UFC 3-300-10N
May 2005
Including Change 2, August 2006

UNIFIED FACILITIES CRITERIA (UFC)

STRUCTURAL ENGINEERING

CANCELLED

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

UNIFIED FACILITIES CRITERIA (UFC)

CRITERIA FORMAT STANDARD

Any copyrighted material included in this UFC is identified at its point of use.
Use of the copyrighted material apart from this UFC must have the permission of the copyright holder.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

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

Change No.	Date	Location
1	Dec 2005	FOREWORD
2	July 2006	See changes occurring throughout document as described in “Revision Summary Sheet”.

CANCELLED

_____

This UFC supersedes the Atlantic Division Structural Design Guide, dated July 2002, and SODIV-TG-1001, dated March 1997 and SODIV-TG-1007, dated August 1997

The format of this document does not conform to UFC 1-300-01.

FOREWORD

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

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

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

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

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

AUTHORIZED BY:

DONALD L. BASHAM, P.E.
Chief, Engineering and Construction
U.S. Army Corps of Engineers

DR. JAMES W WRIGHT, P.E.
Chief Engineer
Naval Facilities Engineering Command

KATHLEEN I. FERGUSON, P.E.
The Deputy Civil Engineer
DCS/Installations & Logistics
Department of the Air Force

Dr. GET W. MOY, P.E.
Director, Installations Requirements and Management
Office of the Deputy Under Secretary of Defense (Installations and Environment)

CANCELLED

UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 1-300-10N
Superseding:

Description of Changes: This update to UFC 3-300-10N incorporates new structural design criteria, deletes other structural design criteria, and separates design criteria from best practices. This format also includes minor editorial changes to correct errors in spelling, grammar and format.

Reasons for Changes:

- New design criteria reflect current requirements for structural design for DoD project, and includes criteria that were omitted from the previous version.
- Design criteria that are included in other documents are deleted to avoid conflicts. In particular, criteria that repeat provisions of the International Building Code, UFC 1-200-01, or other referenced UFC's have been deleted.
- References to NAVFAC or NAVFAC divisions have been deleted to allow the document to be used by all services.
- Previous criteria that are not mandatory, but reflect "best practices" or lessons learned, have been moved into Appendix B.

Impact: There are negligible cost impacts. However, the following benefits should be realized.

- The UFC should be easier to use, since criteria from other documents have been deleted.
- The UFC may now be cited by all services.
- Non-mandatory "best practices" are clearly identified.

CANCELLED

CONTENTS

CANCELLED

CANCELLED

CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

The purpose of this UFC is to provide technical guidance and outline technical requirements for the more typical aspects of the structural engineering design portion of Architect/Engineer (A/E) contracts for the Naval Facilities Engineering Command (NAVFAC). The information provided in this guide must be utilized by structural engineers in the development of the plans, specifications, calculations, and Design-Build Request for Proposals (RFP) and must serve as the minimum engineering design requirements. Project conditions may dictate the need for design that exceeds these minimum requirements.

1-2 APPLICABILITY.

This UFC applies to all NAVFAC Facilities Engineering Command (FEC) or Engineering Field Division / Engineering Field Activity (EFD / EFA) and their contractors that are preparing construction contract documents and specifications for all projects on military installations under the Naval Facilities Engineering Command. It is applicable to the traditional engineering services customary for Design-Bid-Build construction contracts and for Design-Build construction contracts.

1-3 REFERENCES.

Appendix A contains the list of references used in this UFC. Furthermore, this UFC references UFC 1-200-01, *General Building Requirements*, as applicable, except as modified herein. This UFC contains requirements for facilities and professional services for the Navy only.

1-4 COMMUNICATION.

Direct communication with the government's project manager and structural reviewer is encouraged. This may avoid unnecessary re-submittal of plans and specifications due to a misunderstood comment. The reviewer's name, phone number and email address can be found on the comment sheets.

CANCELLED

CHAPTER 2 DESIGN REQUIREMENTS

2-1 GENERAL GUIDANCE.

2-1.1 Design Criteria.

All structural design must be in accordance with UFC 1-200-01 as modified below. The design of piers and wharfs must be in accordance with UFC 4-150-01, *Design: Piers and Wharfs*. Where newer versions of the codes or standards that are referenced in the International Building Code are available, the newer versions may be used with the approval of the Contracting Officer.

2-1.2 Frost Penetration.

Depths to the frost line are provided for specific locations in UFC 3-310-01, *Design: Structural Load Data*. The minimum depth of footings when not governed by frost penetration requirements must be 300 mm (12 inches).

2-1.3 Earthquake Design Guidance.

