

UFC 3-400-01  
5 July 2002  
Including Change 3, February 2008

# **UNIFIED FACILITIES CRITERIA (UFC)**

## **ENERGY CONSERVATION**



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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

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

<b>Change No.</b>	<b>Date</b>	<b>Location</b>
1	Dec 2007	Incorporate EAct05 requirements in Paras. 1, 2 & 4
2	Jan 2008	Throughout Paras 1 & 2; Delete Paras. 3 – 5
3	Feb 2008	1-1, 1-3, 1-3.1.2, 2-1.1, 2-1.2, 2-1.3, 2-2, 2-3, 2-4, 2-4.2, 2-5

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This UFC supersedes Military Handbook 1190, dated 1 September 1987, Chapter 8, and TI 800-01, dated 20 July 1998, Chapter 11.

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**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/>.

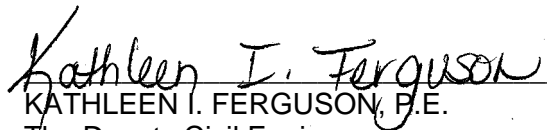
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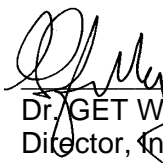

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## **ENERGY CONSERVATION**

### **1-0 INTRODUCTION**

**1-1 PURPOSE.** This document establishes minimum standards and policy for energy \2\2/ conservation in new construction and renovation of existing facilities. Federal facilities are required to comply with various Executive Orders and Congressional actions regarding energy \3\ /3/use, conservation and efficiency standards.\2\ /2/

**1-2 SCOPE.** \2\The provisions of this UFC are applicable to all new and existing DOD facilities located on or outside of DOD installations, whether acquired or leased, by appropriated or non-appropriated funds, or third party financed and constructed.

**1-3 CRITERIA.** This UFC implements the following public laws and industry standards:/2/

ASHRAE Standard 90.1 – \1\ 2004 /1/, Energy Standard for Buildings Except Low-Rise Residential Buildings, American Society of Heating Refrigeration and Air Conditioning Engineers, Inc., Atlanta Georgia \2\

[USC](#) Title 10, Part 433, Energy Efficient Standards for the Design and Construction of New Federal and Commercial and Multi-Family High Rise Residential Buildings

[USC](#) Title 10, Part 435, Energy Efficient Standards for New Federal Low Rise Residential Buildings/2/

Title 10 [Code of Federal Regulations](#), Part 436 – Federal Energy Management and Planning Programs, Subpart A – Methodology and Procedures for Life Cycle Cost Analysis \2\

\3\ ICC International Energy Conservation Code 2003 Including the Supplement Edition 2004 /3/

ICC International Energy Conservation Code 2004 Including the Supplement Edition 2005

\3\ Executive Order 13221 - Energy Efficient Standby Power Devices \3\

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**1-3.1 Applications/Types of Work Efforts.** This UFC applies to all work necessary to build, maintain, or change DOD facilities.

**1-3.1.1 New Construction.** All new construction must comply with this UFC.

**1-3.1.2 Renovation (including renewal, renovation and sustainment).**

a. Where renovation costs are greater than or equal to 25 percent of the replacement cost of the building, the entire building shall be brought into compliance with the requirements for new construction listed above. The replacement cost of the building is exclusive of the cost to bring the building into compliance.

b. Where renovation costs are less than 25 percent of the replacement cost of the building the entire building shall be brought into compliance with the requirements for new construction referenced above to the maximum extent practical. All new work shall comply with the requirements for new construction referenced above.

