE Guide Books. Utilize ASHRAE 169 Table A-6 to determine the appropriate climate zone for the installation in Japan. A consolidated list of Japan climate zone data can be found in Chapter 16.

11.3.1 DESIGN CONDITIONS

Outdoor and indoor design conditions should be in accordance with UFC 3-410-01, Heating, Ventilating and Air Conditioning.

11.3.2 MECHANICAL ROOM LAYOUT REQUIREMENTS

Mechanical equipment room layout should be provided with ample floor space to accommodate routine maintenance of equipment and have head-room to accommodate specified equipment. Space provided in rooms for service and/or replacement of coils, tubes, motors, and other equipment items should be dimensioned on the drawings. Provisions for installation and future replacement of equipment should be coordinated with the architectural design. The arrangement and selection of mechanical equipment should allow complete with removal of the largest piece of equipment without dismantling adjacent systems or structures. Doors should be located to facilitate such service. Mechanical rooms located above and/or adjacent to normally occupied spaces should be avoided to the greatest extent possible to avoid noise and vibration transmission.

11.3.3 ELECTRICAL EQUIPMENT / PANEL COORDINATION

Arrangement of all mechanical equipment and piping should be coordinated with electrical work to provide dedicated space for location of electrical panels, conduit, switches, etc. Clearance required by NEC above and in front of electrical panels and

devices should be provided. Mechanical equipment (pipes, ducts, etc.) will not be installed within space which is dedicated to electrical switchboards and panelboards (See NFPA 70 Article 408.18 A & B). When electrical equipment is located in a mechanical equipment room, the dedicated electrical space should be indicated by a dashed line and noted "Electrical equipment space".

11.3.4 ROOF MOUNTED EQUIPMENT

Except for intake or relief penthouses, locating mechanical equipment on sloped roofs should be avoided. Equipment requiring maintenance should be located on sloped roofs only with specific concurrence from the Installation. Where equipment requiring maintenance is located on a flat roof, provisions should be made for accessing the equipment for maintenance. Provisions should also be made for protecting the roof from physical damage while the equipment is be accessed.

11.3.5 EQUIPMENT ANCHORING

In Okinawa, tie-downs are required for air cooled condensing units and roof mounted DOAS units due to frequency and intensity of typhoons.

11.3.6 SECURITY

Acoustic protection and man-bars should be provided for all HVAC ducts serving SCIF areas. Provide acoustic protection for these ducts equivalent to the STC rating of the wall in which the duct penetrates. SCIF design should follow the guidance of UFC 4-010-05 SENSITIVE COMPARTMENTED INFORMATION FACILITIES PLANNING, DESIGN, AND CONSTRUCTION unless other guidance has been provided. TEMPEST shielding should follow that outlined in the ELECTRICAL SECTION.

11.3.7 INSTRUMENTATION

Provide sufficient instrumentation to aid maintenance personnel in balancing and/or troubleshooting mechanical systems. Instrumentation should be provided in the media at each change in temperature and at all mixing points in hydronic systems and air handling systems. Discharges of air handling units and hydronic blending stations should be provided with instrumentation. Hydronic zone return mains should be provided with instrumentation.

Pressure gauges, thermometers, flow indicators, sight glasses, etc. should be easily read from the adjacent floor. Provide an isolation valve on each pressure gauge. Thermometers should have separable socket thermo-wells. Allow for the removal, repair, or cleaning of flow measuring devices without having to shut down the system. Pressure gauge(s) should be installed to allow reading of pump suction and discharge pressure and strainer differential pressure.

11.3.8 INTERIOR DESIGN COORDINATION

All mechanical items located in finished areas and on exterior walls or roofs, should be coordinated with and painted to match the color scheme requirements of Japan Edited Specifications.

11.3.9 ANTITERRORISM

Antiterrorism requirements should be provided in accordance with UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings.

11.4 EXTERIOR HEAT DISTRIBUTION SYSTEM

Exterior heat distribution systems should extend from and include the point of connection, to the existing system, to the service entrance at the facility. The design should comply with the requirements of UFC 3-430-01FA, Heating and Cooling Distribution Systems.

11.5 EQUIPMENT IDENTIFICATION

PROVIDE A BRASS NAMETAG FOR EACH VALVE, TEMPERATURE CONTROL DEVICE, DIRECT DIGITAL CONTROLS (DDC) DEVICE, ETC., INSTALLED IN ALL MECHANICAL SYSTEMS.

11.6 THERMAL INSULATION OF MECHANICAL SYSTEMS

Insulation of installed systems should meet the requirements of the Japan Edited Specifications.

11.6.1 DUCTWORK

11.6.2 ALL HEATING AND AIR CONDITIONING SUPPLY DUCTS SHOULD BE INSULATED IN ACCORDANCE WITH UFC 3-410-01. ALL OUTSIDE AIR DUCTS ABOVE FINISHED CEILING SPACES WILL BE INSULATED TO PREVENT CONDENSATION DURING WINTER.FT.)

11.7 COMPRESSED AIR SYSTEMS

Compressed air systems will be designed in accordance with the requirements of UFC 3-420-02FA Compressed Air.

11.8 ENGINE-GENERATOR SYSTEM

Guidance contained herein addresses the engine and its accessories while guidance on the generator and its accessories is given in the electrical chapter.

11.8.1 GENERATOR SET SELECTION

Designer notes contained in UFC 3-540-01 and the Japan Edited Specifications should be reviewed and understood prior to initiating design. It is common for manufacturer's standard cataloged generator sets to not meet the requirements of the guide specifications. Engines larger than those cataloged with standard generator sets are often required to conform to the guide specifications. The designer must ensure that adequate space is provided to accommodate a generator set that conforms to the specifications. A minimum of three generator sets should be selected which conform to the specifications. The selections should be included in the Design Analysis. Space for the generator set should be based on the largest of the selected generator sets.

11.8.2 GENERATOR SET LOCATIONS

Generator sets should be located inside except when an exterior location is specifically requested and/or approved by the Installation. When generator sets are located inside, consideration should be given to locating the radiator outside the building to eliminate the ventilation problems associated with an interior radiator. If the radiator must be located indoors, provisions must be made to ventilate the room. Consideration should be given to recirculating the discharge air from the radiator into the room to heat the room. The recirculation dampers should be controlled to maintain the space temperature during the heating season. Interior generator sets should be located on concrete equipment pads isolated from the building. Generator sets located outside should be housed in a factory-fabricated enclosure.

11.8.3 MECHANICAL VENTILATION

Rooms containing generator sets should be provided with mechanical ventilation to prevent excessive interior temperatures.

11.8.4 JACKET WATER HEATERS

Jacket water heaters will be specified for all generator set applications installed inside or outside. Glow plugs will be required for all units installed exterior.

11.8.5 FUEL OIL SYSTEM

The design and installation of fuel oil systems should conform to NFPA 31 and NFPA 37.

11.8.6 EXTERIOR FUEL OIL STORAGE TANK

Fuel oil storage tanks should be installed underground unless specifically requested by the Stakeholder to be above ground. Tanks will be double wall or provided with other leak and spill containment and leak detection conforming to Federal and local regulations. Piping should be double walled with leak detection to meet all Federal and Local regulations. If the fuel tank is requested by the Stakeholder to be installed above ground, the designer should ensure that the Stakeholder is aware that fuel conditioners may have to be added to the fuel in winter to prevent fuel gelling at low temperatures. Fuel oil storage tanks should be sized per UFC 3-540-01 unless directed otherwise.

11.8.7 FUEL OIL DAY TANK

An auxiliary or day tank should be provided to ensure a ready supply of fuel to the engine. Day tanks should be sized to provide a minimum of two hours operating supply for the engine but in no case will the fuel storage capacity exceed that permitted by NFPA 31 and NFPA 37. Each day tank should be provided with a vent to the exterior, an overflow piped to the main storage tank, and a valve drain. Day tanks should be located so that when full, the fuel level is below the engine fuel injectors. Day tanks should be provided with high, low, and low low level switches which provide alarm inputs to the Installation UMCS.

11.8.8 FUEL OIL PIPING

Fuel oil piping in prime power plants will be installed in floor trenches with removable covers. Fuel oil piping in standby plants will be installed to minimize tripping hazards and will be installed in floor trenches if practical.

11.8.9 MUFFLERS AND EXHAUST PIPING

When generator sets are installed inside, the muffler should be installed inside to eliminate unsightly exterior muffler installations. Mufflers and exhaust piping installed inside should be insulated. Exhaust pipe outlets should discharge horizontal, be directed away from buildings, and should be a minimum 3 m (10 ft) above the ground. The discharges should be mitered to minimize entry of snow and rain.

11.9 INTERIOR GAS PIPING SYSTEM

The interior gas piping system should extend from the outlet of the meter set and service regulator assembly to the point of connection of each gas utilization device. The gas piping system should be steel, designed in accordance with ANSI Z223.1 and NFPA 54.

11.9.1 GAS PIPE SIZING

Calculate the gas demand, in terms of cubic feet per hour, for each appliance connected to the piping system. Gas piping should be sized in accordance with NFPA 54 to supply the demand without excessive pressure drop between the point of delivery and the gas utilization equipment. Minimum interior gas pipe size should be 15 mm (1/2 in). The calorific value of the natural gas to be used in calculations for sizing equipment and piping should be obtained from the local utility, the Directorate of Public Works or the Base Civil Engineers office. If this information cannot be obtained the approximate value of 1000 Btu/ft^3 should be used.

11.9.2 EQUIPMENT CONNECTIONS

In general the final connection to gas equipment should be made with rigid metallic pipe and fittings except flexible connectors can be used if not expected to be vulnerable to physical abuse. Flexible connectors must be used for residential kitchen ranges and should be at least 1000 mm (40 in) long. Flexible connectors can be used for residential dryers. Other acceptable uses of flexible connectors include equipment located where accessibility will be limited to qualified personnel. Acceptable examples include equipment in locked equipment rooms, equipment suspended at least 3 m (10 ft) above floor, and equipment in remote buildings. Flexible connectors must conform with ANSI Z21.45 except flexible connectors for movable food service equipment must conform to ANSI Z21.69. In addition to cautions listed in instructions required by the ANSI standards, flexible connectors will not be allowed to pass through equipment cabinets. Accessible gas shutoff valve and coupling are required for each piece of gas equipment.

11.10 BOILER FUEL OIL SYSTEM

The fuel oil system for hot water and steam boilers should be designed in accordance with NFPA 31.

11.10.1 EXTERIOR FUEL OIL SYSTEM

Normally, a 30-day operational storage of fuel oil will be provided for individual building heating systems. Existing bulk storage facilities will be considered in reducing the 30-day requirement. For new buildings, demand calculations will be made using ASHRAE degree-day method, while existing buildings will use actual consumption by previous delivery and burning records.

11.10.1.1 ABOVEGROUND FUEL OIL STORAGE TANK

All aboveground storage tanks should be provided with secondary containment and a leak detection system. Fuel selection should be compatible (non-gel) with the climate of the installation. Where bottom of fuel oil storage tank is above boiler room floor elevation, an anti-siphon check-valve should be installed in the fuel oil supply line.

11.10.1.2 BELOWGROUND FUEL OIL STORAGE TANK

All buried storage tanks should be double walled with leak monitoring system. Where tank is below boiler room floor elevation, provide a foot valve, or ball or lift check-valve in the fuel oil supply line.

11.10.1.3 EXTERIOR PIPING

Exterior piping should be double walled in accordance with Local and Federal regulations.

11.10.2 INTERIOR FUEL SYSTEM

11.10.2.1 FUEL OIL DAY TANK

Fuel oil day tanks should be provided when necessary to reduce the suction head at the fuel oil inlet to fuel burning appliances. An operating supply fuel oil day tank will be provided and located in the same room as the fuel burning appliances. The fuel oil day tank should be sized for a minimum 4 hour oil supply. The day tank will not larger than that permitted by NFPA 31. Fuel oil day tanks should be provided with minimum 100 percent secondary containment and an overflow line which returns to the main fuel oil storage tank. Installation of fuel oil day tank should be in accordance with NFPA 31. Day tanks should be provided with high, low and low low level switches which provide alarm inputs to the Installation UMCS.

11.10.2.2 APPURTENANCES

Provide level indicators, pressure gauges and flow measuring devices on all fuel oil equipment to facilitate system trouble shooting.

11.10.2.3 INTERIOR PIPING

Fuel oil piping in large boiler plants will be installed in floor trenches with removable covers. Fuel oil piping serving facility boilers will be installed to minimize tripping hazards and will be installed in floor trenches if practical.

11.11 HEATING SYSTEM

Gas- or oil-fired hot water boilers, Installation high temperature hot water or steam distribution system and geothermal heat pumps should all be considered, as applicable,

as the facility heating source. Circulating pump, water supply distribution system, and associated heating equipment will comply with the recommendations of the ASHRAE Handbooks. System selection should be based upon energy source available, life cycle cost, and energy efficiency.

When utilizing the Installation HTHW or steam distribution system, the piping in the mechanical room should be designed to accommodate the pressures and temperatures of these systems without using expansion joints. A finite element analysis computer program should be conducted on all piping of these systems to ensure the stresses, forces and moments are within allowable limits presented in ASME B31.1, Power Piping Code. This should include the distribution piping from the building entrance to the appliance using the heating media (converters, unit heaters, sterilizers, etc.). The analysis should be conducted early in the design process in the event that additional mechanical room space is required to accommodate routing of piping. The designer must obtain information from the manufacturer to incorporate into the finite element analysis program to ensure stresses are not excessive at the control valve. Various design methods may be incorporated, such as piping bends and loops or control valve isolation, to maintain pressures and stresses to acceptable levels. Where boilers are provided, consideration should be given to providing multiple boilers, with a combined capacity meeting the facilities heating requirement, to increase system reliability.

11.11.1 BOILERS

Type of fuel or firing rate required will be factored into the decision on what type of boiler will be used. All boilers over 120 kW (400,000 Btu/hr) Net Output capacity should be of the forced draft type with modulating burner. Sealed combustion, condensing boilers will be considered, where possible, due to their higher efficiency. Where high efficiency boilers are utilized, the design supply and return water temperatures should allow for full utilization of the boilers condensing capability. Low NOx boilers, 20 ppm or less, should be provided at Fort Carson. Boilers should have a minimum turndown ratio of 7:1.

11.11.1.1 BOILER CONNECTION

Design of boiler connection and auxiliary equipment should conform to the requirements of ASME Boiler & Pressure Vessel Code, where applicable.

11.11.1.2 LOW-WATER CUTOFF

Float-type safety water feeders with low water cutoffs should be provided for hot water boilers where required by the ASME Boiler & Pressure Vessel Code or by the manufacturer.

11.11.1.3 WATER COLUMN CONNECTIONS

Provide crosses at right-angle turns on water column connections to boilers.

11.11.1.4 VENT AND STACK CONNECTIONS

Boiler vent or stack connections should be in accordance with UL 441, NFPA 54, NFPA 211, and Paragraph entitled "Vents and Stacks".

11.11.2 COMBUSTION AIR

For facilities where sealed combustion boilers are utilized, combustion air and vent piping should be provided in accordance with the manufacturers requirements. Where non-sealed combustion boilers are utilized, Boiler Rooms should be provided with combustion air openings in accordance with the requirements of NFPA 54. Do not provide combustion air openings in Boiler Room doors. To prevent mechanical room freeze-up when outside air quantities are large, the combustion air louver should be equipped with a combustion air heating coil or a unit heater may be installed with air flow directed at the combustion air louver. If a boiler burner is to be cycled during normal operation, provide motorized damper interlocked with burner. Ductwork should be provided at the louvers to prevent cold air from “dumping” into the Mechanical Room and to control entry of snow through the outside air louvers. The bottom of the ductwork should be sealed watertight and should be provided with a drain line piped to the nearest floor drain.

11.11.3 HIGH TEMPERATURE WATER SYSTEMS

High temperature hot water material and equipment with their accessories and controls should comply with the requirements of the applicable UFGS. For facility heating applications, high temperature hot water should be converted to hot water; unless otherwise approved by the Japan District.

11.11.4 FREEZE PROTECTION

Where any portion of the heating water system is subject to freezing conditions, that portion or system should be provided with freeze protection.

11.11.5 DISTRIBUTION PIPING

Heating water system piping should grade down in the direction of flow where possible. Piping should be designed without pockets, which will permit accumulation of air, and venting should be provided at a minimum number of high points. Manual drains and vents should be provided at all low and high points in the piping system.

11.11.6 FIN TUBE RADIATION

In buildings heated by radiators, indicate on the drawings the mounting height from bottom of radiator cover to floor. Height should be coordinated with installation of electrical outlets to prevent any interference. Where necessary to clear electrical receptacles, fin-tube radiators will be installed with the bottom of the radiator cover 400 mm (16 in) above the floor, space permitting. Space allocation should be carefully coordinated with architectural design where radiation is installed in toilet rooms. In Quarters and Administrative buildings, hot water fin-tube radiators should be provided with individual room temperature control and should be equipped with solid front, slotted, sloping top covers.

11.11.7 SPACE HEATERS

Space heaters employing open flame, glowing elements, or heated surfaces over 232°C (450°F). in contact with recirculated air should not be installed in hangars, garages, or other spaces where there is a possibility of explosive mixtures of gases reaching the

open flame, glowing element, or hot surface, unless installed in accordance with NFPA 409, NFPA 88A or NFPA 88B. Closed flame infra-red heaters using outside air for combustion and outside exhaust may be considered for hangars and garages. High or medium temperature water or steam is desired wherever practicable. Motors, drives, controls, fans, and ductwork employed in connection with space heaters for such areas should be in accordance with NFPA 409 and NFPA 70, NFPA 88A or NFPA 88B. Direct fired heaters are prohibited in areas subject to hazardous concentrations of flammable gas, vapors, or dust.

11.11.8 INFRARED RADIATION HEATING

Infrared radiant heating will be considered for high bay areas or where spot heating is required. Gas, oil, and electricity may be considered as fuel sources. Night setback of these systems will be considered where experience has demonstrated that it is cost effective.

11.11.9 ELECTRIC RESISTANCE HEATING

Electric resistance heating is not permitted except by USACE approval.

11.11.10 HEAT PUMPS

Where geothermal heat pumps (water-to-air or water-to-water) are being considered, the size and location of the well field should be discussed with and approved by the Installation prior to the finalizing the decision to use heat pumps.

11.11.11 VESTIBULES

Vestibules may be heated to 10°C (50°F) to melt tracked-in snow in locations where conditions warrant. Otherwise, vestibules will not be heated or air-conditioned.

11.11.12 HANGAR DOOR TRACKS

Readiness, Alert, Maintenance and Multi-Purpose Hangars should be provided with either raised door tracks or with ice-melting coils for the doors where the annual snowfall is 500 mm (20 in) or more. Coils should be used only on the apron side of Alert hangars. Condensate-return-pipe door-loop trenches should be located on architectural floor plan and detailed on the structural plans.

11.11.13 STEAM SYSTEM

This section contains instructions and engineering information relating to the design of the steam system. The steam system design should meet the requirements of the applicable Unified Facilities Criteria and, unless otherwise stated, will comply with the ASHRAE Handbooks. Low-pressure steam boilers should be provided only when there is an end use requirement for steam (i.e. humidification, sterilization, etc.).

11.11.14 STEAM CAPACITY

Steam at a pressure of 0.1 MPa (15 psig) should be provided for the air handling unit humidification systems. The entire facility will be provided with humidification to maintain a minimum of 30 percent relative humidity (RH). Provide gross humidity control through the central air handling unit systems to maintain 30% RH. No areas within the facility require precise humidity control.

11.11.15 BOILER

Low pressure steam 0.1 MPa (15 psig) should be generated by a cast iron type steam boiler rated for a pressure of 0.2 MPa (30 psig) and provided with a combination natural gas and #2 diesel fuel oil burner. Boiler should be provided with furnace draft regulator operating a damper by a power cylinder or equal designed to maintain required furnace draft within 0.01-inch water column, and flame failure protection of electronic type with separate supervision of pilot and main flame. Controls should be programmed for prepurge and postpurge of combustion chamber.

11.11.15.1 BOILER CONNECTION

Design of boiler connection and auxiliary equipment should conform to the requirements of ASME Boiler Code, where applicable.

11.11.15.2 SAFETY CONNECTIONS

Float-type safety water feeder with low water cutoff should be provided.

11.11.15.3 WATER COLUMN CONNECTIONS

Provide crosses at right-angle turns on water column connections to boiler.

11.11.15.4 VENT AND STACK CONNECTIONS

Boiler vent or stack connections should be in accordance with UL 441, NFPA 54, NFPA 211, and Paragraph entitled "Vents and Stacks".

11.11.15.5 BOILER LOCATION

The steam boiler and all fuel burning equipment should be located in the same room as the hot water boiler.

11.11.15.6 DISTRIBUTION PIPING

Distribution Piping should follow the guidance in ASHRAE.

11.11.15.7 CONDENSATE PIPING

Condensate Coolers should follow guidance in ASHRAE.

11.11.15.8 STEAM TRAPS

Steam traps should be sized in accordance with UFC 3-430-01FA. Capacities should be scheduled on the drawings. Schedule must include flow capacity, type of trap, inlet pressure, and differential pressure.

11.11.15.9 WATER TREATMENT

Makeup water for the steam system will be treated to prevent corrosion and scale buildup. The water treatment system will consist of a water softening system and automatic blowdown.

11.11.15.10 WATER SOFTENER

Makeup water will be softened to reduce the hardness to less than 5.0 mg/l. Two softener tanks will be provided with a single regeneration tank. Investigate other considerations.

11.11.15.11 AUTOMATIC BLOWDOWN

The boiler will be provided with an automatic boiler blowdown to control and monitor dissolved solids. The controls will incorporate a timer, which will initiate blowdown and a conductivity sensor to control the length of blowdowns.

11.11.16 COMBUSTION AIR

Combustion air intake for the hot water system should be sized to handle the steam boiler also.

11.11.17 HUMIDIFIERS

Packaged steam dispersion tube type injection humidifier panels will be provided for each Air Handling Unit.

11.11.18 FREEZE-PROOF COILS

Steam distributing nonfreeze-type coils should be used for combustion air, makeup air, or preheat coils, in steam systems.

11.12 VENTS AND STACKS

Stacks should be in accordance with NFPA 211. Generally, all stacks will be of the prefabricated type with an individual stack provided for each appliance. Stacks are generally used for forced draft applications. Vents should conform to UL 441 and should be type B. Vents are generally used for atmospheric burners. Vents can be tied together to a main vent. Combined stacks will not be used for appliances with power burners or draft fans. Stacks and vents cannot be tied together. Height of stacks and vents should be as required by NFPA 54 and should be provided with a rain cap.

11.13 REFRIGERATION SYSTEM FOR COLD STORAGE FACILITIES

This portion provides guidance in the design of refrigeration for cold storage facilities. The refrigeration system should follow the guidance in ASHRAE. The materials will comply with the Unified Facilities Guide Specification.

11.13.1 COMPRESSORS

Compressor capacity should be selected, divided, and cross-connected to provide a stand-by unit to protect frozen food. Provide oil traps and double risers on suction and hot gas risers when compressor capacity modulation is used.

11.13.2 EVAPORATORS

Freezer room evaporators should be fan-type unit coolers provided with electrical defrost. These should be wired, as necessary, and piped to floor drain. Condensate drain should be insulated and heat traced.

11.13.3 CONDENSERS

Provide head pressure control on all refrigerant condensers.

11.13.4 PREFABRICATED REFRIGERATORS

Prefabricated refrigerators to be mounted on concrete curb or 100 mm (4 in) concrete blocks with vent opening 50 mm (2 in) above finished floor, equipped with insect screens. Drain from unit cooler to discharge outside of refrigerator base.

11.13.5 DRAIN LINES

Defrost-water drain lines should be provided for each unit cooler.

11.13.5.1 COLD STORAGE PLANTS

Where external wall areas are exposed to outside temperature, provide heat to prevent temperatures in storage spaces from dropping too low during extended periods of extreme cold weather.

11.13.5.2 FROST MITIGATION

Frost migration through freezer room floors should be prevented by a ventilation system under the floor or by a circulating glycol system which uses recovered heat from the refrigeration system.

11.14 REFRIGERATION/CHILLED WATER SYSTEM

This section contains instructions and engineering information relating to the design of the facility refrigeration/chilled water, including the exterior air-cooled condensing unit, air-cooled condenser, chiller unit, interior reciprocating chiller, interior piping distribution system, and the pumping system. Conceal piping in permanent-structures. Exposed piping attached to or near equipment, or subject to high heat or frequent washing, must be copper, brass, or chromium plate. The cooling system should be meet the requirements of Unified Facilities Guide Specification.

11.14.1 DESIGN TEMPERATURES

Outside design temperatures for 1% plus 3°C (5°F) should be for air-cooled condensers and condensing units per UFC 3-410-01 paragraph 3-4.2.5. For cooling towers and evaporative condensers, use 1% wet bulb temperature as obtained from UFC 3-440-05N Table 3.

11.14.2 BUILDING SYSTEM

The building chilled water system should consist of one of the following: chilled water, DX, system using steam absorption, centrifugal, reciprocating equipment with a cooling tower, air cooled condenser, condensing unit. System selection should be based upon a life cycle cost analysis and any other criteria furnished. Currently available Variable Refrigerant Flow (VRF) systems do not meet the open control requirements in UFC 3-410-01. Until manufacturers are able to provide open control system that meet these requirements, VRF system are not allowed. However, VRF systems shall be included as an alternative in the life cycle cost analysis for projects where VRF is a feasible option.

11.14.3 REFRIGERATION EQUIPMENT

DX evaporators should be provided with double suction risers where suction line is trapped or rises above the evaporator and the compressor is provided with capacity

reduction. Use of direct evaporative cooling is prohibited because of the possible health problems with aspergillus fumigatus and legionella pneumophila. Where systems will be used for mid-season and/or year-round operation, provide head pressure control or appropriate cooling tower control. "One time" pump-down cycles will be required, where applicable. R-32 refrigerant is permitted for U.S. Army facilities in Japan in accordance with ASHRAE 15 - Addendum d, and ASHRAE 34 – Addendum g. Army facilities in Japan. For all other DOD components, verify if the use of R-32 refrigerant is acceptable during the concept design charrette.

11.14.4 CIRCULATING PUMPS

Two circulating pumps should be provided for the secondary system, each sized for 100 percent of the load, with one of the pumps being standby. Pumps should be located in the mechanical room and should be base mounted, horizontal split-case centrifugal type with mechanical seals.

11.14.5 PIPE MATERIALS

Hydronic piping (chilled, hot water, etc.) should utilize materials and fittings per the Japan Edited Specifications.

11.14.6 WATER TREATMENT

Determination of the local water composition is essential to the design of water treatment for mechanical systems. A water analysis may be available from the using agency. If an analysis is unavailable, the designer will obtain a sample of the raw water. The sample will be tested and the results will be included within the specifications. Water treatment systems for cooling towers will provide for prevention of corrosion, scale, and biological formations. Closed chilled water systems, and dual temperatures systems will be treated for initial fill with allowance for the addition of chemicals as needed.

11.15 AIR SUPPLY AND DISTRIBUTION SYSTEM

This section contains instructions and engineering requirements relating to the design of the air conditioning supply and distribution systems. The design of all systems will comply with the ASHRAE Handbooks, to the requirements of NFPA 90A, NFPA 90B, and NFPA 91, and should meet the requirements of Unified Facilities Guide Specifications.

11.15.1 BASIC DESIGN PRINCIPLES

All designs will be based on the following basic principles:

- Interior design conditions selected, including temperature, humidity, filtration, ventilation, air changes, etc., will be suitable for the intended occupancy.
- The designer will evaluate all energy conservation items that appear to have potential for savings such as heat recovery for HVAC and service water heating, economizer cycles, and plastic door strips for load docks and include those items in the design that are life cycle cost effective.
- The design will be as simple as possible.

- Adequate space will be provided to access items that require maintenance such as filters, coils and drain pans, and strainers.
- Recovered heat will be used for reheat where possible.
- Utilize energy recovery to the greatest extent that a life cycle cost analysis finds feasible.

11.15.2 TEMPERATURE SETTINGS

HVAC Sequence of Control should include procedure for Base personnel to reset HVAC Control settings in occupied zones if future energy conservation actions are required. The design relative humidity will conform to the recommendations in ASHRAE unless other direction has been provided.

11.15.3 AIR CONDITIONING LOADS

Air conditioning loads should be calculated using ASHRAE methods. Hourly Analysis Program (HAP) by Carrier Corporation, Trace 700 by Trane Corporation, DOE-2 by the United States Department of Energy, or EnergyPlus by the United States Department of Defense and the United States Department of Energy computer programs are acceptable for calculating loads and/or energy consumption.

11.15.4 INFILTRATIONS

Where acceptable, air distribution systems for central HVAC systems will be designed to maintain a slight positive pressure within the area served in order to reduce or eliminate infiltration.

11.15.5 OUTDOOR AIR INTAKES

Outdoor air intakes will be located in areas where the potential for air contamination is lowest. Basic guidelines include the following:

- Maximize distance between intakes and cooling towers, plumbing vents, loading docks, traffic, etc.
- Maintain a minimum distance of 10 m (30 ft) between intakes and exhausts, more if possible.
- Locate intakes and exhausts on different building faces.

11.15.6 FILTRATION

For administrative facilities, commercial facilities, and similar occupancies where indoor air quality is of primary concern, the combined supply air, including return and outside air, will be filtered by a combination of 25 to 30 percent efficient prefilter(s) and 80 to 85 percent efficient final filter(s) as determined by the dust spot test specified in ASHRAE Standard 52.1. Due to the decrease in system airflow as the pressure drop across the filters increases, fans should be sized for the "dirty" filter condition. This will ensure that the fan has adequate capacity to deliver the design airflow as the filter becomes loaded. In addition, in order to ensure that this fan capacity is "available", test and balance criteria in the appropriate Unified Facilities Guide Specification (UFGS) should be followed.

11.15.7 DUCTWORK DESIGN

All ductwork for heating/ventilating only systems should be insulated per Japan Edited Specification for air conditioned ductwork where future air conditioning of building is anticipated.

- Supply air duct systems for variable air volume (VAV) systems should be sized using the static regain method.
- Return air ductwork should be routed into each area isolated by walls which extend to the above flooring or roof structure; the use of transfer ducts or openings should not be used.
- The use of the T-Method for duct design is encouraged due to its ability to optimize both first and operational costs of the entire air distribution system. Either the T-Method or the Static Regain method will be used to design ducts for VAV systems. The use of round or oval prefabricated duct is recommended. Round/oval prefabricated duct reduces leakage and friction losses, therefore reducing the amount of conditioning and fan energy required. The additional material cost for round/oval prefabricated duct would be at least partially offset by reduced installation cost and time.
- Specify typical duct sizes in accordance with JIS A 4009.

11.16 SPECIAL CRITERIA FOR HUMID ENVIRONMENTS

Humid areas are defined as those areas where: The UFC 3-400-02 engineering weather Air Conditioning/Humid Area Criteria data for the wet bulb temperature is 19.5°C (67°F) or higher for over 3,000 hours or where the wet bulb temperature is 23°C (73°F) or higher for over 1500 hours. The following criteria should be used in the design of air conditioned facilities located in humid areas; ITG FY05-2 NAVFAC Humid Area HVAC Design Criteria and/or Air Force ETL 04-03, Design for Prevention of Mold in Air Force Facilities.

High Humidity areas are defined as those where the 1 percent ambient dewpoint (DP) temperature exceeds 70 degrees F (21.1C). These locations should use UFC 3-440-05N Tropical Engineering for the design of HVAC systems. Dewpoint design data can be found by accessing the additional content in the PDF version of the ASHRAE Fundamentals Handbook.

See Chapter 16 - CLIMATE DATA for more information.

11.16.1 SYSTEM SELECTION

Air-conditioning will be provided by an all air system. The system may consist of a central air-handling unit with chilled water coils or a unitary direct expansion-type unit(s) capable of controlling the dew point of the supply air for all load conditions. Systems such as variable volume constant temperature, bypass variable air volume, variable temperature constant volume, and terminal air blenders should be considered. In addition to life cycle costs considerations, system selection will be based on the capability of the air-conditioning system to control the humidity in the conditioned space

continuously under full load and part load conditions. System selection will be supported by an energy analysis computer program that will consider the latent-heat gain due to vapor flow through the building structure, to air bypassed through cooling coils, and to the dehumidification performance of the air-conditioning system under varying external and internal load conditions. Low sensible loads and high latent loads (relatively cool cloudy days) will, in some cases, cause inside relative humidity to be higher than desired. If analysis indicates that this condition will occur, reheat will be used.

11.16.2 FAN COIL UNITS

Room fan coil units will not be used unless dehumidified ventilation air is supplied to each unit or separately to the space served by the unit and positive pressure is maintained in the space.

11.16.3 AIR HANDLING UNITS

Draw-through type air handling units will be specified in order to use the fan energy for reheat. Air distribution system will be designed to prevent infiltration at the highest anticipated sustained prevailing wind.

11.16.4 VENTILATION

Outside air will be conditioned at all times through a continuously operating air-conditioning system.