All earthquake design must be in accordance with UFC 1-200-01. (UFC 3-310-04 is under development at the publication date of this UFC, and when complete will provide additional earthquake design guidance.)

The minimum requirements for assessing and enhancing the seismic safety of existing buildings within the United States, its territories and possessions is defined in ICSSSC RP6 / NISTIR 6762. The minimum requirements for assessing and enhancing the seismic safety of existing buildings at all other locations is defined by the "NAVFAC Seismic Hazards Mitigation Program for Facilities Outside of the Continental United States, its Territories and Possessions," dated March 2000; as modified below:

- All "Standard Occupancy" buildings located in regions of Low Seismic Hazard Potential shall be exempted from the Seismic Hazards Mitigation Program

- For locations outside of the United States, its territories and possessions, UFC 3-310-01 shall be used to determine the potential Seismic Loading. The Seismic Hazard Potential shall be defined as High, Moderate, or Low based upon the **10/50 S_S** and the **10/50 S_1** spectral response accelerations adjusted to reflect site class effects, and utilizing the following relationships:
  - <u>High Seismic Hazard Potential:</u>
    (10/50) S_{MS} >= 0.50g **and**
    (10/50) S_{M1} >= 0.20g
  - <u>Moderate Seismic Hazard Potential:</u>
    0.167 <= (10/50) S_{MS} < 0.50g **or**
    0.067 <= (10/50) S_{M1} < 0.20g
  - <u>Low Seismic Hazard Potential:</u>
    (10/50) S_{MS} < 0.167g **and**

CANCELLED

(10/50) $S_{M1} < 0.067g$

- Seismic evaluation of existing buildings shall be in accordance with ASCE 31-03. Rehabilitation of existing buildings for seismic loads shall be in accordance with FEMA 356.

2-1.4 **Antiterrorism Design Guidance.**

Structural design for Antiterrorism must be in accordance with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

2-1.4.1 **Progressive Collapse Prevention.** Structural design for Progressive Collapse Prevention must be in accordance with UFC 4-023-03, *Design of Buildings to Resist Progressive Collapse*.

2-1.5 **Extraordinary Events.**

When specifically required, strength and stability must be checked to ensure that structures are capable of withstanding the effects of extraordinary (i.e. low probability) events such as fires, explosions and vehicular impact.

2-1.6 **Proprietary Materials.**

Design values for proprietary materials must be obtained from International Code Council – Evaluation Services (ICC-ES) Evaluation Reports. Proprietary materials must not be used without prior approval of the Contracting Officer.

CANCELLED

2-2 SYSTEMS REQUIREMENTS.

2-2.1 General.

2-2.1.1 Requirements listed below are minimum. Design loads and conditions may demand designs that exceed these minimum requirements. Design calculations must include a source for all design forces/stresses used that are not governed by industry standards defined in this document.

2-2.1.2 Accomplish work in accordance with publications listed except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word “must” had been substituted for the words “should”, or “could”, or “may”, wherever they appear. Interpret reference to the “Building Official”, the “Structural Engineer”, and the “Architect/Engineer” to mean the Contracting Officer.

2-2.2 Concrete.

2-2.2.1 Unless otherwise noted herein, all concrete design and construction must be in accordance with UFC 1-200-01.

2-2.2.2 Concrete construction must be in accordance with ACI 301.

2-2.2.3 Concrete floors and slabs must be in accordance with ACI 302.1R.

2-2.2.4 Concrete construction tolerances must be in accordance with ACI 117.

2-2.2.5 Vapor retarders, when required, must not be less than 0.25mm (10 mils) thick.

2-2.2.6 For concrete floor slabs on ground, the location of construction joints and control joints must be coordinated with joints in any hard-surface finish flooring.

2-2.2.7 All prestressed, precast structural concrete members must be manufactured in a plant certified by the Prestressed Concrete Institute (PCI) in the appropriate category.

2-2.2.8 Epoxy-coated reinforcing steel must be produced in accordance with ASTM A934 in plants certified by the Concrete Reinforcing Steel Institute (CRSI) for fusion-bonded epoxy coatings applied after fabrication.

2-2.3 Masonry.

2-2.3.1 Unless otherwise noted herein, all masonry design and construction must be in accordance with UFC 1-200-01.

2-2.3.2 All concrete masonry must have a specified compressive strength (f’m) of not less than 10.3 MPa (1,500 psi).

CANCELLED

2-2.3.3 All clay masonry must have a specified compressive strength (f'm) of not less than 6.9 MPa (1,000 psi).

2-2.3.4 Provide control joints in masonry walls in accordance with NCMA Tek 10-2B or Tek 10-3 and BIA Technical Notes 18A. The structural engineer must coordinate with the architect to assure that the requirements for masonry control and expansion joints are clearly shown on the construction drawings.

