



# Department of Defense Legacy Resource Management Program

DoD Legacy Project 14-735

## **Implementing Environmental & Economic Cost-Benefits of Reusing DoD's Pre-World War II Buildings**

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A roster of Study Team members is provided on the next page.

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# Executive Summary

Identifying the constraints to repurposing and modernizing Pre-World War II masonry buildings in an efficient and sensible manner is the goal of this DoD Legacy Project, Number 14-735: Implementing Environmental & Economic Cost-benefits of Reusing DoD's Pre-World War II Buildings (Legacy Report). Overcoming these constraints will facilitate the continued economic and mission-supporting use of these buildings.

There are over 185,000 assets listed in the DoD Real Property Asset Database which are fifty years old or older; 9000 are masonry buildings constructed prior to 1941. This subset of buildings was chosen as the focus of the current study due to their typical proximity to the core of the installation, historic significance, and demonstrated durability.

Our previous study, Environmental Security Technology Certification Program (ESTCP) Project SI-0931: Demonstrating the Environmental & Economic Cost-Benefits of Reusing DoD's Pre-World War II Buildings, (ESTCP Study) found that there was an incomplete understanding within DoD of the value of these resources with regard to costing, planning and energy requirements. The results of the ESTCP study showed that reuse of DoD's Pre-World War II masonry buildings can result in carbon emission reductions comparable to new construction and can be an active part of reaching mission sustainability goals. Such reductions occur through avoidance of carbon emissions associated with manufacturing and transporting new building materials while achieving cost-effectiveness and comparable levels of energy efficiency over the building life cycle. That study led to a need to identify the constraints to reusing these buildings.

The approach of our study was to look within codes, policies and data for constraints (triggers, prescriptions or decision rules) that could be preventing the DoD from better utilizing Pre-World War II (WWII) Buildings. The authors of the study found several constraints to the reuse of DoD Pre-WWII masonry buildings to actively support the military mission:

**1** Plant Replacement Value (PRV) is a key component of project planning since it sets the threshold for code compliance requirements and the economic life of the asset. Use of a PRVs as entered into real property databases should be avoided since the PRV value represents macro-level estimating and can frequently be out-of-date. If the renovation or modernization costs are 50% or more of the PRV then a Level 3 Code compliance is required under the International Existing Building Code which then also triggers Anti-Terrorism / Force Protection (ATFP) and Progressive Collapse compliance. This substantially increases the cost of the modernization forcing the project to compete with New Footprint MILCON and the project is not funded. Economic analysis guidance documents such as NAVFAC P-442 Economic Analysis Handbook should highlight DoD's requirement that an updated, project-specific PRV be prepared as part of project planning.

**2** MILCON, rather than Sustainment, Restoration and Modernization (SRM) money should be seen as the primary vehicle for modernization of existing buildings and substantial rehabilitation projects should be as highly valued and competitive as new construction. SRM funded projects are limited to \$750,000, which is often not sufficient for a substantial rehabilitation of some pre- WWII masonry buildings. As a result, existing buildings may be

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rehabilitated in an ad hoc manner, never receiving long-term major improvements to system, energy, or ATPF, which would make them sought-after space for mission use. In the economic analysis documents, there should be better guidance to planners to the alternative of reusing buildings rather than new construction.

- 3 Progressive Collapse and ATPF requirements within the UFCs do not take into account the inherent strengths of Pre-World War II masonry buildings. The structural behavior of thick-walled masonry buildings is distinct from non-structural veneer masonry on which the rules are based. Moreover, the mandatory progressive collapse intervention for two-story buildings with basements is in many cases not necessary for safety. Adapting the prescriptive policy and providing guidance for more accurate analysis can reduce costs without compromising safety or security.
- 4 Pre- WWII masonry buildings are consistently given a low Mission Dependency Index (MDI) which discourages new or critical mission uses. Management data, which is used to determine which buildings should be sustained, restored or modernized, is based on the MDI, condition rating, configuration rating and capacity ratings. The configuration ratings and capacity ratings indicate if a building can meet the mission or support command through functionality. Condition ratings are based on physical condition of the building. Since pre- WWII masonry buildings almost never go through substantial modernization, they are not used by installations to support critical mission functions and because they do not support critical mission functions, they are not chosen for substantial modernization.
- 5 DoD's Installation Master Planning guidance is primarily oriented towards new construction and does not give weight to the reuse of historic buildings to meet mission requirements. For example, Installation Master Planning principles do not include any principles specifically related to historic structures. The role of the Cultural Resource Manager in installation master planning is advisory and insufficient to ensure that historic buildings, particularly Pre-WWII buildings are duly considered for reuse in installation master plans. DoD's Economic Analysis guidance should also have analysts clearly tie project alternatives to the Installation Master Plan.
- 6 DoD's Economic Analysis guidance documents' use of the terms 'repair,' 'reuse,' 'renovation,' 'modernization,' and 'conversion' is confusing and often inconsistent; no guidance is provided to analysts to formulate project alternatives within the context of the Installation. Guidance documents should set forth clear and uniform terminology that is generally consistent with how the same terms are defined in DoD funding programs.
- 7 DoD's Economic Analysis guidance is written in a manner that frequently presumes that new construction will likely be preferable to restoration or modernization of existing historic buildings. Guidance documents should be revised to provide narrative examples as preferred outcomes, balanced between new construction and restoration / modernization. Better guidance for estimating the residual value of a restoration or modernization project alternative should also be provided. Overall, Economic Analysis guidance documents should provide sufficient direction to analysts to give equal analytic footing for Pre-WWII buildings and new construction. This will ensure that Economic Analyses are objective, transparent, and as accurate as possible.

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8 The National Fire Protection Association (NFPA) 914 Code for Fire Protection of Historic Structures should be implemented for the reuse of Pre-World War II masonry buildings. NFPA 914 provides for an alternative compliance for meeting fire code requirements in the modernization of an existing building, at substantial savings. According to the Code, NFPA 914 uses a prescriptive approach as well as a performance-based approach to finding solutions to the life and fire safety challenges in existing building modernization.

These findings are based on a review of DoD policies, guidance, and other governing documents, as well as interviews with service representatives at three different installations (one each from the Army, Navy and Air Force). This report details the process utilized to arrive at these findings, provides specific commentary on several DoD policy / guidance documents, and makes recommendations on approaches to rectify certain perceived deficiencies.