11.16.5 AIR AND WATER TEMPERATURES

The supply air temperature and quantity, and chilled water temperature will be based on the sensible heat factor, coil bypass factor, and apparatus dew point.

11.16.6 OUTDOOR DESIGN TEMPERATURES

Refer to the UFC/s for direction on the correct outdoor design temperatures to be used in cooling load calculations and equipment selections.

11.16.7 CLOSETS AND STORAGE AREAS IN AIR CONDITIONED FACILITIES

These area should be either directly air conditioned or provided with exhaust to transfer conditioned air from adjacent spaces.

11.16.8 REHEAT

Where reheat is required to maintain indoor relative humidity below 60 percent, heat recovery, such as reclamation of condenser heat, should be considered in life cycle cost analysis.

11.16.9 ECONOMIZER CYCLE

Economizer cycle will generally not be used due to the high moisture content of outside air.

11.17 VENTILATION AND EXHAUST SYSTEMS

This section contains instructions and engineering requirements relating to the design of the mechanical ventilation and exhaust systems. The design of all systems should

comply with ASHRAE Handbooks, ASHRAE Standard 62, to the requirements of NFPA 90A, NFPA 90B, and NFPA 91, and should meet the requirements of Unified Facilities Guide Specifications.

11.17.1 OUTDOOR INTAKES, RELIEF AND EXHAUSTS

Outdoor air intakes should be located in areas where the potential for air contamination is lowest and where applicable, the locations should be in accordance with the requirements of UFC 4-010-01. Maximize the distance between intakes and exhausts by maintaining a minimum distance of 10 m (30 ft) between intakes and exhausts; more if possible. Provide each outside air intake, relief, and exhaust with a fixed louver with birdscreen. If feasible, locate intakes and exhausts on different building faces. In Okinawa, provide exterior stainless steel hoods over all HVAC building openings due to the frequency of typhoon driven rain.

11.17.2 SUPPLY AND EXHAUST FANS

Exterior wall and roof mounted supply or exhaust fans should be avoided; provide interior fans with ductwork connected to a louver. Except for interior wall mounted propeller units, all fans should be centrifugal type and connected directly to weather-proof louvers or roof vents using ductwork. Fan type (air foil, forward/backward curve, propeller, etc.) and drive type (direct or belt) should be specified on the mechanical fan equipment schedules on the design drawings. Care should be taken to ensure that the noise level generated by exhaust fans and associated relief louvers is not transmitted to the exterior of the building. All possible steps should be taken to keep the noise below NC60. Any in-line fans located outside the main mechanical and electrical areas should be the provided with acoustical enclosures to inhibit noise transmission to the adjoining occupied spaces.

Where possible, exhaust fans in all buildings in housing, recreational, hospital, and administrative areas should be of the centrifugal type, discharging through louvers in the side wall of the building using ductwork, as necessary. Roof-mounted fans of the low-silhouette type may be used in shop, flight line, or warehouse areas. Where exhaust ventilating fans or intakes are provided in buildings, a positive means (gravity dampers are not acceptable) of closing the fan housing or ducts should be provided in order to prevent heat loss in cold weather, except as prohibited by NFPA Standard 96.

11.17.3 GENERAL ITEMS

Incorporate the following as applicable:

- Ventilation for variable air volume systems will ensure proper ventilation rates at low and high system air flow.
- Year-round supply (make-up) air should be provided to equal the total quantity of all exhaust hoods.
- Where desirable, designer may incorporate a purge mode into system design. This mode could be used, for example, to purge the building with outside air during off-hours or to purge the affected zone during building maintenance, such as painting.

- Utilize energy recovery to the greatest extent possible. In general, all ASHRAE 62.1 Air Class 1 & 2 exhaust air should be balanced with the outdoor ventilation rate requirements to be used for air to air energy recovery such as enthalpy wheel or plate frame heat exchangers. Where energy recovery is utilized, outside air heating coil capacities should be sized based on minimum 50% energy recovery (i.e. outside air heating coil capacities should not be sized based on Winter Design entering air temperature). Where energy recovery is utilized, ensure proper control sequence and/or bypass is provided so as not to increase the mechanical cooling load. For enthalpy wheels, the wheel should stop when OSA temperature is less than return air temperature but the OSA temperature is still higher than the desired supply air setpoint. For plate frame heat exchangers, bypass pathways with dampers must be provided.
- Make up air for highly negatively pressurized/exhausted areas, such as kitchens and labs, must be provided locally via proper mechanical transfer air from adjacent spaces (ducted or wall transfer grilles) or direct make up air units where adjacent spaces cannot provide the required make up air quantity.

11.17.4 TOILET / JANITOR ROOMS

The toilet rooms and janitor closet(s) should be exhausted at a rate specified in ASHRAE 62.1. The required make-up air for the exhaust system should be from undercut doors or, if necessary, through door or wall transfer grilles. Exhaust registers, in lieu of grilles, should be provided in areas with rigid ceilings.

11.17.5 SHOWER AREAS

Shower areas should be exhausted at the rate specified in ASHRAE 62.1.

11.17.6 COPY ROOMS

Where practical, photocopiers and laser printers should be located in a separate room. Copy rooms with photocopiers and laser printers and should be maintained at a negative pressure relative to adjacent areas. All conditioned supply air to the room should be exhausted and not returned to the air handling unit system due to contaminants.

11.17.7 MECHANICAL/ELECTRICAL ROOMS

Mechanical and electrical equipment rooms should have a thermostatically controlled ventilation system in accordance with UFC 3-410-01, Chapter 4-2.4.5. Wall or door intake louvers should be provided to ensure adequate make-up air is provided.

The ventilation fan will have a two-speed motor, which is sized, at the high speed, to have adequate capacity to limit the room dry bulb temperature to a maximum of 6°C (10°F) above the outdoor dry bulb temperature when both equipment and ambient loads are at their maximum peaks. The high speed will be activated 6°C (10°F) below the maximum temperature at which the most sensitive item of equipment in the room can operate. The low speed will operate at 11°C (20°F) below that of the high speed.

11.17.8 BOILER AND FURNACE ROOM

The boiler room should be cooled via ventilation of outside air to a temperature of no greater than 10°F over ambient conditions by a thermostatically controlled supply or exhaust fan set to operate when temperature exceeds 30°C (85°F). Supply fans should be used when atmospheric burners are permitted. Combustion air should be provided by louvers sized and located in accordance with NFPA 54.

11.17.9 FIRE PROTECTION ROOM

The Fire Protection room should be cooled via ventilation of outside air to a temperature of no greater than 6°C (10°F) over ambient conditions by a thermostatically controlled fan set to operate when temperature exceeds 30°C (85°F).

A Fire Protection room with pipes subject to freezing shall be protected in accordance with NFPA requirements.

11.17.10 LAUNDRY ROOMS

Ensure exhaust fan in laundry room are sized for appropriate air change. Cloth dryer exhaust venting must be adequate to prevent accumulation of lint in dryer exhaust systems, and provided with access for inspection and cleanout. Individual exhausts are preferred but where not possible, a manifold exhaust maybe used. Booster fans may be used where required to maintain adequate velocity. Make up air should be provided for the dryers. Design should follow the requirements of ETL 1110-3-483. (See ECB 2008-9)

11.17.11 AUTOMOTIVE MAINTENANCE SHOPS

Shops will be provided with a suitable engine exhaust ventilating system. General ventilation should be provided per NFPA 30A.

11.17.12 BATTERY ROOMS

Battery rooms should be ventilated at four air changes per hour.

11.17.13 VEHICLE EXHAUST SYSTEMS

The design should comply with ASHRAE, NFPA 90A, NFPA 90B and NFPA 96 and meet all the requirements of the Unified Facilities Guide Specifications.

11.17.14 COMMUNICATIONS ROOM

Provide split type heat pump unit in each Communication room for cooling/heating and relative humidity requirement in accordance with TIA-569-E, Table 2“Temperature and Humidity Requirements for Telecommunication Spaces”. OA should be provided in order to maintain a positive pressure differential with respect to surrounding areas as required.

11.18 FOOD SERVICE FACILITY REQUIREMENTS

Dining hall ventilation should be designed in accordance with the requirements of ASHRAE and NFPA 96 and other criteria as furnished.

11.19 MEDICAL FACILITY REQUIREMENTS

Design requirements should be in accordance with UFC 4-510-01, ASHRAE, and other furnished criteria.

11.20 HVAC TEMPERATURE CONTROL SYSTEM

HVAC Temperature control systems should utilized direct digital controls in accordance with UFC 3-410-02 and the Japan Edited Specifications. Temperature control system should consist of standard components. Temperature controls should be provided for the operation of each item of mechanical equipment (i.e., boilers, air handling units, pumps, chillers, unit heaters, exhaust fans, fin tube radiation, etc.). The controls should be designed to reduce energy consumption and consider year-round control of both heating and air-conditioning. Where applicable, night setback, building warm-up temperature reset, economy cycle, and other techniques should be used. Control systems should be as required by this document or other furnished criteria, as agreed upon by all parties during design. Proprietary systems will require a request for waiver from the User and approval by the Competition Advocate. Where applicable, HVAC control systems should be integrated into the Installation wide Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control System (EMCS) such that all monitoring and control points in the building HVAC control system can also be monitored and / or controlled from the UMCS / EMCS. The DOR should coordinate in the early design phases with the installation for project specific DDC/UMCS requirements. In general, for MILCON project, the DDC will be LonWorks or BACnet.

11.20.1 DESIGN REQUIREMENTS

The preliminary sequence of control should be on the early preliminary drawings or in the Design Analysis narrative while the final design drawings should provide the following for each item of mechanical equipment:

11.20.1.1 CONTROL SCHEMATICS

Control schematics should comply with UFC 3-410-02. Schematics should be complete, easily understandable control schematics of each system being controlled and functional interface of control components to the system should be provided and should be drawn to a scale that will be legible and tolerate one-half scale reduction. Ample space should be allowed to indicate all performance parameters such as set point, throttling range, and action. This large scale drawing should be easily read by the mechanic who will be using these drawings as part of the maintenance documentation. Each control component should be identified by an alphanumeric designator, such as T1 and R1. These designators should be used for cross-referencing to all other HVAC control items. Control schematic drawings should clearly identify all of the equipment based on the indicated Mark Type/Equipment ID as shown on the mechanical equipment schedules.

11.20.1.2 SEQUENCE OF CONTROL

The sequence of control should be a narrative statement of the sequence of operation and should be detailed in discussion and address seasonal operations and should be

subsectioned to completely describe all applicable items such as safety controls, timed controls, mixed air section, fan, coil, and terminal unit coil control. Include interface to fire/smoke/detection and alarm systems and to UMCS / EMCS. Sequence of control should identify the conditions for on/off and open/close position of valves, actuators, motors, etc. (i.e., normally closed CW valve should be fully closed at 13°C (55°F) and fully open at 15°C (58°F) SA temperature), in sufficient detail to establish final control action, setpoint, and throttling range. For all projects on mainland Japan, ensure proper freeze protection sequences are developed. The preferred method is to open the chilled water valves to 100% and turn on the pumps to keep water circulating. Chillers should operate via the own internal freeze protection features.

11.20.1.3 POINTS SCHEDULE

Control drawings should include Points Schedules for all DDC controlled HVAC equipment. Points Schedules should comply with UFC 3-410-02 and the Japan Edited Specifications.

11.20.1.4 LEGENDS

A controls legend defining all symbols and abbreviations used on submittal drawings and documents should be provided. The controls legend should be a separate sheet(s) from that of the general mechanical legend sheet(s).

11.20.1.5 SYSTEM OPERATING SCHEDULE

Tabular presentation of control system operation should be provided. The operating schedule should compare temperature or other air conditions with valve or damper position and signal input to the controlled device.

11.20.1.6 READABILITY

As many of the above items pertaining to the same HVAC system should be included on the same drawing without compromising readability.

11.20.1.7 CONTROL SETTINGS

DDC systems should include operator ability to adjust all setpoints (temperatures, pressures, flow rates, etc.). The system should perform supervisory monitoring and control functions including but not limited to: scheduling, alarm handling, trending, overrides, report generation, and electrical demand limiting.

Utility Control System/Energy Monitoring and Control Systems

The facility should be monitored and controlled by the base-wide UMCS / EMCS where one is available. The design of the UMCS / EMCS system should be in accordance with UFC 3-401-01 and the Japan Edited Specification, unless otherwise stated. For projects that require the building system to provide UMCS functionality (i.e. standalone without connection to a UMCS), include the necessary requirements from UFGS 25 10 10 Utility Monitoring and Control System (UMCS) Front End and Integration in the project specifications.

11.20.2 STAKEHOLDER COORDINATION

The Designer should work with the Stakeholder to determine the following:

- The type of existing UMCS / EMCS system.
- Justification of proprietary specifications.
- Lon / BACnet compliance.
- The existing EMCS system expansion capabilities.
- The new building Input/Output (I/O) point selection should be determined with input and approval from the UMCS / EMCS system manager or the Base Civil Engineer.
- Of the selected Input/Output (I/O) points, determine which points will be for control and which points will be for monitoring purposes only.

11.20.3 CONCEPT DESIGN REQUIREMENTS

The following items should be addressed in the design submittal:

- General discussion of how the building system will be connected to the UMCS / EMCS.
- Preliminary Input/Output (I/O) schedule sheets coordinated with the Stakeholder
- A separate line item on the estimate for connection from the building system to the central EMCS.

11.20.4 FINAL DESIGN REQUIREMENTS

The following items should be included in the final design documents:

- The building system including all required HVAC control panels will be shown on the drawings, as has been coordinated with the Stakeholder or outlined by other furnished criteria.
- Sensors and EMCS connections should be shown on the floor plans and on Temperature Control schematics.
- Provide a separate dedicated 20 amp/120-volt power circuit to each HVAC control panel.
- I/O summary sheets should be on the drawings. Failure modes should be shown on the I/O sheets
- UMCS Unified Facilities Guide Specifications (UFGS), for Utility Monitoring and Control Systems, should be edited.
- A cost estimate should be provided for the building HVAC control system. A separate estimated cost should be provided for HVAC control system connection and integration into UMCS / EMCS.

11.20.5 DESIGNER NOTES

When proprietary DDC System is required by the user, it is necessary to indicate in the contract specifications that exception is taken to the Federal Acquisition Regulation (far) 52.236-5, Material and Workmanship, which states:

"References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, should be regarded as establishing a standard of quality and should not be construed as limiting competition." Therefore, for proprietary items with Sole Source Justification approval by the COE Competition

Advocate, the following paragraph should be edited and inserted in the Technical Specifications for the item required:

> Notwithstanding Section 00 72 00 Contract Clauses FAR 52.236.5, Material and Workmanship, [PRODUCT] shall be manufactured by [MANUFACTURER] in order that [REASON]. No other product will be acceptable. The Competition Advocate authorizes sole source procurement. The [PRODUCT] listed shall be the equipment, material, article, or patented process. The [MANUFACTURER] listed shall be the full legal company name of the manufacturer. The [REASON] listed shall be the reason(s) why it is necessary to procure the item through sole source procurement.

11.20.6 GUIDE SPECIFICATIONS

The Japan Edited Specifications should be completely edited and fully coordinated with the drawings to accurately and clearly identify the product and installation requirements for the facility. The specifications should not be edited to reduce the level of quality for equipment, services provided materials, and items of equipment. Installation requirements identified in the provided specifications but not required for the facility should be deleted. Where materials, items of equipment, or installation requirements are not covered in the provided specifications; special sections within each guide specification should be prepared to cover those subjects. Government approval is required for any addition of materials, items of equipment, or installation requirements not covered in the provided specifications. The use of proprietary brand names in the specifications should not be used. See Chapter 3 - SPECIFICATIONS for further guidance.

11.21 ELEVATORS

Elevator design and ventilation should follow UFC 3-490-06.

11.22 HVAC COMMISSIONING

Department of Defense requires the use of an ASHRAE Defined “Total Building Commissioning” process for the projects. Furthermore, it requires that the agent providing the Commissioning review and execution services be independent of the work of design agents.

11.22.1 APPLICABLE CRITERIA

All work should conform to, but not limited to, the following criteria:

- ASHRAE Guideline 0-2013, The Commissioning Process
- ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process
- ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings
- ER 1110-345-723 Total Building Commissioning Procedures for USACE Projects.

11.22.2 DESIGN COMMISSION AGENT (CXD)

Design Commission Agent (CxD) along with the Designer of Record (DOR) are responsible for developing the detailed Commission plans, construction specifications, and design analysis which identify suitable materials, testing procedures, equipment and testing checklist, and functional performance testing procedures for the designed systems.

11.22.3 COMMISSIONING AUTHORITY (CXG)

The Architect-Engineer (A-E) who serve as the USACE Commissioning Authority (CxG), per ER 1110-345-723, should review the necessary owner systems information; provides technical guidance necessary to develop the proper design, construction, and commissioning documents; and ensures of commissioning of the various systems. Maintain strict independence from the Designer of Record, Contractor, and all subcontractors. Report directly to the USACE Technical Lead (TL) and during construction, the USACE Project Engineer (PE) as Owner's Agent. Immediately report any violations of the Commissioning protocol to the TL and PE.

11.23 DESIGN SUBMITTAL REQUIREMENTS

Design submittal documentation requirements should be in full compliance with UFC 3-401-01 & 3-410-01 as well as this section.

11.23.1 PARAMETRIC DESIGN – 15%

This section contains instructions and requirements for the following Project Definition Design submittal requirements:

- Mechanical Equipment Room Sizing Requirements
- Design Drawings
- Guide Specifications
- Design Analysis Narrative
- Design Analysis Calculations

Compliance with the design requirements for the building mechanical systems will be determined by a review of the submitted drawings and Design Analysis. All conflicts, lack of specific criteria, and/or direction, inconsistencies, ambiguities, and lack of thorough understanding of the nature and scope of work should be identified or resolved prior to submittal of the follow on stages of design.

11.23.1.1 DESIGN DRAWINGS

Design drawings should be fully coordinated with the Design Analysis. Floor plans should use the architectural floor plans as a basis, with the building outline half-toned. Unless otherwise indicated, all floor plans should be drawn at a minimum 1/8" (100) scale and should show room names and numbers. The following design drawings should be included in the Project Definition Design submittal:

EXTERIOR UTILITY DRAWINGS

The following exterior utility drawings should be provided:

- Removal Plan: All existing exterior mechanical utilities and utilities which are to be removed should be indicated on the Site Removal Plan located in the civil section of the drawing package.
- Utility Plan: All existing and new mechanical utilities should be indicated on the Site Composite Utilities Plan located in the civil section of the drawing package. The location of existing exterior utilities should be thoroughly checked and indicated on plans and profiles, thus preventing interference with new services. The utility drawing should indicate all new utilities, including tie-in points, and existing utilities, which are to be abandoned.

REMOVAL PLANS

General removal drawings required for the rehabilitation or modification of the existing facilities should be provided. Removal drawings may be combined into a composite removal plan as long as legibility is not compromised.

MECHANICAL DRAWINGS

Show on mechanical drawings, all major items of mechanical equipment systems to determine proper space allocation within the intent of the architectural layout requirements. Plans, elevations, and sections should be developed sufficiently to insure that major equipment items, piping, and ductwork cause no interference with structural members, electrical equipment, etc. The following HVAC drawings should be provided:

- Composite Mechanical Plan: A composite mechanical plan should be provided showing the tentative layout of the main supply/return air ductwork and piping distribution systems. All interior walls that extend from the floor to the roof structure should be identified on the plan. Outlines of all electrical panels and equipment should be shown. A key plan and room schedule legend should also be included on the composite plan.
- Enlarged Mechanical Room Plan: An enlarged mechanical room plan showing all mechanical and plumbing systems and drawn at a minimum 20 scale should be provided. Plans should show layout of all equipment, piping, and ducts located within the rooms. Mechanical equipment should include (but not limited to) air handling units with outside air intakes, relief air, and associated supply/return ducts, CW pumps, exhaust/supply fans, mechanical and boiler room ventilation intake/relief openings, gas service entrance, combustion air opening, unit heaters, HW pumps, boilers, expansion tanks, and HVAC control panels. Plans should show dedicated access space for items requiring maintenance.
- Plumbing equipment should include the water service entrance, and lawn sprinkler apparatus. In addition, all electrical panels and equipment located in the room should be outlined in half-tone.
- Mechanical Room Sections: For each air handling unit within the mechanical room, a mechanical room section view should be provided showing, but not limited to, all AHU components, ductwork connections/routing, and relationship to adjacent structural features.

HVAC CONTROL DRAWINGS

Simplified, one-line type control schematics with anticipated sequence of operation should be provided for all air handling unit systems.

11.23.1.2 GUIDE SPECIFICATIONS

No guide specifications are required to be edited and submitted at this design stage, but a listing of the guide specifications intended for editing should be included as part of the Design Analysis.

11.23.1.3 DESIGN ANALYSIS NARRATIVE

The narrative portion of the Design Analysis should contain a narrative description and analysis for each of the mechanical portions of the design. The basis and reasons for specific engineering decisions, special features, unusual requirements, etc., should be explained or summarized as applicable. If it is necessary to deviate from criteria or standard practice, reasons should also be included. Design statements should be provided in sufficient detail to enable the reviewer to get a clear picture and understanding of all included work so that approval will be granted. Narrative should be complete relative to scope and intended design approaches.

The total scope projected to final design should be outlined in a form that will be conveniently adapted, expanded, and detailed at the final design stage. If alternatives were to be evaluated and selected by the designer, conclusions should be included; if final decisions were to be deferred to future conferences or reviews, report the findings (pros and cons) of the evaluation.

The Design Analysis should carry a complete narrative for every item and system covered in the design, and will include, but not be limited to, the following:

- Index: Provide a Design Analysis index identifying all main and sub-paragraph headings.
- Project Summary: Provide a brief description of the mechanical design objectives.
- Applicable Criteria: A list of all applicable criteria used for basis of design.
- Guide Specifications: A list of all Guide Specifications that will be used for the Final Design of the project.
- Design Conditions: A list of Mechanical HVAC design conditions including elevation, latitude, heating/cooling degree days, winter and summer inside/outside summer design temperatures, hours of building occupation/ operation, ventilation rates, etc. should be provided.
- System Descriptions: Using the Technical Design Requirements Section as a basis, provide a complete description of all building systems; include the designer's reasons for selecting specific materials, systems, etc. in which the reason for selection is not obvious. Document the decision of which systems will be included in the life cycle cost analysis.
- Zone HVAC System Descriptions: A complete description of all building Zone HVAC systems should be provided.

11.23.1.4 DESIGN ANALYSIS CALCULATIONS

The Design Analysis calculations should provide an estimate of the heating and cooling loads and a preliminary selection of the type and size of all equipment located in the mechanical room. A minimum of two, preferably three manufacturers should be selected to determine the maximum size and weight of each item of mechanical equipment. Mechanical equipment rooms should be laid out to accommodate the largest of the manufacturer's available equipment. A Design Analysis index identifying all calculation items should be provided. In addition, a list of Mechanical HVAC design conditions including elevation, latitude, heating/cooling degree days, winter and summer inside/outside summer design temperatures, hours of building occupation/ operation, ventilation rates, etc. should be provided.

11.23.2 CONCEPT DESIGN – 35%

This section contains instructions and requirements for the following Concept Design submittal requirements:

- Design Drawings
- Guide Specifications
- Design Analysis Narrative
- Design Analysis Calculations

Compliance with the design requirements for the building mechanical systems will be determined by a review of the submitted drawings and Design Analysis. All conflicts, lack of specific criteria, and/or direction, inconsistencies, ambiguities, and lack of thorough understanding of the nature and scope of work should be identified or resolved prior to submittal of the next design phase.

11.23.2.1 DESIGN DRAWINGS

Design drawings should be fully coordinated with the Design Analysis. Provide sufficient plans, mechanical room sections, HVAC control diagrams, sequence of operational control description, etc., as necessary to define the required design intent.

Large-scale plans of congested areas should be provided. Floor plans should use the architectural floor plans as a basis, with the building outline half-toned. Unless otherwise indicated, all floor plans should be drawn at a minimum 50 scale and should show room names and numbers. Sheet reference number sequencing should be in accordance with the CADD Standards identified.

The following design drawings should be included in the Early Preliminary Design submittal:

EXTERIOR UTILITY DRAWINGS

The following exterior utility drawings should be provided:

- Removal Plan: All existing exterior mechanical utilities and utilities which are to be removed should be indicated on the Site Removal Plan located in the civil section of the drawing package.

- Utility Plan: All existing and new mechanical utilities including main fuel piping runs and fuel piping problem areas should be indicated on the Site Composite Utilities Plan located in the civil section of the drawing package. The location of existing exterior utilities should be thoroughly checked and indicated on plans and profiles, thus preventing interference with new services. The utility drawing should indicate all new utilities, including tie-in points, and existing utilities, which are to be abandoned.

REMOVAL PLANS

Any removal drawings required for the rehabilitation or modification of the existing facilities should be provided.

PLUMBING DRAWINGS

The following plumbing drawings should be provided:

- Composite Plumbing Plan: For reference, a composite plumbing plan should be provided showing the entire facility and all plumbing systems on one sheet. Building outline, electrical equipment, and pertinent HVAC equipment should be half-toned with plumbing system at standard line weight. No construction notes should be provided on the plan. A key plan and room schedule legend should also be included on the composite plumbing plan sheet.
- Plumbing Plans: Plumbing plans showing the design and tentative layout of the domestic hot and cold water distribution systems; make-up water piping; soil, waste and vent piping; and storm water drainage system should be provided. Plans should show all anticipated routing of piping systems from the connections within the structure to a point 1.5 m outside the structure. The grade of all drain lines should be calculated and invert elevations established. All electrical panels/equipment and pertinent HVAC equipment (expansion tanks, boilers, AHU's, pumps, lawn sprinkler system, etc.) should be outlined in half-tone on the plumbing plans. Plans may combine building areas and be drawn at 100 scale as long as legibility is not compromised.

MECHANICAL HVAC DRAWINGS

Show on mechanical HVAC drawings, all items of mechanical equipment, including boiler room equipment, HVAC equipment layout, air handling units, air distribution and exhaust systems, etc., to determine proper space allocation within the intent of the architectural layout requirements. Plans, elevations, and sections should be developed sufficiently to insure that major equipment items, piping, and ductwork cause no interference with structural members, electrical equipment, etc. The following HVAC drawings should be provided:

- Composite Mechanical HVAC Plan: For reference, a composite mechanical HVAC plan should be provided showing the entire facility and all associated mechanical systems on one sheet. Building outline and electrical equipment should be half-toned with mechanical systems at standard line weight. No construction notes should be provided on the plan. A key plan and room

schedule legend should also be included on the composite mechanical plan sheet.

- Mechanical HVAC Plans: Mechanical HVAC plans showing the design and tentative layout of the hot water piping distribution system and equipment, the air supply and distribution systems, and the ventilation and exhaust systems should be provided. All main supply and return air ductwork should be shown as double-lined, other ducts may be single-lined. Air supply and distribution systems should include VAV box locations. The location of all ceiling diffusers, grilles, and registers should be shown. All electrical panels/equipment and pertinent plumbing equipment should be outlined in half-tone on the HVAC plans. Mechanical plans should be drawn at 50 scale.
- Enlarged Mechanical Room Plan: An enlarged mechanical room plan showing all mechanical and plumbing systems and drawn at a minimum 50 scale should be provided. Plans should show layout of all equipment, piping, and ducts located within the rooms. Mechanical equipment should include (but not limited to) air handling units with outside air intakes, relief air, and associated supply/return ducts, CW pumps, exhaust/supply fans, mechanical and boiler room ventilation intake/relief openings, gas service entrance, combustion air opening, unit heaters, HW pumps, boilers, expansion tanks, and HVAC control panels. Plans should show dedicated access space for items requiring maintenance. Plumbing equipment should include the water service entrance, fire protection entrance and risers, lawn sprinkler apparatus, and any electrical equipment or panels located in the room. In addition, all electrical panels and equipment located in the room should be outlined in half-tone.
- Mechanical Room Sections: For each air handling unit within the mechanical room, a mechanical room section view should be provided showing, but not limited to, all AHU components, ductwork connections/routing, and relationship to adjacent structural features.
- Chilled Water System Flow Diagram: Provide flow diagram showing connections to the existing chilled water system, the piping layout to the facility, and the facility piping system including the pumps and connected CW equipment. Each pump and equipment item should show associated GPM flowrate. All isolation and control valves, bypass piping, etc. should be shown.
- Airflow Diagrams: Airflow diagrams should be provided for each Air Handling Unit system showing airflow quantities for outside air, return air, and supply air. Supply-air side of each diagram should be broken down into zones, with each zones supply, return, and relief/exhaust airflow quantities identified.
- Mechanical Detail Sheets: Mechanical details should be provided for each item of mechanical equipment. Furnished generic details should be used whenever possible and should be completed and/or revised as necessary to suit the project requirements. Any new details should be drawn at a minimum scale of 20.
- Mechanical Schedule Sheets: Schedules, with preliminary capacities, should be provided for each item of mechanical equipment. Furnished typical equipment

schedules should be used wherever possible and should be completed and/or revised as necessary to suit the project requirements.

HVAC CONTROL DRAWINGS

Simplified, one-line type control schematics with detailed sequence of operation should be provided for all mechanical equipment and systems. Sequence of operation for each item of equipment and system should be subsectioned into paragraphs describing discreet operational requirements.

11.23.2.2 GUIDE SPECIFICATIONS

No guide specifications are required to be edited and submitted at this design stage, but a listing of the guide specifications intended for editing should be included as part of the Design Analysis.

11.23.2.3 DESIGN ANALYSIS

NARRATIVE

The narrative portion of the Design Analysis should contain a narrative description and analysis for each of the mechanical portions of the design. The basis and reasons for specific engineering decisions, special features, unusual requirements, etc., should be explained or summarized as applicable. If it is necessary to deviate from criteria or standard practice, reasons should also be included. Design statements should be provided in sufficient detail to enable the reviewer to get a clear picture and understanding of all included work so that approval will be granted.

Narrative should be complete relative to scope and intended design approaches. The total scope projected to final design should be outlined in a form that will be conveniently adapted, expanded, and detailed at the final design stage. If alternatives were to be evaluated and selected by the designer, conclusions should be included; if final decisions were to be deferred to future conferences or reviews, report the findings (pros and cons) of the evaluation.

The Design Analysis should carry a complete narrative for every item and system covered in the design, and will include, but not be limited to, the following:

- Index: Provide a Design Analysis index identifying all main and sub-paragraph headings.
- Project Summary: Provide a brief description of the mechanical design objectives.
- Applicable Criteria: A list of all applicable criteria used for basis of design.
- Guide Specifications: A list of all Guide Specifications that will be used for the Final design of the project.
- Design Conditions: A list of Mechanical HVAC design conditions including elevation, latitude, heating/cooling degree days, winter and summer inside/outside summer design temperatures, hours of building occupation/ operation, ventilation rates, etc. should be provided.
- System Descriptions: Using the Technical Design Requirements Section as a basis, provide a complete description of all building systems; include the

designer's reasons for selecting specific materials, systems, etc. in which the reason for selection is not obvious. Provide executive summary of life cycle cost analysis outcome.

- Zone HVAC System Descriptions: A complete description of all building Zone HVAC systems.

CALCULATIONS

The Design Analysis calculations should provide an estimate of the heating and cooling loads and a preliminary selection of the type and size of mechanical equipment. A minimum of two, preferably three manufacturers should be selected to determine the maximum size and weight of mechanical equipment. Mechanical equipment rooms should be laid out to accommodate the largest of the manufacturer’s available equipment.

Design calculations should be given in sufficient detail to enable the reviewer to get a clear picture and understanding of all included work to allow approval. Backup data should be furnished to support basic design decisions related to sizing of major equipment and materials, performance of specific systems or equipment. Manufacturer's catalog data sheets should be provided for each item of equipment and should be labeled to match the mechanical equipment schedules identification type. Calculations may be performed by manual or computerized procedures. Use of standardized charts, curves, tables, graphs will generally be acceptable for portions of required calculations or in lieu of specific calculation procedures. Such data must be from a recognized source, which is identified in the Design Analysis. If possible, a copy of applicable sheets or pages should be included with the calculations.

Preliminary design calculations and computations should be provided for all systems. The following should be included:

- Index: Provide a Design Analysis index identifying all calculation items.
- Design Conditions: A list of Mechanical HVAC design conditions including elevation, latitude, heating/cooling degree days, winter and summer inside/outside summer design temperatures, hours of building occupation/ operation, ventilation rates, etc. should be provided.
- Area Air-Conditioning Loads: Preliminary cooling calculations should be prepared using the Cooling Load Temperature Differential/Cooling Load Factors (CLTD/CLF) Method as described in the ASHRAE Handbook Fundamentals.
- Block Air-Conditioning Loads: Preliminary block cooling load calculations, each encompassing all areas served by an air handling unit, should be prepared using the CLTD/CLF Method. Separate block load calculations should be provided for each of the air handling units, including the outside-air handling unit. The calculated size of equipment and distribution system may be increased by up to 10 percent to compensate for morning recovery due to night set forward or by up to 10 percent to compensate for unanticipated loads or changes in space usage; however, size of equipment and distribution system will not be increased by more than 15 percent total.