**1-3.2 Authority Having Jurisdiction (AHJ).** The term AHJ as used in this UFC and its references refers to the component office of responsibility, i.e. U.S. Army, HQUSACE/CECW-CE; U.S. Navy, NAVFACENGCOM HQ Code CHE; U.S. Marine Corps, HQMC Code LFF-1; U.S. Air Force, HQ AFCEA/CES; Defense Logistics Agency, DES-SE; National Geospatial-Intelligence, Security and Installations; and for all other DOD components, Deputy Undersecretary of Defense for Installations./2/

## **2-0 GENERAL REQUIREMENTS.**

### **2-1 BASIC CRITERIA.**

**2-1.1** New buildings including all Army Unaccompanied Enlisted Personnel Housing (UEPH), regardless of height, but excluding other single family and low rise multi-family residential buildings shall be designed and constructed in accordance with the Energy Policy Act of 2005 as codified in the CFR Title 10 CFR Part 433. Specifically, new buildings shall be designed to comply with ASHRAE Standard 90.1. In addition, to complying with the standard, buildings shall also achieve an energy consumption level that is at least 30 percent below the level achieved under ASHRAE Standard 90.1. If a minimum of 30 percent energy consumption savings can not be achieved in a life cycle cost effective manner, the maximum savings level that is cost effective shall be achieved. Energy consumption levels for both the baseline building and proposed building shall be determined by using the Performance Rating Method found in ASHRAE Standard 90.1 Appendix G except the formula for calculating the Performance Rating in paragraph G1.2 shall read as follows:

Percentage improvement =  $100 \times (\text{Baseline building consumption} - \text{Proposed building consumption}) / (\text{Baseline building consumption} - \text{Receptacle and process loads})$ .

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Laboratory fume hoods and kitchen ventilation systems shall be included as part of the HVAC loads subject to the 30 percent savings requirements, rather than as process loads.

2-1.2 New \3\ single /3/ family housing and low rise (3 stories or less) multi-family residential buildings shall be designed and constructed in accordance with CFR Title 10 CFR Part 435. Specifically, new residential buildings shall be designed to comply with the ICC International Energy Conservation Code. In addition, to complying with the code, buildings shall also achieve an energy consumption level that is at least 30 percent below the level achieved under ICC International Energy Conservation Code. Energy consumption levels for both the baseline building and proposed building shall be determined by using the Simulated Performance Alternative found in the ICC International Energy Conservation Code (see section 404 of the January 2005 Supplement Edition). If a minimum of 30 percent energy consumption savings can not be achieved in a life cycle cost effective manner, the maximum savings level that is life cycle cost effective shall be achieved. Space lighting, space heating, space cooling, and domestic water heating shall be included as subject to the 30 percent savings requirements.

\3\2-1.3/3/ All energy consuming products shall be either ENERGY STAR-qualified or \3\ FEMP-recommended /3/. These products are in the upper 25 percent of energy efficiency in their class. These purchasing requirements are codified by FAR Part 23. Additional details regarding these purchasing requirements can be found at:

[www.energystar.gov/products](http://www.energystar.gov/products)

<http://www.eere.energy.gov/femp/procurement/>

All energy consuming products shall also be designated as using “low standby power” as required by Executive Order 13221. Instructions on how to determine what qualifies as “low standby power” by product type can be found at:

[http://www.eere.energy.gov/femp/procurement/eep\\_standby\\_power.html](http://www.eere.energy.gov/femp/procurement/eep_standby_power.html)

**2-2 POTENTIAL ENERGY CONSERVATION MEASURES.** All relevant energy conservation measures shall be optimized as a group to ensure that overall energy consumption is reduced to the lowest level consistent with the LCCA. The energy conservation measures that are relevant shall be determined for each project and, as a minimum, shall include each of the following. The relevant measures and all calculations shall be captured in the Energy Compliance Analysis (see sec.2-4):

- Optimization of building position and orientation to either reduce heating and cooling loads or energy consumption to heat and cool the building as customarily appropriate.