## Key Recommendation

**To address the issues identified in this report, the Study Team recommends that DoD consider developing a new UFC for the restoration or modernization of specific types of Pre-World War II masonry buildings by unifying treatments for this class of building into a single UFC, thereby streamlining the application of best practices;** the new UFC would be organized to provide criteria and direction at each stage of the project development process including master planning, AT/FP, economic analysis and Section 106 compliance. The development and use of such a UFC for Pre-WWII masonry buildings would support the use of these buildings and streamline compliance for cultural resources. Under Section 106 of the National Historic Preservation Act, treatment standards for this building type could be adopted by the Advisory Council on Historic Preservation through a nationwide programmatic agreement with the National Conference of State Historic Preservation Officers to be determined as constituting a no adverse effect to historic properties which are on or eligible for the National Register of Historic Places.

# Introduction and Background

## Purpose of Study

This study seeks to improve DoD's existing installation and project planning guidance for the reuse of Pre-World War II masonry buildings, which are found throughout the DoD inventory<sup>1</sup>. A fundamental premise of this study is that these buildings represent a potentially valuable resource that can be better utilized to meet DoD's multiple goals of mission readiness, energy efficiency, and responsible stewardship of its historic properties.

## Key Findings of 2012 ESTCP Project SI-0931

This study builds on key findings from a previous DoD report entitled "Demonstrating the Environmental & Economic Cost-Benefits of Reusing DoD's Pre-World War II Buildings." This report was funded by ESTCP under Project SI-0931. The key findings of this project were:

- Modernization of DoD's Pre-WWII masonry buildings can be significantly less expensive than new construction.
- DoD's LEED Silver standard can be met at less cost with modernization and Pre-WWII masonry buildings can contribute significantly to DoD's goals of lowering greenhouse gas (GHG) emissions.
- By leveraging original design features for thermal comfort ("original design intelligence") with new, energy-efficient buildings systems, DoD can modernize Pre-WWII masonry buildings to match the energy performance of new construction.
- Mission critical building requirements can be fulfilled through the adaptive reuse and modernization of Pre-WWII masonry buildings.
- Historic buildings should be considered a potentially valuable asset and consideration of their reuse and modernization should be integrated into installation master plans.
- Prescriptive and rigid application of ATFP and progressive collapse standards can result in significantly higher modernization costs and at the same time generate higher levels of Scope 3 GHG emissions than carefully specified ATFP treatments.

## Focus on Pre-WWII Masonry Buildings

As of Fiscal Year 2015, there were over 185,000 assets listed in the DoD Real Property Asset Database (RPAD) which are classified as fifty years old or older, and potentially subject to review and evaluation for listing on the National Register of Historic Places (NRHP) and treatment under the National Historic Preservation Act (NHPA). In recent years, DoD has undertaken several initiatives to better address historic assets, including programmatic approaches to managing them by type, and by construction era.

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<sup>1</sup> For the purposes of this study, 'Pre-WWII buildings' are those constructed on or before 1 January 1941.

# Introduction and Background

Masonry buildings constructed prior to 1941 represent about 9,000 assets. This building type was chosen for the study because many of them are within the core footprint of active installations, have demonstrated durability in a range of physical environments, and have the potential to be highly adaptable. Also, this inventory of Pre-WWII masonry buildings contains a high proportion of historically significant buildings, many located within districts listed on / eligible for listing on the NRHP. Under the NHPA, DoD is required to consider utilizing, including reusing, these historic properties as alternatives to demolition. Prior work by this Study Team completed under the DoD Environmental Security Technology Certification Program (ESTCP) has found that Pre-WWII masonry buildings can possess qualities which, if recaptured through appropriate retention, repurposing and modernization, can lower both military construction costs and carbon emissions at military installations.

## Approach

To unlock the value of its stock of Pre-WWII buildings, DoD should review and adjust its guidance documents related to military planning, uniform facilities criteria, energy efficiency, construction, and economic analysis with the goal of giving project analysts clear direction to consider the restoration or modernization of historic buildings as a viable project alternative to new construction. To this end, this study reviews and evaluates key DoD policies and issuances and makes recommendations to improve DoD's decision-making related to identifying, restoring, modernizing, reusing, and managing its Pre-WWII masonry building assets.

The Study Team worked with over twenty staff from the Office of the Assistant Secretary of Defense for Energy, Installations and Environment, and other DoD facilities, cultural resource managers and asset managers to focus our reviews, evaluations, and recommendations specifically on:

- Identifying appropriate design exceptions
- Avoidance of prescriptive treatments, “one-size fits all” approaches
- Master planning for site-wide ATFP treatments and utilization of historic properties
- Specification of full restoration and modernization alternatives in-lieu of piece-meal sustainment projects
- Other issues and items as identified such as fire and life safety code issues

Our approach to the study was to look within DoD codes, policies and data for triggers, prescriptions or decision rules that could be preventing DoD from better utilizing Pre-WWII Buildings. The core of our effort was a detailed review of selected topics within the Unified Facility Criteria and related policies pertaining to structural, economic, and planning issues. We supplemented this review with interviews to gain understanding about the actual practices at the installations, an examination of the accuracy of information included in the RPAD, and an analysis of funding decision-making processes<sup>2</sup>.

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<sup>2</sup> The RPAD includes information provided by the Military Services from their own collection systems of record. The RPAD is updated annually and is only as accurate as the information provided by the Services. More information on the RPAD is included in the 'Code Commentary' section of this report.

# Introduction and Background

The scope of work for this Legacy study includes the following work plan elements:

- Extract key findings and recommendations from the ESTCP report
- Correlate ESTCP Report key findings with relevant DoD policy, guidance, and publications
- Interview Installation personnel (previous contacts at three installations), and incorporate inputs from installation interviews
- Using the Construction Criteria Base as a source, and with guidance from Project Partners, suggest ways to integrate key findings into existing DoD facilities analysis and planning documents:
  - a. ATFP UFCs
  - b. Installation Master Planning
  - c. Economic analysis and cost estimation guidance
  - d. Changes to DoD 1391
  - e. Mission Dependency Index
  - f. Plant Replacement Value
  - g. Real Property Inventory:
    - i. Identify Pre-WWII masonry buildings in the Real Property Inventory
    - ii. Provide guidance in correctly identifying Pre WWII masonry buildings by structural type
- Prepare study summary materials to educate and train project planners, space planners and facilities engineers through outreach opportunities

We based some of our recommendations on alternative practices from outside of DoD, both from other agencies or from private industry. In some cases, the recommendations point to simple shifts in interpretation within DoD's existing code framework.