- Psychometric Charts: A psychometric plot, corrected for site elevation, should be provided for each of the air handling units. All points in the conditioning process (outside air, return air, mixed air, coil leaving condition, and fan temperature rise) should be clearly identified on the psychometric chart and verification of both sensible, latent, and total capacity should be shown using the appropriate data from the chart.
- Life Cycle Cost Analysis including first cost estimates, annual energy costs assumption, annual maintenance cost assumptions, and BLCC reports.
- Air Handling Unit Selections
- Chiller Plant Sizing Summary & Selections
- Chilled & Hot Water Pump Selections
- Heating and Cooling Load Calculations based on primary systems and zones
- Building Envelope U-Factors
- Heating Plant/Boiler Sizing Summary & Selections
- Supply & Exhaust Fan Selections
- Pressure loss calculations for all air fans and hydronic pumps
- Terminal Unit Selections
- Unitary Heating/Cooling Sizing & Selections
- Combustion-Air Intake
- ASHRAE 62.1 Ventilation & Exhaust Rate Calculations
- Domestic Water Demand: Plumbing fixture determination, listing quantity and types of fixtures identified by federal or military specifications. Fixture units for drainage, venting, cold and hot water piping. Determination of number of fixtures, cold water demand, hot water demand, pipe sizing, equipment selection, etc. should be provided.
- Domestic Hot Water Demand: Unless otherwise stated in this guide, the design guidance provided for service water heating in ASHRAE Handbook HVAC Systems and Applications will be followed. Water service pipes will be sized in accordance with the IPC. Consideration will be given to increasing pipe sizes based on the anticipated future installation of fixtures when performing design calculations.
- Roof Drainage System: Roof areas used in determining storm drainage pipe sizes and sizing of pipes should be provided.
- Hydrant Fueling Systems: 90% completed surge analysis, 90% completed piping stress analysis

11.23.3 INTERMEDIATE DESIGN – 65%

The purpose of the Intermediate Design phase is to validate that the design is being developed in accordance with the approved design criteria and is meeting the Stakeholder's expectations. The A-E must be thoroughly familiar with the approved design development document information prior to the start of this stage. This stage of design development should also verify the progress of the contract drawings, review general technical competency, and assure compliance with the Japan District's design standards. The Intermediate Design should include the requirements listed for the

previous stages of design. The Intermediate Design should incorporate specific criteria furnished and all previously concurred DrChecks review comments.

11.23.4 FINAL DESIGN – 100%

This section contains instructions and requirements for the following final design submittal requirements:

- Design Drawings
- Guide Specifications
- Design Analysis Narrative
- Design Analysis Calculations

The final design submittal should include all the information presented in the previous submittals, updated to 100% design status, and corrected to reflect changes made in response to review comments. Compliance with the design requirements for the building mechanical systems will be determined by a review of the submitted Design Analysis, drawings, and specifications. All conflicts, lack of specific criteria, and/or direction, inconsistencies, ambiguities, and lack of thorough understanding of the nature and scope of work should be resolved prior to starting this final design stage.

11.23.4.1 DESIGN DRAWINGS

Final design drawings should be fully coordinated with the Design Analysis and specifications. Provide sufficient plans, piping diagrams and isometrics, mechanical room sections, water and air flow diagrams, details, schedules, control diagrams, sequence of control operation description, etc., as necessary to define the required design intent. Large-scale plans of congested areas should be provided. Coordinate with architectural design for provision of access panels for all concealed valves, traps and air vents, etc. Floor plans should use the architectural floor plans as a basis, with the building outline half-toned. Unless otherwise indicated, all floor plans should be drawn at a minimum 50 scale and should show room names and numbers. Sheet reference number sequencing should be in accordance with the CADD Standards identified.

The final design drawings should include all the drawings submitted at the Concept and Intermediate design stage, updated to 100% design status. In addition, the following drawings should be provided:

MECHANICAL ABBREVIATION, LEGEND, AND GENERAL NOTES SHEET

This sheet should include all mechanical abbreviations and symbols that will be used on the drawings. Symbols should be grouped into sections; as a minimum, Plumbing, Heating, Chilled Water, Miscellaneous Piping, Valves and Fittings, and Air Conditioning sections should be provided. Include any mechanical general installation notes that may be required to clarify the construction intent that may not be readily apparent in the specifications or on the drawings. General notes may be provided on a separate sheet if space does not exist on the Abbreviation and Legend sheet.

PLUMBING DRAWINGS

The following plumbing drawings should be provided:

- Composite Plumbing Plan: For reference, a composite plumbing plan should be provided showing the entire facility and all plumbing systems on one sheet. Building outline, electrical equipment, and pertinent HVAC equipment should be half-toned with plumbing system at standard line weight. No construction notes should be provided on the plan. A key plan and room schedule legend should also be included on the composite plumbing plan sheet.
- Enlarged Toilet Room Plans: Enlarged toilet room plans showing all fixtures, water, waste, and vent piping should be provided for each toilet area. Enlarged plans should be drawn at a minimum 50 scale.
- Plumbing Riser Diagrams: Plumbing water and Waste/Vent riser diagrams should be provided for each toilet area. Riser diagrams are recommended to be located on the same sheet as the respective enlarged toilet room plans.
- Plumbing Detail and Schedule Sheet: The following details should be provided; roof/overflow drains, electric water heater, and water service entrance. The provided plumbing fixture schedule and a contractor generated electric water heater schedule should be provided.
- Enlarged Mechanical Room Plumbing Plan: An enlarged mechanical room plumbing plan drawn at a minimum 50 scale should be provided. Plan should show layout of all equipment and piping within the rooms. In addition to all the plumbing systems required, the plan should show half- toned outlines of all HVAC equipment located in the room, gas service and chilled water entrances, lawn sprinkler apparatus, and the outline of any electrical panels or equipment located in the room.

MECHANICAL HVAC DRAWINGS

Show on mechanical HVAC drawings, all items of mechanical equipment, including boiler room equipment, HVAC equipment layout, air handling units, air distribution and exhaust systems, etc., to determine proper space allocation within the intent of the architectural layout requirements. Plans, elevations, and sections should be developed sufficiently to insure that major equipment items, piping, and ductwork cause no interference with structural members, electrical equipment, etc. The following HVAC drawings should be provided:

- Hot Water System Flow Diagram: Provide a hot water flow diagram showing the primary and secondary piping systems; including the boiler, pumps, and connected HW equipment. Each equipment item should show associated flowrate.
- Chilled Water System Flow Diagram: Provide flow diagram showing connections to the existing chilled water system, the piping layout to the facility, and the facility piping system including the pumps and connected CW equipment. Each pump and equipment item should show associated flowrate. All isolation and control valves, bypass piping, etc. should be shown.
- Airflow Diagrams: Airflow diagrams should be provided for each Air Handling Unit system showing airflow quantities for outside air, return air, and supply air.

Supply-air side of each diagram should be broken down into zones, with each zones supply, return, and relief/exhaust airflow quantities identified.

- Mechanical Schedule Sheets: Schedules should be provided for each item of mechanical equipment. Furnished generic equipment schedules should be used wherever possible and should be completed and/or revised as necessary to suit the project requirements.
- Mechanical Room 3D Sheets: Each Mechanical room should be shown in 3D perspective. The current state of BIM technology allows for ease of creation of 3D views that can convey greater detail than 2D plan or section views. Provide 3D perspective view of each mechanical room that supplements the plan and section views in showing equipment layout, ductwork and piping layout and configuration.

HVAC CONTROL DRAWINGS

In accordance with the Technical Design Requirements, detailed HVAC system sequence of control, schematics, diagrams, and point lists are required for all mechanical systems.

11.23.4.2 GUIDE SPECIFICATIONS

The guide specifications should be fully edited and coordinated with the drawings and Design Analysis to identify the product and installation requirements of the facility.

Materials, items of equipment, or installation requirements identified in the provided specifications but not required for the facility should be marked for deletion. Where materials, items of equipment, or installation requirements are not covered in the provided specifications; special sections within each guide specification should be prepared to cover those subjects. Specifications should be prepared in accordance with Chapter 18: Specifications of this Design Guide.

11.23.4.3 DESIGN ANALYSIS NARRATIVE AND CALCULATIONS

The final Design Analysis Narrative and Calculations should include the basic information presented in the previous submittals and should be corrected to reflect changes in content made in response to review comments. The text and content of the previous narrative and calculations should be expanded to reflect the completed design.

BASIS OF DESIGN MECHANICAL EQUIPMENT DATA SHEETS

For each specific mechanical equipment listed on the mechanical schedules provide computer generated original equipment manufacturer basis of design performance selections which clearly indicates make, model, and operating performance parameters that are project specific and match the mechanical schedules. Performance data should be in metric. Generic manufacturer's catalog cut sheets are not acceptable for the final submittal with the exception of Japanese based manufacturers. When Japanese manufacturers are the primary Basis of Design and computer generated performance data cannot be obtained, the data sheets should clearly identify the unit model, performance parameters, and physical size.

11.24 COMMON DEFICIENCIES

The requirements stated below have been repeatedly overlooked in the past. Carefully compare the mechanical design and contract documents with these requirements throughout the design process to.

11.24.1 GENERAL

- Not using correct abbreviations, terminology, or symbols on the drawings. Abbreviations & symbols must match what is used on the standard abbreviation sheet and terminology must match what is used in the standard guide specifications.
- Not using the correct scales, north arrow designation, section cut system, or incomplete dimensioning on the drawings.
- Specifications not tailored to be project specific.

11.24.2 DESIGN ANALYSIS

- Inadequate cooling/heating load calculations.
- Inadequate supporting calculations for the design & equipment selection.
- Inadequate supporting basis of design equipment selection data sheets.

11.24.3 DRAWINGS

- Equipment schedules not completed and/or inconsistent data where equipment cannot be properly selected/sized.
- Drawing scale is too small to completely show plan details
- Drawings contain unnecessary reference drawings such as reflected ceiling grids.
- Incomplete/Missing Control Sequences of Operation, Schematics, & Points Lists.

11.24.4 SPECIFICATIONS

- Specification not completely edited and not coordinated with the drawings
- Specific manufacturer names and model numbers should not be specified on the drawings.
- Specification sections not applicable to the project and/or missing spec sections.

11.25 SEISMIC DESIGN REQUIREMENTS (OF HVAC SYSTEMS)

- The following provides information on the fundamentals on the subject, and highlights various frequently overlooked aspects. *(Code and criteria references are included in parenthesis.)*
- <u>Acceptable Alternatives:</u>
  - Japanese components and technical criteria shall meet the functional intent of ASCE 7-10, and UFC 3-310-01. DoR shall identify all Acceptable Alternatives in the Design Analysis.
- <u>Designated Seismic Systems:</u>

- Key information for Designated Seismic Systems can be found in ASCE 7, 13.1.3 and UFC 3-310-04, 2-13.6.10.3.
- Mechanical designated seismic systems are not typically part of Risk Categories I, II, and III structures.
    - Specify component certification per ASCE 7, 13.2.2, and UFC 3-301-01, 3-6.2-13.2.2.1.
    - Specify name plate per UFC 3-301-01, 3-6.2 -13.2.2.2. Locate name plate on or adjacent to equipment.
    - Identify designated seismic systems in the 01 45 35, Statement of Special Inspections.
    - Japanese component meets intent of ASCE 7-10, and UFC 3-310-01. If component is a designated seismic system provide name plate, and special inspection.
    - Japanese component meets intent of ASCE 7-10, and UFC 3-310-01. If component is a designated seismic system provide name plate, and special inspection.
-
- For mechanical equipment, components and systems in Risk Category I, II, III and IV structures, two separate lists of nonstructural systems/components must be provided:
- 1) components/systems with an Ip = 1.0
- 2) components/systems with Ip = 1.5
-
- Special Inspections are required for Designated Seismic Systems (IBC 2018, 1705.12.4)
    - Identify Designated Seismic Systems in the 01 45 35 Statement of Special Inspections. Identify corresponding Special Inspection in the 01 45 35 Schedule of Special Inspections.
- <u>Common Mechanical General Notes (DoR to edit, per project requirements):</u>
    - Brace all components weighing 20 lbs. (9 kg) and greater. *(ASCE 7, 13.1.4)*
    - Install 1-nut top and bottom at each threaded rod for suspended equipment. *(UFC 3-301-01, B-3.2.3)*
    - Provide enough space between wall and component to install cabling. 45 + 15 degrees. *(UFC 3-301-01, B-3.2.3)*
    - Brace rectangular air handling ducts with a cross sectional area greater than 6 sf. *(ASCE 7, 13.6.7 and 26 05 48.19, 1.2.5.2)*
    - Brace all round air handling ducts greater than 28 in. *(ASCE 7, 13.6.7 and 26 05 48.19, 1.2.5.2)*
    - Hangers must be positively attached to the duct within 2 in. (50 mm) of the top of duct with a minimum of two #10 sheet metal screws. *(SMACNA Seismic Restraint Manual and 23 05 48.19, 3.7.2)*

- Attach two 12 GA. Hanger wires at diagonal corners of 24 in. x 24 in. diffuser *(SMACNA Seismic Restraint, Fig. 10-14 or ASCE 7-10, 13.6.7, ASTM E580)*
- Positively attach dampers to wall with approved seismic rated anchor. *(ASCE 7, 13.6.7)*
- Components mounted on vibration isolators shall have bumper restraint or snubbers in each horizontal direction. *(ASCE 7, 13.6.5.5).*
- C-type beam and large flange clips are permitted for hangers provided they are equipped with restraining strap. *(ASCE 7, 13.4.6)*
- If post-installed anchors are installed for non-vibration isolated equipment, anchors shall be qualified in accordance with ACI 355.2. *(ASCE 7, 13.6.5.5)*
- Floor or pad mounted mission critical equipment in Risk category IV buildings SDC = E should use cast in place anchor bolts to anchor them. Alternatively, post-installed anchors shall be permitted to be used provided they are qualified per ACI 355.2. For this equipment, two nuts should be provided on each bolt and anchor bolts should conform to ASTM F1554-07 ae1 (*UFC 3-301-01, B-3.2.2)*
- Brace components weighing 400 lbs. and have a center of mass located 4 ft. (1.22m) or less above the adjacent floor level *(ASCE 7-10, 13.1.4, 6., c., i.)*

- <u>Other:</u>
  - When developing design for suspended equipment consider interaction between electrical and mechanical components. *(ASCE 7, 13.6.1)*
  - The Design of Record shall provide bracing details for mechanical system components.
  - The DoR shall provide details of ducts passing through seismic/isolation joints.

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CHAPTER 12 - PIPING/PLUMBING

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

12.1 GENERAL

The design of all plumbing systems should meet the instructions and requirements contained herein, the other government furnished criteria, and the requirements of the Unified Facilities Guide Specifications. Where conflicts between the above documents exist, these instructions should take precedence.

Plumbing designs should be economical, maintainable, sustainable, and energy conserving with full consideration given to the functional requirements and planned life of the facility. Plumbing design should also consider life cycle operability, maintenance and repair of the facility and real property installed equipment components and systems.

12.2 DESIGN CRITERIA

The design publications listed below should be used as sources of criteria for plumbing design. The criteria from these sources may be supplemented, but not supplanted, by applicable criteria contained in nationally recognized codes, standards, and specifications.

Many of the referenced government engineer publications can be found in the Whole Building Design Guide at http://www.wbdg.org.

12.3 GENERAL PIPING REQUIREMENTS

As applicable, the following should be provided for all piping systems:

- All piping and equipment located in finished areas of the building should be concealed or furred-in; exposed piping and equipment is allowed in utility, equipment, storage, boiler, and other rooms of this nature.
- All pumps, regardless of service, should be non-overloading allowing the pump to operate at any point on its characteristic curve.
- Provide vent and drain valves with hose-end connections on all piping systems. Air vents should be installed on all high points in piping systems. Drain valves should be installed at low points and at equipment, which must be dismantled for servicing.
- Pipe taps, suitable for use with either a 6 mm (1/8 in) OD temperature or pressure probe, should be located at each pressure gauge, thermometer, pressure sensor and temperature sensor.

- Provide isolation valves, balancing valve, flow measuring device, and pressure/temperature test ports at all heating and/or cooling terminal units.
- All coils should be provided with valved drain and air vent connections.
- On air handling units with multiple coils, isolation valves should be installed on the supply piping and a balancing valve on the return piping of each coil. A thermometer should be installed on the supply piping of each coil. Pressure / temperature test ports should be provided on the supply and return piping of each coil.
- Strainers should be provided with a valved blowdown connection and, where indicated, piped to a floor drain.
- Water and natural gas service lines should be metered where they enter the building.
- All underground metallic lines, fittings, and valves; except for cast- iron soil and storm drain piping systems, should be cathodically protected in accordance with Electrical Section paragraph entitled "Cathodic Protection".
- All exterior, underground non-metallic piping should be buried with locator wire and pipe detection tape.
- All pipe, ductwork, and equipment supports and hangers should be coordinated with the roof design to avoid overloading of any of the structural elements.

12.4 IDENTIFICATION OF PIPING

All exposed or concealed piping in accessible spaces should be identified with color coded bands and titles in accordance with American National Standards Institute (ANSI) Standard A13.1, Scheme for Identification of Piping Systems.

12.5 FIRE PROTECTION IN BUILDINGS

All water pipes for fire protection systems will be designed under the provisions of the applicable NFPA Chapters. [To avoid conflict with NFPA recommendations, the criteria in the following paragraphs are not applicable to piping expressly designed for fire protection.]

12.6 PLUMBING SYSTEMS

The plumbing system consists of the water supply distribution system; fixtures, and fixture traps; soil, waste, and vent piping; storm water drainage; acid and industrial waste disposal systems. The plumbing system extends from connections within the facility to a point 1.5 m (5 ft) outside the facility. The design of the plumbing system will comply with the most current edition of the International Plumbing Code (IPC) and UFC 3-420-01 Plumbing Systems unless otherwise stated. All plumbing products should be lead free meeting the safe drinking water requirements of ANSI/NSF 61 Section 9.

12.6.1 PIPE MATERIALS

Pipe materials for the domestic water system should be specified as nonferrous.

12.6.2 WATER SERVICE

Underground water pipes will be installed below the recognized frost line. Service lines will enter the building in an accessible location and when entering through the floor, a displacement type water entrance should be provided. When the incoming pressure of water supply exceeds the water pressure necessary for proper building operation by 0.7MPa (10 psig), a pressure reducing valve will be provided. Water meters are required for all domestic water service lines and should be located in the facility Mechanical Room. Meters may be installed at alternate locations in the facility if locating the meter in the Mechanical Room is not practical.

12.6.3 PIPING RUNS

Piping runs will be arranged to minimize interference with ordinary movement of personnel and equipment. The water supply piping will be distributed throughout the building, with mains generally running above the ceiling of the lowest floor. Neither water nor drainage piping will be located over electrical wiring or equipment unless adequate protection against water (including condensation) damage has been provided. Insulation alone is not adequate protection against condensation. Water and waste piping will not be located in exterior walls, attics, or other spaces where there is danger of freezing. Where piping is to be concealed in wall spaces or pipe chases, such spaces should be checked to ensure that clearances are adequate to properly accommodate the piping. Water piping should be designed for a maximum velocity of 2.5 m/s (8 ft/s) at full flow.

12.6.4 PROTECTION OF WATER SUPPLIES

Cross connections between water supply piping and waste, drain, vent, or sewer piping are prohibited. Piping will be designed so that a negative pressure in the water supply pipe and a stopped-up waste, drain, vent, or sewer pipe will not cause backflow of waste water into the water supply piping. Backflow prevention should be provided in accordance with the latest version of the IPC. (Single check valves are not considered adequate protection against back flow.)

12.6.5 BACK-SIPHONAGE

The supply outlet connection to each fixture or appliance that is subject to back-siphonage of non-potable liquids, solids, or gases will be protected in accordance with the IPC. Air gaps will conform to the IPC. Double check valve assemblies, reduced pressure principle assemblies, atmospheric (non-pressure) type vacuum breakers, and pressure type vacuum breakers will be tested, approved, and listed by the Foundation for Cross-Connection Control & Hydraulic Research. Pipe-applied atmospheric type vacuum breakers, hose connection vacuum breakers, and backflow preventers with intermediate atmospheric vent will be in accordance with American Society of Sanitary Engineering (ASSE) Standards 1001, 1011, and 1012.

12.6.6 SERVICE STOP VALVES

Servicing stop valves should be installed in all water connections to all installed equipment items, as necessary for normal maintenance or replacement, and should be shown on the drawings, except when called for in the project specifications.

12.6.7 FIXTURES

All plumbing fixtures, including but not limited to water closet, lavatory, shower, kitchen sink, service sink should be low flow water conserving fixture to meet UFC 1-200-02.

The maximum water flow values are 20% less than those in the International Plumbing Code (IPC) as required to comply with DoD mandates for water conservation identified in UFC 3-420-01.

12.6.8 WATER HAMMER ARRESTERS

Commercially available water hammer arresters should be provided at all quick closing vales such as solenoid valves and will be installed according to manufacturer recommendations. Vertical capped pipe columns are not permitted. Water hammer arrestors are not classified "A" thru "C" like on US products. Add drawing note "Size and install per manufacturer's instructions" as fixture units for calculation used per manufacturer can differ.

12.6.9 WATER COOLERS

Electric, refrigerated water coolers should be used for all drinking water requirements, except in hazardous areas per N.E.C. Article 500. Refrigerant R-12 should not be allowed.

12.6.10 WALL HYDRANTS

Freeze-proof wall hydrants with vacuum- breaker-backflow-preventer should be located on outside walls so that, with no more than 30 m (100 ft) of garden hose, the entire perimeter of a facility can be watered without crossing main building entrances.

12.6.11 EMERGENCY SHOWER AND EYEWASH

Emergency showers and eyewash should be provided where hazardous materials are stored or used or as required by the Stakeholder and should be installed in accordance with ANSI Standard Z385.1 In accordance with ANSI Standard Z385.1, a heated water system should provide tepid water (15.5 to 38°C (60 to 100°F)) for a 15 minute duration at the flow rate required by the installed shower/eyewash. Water temperature should be maintained by a thermostatically controlled mixing valve designed for this application.

12.6.12 LAUNDRY TRAYS

US style laundry trays are not available in Japan. If required this product will either be purchased from the US or specify another type of sink.

12.6.13 MOP SINKS

Floor mounted mop sinks are not available in Japan. If required this product will either be purchased from the US or the architect should provide a cast in place concrete sink. Otherwise a standard service sink may be used.

12.6.14 DOMESTIC HOT-WATER

Domestic water heating energy source should be selected by the designer. Use of electricity will be avoided if possible. Electricity is allowable for point-of-use water

heaters only. Domestic hot-water design temperatures should be 43°C (110°F) for distribution. Domestic hot water should be stored at 60°C (140°F).

12.6.15 CIRCULATING PUMPS

Criteria determining the need for circulating pumps in ASHRAE HANDBOOK-HVAC Applications will be followed. Pump sizing will also be in accordance with simplified method in ASHRAE unless specific conditions warrant the need for more detailed calculations. In facilities operated on a nominal 40-hour week or on a nominal two-shift basis (either a 5- or a 7-day week), a clock or automatic control by the facility HVAC control system will be installed on domestic hot-water circulating pumps to permit operation only during periods of occupancy plus 30 minutes before and after.

12.6.16 FLOOR DRAINS

Floor drains should be provided in toilet rooms with three or more water closets. Provide floor drains in shower drying areas serving two or more showers. In utility and boiler rooms, provide enough floor drains to avoid running equipment drain pipes above the floor.

12.6.17 ACID WASTE SYSTEMS

The selection of pipe and fitting materials for acid waste and vent applications will be based upon the type, concentration, and temperature of acid waste to be handled. Acid neutralization tanks should be provided for all acid waste drainage systems.

12.6.18 VENTS

Where feasible, provide circuit vents in a concealed space to a main vent through the roof in lieu of an excessive number of individual vents through the roof. Waste and vent piping should be concealed unless otherwise specifically instructed.

12.6.19 STORM DRAINAGE

Storm drainage will include roof drains, leaders, and conductors within the building and to a point 1.5 m (5 ft.) outside the building. Roof drainage systems will be designed in accordance with rainfall intensity-frequency data in the IPC.

12.7 SEISMIC DESIGN REQUIREMENTS (OF PLUMBING SYSTEMS)

The following provides information on the fundamentals on the subject, and highlights various frequently overlooked aspects. *(Code and criteria references are included in parenthesis.)*

- Piping not detailed to accommodate the seismic relative displacement at connections to other components shall be provided with connections having sufficient flexibility to avoid failure of the connection between components. *(ASCE 7-10, 13.6.8).*
- Utility and service lines, at the interface of adjacent structures or portions of the same structure that move independently, utility line shall be provided with adequate flexibility to accommodate the anticipated

differential movement between the portions that move independently. *(ASCE 7-10, 13.6.6)*

- When pipes enter a building, flexible couplings should be provided to allow for movement between the soil and building. *(UFC 3-301-01, B-3.2.4.1)*
- For Seismic Design Categories D, E, or F where Ip = 1.0, the nominal pipe size shall be 3 in. (80mm) or more (ASCE 7-10, 13.6.8.3). Analyze pipe for bracing requirements.
- For Seismic Design Categories D, E, or F and the Ip is greater than 1.0 the nominal pipe size shall be 1 in. (25 mm) or less (ASCE 7-10, 13.6.8.3, b. Analyze pipe for bracing requirements
- Trapeze assemblies are used to support piping whereby no single pipe exceeds the limits set forth in 3a, 3b, or 3c below and the total weight of the piing supported by the trapeze assemblies is less than 10 lb/ft (146 N/m)
- Provide flexible couplings at the bottom of all pipe risers for pipe 3 in. or greater (23 05 48.19, 3.3.1)

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CHAPTER 13 - ELECTRICAL

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

13.1 GENERAL

This chapter covers instructions for the preparation of drawings, specifications and design analysis as related to power, lighting, cathodic protection, and electronic systems as well as energy conservation features. Fire alarm system connections are covered in the chapter on Fire Protection.

13.2 DESIGN CRITERIA

Government design and contracting activities are controlled by Federal Acquisition Regulations (FARS). The details of the electrical design should conform to the electrical portions of applicable military design and construction manuals and supplementary criteria documents as listed in the following paragraphs. The Japan District Design Guide should serve as the basic criteria document for electrical design of Corps of Engineers projects.

Whenever reference is made in this chapter to any publication, standard or code, or paragraph therein, the issue/version of publication indicated in the AE contract should be used unless direction is provided to the contrary. If dates are not indicated in the AE contract or in the absence or other direction, the issue/version of publication in effect at the time the design was started should be used. Many military publications are available electronically at http://www.wbdg.org/ccb/ccb.php. Consult this website to ensure the latest versions are used.

UNIFIED FACILITY CRITERIA (UFC)

UFC 1-200-01	DoD Building Code (General Building Requirements)
UFC 1-200-02	High Performance and Sustainable Building Requirements
UFC 3-260-01	Airfield and Heliport Planning and Design
UFC 3-501-01	Electrical Engineering
UFC 3-510-01	Foreign Voltages and Frequencies Guide
UFC 3-520-01	Interior Electrical Systems
UFC 3-520-05	Stationary Battery Areas
UFC 3-530-01	Interior and Exterior Lighting Systems and Controls

UFC 3-535-01	Visual Air Navigation Facilities
UFC 3-540-01	Engine-Driven Generator Systems for Backup Power Applications
UFC 3-550-01	Exterior Electrical Power Distribution
UFC 3-555-01N	400 Hertz Medium Voltage Conversion/Distribution Systems
UFC 3-560-01	Electrical Safety, O&M
UFC 3-570-02A	Cathodic Protection
UFC 3-570-02N	Electrical Engineering Cathodic Protection
UFC 3-570-06	Operation and Maintenance: Cathodic Protection Systems
UFC 3-575-01	Lightning and Static Electricity Protection Systems
UFC 3-580-01	Telecommunications Interior Infrastructure Planning and Design
UFC 3-600-01	Fire Protection Engineering for Facilities
UFC 4-010-01	DoD Minimum Antiterrorism Standards for Buildings
UFC 4-010-06	Cybersecurity of Facility-Related Control Systems
UFC 4-021-01	Design and O&M: Mass Notification Systems
UFC 4-021-02	Electronic Security Systems
UFC-4-510-01	Military Medical Facilities
UFC-4-711-01	Family Housing

ARMY PUBLICATIONS

TM 5-683	Facilities Engineering Electrical Interior Facilities [AFJMAN 32-1083]
TM 5-684	Facilities Engineering Electrical Exterior Facilities [AFJMAN 32-1082]
TM 5-811-3	Electrical Design: Lightning and Static Electricity Protection [AFM 88-9, Chap 3]

POWER SYSTEMS AND EQUIPMENT

TL 1110-3-412	Transformer Application Guidance - rescinded 04 Mar 09
TL 1110-3-432	Exit Signs - rescinded 04 Mar 09
TI 811-16	Lighting Design

COMMUNICATIONS SYSTEMS AND EQUIPMENT

I3A	Technical Criteria for Installation Information Infrastructure Architecture

FIRE PROTECTION

See Chapter 11 - "FIRE PROTECTION" for criteria publications

MISCELLANEOUS

TL 1110-3-403	Electrical Power Systems for Nonlinear Loads - rescinded 04 Mar 09
TL 1110-3-465	Design and Construction of Water Meters and Appurtenances at New Army Facilities - rescinded 04 Mar 09
TL 1110-3-466	Selection and Design of Oil/Water Separators at Army Facilities - rescinded 04 Mar 09
TL 1110-3-474	Cathodic Protection - rescinded 04 Mar 09
TL 1110-9-10(FR)	Cathodic Protection Systems Using Ceramic Anodes - rescinded 04 Mar 09
TI 810-90	Elevator Systems

AIR FORCE PUBLICATIONS

POWER SYSTEMS AND EQUIPMENT

AFJMAN 32-1083	Facilities Engineering Electrical Interior Facilities [TM 5-683]
AFM 88-9, Chap. 3	Electrical Design: Lightning and Static Electricity Protection [TM 5-811-3]

MISCELLANEOUS

AFH 32-1290	Cathodic Protection Field Testing
AFI 32-1065	Grounding Systems
DCID 6/9	Director of Central Intelligence Directives

Air Force Base Area Network Functional Specification

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 189.1	Standard for the Design of High-Performance Green Buildings Except Low-Rise

ILLUMINATING SOCIETY OF NORTH AMERICA

IES	Illuminating Engineering Society: The Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

IEEE/ANSI C2	National Electrical Safety Code

IEEE 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book)
IEEE 1110	Powering and Grounding Sensitive Electronic Equipment (Emerald Book)
IEEE 466	Emergency and Standby Power for Industrial and Commercial Applications. (Orange Book)

The entire color book series.

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA 5.1	Instrumentation Symbols and Identification
ISA 5.2	Binary Logic Diagrams for Process Operations

INTERNATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS (IAEI)

IAEI	Soares Book on Grounding

INTERIM TECHNICAL GUIDANCE (ITG)

ITG 2013-01	Navy Interim Technical Guidance - Elevator Design

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 70E	(OSHA) Standard for Electrical Safety in the Workplace
NFPA 72	National Fire Alarm Code
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 101	Life Safety Code
NFPA 780	Lightning Protection Code
NFPA 170	Standard for Fire Safety Symbols

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0177	Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE RP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE RP0193	External Cathodic Protection of On-Grade Carbon Steel Storage Tank Bottoms
NACE RP0285	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
NACE RP0286	Electrical Isolation of Cathodically Protected Pipelines

MILITARY HANDBOOKS

MIL HDBK 419A	Military Handbook Grounding, Bonding and Shielding for Electronic Equipment and Facilities
MIL HDBK 1190	Military Handbook for Facility Planning and Design Guide

MISCELLANEOUS REFERENCES

AFI 32-1054	Corrosion Control
ANSI-TIA-EIA 568B	Commercial Building Telecommunications Cabling Standard
ER 1110-345-700	Design Analysis, Drawings and Specifications
ER 1110-345-100	Design Policy for Military Construction
AMCR 385-100	Army Material Command Safety Manual

CADD Electrical Lighting Details; Construction Criteria Base (CCB); NAVFAC

CADD Details at http://www.wbdg.org/ccb/browse_cat.php?o=78&c=232

https://cadlib.wes.army.mil/DetailsLibrary/

CFR 28 Part 36	Nondiscrimination on the Basis of Disability of by Public Accommodation and in Commercial Facilities, Final Edition (ABA). (In case of a conflict with NFPA 72 and/or FED-STD 795, this document takes precedence.)
CFR 49 Part 192	Transportation of Natural and other Gas by Pipeline: Minimum Federal Safety Standards
CFR 49 Part 195	Transportation of Hazardous Liquids by Pipeline
CFR 40 Part 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Fuel Storage Tanks (UST)
FED-STD-795	Uniform Federal Accessibility Standards
TIA	Telecommunication Industry Association

In addition to the codes and standards listed above, all electrical work should comply with the applicable requirements of the latest edition of the standards of the National Electrical Manufacturer's Association (NEMA); Insulated Power Cable Engineer's Association (IPCEA); and all applicable federal, state, city, and local codes, regulations, ordinances, publications and manuals. All new manufactured equipment should be listed by the Underwriter's Laboratory (UL) or a similar testing laboratory acceptable to the Corps of Engineers. When codes conflict, the more stringent standard should govern.