2-2.3.5 Concrete masonry unit foundation walls below grade must be completely filled with grout.

2-2.3.6 Shear walls must use running bond construction.

2-2.3.7 Air spaces, cavities, chases, expansion joints, and spaces to be grouted must be kept free from mortar and other debris.

2-2.3.8 Provide anchors and ties for cavity walls. Do not use corrugated metal ties or ties with an integral drip in cavity walls.

2-2.4 **Structural Steel.**

2-2.4.1 Unless otherwise noted herein, all structural steel design and construction must be in accordance with UFC 1-200-01.

2-2.4.2 Refer to FEMA 350, FEMA 351, FEMA 352, FEMA 353, FEMA 355, and 2002 AISC Seismic Provisions for Structural Steel Buildings for additional seismic design guidance for structural steel buildings.

2-2.4.3 Structural steel fabrication and erection procedures must be in accordance with AISC Code of Standard Practice.

2-2.4.4 Structural steel framing systems must be designed for vibration serviceability due to human activity in accordance with AISC Steel Design Guide 11.

2-2.4.5 Provide Direct Tension-Indicating (DTI) washers at all bolted connections.

2-2.4.6 Any single panel point of the lower chord of exposed roof joists or trusses or any point along the length of exposed primary structural members supporting roofs over manufacturing, storage and warehousing, or maintenance shops must be capable of safely supporting a suspended concentrated load of 8.90 kN (2000 pounds) in addition to dead loads. For all other occupancies, a concentrated load of 0.89 kN (200 pounds) must be used instead of 8.90 kN (2,000 pounds).

2-2.4.7 All structural steel exposed to the weather must adequately protected to prevent corrosion. All galvanized structural steel must in accordance with ASTM A123/123M or ASTM A153/153M, as applicable. Galvanize after fabrication where practicable. Repair galvanized coatings using ASTM A780 zinc-rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting.

CANCELLED

2-2.4.8 All weld metal and base metal subjected to cyclic tension must be supplied with "charpy" V-notch testing in accordance with ASTM A6 supplementary requirement SS. (5 specimen option). The impact test must meet a minimum average value of 27.1 Joules (20 ft-lbs) absorbed energy at –18 degrees C (0 degrees F).

2-2.5 **Steel Joists.**

Unless otherwise noted herein, all steel joist design and construction must be in accordance with UFC 1-200-01.

2-2.6 **Steel Deck.**

2-2.6.1 Unless otherwise noted herein, all steel deck design and construction must be in accordance with UFC 1-200-01.

2-2.6.2 Steel form decks must be a minimum of 0.378mm (0.149 inches -28 gage) thick. Roof and composite decks must be a minimum 0.909 mm (0.0358 inches – 20 gage) thick.

2-2.6.3 At a minimum, all steel deck must be galvanized in accordance with ASTM A 653/653M G60 specifications. For steel deck exposed to spray from salt, salt water, brackish water, or seawater provide ASTM A 653/653M G90 galvanizing.

2-2.7 **Cold-Formed Steel Framing.**

2-2.7.1 Unless otherwise noted herein, all cold-formed steel framing design and construction must be in accordance with UFC 1-200-01.

2-2.7.2 Design using cold-formed steel studs and joists must comply with material specifications, nomenclature, section properties, and load tables found in SSMA Product Technical information.

2-2.7.3 Minimum thickness of cold-formed steel framing members to be welded must be 1.44 mm (0.0566 inches – 16 gage) thick.

2-2.7.4 All cold-formed steel-framed walls must be anchored to foundations with galvanized anchors as needed to resist the design forces. Anchors for exterior walls, interior load-bearing walls, and shear walls must not be less than 12.7mm (1/2 inch) diameter embedded anchor bolts, expansion bolts, or adhesive anchor system with 101mm (4 inches) embedment spaced a maximum of 1219mm (48 inches) on center. Anchors for interior non-bearing, non-shearwall partitions must not be less than 10mm (3/8 inch) diameter embedded anchor bolts, expansion anchors, or adhesive anchor systems with 101mm (4 inch) embedment spaced a maximum of 1219mm (48 inches) on center, or with 3.7mm (0.145 inch) diameter powder-actuated fasteners spaced at 610mm (24 inches) on center.

2-2.7.5 Cold-formed steel members must be connected with screw fasteners or by welding. The use of “pneumatic nailing” is not permitted.

CANCELLED

2-2.7.6 For cold-formed steel members exposed to spray from salt, salt water, brackish water, or seawater provide G90 galvanizing, and connect with corrosion-resistant fasteners.