# Introduction and Background

## Terminology

This study utilizes the following terminology, abbreviations and acronyms:

<b>ASHRAE</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers
<b>ATFP</b>	Anti-Terrorism/Force Protection
<b>BSI</b>	Business Systems & Information
<b>Capacity Ratings</b>	A percentage calculation of the sum of total assets compared to the total requirements to determine if these are sufficient facilities to meet the mission at a site or installation location.
<b>Condition Ratings</b>	Physical condition of the facility as calculated by the Facility Condition Assessment Program.
<b>Configuration Ratings</b>	A measurement of the facilities capability to support the component commands of the mission with respect to functionality. Ratings are calculated in Service data systems (e.g. iNFADS), and consider deficiency codes.
<b>CRM</b>	Cultural Resource Manager
<b>DASD (ESOH)</b>	Deputy Assistant Secretary of Defense (Environment, Safety & Occupational Health)
<b>DoD</b>	Department of Defense
<b>EPG</b>	Electronic Project Generator, a web based application for the creation, storage, retrieval, review, approval and submission of DD 1391 documents for all MILCON Projects. The EPG is synchronized with Military Service data system (e.g. iNFADS) and Service IPL and updated on a daily basis with Service real property data.
<b>ESTCP</b>	Environmental Security Technology Certification Program
<b>FEMA</b>	Federal Emergency Management Agency (prepare, prevent, respond to and recover from disasters/hazards)
<b>FPO</b>	Federal Preservation Officer
<b>FSL</b>	Facility Security Level
<b>GHG</b>	Greenhouse Gas
<b>HPS</b>	Historic Preservation Standards
<b>IMP</b>	Installation Master Plan
<b>iNFADS</b>	Internet Naval Facilities Assets Data Store. iNFADS Data is based on the Facilities Readiness Evaluation System combining the MDI, Condition Rating, Configuration Rating, and Capacity Rating. iNFADS also serves as an accountable property system of record for Department of the Navy real property assets in addition to other capabilities.
<b>IPL</b>	Integrated Priority List, the application that installations and regions use to submit their MILCON, Special Projects and Unspecified Military Construction-MILCON. Projects only appear in the IPL after the installation has linked a DD 1391 from EPG to the IPL.

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ISC	Interagency Security Committee
LCCA	Life-cycle Cost Analysis
LEED	Leadership in Energy and Environmental Design (US Green Building Council)
MDI	Mission Dependency Index is an Operational Risk Metric. MDI scores range from 0-100 and are subdivided into four categories - Critical, Significant, Moderate, Low based on the score.
MILCON	Military Construction
MOU	Memorandum of Understanding
NAVFAC	Naval Facilities Engineering
NF	New Footprint
NFPA	National Fire Protection Association
Original Design Intelligence	Operational attributes of elements as originally intended. Example: pre-1940 buildings were designed to be ‘passively’ cooled since mechanical air conditioning systems were not yet widely in use.
OASD (EIE)	Office of the Assistant Secretary of Defense for Energy, Installations and Environment
Progressive Collapse Analysis	A structure’s potential to fail, redistribution of loads, consequent to cancelled contribution of structural member(s) (e.g. bomb, fire, etc.) – leads to collapse.
PDC	Protective Design Center
RFP	Request for Proposal
RPAD	Real Property Asset Database
RPIM	Real Property Information Model
TBA	To Be Assessed
Tie Force Method	Building is mechanically tied together, gravity and lateral loads, horizontal and vertical ties to enhance continuity and ductility, develop alternate load paths in the structure, paths of ties must be straight and continuous, no changes in direction are permitted.
UFC	Unified Facilities Criteria
“Masonry Building”	Typically, the vertical primary structural components of Pre-WWII masonry buildings are load-bearing walls made of masonry units bonded by mortar. Masonry veneer and infill are not primary structural components. Brick was a common unit masonry material. Other unit masonry types include concrete masonry units (CMU) for example. A load-bearing brick wall is typically made of several wythes of bricks that are bonded with each other following a given bond pattern. Common multi-wythe brick walls are typically unreinforced.

# Code Commentary by Study Team

## Code Commentary by Study Team

In this section, the Study Team reviews the following selected policies and issuances relevant to the management of DoD’s Pre-WWII masonry buildings. The order of presentation is determined by the date of the most recent version / revision of the policy.

“Protective Design Center Technical Report (PDC TR) 06-08: Single Degree of Freedom Structural Response Limits for Antiterrorism Design” 2008.....	13
“PDC TR 10-01: Conventional Construction Standoff Distances of the Low and Very Low Levels of Protection IAW UFC 4-010-01” 2010. ....	14
“UFC 4-010-01: DoD Minimum Antiterrorism Standards for Buildings” 2013. ....	16
“UFC 4-023-03: Design of Buildings to Resist Progressive Collapse” 2013. ....	24
“Economic Analysis Handbook.” 2013. NAVFAC P-442. ....	25
“Unified Facilities Criteria (UFC) 2-100-01: Installation Master Planning.” 2012.....	37
National Fire Protection Association 914 Code for Fire Protection of Historic Structures (last updated 2015) .....	43
Commentary on the Real Property Asset Database.....	44

“Protective Design Center Technical Report (PDC TR) – Single Degree of Freedom Structural Response Limits for Antiterrorism Design” 2008. PDC TR-06-08.

