

Overview of UFC 3-340-02, Change 1



William H. Zehrt, Jr., PE
US Department of Defense Explosives Safety Board

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Presentation Outline

- **Introduction**
- **Overview of UFC 3-340-02**
- **Development of Change 1**
- **Future Work**
- **Conclusions**
- **Questions???**



Introduction

- **US Department of Defense Explosives Safety Board (DDESB) was established in 1928 after a major explosives accident at the Naval Ammunition Depot, Lake Denmark, New Jersey. The accident virtually destroyed the depot, causing heavy damage to adjacent Picatinny Arsenal and the surrounding communities, killing 21 people, and seriously injuring 53 others.**





Introduction

- **DDESB Mission: Provide objective advice to the Secretary of Defense and Service Secretaries on matters concerning explosives safety and prevent hazardous conditions to life and property on and off Department of Defense installations from the explosives and environmental effects of DoD-titled munitions.**
- **Specific criteria for protecting personnel and property from DoD-titled ammunition and explosives are provided in DoD 6055.09-M, “DoD Ammunition and Explosives Safety Standards.”**
 - **Preferred approach: Use distance to provide the required protection; minimum default separation distances are defined in DoD 6055.09-M.**
 - **Alternate approach: If unable to satisfy default separation distance requirement, may use UFC 3-340-02 to design protective construction that will provide equivalent protection.**



UFC 3-340-02 Overview

- **Proponent: DDESB**
- **Primary Objective: Establish design procedures and construction techniques to prevent or delay an explosion propagation between adjacent bays or buildings, to protect personnel against death or serious injury, and to protect property.**
- **Applicability: Design of protective construction in facilities used for development, testing, production, storage, maintenance, modification, inspection, demilitarization and disposal of DoD-titled ammunition and explosives.**



UFC 3-340-02 Overview

- **“Structures to Resist the Effects of Accidental Explosions,” Army Technical Manual 5-1300/NAVFAC P-397/AFR 88-22 (TM 5-1300), first published in 1969.**
 - **Based on data from an extensive DoD explosives testing program of various protective construction concepts.**
 - **Heavy emphasis on continuously supported, reinforced concrete slab/wall elements.**
- **TM 5-1300, revision 1, published in 1990; greatly expanded content.**



UFC 3-340-02 Overview

- **UFC 3-340-02 released on 5 December 2008**
 - **Converted manual to UFC format**
 - **Incorporated numerous updates to the manual's reinforced concrete design guidance.**
- **UFC 3-340-02, Change 1 released on 1 July 2014**
- **UFC 3-340-02, Change 2 released on 1 September 2014**
 - **Corrected unit errors in change 1's concrete spall/breach guidance; all other change 1 revisions remain in effect.**
 - **Available for download from Whole Building Design Guide website (www.wbdg.org)**



UFC 3-340-02 Overview

- **What makes UFC 3-340-02 unique?**
 - **Approved for public release.**
 - **May be used to design protective construction to withstand an internal or an external explosive detonation.**
 - **Used throughout the world to design blast resistant government, commercial, and industrial structures.**
 - **Specifically written to facilitate use by first-time blast designers.**
 - **Step-by-step examples in chapter appendices include references to applicable equations, figures, and tables.**



Overview of UFC 3-340-02

- **Chapter 1 – Introduction**
 - **Protection Category 1 – Protect personnel. Exposure limits defined in DoD 6055.09-M.**
 - **Incident blast overpressure ≤ 2.3 psi [15.9 kPa].**
 - **Fragment energy < 58 ft-lbs [79 joules]**
 - **Thermal flux: Heat fluxes and exposure times should be less than that given by the equation $t = 200q^{-1.46}$ where “t” is the time in seconds that a person is exposed and “q” is the received heat flux in kilowatts (kW) per m²).**
 - **Protection Category 2 – Protect equipment, supplies and stored explosives.**
 - **Protection Category 3 – Prevent communication of detonation.**
 - **Protection Category 4 – Prevent mass detonation.**



Overview of UFC 3-340-02

- **Chapter 2 – Blast, Fragment and Shock Loads**
- **Chapter 3 – Principles of Dynamic Analysis**
- **Chapter 4 – Reinforced Concrete Design**
- **Chapter 5 – Structural Steel Design**
- **Chapter 6 – Special Considerations**



UFC 3-340-02 Technical Working Group

- **Established by DDESB in 2003**
- **Representatives from DDESB, Army, Navy, Marine Corps and Air Force organizations.**
- **Meet annually to present ongoing research, to review draft updates, and to plan/prioritize future work.**



Rules of Engagement

- **Due to limited funds, prioritize work based on Service need and potential benefit.**
 - **Base revisions upon existing research.**
 - **Align explosives safety, hardened structure, and anti-terrorism/ force protection requirements, where feasible.**
 - **Retain English units.**
 - **Retain open distribution.**
 - **Correct errors/typos and clarify guidance, as warranted (items often identified through user comments).**



UFC 3-340-02, Change 1 (1 Jul 14)

- **Major revision to masonry analysis and design sections.**
- **New performance and validation testing criteria for mechanical splices of reinforcing bars.**
- **Scope of each chapter expanded to clarify intended applications and limitations; UFC is specifically written to satisfy DoD 6055.09-M explosives safety requirements.**
- **Figure 2-152 expanded to provide peak quasi-static pressures for lower charge weight to volume ratios**
- **Supplementary minimum lap splice requirements, previously provided in TM 5-1300, revision 1(1990), reintroduced and guidance added on permissible uses of non-contact lap splices.**
- **Protection Category 2 support rotation limit for continuously supported reinforced concrete slabs and for reinforced concrete beams reduced to 6-degees to limit potential for concrete scabbing.**



Future Work

- **Revise glass analysis/design sections.**
- **Update and expand structural steel design guidance.**
- **Revise gas pressure calculation procedure for partial blast containment cells.**
- **Investigate/develop guidance on permissible uses of other DoD/Service blast load prediction, analysis and design software (e.g., SBEDS used by AT/FP community).**
- **Expand analysis/design guidance for precast and prestressed concrete elements.**
- **Add new guidance/sections**
 - **Allowable uses of headed reinforcing bars**
 - **Retrofit of existing structures**
 - **Innovative structural systems and materials**



Conclusions

- **Since its initial publication in 1969, TM 5-1300/UFC 3-340-02 has provided uniquely practical and straightforward procedures for analyzing and designing blast resistant structures.**
- **UFC 3-340-02 is the only blast design manual approved by US Department of Defense/DDESB for explosives safety applications.**
- **Given its open distribution, UFC 3-340-02's procedures are referenced extensively by other user communities in their blast design manuals.**
- **UFC 3-340-02, change 1 incorporates much needed revisions to the manual's masonry and mechanical splice guidance.**
- **Additional revisions are needed.**
- **Questions???**