2-2.8 **Aluminum.**

Unless otherwise noted herein, all aluminum design and construction must be in accordance with UFC 1-200-01.

2-2.9 **Wood Framing.**

2-2.9.1 Unless otherwise noted herein, all wood framing design and construction must be in accordance with UFC 1-200-01.

2-2.9.2 The minimum thickness of wood structural panels used for horizontal or vertical diaphragms must be 12.7mm (1/2 inch).

2-2.9.3 All wood-framed walls must be anchored to foundations with galvanized anchors as needed to resist the design forces. Anchors for exterior walls, interior load-bearing walls, and shear walls must not be less than 12.7mm (1/2 inch) diameter embedded anchor bolts, expansion bolts, or adhesive anchor system with 102mm (4 inches) embedment spaced a maximum of 1219mm (48 inches) on center. Anchors for interior non-bearing, non-shearwall partitions must not be less than 10mm (3/8 inch) diameter embedded anchor bolts, expansion anchors, or adhesive anchor systems with 102mm (4 inch) embedment spaced a maximum of 1219mm (48 inches) on center, or with 3.7mm (0.145 inch) diameter powder-actuated fasteners spaced at 610mm (24 inches) on center.

2-2.10 **Metal Building Systems.**

2-2.10.1 All metal buildings must be designed, detailed, fabricated, and erected in accordance with the *MBMA Metal Building Systems Manual*, and with the requirements of paragraph 2-2.11.

2-2.10.2 Metal building systems that contain and support overhead cranes must comply with the requirements of paragraph 2-2.12.

2-2.10.3 The metal building fabricator must be certified through the AISC Plant Quality Certification Program in the MB category.

2-2.10.4 The structural engineer-of-record must design the building foundation and anchor rod embedment, based on assumed calculated loads or loads provided by a metal building representative. After the metal building supplier submits shop drawings and design analyses for the metal building, the structural engineer-of-record must verify that under all loading conditions, the loads imposed by the metal building system onto the foundation and anchor rods do not exceed the design capacity of the foundation system.

CANCELLED

2-2.10.5 Due to the relatively high lateral drift allowances for pre-engineered structures in the MBMA specifications, the use of masonry veneers and masonry exterior enclosures must be avoided for metal building systems unless the structural engineer-of-record demonstrates by a relative stiffness analysis that the building displacements and veneer backing displacements will not damage the masonry. Design and construction of masonry veneers must comply with the requirements of UFC 1-200-01 and ACI 530.

2-2.10.6 Metal building systems must not be attached to existing structures unless the transfer of lateral loads into the existing structures has been accounted for in modifications to the existing structural system.

2-2.10.7 Where additions or interior modifications are to be made to an existing metal building, the new construction must be separated from the existing structure, so that no new loads are applied to the existing framing, unless the metal building was designed for the additional loads, or the Structural Engineer determines by calculation that the existing structure can safely support the superimposed loads.

2-2.11 **Delegate-Engineered Systems or Component Parts.**

2-2.11.1 The engineer of record for a structure may delegate responsibility for the design of the following systems or component parts of the structure to a qualified delegated engineer. Both the engineer of record for the structure and the delegated engineer must comply with the requirements of this UFC.

a. Prefabricated wood components

b. Cast-in-place post-tensioned concrete structural systems

c. Precast, prestressed concrete components

d. Open web steel joists and joist girders

e. Pre-engineered metal buildings

f. Foundation systems

g. Structural steel connections

h. Cold-formed steel joist/stud/truss framing and pre-fabricated components

i. Seismic anchorage of equipment

j. Proprietary track for under-hung cranes and monorails

CANCELLED

2-2.11.2 The structural construction documents must include the following:

a. Complete dimensional information as required to design the system or component part

b. The nature, location, and magnitude of all design loads to be imposed on the structure

c. All design criteria for both the overall structure and the system or component part to be designed by the delegated engineer

d. All serviceability limit states that apply to the system or component part to be designed by the delegated engineer

2-2.11.3 The delegated engineering submittals must include the following:

a. Identification of the project

b. A printed title block bearing the printed name, address, license number of the delegated engineer, and the date of the drawing

c. The seal and signature of the delegated engineer

d. Installation or erection drawings, showing full details of materials to be used, including necessary accessories and instructions for construction, component details, and connection details

e. Calculations, showing all loads and other design criteria, and the magnitude and location of loads and reactions on other portions of the structural system

2-2.11.4 The structural engineer of record must review all submittals to verify compliance with the design intent and the specified design criteria, and to ensure coordination with the contract documents and other shop drawings. All submittals from the delegated engineer must be approved prior to the start of fabrication of the system or component part, and prior to any field construction that may be affected by the system or component part.