U.S. Army Corps of Engineers. <https://pdc.usace.army.mil/library/tr/06-08/>

	DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
	<p>FORWARD</p> <p>p. i:</p> <p>[...]</p> <p><i>The prevalent method used in DoD to design structures to resist the airblast loading from terrorist explosive threats is the single degree of freedom (SDOF) process. The SDOF methodology is detailed in Army TM 5-1300, UFC 3-340-1, and other non-government references. The SDOF process has been automated in the SBEDS Excel® workbook. Specific detail of the SDOF methodology are airblast loading used I SBEDS are provided in PDC-TR-06-01.</i></p> <p>[...]</p>	<p><b>THE POLICY SHOULD GO BEYOND SDOF FOR MASONRY STRUCTURES</b></p> <p>The single degree of freedom (SDOF) method used to evaluate compliance with standoff distance and supporting structure requirements of UFC 4-010-01 is a prevalent analysis methodology<sup>3</sup>.</p> <p>The SDOF method is often appropriate but it can result in too conservative solutions or inadequate representations of system structural behavior in some cases<sup>4</sup>.</p>	
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">SUPPORTING DOCUMENTS</p>	<p>PDC TR-06-01 <sup>6</sup></p> <p>CHAPTER 1- INTRODUCTION</p> <p>p. 1-1 – 1-2: <a href="https://pdc.usace.army.mil/library/tr/06-01/">https://pdc.usace.army.mil/library/tr/06-01/</a></p> <p><b>1-1 PURPOSE AND SCOPE</b></p> <p><i>This technical report explains the methodology for the SBEDS workbook. The SBEDS workbook is an Excel-based tool for design of structural components subjected to dynamic loads using single degree of freedom (SDOF) methodology. It was developed by the U.S. Army Corps of Engineers Protective Design Center as a tool for designers to use in satisfying Department of Defense (DoD) antiterrorism standards.</i></p> <p><i>The SBEDS workbook is intended for structural engineers with some experience in structural dynamics and blast effects. It is not for the non-structural engineer. SBEDS is suited for preliminary design or final design when used by a skilled engineer. SBEDS will aid the engineer in design of the member, but the actual design of members and connections is the full responsibility of the engineer.</i></p> <p><b>1-2 APPLICABILITY</b></p> <p><i>The SBEDS workbook and the methodology in this report applies to new construction, major renovations, and leased buildings and must be utilized in accordance with the applicability requirements of UFC 4-010-01 Minimum Antiterrorism Standards for Buildings (UFC 4-010-01) or as directed by Service Guidance. See UFC 4 -010-01 for additional detail on the structures that must be considered.</i></p> <p>[...]</p>	<p>Therefore, the policy is incomplete as it should also inform structural engineers about other analysis methodologies such as the nonlinear dynamic finite-element method (NDFEM). NDFEM analyses can include multiple degrees of freedom and take geometrical and material nonlinearities into account<sup>5</sup>.</p>	

<sup>3</sup> “Single Degree of Freedom Structural Response Limits for Antiterrorism Design,” i; “Methodology Manual for the Single-Degree-of-Freedom Blast Effects Design Spreadsheets (SBEDS),” 1–1.

<sup>4</sup> Beach and Van Eepoel, “Blast Protection and Historic Preservation,” 68.

<sup>5</sup> Ibid.

<sup>6</sup> “Methodology Manual for the Single-Degree-of-Freedom Blast Effects Design Spreadsheets (SBEDS),” 1–1.

“Protective Design Center Technical Report (PDC TR) - Conventional Construction Standoff Distances of the Low and Very Low Levels of Protection IAW UFC 4-010-01” 2010. PDC TR -10-01.

U.S. Army Corps of Engineers. <https://pdc.usace.army.mil/library/tr/10-01>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
4 APPROACH	<p>p. 4:</p> <p>[...]  <i>Heavy construction consists of concrete and masonry walls. Four walls are studied unreinforced walls, lightly reinforced walls, moderately reinforced, and heavily reinforced. The reinforcement ratios are defined in Appendix D. Only grouted cells contain reinforcing. All walls studied as <b>in-fill construction. Axial loads are not included</b> in analysis work, <b>conservative</b>.</i></p> <p><i>a. Analysis assumptions and results for masonry walls found in Appendix D, concrete walls in Appendix E and European block walls in Appendix F.</i></p> <p><i>b. <b>In-fill panels are secondary components.</b> Only the flexural response of the reinforced masonry walls considered.</i></p>	<p><b>THE POLICY TREATS ALL URM WALLS AS SECONDARY</b></p> <p>In this UFC/PDC-TR, masonry walls are considered only as secondary structural components. This approach is excessively conservative for most Pre-WWII load-bearing masonry buildings.</p> <p>Masonry walls of Pre-WWII buildings are often primary structural components since they directly support other structural members such as floors. Considering masonry walls only as secondary structural components may be too conservative. It is important to consider the actual load configuration, characteristics and material properties of masonry walls within the retrofit design approach of existing buildings<sup>7</sup>.</p>
5 FINDINGS	<p>p. 8:</p> <p>[...]  <i>f. This study reviewed unreinforced masonry and European block as <b>nonbearing walls</b>. The addition of axial load would add to the walls flexural resistance, but was ignored to remain conservative.</i></p>	<p>In the same vein, European blocks are not necessarily nonbearing elements by default.</p>
APPENDIX A – EXPANDED TABLE 2-1 FROM UFC 4-10-01	<p>p. 13:</p> <p>[...]  <i>3. <b>Secondary structural components</b> = non-loading bearing infill wall components and any other structural component supported by a primary framing component.</i></p>	<p>USACE should consider refining the data and/or perform additional blast load analyses to develop appropriate standoff distances for load bearing unreinforced masonry. In particular, analysis assumptions should take representative permanent axial loads into account. The outcome and findings would update UFC 4-10-01 Table 2-3<sup>8</sup>.</p>

<sup>7</sup> Beach and Van Eepoel, “Blast Protection and Historic Preservation,” 76.