- Building insulation optimization
- Sealing building envelope for air tightness
- “Cool roof”
- Using motion detectors to reduce lighting and to setback or setforward heating and cooling in unoccupied rooms
- Using centralized exhausts of nontoxic, nonflammable air streams with latent and sensible heat recovery employing heat exchangers rated for zero cross-contamination used to either reduce the ventilation air heating and cooling load or the energy consumption to heat or cool the ventilation air as customarily appropriate.
- Natural lighting
- Using existing district heating and cooling systems

Where available, use alternative funding from sources such as rebates from the utility companies to pay for energy\3\ /3/. /2/

**2-3 FUNCTIONAL REQUIREMENTS AND COMFORT.** The mission and function of the facility and the long term comfort, health and productivity of the occupants are critical considerations in the planning, design and construction of any facility. \1\ \2\ Generally, all practical and life cycle cost effective /1/energy/2\3\ /3/ will be included in the planning, design and construction of facilities. However, features that will adversely impact the mission or comfort, health and productivity of the occupants shall not be included. In addition, system selection and incorporation of energy\3\ /3/ conserving features shall be closely coordinated with the facility user and maintenance staff. Only those systems and features that can be effectively operated and maintained will be considered.

**2-4 \2\ENERGY COMPLIANCE ANALYSIS AND LIFE CYCLE COST ANALYSIS CALCULATION METHODS.** All analysis shall be performed based on the actual conditions expected over the life of the facility including anticipated occupancies, scheduled hours of operation and process loads. Realistic energy usage and efficiencies, maintenance cost and repairs and renovations shall be included. All calculations shall be performed using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting, and other energy producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads used in the design. The energy savings and any parasitic energy loads associated with the utilization of recovered energy, solar heat, solar photovoltaic energy and other renewable or waste heat applications shall be included. The program will perform 8760 hourly calculations. The Department of Energy maintains a list of building energy\3\ /3/ tools for design. A



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number of the programs may be of benefit in performing energy conservation calculations, comparing energy system alternatives and evaluating specific conservation measures. The web address for additional information is:

<http://www.energytoolsdirectory.gov/>

**2-4.1 Energy Compliance Analysis.** In order to demonstrate compliance with the requirements of this BASIC CRITERIA with regards to achieving the required reduction in energy consumption, each design team shall prepare an Energy Compliance Analysis (ECA) for their project. The ECA shall identify the specific energy conservation criteria that applies to the project, the software used to prepare the necessary calculations, a summary of all input to and output from the calculations, the projects energy target, and the calculated energy consumption of the proposed design. The ECA shall also include a separate narrative prepared by each of the following individuals: the Lead Project Architect, Lead Project Mechanical Engineer, and the Lead Project Electrical Engineer. Each of the three narratives shall list the conservation measures considered for that discipline, the impact of each measure considered on the calculated energy consumption, and finally a list of conservation measures adopted in the design. The ECA shall be submitted for approval along with the Concept Design, shall be updated as necessary as the design progresses, and the completed document submitted with the Final Design.

**2-4.2 Life Cycle Cost Analysis.** In order to demonstrate compliance with Title 10 Code of Federal Regulations Part 436, Subpart A and to demonstrate compliance with the BASIC CRITERIA with regards to life cycle cost effectiveness of the proposed design, each design team shall prepare a Life Cycle Cost Analysis (LCCA) for their project. \3\ The LCCA shall be prepared using \3\ /3/ the Building Life Cycle Costing (BLCC) program, available from the National Institute of Standards and Technology, a link to BLCC (under Energy Economics) at the Department of Energy's building energy tools web site, and at:

<http://www.eren.doe.gov/femp/techassist/softwaretools/softwaretools.html>

The appropriate cost and savings associated with the utilization of recovered energy, solar heat, solar photovoltaic energy and other renewable or waste heat applications shall be included. The LCCA shall be submitted for approval along with the Concept Design, shall be updated as necessary as the design progresses, and the completed document submitted with the Final Design. /2/

**2-5 METERS.** \2\ Utility meters can be a valuable tool in the effective management of energy \3\ /3/use at both the individual facility and installation level. A utility meter shall be furnished at each building, for each utility serving the building (e.g. district steam, district hot and chilled water, electricity, natural gas, fuel oil, etc.) in the normal units of the utility (i.e. kWh, kW, cf, gallons, etc.).\3\3/ Design and installation of all meters shall be connected to a base wide energy and utility monitoring and control system directly or via the building HVAC control system.



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