2-2.11.5 The following submittals do not require the seal of a professional engineer:

a. Drawings prepared solely to serve as a guide for fabrication and installation and requiring no engineering input such as reinforcing steel shop drawings, structural steel, and steel joist and joist girder erection drawings.

b. Catalog information on standard products not fabricated for a specific project.

CANCELLED

2-2.12 **Cranes.**

All crane design and installation must be in accordance with the applicable provisions of the following:

a. NAVFACINST 11450.1A, *Acquisition and Management of Weight Handling Equipment*

b. NAVFAC P-307, Appendix E, *Weight Handling Equipment*

c. UFC 3-320-07N, *Design: Weight Handling Facilities*

d. CMAA Specification #70, *Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*

e. CMAA Specification #74, *Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist*

f. ANSI MH27.1, *Specifications for Patented-Track Underhung Cranes and Monorail Systems*

2-2.12.1 The design of crane or monorail support members and systems must also be in accordance with UFC 1-200-01, except Paragraph 1607.12.2 of the IBC will be modified to require the maximum wheel loads of the crane shall be increased by 25 percent for all types of overhead cranes to determine the induced vertical impact or vibration force.

2-2.13 **Fall Protection.**

Fall prevention and protection must be considered at a facility whenever there is a need to perform maintenance work or storing of equipment at heights. At the planning and design phase of a project, fall hazards should be considered and eliminated whenever possible. When elimination or prevention of fall hazards is not feasible, the design must include certified and labeled anchorages meeting the requirements of OSHA and the American National Standards Institute, ANSI Z359.1. Where fall protection is required in the vicinity of weight handling equipment, care must be taken to prevent potential conflicts between the weight handling equipment and the fall protection measures.

2-3 **QUALITY ASSURANCE.**

2-3.1 **General.**

Quality Assurance / Quality Control must be in accordance with UFC 1-200-01. This will include inspection and testing, and may include a Quality Assurance Plan and Structural Observations where applicable.

CANCELLED

2-3.1.1 When warranted by the project scope, the structural engineer of record must require additional inspections, tests, certifications, documentation and observation, beyond those required by UFC 1-200-01. Additional inspections, tests, certifications, documentation, or observations may be required for proprietary materials and systems.

2-3.1.2 The construction documents must contain a list of all required special inspections, field tests, laboratory tests, certifications, documentation, and field observations.

CANCELLED

CHAPTER 3 DESIGN ANALYSIS AND DOCUMENTATION

3-1 BASIS OF DESIGN

Provide a narrative report on how the design concept satisfies the customer's requirements, meets criteria and is cost effective. Include statements on the following:

3-1.1 List a summary of the criteria upon which the structural design will be based. Include a statement of live loading to be used, to include floor loads, wind, snow, earthquake, etc., with references to justify the criteria used.

3-1.2 List all assumptions required for the structural design where the design criteria is undefined, unclear, conflicting, or unknown. State the basis for the assumption made.

3-1.3 Describe the gravity and lateral load structural systems selected for all facilities to be constructed, and explain why it was selected. Provide all pertinent information, such as capacity, size, dimensions, and a list of material selected with design strengths.

3-1.4 Provide a narrative summary of the type of foundation to be used, method by which the allowable bearing values are to be determined, and maximum allowable bearing capacity and lateral-force resisting capacity of the foundations, as well as other allowable soil parameters used in the design.

3-1.5 Describe the structural floor and roof systems proposed. Include a description of the lateral force resisting system with appropriate materials and dimensions. Clearly describe the load path to the foundation for both the vertical and the lateral-force resisting system. Include definitions of the manner in which foundations and slabs on grade are used to distribute lateral forces between the structure and the ground.

3-1.6 When appropriate, provide a statement of any special considerations that affect the design (e.g., "superflat floors" for high stacking warehouses, special corrosion resistance requirements, fire-resistive requirements, retractable roofs, crane or monorail, etc.).

3-2 DRAWINGS.

See UFC 1-300-09N. Structural drawings should be provided that sufficiently define and detail all structural work.

3-2.1 Structural Notes.

The drawings must contain a set of "Structural Notes" in accordance with UFC 1-200-01 which provide critical reference information for use when future modifications and evaluations are made (e.g., Design Criteria, References to Design Standards, General Construction Requirements).

CANCELLED

3-2.1.1 **Loads.** Provide loading information in accordance with UFC 1-200-01. Identify the source for all loads listed.

3-2.1.2. **Foundation Conditions.** Fully describe the foundation conditions, including the following, where applicable:

3-2.1.2.1 Describe site conditions, type of foundation to be used and the method employed to determine allowable soil bearing values.