<sup>8</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 27.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
APPENDIX D – REINFORCED AND UNREINFORCED MASONRY	p. 27: [...] <p>8. <i>Unreinforced Masonry Wall Layups:</i></p> <p>a. <i>CMU1 – 8’ tall, 6” thick with 10 psf support weight</i></p> <p>b. <i>CMU2 – 8’ tall, 8” thick with 10 psf support weight</i></p> <p>c. <i>CMU3 – 8’ tall, 10” thick with 10 psf support weight</i></p> <p>d. <i>CMU4 – 8’ tall, 12” thick with 10 psf support weight</i></p> [...]	<p><b>THE POLICY IS UNDERESTIMATES MASONRY WALL PERFORMANCE</b></p> <p>The UFC standoff assumptions rely on masonry wall thicknesses ranging from 6 to 12 inches<sup>9</sup> for unreinforced masonry. Those values are inadequate as they underestimate actual wall thicknesses of most Pre-WWII masonry buildings. Moreover, it appears that the layups that were analyzed for unreinforced masonry walls were all made of concrete masonry units (CMU)<sup>10</sup>; disregarding brick walls.</p>
APPENDIX F – EUROPEAN BLOCK WALL	p. 38: [...] <p>3. <i>Walls:</i></p> <p>a. <i>Thickness: 6 and 8 inch</i></p>	<p>Typically, the thickness of Pre-WWII masonry walls is not less than 12 inches for warehouses, barracks, shops, etc. for instance<sup>11</sup>. In the same vein, the thickness of European blocks can exceed 8 inches, as emphasized by the right figure on the bottom of PDC TR-10-01 report page 38 showing a thickness of 240 mm (9 ½”).</p>
<div style="writing-mode: vertical-rl; transform: rotate(180deg);">SUPPORTING DOCUMENTS</div> <p><b>UFC 4-010-01<sup>15</sup></b></p> <p>2-4.8.1 CONVENTIONAL CONSTRUCTION STANDOFF DISTANCE</p>	p. 26: <a href="https://www.wbdg.org/ccb/DOD/UFC/ufc_4_010_01.pdf">https://www.wbdg.org/ccb/DOD/UFC/ufc_4_010_01.pdf</a> <p><i>The wall and roof types in Table 2-3 are those that were analyzed to establish the conventional construction standoff distances in Tables B-1 and B-2. Those distances may be used as long as the construction for the applicable walls fits within the ranges of properties in Table 2-3. Any construction outside those ranges will have to be analyzed.</i></p> [...]	<p>In addition to the wall thickness, other parameters such as the bond pattern (i.e., the manner the brickwork is laid up) have a major influence on the blast behavior. The blast resistance of brickwork is increased for brick bonds having a larger percentage of header courses<sup>12</sup>.</p> <p>Analysis is required for any construction outside the range of masonry wall thicknesses in Table 2-3 of UFC 4-010-01<sup>13</sup>. This is challenging since very little information on the blast behavior of existing masonry structures is available. The Canadian government, in partnership with US institution(s) (Technical Support Working Group (TSWG)), will launch a test campaign (3-years project) on the blast behavior of existing masonry walls/structures in the near future.</p> <p>USACE should consider refining the data and/or performing additional blast load analyses to develop appropriate standoff distances for realistic wall thicknesses and bond patterns, which may decrease standoff distances in UFC 4-010-01 Table 2-3<sup>14</sup>.</p>

<sup>9</sup> For unreinforced masonry, the default wall thickness for analysis of “6 to 12 inches” is, in practice, necessarily limited to 6-inches.

<sup>10</sup> “Conventional Construction Standoff Distances of the Low and Very Low Levels of Protection IAW UFC 4-010-01,” 27.

<sup>11</sup> *Masonry, Carpentry, Joinery.*, 96–102.

<sup>12</sup> *Wessman and Rose, Aerial Bombardment Protection*, 173.

<sup>13</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 26.

<sup>14</sup> *Ibid.*, 27.

<sup>15</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings.”

# “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings” 2013. UFC 4-010-01.

Department of Defense, United States of America. [https://www.wbdg.org/ccb/DOD/UFC/ufc\\_4\\_010\\_01.pdf](https://www.wbdg.org/ccb/DOD/UFC/ufc_4_010_01.pdf)

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
2-4.15 ALTERNATE WINDOW TREATMENTS	<p>p. 32:</p> <p><i>Standard 10 does not allow for the use of window treatments such as <b>fragment retention films and blast curtains where buildings are required to meet these standards</b>. The primary reason for that is the fact that such solutions commonly have much shorter design lives than laminated glass windows, which requires their replacement multiple times as compared to laminated glass windows. Laminated glass, while more expensive initially, is less expensive over its life cycle. Additionally, in the case of blast curtains there need to be operational procedures to ensure that they remain closed at all times for them to be effective. Film and curtain solutions are good interim solutions where compliance with these standards is not required.</i></p>	<p><b>THE POLICY COULD BE MORE FLEXIBLE</b></p> <p>The use of fragment retention films and blast curtains is prohibited for buildings required to meet the UFCs, primarily because of economic considerations. This policy is too strict since it – indirectly – considers that life-cycle cost analyses supersede historic preservation features systematically.</p> <p>DoD standards are more restrictive than <i>ISC Security Design Criteria</i> (2004). Even for medium and high levels of protection, preferred glazing systems recommended by ISC involve the use of fragment retention films or blast curtains<sup>16,17</sup>. Regarding fragment retention films, it is a given that they are not a durable retrofit<sup>18</sup> and that they have a higher life-cycle cost than window replacement over the long term<sup>19</sup>. However, they could be a suitable alternative when the preservation of the historic fabric prevails over life-cycle cost. Mechanically-attached films, for instance, can provide a high level of protection, which can be beneficial for retrofitting existing windows, provided that the mullions, window frame and supporting wall can withstand the increased load transfer<sup>20</sup>.</p> <p>In particular, for historic buildings, some blast-resistant replacement windows would irreversibly affect the building’s historic character and architectural features<sup>21</sup>. Therefore, DoD should consider the use of fragment retention films when the heritage value of a building (historic building or existing building under certain conditions) is a predominant design criterion.</p>

<sup>16</sup> “ISC Security Design Criteria For New Federal Office Buildings and Major Modernization Projects (Part I),” 32.

<sup>17</sup> Note that *ISC Security Design Criteria* (2004) do not distinguish historic buildings from existing buildings in general within their security design criteria. In most cases, existing buildings are subjected to the same requirements as for new construction Ibid., 36–37.

<sup>18</sup> Periodic reapplication is necessary (Webster, Reicher, and Cohen, “Antiterrorism Measures for Historic Properties, DoD - Legacy Resource Management Program,” 97.

<sup>19</sup> Ibid.

<sup>20</sup> Lin et al., “Survey of Window Retrofit Solutions for Blast Mitigation,” 89; “Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings, Risk Management Series,” 3–24.