CODE ENFORCEMENT

In projects where the Corps of Engineers will be the code enforcing authority, project-specific or site-specific interpretations of given provisions can be made, however such variations should be consistent with Code intent or objectives and should be approved by the Contracting Officer. Variations must provide equivalent or superior safety and/or

reliability. If nongovernment facilities are involved, verify proposed arrangement with the applicable Code enforcing authority.

13.3 USE OF GOVERNMENT FURNISHED EQUIPMENT

Certain projects will require that design documents include provisions for accommodation of Government-Furnished Equipment either Government Installed (GFGI) or Contractor Installed (GFCI). If equipment is GFGI, electrical support to the designated equipment location is sufficient. If equipment is GFCI, documents need to stipulate where equipment will be located on site, identify any special transporting and installation requirements, in addition to designing the electrical support subsystem. A list of the electrical GFCI items plus special instructions needs to be given to Specifications Section for insertion in Section 00 73 00 "Special Contract Requirements" (typically paragraph "Government- Furnished Property"). Approximate value of the equipment should be noted.

If equipment is Government Furnished and will be on site for Contractor installation, feeders should be extended directly to the assembly and connected in a terminal box, wiring compartment, or control cabinet.

If the equipment will be installed later by others, extend the feeder to a junction box located adjacent to the space reserved for the particular item (tape ends of conductors or install a terminal block). Provide or verify that a disconnecting means is available within sight of the equipment location.

13.4 HARD METRIC DESIGN CONSIDERATIONS

Drawings, specification and design analysis submittals should be provided using metric units.

- Conduit and conductor sizes: All conduits, tubing, fittings and conductors should be indicated on project drawings in metric units and use Japanese industry standard sizes such as millimeters (mm) or millimeters squared (mm^2). JIS equivalent conduit and conductor sizing should be specified for all projects.
- Temperature ratings: All temperature ratings should be in degrees Celsius (°C).
- HVAC Controls: All HVAC control equipment and devices including all thermostats, meters, gauges, etc. should be shown on plans and specifications as IP units only.
- Light Fixtures: Use hard metric fixture sizes for lay-in type when using a hard metric ceiling grid. Common fixture sizes are 600 by 600 mm and 600 by 1200 mm. The hard metric fixtures are manufactured to accommodate the 609 mm (24-inch) and 1218 mm (48-inch) length tube. Because of the tube length, some metric fixtures cannot be laid out in continuous row configurations. Designer must verify restriction on metric fixture layouts with manufacturers. Caution must be used to not take an older design based on inch-pound system and merely convert to hard metric because new requirements may substantially change the lighting layout. Local Japanese light fixtures should be used to the maximum extent possible.

13.5 REHABILITATION (ADD/ALTER) WORK

13.5.1 VERIFICATION OF EXISTING CONDITIONS

A field survey should be made to obtain accurate design information. An electrical power study should be made if necessary to determine existing system loads (Estimated Maximum Demands (EMDs). As-Built plans used for design should be verified in the field. If as-built plans are inserted in contract documents to show removal or new work, the existing legend symbols, details, etc., should be revised or added to as required or directed.

Accuracy of existing drawings should be determined before beginning the design effort. Existing drawings may be included into contract documents for reference purposes ("For Information Only" drawings) if reasonably complete and accurate.

13.5.2 REUSE OF EXISTING EQUIPMENT AND MATERIALS

In the absence of specific directions for a given project, the following guidelines apply: existing wiring should be removed and not reinstalled; incandescent luminaires should be removed; fluorescent and HID fixtures, if in good condition and energy-efficient, can be removed and reinstalled after cleaning and relamping; conduit can be reused if verified suitable for use; reuse of safety switches, toggle switches, and duplex receptacles under 30 amps could be allowed at the option of the contractor, however if items have received 5 years of use it is preferred that new components be required.

13.5.3 DISPOSITION OF SALVAGE

Equipment and material that is to be removed and not reinstalled will become Contractor's property to be disposed off-site typically. Contract documents need to address disposition requirements. If particular items are to remain Government property, arrangements need to be spelled out (removal, delivery to a designated location, etc). Details should be verified with Specifications Section to ensure that drawings and specification are coordinated. Certain equipment and materials must be disposed of in accordance with specific regulations (PCB transformers, ballasts, lamps employing mercury or radioactive elements, etc).

13.6 ENVIRONMENTAL CONSIDERATIONS

13.6.1 DAMP OR WET LOCATIONS

Designers need to examine project features and areas for environments that could be classified as a wet or damp location per NEC. Areas should be identified on the plans or adjust specification verbiage as required to identify. Most wet location equipment are UL rated for "Wet Location with Cover Closed" (i.e. passive use, de-energized, load unplugged, self-closing cover); fully rated "Wet Location" use (active use, energized, plug inserted) requires special construction. Devices which have a weatherproof cover which is not self-closing can qualify only for a "Damp Location" rating.

13.6.2 HAZARDOUS LOCATIONS

The type (Class, Group, Division) of hazardous environment applicable to specific locations should be identified on the plans and the boundaries of the area(s) delineated.

13.6.3 ALTITUDE DERATING

Capacities of certain equipment installed in locations above 1000 meters above sea level need to be adjusted to compensate for greater tendency to overheating. Equipment includes motors, generators, UPS, and some electronics assemblies.

Generators should be derated for altitude (1 percent for each 100 meters or fraction thereof above 1000 feet mean sea level). Diesel-Generator sets, stationary, should be specified in accordance with Guide Specification UFGS 26 32 15.00 10 for 100 to 2500 kW sizes and Guide Specification UFGS 26 32 14.00 10 for 15-300 kW sizes.

Use the following guidance for generator sizing:

- Industrial Facilities use 10% maximum frequency deviation and 20% maximum voltage deviation.
- Offices and General Facilities use 8% maximum frequency deviation and 15% maximum voltage deviation. Computer Facilities use 5% maximum frequency deviation and 10% maximum voltage deviation.

These numbers are general guidelines for generator sizing. The designer should get approval before significantly deviating from these ranges.

Motor capacity can be derated similar to the procedure used for generators or a service factor of 1.15 can be stipulated.

Derate transformers at one-half the percentage applied to generators.

13.6.4 FROST DEPTH

Refer to UFC 3-301-01, for a comprehensive list of frost penetrations. These values should normally be used for design, which involves frost depth considerations. If other frost depths have been approved by local authorities or standard commercial practices in given areas, those values may be substituted, however, if the variance exceeds 25 percent in decreased depth, approval of Japan District, Electrical Design Section is required. In accordance with Utility practice in the area, lesser depths will be permitted with some restrictions. Encased duct is to be placed at 600 mm (or 24 inches) below grade, Non-encased duct can be placed at 600 mm (or 24 inches) and direct burial cable at 750 mm (or 30 inches) minimum if 200 mm (or 8 inches) of sand backfill is provided above and below (vs. 6 inches (150 mm) above, 3 inches (75 mm) below in the TM). If plowing is permitted, cable must be placed below frost depth.

13.7 SPACE CRITERIA

13.7.1 ELECTRICAL AND TELECOMMUNICATIONS SPACE ALLOWANCE

When a project is received, the electrical designer should review the DD 1391 single gross square footage for adequate space allowances, for both the electrical utility space and communications. The Electrical Room Sizing Survey Data and EIA/TIA-569 for communications space should be used as an aid unless more pertinent information is available. For most facilities, electrical space would suffice with 2% of the gross building square footage. Shortages of space allowances should immediately be reported to the Project Manager, so the Stakeholder can be consulted as how to proceed. The spaces initially identified are for planning purposes, actual space required for the design needs to be coordinated between the architect and the electrical designer at the 5% stage and as the design progresses. Notify project Architects as soon as possible when electrical room and/or telecommunications rooms do not meet the proper clearances and minimum room sizes prescribed in the NEC, TIA and UFC 3-580-01.

13.7.2 EQUIPMENT ROOM

Electrical equipment should be located in rooms or space dedicated exclusively to such equipment. Electrical designers should coordinate with architects and other disciplines as required to ensure that an electrical equipment room (or dedicated electrical space) will be provided and be in a suitable location and of adequate size. Drawings should clearly identify such a reserved space. The electrical designer must verify that adequate ventilation is available particularly when electrical apparatus is added to existing equipment rooms, placed in closets or congested electrical or mechanical equipment rooms. Locations with extensive communications facilities should also provide a dedicated communications room unless approved otherwise.

13.7.3 EQUIPMENT CLOSET

In larger facilities closets should be provided for stepdown transformers, distribution panels, communications auxiliaries, communications terminal boards, etc. The preceding provisions for equipment will be generally applicable to closets also. Space in janitors' closets and other storage rooms will generally be unacceptable because it is difficult to ensure that the code required space will remain unrestricted.

13.7.4 CLEARANCES AND ACCESS

Ensure compliance with working space requirements of NEC Article 110, including entrance requirements for high ampacity equipment.

13.7.5 EQUIPMENT PADS

In applications where floors are washed down periodically or where accidental discharge could occur, concrete "housekeeping" pads are required to be placed under switchgear and other electrical equipment. Pads should extend 75mm to 150mm above the floor with a 25mm minimum border around the equipment. Details should be coordinated with the structural designer. Design should be such that operating handles

of overcurrent devices and switches will be positioned a maximum of 2m above the adjacent floor.

13.7.6 DISABILITY ACCOMMODATIONS

All projects and designs will incorporate provisions of the Architectural Barriers Act (ABA) and the Uniform Federal Accessibility Standards (UFAS) unless excluded. Electrically the primary considerations are the installation heights of switches and receptacles. They must be installed no higher than 1220mm (48”) and not less than 380mm (15”) above finished floor. Provisions pertaining to clearances will generally be accommodated by other disciplines, however electrical designers need to observe some precautions such as avoiding equipment configurations which would project into restricted clear space in corridors.

13.8 DESIGN SUBMITTAL REQUIREMENTS

This chapter entails descriptions of minimally accepted electrical and telecommunications submittal requirements for each phase of the design.

13.8.1 PARAMETRIC DESIGN

The Project Definition Design Analysis should include all data and any calculations (if required) to support design decisions and estimates at this stage of design. The analysis should incorporate specific criteria furnished and conference minutes of all systems considered. The design analysis should include the following:

13.8.1.1 DESIGN ANALYSIS

DESIGN ANALYSIS NARRATIVE

Electrical and Telecommunications work should be described to the extent necessary to identify scope, proposed configurations, and tentative sizes of major equipment such that funding costs can be verified. The narrative should address the following as a minimum (as required):

- Exterior and interior power distribution
- Exterior and interior lighting
- Exterior and interior communication systems
- Emergency power
- Lightning protection risk analysis
- Grounding
- Any specialty equipment project specific

General statements of intent are acceptable for conventional applications or standard practices (Examples: "Illumination in parking lots of 0.2 foot-candle horizontal average per UFC 3-530-01 will be achieved using fully shielded 100W LED cobra head luminaires. Receptacle configurations will consist of conventional 20A duplex outlets throughout dwelling units, to be spaced so that no point measured horizontally is more than 1.8m (6ft) from a receptacle per NEC.") Designers’ intentions relative to special requirements or unique design features should be defined in greater depth. Such areas might involve 400 Hz power, hazardous environments, security lighting, intrusion detection, UPS equipment, single point grounding, TEMPEST vaults, filtered power lines, EMCS, surge protection, seismic treatment, etc.

13.8.2 CONCEPT DESIGN

The Concept Design should incorporate specific criteria furnished and conference minutes of all systems considered. It should also include the requirements from the Parametric Design, as well as those requirements stated below:

13.8.2.1 DRAWINGS

GENERAL

- Legend and abbreviations sheet indicating symbols used in the drawings and their corresponding designation.
- Identify typical details planned to be used in the project.

EXTERIOR ELECTRICAL

- Identify existing and new electrical primary and secondary lines (both overhead and underground).
- Identify demolition and installation work clearly that shows work delineation points for feeders, transformers, manholes/handholes, special grounding requirements, switchgear, light fixtures, poles and other electrical equipment and all associated accessories. If extensive, provide separate demolition/installation drawing(s).
- Indicate electrical characteristics for some of the major electrical items such as voltage, phase, size, frequency, and kVA.
- For extensive exterior electrical work, provide a site one-line diagram.

INTERIOR ELECTRICAL

- Identify preliminary lighting layout with light fixtures and control devices such as sensors and switches for all areas.
- Identify location and ratings for some of the electrical service equipment such as panelboards, switchgear, motor loads, etc.
- Preliminary one-line/riser diagram that show some of the sizes of conduits, conductors, panels, etc. including the main service feeder.
- Identify preliminary receptacle layout.

EXTERIOR TELECOMMUNICATIONS

- Identify existing and new telecommunications service lines (both overhead and underground)
- Identify demolition and installation work clearly that shows work delineation points for manholes/handholes on a separate telecommunications site plan or as part of the electrical site plan(s) if telecommunications work is not extensive. If extensive, provide separate demolition/installation drawing(s).

INTERIOR TELECOMMUNICATIONS

- Identify location for some of the telecommunication equipment racks, panels, and cable runway routing.

- Preliminary riser diagrams that show some of the sizes of conduits, cables, panels, etc.
- Identify preliminary layout for telephone, data, CATV, and other telecommunication systems on floor plan as required.

13.8.2.2 SPECIFICATIONS

SPECIFICATIONS LIST

Provide a list of specifications to be used in the project, indicating the specification number and specification name as shown in the Unified Facilities Guide Specifications (UFGS).

13.8.2.3 DESIGN ANALYSIS

DESIGN ANALYSIS NARRATIVE

Narrative should be well established at this point, relative to scope and intended design approaches. The total scope projected to final design should be briefly outlined in a form that could be conveniently adapted, expanded, and detailed at the final design stages. The basis of significant design selections should be explained or summarized as applicable. If alternatives were to be evaluated/selected by the designer, conclusions should be included; if final decisions were to be deferred to future conferences or reviews, report the findings (pros and cons) of the evaluation. Any additional criteria, deviations concerning criteria, questions or problems should be identified and listed.

DESIGN ANALYSIS APPENDIX

The appendix should include the following as a minimum (as required):

- Datasheets of proposed luminaires, panelboards, transformers and any relevant electrical and telecommunications equipment.
- Preliminary calculations include load analysis for sizing transformer, and lightning protection risk analysis.

13.8.3 INTERMEDIATE DESIGN

The Intermediate Design should incorporate specific criteria furnished and conference minutes of all systems considered. It should also include the requirements listed for the previous stages of design as well as those requirements stated below:

13.8.3.1 DRAWINGS

GENERAL

- Legend and abbreviations sheet indicating symbols used in the drawings and their corresponding designation should be close to final including lighting fixture and equipment connection tags.
- Thoroughly check electrical plans for discrepancies and conflicts, particularly as related between other disciplines and various systems
- Congested areas where there can be interference with various electrical systems, cable trays, piping, ducts, etc., should be thoroughly detailed by expanded scale drawings.

- Chosen systems, equipment, and items used in the project should be thoroughly detailed on the detail sheets, including dimensions, salient characteristics, and any related notes.
- Circuiting and routing should be shown.
- Include pertinent notes for clarification and/or addition of construction requirements.

EXTERIOR ELECTRICAL

- Provide corresponding details and notes as necessary for demolition and installation work.
- Indicate electrical characteristics for all electrical items such as voltage, phase, size, frequency, and kVA.
- Provide lighting layout with light fixtures and control devices such as sensors and switches according to minimum illumination requirements in codes and regulations such as UFC 3-530-01 and Illuminating Engineering Society: The Lighting Handbook (including dimensions, salient characteristics, and any related notes).
- Provide lightning protection system and grounding plans with details that show layout of grounding rods, conductors, and air terminals (including sizes, dimensions, material type). Copper is typically used in the Japanese market.

INTERIOR ELECTRICAL

- Provide lighting layout with light fixtures and control devices such as sensors and switches for all areas according to minimum illumination requirements in codes and regulations such as UFC 3-530-01 and Illuminating Engineering Society: The Lighting Handbook (including dimensions, salient characteristics, and any related notes on lighting schedule).
- Provide location and ratings for all electrical service equipment such as panelboards, switchgear, motor loads, mechanical loads, etc. (including panel schedules, physical layout arrangement, front elevation detail for free-standing equipment)
- Provide one-line/riser diagram that show all the sizes of conduits, conductors, panels, etc. (including circuit breaker frame sizes, trip amps, short circuit ratings)
- Provide receptacle layout and power for all electrical equipment with circuiting and routing shown (including light fixtures and switches).

EXTERIOR TELECOMMUNICATIONS

- Provide corresponding details and notes as necessary for demolition and installation work.

INTERIOR TELECOMMUNICATIONS

- Provide location for all of the telecommunication equipment racks, panels, telephone/data and CATV outlets, devices, cable runway routing, etc. on the floor plans in accordance to codes and regulations such as UFC 3-580-01, TIA and Architectural Barriers Act (ABA).

- Provide riser diagrams that show all the sizes of conduits, cables, panels, etc. for intrusion detection system, public address system, telephone system, LAN system, etc. as required (including the routing and location of the various components and interconnections with other systems)
- Provide cable runway and protective distribution system (PDS) routing.
- Provide details of telephone/data and CATV outlets, telephone backboard arrangement, and other items as required.

13.8.3.2 SPECIFICATIONS

Read Thoroughly And Comply With The Instructions In Front Of Each Set Of Guide Specifications, Including Notes To Specification Writer.

- Cross out not applicable index items, publications, paragraphs, phrases, words, and sentences. Fill in blanks as applicable.
- Add Japanese industry standards, publication references, paragraphs, phrases, words, and sentences for items not adequately covered by specifications.
- Do not specify proprietary items unless approved.
- Ascertain that major or special types of equipment are available commercially in the local project area.
- For a design whose demand load is 500 kVA and above, or is for a processing system that would be undesirable for the system to cease functioning, the specifications should require the construction contractor to provide a system short circuit study, and time coordination curves for the equipment.
- If the design is predominately exterior overhead or underground with a small amount of information required that is contained in the interior electrical specification, the design specifications may include excerpts from the interior specifications in either the overhead or underground specifications. This procedure must have prior approval.

13.8.3.3 DESIGN ANALYSIS

DESIGN ANALYSIS NARRATIVE

This stage of Design Analysis should be an entirely updated and complied with the criteria furnished. Any additional criteria, deviations concerning criteria, questions or problems should be listed here.

DESIGN ANALYSIS APPENDIX

The appendix should include the following as a minimum (as required):

- Datasheets of proposed luminaires, panelboards, transformers and any relevant electrical and telecommunications equipment.
- Calculations include load analysis with applicable demand, future growth and diversity factors; short circuit analysis; voltage drop; lighting (point-to-point illumination values showing reference plane height, fixtures) and lightning protection risk analysis.

Seismic protection calculations may be performed by a registered US engineer, or by a Japanese 1st Class Qualified Architect

13.8.4 FINAL DESIGN

The Final Design should incorporate specific criteria furnished and meeting minutes of all systems considered and should essentially be complete. It should also include the requirements listed for the previous stages of design as well as the requirements stated below:

13.8.4.1 DRAWINGS

GENERAL

- All details for final package should be on the drawings (pole details, fixture details, etc.).
- Complete all circuiting.
- Complete all schedules including panel schedules and lighting schedules.
- Thoroughly check the drawings for discrepancies, for compatibility between drawings and specifications, and for compatibility between disciplines.

13.8.4.2 SPECIFICATIONS

Final specifications should incorporate all previous comments and provide all information previously required by early percentages.

13.8.4.3 DESIGN ANALYSIS

DESIGN ANALYSIS NARRATIVE AND APPENDIX

This analysis is an extension of the previous approved design analysis and should contain all the information required by previous design analysis descriptions. This design analysis should support and verify that the design complies with the requirements of the project. All final calculations are to be included.

13.8.5 READY TO ADVERTISE-RTA

The comments generated during the Final Review should be incorporated into the completed specifications and drawings before they are submitted as Ready-to-Advertise. The analysis typically is not republished at this time, but changes should be made and place in the project folder e.g. calculations which were required to be updated. The drawings and specifications should be complete and thoroughly checked.

13.9 DESIGN CALCULATIONS AND POWER SYSTEMS ANALYSIS

An analysis of the distribution system should be performed in every design. In some applications a cursory analysis will be adequate, while others will require an extensive exercise. Power system analysis should be performed on new portions of the distribution system and generally include the first upstream device on the existing portion of the system, at a minimum. If the results of the evaluation show that the existing configuration would need to be adjusted or individual components replaced, coordinate with the local installation and Japan District for approval.

13.9.1 LIFE CYCLE COST ANALYISIS (LCCA)

At the beginning of the project, the electrical designer should conduct market research for electrical features that can enhance the performance of the electrical system, while saving project cost, maintenance cost, and energy cost considering local markets and standard practices in Japan. Any electrical feature that deviates from the prescribed systems in the UFC should be evaluated and have LCCA included in the Design Analysis. See Chapter 12 for Life Cycle Cost Analysis methodology and documentation.

13.9.2 LIGHTNING PROTECTION RISK ANALYSIS

A lightning protection risk analysis should be conducted to assess if the project building/structure will require lightning protection. Lightning protection analysis should consider the average flash density at the project location, building dimensions, and surrounding structures that could affect the analysis. Comply with NFPA 780 guidelines as a minimum.

13.9.3 GROUNDING

Determination of the grounding system should be calculated based off the Military Handbook MIL-HDBK-419A for Grounding, Bonding, and Shielding for Electronic Equipment and Facilities, and the NEC as a minimum. Soil resistivity of the project site should be acquired either through the site survey report or historical data from a credible source. Spacing between ground rods should be at least double the length of the ground rod. Use copper for all grounding items, utilizing exothermically bonding by Cadweld or acceptable alternative for bonding. Provide grounding test wells at the four farthest corners of the building as a minimum. Refer to ANSI_TIA-607 for Telecommunications Bonding and Grounding.

13.9.4 LIGHTING

In the design analysis, provide a table listing of all rooms, spaces, and areas in the project; as well as their corresponding room classification per ASHRAE 90.1, ceiling heights, fixture mounting heights, targeted illumination heights, fixture types used, power consumption per fixture, quantity of fixtures and target uniformity and illumination levels per UFC and IES. Computations may be done manually or by computer assisted techniques. The method used must be identified by including computation forms or by including printouts plus an explanation of the method used. Complete calculations for each room/area should be included in the Design Analysis. Input data and results must be summarized in a recap form for all cases when the project has more than five rooms/areas. Calculations should be adjusted to compensate for special applications -- irregularly shaped rooms, open sides, ceiling obstructions (beams, ductwork), corridors, etc.

13.9.4.1 EXTERIOR LIGHTING

Exterior calculations will typically require the use of a computer program in order to obtain the point-to-point values. Small exterior lighting projects with just a parking lot and/or short section of street can use templates for deriving the spacing of light poles. If submitting for light pollution LEED credit, provide exterior lighting calculations

demonstrating compliance with light trespass and pollution requirements within the project LEED boundary.

13.9.4.2 INTERIOR LIGHTING

It is recommended that computations be based on the simple lumen method using coefficients of utilization corresponding to 70 percent ceiling, 50 percent wall and 20 percent floor reflectance factors in office type applications (white suspended ceilings and light colored unobstructed walls). Consider 50 percent/30 percent factors for applications with CMU (concrete masonry unit) walls, dark colors, irregular surfaces and/or structural obstructions. A maintenance factor of 0.7 should be used for the typical application (this value should be adjusted for non-typical applications - 0.75 or 0.8 for a well maintained office or lab with a filtered air supply, 0.65 for a mechanical room with minimal maintenance). If the lumen method is used for corridor calculations, the calculations should be performed using a module in which the length does not exceed 3 times the width (2:1 ratio referred).

13.9.4.3 EMERGENCY LIGHTING

Provide emergency lighting calculations simulating the lighting levels on the path of egress during an emergency situation. Emergency lighting illumination should meet NFPA 101.

13.9.4.4 DAYLIGHTING

Coordinate with the project architects for locations and dimensions of windows, skylights, and regularly occupied spaces as defined in the project. Daylighting simulations should be calculated in compliance with UFC 1-200-02 for ASHRAE requirements and calculated in accordance with the selected third party certification rating tool. Method of calculation can either be the (1) Spatial Daylight Autonomy method or the (2) Illuminance Calculations as described in UFC 1-200-02 and elected third party certification green rating tool.

13.9.4.5 LIGHTING ENERGY CONSUMPTION

Include a lighting energy consumption calculation, which entails all designed exterior and interior lighting fixtures' total power consumption and how it compares to the ASHRAE 90.1 and ASHRAE 189.1 baselines calculated for the project. State any assumptions made and the room/space classification used to determine the watts/sf selection from the ASHAE 90.1 baseline tables. For determining the exterior lighting baseline consumption, use a per fixture count method using HID lamps (i.e. if project is being designed for 10 exterior LED pole lights, use 10 exterior HID pole lights as the baseline for the exterior lighting energy consumption). Total designed lighting energy consumption should be 30% less than the calculated baseline energy consumption from the AHRAE tables for the whole project.

13.9.5 TRANSFORMER SIZING

Document how transformer sizes were determined for the project, showing connected load, demand load, and diversity factor according to UFC 3-501-01.

13.9.6 VOLTAGE DROP

Calculations must be in accordance with the NEC and applicable IEEE guidelines. Interpolation and projection techniques may be used (i.e., a calculation for a 35 meter feeder to a 225A panel would not be necessary if a calculation for a 40 meter feeder to a 225A panel had already been performed). Calculations must be sufficient to encompass the application range of the project.

13.9.6.1 PRIMARY – OVER 600 VOLTS

Distribution system design for voltages over 600 volts should be based on a maximum of 2% voltage drop.

13.9.6.2 SECONDARY – OVER 600 VOLTS OR LESS

Distribution and branch circuit system design should be based on a maximum of 5% voltage drop from the transformer to the utilization equipment. This should be split such that there will be 2% or less voltage drop from the transformer (service drop, service entrance, etc.) to the branch circuit panelboard (proportioned most economically between the service and feeder conductors) and 3% voltage drop or more on branch circuits.

13.9.7 SHORT CIRCUIT ANALYSIS

It is the designer's responsibility to ensure that the distribution system is adequately protected against the effects of short circuits by specifying components with adequate short circuit ratings and/or specifying protective devices or components that will reduce fault current levels or durations. The minimum acceptable short circuit ratings should be shown on the plans. Higher rated equipment should be specified if any of the following conditions apply: if data on available fault current is questionable, if utility substation or line capacity is projected to increase, or if calculated fault values fall near a standard equipment rating.

The designer should be aware when calculating let-through current on transformers that the transformer impedances used must be in compliance with DOE 10 CFR Part 431, Subpart K. Low-voltage, dry type transformers manufactured on or after January 1, 2007 and liquid-immersed distribution transformer manufactured on or after January 1, 2010 must be manufactured to conform with the efficiencies specified in DOE 10 CFR Part 431, Subpart K. These increased efficiency levels will result in lower transformer impedances which will result in higher let through currents on the transformer secondaries. Reference UFGS Specification 26 12 19.10 (Designer Notes on last page of specification) for typical impedances.

13.9.7.1 BASIC REQUIREMENT

Maximum theoretical fault current levels based on infinite bus conditions must be determined for all projects if enough information on the installed equipment is available. Otherwise, a simple Point to Point Approach should suffice during design. Additionally, more specific analysis should be performed in most projects to determine whether equipment ratings can be reduced from infinite bus ratings to reduce cost while maintaining conservative protective margins. This approach will require obtaining actual

available short circuit information. This approach should only be used if approved by the Japan District, Electrical Design Section. The analysis by the designer should be in the form of a reference or baseline model with design values (ratings, settings, sizes, as applicable) to be confirmed and refined by a more extensive Construction Contractor analysis based on specific characteristics of the equipment actually selected.

13.9.7.2 EXTENT OF ANALYSIS

- Low Fault-Levels. If the fault level (at the service transformer secondary) is 14,000 A.I.C. (Amps Interrupting Capacity) or less for 480 V systems and 10,000 A.I.C. or less for 208 V systems, a simple analysis can be provided.
- High Fault-Levels. If the theoretical fault levels would exceed 50,000 A.I.C., an extensive analysis should be performed based on actual fault current levels available upstream of the service transformer.
- Computerized analysis using software such as EasyPower is preferred. The evaluation should continue downstream and system/equipment modifications should be implemented until calculated fault levels are attenuated to 14,000 A.I.C. or less for 480 V systems, 10,000 A.I.C. or less for 208 V systems.
- Intermediate Fault-Levels. Unless other direction has been given, the type and extent of analysis and documentation in the 14,000 to 50,000 A.I.C. range should be required. Factors which would recommend an extensive analysis include: available fault levels considerably lower than infinite bus values (and no future utility substation expansion planned), large facilities with a considerable amount of expensive switchgear, considerable economic savings by specifying equipment with S.C. ratings lower than the infinite bus level.

13.9.7.3 CALCULATION PROCEDURES

Use guidelines of IEEE publications (ANSI/IEEE 242, etc.) to the extent applicable. Comprehensive systems type calculations should show maximum three phase, phase-to phase, and phase-to-ground fault currents throughout the system. Phase-to-phase-to-ground data is recommended, but not mandatory. Available fault current levels should be obtained from or verified with the installation or local utility company as applicable.

13.9.8 INTERRUPTING RATINGS

Equipment ratings should be determined based on results of the above analysis. Minimum standard interrupting ratings should be identified on the plans, preferably on a one-line diagram or alternatively in panel schedules. Ratings may be called out in the specifications when single items are involved. The designer should identify variables (such as equipment impedances) which could affect available short circuit current and verify that equipment acceptable under contract plans and specifications would not permit fault current levels higher than the specified interrupting ratings. If not adequate as is, increase specified ratings, increase the minimum acceptable impedance values where stated, and/or insert minimum values where none have been stated.

13.9.9 PROTECTIVE COORDINATION ANALYSIS

The proposed electrical distribution design must be analyzed to determine the most advantageous locations, sizes, settings for overcurrent devices, relays, ground fault equipment, etc. as applicable. The designer should strive to determine an optimum arrangement that would minimize the amount of nuisance or multiple tripping, limit outages to the shortest duration, and impact the smallest areas practicable. Selection of device types and sizes should be evaluated to best achieve a well-coordinated arrangement. Generic or sample requirements should be defined by the designer. Designer should have the construction contractor recreate, complete, or verify, the theoretical or baseline configuration by performing a short circuit and coordination study based on the specific electrical and mechanical equipment proposed. If connection is made to, or will affect, existing installations, the scope of the evaluation must include the existing system or equipment. (An extensive analysis and formatted presentation will not be necessary for smaller applications having simple basic configurations and standard features (example: single 600A, radial service using non-adjustable molded case circuit breakers); however, sufficient investigation and calculations should be performed to determine available fault current and/or verify adequacy of equipment ratings relative to infinite bus values.) System coordination and design analysis may be performed by a Japanese engineer with qualifications equivalent or equal to the requirements of US engineers.

13.9.10 ARC FLASH ANALYSIS

The electrical distribution system should be designed to minimize exposure of electrical workers to Arc Flash hazards. Arc Flash Analysis should be conducted when electrical equipment is likely to be worked on when energized to determine the best electrical distribution layout that will result in low Arc Flash levels. Designer should have the construction contractor verify, calculate and create the arc flash analysis based off actual attributes of the installed equipment. Provide Arc Flash labels as required per UFC 3-560-01.

13.10 EXTERIOR ELECTRICAL DESIGN

13.10.1 EXTERIOR SYSTEM VOLTAGE SELECTION – MEDIUM VOLTAGE

13.10.1.1 MEDIUM VOLTAGE DISTRIBUTION

Typical medium voltage distribution in mainland Japan is 6.6 kV and 3.3 kV for older projects. Specify 6.6 kV rated cables and related accessories (except surge arresters which should be sized to the lower system voltage) to allow for future conversion to the higher rated voltage level with minimum inconvenience and cost. Typical medium voltage distribution in Okinawa is 13.8 kV. Specify 15kV rated system for 13.8kV distribution systems. Medium voltage cables shall be tested using the High Direct Current Voltage (HDCV) method per IEEE400.1, using an engineer from the Japan Electrical Safety Inspection Association. Very Low Frequency (VLF) testing of medium voltage cable shall not be required. Medium voltage cable splices and terminations shall be performed by qualified personnel certified by the National Cable Splicing

Certification Board (NCSCB) or by personnel certified as Qualification for High Voltage Electric Work Handling Engineer in Japan. Contract drawing designation for transformers typically omit the delta symbol, but the “Y” must be retained in all cases.

LOW VOLTAGE DISTRIBUTION

- **Phase Configuration (Three-Phase vs. Single-Phase):** Three-phase power should be standard practice. Single-phase service should be limited to housing and similar low demand applications unless specifically directed otherwise.
- **Voltage Configuration**: The designer should choose the electrical system voltages to be utilized in the project based off locally available equipment voltages, base engineers preference and Stakeholder needs at the earliest stage of design as possible. By the Concept Design stage, the electrical system voltages to be used in the project should be finalized. Ensure that products selected are readily available in the market by providing manufacturer cutsheets reflecting the selected voltages. Typical Japanese three phase mechanical equipment run at 400 V and/or 200 V. Consider using typical Japanese three phase 400 V and/or three phase 200 V exterior oil-filled transformers for these applications if possible. Dry type transformers should be employed as required to support 100 and 200 volt loads. The 208Y/120 V system could be considered to serve US materials when required.