3-2.1.2.2 Indicate the minimum allowable soil bearing capacity for shallow foundations, or the pile or pier capacity in both tension and compression for deep foundations.

3-2.1.2.3 Indicate the passive, active and at rest design pressures, the coefficient of friction and the sub-grade modulus.

3-2.1.2.4 Indicate if a site-specific design spectrum has been used in the design and give the site class in accord with the seismic design criteria used in the seismic design.

3-2.1.3 **Materials.** Clearly define the types, grades, and properties of materials for each structural element and system.

3-2.1.4 **Quality Assurance.** Provide a summary of the quality assurance requirements.

3-2.1.5 **Ammunition and Explosive Storage Facilities.** Drawings that include a standard approved design for Ammunition and Explosive storage facilities must include a note clearly identifying the source, name, and date of the standard design.

3-2.1.6 **Marine Structures.** List mooring, berthing and deck loads for marine structures, including ship classes, (e.g., DDG 51, CG 47, CVN, etc.) with associated displacements.

3-3 SPECIFICATIONS.

See UFC 1-300-09N, *Design Procedures.*

3-4 CALCULATIONS.

3-4.1 Provide calculations to support all items and details outlined on the drawings and specifications. Structural calculations must be legible, orderly, and easily understandable. A registered practicing structural engineer different from the originator must check calculations.

3-4.2 Include a cover sheet indicating the project title, location, construction contract number, and the names of the persons originating and checking the calculations.

CANCELLED

3-4.3 Include a table of contents.

3-4.4 Provide a brief statement describing the structural system, significant design parameters, and any restrictions that may affect the project design within the calculations.

3-4.5 Provide all design criteria including the following:

3-4.5.1 Loads. Include all loadings, forces, temperature changes, induced settlements, etc. that may affect the design of the structure. The list must include the application/location, magnitude, and units of measure for each load.

3-4.5.2 Restrictions. Include all limiting factors such as deflection limits (horizontal and vertical), height restrictions, special tolerances for installing or operating equipment, or other special restrictions that may affect the design of the structure.

3-4.5.3 Materials. Include all materials to be used and their allowable stress limits, yield strength, type, grade, class, and all other applicable material properties.

3-4.5.4 References. Include all criteria, accepted standards, manuals, codes, texts, papers, or other design information used in the analysis and design that is accepted in a public domain. All references must be appropriately identified. Abbreviations such as AISC, ASTM, ACI, etc. are acceptable. When a facility user provides criteria, document the originator in the calculations.

3-4.6 Provide structural calculations for the main framing systems and all beams, columns, walls, foundations, slabs, bracing, diaphragms, equipment supports, etc., and component inter-connections to provide a safe, stable, efficient and cost-effective structural system for the project, considering all design loads and criteria.

3-4.7 Provide an adequate number of sketches with sufficient detail to make the designer's intention clear, concise, and easily understandable. Note all assumptions and references to codes, standards, criteria, drawings, and computer output.

3-4.8 Design for lateral forces must include design calculations for wind, seismic, and other potential loadings. The construction drawings must depict the governing design elements based on both seismic and wind design requirements.

3-4.9 Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Results must include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.

3-5 COST ESTIMATE.

CANCELLED

See UFC 1-300-09N.

CANCELLED

CHAPTER 4 DESIGN-BUILD SUBMITTAL REQUIREMENTS

4-1 DESIGN-BUILD DOCUMENTATION REQUIREMENTS.

There are two instances where Design-Build construction documentation may vary from Design-Bid-Build documentation. In Design-Build, the Contractor may submit manufacturer's catalog data for a particular product in lieu of a prescriptive specification. The other instance is that shop drawings can be included as design drawings. Refer to the Design-Build Request for Proposal (RFP) for additional direction for these two instances.

4-2 CRITICAL PATH DESIGN SUBMITTALS.

The government prefers to review as few submittal packages as possible. Critical Path Design Submittals are acceptable if they are substantiated as having an impact to the critical path in the Contractor's Accepted Network Analysis Schedule. A Critical Path Design Submittal must include all Design Analyses, Drawings, Specifications, and Product Data required to fully describe the project element for Government review.

4-2.1 Foundation Submittal.

This submittal must be a complete final submittal of the foundation design.

4-2.2 Structural Submittal.

This submittal must be a complete final submittal of the structural system of the building(s), including the foundation design.

4-2.3 Building Enclosure Submittal.

This submittal must be a complete final submittal and must include all construction documentation of the exterior building enclosure, including foundation design, structural system, along with the architectural exterior walls, windows and other glazing, and roofing.

4-2.4 Remaining Work Submittal.

