UFC 3-340-02
5 December 2008
Change 2, 1 September 2014

UNIFIED FACILITIES CRITERIA (UFC)

STRUCTURES TO RESIST THE EFFECTS OF ACCIDENTAL EXPLOSIONS

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UNIFIED FACILITIES CRITERIA (UFC)

STRUCTURES TO RESIST THE EFFECTS OF ACCIDENTAL EXPLOSIONS

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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	TBD	See Change Summary sheet for details. Editorial changes throughout.

This UFC supersedes ARMY TM 5-1300, dated November 1990.

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 most 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 Center (AFCEC) 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. 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/.

Refer to UFC 1-200-01, General Building Requirements, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-340-02 SUMMARY SHEET

Document: UFC 3-340-02 with Change 2
Superseding: UFC 3-340-02 with Change 1 dated 1 July 2014

Description of Changes:

- Rescinding changes to section 4-55 and figure 4-65a. The equations and figure updated in Change 1 were mistakenly based on SI units. This section now matches the 5 December 2008 version, which is based on U.S. customary units. Other Change 1 revisions are still valid.

Reason for Changes:

- To correct errors

Impact: There are no anticipated cost impacts.

UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-340-02 SUMMARY SHEET

Document: UFC 3-340-02 with Change 1
Superseding: UFC 3-340-02 dated 8 December 2008

Description of Changes:

- Revised section 4-55 and figure 4-65a to incorporate updated spall and breach thresholds for reinforced concrete walls
- Implemented major revision to the masonry analysis and design guidance in sections 6-7, 6-8 and 6-9 and incorporated new example problems 6A-1a and 6A-1b, illustrating the new procedures
- Revised performance requirements for mechanical splices of reinforcing bars and added mandatory validation testing protocol to section 4-21.8
- Added guidance to the Scope sections (fourth section in each chapter) clarifying the intended applications and limitations of this document in satisfying DoD 6055.09-M requirements
- Corrected constants in equations 2-60, 2-62 and 2-63
- Expanded figure 2-152 to show peak quasistatic pressure for lower charge weight to volume ratios
- Modified figures 3-29 through 3-32 and figure 3-38 to correct errors that occurred during conversion of tri-service document Army TM 5-1300, Navy NAVFAC P-397, and Air Force AFR 88-22, Revision 1 (TM 5-1300) to UFC 3-340-02. These figures are now consistent with previous tri-service manual.
- Added supplementary minimum lap splice requirements, previously provided in TM 5-1300, and introduced guidance on acceptable applications of non-contract lap splices to section 4-21.7
- Revised variables in equation 2-47 to align equation with other DoD fragment velocity models; calculated values for the velocity change coefficient, k_v, will not be affected by this change.
- Revised Chapter 4 to exclude use of steel wire reinforcement and steel welded wire reinforcement for reinforced concrete
- Reduced support rotation limit for continuously supported reinforced concrete slabs and reinforced concrete beams designed for Protection Category 2 to 6-degrees. Per section 1-9, Protection Category 2 is used to protect equipment, supplies and stored explosives from fragment impact, blast pressures and structural response. This change should prevent any significant concrete scabbing of these elements, enhancing protection to these items.

Reasons for Changes:

- To correct errors and inconsistencies and to add clarifications
- To clarify applications and limitations of this document in satisfying DoD 6055.09-M requirements
- To update sections based on current state-of-the-knowledge and recent testing
- To improve document usability and change the document format to simplify implementation of future changes

Impact: There are no anticipated cost impacts. However, the following benefits should be realized.

- The document has a more user-friendly format including the ability to simultaneously view figures and tables with the discussion in the text
- The new masonry design procedures are based on current construction practice and allow the more cost effective use of blast resistant masonry walls
- The new mechanical splice requirements will, for the first time, allow mechanical couplers to be used in blast resistant construction, significantly reducing reinforcing bar congestion and simplifying concrete placement
- The changes to the document's format will simplify implementation of future changes

UNIFIED FACILITIES CRITERIA (UFC)
UFC 3-340-02 SUMMARY SHEET
(Provided for Archiving Purposes)

Document: UFC 3-340-02 (dated 8 December 2008)
Superseding: ARMY TM 5-1300, Navy NAVFAC P-397, and Air Force AFR 88-22 (dated November 1990)

Description of Changes:

- All substantive changes were made to Chapter 4, Reinforced Concrete Design as detailed in table below.