13.10.2 OVERHEAD DISTRIBUTION

Overhead Distribution Lines – Medium Voltage: Design per UFC 3-550-01, Section 3-10 “Overhead Power Distribution”.

13.10.3 UNDERGROUND CONSTRUCTION

13.10.3.1 UNDERGROUND DISTRIBUTION LINES-MEDIUM VOLTAGE

Design should be based on IEEE/ANSI C2 (the National Electrical Safety Code), UFC 3-550-01, and UFGS 33 71 02. Primary cable should normally be installed in concrete-encased duct banks or rigid steel (heavy wall) conduits. Direct burial is not acceptable for primary cable installation unless so directed in writing. Splices should be made per UFC 3-550-01, Section 3-11.5. Underground lines should be routed to avoid crossing under paved surfaces, buildings, or other structures whenever possible.

13.10.3.2 CABLE CONFIGURATION

Use of ethylene propylene insulation is preferred where long life is a consideration or where electrical characteristics are more significant than physical durability. Cross-linked polyethylene insulation with option of polyvinyl or polyethylene jacket is preferred for other applications. Shielded construction should be standard.

13.10.3.3 CABLE ACCESSORIES

Components should be as indicated in UFGS 33 71 02. Potheads should not be specified to the exclusion of other type of terminations. Termination kits will be specified instead of potheads. Cable taps should be made using primary junction boxes,

preformed junction assemblies, or modular splice assemblies similar to G & W's Universal Splice.

13.10.3.4 CONDUCTOR SIZING

Conductor size should be 38 mm. sq. minimum for 6.6 kV class service (For either wye or delta system), 14 mm. sq. minimum for 5 kV class grounded or ungrounded neutral service. For Okinawa, size new primary conductor to carry existing and projected future loads with the circuit capacity. Specify 15 KV rated system for 13.8 kV distribution. Design documents should permit the use of single conductor cable rather than being restricted to the multi-conductor construction. JIS equivalent conductor sizing should be specified for all projects.

13.10.4 DUCT BANKS

13.10.4.1 REINFORCED CONCRETE APPLICATIONS

Reinforced concrete encased duct banks are required under aircraft pavement, railroads, or paving subject to frequent heavy equipment use. Where reinforced concrete is required, it should be so designated on the drawings.

13.10.4.2 MANHOLES, HANDHOLES, AND PULL BOXES

Japanese precast concrete manholes and handholes shall be specified wherever possible. They shall not be held to the AC1318M/ACI SP-66 standard, since it is only applicable to US made products.

13.10.4.3 DUCT INTERFACING

Duct should enter manholes perpendicular to the wall or within 30 degrees.

13.10.4.4 SPACING

Manholes should be spaced at intervals not exceeding 150 meters for straight runs. Recommended spacing should not exceed 90 meters with 45 degrees maximum bend, 60 meters for 90 degrees maximum, 45 meters for 135 degrees, 30 meters for 180 degrees. Vertical bends into equipment pads must be counted in determining the total bend. Provide an analysis with calculations and pulling criteria if these limits are exceeded.

13.10.5 DIRECT BURIAL – LOW VOLTAGE

Direct burial can be considered for feeders to isolated equipment such as pumps, for service to lighting in remote uncongested areas, and similar applications. For direct buried installations, verify the frost depth applicable to the particular project area. Note that ANSI C2 (Section 353D2b) recommends cable installation below frost depth in areas where frost could damage cable. Preferred practice for Japan District applications is to install direct burial cable in trenches at 750 mm minimum below grade, duct at 600 mm, with 200 mm sand backfill above and below; if plowing is used, cable must be placed below frost depth.

13.10.6 INSTALLATION – LOW VOLTAGE

Conduit should be employed for low voltage wiring extended under hard surfaced parking lots, sidewalks, driveways, ramps, and other paving. The secondary from service transformers is to be in duct unless direct burial has been specifically requested. Conduit should also be used for secondary lines in congested areas with other utilities.

13.10.7 EXTERIOR TRANSFORMERS AND EQUIPMENT

13.10.7.1 MEDIUM VOLTAGE DISTRIBUTION EQUIPMENT

Refer to UFC 3-550-01, UFGS 26 11 14.00 10, 33 71 01, and 33 71 02 as applicable.

- Pole Mounted Switches, Sectionalizers, and Miscellaneous Equipment: Feeder and distribution system sectionalizing should be provided by using gang-operated, load-break/interrupting switches in lieu of fused cutouts. Power factor correction capacitors, fixed and/or switched, should be provided.
- Pad Mounted Switchgear: Above grade locations are preferred for switching functions. Switches should be live front air-break type.
- Below Grade Assemblies: Below grade equipment must be suitable for wet location use. Switches should be dead front vacuum type.
- Interior Applications – Indoor Medium Voltage Transformers: Medium voltage transformers installed indoors must be dry type, epoxy-encapsulated type, or be installed in fire resistive vaults with curbed liquid containment structures. Installation must conform to provisions of NEC and UFC-3-600-01.

Equipment testing shall be performed in accordance with NETA ATS standard, or by personnel certified by the Electrical Safety Inspection Association of Japan.

13.10.7.2 MEDIUM VOLTAGE TRANSFORMERS AND SUBSTATIONS

In selecting transformers, the designer should utilize standard voltage and connections as much as possible. The primary and secondary arrangements considered standard by manufacturers will depend on the application (i.e., overhead vs underground, single phase vs three phase, dry type vs oil filled, power vs distribution class, etc.). Refer to ANSI Std. C84.1, "Voltage Ratings for Electric Power Systems and Equipment," and C57.12.00, C57.12.21, C57.12.25, or C57.12.26 as applicable. Except for Okinawa areas, transformer should be Japanese cubicle type. For Okinawa areas, transformer should be US pad mounted type transformer.

Ensure that the step down transformer KVA rating is consistent with the Japanese transformer standard KVA rating as the following:

Table 22: Transformer Phase Voltage Requirements

PHASE	KVA
SINGLE PHASE	10, 20, 30, 50, 75, 100, 150, 200, 300, 500

THREE PHASE	20, 30, 50, 75, 100, 150, 200, 300, 500, 750, 1000, 1500, 2000

- Secondary Unit Substation (Load-Center Transformer*)*: See UFGS 33 71 02 and UFC 3-550-01.
- Pole Mounted: Aerial type transformers should be provided in areas where a ground-mounted installation would not be suitable. They may also be used in remote applications where existing practice is overhead construction. Transformers should be Distribution Transformer Type I mineral-oil insulated. Transformer banks of 300 kVA or less should be radial or cluster-mounted on a single pole. Transformer banks of more than 300 kVA should be platform-mounted. Pole mounted transformers should be cluster mounted.
- Pad Mounted: The pad-mounted compartmental-type should comply with (ANSI C57.12.21 single phase live front), (ANSI C57.12.21 three-phase live front), (ANSI C57.12.25 single phase dead front), and (ANSI C57.12.26 three phase dead front).
- Transformer Sizing – Oil Insulated: For oil immersed, self-cooled, "exposed to the weather" applications, the kVA (kilovolt-ampere) rating of transformers may be computed conservatively using 100 percent of the calculated, diversified Estimated Maximum Demand (EMD) or more economically by allowing temporary overloading per the method of the following subparagraphs. The conservative approach should be followed for applications involving 40 degree C or over ambient, peak loads lasting more than 8 hours, existing facilities where accurate load data can't be obtained or is of questionable accuracy, or new facilities where future loading can't be predicted with confidence. The economical approach incorporating short-term overload is preferred where design life of the facility is under 15 years. The more economical sizing approach could also be used if temperature monitoring and relaying is specified to either shut down the transformer, activate alarms, or energize forced air cooling whenever loading exceeds tolerable levels.

Transformer Location

Transformers of the mineral oil insulated or low flammability ("non-flammable", "less flammable liquid-filled") type should be located per UFC 3-600-1, Sec 4-35.5. In addition to fire safety reasons, transformer locations on DoD installations are also restricted by antiterrorism/force protection considerations, as described in UFC 4-010-01.

13.10.7.3 AUXILIARY POWER SUPPLIES

13.10.7.4 POWER SOURCES – NORMAL AND EMERGENCY

Recommended references are IEEE 446 "Emergency and Standby Power for Industrial and Commercial Applications" (Orange Book) and IEEE 141 "Electric Power Distribution for Industrial Plants" (Red Book).

13.10.7.5 UTILITY POWER

Available capacity and power quality of the normal source should be verified, if information has not been furnished in the project criteria package. In most projects on military complexes, the existing distribution system has capacity and is sufficiently reliable for administrative type functions. Designers can select and detail a proposed interface and address specific aspects in the Design Analysis for Stakeholder review and comment. In other projects investigation and coordination will be necessary.

13.10.7.6 GENERATORS – PRIME POWER AND STANDBY

Refer to application notes in UFGS 26 32 14.00 10 and 26 32 15.00 10. Note that various manufacturers will offer the same basic engine-generator package in both standby and prime power versions. The prime power set will carry a lower kW output rating because of the continuous physical demands, heating effects, reduction in life, etc. The standby unit is rated for a higher output since use is occasional allowing heat dissipation, less overall stress to insulation, and longer life. If a standby unit is intended to support frequent, drastic load shifts (no load to 100 percent), the transient performance and testing standards required should be more stringent.

- Direct Current Systems: A battery inverter arrangement should be used instead of a battery system using a centrally located battery bank and a DC distribution system.
- Battery Supplies: Provide for Uninterruptible Power Supply (UPS) installations per UFGS 26 32 33.00 20 or 26 32 33.00 10, as applicable. An UPS installation may also be required for powering control circuits, and other sources such as UPS, EPS, or generators will not be provided or would not be available when needed.
- Local AC/DC Inverters: In military projects, use of standard units is recommended. (Examples: The B-8 and B-9 rectifier will operate with 480V or 240V 3-phase input and deliver 200A or 400A respectively at 28V.)

13.10.7.7 MEDICAL FACILITY APPLICATION

Refer to IEEE 602 "Electric Power Systems in Health Care Facilities" (White Book) and UFC 4-510-01 hospitals.

13.10.7.8 UNINTERRUPTIBLE AND GROUNDING DESIGN

13.10.8 SYSTEM PROTECTION – MEDIUM VOLTAGE

13.10.8.1 MEDIUM VOLTAGE – OVERVOLTAGE PROTECTION

The preferred arrestor arrangement is distribution class "MOV" surge arresters at pad-mounted transformers and intermediate class surge arresters on all overhead to underground transition poles. Arrestor sizes are to be shown on plans.

13.10.8.2 MEDIUM VOLTAGE – OVERCURRENT PROTECTION

Fuse cutouts are sufficient at overhead transformers. Drywell type current limiting fuses are preferred for most pad mount transformer installations. Use power fuses in switchgear - size and type per protective coordination analysis.

13.10.8.3 MEDIUM VOLTAGE – FERRORESONANCE CONSIDERATIONS

Ferroresonance conditions result in sustained overvoltages being imposed on distribution components which will suffer shortened life or complete failure. The more severe damage will occur to transformers and metal oxide arresters (silicon carbide arresters can sustain longer durations.) The probability of the phenomenon occurring increases proportionate to the extent the following factors are present: single phase switching or overcurrent device operation, delta primary transformer, long length of underground primary cable (or as short as 90 meters (or 300 feet) if other factors are present), a comparatively high voltage primary line serving a relatively small transformer, an unloaded or lightly loaded secondary. Mitigating measures include use of grounded wye primary lines and transformers, ganged switching and overcurrent equipment, switching at the transformer instead of upstream poles, and switching with transformer loaded.

13.10.9 SERVICE ENTRACE FEEDER AND ENTRANCE EQUIPMENT

13.10.9.1 SERVICE ENTRANCE FEEDER CONFIGURATION

- Overhead Secondary: Overhead services may be considered for use in industrial-type areas where appearance is not a significant factor, existing service is overhead, and where cost considerations are critical. Conductor size should be based on the building estimated maximum demand (EMD) and the NEC Table, column entitled "Bare and Covered Conductors." The conductor coverings should be left to the options shown in UFGS 33 71 01 for Service Drops, except that messenger (neutral) supported conductors should be used in lieu of open wire on secondary racks.
- Underground Secondary: Underground services from a pad mounted transformer should be used for the typical project. Conductor size should be based on the building estimated maximum demand (EMD). Type USE or equivalent EPR or XLPE cable with outer covering should be specified.

13.10.9.2 SERVICE DISCONNECTING PROVISIONS

Location: Service equipment should be located in rooms or space dedicated exclusively to electrical equipment (see paragraph "Equipment Rooms"). Service entrance equipment should be readily accessible and be located as near as practical to the point of entrance of the main service feeder per NEC.

13.10.9.3 LIFE SAFETY AUXILIARIES

Unless other direction is provided for a specific project, the normal power supply for emergency systems should be via a dedicated feeder that would not be subject to power interruption from switching actions or faults occurring within the facility external to the emergency system components. When a tap is made upstream of the facility main disconnecting means, the 10 and 25 foot tap rule requirements of NEC should be met. Provide current limiting fuses in the disconnect.

13.10.9.4 POWER METERING

- Primary Metering: Primary metering may be advantageous at project boundaries if an entire complex is to be served. Provide support structures, current and voltage transformers, and meter housing. Many utilities will provide the meter head or require approval of a Stakeholder-supplied unit. Verify details with the specific utility.
- Secondary Metering: Preferred location is the service switchboard located in the electrical equipment room. Coordinate meter location with Stakeholder. Comply with ASHRAE 189.1 submetering requirements as required by the Stakeholder.
- EMCS Provisions: Unless other direction is provided, furnish contacts for EMCS/UMCS interfaces. See UFGS 26 20 00.

13.10.10 CONDUCTOR AND CONDUIT TYPES

Coordinate with base electrical engineers on required conductor and conduit types specific to their installation. Japanese conduit shall be specified wherever possible. Set screw type fittings for metallic conduit shall be acceptable Ensure that conductors and conduit sizes are specified in hard metric and with Japanese standard sizes. If installation-specific requirements are not specified, apply the following or refer to UFC requirements as a minimum:

13.10.10.1 CONDUCTORS

For low voltage, 600 volts and below: EM-IE type with the appropriate rating

For high voltage, 6.6 kV or higher: EM-CET type with the appropriate rating

13.10.10.2 CONDUITS

Table 23: Conduits

APPLICATION	TYPE
Interior – Above Ceiling or concealed locations	Type E (EMTS) conduits
Interior and exposed	Type E (EMTS) conduits or Type G (thick wall/steel) conduits for wet/damp/hazardous areas
Exterior direct burial	Type FEP (corrugated plastic) conduits for non-paved areas or Type GLT (plastic coated rigid steel) conduits for under paved areas or Type HIVE (extra heavy wall rigid PVC) conduits under heavy traffic areas
Exterior/Concrete embedded	Type VE (PVC) conduits or Type PE (PVC coated rigid steel) conduits or Type HIVE (extra heavy wall rigid PVC) conduits under heavy traffic areas

13.11 INTERIOR ELECTRICAL DESIGN

13.11.1 LOW-VOLTAGE DISTRIBUTION EQUIPMENT

Power distribution equipment should be provided in accordance with UFGS 26 20 00 and UFGS 26 23 00. For details of design, see NEMA Standards Publications PB-2 and SG5, current editions, and appropriate manufacturer's catalog and specifications. In general, switchboards would be of limited benefit for loads of less than 600 amperes. Spare circuits in equipment assemblies should be apportioned at one spare for every 4-6 active circuits however at least one spare circuit should be provided in each equipment assembly unless other direction is given.

13.11.2 SUBMETERING

Provide submetering if required by the UFC. As much as possible, dedicate each branch panel to one load type (i.e. lighting panel, receptacle panel, mechanical panel, etc.).

13.11.3 SYSTEM PROTECTION – LOW VOLTAGE

13.11.3.1 LOW VOLTAGE – OVERVOLTAGE PROTECTION

Molded-case circuit breakers should normally be used in branch circuit panelboards and are recommended for distribution panels if served by a fuse type switchboard. Refer to designer notes in UFGS 26 20 00 for recommended application of insulated-case breakers and low-voltage power circuit breakers. Specify solid state multifunction type devices in switchgear or larger distribution panels if the objectives of the protective coordination analysis could be best achieved. Bolt-on circuit breakers should be provided for panelboards. Plug-in circuit breakers should only be used for family housing, if approved by the User.

13.11.3.2 LOW VOLTAGE – FUSES

In fusible switchboards and safety switches, use dual element, current-limiting type (RK1 or RK5) for most projects. See designer notes in UFGS 26 20 00.

13.11.3.3 LOW VOLTAGE – CIRCUIT BREAKERS

Molded-case circuit breakers should normally be used in branch circuit panelboards and are recommended for distribution panels if served by a fuse type switchboard. Refer to designer notes in UFGS 26 20 00 for recommended application of insulated-case breakers and low-voltage power circuit breakers. Specify solid state multifunction type devices in switchgear or larger distribution panels if the objectives of the protective coordination analysis could be best achieved. Bolt-on circuit breakers should be provided for panelboards. Plug-in circuit breakers should only be used for family housing, if approved by the User.

13.11.3.4 LOW VOLTAGE – RELAYS

Fuses and molded-case circuit breakers perform reliably in the short circuit range (abnormal currents exceeding 6 times the nominal rating) and well into the overload range (approximately 1-1/2 to 6 times nominal rating). Performance is not certain or consistent for slight overloads (i.e., in the 110 to 125 percent range). If precise operation

and tight protective margins are essential, adjustable current sensing relays are recommended.

13.11.3.5 LOW VOLTAGE – GROUND FAULT PROTECTION FOR EQUIPMENT

Provide ground fault protection on grounded wye services with service disconnecting means of 1000A and larger (480Y/277V typically) per NEC. Annunciation only can be substituted for automatic system shutdown on emergency systems and where critical processes must be maintained.

13.11.3.6 LOW VOLTAGE – GROUND FAULT PROTECTION FOR PERSONNEL

Provide ground fault protection on receptacles in lavatories and on the exterior of buildings and in other locations addressed in the NEC. GFCI circuit breakers (or feed-through receptacles) need dedicated neutrals to function properly. If a 3-phase feeder or 2-leg single-phase feeder is used, multiple neutrals must be provided downstream in lieu of a shared neutral.

13.11.3.7 ARC FAULT PROTECTION FOR PERSONNEL

Provide ground fault protection on receptacles in lavatories and on the exterior of buildings and in other locations addressed in the NEC. GFCI circuit breakers (or feed-through receptacles) need dedicated neutrals to function properly. If a 3-phase feeder or 2-leg single-phase feeder is used, multiple neutrals must be provided downstream in lieu of a shared neutral.

13.11.4 HEAVY-DUTY (INSULATED-CASE CIRCUIT BREAKER) SWITCHBOARD

Assemblies may require rear access.

13.11.5 NORMAL-DUTY (INSULATED-CASE CIRCUIT BREAKER) SWITCHBOARD

Rear access is not required.

13.11.6 PANELBOARDS

For all except smaller projects, it is preferred that lighting and power loads be supplied from separate panels. In some projects, it will be desirable to further separate sensitive loads (precision instrumentation, etc.) from harmonics generating equipment or to group motor loads. Odd and even circuits should be balanced to the extent practical; i.e., three pole breakers opposite three pole breakers and one pole breaker opposite one pole breaker, etc.

13.11.6.1 PANEL CONFIGURATION AND LOAD IDENTIFICATION

Loads are to be shown in watts unless vector addition is used. The type and size of each load should be shown in the "Load" column of the panel schedules. The load to be shown should be the actual connected load (nameplate rating) of the equipment (such as electric heating equipment). If there are many loads of the same type, distinguish by number (EF#4, pump P2, etc.) or location (Rm 315, kitchen, etc.).

13.11.6.2 BUS RATINGS

Required capacity should be computed from the estimated maximum demand of the panel board and specified as the next larger manufactured standard bus or main lug size. Bus sizes for circuit breaker panel boards are 100, 225, 400, 600, 800, and 1200 amp and for fusible panel board main lug sizes are 200, 400, and 600A. Loading on panels must not exceed 80 percent of bus rating (see paragraph "Feeders and Branch Circuits"). Panel boards serving predominantly nonlinear loads should be supplied with a 200 percent neutral bar.

13.11.6.3 OVERCURRENT CALCULATIONS

For panel boards with heavy motor loads, computations must also consider starting current of the largest motor or motors in addition to the continuous demand amperes correlating to the EMD watts or volt amps.

13.11.6.4 SPARE CIRCUITS

Spares should be provided as follows: facilities with low or average electrical use (schools, office, dormitory, mess hall) - at least one spare for every six (6) active circuits; facilities subject to relatively intense electrical use (shops, manufacturing, hangars, etc.) - one spare for four (4) active. Coordinate positions of active and spare circuits to provide a balanced phase panel. Indicate in the panelboard schedules whether a pole is a spare or a space. With spares, indicate the circuit breaker rating. Flush mounted panels that are inaccessible for future addition of wiring may have a minimum of spare circuits; empty conduits should be routed to the nearest J-Box above the panelboard, if possible.

13.11.6.5 PHASE BALANCE

Since the usual circuiting patterns tend to load up Phase A, designers should review their layouts after initial allocations are made and compensate by shifting spares or heavier loads to B and C phases.

13.11.7 INTERIOR TRANSFORMERS

13.11.7.1 CONVENTIONAL DRY TYPE

Low-voltage general-purpose dry-type transformers should be sized so that the maximum continuous load would not exceed 80 to 100 percent of the nameplate. Standard units with a Class 220 (formerly Class H) insulation system can support rated load in a 40°C ambient without exceeding a 150°C temperature rise under full-rated load would not exceed 80 to 100 percent of the nameplate.

13.11.7.2 EPOXY-ENCAPSULATED TYPE

Consider isolation transformers for health care facilities or other applications where sensitive loads could be grouped and served by a dedicated transformer. The isolation shield should be grounded in the same manner as the secondary neutral of general-purpose transformers.

13.11.7.3 BUCK-BOOST

Provide where necessary to accommodate individual loads designed to operate at different voltages than the facility system (example 230V motor-driven appliance to be supplied from a 208V system).

13.11.7.4 K-FACTOR RATED UNITS / HARMONIC MITIGATION

Provide K-factor transformers for nonlinear (harmonics generating) loads (K-4 for 50 percent, K-13 if 100 percent nonlinear). Some caution should be exercised when using formulas to calculate theoretical K-factors, the need for units with ratings higher than K-13 is unlikely and should be justified in the Design Analysis. Consideration should be given to application of harmonic mitigation transformers in lieu of k-rated transformers where nonlinear (harmonics generating) loads are present in a facility. The advantage of harmonic mitigation transformers is that a significant portion of the harmonics can be cancelled out instead of just installing a k-rated transformer which is designed to accommodate the extra heat generated by the presence of harmonic currents. When treating these higher level harmonic currents, it is important to balance the load between the transformers, as only the balanced portion of the load is treated. Voltage distortion is normally greatest at the point where the equipment is connected to the distribution system. Therefore, to attain maximum benefit, harmonic mitigating transformers should be installed as close as possible to the panels they feed.

13.11.7.5 CONTROL TRANSFORMERS

Use of 120V control transformers with one fused leg and one grounded leg is recommended for all control circuits.

13.11.8 FEEDERS AND BRANCH CIRCUITS

13.11.8.1 SIZING

Sizes should be based on the load supplied (Panel board EMD) and voltage drop. The ampacity of feeder conductors should not be less than 30 amps, see NEC. Where more than one panel board is supplied, a diversity factor can be applied. Assume EMDs will be continuous (sustained for over 2 hours) and size conductors at 125 percent of EMD (or load the conductors to 80 percent maximum of their rated ampacity). JIS equivalent cable sizing should be specified for all projects.

13.11.8.2 TRANSFORMER FEEDER SIZING

Sizes for primary and secondary feeders for transformers are recommended to be based on transformer kVA. Use of kVA instead of EMD allows future load growth to utilize full use of the transformer capacity.

13.11.8.3 NEUTRAL SIZING

Use of full size neutrals should be standard practice (i.e. having the same ampacity as the phase conductors). Include back-up data in the Design Analysis for all cases where reduced neutrals have been permitted. For all applications involving discharge type lighting (fluorescent, HID) or other harmonics generating equipment (inverter, variable frequency drives, other solid state apparatus), the neutral must be treated as a current carrying conductor (see NEC Table). In data processing applications including personal

computers, the neutral must be sized larger than the phase conductors. Size the neutral at 200 percent minimum (of the phase conductors) unless a harmonic analysis or field data demonstrates that a smaller size would be adequate. Single-phase branch circuits with oversized neutrals should not share neutrals with other circuits.

13.11.8.4 DERATING

Ampacity of conductors is affected by two NEC derating factors. One is an adjustment factor that is applied when there are more three current carrying conductors installed in a raceway. When nonlinear loads are served, the neutral must be treated as a phase conductor. If a double size neutral is employed, count it as two line conductors. The other derating factor is for temperature correction. Temperature correction is required when the ambient temperature in a given area is different than 26°C - 30°C (78oF - 86oF). Typically installations where this would be a factor would include rooms with outside air ventilation such as mechanical and electrical rooms. The NEC also recommends considering temperature correction for circuits run in conduits on roof tops.

13.11.8.5 PARALLEL RUNS

Use of bus duct should be considered in lieu of parallel runs of cable when required ampacity is at or above 800A. Parallel runs of cable should be limited to 3 legs generally or 4 maximum. If these approaches are not practical, use of a higher distribution voltage should be given strong consideration (especially if a 208Y/120V system is involved). Use of cable sizes above 500 kcmil tends to yield minimal ampacity gains relative to cost. Substitution of parallel cable arrangements will generally be more cost effective and installation less cumbersome. Each leg must contain all circuit conductors (phase, neutral, and ground) in a common raceway to function properly and must be equal in length, size, configuration, materials, brand, etc. to ensure proportionate division of current. Equipment grounding conductors in each leg must be sized to carry the total fault current based on the rating of the upstream overcurrent device (i.e., per NEC Table which means that the grounding conductor is not down-sized to the size of the parallel conductor, but is sized to the breaker rating). Apportioning fault currents in the same manner as load currents is not acceptable.

13.11.8.6 CABLE AND CONDUCTORS

Sizing of wiring, conduit, and related items is to be based on use of copper conductors. When special cable (such as oil resistant) is required, the type should be identified, preferably on the drawings at specific locations or equipment. The requirement could be inserted in the specifications if it is applied generically. JIS equivalent cable sizing should be specified for all projects.

13.11.8.7 CONDUCTOR AND TERMINAL RATINGS

For USA products, most available terminating components and materials are UL approved based on use with 60°C conductor insulation in circuits of 100A or less and 75°C insulation in circuits over 100A. Designers should therefore size conductors using the 60°C ampacity column of NEC Table for sizes through #1 AWG and the 75°C column for #1/0 and larger. Size of conduit, however, should be based on THW

insulation (or type USE for underground feeders). For Japanese conductors, they should be sized per ampacity tables from manufacturer.

13.11.8.8 CONDUCTOR IDENTIFICATION

See UFGS 26 20 00 specification and designer notes.

13.11.9 RACEWAY AND CABLE TRAY

For USA products, sizing should be based on use of single conductor cable with THW or RHW insulation for conductor sizes #1 and smaller and THHN for #1/0 and larger. Designer can base conduit size on TW for all conductor sizes, if desired. JIS equivalent conduit sizing should be specified for all projects. Japanese metal raceways shall be specified wherever possible. In such cases, standard UL5 shall not be applicable.

13.11.9.1 CONDUIT

The NEC Tables, which prescribes minimum sizes of conduit, should be used with some discretion (limit to short runs with one bend maximum). To reduce the possibility of insulation damage, it is recommended that for longer runs or runs with two bends or more, raceways be sized one or two sizes larger than the minimums in the tables. Underground conduit should be sized on the basis of type USE cable. Japanese conduit shall be specified wherever possible. Set screw type fittings for metallic conduit shall be acceptable.

13.11.9.2 CABLE TRAY

Verify that cable fill does not exceed NEC Table. Covered tray is usually required - verify for specific projects.

13.11.9.3 SERVICE POSTS

Consider the use of service post for rehabilitation of existing facilities. Use of under floor systems is preferred in new construction (possible exception: large bay area with multiple desk locations that change periodically).

13.11.9.4 SURFACE MOUNTED RACEWAY AND WIREWAYS

Consider surface metal raceway, sized for multi-outlet application (e.g. Wiremold 3000 or 4000), in maintenance facilities with multiple work benches or test sets. Typically, mount on longer walls with receptacles spotted at 0.6-1.2 meter intervals and provide a parallel equipment/static ground bar. Smaller cross-section versions (e.g. Wiremold 1900 and 2000) may be considered for existing facilities where concealed installation would not be practicable and where the appearance would be less objectionable than conduit.

13.11.9.5 UNDERFLOOR SYSTEMS

In new construction, the preferred method of providing electrical support to scattered loads in the central portions of open expanses is installation of underfloor raceway or duct in the concrete floor. If extensive raceway volume is required to support concentrated demands or multiple services, the cellular floor configuration is recommended. Arrangements and details need to be coordinated with the structural and architectural designers. Service outlet fittings should be located at tentative locations of

Stakeholder loads. Provide 10-20 percent spare fittings if other direction is not furnished. If only a few devices would be required, use individual floor boxes supplied by conduit. In small offices with carpet and low volume or lightweight traffic, a ribbon type undercarpet cable system could be considered. Cable should be 5-conductor (3-phase, 4-wire plus ground), Type FCC conforming to NEC.

13.11.9.6 BUS DUCT AND CABLEBUS

When load demand reaches the 800-1000A range, feeder type bus duct should be considered in lieu of parallel cable runs. Plug-in type busway, overhead or wall mounted, would be recommended for industrial applications with multiple loads of 30A or more, particularly if the arrangement, size, and location would be subject to periodic changes in mission scope or function. Note that tap boxes (cable feeder/duct interface) are bulky; in finished areas an above ceiling placement is recommended. Cablebus can also be considered. If parallel runs are involved each leg must be of equal length.

13.11.10 MOTORS

13.11.10.1 ELECTRICAL CONSIDERATIONS

Sizes and Capacities should be based on the performance requirements specified for the specific equipment the motor is to power. It is preferred that single-phase motors be limited to 3/4 HP maximum. Since motor size typically cannot be exactly specified without being proprietary, one of the following (or something similar) should be placed on the plans:

- A note on appropriate sheets reading "Motor-use indicated. The H.P. rating shown is not mandatory if required equipment performance can be achieved with other sizes. See Specification."
- A note similar to the following on sheets containing motor, or panel schedules or electric power plans:
- "Horsepower and wattage sizes of motor loads and other equipment are indicated in panel schedules and one-line diagrams. These are tentative design values used to size electrical supporting accessories and materials. Since motor size can vary by manufacturer, actual sizes will be governed by performance criteria in the specifications or data on non-electrical plans. Electrical support items such as conduit, conductors, overcurrent devices (also panels, transformers, etc. if affected) should be increased in size if necessary to accommodate the equipment actually selected by the Contractor at no additional cost to the Government."
- "The horsepowers indicated are approximate. Motors are to be provided and sized in accordance with performance information given in other portions of the plans and specifications. If motors, or other components or equipment are furnished in sizes other than the design size indicated, it is the responsibility of the Contractor to adjust the indicated sizes of wiring, circuit breakers, etc. and to re-circuit if necessary at no additional cost to the Government. (See Specifications.)"

13.11.10.2 VOLTAGE RATINGS

When ratings are specified, ensure the value pertains to the motor (per NEMA MG-1) not the line (see paragraph "System Selections"). Note that 200V motors for use on 208Y/120V systems are available only in 3-phase versions, the proper single-phase motor rating would be 115V (120V nominal line to neutral). A 230V single-phase motor could be connected to a 240/120V system or to 2 poles of a 240V delta system.

13.11.10.3 ADJUSTABLE SPEED DRIVES (ASDS)

Coordinate selection of ASD type and layout specifics with the mechanical designer. Note that the variable frequency type will generate harmonics that can affect other input side loads and also reduce the output side efficiency; VFDs also have a tendency to oscillate on cold start. Consider use of filtering, isolation transformers, grouping of loads to maintain power quality. In some applications, alternate techniques such as multispeed motors, VAVs, eddy current drives, magnetic clutches, hydraulic couplings, DC motor, etc. may be more cost effective or reliable than ASDs.

13.11.10.4 HIGH EFFICIENCY AND PREMIUM EFFICIENCY MOTORS

High efficiency and premium efficiency motors should be applied as indicated by UFGS 26 20 00.

13.11.10.5 DISCONNECTING PROVISIONS

Disconnects should be shown on floor plans and one line diagrams. Since the disconnect and starter represent different functions, it is preferred that different symbols be used. The contractor should be allowed to provide combination starters at his option.