A Remaining Work Submittal would be a submittal that incorporated all other work that was not included in a previously submitted Critical Path Submittal described in the previous paragraphs. A Remaining Work Submittal, combined with all of the subsequent Critical Path Submittals, must be a complete set of construction documents for a facility.

4-3 QUALITY ASSURANCE / QUALITY CONTROL.

Quality Assurance / Quality Control must be in accordance with UFC 1-200-01. This will include inspection and testing, and may include a Quality Assurance Plan and Structural Observations where applicable.

CANCELED

4-3.1 **Structural Inspection.**

A "QC Specialist" for NAVFAC projects is equivalent to a "Special Inspector" as defined in the International Building Code. Quality Control (QC) specialists must be identified as required for the inspection of materials, installation, fabrication, erection or placement of components and connections, as defined in the International Building Code. The QC Specialists must demonstrate competence and be qualified and / or certified for the inspection of the particular type of construction or operation as applicable.

CANCELLED

APPENDIX A REFERENCES

GOVERNMENT PUBLICATIONS:

1. Department of Defense

United Facilities Criteria Internet Site

UFC's can be obtained at either the main UFC website at http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4 or the Navy Design-Build website at http://www.wbdg.org/ndbm/DesignGuid/DesignGuid.html?Tab=DesignGuid

UFC 1-200-01, *General Building Requirements*

UFC 1-300-09N, *Design Procedures*

UFC 3-100-10, *Architecture*

UFC 3-310-01, *Design: Structural Load Data*

UFC 3-310-04, *Design: Seismic Design*

UFC 3-320-07N, *Design: Weight Handling Facilities*

UFC 3-340-01, *Design and Analysis of Hardened Structures to Conventional Weapons Effects*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-023-03, *Design of Buildings to Resist Progressive Collapse*

UFC 4-150-01, *Design: Piers and Wharfs*

2. Department of the Navy

https://navfacilitator.navfac.navy.mil/cheng/enet/tdls/seismic/docs/Inst_11000040.pdf

NAVFACINST 11000.40, *Seismic Safety Requirements for Navy Owned and Leased Buildings*

Standardization Documents Order Desk
700 Robbins Avenue, Bldg. 4D
Philadelphia, PA 19111-5094

NAVFACINST 11450.1A, *Acquisition and Management of Weight Handling Equipment*

NAVFAC P-307, *Weight Handling Equipment*

CANCELLED

3. Departments of the Air Force, Army, Navy

   Standardization Documents Order Desk
   700 Robbins Avenue, Bldg. 4D
   Philadelphia, PA 19111-5094

   TM5-1300/NAVFAC P-397/AFR 88-22, *Structures to Resist the Effects of Accidental Explosions*

4. Federal Emergency Management Agency
   Federal Center Plaza
   500 C. Street S.W.
   Washington, D.C. 20472

   FEMA 350, *Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings*

   FEMA 351, *Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings*

   FEMA 352, *Recommended Post-Earthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings*

   FEMA 353, *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications*

   FEMA 355, *Seismic Design Criteria for Steel Moment-Frame Structures*

NON-GOVERNMENT PUBLICATIONS:

5. American Concrete Institute
   P.O. Box 9094
   Farmington Hills, MI 48333-9094

   ACI 117 (1990), *Standard Specifications for Tolerances for Concrete Construction and Materials*

   ACI 301 (1999), *Specifications for Structural Concrete*

   ACI 302.1R (1996), *Guide for Concrete Floor and Slab Construction*

CANCELLED

ACI 530 (2002), *Building Code Requirements for Masonry Structures*

6. American Institute of Steel Construction
One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001

AISC *Code of Standard Practice for Steel Buildings and Bridges*, (2005)

AISC Seismic (2005), *Seismic Provisions for Structural Steel Buildings*

AISC Steel Design Guide 11 (1997), *Floor Vibrations Due to Human Activity*

7. American National Standards Institute
1819 L Street, NW
6th floor
Washington, DC 20036
(http://www.ansi.org)

ANSI Z359.1, *Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components*

ANSI MH27.1, *Specifications for Patented-Track Underhung Cranes and Monorail Systems*

8. American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

ASTM A6 (2002) *General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling*

ASTM A123/A123M (2000), *Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM A153/A153M (1998), *Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

ASTM A653 (1997), *Steel Sheet, Zinc Coated or Zinc Coated (Galvanized or Zinc-iron Alloy Coated) by the Hot-dip Process*

ASTM A780 (1993; Rev. A), *Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings*