<sup>21</sup> Webster, Reicher, and Cohen, “Antiterrorism Measures for Historic Properties, DoD - Legacy Resource Management Program,” 96.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>1-10 HISTORIC PRESERVATION COMPLIANCE FOR IMPLEMENTATION OF ANTI-TERRORISM STANDARDS</p>	<p>p. 14:</p> <p><i>Implementation of these standards will not supersede DoD’s obligation to comply with the National Historic Preservation Act and its implementing regulations. Conversely, historic preservation compliance does not negate the requirement to implement DoD policy on these antiterrorism standards for buildings.</i></p> <p><i>The planning for and implementation of these standards in historic buildings may constitute an undertaking as defined by the National Historic Preservation Act. Personnel responsible for such buildings should <b>seek the assistance of preservation professionals</b> in the consideration of the processes established by section 106 and its implementing regulations contained in 36 CFR Part 800. Once a building has been determined to be an historic property, the section 106 process requires determination of the effects of the anti-terrorism measures upon the building and, if adverse, how the effects can be avoided, minimized and/or mitigated. Planning should be designed to allow State Historic Preservation Offices, the Advisory Council on Historic Preservation, and other parties and stakeholders to consider, review and consult as appropriate on proposed DoD actions and their impacts to buildings that are historic properties.</i></p> <p>[...]</p>	<p><b>THE POLICY DOES NOT ADDRESS EXISTING BUILDINGS THAT ARE NOT HISTORIC</b></p> <p>The policy discusses the compliance of historic buildings with UFC standards. It does not, however, broach existing buildings that are not historic.</p> <p>The structural retrofit of existing masonry buildings in general should also require the assistance of preservation professionals. Preservation professionals are familiar with the specific features of existing buildings. One should profit from their technical and practical know-how when the structural upgrade of window systems and/or supporting structural elements is required.</p> <p>DoD should consider extending the content of the policy by also dealing with existing buildings that are not (yet) historic. This way, the flexibility that is allowed by UFC standards for existing buildings<sup>22</sup> could be better introduced and understood by decision makers.</p> <p>In addition, guidelines on “best rehabilitation practices” could be developed to help decision makers define suitable design strategies.</p>
<p>2-2 PHILOSOPHY</p>	<p>p. 17:</p> <p>[...]</p> <p><i>Furthermore, given what is known about terrorism, all DoD decision makers must commit to making smarter investments with the scarce resources available and <b>stop investing money in inadequate buildings</b> that DoD personnel will have to occupy for decades, regardless of the threat environment. [...]</i></p>	<p><b>THE POLICY MAY INHIBIT REUSE</b></p> <p>Though the purpose of the policy may be legitimate, the way it is phrased could prompt DoD decision makers to demolish and reconstruct instead of retrofitting existing buildings.</p> <p>DoD should consider rephrasing the policy in order to be more neutral. As emphasized in the 2012 ESTCP report entitled Demonstrating the Environmental &amp; Economic Cost-Benefits of reusing DoD’s Pre-World War II Buildings (report # EW-200931), the modernization of DoD’s Pre-WWII masonry buildings can be significantly less expensive than new construction<sup>23</sup>.</p>

<sup>22</sup> See sections 2-4.8.2 *Minimum Standoff Distance*, 2-4.8.3 *Operational Option for Existing Buildings*, B-1.1.2 *Minimum Standoff Distance* and B-1.1.6.2 *Existing Buildings* of UFC 4-010-01 for instance.

<sup>23</sup> “Demonstrating the Environmental & Economic Cost-Benefits of Reusing DoD’s Pre-World War II Buildings,” sec. IV.

UFC 4-010-01, continued.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
1-8.2.3 WINDOW, SKYLIGHT, AND GLAZED DOOR REPLACEMENT AND INSTALLATION	<p>p. 10:</p> <p><i>Because of the significance of glazing hazards in a blast environment, implementation of all provisions of the paragraphs in Appendix B, under Standard 10 and Standard 12 of these standards <b>is mandatory for existing inhabited buildings</b> any time a window, skylight, or glazed door is being replaced. \1\ This also applies to installation of supplemental windows behind existing windows and to installation of windows in new openings /1/, Note that the window replacement and glazing costs should not be used to cause any building to exceed 50% of the plant replacement value where only this trigger applies to the building as described in the paragraph above entitled, “Major Investments”.</i></p>	<p><b>THE POLICY SHOULD BE CLARIFIED</b></p> <p>According to the policy, all provisions under Standard 10 and Standard 12 are mandatory for existing buildings, thus including historic buildings. Per section 1-10 <i>Historic Preservation Compliance for Implementation of Anti-terrorism Standards</i> of UFC 4-010-01, the implementation of these standards shall not supersede DoD’s obligation to comply with the National Historic Preservation Act and vice versa.</p> <p>DoD should consider developing a decision framework to help resolve the inherent ambiguity, to avoid an adverse effect under Section 106 of the National historic Preservation Act.</p>
2-4.8.2 MINIMUM STANDOFF DISTANCE	<p>p. 29:</p> <p><i>[...]</i>  <i>For existing buildings, the standoff distances less than the “Minimum Standoff Distance” column of Table B-1 will not be allowed except where providing the minimum standoff distance is not possible. In those cases, lesser standoff distances may be allowed <b>where the required level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit.</b> This is allowed for existing buildings because of the recognition that there are instances where providing even the minimum standoff distances is impractical.</i></p>	<p><b>THE POLICY SHOULD BE BROADENED</b></p> <p>Less than the minimum standoff distance can be allowed for existing buildings provided that the required level of protection can be shown to be achieved through analysis, hardening, mitigation or retrofit. The policy briefly states that alternatives exist but it does not provide additional information that would make them easier to put into practice.</p> <p>Available federal and non-federal reports, guidelines and articles provide valuable information on mitigation and retrofit options. Those options include, but are not limited to: secondary window systems (interior/exterior), high-strength transparent fabric systems to stop flying debris (interior), energy-absorbing replacement window frames, sprayed-on polymer coating on interior wall face, interior metal-stud frame system to transfer loads into the floors, take the mass of existing masonry walls into account in the analysis, close or move (a portion of) nearby parking and streets to maximize available standoff distance, investments in/improvements of site boundaries (e.g., controlled perimeter, controlled parking), etc.</p> <p>DoD should consider providing a list of ‘best practice’ publications<sup>24</sup> discussing options that could help DoD decision makers.</p>