13.11.10.6 MOTORS AND APPLICATIONS

A disconnecting means should be provided for all motor operated equipment and fixed appliances. The disconnect must be in view from the motor or appliance location unless it is lockable. It is preferred that a local disconnect be supplied within the view of a motor or appliance, even if locking type disconnects would be available at the controller location. The safety switch configuration is preferred unless the motor is in sight of a panel, switchboard, motor control center, etc.

13.11.10.7 MOTOR SCHEDULES

For projects that will have a number of motors, a motor schedule that shows each motor name, horsepower rating, number of phases, FLA, and voltage used should be included in the electrical sheets.

13.11.10.8 MOTOR CONTROLLERS

- Control Circuits: Control voltage should be 120 volts. Circuits should be supplied via a control transformer with one fused leg and one grounded leg in the typical application (both legs fused if not grounded).
- Individual Starters: Electrically operated, electrically held magnetic starters are to be the norm for polyphase motors. Frequent on/off manual operation should

utilize pushbuttons in lieu of the on and off positions of the 3-position selector switch.

- Motor Control Centers: MCCs should be provided for applications involving large motors, numerous smaller motors, clusters of motors (mechanical equipment rooms, heavy equipment repair facilities, etc), or controls that extend to a variety of devices and/or interface with more than one controller. The preferred assembly configuration would be a Class I control center with Type B wiring (per NEMA ICS 2).
- Special Purpose Controllers: Reduced voltage starters should be provided whenever motor locked rotor current exceeds the rating of supply transformers or conductors. Coordination of motor and controller selection with mechanical designers must include requirements for special controllers such as multi-speed or reversing types.
- Switches: Switches with pilot lights used as indicators require 4 wires - 2 hot plus neutral and ground. Switches with lighted toggles ("night light") are interchangeable with conventional toggle switches.

13.11.10.9 MISCELLANEOUS LOW VOLTAGE APPARATUS AND EQUIPMENT

Circuit loading of fixed equipment should not exceed 80% of the circuit capacity.

13.11.10.10 HEATING APPLIANCES

Electric heating will be limited to supplemental uses unless specifically authorized.

13.11.10.11 PHASE CONVERTERS

Use of phase converters should be considered for remote applications with minimal loads (10 Hp pump, etc) located some distance from nearest three-phase line. The rotary type should be specified rather than solid state versions.

13.11.10.12 FREQUENCY CONVERTERS

Converters are typically used to supply 400 Hz power to aircraft and associated maintenance and test equipment. Government furnished motor-generator sets or solid state frequency converters are typically used. Electrical service to and from the designated converter locations is required. The more common sizes are the 15 kW MD-2, 30 kW MD-3, 50 kW MD-4, 60 kW ECU-105E and 100 kW EPU-5/E (input 23.3 kVA, 30.0 kVA, 83.2 kVA, 112.7 kVA, and 200 kVA at 480V).

13.11.10.13 DISCONNECTING PROVISIONS

See UFGS 26 20 00. A disconnecting means should be provided for all fixed appliances. The disconnect must be in view from the appliance location unless it is lockable. (Also see paragraph "Motors and Drives".)

13.11.10.14 ELEVATORS

Coordinate with architectural and structural designers to determine what components will be furnished by the manufacturer in the elevator package and what must be shown on electrical drawings (or described in electrical specifications). ANSI A17.1 (Safety

Code for Elevators and Escalators) requires a switched luminaire and a receptacle in the pit area; the typical elevator package does not include these items. Designers should also check for special requirements in local codes (it is the policy to conform to state codes on Government property whenever feasible). (See UFGS 14 24 00.)

In recent projects, local Japanese elevators have been deemed acceptable if the following information is provided:

- Get an official letter/memo from the elevator manufacturer stating the elevators can meet the requirements of ASME A17.1.
- The official letter/memo should also confirm the elevators meet the requirements from UFC 3-600-01, 4-12.4.

If the elevator manufacturer can provide this information, Japan District will review it for compliance.

13.11.10.15 CRANES AND HOISTS

(See UFGS 41 22 13.13 or similar sections.) The electrical designer needs to coordinate motor sizes and voltages, type and location of controls, routing and height of tracks and rails with structural, architectural, or mechanical designers as applicable.

13.11.11 SPECIAL APPLICATION – LOW VOLTAGE

13.11.11.1 INFORMATION TECHNOLOGY EQUIPMENT

Provide capability to shut off service to information technology equipment and HVAC by means of a shunt trip main circuit breaker controlled by pushbuttons (or similar arrangement) located at the exits of the information technology equipment area (See NEC). Emergency Power OFF (EPO) pushbuttons should be of the extended guard style and/or should have a safety cover to prevent accidental activation.

13.11.11.2 400 HZ DISTRIBUTION

Design needs to consider a variety of special techniques to compensate for high inductive losses - equipment needs to be designed specifically for 400 Hz operation or be capacity derated (cable, transformers, breakers, panelboards, etc). Conduit and equipment enclosures should be nonferrous to the extent practicable (PVC coated aluminum conduit, non-magnetic stainless steel enclosures and aluminum-housing bus duct preferred). Conductor sizing needs to take into account decreased amperage rating, increased inductive reactance (6.6 times the 60 Hz), and increased AC resistance. Single conductors will have the worst voltage drop and should be used for smaller loads and/or lengths. The next level up would be a jacketed three-phase power cable assembly. This type of assembly provides a lower voltage drop and is not much more expensive than single conductors. Another option is the use of contrahelically wound cable. Standard manufacture of these cables uses six phase conductors spiraled in an ABCABC rotation around a neutral (neutral and phase conductors all the same size) and a single ground conductor on the outside. This cable is more expensive and does require the conduit to be increased in size. The use of conductors over 1/0 AWG is typically not cost effective and parallel conductors should be considered. Use of Line Drop Compensators (LDC), adjustable to line conditions, is recommended for

applications with larger ampacity feeders, runs exceeding 45 meters, or where load type and configurations could change. LDCs must be 400 Hz type designed for aircraft application - the 60 Hz power line-regulating type is not suitable. Acceptable units are available from Teledyne Inet (Series ILD, 90 kVA), Rapid Power Technologies (90 kVA) and Hobart Bros (90 and 140 kVA). Recommended design references are "A Guide to 400 Hz Power Distribution" from Actual Specifying Engineer, February 1972 and IEEE 241 "Recommended Practice for Electric Power in Commercial Buildings".

Contact manufacturer application engineers for capability of specific products.

13.11.12 RECEPTACLES

13.11.12.1 GENERAL USE RECEPTACLES

Single and Duplex Receptacles for general purpose applications should be 15 amp, 125 volt, 2-pole, 3-wire grounding type. In general, a maximum of nine (9) duplex receptacles may be connected to a receptacle circuit, however, 5-8 receptacles is the preferred range for most circuits. Where the circuit is intended for low powered equipment, a higher maximum number of receptacles might be acceptable; and where a circuit is designed for shop type equipment (such as electric drills, soldering irons, woodworking tools, etc.) maintenance equipment, appliances, test instrumentation, medical apparatus, etc., as few as one or two receptacles might be acceptable. The number of receptacles per circuit should be the designer's judgment, based on economics and the above guidelines. Receptacle circuits should not supply lighting loads. In offices and dwelling rooms, general use receptacles on walls should be 3.5 meters (or 12 feet) on center. In other areas, receptacles may be up to 6 meters (or 20 feet) on center. The preferred design approach is to have a green grounding conductor installed with the power conductors. This is mandatory for Air Force Projects.

13.11.12.2 DEDICATED RECEPTACLES

Special use receptacles should be located where required by specific design criteria and should be designed to suit the equipment served. Receptacles and circuits should not be loaded to more than 80% of circuit or receptacle capacity. Floor cleaning receptacle circuits (simplex configuration, 20A, 120V, 1600W load) should be furnished in larger facilities (1,000 sq. m.) and considered for smaller buildings. Place at 15 meter maximum intervals in corridors.

Suggest using 400VA per computer receptacle with a maximum of 4 computer receptacles per 20A, 120V circuit.

13.11.12.3 AUTOMATIC RECEPTACLE CONTROLS

Provide automatic receptacle controls in accordance with ASHRAE 90.1 – 2013 per UFC 3-520-01, Section 3-17.

13.11.13 ELECTRICAL SUPPORT FOR FIRE PROTECTION

13.11.13.1 SUPPRESSION SYSTEM

Coordinate with mechanical or fire protection designer relative to types of systems and devices that will be specified. Provide connections to alarm contacts (water flow indicators) and supervisory contacts (OSY valves, PIVs, low pressure, etc).

13.11.13.2 FIRE PUMPS

Coordinate size and locations. Ensure that electrical design gives precedence to maintaining pump operation vs. motor protection. Fire pump installations, electrical service, and sizing of transformers, must conform to NFPA-20.

13.11.13.3 ELECTRONIC MONITORING SYSTEM

Coordinate requirements for monitoring fire alarm, smoke control, and other special systems with other designers as required.

13.11.13.4 FIRE PROTECTION CONFIGURATION

Coordinate requirements with fire protection, mechanical, or architectural designers as required. Ensure that fire alarm system is consistent with overall protection philosophies.

13.11.13.5 ELECTRICAL INSTALLATION IN FIRE BARRIERS OR SPACES

Recommended references are IEEE 446 "Emergency and Standby Power for Industrial and Commercial Applications" (Orange Book) and IEEE 141 "Electric Power Distribution for Industrial Plants" (Red Book).

13.11.14 LIGHTING DESIGN

The lighting system should be designed to meet the lighting levels prescribed in the UFC and IES, considering Stakeholder needs, energy efficiency and initial cost. Luminaires should be scheduled in the plans using a lighting fixture schedule. Loading of branch circuits supplying luminaires should not exceed 80 percent of the circuit capacity.

13.11.15 CRITERIA

Lighting design should generally be in accordance with the UFC and the "Lighting Handbook", published by the Illumination Engineering Society. The designer should take into consideration meeting proper uniformity levels per UFC, in addition to meeting the recommended illumination levels.

13.11.16 LUMINAIRE SELECTION

Lighting fixtures should be locally manufactured in Japan to the maximum extent possible, Japanese fixtures shall not be required to be Energy Star qualified. The lighting fixture details are to be placed on the project drawings. A visual representation with a generic description of performance and construction requirements should be placed on drawings. Examples of lighting fixture details are shown in the Standard Criteria Base (CCB) contained in standard drawing series CADD Electrical Lighting

Details; Construction Criteria Base (CCB); NAVFAC CADD Details at http://www.wbdg.org/ccb/browse_cat.php?o=78&c=232 .

Exterior applications should utilize enclosed luminaires in lieu of open type.

13.11.17 LAMPS, DRIVERS AND BALLASTS

Lamps should generally be LED type where Life Cycle Cost Effective. Self-Ballasted Mercury Vapor Lamps should not be used in new design. If fluorescent lamps were to be used, they should be specified as the rapid start type. Use of high frequency electronic (solid state) ballasts and T8 lamps should be permissible where LEDs are not deemed life cycle cost effective. The use of electronic ballasts in specific applications should consider harmonics generation, interference problems, and reliability problems with some brands. Electronic ballast performance must conform to the requirements specified in UFGS 26 51 00. The use of incandescent lamps should be limited to special applications only.

13.11.18 SELECTION OF GENERAL ILLUMINATION VS. TASK LIGHTING

Lighting directed to specific tasks should be given strong consideration when illumination levels exceeding 30 foot-candles are required (exceptions: drafting rooms, precision maintenance shops).

13.11.19 ENERGY EFFICIENT LIGHTING

13.11.19.1 APPLICATION REQUIREMENTS

Light Emitting Diode (LED) lamps should be specified in most cases. Where LEDs are deemed not Life-cycle cost effective or are restricted for other reasons, fluorescent lamps should be considered. Use low energy ballasts, and multiple switching of lamps, ballasts, or fixtures when possible. Avoid the use of incandescent lamps, low efficiency mercury vapor lamps and low efficiency ballasts. To avoid light level degradation due to short lamp lifespans of fluorescents, utilize LED or Induction lamps for high bay applications where cost effective.

13.11.19.2 LAMP BALLAST COORDINATION

Energy saving lamps typically must be operated with compatible ballasts and within specified environmental conditions in order to assure proper performance. In some cases, the lamp and ballast must be of the same manufacturer for optimum performance. If energy efficient lamps are to be used, the existing ballast must be replaced with an energy saving type or a conventional 40-watt ballast that is rated for use with either standard 40-watt lamps or the 34-watt energy saving type.

13.11.19.3 DESIGN CALCULATIONS

Energy related lighting calculations should be based on actual wattage of lamps and ballasts. Illumination calculations should use actual lumens of the particular lamp type or from manufacturers' catalogs and IES files.

13.11.20 EMERGENCY AND EGRESS LIGHTING

Emergency lighting systems, egress lighting, and exit signs should be provided in accordance with the requirements of NFPA 101. Illumination at points of egress must be a minimum of one foot-candle. Use of LED units is preferred followed by fluorescent. Fixtures containing radioactive materials are not acceptable. LED versions is encouraged (energy consumption approximately 15 percent of conventional type, with "lamp" life exceeding 10 years). For Air Force projects, comply with ETL 99-4 on Emergency Lighting and Marking of Exits.

13.11.20.1 BACKUP POWER PROVISIONS

Backup power for the emergency lighting system should be obtained from an Emergency Power System (battery inverter assembly), from an automatic standby AC generator, or from integral batteries. Individual self-contained battery unit type luminaires (Emergency Light Sets) is the preferred method when a generator or a battery inverter assembly is not available.

Where automatic standby AC generated power is available, a battery system will not normally be required. (The generator must be capable of supporting the load within 10 seconds of a loss of normal power. Central battery inverter systems (see Paragraph "Emergency Power System") should be used in facilities where more than seven battery powered exit and egress lights would otherwise be required and with express permission of the User. These systems have a history of high maintenance and with them being a single point of failure are typically not desired. Terminals or a receptacle must be provided to allow substitution of a temporary alternate source during a maintenance shutdown. Power must be supplied from a point which will be energized continuously under normal conditions and which will be automatically transferred to generated power under emergency conditions.

13.11.20.2 CONNECTIONS

The emergency or egress lighting system should be supplied from a dedicated distribution system. If the emergency or egress lighting system is off of a single unit such as a central battery inverter, it needs to be connected to a dedicated disconnecting means. Otherwise, individual battery units are connected to the light fixture circuit. Egress lighting (exit lights and egress luminaires in corridors) must be connected in a "nightlight" mode (i.e., unswitched and connected to a source with backup power). Emergency lighting, which is supplementary and not mandatory to comply with life safety provisions, may be connected in a "standby" mode. Such luminaires may be locally switched, if a third unswitched lead is extended upstream of the local switch to monitor building power (i.e., one switched wire, one unswitched, and one neutral to the luminaire). Provide notes or symbols on drawings to ensure proper connections. Wall mounted emergency light sets must be direct wired; cord-connected assemblies are not authorized. If a flexible connection is desired, extend liquid-tight conduit from an adjacent junction box. In areas with high intensity discharge (HID) lighting, emergency lighting should stay on for at least 10 minutes after power returns to ensure the HID lights are on.

13.11.20.3 LOAD ALLOWANCE FOR EGRESS LIGHTS

Virtually all LED exit light drivers operate at low power factors (0.4 - 0.5 for 120V units, 0.25 - 0.4 for 277V). Inverter sizing and energy calculations must use the values from the manufacturer as much as possible.

13.11.20.4 ELECTRONIC BALLASTS

Use of electronic ballasts is encouraged for applications where high frequency interference would not be a concern. Design must also consider possible effects of input side harmonics generation. Use of electronic ballasts should be avoided in health care areas and electronics maintenance shops.

13.11.21 RECOMMENDED CIRCUIT CONFIGURATIONS FOR LIGHTING

13.11.21.1 INTERIOR APPLICATIONS

Only line to neutral circuiting should be employed for interior lighting installations. Utilize higher line to neutral voltages in larger facilities to mitigate voltage drop.

13.11.21.2 EXTERIOR APPLICATIONS

The supply circuit should be multiple type for new facilities; series type circuits should be limited to rehab type projects or expansions of existing facilities. Street lighting circuits may be designed for 10% maximum voltage drop if constant wattage ballasts are used, 5% maximum is preferred for other lighting.

13.11.22 LIGHTING CONTROLS

13.11.22.1 PHOTOCELL

Use photocells for control of individual luminaires on buildings, along roadways, and other exterior locations if suitable. Place photocell on a south-facing wall and where it cannot be obstructed from sunlight when using one photocell to control multiple light fixtures.

13.11.22.2 CONTACTOR

Provide contactors to switch multiple or higher amperage circuits, for combined manual and automatic control, and for multi-function operating arrangements.

13.11.22.3 VACANCY/OCCUPANCY/DAYLIGHT SENSORS

Vacancy sensors should be used in small and confined spaces such as individual office spaces and storage rooms. Occupancy sensors may be considered for locations such as corridors and restrooms where use would be intermittent and where control would generally be accessible to several individuals or functions. Dual-technology sensors (Passive Infrared and Ultrasonic combined) are preferred. Use of traditional manual on/off light switches should be utilized where automatic off of lights can be a life safety concern such as in mechanical/electrical rooms. Daylight sensors should be used to the maximum extent possible. Coordinate regularly occupied spaces that have daylight access with Architecture.

13.11.23 SPECIFIC LIGHTING APPLICATIONS

13.11.23.1 GENERAL OFFICE LIGHTING

Target illumination level should be 30 foot-candles with task lighting to supplement the general illumination. Recessed light fixtures are preferred in the typical applications. Consider multilevel switching in perimeter rooms and in larger areas subject to variable use, but do not use multilevel switching as a means of manual energy conservation.

13.11.23.2 AREA LIGHTING

Area lighting type luminaires should be provided in areas where general illumination is desired and walkway, parking lot, and/or street lighting is not considered sufficient. Luminaires mounted on the exterior of a building may be used as part of, or to supplement, area lighting. All exterior luminaires should be full cut off luminaires to mitigate any uplight.

13.11.23.3 STREET LIGHTING

If power lines run parallel to a roadway, luminaires may be installed on the distribution poles.

13.11.23.4 PARKING AREAS

Illumination should be provided for all parking areas unless directed otherwise. Target level should be 0.2 foot-candles average (horizontal) except at handicapped spaces where 1-2 foot-candles is desirable.

13.11.23.5 SECURITY LIGHTING

Refer to project criteria package and to UFC 3-550-01. If contactors are used, specify the electrically operated, mechanically held type.

13.12 LIGHTNING PROTECTION AND GROUNDING DESIGN

13.12.1 LIGHTNING PROTECTION

Lightning protection should be designed as a stand-alone system and not share components with other systems. Ground electrodes of other systems should be interconnected below grade and other portions may be interconnected as appropriate, but a single ground rod and a single conductor to ground would not normally be acceptable. (See NEC)

13.12.1.1 LIGHTNING PROTECTION FOR FACILITIES

A risk assessment analysis per NFPA 780 is recommended to determine probability of loss due to lightning striking an unprotected structure. Note that some structures can have a comparatively high potential for being hit by lightning, but a much lower probability of loss (steel compared to wood structures). The analysis puts primary emphasis on the risk to the structure vs. damage to contents or injury to occupants. Air Force projects also need to comply with AFI 32-1065. AFI 32-1065 has special requirements regarding connections, which are not standard for lightning protection systems.

13.12.1.2 AMMUNITION PLANTS

Design typically comply with AMCR 385-100 Safety Manual, as directed by the Stakeholder.

13.12.1.3 STORAGE TANKS

Tanks should be grounded. They will not require air terminals if the wall thickness is more than 3/16-inch thick.

13.12.1.4 OTHER APPLICATIONS

In general, other facilities will require protection as determined by the criteria in Army TM 5-811-3 or when so directed by the Stakeholder.

13.12.1.5 LIGHTNING PROTECTION FOR ELECTRICAL SYSTEMS

Surge Arresters: Protection will usually be accomplished via surge arresters or suppressor and proper grounding techniques. The path to ground should be as short and straight as possible to minimize voltage buildup and secondary flashes and alternate paths to ground. To best ensure this objective, the lightning protection configuration should be laid out first and then the protected components positioned in parallel.

13.12.2 GROUNDING

Information on grounding of power systems is available in the IEEE Green Book (IEEE 142 "Grounding of Industrial and Commercial Power Systems"). If the application involves sensitive electronics testing, maintenance, communications, or data processing functions, Mil Hdbk 419A "Grounding, Bonding, and Shielding for Electronic Equipments and Facilities", ANSI_TIA-607 “Telecommunications Bonding and Grounding”, and IEEE 1100 (Emerald Book) should be utilized for reference and design criteria.

13.12.2.1 OBJECTIVES

Equipment and systems are grounded for several reasons; to increase the operating stability of power systems, to minimize damage to equipment, prevent malfunctioning of equipment, and to provide for safety of personnel.

Designers should strive to reduce voltage differentials between equipment and systems, provide low impedance paths for fault currents, and select configurations with the least probability of developing circulating currents.

13.12.2.2 TRANSFORMER GROUNDING

The preferred power system configuration for both primary and secondary distribution is the grounded wye connection with the system neutral connected to ground at transformer locations and at building services. If a delta tap is made off the wye system, the neutral should be extended to the building service to ensure a low impedance path for fault currents and proper operation of overcurrent devices.

Pad-Mounted Transformer:

- If the transformer is delta on the primary, but the primary system voltage is a grounded-wye, be sure to bring the neutral (grounded conductor) and connect to the ground lug on the transformer.
- If the transformer is grounded-wye grounded-wye, then the primary neutral and secondary neutral are to be tied together at the X0 terminal.
- Frame of the transformer is to be grounded from the high voltage equipment pad and the low voltage equipment pad.
- On a grounded-wye secondary, a ground strap is required from X0 to the frame, since UFGS 33 70 02.00 10 requires X0 to be isolated from the frame.
- If a building has a lightning protection system with a ground ring and the transformer has a ground ring and the ground rings are within 7.5 meters of each other, then it is suggested that the rings be interconnected below grade.
- Service from transformer to building should not have a grounding conductor. NEC does not require this conductor. If the service is a bus duct, there may be a benefit to installing a grounding conductor of the same size as the neutral. This is a designer's choice.
- Install a counterpoise around concrete pads connected to 2 rods minimum (4 preferred, one at each corner).
- Extend separate conductors from arresters and transformer neutral/housing.

Neutral Grounding Methods: Solidly grounded neutrals should be the normal practice. If resistance or other techniques are employed, provide backup data and reasoning in the Design Analysis.

13.12.2.3 LIGHTNING AND SURGE PROTECTION

Facilities and equipment subject to lightning and other voltage surges require low impedance conductors connected directly to ground to dissipate overvoltages away from protected components. The path should be as short and straight as possible to minimize voltage magnitude and flashover to adjacent items. Ground electrodes must be interconnected below grade with any electrodes of other systems located within 7.5 meters (interconnection is recommended within 30 meters).

13.12.2.4 EQUIPMENT GROUNDING

All electrical equipment should be connected to an equipment grounding conductor sized per NEC Table. A separate cable must be provided if nonmetallic raceway is used and for receptacle circuits in EMT. Separate grounding conductors are also required for feeders and motor circuits. Large metal items within buildings should be interconnected to the equipment ground system. Equipment ground conductors should not be extended between the building service and the service transformer when the neutral is bonded at both locations. If a ground conductor is extended and both ends are interconnected (bonded) to neutral and ground in the usual manner, neutral current can flow on the equipment conductor in violation of NEC.

13.12.2.5 SIGNAL REFERENCE SUBSYSTEM

A signal reference ground configuration should be provided in electronics facilities with strict performance requirements. The objective is to interconnect equipment in a given

location to ensure that each item operates at the same reference voltage and all enclosures are maintained at the same voltage. Techniques vary depending on operating or processing frequencies of the equipment involved. Design should be as prescribed in Mil Hdbk 419A and IEEE 1100.

13.12.2.6 STATIC

Provisions for dissipating static buildup should be provided for fuel handling locations, at aircraft parking locations, and other similar applications. The grounding receptacle detailed in TM 5-811-3 (Fig 3-1) may be used in the absence of other direction; a shepherds hook configuration is often required for aircraft facilities. See AFM 85-16.

13.12.2.7 BONDING CONSIDERATIONS

Bonding involves connection of equipment to grounding conductors, conductors to electrodes, interconnections between systems and equipment. Buried connections below grade should be made by the exothermic weld (thermo weld) process or equivalent. Below grade connections in wells and exposed above grade connections may use pressure connectors or set-screw clamps. The main bonding jumper (neutral to equipment ground and equipment ground to enclosure) should be sized per NEC Table and equipment bonding jumpers should be sized according to table.

- **Multi-Point:** Multi-point grounding is the recommended procedure for long lengths of distribution line to limit voltage gradients to approximately 25 volts. Neutrals of overhead lines should be grounded at each pole, in addition to each transformer, and arrestor. Shields of underground cable should be grounded at each manhole and splice.
- **Single Point:** See IEEE 1100 and Mil Hdbk 419A:
- **Isolated Arrangement:** The NEC requires all electrical equipment and other items to be connected to the equipment grounding conductor. This normally results in multiple connections between the end use load and the service entrance location. Separate conductors dedicated to specific loads can be connected from the load directly to the service point without intermediate connections. This arrangement is recommended for personal computer applications (with corresponding isolated ground type receptacles).
- **Supplemental Provisions:** Equipment ground conductors need to be installed in the same raceway as corresponding supply conductors to conform to the NEC. Additional ground conductors, bonding jumpers, and ground electrodes can be included as supplemental measures once the basic NEC equipment grounding path has been provided.

13.12.2.8 ELECTRONIC SUBSYSTEM

PERFORMANCE REQUIREMENTS

Effectiveness of the electrode subsystem will be evaluated by resistance measurements. The preferred procedure is the fall-of-potential method using a reference electrode (see "Standard Handbook for Electrical Engineers" by Fink and Carroll or Biddle Instruments (AVO International) Ground-Resistance Testing Manual "Getting Down To Earth". For conventional power system grounding, the target level

should be 15 ohms with a maximum permissible upper limit of 25 ohms. If an electronics facility is involved, target levels under 5 ohms are generally desired. Special electrode arrangements and testing techniques (bridge type instrumentation) are typically necessary.

MADE ELECTRODES

Each building must be supplied with at least one made electrode. The preferred type is a copper or copperclad 10-foot rod. 8-foot rods are acceptable at individual overhead line-poles. Multiple installation of rod-type electrodes is most effective when rods are horizontally spaced at approximately twice the vertical length of the rod.

WATER PIPE

Interior metallic water piping should be bonded to the equipment grounding system. Exterior water piping may be interconnected with the made electrodes, but it cannot be substituted for the made electrode. Jumpers must not be connected across cathodic protection isolation fittings.

GROUND RING

A ground ring should be provided around facilities where lightning protection is to be installed, and at munitions igloos, transformer pads, and other facilities such as electronics test labs. Provide a minimum of 4 ground rods.

GROUND GRID

Design of a grid configuration with all components bonded is recommended for transmission substations or switchyards.

UFER SYSTEM

In areas with dry soils of high resistivity values, traditional grounding methods are frequently inadequate. In the Ufer system, the electrode consists of 6- 15 meters (or 20-50 feet) of bare copper conductor (#4 min) placed horizontally in concrete - typically the building foundation or sidewalls. Connection to rebar or additional conductor length improves performance. This arrangement has demonstrated consistent superior performance over extended periods. Note that every building design with rebar installed in concrete such as the footings should have the rebar tied to the grounding system, EXCEPT when concrete installed has insulation, vapor barriers, films or similar items separating concrete from the earth. See NEC, Section 250.52.

DEEP WELL SYSTEM

In areas with sandy soil and low water table, the deep well system should be considered. Wells are drilled into the water table, casings and deep electrodes installed. A ground ring arrangement should be installed to interconnect the deep wells and all facilities. Note: An environmental permit is usually required any time the water table is penetrated.

GROUND WELL

Provide ground wells where periodic access to ground electrodes is desired for testing the grounding system or for temporary grounding of special equipment. Common

applications are munitions facilities (in ground ring) and avionics maintenance shops (in floor adjacent to test sets). Use a 10-foot rod within a sewer-pipe end cap for conductor connections and provide a corrosion resistant cover.

SPECIAL ARRANGEMENTS

Supplemental electrode installations arranged in triangle or star patterns may be provided for specific electronics applications or shielded vaults. The subsystem should have the traditional connection to building service unless the installation is electrically isolated from the rest of the structure (insulating barriers, isolation transformers, etc). Below grade interconnection of the electrode subsystems is recommended.

13.12.2.9 SPECIAL APPLICATIONS

OVERHEAD LINES

Connect neutral to ground at each line pole and transformer pole, plus separate arrester connections.

GUY WIRES

Guy wires connected to structures supporting conductors with a potential of more than 300 volts should be effectively grounded as follows:

HIGH RESISTIVITY SOILS

In soils with resistivity of 30,000 ohm-cm or greater, guy wires may be connected to the system neutral if the system neutral is solidly grounded. Guys may also be grounded through the pole ground wire if the pole ground wire is connected to a grounded neutral (preferred method). In either case, the connection to the guy wire itself should be coated with silicone grease or other water inhibitor.

LOW RESISTIVITY SOILS

In soils with a resistivity of less than 30,000 ohm-cm and where corrosion of underground structures is a problem, galvanized anchors and guys should not be connected to copper grounding systems since severe corrosion may result. Strain insulators should be installed in the guy wire in lieu of grounding. Insulators may be either the cross- connected porcelain type ("Johnny ball") or the fiberglass rod type, however the flash over rating (wet) must be equal to the phase-to-phase voltage of the electrical circuit.

UNGROUNDED APPLICATIONS

On systems where a grounded neutral is not present, the above mentioned guy insulators should be installed. If this is not possible, then the guy must be grounded and galvanized ground rods must be used.

UNDERGROUND CABLE AND MANHOLES

Ground the cable and hardware. See UFGS 33 71 02.

13.13 SEISMIC DESIGN REQUIREMENTS (OF ELECTRICAL SYSTEMS)

The following provides information on the fundamentals on the subject, and highlights various frequently overlooked aspects. *(Code and criteria references are included in parenthesis.)*

Acceptable Alternatives:

- Japanese components and technical criteria shall meet the functional intent of ASCE 7-10, and UFC 3-310-01. DoR shall identify all Acceptable Alternatives in the Design Analysis.

Designated Seismic Systems:

Identify Designated Seismic Systems in the 01 45 35, Statement of Special Inspections (Ex; switch gear, panels, emergency fixtures, UPS, inverter etc.) and Schedule of Special Inspections. *(IBC 2018, 1705.12.4.)*

Key information for Designated Seismic Systems can be found in ASCE 7, 13.1.3 and UFC 3-310-04, 2-13.6.10.3.

- Electrical Designated Seismic Systems are part of Risk Category I, II, III, and IV structures.
- Specify component certification per ASCE 7, 13.2.2, and UFC 3-310-04, 2-13.2.2.1.
- Specify name plate per UFC 3-310-04, 2-13.2.2.2. Locate name plate on or adjacent to equipment.
- For electrical equipment, components and systems in Risk Category I, II, III and IV structures, two separate lists of nonstructural components must be provided; components/systems with Ip= 1.0 and components/systems with an Ip = 1.5 (designated seismic systems). *(Specifications 26 05 48.00 10, 1.2.2; Also reference ASCE 7-10, 13.1.3.)*
- Automatic Transfer Switch: Identify this component as a Designated Seismic System, with an Ip = 1.5. *(ASCE 7-10, 13.1.3)*
- Generator: identify this component as a Designated Seismic System, with an Ip = 1.5 *(ASCE 7-10, 13.1.3)*
- Emergency generator, ATS, switchgear, and control panelboard shall be certified by NIPPON Engine Generator Association (NEGA) and in conformance with Fire Protection Law of Standby Generator. Component requires name plate and special inspection.