CANCELLED

	ASTM A934 (2001), *Epoxy-Coated Prefabricated Steel Reinforcing Bars*
9. Brick Institute of America 11490 Commerce Park Drive Reston, VA 20191-1525 http://www.bia.org/BIA/technotes/t18a.htm	BIA Technical Note 18A, *Design and Detailing of Movement Joints, Part 2* (1991, Reissued 2001)
10. Crane Manufacturers Association of America 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217-3992	CMAA Specification #70, *Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*, (2004) CMAA Specification #74, *Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist*, (2004)
11. International Code Council 5203 Leesburg Pike, Suite 708 Falls Church, VA 22041	International Building Code (IBC-2003)
12. Metal Buildings Manufacturers Association 1300 Sumner Avenue Cleveland, OH 44115	*Metal Building Systems Manual*, (2002)
13. National Concrete Masonry Association 13750 Sunrise Valley Drive Herndon, VA 20171-4662 http://www.ncma.org/	NCMA-Tek 10-2B (2003), *Control Joints for Concrete Masonry Walls - Empirical Method* NCMA-Tek 10-3 (2003), *Control Joints for Concrete Masonry Walls - Alternative Engineered Method*
14. Steel Stud Manufacturers Association 8 S. Michigan Avenue Chicago, IL 60603	*Product Technical Information*, 2001

CANCELLED

APPENDIX B BEST PRACTICES

B-1 **SELECTION OF STRUCTURAL SYSTEMS.** Consider logical alternatives for the foundations and for the framing systems when selecting the structural system. The following factors should be considered:

a. Total Life Cycle cost effectiveness of the structural system (the design life of the facility, and the maintenance costs over this period)

b. Constructability

c. Experience level and availability of local contractors and labor force

d. Availability of materials at the project location

e. Experience of inspection personnel

f. Construction schedule and methods

g. Site environment, including accessibility, climate, seismic hazard, subsurface conditions, and wind velocity

B-2 SYSTEMS BEST PRACTICES.

B-2.1 General.

Construction Adjustments: Where building finishes or other building features that are supported by structural elements require close construction tolerances, attachments to the structural elements should be detailed such that adjustments may be made in the field to compensate for lack of correct fit.

B-2.2 Concrete.

B-2.2.1 All concrete should have a specified compressive strength (f'c) of not less than 20 Mpa (3,000 psi) at 28 days.

B-2.2.2 With the exception of floor slabs in aircraft hangars and heavy industrial facilities where the slab is designed as a rigid pavement, concrete floor slabs on ground should be reinforced and have a thickness of not less than 101mm (4 inches). Minimum reinforcing should be #3 reinforcing bars at 406mm (16") on center or 152x152 - MW18.7xMW18.7 (6x6-W2.9xW2.9) welded wire reinforcing. The slab reinforcing should be placed on firm supports approximately 1/3 the slab depth from the top of slab with a minimum cover of 38mm (1-1/2 inches).

B-2.2.3 Concrete wall and column footings should have a minimum thickness of 305mm (12 inches), and a minimum width of 457mm (18 inches).

CANCELLED

B-2.2.4 Concrete for floors: The following criteria should apply unless structural or durability requirement necessitate higher strengths. Slump may be increased to 203mm (8 inches) when a high-range water-reducing admixture is used:

Usual Class Traffic	Typical Uses	28 day strength		Max. Slump	
		MPa	psi	mm	in
1. Light foot	Residential or tile covered	20	3000	100	4
2. Foot	Offices, churches, schools, hospitals, residences	25	3500	100	4
3. Light foot & pneumatic wheels	Drives, garage floors and sidewalks for residence	25	3500	100	4
4. Foot and pneumatic wheels	Light industrial, commercial	30	4000	75	3
5. Foot and wheels, abrasive wear	Single-course industrial, integral topping	35	4500	75	3
6. Foot and steel-tire vehicles, severe abrasion	Two-course, heavy industrial topping	See ACI 302.1R			

B-2.2.5 The following maximum water-cement (W/C) guidelines should apply to all structural concrete not exposed to severe conditions:

Compressive Strength (28 days)	Without Air-entrainment	With Air-entrainment
20.7 Mpa (3000 psi)	0.58	0.50
24.1 Mpa (3500 psi)	0.54	0.48
27.6 Mpa (4000 psi)	0.50	0.45

B-2.7 **Cold-Formed Steel Framing.**

The design of cold-formed framing for all architectural uses (interior partitions, secondary framing members, support systems for architectural finishes, etc.) should be coordinated by the Project Architect and the Structural Engineer.

B-2.9 **Wood Framing.**

The moisture content of lumber should not exceed 19 percent for dimensional lumber, or 25 percent for timbers, at the time of delivery to the site. For other lumber products, the moisture content must be in accordance with the standard under which the product is produced.

CANCELLED