<sup>24</sup> The list of publications could include for example: Webster, Reicher, and Cohen, “Antiterrorism Measures for Historic Properties, DoD - Legacy Resource Management Program”; Lin et al., “Survey of Window Retrofit Solutions for Blast Mitigation”; Beach and Van Eepoel, “Blast Protection and Historic Preservation”; Alderson, “Upgrading Historic Building Windows”; Ward, “Retrofitting Existing Masonry Buildings to Resist Explosions”; Helmy, Hadhoud, and Mourad, “Infilled Masonry Walls Contribution in Mitigating Progressive Collapse of Multistory Reinforced Concrete Structures according to UFC Guidelines”; “Perimeter Security for Historic Buildings: Technical Pilot”; Garrity, “Retro-Reinforcement of Existing Masonry Structures”; “Retrofitting Existing Buildings to Resist Explosive Threats”; “Site and Urban Design for Security: Guidance against Potential Terrorist Attacks, Risk Management Series”; “Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings, Risk Management Series”; “ISC Security Design Criteria For New Federal Office Buildings and Major Modernization Projects (Part I).”.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
2-4.8.1 CONVENTIONAL CONSTRUCTION STANDOFF DISTANCE	<p>p. 26:</p> <p>[...]</p> <p>\1 Note that <b>Tables B-1 and B-2 do not address windows</b>. For some wall types in those tables the conventional construction standoff distances will require window and door construction that is significantly heavier and more expensive than windows and doors designed at the conventional construction standoff distances in previous versions of these standards. Tradeoffs between standoff distance and the associated wall, window, and door construction will have to be analyzed to determine what standoff distances are most economical. Those tradeoffs will generally need to be analyzed when standoff distances are less than 82 feet (25 meters) for Explosive Weight I and 33 feet (10 meters) for Explosive Weight II /1/. [...]</p>	<p><b>THE POLICY IS TOO STRICT</b></p> <p>If a building meets conventional construction standoff distances, its building components do not require a specific analysis of blast effects, except for doors and windows. Actually, all provisions of Standard 10 – Windows and Skylights of UFC 4-010-01 apply regardless of the standoff distance. As a result, if the window glass or frame has to be replaced<sup>25</sup>, existing anchor connection details and masonry walls may not be able to support the blast loads transferred, which could compel a significant structural hardening of the walls. The structural hardening can be heavy depending on the wall type, which can irreversibly alter the historic fabric. Furthermore, successive hardening interventions can also cause an increment of damage to the historic fabric. Therefore, the policy seems to be too strict, resulting in a design that could be too conservative and lead to avoidable cost increases.</p>
B-1 SITE PLANNING	<p>p. 49:</p> <p>[...]</p> <p>The following standards detail standoff distances, referred to as “conventional construction standoff distances,” that when achieved will allow for buildings to be built with minimal additional construction costs for blast protection. Note, however, that <b>standoff distances for building walls may require more heavily constructed windows and doors, which may result in significant building cost increases</b>. [...]</p>	<p>For instance, a building for which actual standoff distances exceed by far the required conventional construction standoff distances prescribed in Table B-1 may not need to fully comply with all provisions of Standard 10. In the same vein, alternative window treatments (see sections 2-4.15 and B-3.1.8) such as fragment retention films or blast curtains could be allowed for existing buildings that are required to comply with UFC standards, provided that they meet conventional construction standoff distances<sup>26</sup>.</p>
B-3.1 STANDARD 10. WINDOWS AND SKYLIGHTS	<p>p. 69:</p> <p>To minimize hazards from flying debris from windows and skylights, apply the following provisions for glazing, framing, connections, and supporting structural elements for <b>all new and existing buildings</b> required to comply with these standards. These provisions <b>apply to window systems at all standoff distances, even those that meet or exceed the wall conventional construction standoff distances</b>. [...]</p>	<p>DoD should review the applicability of Standard 10 in order to nuance and introduce some flexibility to the policy.</p>

<sup>25</sup> Which is often the case since it is one of the most direct routes to comply with UFC 4-010-01: full window replacement with a custom-designed new blast window. In particular, existing window frames made of wood often do not comply with UFC because they perform poorly in blast. Webster, Reicher, and Cohen, “Antiterrorism Measures for Historic Properties, DoD - Legacy Resource Management Program,” 102, 115.

<sup>26</sup> This nuance could be added to the existing commentary made on section 2-4.15 *Alternate Window Treatments* “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 32., see page 4 of this report.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>B-1.1.6.2 EXISTING BUILDINGS</p>	<p>p. 58:</p> <p><i>Where possible, move parking and roadways away from existing buildings required to comply with these standards in accordance with the standoff distances and explosive weights in Table B-1. It is recognized, however, that <b>moving existing parking areas and roadways or applying structural retrofits may be impractical in some cases</b>; therefore, the following operational options are provided for existing buildings required to comply with these standards:</i></p> <p><i>a. Controlled Parking Areas.</i>  <i>Controlled parking associated with existing buildings may be allowed to be as close as the minimum standoff distance in Table B-1 <b>without hardening or analysis if access control</b> (see definition in glossary) <b>to the parking area is established at the applicable conventional construction standoff distance</b> for parking in Table B-1.</i>  <i>[...]</i></p> <p><i>b. Parking Within a Controlled Perimeter.</i>  <i>The applicable conventional construction or minimum standoff distance at which access will be controlled will be based on the standoff distances for parking and roadways within a controlled perimeter in Table B-1 and illustrated in Figure B-3 for the applicable building category.</i>  <i>[...]</i></p>	<p><b>THE POLICY COULD BE CLARIFIED</b></p> <p>By default, blast analysis – and potentially heavy structural hardening – is required for buildings that do not meet conventional construction standoff distances<sup>27</sup>. When compliance with UFC standards is impractical, operational options are provided<sup>28</sup>, introducing some flexibility. Although the benefit of controlled parking areas is clearly identified<sup>29</sup>, the added-value of other operational options is not straightforward.</p> <p>DoD should clarify the added value of the proposed operational options in order to support DoD decision makers. For instance, with regard to Option <i>b. – Parking Within a Controlled Perimeter</i>, it should be clearly stated that the installation of a controlled perimeter allows reduction of both conventional construction and minimum standoff distances, per table B-1 of UFC 4-010-01<sup>30</sup>.</p>
<p>B-1.1.14 LOCATION OF TRASH CONTAINERS</p>	<p>p. 61-62:</p> <p><i>For buildings that are required to comply with these standards, provide standoff distances from the nearest points of trash containers or trash container enclosures to the closest points on the building exteriors or inhabited portions of the buildings or to specific building components in accordance with the conventional construction standoff distance from trash containers in Tables B-1 and B-2. <b>Where the applicable conventional construction standoff distance is not available, analyze the building and apply building hardening as necessary to mitigate the effects of the explosives indicated for trash containers in Table B-1 at the achievable standoff distance to the appropriate level of protection.</b></i>  <i>[...]</i></p>	<p><b>THE POLICY SEEMS TO BE INFLEXIBLE</b></p> <p>If the distance between trash containers and an existing building does not meet conventional construction standoff distances, the building has to be designed for blast protection. In that case, the first recommendation made by the policy is to harden the building<sup>31</sup>.</p> <p>The first and least expensive alternative may be to move trash containers in order to increase standoff distances and potentially avoid any building hardening, when possible. Although keeping trash containers further away from an existing building is a site mitigation measure that does not significantly provide greater protection, it can be a relatively cheap and easy alternative that can help increase the unobstructed spaces and standoff distances<sup>32</sup>.</p>

<sup>27</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 41, 57.