Common Electrical General Notes (DoR to edit, per project requirements):

- Pendant Fixtures: Install restraining devices (cabling) to hold stems in the support position. *(UFC 3-310-04, B-3.5.2).* Pendant fixtures shall be supported directly from the structure above using no less than No. 9 gauge wire or an approved support *(ASTM E580, 4.4.6)*
- Light fixtures weighing less than or equal to 10 lb. shall have two No. 12-gauge safety wires connected from the fixture housing to the structure *(ASTM E580, 5.3.5 and Acoustical Ceiling Manufacturer).*

- Lighting fixtures weighing greater than 10 lb [5 kg] shall have two no. 12 gauge [2.70 mm] safety wires connected from the fixture housing (not detachable end plates to the structure above. *(ASTM E 580)* Lighting fixtures weighing greater than 56 lb [25 kg] or more shall be supported directly from the structure above by approved hangers. *(ASTM E 580)*
- Downlights shall not rely on ceiling panel for support. *(NFPA 70, 410.36)*
- Surface mounted lighting fixtures shall be positively clamped to the grid. Clamping devices for surface mounted lighting fixtures shall have safety wires to the grid or structure above. *(ASTM E 580)*
- Fixtures attached to the underside of structural slab should be properly anchored to the slab at each corner. *(UFC 3-310-04, B-3.5.2)*
- Luminaires shall be securely fastened to the ceiling framing members by mechanical means. *(NFPA 70, 410.36)*
- Brace all components weighing 400 lbs. (1,780 N)or greater and a center of mass 4 ft. (1.22m) above the floor. *(ASCE 7, 13.1.4)*
- Thickness of the isolation pad installed under the transformer legs shall be taken into considered when calculating anchor embed depth.
- Each surface-mounted individual or continuous row of fluorescent fixtures shall be attached to seismic-resisting ceiling support system. Support devices for attaching fixture to suspended ceilings shall be locking-type scissor clamps, full loop bands or hanger wires at each corner *(UFC 3-310-04, B-3.5.2)*
- C-type beam and large flange clips are permitted for hangers provided they are equipped with restraining strap. *(ASCE 7, 13.4.6)*
- Raceway supported by hangers and each hanger in the raceway run is 12 in. or less than length from the raceway support point to the supporting structure are exempt. Where the rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod *(ASCE 7-10, 13.6.5.6).*
- For the purposes of calculating weight of raceways, assume cable tray is full and brace *(UFC 3-310-04, B-3.2.3 ISAT).*
- Conduit 2.5 in. and greater and attached to panels, cabinets or other equipment subject to seismic relative displacement Dp, shall be provided with flexible connections. *(ASCE 7-10, 13.6.5.6)*
- Underground conduit 4 in. and greater shall have flexible couplings installed where conduit enters the building. (See Specifications 23 05 48.19, para. 3.3.2).
- Where conduit, cable trays, or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements. *(ASCE 7,13.3.2. and 13.6.4.)*

CHAPTER 14 - TELECOMMUNICATIONS

14.1 GENERAL

This chapter covers instructions for the preparation of drawings, specifications and design analysis as related to power, lighting, cathodic protection, and electronic systems as well as energy conservation features. Fire alarm system connections are covered in the chapter on Fire Protection.

14.2 DESIGN CRITERIA

Government design and contracting activities are controlled by Federal Acquisition Regulations (FARS). The details of the electrical design should conform to the electrical portions of applicable military design and construction manuals and supplementary criteria documents as listed in the following paragraphs. The Japan District Design Guide should serve as the basic criteria document for electrical design of Corps of Engineers projects. Whenever reference is made in this chapter to any publication, standard or code, or paragraph therein, the issue/version of publication indicated in the AE contract should be used unless direction is provided to the contrary. If dates are not indicated in the AE contract or in the absence or other direction, the issue/version of publication in effect at the time the design was started should be used. Many Army publications are available electronically at http://www.wbdg.org/ccb/ccb.php. Many of the Air Force publications are available electronically at http://www.epublishing.af.mil. These sites are to be consulted to ensure the latest versions are used. New documents found at the sites, which are not in the list should be brought to the attention of the Japan District Electrical Section to see if it should be followed.

TELECOMMUNICATIONS INDUSTRY ASSOCIATION / ELECTRONIC INDUSTRIES ASSOCIATION (TIA / EIA)

TIA/EIA-568-B	Building Telecommunications Wiring Standards
TIA/EIA-569-A	Commercial Building Standard for Telecommunications Pathways and Spaces
TIA/EIA-570-A	Residential and Light Commercial Telecommunications Wiring Standard
TIA/EIA-606-A	The Administration Standard for The Telecommunications Infrastructure of Commercial Buildings
ANSI/J-STD-607-A	Commercial Building Grounding and Bonding Requirements for Telecommunications
ANSI/TIA-607-C	Telecommunications Bonding and Grounding (Earthing) for Customer Premises

In applications limited to installation of outlets, cable, and raceway, provision of grounding should be sufficient. Additional measures such as spark gap arresters or surge suppressor should be considered where an entire system is to be installed.

14.3 DESIGN SUBMITTAL REQUIREMENTS

See Chapter 13.2 “Design Submittal Requirements” under Electrical.

14.4 COMMUNICATIONS – VOICE AND DATA

14.4.1 BASIC REQUIREMENTS AND SCOPE

The telecommunications system design should comply with NEC, Corps of Engineers specifications, TIA/EIA 568A, 569, 607, I3A, and any base-specific requirements. Outside plant should conform to REA publications in the absence of other criteria. The design should form a complete communications system, including, but not limited to: wires, terminations, raceway, cabinets, and outlets, as determined by the criteria for each project. In addition, it will also be necessary to provide instruments and switching equipment. Since head-end equipment and portable items involve a different funding category, the design documents need to separately address this portion of the system. Isolate physically on drawings or flag by symbols, annotations, descriptive notes, etc. to allow quick identification and takeoffs for cost estimates. The designer should consult with the Stakeholder to verify communication requirements.

When involved with a large complex or building (i.e., multi-building complex, etc.), make a determination as early as possible if a private automatic branch exchange (PABX) is or will be planned. PABX installations require special considerations (e.g., space, additional HVAC, vented exhaust systems for batteries, rated walls, hazardous area, etc.). Often, the plans for a PABX may not be stated in the specific project document. State any requirement or anticipated plans for a PABX in the concept design analysis along with all data justifying this need.

14.4.2 RACEWAY AMD CABLE TRAY

For Army projects, provide a conduit system in accordance with Technical Criteria for Installation Information Infrastructure Architecture (I3A). For Air Force projects, provide conduit system in accordance with Air Force Base Area Network Functional Specification 2013. For larger facilities, use of cable tray in corridors is recommended in lieu of individual conduit home runs.

14.4.3 CABLE

Inside cable will be presumed to be in the project scope unless specifically directed otherwise; outside cable will be normally be provided by others under separate contract. Scope should be confirmed at initial design stage. All raceways, cabinets, backboards and boxes will be installed with necessary wiring.

14.4.4 OUTLETS

Provide 8-pin USOC type RJ-45 jacks (verify with Stakeholder).

14.4.5 TERMINATING EQUIPMENT

Outlet and Cabinet (or Backboard) locations (prior to final design) should be provided in accordance with designer's best estimate of the communications requirement. This is necessary for cost estimation. Final locations should be coordinated with the local Communications Installation Engineers prior to final plan submittal.

14.4.6 UNDERGROUND DUCT

Installation in concrete encased duct should be the standard method. If primary power follows the same routing, install in a common duct bank. An extension directly into a building from an adjacent communication pole may be in non-encased PVC if the Stakeholder has no objection.

14.4.7 DRAWINGS

Provide complete riser diagram for each system. Identify location of components by room number, building name or number, etc.

14.5 SPECIAL COMMUNICATIONS AND DATA SYSTEMS

14.5.1 PUBLIC ADDRESS SYSTEMS

Public Address Systems should be provided in accordance with UFGS 27 51 16. Public address systems encompass many applications of amplified voice and music used for entertainment and distribution of voice messages. They run the gamut from a speech reinforcement system in a conference room to a frequency equalized voice and music system for an auditorium, and on to a complex multi-zone system used for both background music and selective paging by zone with multi-media selectable inputs and area level control with paging capability. Most systems involve amplifiers, loudspeakers, and a program input. Inputs include microphones, AM/FM tuners, tape decks, phonographs, and compact disk players. Many configurations can be developed using standard equipment to fit any desired operational requirement. Each system is to be designed to meet the user's criteria requirements.

In many cases, space limitations dictate the use of wall-mounted amplifiers. Dual voice coil speakers should be used for background music systems that require voice paging to override the music levels. The use of miniature relays at zone volume controls to override volume control settings for paging should be avoided. In small systems employing relatively short runs of audio bus cable and low power requirements, a 25-volt distribution system should be used. Where long runs with high power requirements are levied on the distribution network, a 70-volt system should be used. The choice of all system components should be based on design calculations. These calculations should begin with the desired sound pressure level to be achieved in each area and be developed through the system to establish component power capacity and wire sizes.

Specifications should include sufficient technical data to establish minimum equipment quality levels. This data should include frequency response, distortion, RMS power capacity, and minimum number and types of controls. Public address systems should be designed in accordance with the specifications and EIA standards for sound systems.

All-channel paging, consisting of paging microphone, push-to-talk switch paging amplifier, and one or more paging relays, should be provided. All accessories, material and other equipment for a complete public address system should be furnished. The system should be accessed via the telephone system and may be located in the main telephone equipment room for convenience of interfacing. The design of Public

Address System must be coordinated with the telephone system and the user. The system must be sized to be audible at all points throughout the facility. The system can be accessed through individual telephone handsets as well as through PBX switch. The system should provide hands free talk back capabilities in lab areas.

At a minimum, separate paging zones should be provided for the following areas: Administrative offices, Chemical labs, Biological labs, General office areas, Hazardous storage areas, Parking lots, and Exterior secured areas. In multi-floor facilities, further zoning will be required. Controls for individual speaker units should be wall mounted and include volume control and on/off switching.

14.6 FIBER OPTICS

Use of fiber optic cable is encouraged by USACE. FO cable is preferred for LAN backbones and for the voice and data links between buildings. Category 6 type copper wire should be used for horizontal wiring within buildings. Fiber Optic cable should not be used for telephone systems that include PBX type equipment.

14.7 ELECTRONIC SECURITY SYSTEMS

Determine the scope and extent of the electronic security systems (ESS) to be included in the project during the initial planning charrette. ESS includes intrusion detection systems (IDS), access control systems, closed circuit television (CCTV), and duress alarms. Coordinate ESS responsibilities with JED, the project owner, and the base security department. Include in the planning charrette report a list showing the responsibilities of each member of the project delivery team. The list should show how much of the ESS the AE will design (raceways and boxes only, system components, etc.), shall discuss the level of involvement and the responsibilities of outside organizations such as SPAWAR, and shall show which equipment items are project funded and which are funded by other sources.

14.7.1 INTRUSION DETECTION SYSTEMS

See AR 190-13 and other regulations pertaining to specific types of projects. Design direction and supervision is available from the ESS-MCX (Center of Expertise) at Huntsville Division.

A lockable circuit breaker should be reserved for the Intrusion Detection System primary power connection in the 120V power panel located nearest the service entrance.

All signal conductors outside component enclosures must be enclosed in rigid, heavy wall conduit or intermediate metal conduit (IMC). Power cable from the Control Unit and the Monitor Cabinet to their respective junction boxes may be in electrical metal tubing (EMT).

14.7.2 IDS SUPPORT

In a majority of projects, raceway rough in is sufficient plus circuits for 120V power supply.

14.7.3 ACCESS CONTROL

Coordinate with architectural and civil designers as applicable. Generally, providing supply circuits and raceway rough in is sufficient for electrical support.

14.7.4 CCTV

The video security system, where required, should be integrated into the overall function of the facility. Placement of cameras must be carefully considered in order to avoid dead zones. Conduit and wiring should be installed for the system and a camera should be installed at all entrance and exit areas. The location of the camera should be suitable for monitoring people movement when entering or leaving the building and an emergency circuit should provide power for each camera location. Conduit, wiring, cameras, etc., should also be installed in all parking lots, loading docks, and computer areas to provide monitoring.

Cameras should be of the fixed or pan-tilt-zoom type as required for each specific location. Camera components should include cameras, lenses, fixed and remote-control camera accessories, camera housing, and environmental options. Cameras should be housed in proper enclosures for the environment in which they are to operate (e.g., defrosters, heaters, weatherproof enclosures, corrosion resistant or vandal proof enclosures, etc.).

All cameras should be monitored/controlled at the facilities central control station. Monitors should be event driven. Monitor components should include monitors and monitor mounts. Digital video recording equipment should be provided where required, to record unauthorized access (control by guard). A 120 volt single duplex receptacle (emergency power) should be provided immediately adjacent to all CCTV camera locations.

14.7.5 DURESS ALARMS

Determine during the planning charrette the feasibility of any duress alarms that may be requested or required by the owner. Determination shall be based, in part, on the availability an alarm monitoring point, the capacity of the monitoring point, the location of the monitoring point and its distance from the project site, and the type of connection required (hard wired or wireless).

CHAPTER 15 - SUSTAINABILITY

NOTICE TO PRACTITIONER:

All designs and products should be fully accomplished in SI Units throughout the entire design and should be performed in compliance with paragraph 1.4 METRIC POLICY of this guide.

15.1 GENERAL

This section covers requirements for successful implementation of Sustainable Design and Development (SDD).

Sustainable Design and Development is an integrated approach to planning, designing, constructing, operating and maintaining facilities in an environmentally-sensitive manner. Building construction and operation have an enormous direct and indirect impact on the environment. This "sustainable" approach supports an increased commitment to environmental stewardship and conservation, and results in an optimal balance of cost, environmental, societal, and human benefits while meeting the mission and function of the intended facility or infrastructure. The main objectives of sustainable design are to avoid resource depletion of energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create built environments that are livable, comfortable, safe, and productive.

15.2 DESIGN CRITERIA

The design publications listed below are the key criteria for sustainable design. The criteria from these sources may be supplemented, but not supplanted, by applicable criteria contained in nationally recognized codes, standards, and specifications.

Many of the referenced government engineer publications can be found in the Whole Building Design Guide at https://www.wbdg.org/ffc/dod.

Design effort associated with the development of the design documents shall be based on all applicable requirements/criteria, including, but not limited to, the latest versions of the following. In the event any conflict is noted between any requirements/criteria, the more stringent should apply unless specifically noted otherwise:

- HQ AFCESA/CEO ETL 08-13, Incorporating Sustainable Design and Development (SDD) and Facility Energy Attributes in the Air Force Construction Program
- HQ USAF/A7C memo, Air Force Sustainable Design and Development (SDD) Implementing Guidance
- Department of the Army ASA IEE memo, Sustainable Design and Development Policy Update

- NAVFAC ECB 2014-02, NAVFAC Sustainability and Energy Building Requirements
- UFC 1-200-02, High Performance and Sustainable Building Requirements,
- ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings
- LEED BD+C v4 Rating System: https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version
- Green Building Certification Inc. (GBCI) DoD Guiding Principles Certification Program: https://www.usgbc.org/articles/understanding-federal-compliance-and-guiding-principles

15.3 SUSTAINABILITY IMPLEMENTATION

15.3.1 THIRD PARTY CERTIFICATION

Projects meeting the thresholds for Third Party Certification (TPC) in Table 1-1 of UFC 1-200-02 shall obtain third party certification validated by the TPC provider. Projects located on Army Installations shall use the applicable LEED rating system for the project type and achieve at least LEED Silver certification. All other projects in the JED AOR shall use the USGBC/GBCI DoD Guiding Principles Certification (GPC) Program.

15.3.1.1 THIRD PARTY CERTIFICATION (TPC) PROJECT REGISTRATION

The designer shall register the project with the applicable Third Party Certification (TPC) rating system and provide the government with full access. The project registration shall be completed prior to the submission of the Concept design. The split review approach (separate design and construction submittal) shall be used. The designer shall utilize the TPC's online system to prepare all project documentation necessary for the design phase review. The designer shall provide the results of the final design phase review to USACE no later than one-month following the acceptance of the final backcheck design. After project registration, the designer shall grant Project Administrator rights to the JED SDD POC.

15.3.1.2 ACCREDITED PROFESSIONAL

The designer shall have a LEED BD+C Accredited Professional (AP) on the project team from contract award through closeout. The LEED AP shall facilitate an integrated design process, assist each discipline in their responsibilities, ensure correct interpretation of the TPC rating system credits, and ensure TPC rating system design phase supporting documentation is correct and complete.

15.3.1.3 TPC DESIGN DOCUMENTATION SUBMITTAL REQUIREMENTS

At a minimum, at each design submittal the designer shall provide a current TPC checklist along with a narrative describing how each credit will be met on this project. A checklist containing an additional column with the narrative is sufficient. For projects

pursuing GPC certification, the GPA DoD Project Information Form shall be used. The GPA DoD Project Information Form will be provided by GBCI after project registration.

15.3.2 UFC 1-200-02 COMPLIANCE

The designer shall fulfill the requirements of the applicable sections of UFC 1-200-02. Table 1-1 of the UFC shall be used to determine the applicable sections. In the event that one or more of the requirements from UFC 1-200-02 cannot be met, the designer shall provide a written description of the issue along with supporting documentation and calculations. At each design submittal, the designer shall provide a current UFC 1-200-02 compliance checklist along with a narrative describing how each requirement is fulfilled on this project. A checklist containing an additional column with the narrative is sufficient. Projects pursuing GPC certification may use the GPA DoD Project Information Form in lieu of a separate UFC 1-200-02 checklist.

15.3.3 HIGH PERFORMANCE AND SUSTAINABLE BUILDING GUIDANCE (HPSB)

Each DoD agency has an agency specific HPSB Compliance Checklist. This checklist is used by the agency for upward reporting. The designer shall provide a completed agency specific HPSB checklist in the final design submittal. UFC 1-200-02 Section 4-3 contains links to each agency's current HPSB Compliance Checklist.

15.4 ENERGY MODELING

Perform an energy modeling analysis to validate SDD features during design development, document estimated energy reduction levels, and demonstrate compliance with federal mandates and service component policy. Specifically, produce an energy model analysis to show compliance with the UFC 1-200-02 requirements for 30% energy reduction below an ASHRAE 90.1-2013/IECC 2009 baseline, if life-cycle cost effective, and any other specific service component energy reduction target. If the LEED rating system is being used, also modify the energy model for use in accordance with LEED EA Credit 1 – Optimize Energy Performance. The designer shall provide an updated energy model along with each design submittal.

15.4.1 NATIVE FILES

At each phase of design, native simulation files for life cycle cost analysis and energy modeling shall be provided to the Government with each design submittal.

Weather files for modelers are available in one of the following formats EPW (Energy Plus Weather) located at the following website: https://energyplus.net/weather or DOE2 files located at the following website http://doe2.com/index_Wth.html.

15.4.2 ENERGY PERFORMANCE

The goal for most projects is to achieve the highest energy or water efficiency that is life-cycle cost effective within project funds. Projects with energy and water optimization requirements shall comply with the below requirements which apply to the pre-solicitation stages of both design-bid-build and design-build projects.

The building envelope, interior and exterior lighting, HVAC, plumbing, and renewable energy systems for the project shall be based on the results of life-cycle cost analyses prepared in accordance with applicable criteria. The systems and features for the building shall be selected during the concept phase of design for design-bid-build projects and during pre-solicitation/RFP development for design-build projects.

The minimum number of systems/features to analyze shall be as follows:

- Baseline and three alternatives (where applicable) for each of the wall systems, roof systems, lighting systems, and domestic hot water systems.
- Baseline and two alternatives for windows.
- Baseline and three viable alternatives for HVAC systems.

Where separate systems would be used for different areas of the building or different buildings in the project, each area or building shall be evaluated separately. Example: Area A and Area B will have separate HVAC systems; each area will have four alternatives analyzed. In any case where geo-exchange or ground source heat pump systems will be analyzed, both full and hybrid systems shall be analyzed. The number of alternatives to analyze may be reduced at the sole discretion of USACE. The systems/features to be analyzed must be sufficiently varied to ensure that a wide-range of installed costs, maintenance costs, energy savings, etc. are considered; however, the systems/features selected for analysis must also be available within the project funding.

Propose systems/features for analysis based on project stakeholder input (maintenance capability, available utilities, functional requirements, aesthetics, anti-terrorism/force-protection, etc.), preferences, design guides, etc. The AE shall provide brief narratives describing the reasoning used to determine the systems/features proposed for analysis.

The AE shall evaluate the HVAC system feasibility for energy and heat recovery and associated renewable components where applicable.

As an alternative to performing some of these energy and life-cycle cost analyses, data from previous energy and life-cycle cost analyses may be used for similar building types, sizes, occupancy/usage patterns, internal heat gains, utility rates, and climate at the sole discretion of USACE.

The information resulting from the analyses including installed costs, utility costs, operation and maintenance costs, and salvage value along with any other advantages and disadvantages to the systems/features analyzed shall be presented to the project stakeholders for discussion and final selection for incorporation into design at the end of the charrette. The AE shall retain documentation of approval of the systems/features selected.

Full year, 8,760 hourly calculations energy simulations shall be performed using Trane Trace, Carrier HAP, EQuest or IES VE Pro. Other energy simulation software must be approved in advance by the Contracting Officer.

15.4.3 ENERGY COMPLIANCE ANALYSIS

Comply with UFC 1-200-02 High Performance and Sustainable Building Requirements energy modeling requirements. Provide an Energy Compliance Analysis complying with UFC 1-200-02 with the final design submittal. In addition to the requirements of UFC 1-200-02, include the following in the narratives:

- A listing of all energy conservation criteria that applies to the project and how the project has met compliance
- Identification of the software used to prepare the calculations including the vendor and version.
- Summary table showing the baseline and proposed building annual energy consumption, energy costs, and calculated maintenance costs. The table shall show the energy consumption reduction percentage calculated and the energy cost reduction percentage calculated in accordance with TPC requirements.
- Description of each energy conservation feature and strategy designed for the project. Include rationale for selected systems to model. Provide a description of how the design limited or contributed to any maintenance cost increases caused by the energy conservation features and strategies.
- Provide a chart demonstrating the annual energy consumption and energy cost attributed to each end energy use including, but not limited to, lighting, space cooling, space heating, ventilation, receptacle/process loads, and hot water heating.
- Provide a report showing the monthly electricity and natural gas consumption for 12 consecutive months.
- Explanation of modeling assumptions, including but not limited to; material U-values, lighting loads, interior equipment loads, service water heating equipment, space heating equipment, space cooling and heat rejection equipment, fans and other HVAC equipment.

Input and output reports in excess of 100 pages may be provided electronically via CD or DVD. In addition to required reports, provide native files for computer generated calculations and simulations. Required reports include:

- Checksums output. Energy Simulation outputs and inputs for all spaces, systems, plants, schedules.
- Energy Cost Budget and Performance Summary.
- ASHRAE 62.1 output summary and/or calculations.
- LEED and/or Sustainability Summary Output Report.

Load analysis and energy model input and output shall be organized such that each space, zone, system, item of equipment, building component, etc. is correlated with identifiers on design plans and easily identifiable. Examples:

Conference Room #244 is identified as Conf Rm #244 on input/output documents; AHU-2-4 is identified as AHU-2-4 on input/output documents; Zone 3-4 on the input/output files is associated w/ VAV 3-4.

All calculations provided in worksheet format shall be clear with respect to method of calculation or include description of how the calculations were performed.

15.5 LIFE CYCLE COST ANALYSIS (LCCA)

Perform life-cycle cost analyses (LCCA) to evaluate SDD features during design development, and to demonstrate compliance with UFC 1-200-02. The LCCA shall be done in accordance with UFC 1-200-02 and shall be prepared using the National Institute of Standards and Technology Handbook 135 (http://www.nist.gov/el/buildeconomic.cfm). and the Building Life Cycle Costing (BLCC) software program http://www1.eere.energy.gov/femp/information/download_blcc.html

For all projects (regardless of if an energy modeling analysis is done), produce LCCAs for major building envelope features, large building HVAC systems, all renewable energy systems, vegetative roof gardens, specialized wastewater or stormwater treatment systems, and other SDD features that are energy-related.

CHAPTER 16 - CLIMATE DATA

16.1 GENERAL

This chapter will include the related climate data, climate zone information, along with related electrical, mechanical, civil and architectural associated climate information. Please see below for a consolidated list per each installation requirements.

16.2 CLIMATE ZONES

The climatic patterns of Japan have a wide range, from tropical to cold regions, below is a list of how each installations relates to the climate zones as classified by ASHRAE Standard 169-2013.

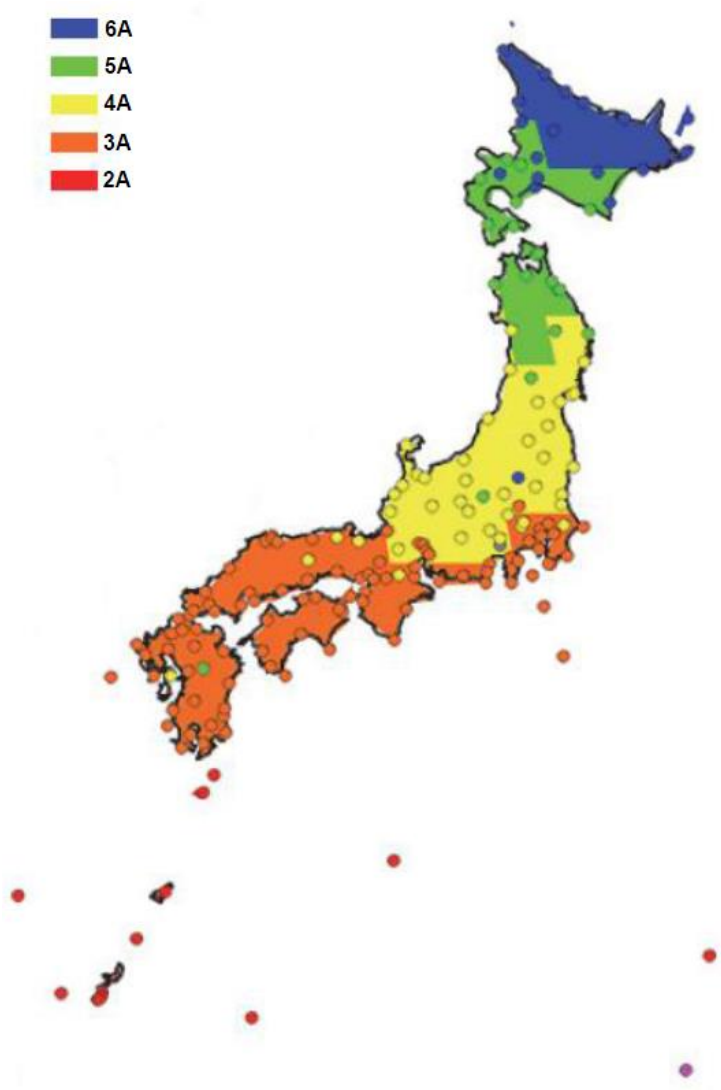

Figure 6: Japan Climate Zone Map, ASHRAE 169-2013

Table 24: Climate Zones for Installations in Japan

INSTALLATION NAME	LOCATION	CLIMATE ZONE
Misawa	Aomori Prefecture	5A
Yokota AFB	Kanagawa Prefecture	4A
Camp Zama	Kanagawa Prefecture	3A
Atsugi	Kanagawa Prefecture	3A
Camp Fuji	Shizuoka Prefecture	4A
Hardy Barracks	Tokyo Prefecture	3A
Yokohama North Dock Yokohama	Kanagawa Prefecture	3A
Sagami General Depot Sagamihara	Kanagawa Prefecture	3A
Sagamihara Housing Area Sagamihara	Kanagawa Prefecture	3A
Akizuki Ammunition Depot	Hiroshima Prefecture	2A
Hiro Ammunition Depot	Hiroshima Prefecture	2A
MCAS Iwakuni	Hiroshima Prefecture	2A
Kawakami Ammunition Dock	Hiroshima Prefecture	2A
Sasebo Naval Base	Nagasaki Prefecture	2A
Gesaji Communication Site	Okinawa Prefecture	2A
Army POL Depots	Okinawa Prefecture	2A
White Beach Area	Okinawa Prefecture	2A
Naha Port	Okinawa Prefecture	2A
Fort Buckner	Okinawa Prefecture	2A
Torii Station	Okinawa Prefecture	2A
Kadena AFB	Okinawa Prefecture	2A

16.3 DRY BULB, WET BULB

Below is a compilation of the dry bulb and wet bulb temperatures based on each location of Japan. The following temperature is conditioned for comfort cooling and comfort heating for general areas only. Follow the UFC 3-410-01 for other specialized technical areas. Please note, that the discrepancies between the UFC and GOJ have been identified for situational awareness, it is recommended to use the latest GOJ,

MLIT, Mechanical and Electrical Design Manual, 2009 Edition information when providing calculations.

Table 25: Dry Bulb Temperature

LOCATION	UFC COOLING	UFC HEATING	GOJ COOLING	GOJ HEATING
Okinawa	91 (F) 32.8 (C)	52 (F) 11.11 (C)	91.22 (F) 32.9 (C)	55.58 (F) 13.1 (C)
Iwakuni	88 (F) 31.1 (C)	32 (F) 0 (C)	93.56 (F) 34.2 (C)	32.18 (F) 0.1 (C)
Yokosuka	88 (F) 31.0 (C)	37 (F) 2.8 (C)	91.76 (F) 33.2 (C)	35.78 (F) 28.4 (C)
Sasebo	90 (F) 32.8 (C)	35(F) 1.6 (C)	92.5 (F) 33.6 (C)	35.42 (F) 1.9 (C)
Atsugi	90 (F) 32(C)	32 (F) 0 (C)	91.76 (F) 33.2 (C)	35.78 (F) 2.1 (C)
Yokota	90 (F) 32.3 (C)	27 (F) -2.7 (C)	93.74 (F) 34.3 (C)	35.6 (F) 2 (C)
Misawa	82 (F) 27.8 (C)	19 (F) -7.2 (C)	87.62 (F) 30.9 (C)	22.1 (F) -5.5 (C)

Table 26: Wet Bulb Temperature

LOCATION	UFC COOLING	UFC HEATING	GOJ COOLING	GOJ HEATING
Okinawa	80 (F) 26.7 (C)	48(F) 8.8 (C)	82.22 (F) 27.9 (C)	46.94 (F) 8.3 (C)
Iwakuni	78 (F) 25.5 (C)	29 (F) -1.6 (C)	80.78 (F) 27.1 (C)	28.4 (F) -2.0 (C)
Yokosuka	78 (F) 25.6 (C)	32 (F) 0 (C)	80.24 (F) 26.8 (C)	28.4 (F) -2.0 (C)
Sasebo	78 (F) 25.6 (C)	31(F) -0.5 (C)	81.32 (F) 27.4 (C)	30.38 (F) -0.9 (C)
Atsugi	77 (F) 25 (C)	28 (F) -2.2 (C)	80.24 (F) 26.8 (C)	28.4 (F) -2 (C)

LOCATION	UFC COOLING	UFC HEATING	GOJ COOLING	GOJ HEATING
Yokota	77 (F) 25 (C)	25 (F) -3.8 (C)	80.42 (F) 26.9 (C)	27.68 (F) -2.4 (C)
Misawa	73 (F) 22.8 (C)	17 (F) -8.3 (C)	77.18 (F) 25.1 (C)	20.12 (F) -6.6 (C)

16.4 RAINFALL DATA

The Air Force has published data regarding rainfall throughout Japan. Please reference the provided link for site specific information on their website: https://www.climate.af.mil/product_locator/?userinput=&product=ewd&country_cd=JA&latitude=&longitude=&distance=&sortBy=name&ascendingOrDescending=ASC

Japan Meteorological Agency provides rainfall data here: www.jma.go.jp/jma/index.html.