Description	References
Increases maximum design support rotation for nonlaced reinforced concrete elements under flexural action to 6-degrees	Section 4-9.2, Section 4-9.3, Section 4-16, Section 4-23.3, Section 4-24, Section 4-25.1, Section 4-25.3, Section 4-26.1 and Section 4-34
Increases maximum design support rotation for nonlaced reinforced concrete elements under tension membrane action to 12-degrees.	Section 4-9.3 and Section 4-25.4
Allows use of ASTM A 706 reinforcing bars in lieu of ASTM A 615 reinforcing bars.	Section 4-12.2
Updates and expands dynamic increase factor data for concrete and reinforcing bars.	Section 4-13.2, Figure 4-9a, Figure 4-9b and Figure 4-10
Revises dynamic design stresses for elements with a maximum design support rotation, θm, $5o < \theta m \leq 6o$.	Section 4-13.3 (Table 4-2)
Provides new equations for calculating minimum reinforcement ratios for slabs. Equations now explicitly consider the concrete's compressive strength and the reinforcing bar's yield strength.	Section 4-17.3, Table 4-3, Section 4-33.4.2 and Appendix 4A (Example 4A-1, step 6 and Example 4A-4, step 6)
Adds alternate ACI equation for calculating the allowable shear stress on the unreinforced web of an element subjected to flexure only.	Section 4-18.2

Description	References
Revises diagonal tension design requirements for slabs that are based upon the scaled charge distance.	Section 4-18.3
Updates minimum design shear stresses. In addition, instead of basing requirements upon close-in and far design ranges, requirements are now based upon the scaled charge distance from an element.	Section 4-18.4 and Table 4-4
Revises the equation for allowable ultimate direct shear force, Vd, that may be resisted by the concrete in a slab.	Section 4-19.2 and Section 4-19.3
Adds new sections on tension design requirements in non-laced slabs, laced slabs and beams (previously provided in section 4-68).	Section 4-20A, Section 4-26.3 and Section 4-35A
Significantly revises reinforcing bar development and lap splice requirements. In general, reinforcing bar development and lap splice lengths now calculated in accordance with the provisions of the latest ACI 318 Building Code. Supplementary requirements are noted.	Section 4-21 and subsections, Section 4-64, Section 4-65.3 and Section 4-66 subsections
Significantly expands allowable uses of single leg stirrups for diagonal tension reinforcement in slabs. Provides limits on the use of 3 different single leg stirrup types (designated as Type A, Type B and Type C).	Section 4-22 and Section 4-32
Updates figures summarizing design parameters for unlaced and laced elements to incorporate new criteria.	Figure 4-17 and Figure 4-29
Replaces minimum reinforcement ratio guidance with new equations that explicitly consider the concrete's compressive strength and the reinforcing bar's yield strength.	Section 4-38.3 and Appendix 4A (Example 4A-6, step 4d)
Provides new equations for calculating the minimum area of closed ties in columns.	Section 4-48.4
Provides new equations for calculating the minimum area of spiral reinforcement in columns.	Section 4-49.4
Section completely revised to incorporate UFC 3- 340-01's procedures for predicting concrete spall and breach. Since UFC 3-340-01 is a limited distribution document, these open distribution procedures were not previously available to the public.	Section 4-55 (including Figure 4-65, Figure 4-65a and Table 4-15a)
Defines Type A, Type B and Type C single leg stirrups and their allowable uses.	Section 4-66.3.1

Description	**References**
Section revised to eliminate now duplicate guidance for non-laced slabs, laced slabs and beams (now provided in Section 4-20A, Section 4-26.3 and Section 4-35A, respectively).	Section 4-68
Figures updated to incorporate changes to design criteria.	Figure 4-1, Figure 4-2, Figure 4-18, Figure 4-21, Figure 4-59, Figure 4-83, Figure 4-85, Figure 4-101, Figure 4-102 and Figure 4-103
Updates and expands bibliography.	Appendix 4C