Table 27: Rainfall Data by Toda Architectural Standard Detailed Drawings, Second Edition 2007 (Continued)

LOCATION	RAINFALL FOR 1 HR					RAINFALL FOR 10 MINUTES				
	mm	YR	MM	DD	START YR	mm	YR	MM	DD	START YR
Wakkanai	64.0	1938	9	1	1938	21.0	1995	8	31	1938
Rumoi	57.5	1988	8	25	1943	15.6	1953	7	31	1943
Asahikawa	57.3	1912	8	14	1908	29.0	2000	7	25	1937
Abashiri	36.8	1925	8	27	1919	23.0	1969	8	1	1937
Sapporo	50.2	1913	8	28	1889	19.4	1953	8	14	1937
Obishiro	56.5	1975	7	17	1919	26.1	1943	8	9	1938
Kushiro	55.9	1947	8	26	1940	21.8	1952	6	20	1940
Nemuro	52.6	1955	10	15	1889	18.0	1993	9	1	1940
Suttsu	57.5	1990	7	25	1938	15.5	1997	9	27	1938
Urakawa	43.5	1958	7	31	1939	19.5	1984	8	3	1939
Hakodate	63.2	1939	8	25	1889	21.3	1959	9	11	1940
Aomori	67.5	2000	7	25	1937	20.5	2000	7	25	1937
Akita	72.4	1964	8	13	1938	27.0	1964	8	13	1942
Morioka	62.7	1938	8	15	1923	22.0	1853	8	1	1940
Miyako	63.6	1959	10	11	1937	22.7	1959	10	10	1940
Sakata	77.8	1949	8	24	1937	23.7	1965	9	5	1937
Yamagata	74.5	1981	8	3	1940	29.0	1958	8	2	1940
Sendai	94.3	1948	9	16	1937	30.0	1950	7	19	1937
Fukushima	70.6	1966	8	12	1940	26.8	1966	8	12	1940
Onahama	61.8	1963	8	30	1940	19.6	1966		22	1940
Wajima	73.7	1936	9	15	1930	24.9	1967	8	24	1930
Aikawa	79.8	1961	8	4	1925	25.0	1999	9	1	1937
Niigata	97.0	1998	8	4	1914	24.0	1967	8	28	1937
Kanazawa	77.3	1950	9	18	1937	29.0	1953	8	24	1937
Toyama	75.0	1970	8	23	1939	33.0	1970	8	23	1939
Nagano	63.0	1933	8	13	1903	26.5	1947	8	17	1937
Takada	64.1	1962	9	15	1923	23.6	1962	9	15	1937
Utsunomiya	100.5	1957	8	7	1930	35.5	1982	6	21	1938
Fukui	56.2	1953	9	14	1940	19.8	1944	8	20	1940
Takayama	52.0	1940	8	14	1914	24.5	1975	6	15	1937
Matsumoto	59.0	1981	7	18	1936	24.3	1947	8	28	1937
Karuizawa	69.4	1960	8	2	1931	38.5	1960	8	2	1937
Maebashi	114.5	1997	9	11	1912	32.0	2001	7	25	1940
Kumagaya	88.5	1943	9	3	1915	35.8	1943	9	3	1940
Mito	81.7	1947	9	15	1906	36.8	1959	7	7	1937
Tsuruga	57.9	1956	8	4	1937	23.4	1963	7	24	1937
Gifu	99.6	1914	7	24	1903	28.5	1975	7	24	1937
Nagoya	97.0	2000	9	11	1891	29.0	1988	9	20	1940

LOCATION	RAINFALL FOR 1 HR					RAINFALL FOR 10 MINUTES				
	mm	YR	MM	DD	START YR	mm	YR	MM	DD	START YR
Iida	79.7	1960	8	5	1929	22.0	1973	8	4	1937
Koufu	73.0	1978	7	8	1937	22.9	1953	7	9	1937

**Note the Starting year statistics – from 2003: edited by National Astronomical Observatory, Chronological scientific tables, Maruzen*

Table 28: (Continued) Rainfall Data by Toda Architectural Standard Detailed Drawings, Second Edition 2007

LOCATION	RAINFALL FOR 1 HR					RAINFALL FOR 10 MINUTES				
	mm	YR	MM	DD	START YR	mm	YR	MM	DD	START YR
Choshi	140.1	1947	8	28	1912	31.2	1957	10	6	1937
Tsu	118.0	1999	9	4	1916	30.0	1946	10	12	1913
Hamamatsu	87.5	1982	11	30	1940	31.5	1982	11	30	1940
Shizuoka	113.0	2003	7	4	1940	29.0	2003	7	4	1940
Tokyo	88.7	1939	7	31	1886	35.0	1966	6	7	1940
Owase	139.0	1972	9	14	1940	36.1	1960	10	7	1940
Yokohama	92.0	1998	7	30	1940	39.0	1995	6	20	1940
Oshima	84.5	1993	7	5	1991	29.0	2003	7	24	1991
Hachijojima	129.5	1999	9	4	1937	32.5	1999	9	4	1937
Saigou	93.0	1988	9	27	1939	26.0	1994	9	22	1939
Matsue	77.9	1944	8	25	1940	25.6	1958	8	1	1940
Tottori	68.0	1981	7	3	1943	23.5	1969	9	7	1943
Hamada	91.0	1983	7	23	1912	27.4	1963	8	30	1940
Kyoto	88.0	1980	8	26	1906	26.0	1980	8	26	1938
Hikone	63.5	2001	7	17	1894	27.5	2001	7	17	1940
Shimono-seki	77.4	1953	6	28	1908	23.3	1940	7	24	1937
Hiroshima	79.2	1926	9	11	1888	26.0	1987	8	13	1937
Okayama	73.5	1997	7	7	1940	26.7	1961	7	9	1940
Kobe	87.7	1939	8	1	1897	28.0	1958	9	11	1937
Osaka	77.5	1979	9	30	1889	24.5	1997	8	5	1937
Wakayama	99.0	1952	7	10	1940	34.5	1950	4	5	1940
Shionomi-saki	145.0	1972	11	14	1937	38.0	1972	11	14	1940
Nara	79.0	2000	5	13	1953	24.7	1959	8	6	1953
Izuhara	116.0	2003	7	23	1904	29.4	1927	9	2	1904
Fukuoka	96.5	1997	7	29	1939	23.5	1997	7	28	1939
Saga	101.5	1937	7	25	1926	26.7	1950	8	6	1926
Oita	81.5	1993	9	3	1937	29.0	1948	8	16	1941
Nagasaki	127.5	1982	7	23	1897	36.0	1959	7	8	1940
Kumamoto	80.5	2003	7	12	1891	27.0	1991	6	30	1937
Kagoshima	104.5	1995	8	11	1902	33.0	1998	10	7	1939
Miyazaki	138.5	1995	9	30	1924	38.5	1995	9	30	1937
Fukue	113.5	1967	7	9	1962	28.5	1989	9	21	1962
Matsuyama	60.5	1992	8	2	1937	21.5	1992	8	2	1937
Takamatsu	68.5	1998	9	22	1941	23.0	1949	7	15	1941
Kochi	129.5	1998	9	24	1940	28.5	1998	9	24	1940
Tokushima	86.9	1950	9	3	1901	32.0	1983	9	7	1937
Shimizu	150.0	1944	10	17	1941	49.0	1946	9	13	1941

LOCATION	RAINFALL FOR 1 HR					RAINFALL FOR 10 MINUTES				
	mm	YR	MM	DD	START YR	mm	YR	MM	DD	START YR
Murotomi-saki	123.8	1949	7	5	1925	38.0	1942	9	17	1940
Naze	116.4	1949	10	21	1896	28.0	1968	9	23	1937
Naha	110.5	1998	7	17	1900	29.5	1979	6	11	1941

**Note the Starting year statistics – from 2003: edited by National Astronomical Observatory, Chronological scientific tables, Maruzen*

CHAPTER 17 - COMMISSIONING

17.1 GENERAL

This chapter provides general guidance regarding commissioning of building systems. The specific commissioning team members, activities, and level of rigor should be tailored to individual projects based on size, complexity, and the planned quality management. The requirements or guidelines in this chapter are specifically written for medium-high complexity MILCON projects. Lower levels of commissioning may be suitable for small, low complexity projects.

LOW COMPLEXITY PROJECTS

Example: a project with several small split-systems with no direct digital controls may only require the typical USACE contractor quality control and quality assurance.

HIGHER LEVELS OF COMMISSIONING MAY BE NECESSARY FOR LARGE, VERY COMPLEX PROJECTS

Example: Complex laboratory projects or hospitals.

17.2 DESIGN CRITERIA

Commissioning requirements for Army, Air Force, and other Department of Defense facilities are outlined by UFC 1-200-02 High Performance and Sustainable Building Requirements, ASHRAE Standard 189.1 Standard for the Design of High-Performance Green Buildings, and Engineering Regulation 1110-345-723 Total Building Commissioning Procedures. If a project has a Leadership in Energy and Environmental Design (LEED) requirement, commissioning requirements are imposed by the LEED Rating Systems. The design publications listed below should be used as sources of criteria for commissioning. The criteria from these sources may be supplemented, but not supplanted, by applicable criteria contained in nationally recognized codes, standards, and specifications.

Many of the referenced government engineer publications can be found in the Whole Building Design Guide at https://www.wbdg.org/ffc/dod.

Design effort associated with the development of the design documents is typically based on all applicable requirements/criteria, including, but not limited to, the latest versions of the following. In the event any conflict is noted between any requirements/criteria, the more stringent typically applies unless specifically noted otherwise.

17.3 COMMISSIONING REQUIREMENTS

The third party commissioning requirements are dependent on the third party rating tool that is selected. See the Sustainability Chapter for determination of stakeholder rating tool.

Please note the following allocation of Commissioning levels based on rating tool.

Table 29: Commissioning Requirements compatibility with TPC

TPC RATING TOOL	COMMISSIONING LEVEL
LEEDv2009	Fundamental Commissioning unless Enhanced Commissioning is requested by stakeholder. (Army only) – Total Building Commissioning.
LEEDv4	Fundamental Commissioning unless Enhanced Commissioning is requested by stakeholder. (Army only) – Total Building Commissioning.
CASBEE	Balancing and Testing
Federal Guiding Principles	Balancing and Testing, unless Total Building Commissioning is requested by the stakeholder.

17.3.1 COMMISSIONING SPECIALIST

By default, the construction contract should require the construction or design-build contractor to hire the commissioning specialist for the project. USACE will provide quality assurance level oversight of the process and participate as an Owner's representative in the commissioning procedures.

Japan Engineering District can accommodate independent or 3rd party commissioning specialists at the request of the funding agency. USACE will hire a commissioning specialist directly or through an A-E firm.

17.3.2 INDEPENDENT COMMISSIONING SPECALIST

When Enhanced Commissioning is a stakeholder requirement for the project, a task order to hire a commissioning specialist must be developed for the project. Applicable criteria and needs vary from project to project; therefore, the task order scope of work must be tailored specifically for each project. Early in pre-solicitation phase of the project, the USACE Project Engineer/Architect must engage the Japan Engineering District commissioning coordinator to determine how to implement independent or 3rd party commissioning and to develop a scope of work for the commissioning specialist.

17.3.3 SPECIFICATIONS

Construction or Design-Build projects in the Japan Engineering District should use the UFGS specification 01 91 00.15 Total Building Commissioning.

The specification should be edited in accordance with the specifier notes therein and should be included in the solicitation of the construction or design-build contract.

17.3.4 COMMISSIONING DESIGN REVIEW

Projects using 3rd party or independent commissioning should have the commissioning specialist review the design documents, the Owner's Project Requirements, and the Basis of Design document with the interim submission. The commissioning specialist should also review the final submission and backcheck comments. Commissioning comments should be entered and addressed through DrChecks similar to other required design reviews.

17.4 COMMISSIONING DOCUMENTS

17.4.1 OWNER'S PROJECT REQUIREMENTS DOCUMENT

The Owner's Project Requirements (OPR) document should be developed by the AE preparing the design or design-build RFP. A design-build RFP should not serve as the OPR document. The OPR should include the information required by LEED and ASHRAE Standard 189.1 and should be attached to the project commissioning specification as an appendix.

The AE should have the OPR complete prior to the interim submission of the design documents for review by the commissioning specialist.

Develop the Owner's Project Requirements by using the Japan District OPR template and customizing it according to this project's requirements prior to the project Charrette Conference. A sample OPR can be attained by request to the Japan District SEPM. During the charrette, coordinate with the user and installation and complete the questionnaire. After the Concept submittal, the third party commissioning agent will inherit the OPR document. Develop the Basis of Design based upon the OPR as an integrated part of the design analysis.

The OPR should include a separate SDD narrative section detailing:

Table 30: OPR SDD Narrative Requirements

ITEM	CATEGORY	INTENT
1	Project Description	Location Project Cost (PA) Beneficial Occupancy Date Area Functional facility use type Occupancy schedule Room by room space type table including occupant load activity description and electrical load
2	Stakeholder Energy and Sustainability	TPC aligned goals One-Site Renewable Energy Requirements LCCA Data required for BLCC5, including utility rate, discount rate and maintenance costs

ITEM	CATEGORY	INTENT
	Goals and Requirements	Quality Requirements of Materials and Construction Equipment and System Maintainability Expectations Commissioning Systems
3	Life Cycle Cost Data	LCCA Data required for BLCC5, including utility rate, discount rate and maintenance costs
4	On-Site Renewable Energy	Resiliency Factor Photovoltaic Requirements
5	Quality Requirements of Materials and Construction	Identify stakeholder expectations
6	Equipment and System Maintainability Expectations	Space Requirements Outdoor Conditions Indoor Conditions Humidity Range Ventilation Rate Filtration Efficiency Occupant Controllability of Systems Commissioning Systems Electrical Systems Mechanical Systems
7	Systems Integration Requirements	Metering – Base Wide Energy Management Control System Metering – Building Metering – Water Metering – Electricity Metering – Gas Metering – Submetering requirements
8	Health, Hygiene and Indoor Environment Requirements	Smoking Policy Recycling Policy VOC requirements Indoor Air Quality requirements – During Construction Indoor Air Quality requirements – Post Occupancy Pressurized space requirements

ITEM	CATEGORY	INTENT
9	Acoustical Requirements	Sound transmittance requirements
10	Vibration	Identify any special equipment or facility areas that are vibration sensitive and may require additional seismic design considerations
11	Building Occupant and O&M Personnel Requirements	Identify the stakeholder requirements for the commissioning documentation and training.

17.4.2 BASIS OF DESIGN

The Basis of Design (BOD) document should be developed by the designer of record. The AE should prepare the BOD for design-bid-build projects and include it as an appendix to the project commissioning specification. A draft BOD should be completed prior to the interim submission of the design documents for review by the commissioning specialist. For design-build projects, the design-build contractor's design team develops the BOD.

17.4.3 COMMISSIONING PLAN

The Commissioning Plan will be developed by the commissioning specialist. For 3rd party or independent commissioning projects, the AE should attach the Commissioning Plan to the project commissioning specification for both design-bid-build and design-build projects. For other projects, the contractor's commissioning specialist develops the Commissioning Plan.

17.4.4 CHECKLISTS

Example commissioning checklists are included in the commissioning specification templates. For projects with a contractor hired commissioning specialist, the AE should retain the example checklists as appendices in the commissioning specification. The commissioning specialist will be required to provide project specific checklists.

For design-bid-build projects with 3rd party or independent commissioning, the commissioning specialist should develop and provide project specific checklist which the AE should attach as appendices to the commissioning specification. For design-build projects with independent commissioning, the AE should retain the example checklists or provide examples prepared by the commissioning specialist as appendices in the commissioning specification.

CHAPTER 18 - ENVIRONMENTAL

18.1 GENERAL

This chapter discusses the preparation of Temporary Environmental Controls specifications, environmental surveys required during the design process, recommendations for specific environmental media, and other noteworthy environmental topics which should be considered during the design process.

18.2 DESIGN CRITERIA

Construction and service projects for military installations in Japan are subject to U.S. regulations as required by the UFGS, the latest version of the Japan Environmental Governing Standards (JEGS), service component and installation guidelines, and applicable Government of Japan (GoJ) and local regulations. The JEGS were developed by comparing and adopting the criteria of the Overseas Environmental Baseline Guidance Document (OEBGD, 1 May 2007), applicable GoJ national and prefectural environmental laws and regulations, and international agreements.

In order to comply with the necessary policies and regulations, it is advisable a project design incorporates the latest version of the UFGS environmental specifications as the project baseline. The existing baseline templates have resolved most of the environmental regulatory issues and challenges unique to military installations in Japan by including installation specific and project specific considerations.

During the design process, the Japan District Technical Services Section provides the latest version of the UFGS environmental specifications (known as 01 57 19 Temporary Environmental Controls) and applicable installation specific supplemental section(s) to the Japan District Environmental Section. After the Environmental Section reviews, tailors, and develops the necessary text, the completed SpecsIntact specifications file is provided back to the Technical Services Section so it can be incorporated into the design package being prepared.

The following sections of this environmental chapter identifies the major environmental factors which should be considered during the development of design packages for military installations in Japan.

18.3 ASBESTOS

The definition for Asbestos Containing Material (ACM) differs between the U.S. and Japan. U.S. regulations define any material which contains 1% asbestos or greater as ACM and Japanese laws and the current JEGS considers any material with an asbestos content of 0.1% or greater as ACM.

The methods for determining the asbestos content also differ between the two countries. In the U.S., the sample must be analyzed separately (discreetly) for each distinctive layer, while the Japan regulations allow all layers of the sample to be

composited prior to testing. For example in analyzing a wall, the U.S. standards will require the laboratories to test the gypsum board, the tape, and the plaster separately, while the Japanese standards allow the laboratory to test the gypsum board, tape and plaster as a single sample resulting in just one result for the wall.

The 2008 version of the JEGS lowered the definition of ACM from 1% to 0.1% by weight, and required the laboratory to analyze samples according to U.S. standards. Any asbestos survey report prior to 2009 (approximate time when the 2008 JEGS was released) should be reviewed carefully. Materials determined to be non-ACM at the time of the survey, may be considered ACM under the current JEGS.

As a general rule, any material identified as “Trace” or containing less than 1% asbestos, must be assumed to be ACM unless further testing in accordance with the JEGS is performed to show that the asbestos content is below 0.1%. In addition, some Installations have determined that a Non-Detect reading from reports prior to 2008 are not valid and must be reconfirmed by further testing.

Applicable specification sections for Asbestos are 02 82 13.00 10, Asbestos Abatement, (with supplemental specification section 02 82 13.00 30 for Air Force projects) and 02 82 16.00 20, Engineering Control of Asbestos Containing Materials.

Products considered to be Asbestos Free or Non-ACM in the U.S. may not necessarily meet that criteria here in Japan. Therefore, it must be made clear in section 01 57 19 and other applicable sections that materials required for the project must be determined to contain less than 0.1% asbestos and that standard manufacturer’s brochures certifying materials are non-ACM may not be considered acceptable for the purpose of certifying the material as non-ACM.

18.4 LEAD

There is a different threshold for Lead Based Paint (LBP) in Japan. The standard for structures built after 1978 cannot be assumed to be relatively free of LBP in Japan as it does in the U.S. The 1978 threshold was implemented based on the date LBP was banned in the U.S. and does not necessarily correlate to regulations in Japan.

Lead in paint is defined below:

Lead Based Paint (LBP) – Paint or other surface coatings that contain lead ≥1.0 milligram per cm^2, or 0.5% by weight or 5,000 ppm by weight.

Lead Containing Paint – Paint or other surface coating that contains lead in excess of 0.009 percent by weight (90 ppm) and up to 0.5 percent by weight (5,000 ppm).

A matter of concern which usually triggers the most stringent action for most contracts, is the 29 Code of Federal Regulations (CFR) which requires worker protection when working with coatings with any detectable levels of lead. This generally drives the designer to state in their design, that all coatings should be assumed to contain lead. However, each design should be analyzed on a case-by-case basis to determine if the presence of lead could trigger a more stringent requirement (clearance testing, disposal, etc.).

Specification sections applicable to Lead are 02 83 13.00 20, Lead in Construction, and 02 83 19.00 30, Abatement of Lead-Based Paint – 18 Wing JEGS-Compliant Specification. Section 02 29 20, Exposure Assessment for Workers Exposed to Lead-Containing Paint should also be considered.

18.5 POLYCHLORINATED BIPHENYLS (PCB)

Japan has a more stringent threshold for determining what is considered PCB free in comparison to the U.S. Per the JEGS, if the dielectric fluid (used in transformers and other electrical components) contains more than 0.5 mg/kg (ppm) PCB it is considered a PCB-containing product.

A label on a U.S. product stating PCB free is generally equivalent to a product containing less than 50 ppm of PCB, which is still considered a PCB-containing material in Japan. Therefore, in order to utilize non-PCB materials in Japan, it must be clearly written that materials possibly containing PCB (transformers, ballasts, etc.), obtain manufacturers' certification that the PCB content is less than 0.5 ppm in lieu of relying on the manufacturer's brochures.

Each Installation has specific procedures on how to handle PCB and non-PCB products manufactured in the U.S. or Japan. The designer should work with the Japan District Environmental Section for coordination with the Installation Environmental Office to ensure the design contains all Installation-specific turn-in requirements/procedures and meets the Installation requirements for disposal.

Applicable specification sections are 02 84 16, Handling of Lighting Ballasts and Lamps Containing PCBs and Mercury and 02 84 33, Removal and Disposal of Polychlorinated Biphenyls (PCBs).

18.6 OZONE DEPLETING SUBSTANCES (ODS)

The procedures for the handling of recovery and disposal of ODS differ from Installation to Installation. The designer should work with the Japan District Environmental Section for coordination with the Installation Environmental Office to ensure the design contains all Installation-specific turn-in requirements/procedures and meets the Installation requirements for disposal.

Specification section 01 57 19 should be modified to state the requirements of the project in regards to ODS. Although Japan District Environmental will be responsible for inserting specification section 01 57 19 into the design package, the designer should coordinate with Japan District to ensure that the requirements for ODS are included in section 01 57 19.

18.7 RADIOACTIVE ISOTOPES

Projects that require the contractor to dispose of material containing radioactive isotopes may require additional guidance in the specifications to incorporate the Installation's site specific procedures. Any luminescence type material should be considered suspect (i.e. non-powered exit signs, etc.) for containing radioactive isotopes.

Specification section 01 57 19 should be modified to state the requirements of the project in regards to radioactive isotopes. Although Japan District Environmental Section will be responsible for inserting specification section 01 57 19 into the design package, the designer should coordinate with Japan District to ensure that the requirements for radioactive isotope disposal are included in section 01 57 19.

18.8 RADON

Levels of Radon gas exceeding 4 picocuries per liter (pCi/L) have been found on Installations in Japan. Environmental Protection Agency standards and protocols are applicable in regards to Radon management.

Radon Resistant New Construction (RRNC) requirements are based on the radon potential category (RPC) of the Installation. Passive radon mitigation systems are typically required for projects located in areas with a moderate or high RPC where predicted average Radon levels are greater than 4 pCi/L. Installations with a low RPC (predicted average < 2 pCi/L) are exempt from radon requirements. The Designer should work with the Japan District Environmental Office for coordination with the Installation Environmental Office or Bioenvironmental Engineering Flight to verify the RPC and ensure that the design includes Installation-specific requirements and procedures.

In general, Radon-related guidance published in the UFC will be followed for construction and renovation in DoD housing, child development centers, and other facilities. For Navy and Marine projects, the Designer should also use the Navy Radon Assessment and Mitigation (NAVRAMP) Guidebook for Naval Shore Installations for supplemental Radon requirements. There are separate NAVRAMP documents for Family Housing and Non-Residential applications. The NAVRAMP details the RRNC designer and installer qualification requirements that should be included in the construction contract documents.

Specification section 31 21 13, Radon Mitigation, may be inserted and modified, as required, to incorporate Radon requirements into the design package. Unless otherwise required by the Installation, it is recommended that monitoring of Radon levels not be included in the construction contract due to the duration of long-term testing and the lengthy foundation settling period required following completion before testing can occur.

18.9 PROTECTION OF HISTORIC AND CULTURAL RESOURCES

Design efforts should include coordination with the Installation Environmental Office and Japan District Environmental Section to determine if the project impacts any known archeological sites, cultural sites, or other cultural resources as listed on the World Heritage list or the GoJ equivalent of the National Register of Historic Places. JEGS, Chapter 12, *Historic and Cultural Resources*, contains criteria to ensure proper protection and management of the resources.

A project involving excavation in previously undeveloped areas of Honshu and Okinawa will require coordination with the Installation Cultural Resource Manager and possibly

the Prefectural Board of Education (BOE) (equivalent to the State Historic Preservation Office in the U.S.), who may require a cultural asset survey and mitigation measures.

Discovery of any historic or cultural resources not previously considered, should require a cessation of activities, securing of the area and coordination with the Installation Cultural Resources Manager and BOE.

18.10 PROTECTION OF NATURAL RESOURCES

To determine if an installation project affects natural resources or any endangered or threatened species listed in the JEGS Table C13.T1 ("Threatened and Endangered Species of Wild Fauna & Flora in Japan") and Table C13.T2 ("Natural Monument Species of Japan"), design efforts should be coordinated with the Japan District Environmental Section and Installation Natural Resources Manager (NRM). Any project-related impacts to an installation's natural resources should be identified and recommendations should be developed to limit or eliminate adverse impacts.

Some installations may have existing natural resources survey results which can be used to develop assumptions, determine if additional surveys are needed, or determine if mitigation/relocation efforts are required before, during or after the project design. Additionally, installations may also have best management practices (BMPs), natural resources or environmental media guidelines during construction (e.g. erosion control measures) or construction monitoring requirements. To obtain the most recent information, the designer should coordinate with the Japan District Environmental Section and the Installation NRM to ensure the appropriate requirements are incorporated into the project design and products.

18.11 FEDERAL ACTIONS ENVIRONMENTAL EFFECTS ABROAD

The National Environmental Policy Act (NEPA) does not directly apply overseas. However, there are several laws and regulations which Federal actions overseas must follow. These include but are not limited to, 32 CFR 187 *(Environmental Effects Abroad of Major Department of Defense Actions)*, Executive Order 12114 (*Environmental Effects Abroad of Major Federal Actions)*, DoD Instruction (DoDI) 4715.05-G *(Overseas Environmental Baseline Guidance),* and specific installation requirements.

32 CFR 187 enables DoD officials to be informed and take account of environmental considerations when authorizing or approving certain major Federal actions that do significant harm to the environment of places outside the U.S. The sole objective of this CFR is to establish internal procedures to determine if environmental concerns are associated with a major Federal and global commons, ecological resources of global importance, environment of a foreign nation, or those actions which can result in toxic or radioactive emissions or effluent conditions in a foreign nation.

For DoD installations in Japan, the environmental considerations process begins in the project planning stages, with the completion of an environmental checklist by the installation that evaluates the environmental impacts of a project. In addition to environmental impacts, the installation uses environmental checklists to make recommendations, include mitigation requirements, and recommend future

surveys/evaluations for the proposed project. The designer should coordinate with the Japan District Environmental Section and the Installation Environmental Office to ensure the most recent recommendations, mitigation requirements, and surveys/evaluations are incorporated and executed in the project design.

18.12 CONTAMINATION REMEDIATION OUTSIDE THE UNITED STATES

Unlike the U.S., there is no remediation program for environmental contamination for DoD installations in Japan. DoDI 4715.08 *(Remediation of Environmental Contamination Outside the United States)* provides limited remediation guidance not much beyond the required initial spill response for overseas DoD installations. In general, the DoDI 4715.08 states that use of MILCON funds for remediation is limited to, “remediation that is necessary to complete the MILCON project.”

Currently, the standard practice at DoD installations in Japan is to refrain from conducting soil testing of excavated soils that are to be reused at the project site or elsewhere within an installation. If excess soil is planned for disposal outside a DoD installation in Japan, soil testing may be required during the design process to determine which local disposal facility can accept the soil and its contaminants if any, and to calculate the associated disposal costs by referencing at a minimum the soil testing guidelines found in the JEGS Table AP1.T7 *(Contaminated Soil Disposal Criteria).*

Some installations have existing maps or survey results of known contaminated areas which can be used to develop assumptions and determine the necessary soil testing criteria for a project. Additionally, installations may also have best management practices (BMPs) and guidelines for disturbing contaminated soils, including testing procedures and requirements on how to manage contaminated soils. To obtain the most recent guidance, the designer should coordinate with the Japan District Environmental Section and the Installation Environmental Office to ensure the appropriate requirements are incorporated into the project design and products.

CHAPTER 19 - CYBERSECURITY

A-E's design shall comply with Cybersecurity of Facility-Related Control Systems UFC 04-010-06, and requirements herein this Chapter when mandated by the A-E scope of work or if programming documents such as the DD1391 require cybersecurity design.

Cybersecurity should be implemented to all control systems with any communication protocol (for example: BACnet, LonWorks, or Internet Protocol (IP).)

Examples of Facility Related Control Systems (FRCS) that require cybersecurity include:

A. Energy Management and Control Systems (EMCS)
B. Utility Monitoring and Control Systems (UMCS)
C. Electronic Security Systems (ESS)
D. Building Automation Systems (BAS)
E. Supervisory Control and Data Acquisition (SCADA) systems
F. HVAC DDC controls
G. Networked Utility Control Systems
H. IP-based Smart Meters
I. IP-based lighting systems.
J. Fire alarm reporting systems
K. IP-based public clock systems

Designs shall comply with the requirements of:

- Unified Facilities Criteria (UFC) 4-010-06 Change 1 Cybersecurity of Facility-Related Control Systems, 18 January 2017

Design progression shall be modeled after the Engineering and Construction Bulletin 2018-11, 09 Aug 18, Control System Cybersecurity Coordination Requirement USACE Cybersecurity Engineering and Construction Checklist and the design deliverables shall be provided as identified within this section of the design guide.

Design solutions shall be such that dependence to networks be minimized. For example, a design that includes a backup generator that can only be started when it is be connected to the network should be avoided. Network-connected equipment shall fail to a safe state. A network connected air handling unit which has ceased to operate, for example, shall be able to resume operation using a manual switch or button connection to the network is interrupted. Extraneous network functions within a building shall not be present in the design. For example, a critical air conditioner for a server room or data center, which must be kept at a low temperature for 24 hours a day, should not have a network configurable operating schedule or set-point.

Design documents shall include system descriptions that provide adequate information for local contractors to prepare a bid. The documents shall include, at a minimum, Cybersecurity device and inventory schedules, inter-connection diagrams for each

network, one-line diagrams, wiring diagrams, sequence of operations, hardware / software descriptions, equipment layout plan views, equipment layout elevations, and keyed explanatory notes.

Cybersecurity design requires consistent coordination to other disciplines that contain FRCS. Within design drawings, provide instrumentation and control diagrams for each control system.

19.1 DESIGN ANALYSIS

Create a standalone “Cybersecurity” Chapter in the Design Analysis. Establish narrative explaining the cybersecurity scope, existing infrastructure and conditions, proposed design approaches and concept summary, and reference to standards policies and procedures.

Include CIA Matrix ratings established that will be implemented in design. Identify if any of the existing FRCS infrastructure has existing ATOs and if they will be modified under this project.

Provide High Level Design Network Diagram (portraying all networked controlled systems) with Purdue Enterprise Reference Architecture (PERA) levels within the Cybersecurity Chapter. The Diagram shall illustrate how network equipment, such as HMIs, controllers, switches, routers, router controllers, gateways, modems (that will be installed in the building and to other facilities) are connected to each other.

The High Level Design Network Diagram(s) shall be utilized to define the architectural placement of the sensors, actuators, and instrumentation serving the control, the controllers, the supervisory level with servers HMIs and historians, the operations support, and finally the business side of organization related to ICS.

Using arrows on the Diagram, indicate direction of data flow and control requests. The intentions are to provide a Logic Diagram(s) displaying the required inputs and outputs as well as typical operations that are performed by the various components of each control network. This can be diagrammed on the High Level Network Diagram, or in a separate Logic Diagram(s) if necessary for clarity.

Provide narrative(s) within the Design Analysis Cybersecurity chapter that outline the communication network and the cybersecurity control measures that will be implemented across each component. These narratives should align to the High Level Design Network Diagrams.

(Examples of a High Level Network Diagrams are shown in Figures 19.1 and 19.2. Intent of Examples are to portray desired content, and not necessarily desired graphics.)

Document the Confidentiality-Integrity-Availability (C-I-A) Impact Ratings and insert the Correlation Control Identifiers (CCIs) at the Parametric, Concept, Intermediate, and Final Design Stages listed below.

For clarity, do not insert explicit references to the Impact Ratings or Correlation Control Identifiers in the specifications or drawings. For example, If Correlation Identifier "PE-11 Emergency Power" is selected during design, then a battery backup or other means of emergency power for the network equipment shall be shown in the drawings and described in the specifications, but an explicit references to "CCI PE-11" or other terms introduced in UFC 04-010-06 or other standards shall be omitted.

Design Analysis Appendix showcasing datasheets of proposed FRCS telecommunications equipment/items to be used in the project.

19.2 PARAMETRIC DESIGN

Provide/develop C-I-A impact rating for each network control system. Utilize the list of C-I-A impact ratings to select the proper list of controls from NIST SP 800-01. Develop a listing of the security controls generated along with recommendations and justifications for further tailoring of the security control set. Using the DoD master Control Correlation Identifier (CCI) list, create a list of relevant CCIs based on the controls selected. Develop a listing indicating the CCIs resulting from the approved tailored security controls list. Categorize CCIs and Identify CCIs that are the designer's responsibility.

A-E shall recommend an initial classification for each CCI. A-E shall present this information at the Design Charrette (or other project meeting(S)) with a control system network architecture diagram.

19.3 CONCEPT DESIGN

The A-E shall provide recommended C-I-A impact Rating for each networked control system in the project..

The Government (System Owner) will provide concurrence/confirmations, or will direct changes to the A-E's recommendations. This is intended to occur at the Concept OBR (or other project meeting(s)).

List the Correlation Control Identifiers for each control system. Indicate who has responsibility for implementing the control (Designer, non-Designer, Impractical).

Recommend Correlation Control Identifiers for deletion or modification based on project scope.

Provide a listing depicting changes to standard CCI requirements along with explanation of changes within the Design Analysis. Indicate which sections of the JES 25 05 11 specification section that will be adapted to include such changes.

19.4 INTERMEDIATE DESIGN

Document C-I-A Impact Rating for each networked control system in the project.

Update the Correlation Control Identifier List, if changed after the Concept Design. Identify the CCIs which have been incorporated into the design. For example, if CCI PE-13 "Fire Protection" has been implemented by providing additional smoke detectors near designated network equipment. Or, for example, if CCI SC-7 "Boundary

Protection…” has been implemented by physically separated cable trays, connection frames, and patch panels for certain network equipment.

Document changes from standard requirements, or selections made when multiple options are available. Otherwise, it is not necessary to document the details of the requirement, just whether a specific CCI has been incorporated.

Provide initial Project Specification DRAFT from JES 25 05 11 Master Spec with additions and deletions.

19.5 FINAL DESIGN SUBMITTAL

Include the final updated High Level Diagram, C-I-A Impact Rating, and Correlation Control Identifier List.

19.6 SPECIFICATIONS

Use the JES (Japan Edited Specification) Specification Section 25 05 11 as the basis, or template.

The final specification should require the construction contractor to list the known vulnerabilities of network equipment that is purchased, list the IP and MAC addresses provided by the base/installation, and practice rudimentary cybersecurity hygiene, such as requesting permission to set up temporary networks and changing default passwords, during construction.

For clarity, avoid references to documents that are not available in Japanese, such as UFC 04-010-06, NIST SP 800-37, NIST SP 800-53, or NIST 800-82.