<sup>28</sup> See also section 2-4.8.3 *Operational Option for Existing Buildings* for further details Ibid., 29..

<sup>29</sup> Analysis or hardening is not required provided that access control to the parking area is established at applicable conventional construction standoff distances, see section *B-1.1.6.2.a*.

<sup>30</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 51.

<sup>31</sup> Other alternatives such as hardening trash enclosures are also suggested Ibid., 62..

<sup>32</sup> “Site and Urban Design for Security: Guidance against Potential Terrorist Attacks, Risk Management Series,” 2–29, 2–30.

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
A GLOSSARY. DEFINITIONS	<p>p. 40-47:</p> <p><i>Low occupancy building: Any building or portion of a building routinely occupied by <b>fewer than 11 DoD personnel</b> or with a population density of <b>less than one person per 430 gross square feet</b> (40 gross square meters). [...]</i></p> <p><i>Inhabited building: Buildings or portions of buildings routinely occupied by <b>11 or more DoD personnel and</b> with a population density of <b>greater than one person per 430 gross square feet</b> (40 gross square meters) [...]. [...]</i></p> <p><i>Primary gathering building: <b>Inhabited buildings</b> or <b>portions of buildings</b> routinely occupied by <b>50 or more DoD personnel and</b> with a population density of <b>greater than one person per 430 gross square feet</b> (40 gross square meters) [...].</i></p> <p><i>Billeting: Any building or portion of a building, regardless of population density, in which <b>11 or more unaccompanied DoD personnel</b> are routinely housed [...]. [...]</i></p> <p><i>DoD building: Any building or portion of a building (permanent, temporary, or expeditionary) owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD [...]. [...]</i></p> <p><i>DoD components: The Office of the Secretary of Defense (OSD); the Military Departments (including their National Guard and Reserve Components); the Chairman, Joint Chiefs of Staff and Joint Staff; the Combatant Commands; the Office of the Inspector General of the Department of Defense; the Defense Agencies; the DoD Field Activities; and all other organizational entities within DoD. [...]</i></p> <p><i>Low occupancy family housing: Family housing with <b>12 or fewer units</b> per building. [...]</i></p> <p><i>High occupancy family housing: Family housing with <b>13 or more units</b> per building. [...]</i></p>	<p><b>THE POLICY MAY BE TOO CONSERVATIVE</b></p> <p>Existing DoD components, inhabited buildings, billeting, high occupancy family housing and expeditionary structures have to comply with UFC 4-010-01 when triggered by defined criteria such as the rehabilitation project cost, the increase in occupancy level and the construction of inhabited building additions. Certain occupancies are exempt from the requirements of UFC 4-010-01, for instance: low occupancy buildings, low occupancy family housing (12 units or fewer per building), town centers with not more than 12 housing units, temporary structures, and gas stations.</p> <p>Within the group of buildings that have to comply, the ones having three stories or more are required to meet the PC requirements described in standard 6. Stories below grade that meet the definition of <i>occupiable spaces</i> per IBC 2012<sup>33</sup> are required to meet the requirements of UFC 4-023-03<sup>34</sup>. The level of progressive collapse design to be enforced depends on the occupancy category (OC) of the building defined by UFC 4-010-01 and UFC 3-301-01<sup>35</sup>.</p> <p>The policy seems to be too flat for three reasons. First, the fact that the standoff distance has no effect on the enforcement of Standard 6 seems inappropriate<sup>36</sup>, especially where a building may exceed the conventional construction standoff distance defined in Table B-1 of UFC 4-010-01. Second, the way the number of stories is counted may be too conservative, in particular regarding underground stories. In the guidelines developed by the <i>General Services Administration</i> (GSA)<sup>37</sup>, progressive collapse resistance is required<sup>38</sup>....</p>

<sup>33</sup> 2012 International Building Code (IBC), A Member of the International Code Family.

<sup>34</sup> “Unified Facilities Criteria (UFC) - Design of Buildings to Resist Progressive Collapse.”

<sup>35</sup> “Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standards for Buildings,” 12, 31, 33, 43, 44; “Unified Facilities Criteria (UFC) - Structural Engineering,” 6–8.

<sup>36</sup> Flat approach that could lead to a highly conservative design in some cases.

<sup>37</sup> “Alternate Path Analysis & Design Guidelines For Progressive Collapse Resistance,” 4–6.

<sup>38</sup> This policy applies for buildings belonging to Facility Security Levels (FSL) of III and IV; FSL level V requires the implementation of the guidelines regardless of the number of stories Ibid., 5..

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
B-1.1 STANDARD 1. STANDOFF DISTANCES	<p>p. 49-50:</p> <p>[...]</p> <p><i>Note that <b>regardless of standoff distance, where buildings are three stories or more, the progressive collapse provisions of Standard 6 must be applied.</b></i></p> <p>[...]</p>	<p><b>THE POLICY MAY BE TOO CONSERVATIVE (CONTINUED)</b></p> <p>...for buildings with four stories or more and the number of stories is measured from the lowest point of exterior grade to the highest point of elevation, thus excluding below-grade stories. Basement walls are likely to be more robust than the walls of above grade stories as they may be laterally braced by earth pressure on one side. Third, the applicability process of Standard 6 of UFC 4-010-01 may be nuanced. For example, the occupancy category of the building may be assessed before, or together with, applying the number of stories criterion, as it is suggested in the applicability flow chart defined by GSA<sup>39</sup>. Indeed, at present, a building belonging to a high occupancy category (e.g., category IV) with two stories does not have to comply with Standard 6 though it may constitute a larger hazard to human life in the event of a collapse than an occupancy category II building with three stories.</p>
B-2.1 STANDARD 6. PROGRESSIVE COLLAPSE RESISTANCE	<p>p. 66-67:</p> <p><i>Progressive collapse is considered to be a significant risk for buildings of <b>three or more stories. Basements and penthouses will be considered stories if there is any space that is designed for human occupancy and that is equipped with means of egress as well as light and ventilation facilities that meet the local building code requirements as detailed in UFC 4-023-03.</b> For all new and existing DoD buildings of three stories or more required to comply with these standards, regardless of the standoff distance provided, follow the requirements in UFC 4-023-03 Design of Buildings to Resist Progressive Collapse. Design the superstructures to sustain local damage with the structural systems remaining stable without being damaged to extents disproportionate to the original local damage.</i></p>	<p>To sum up, DoD should consider to refine the applicability procedure of Standard 6 by taking the standoff distance, number of stories<sup>40</sup> and occupancy category into account in a more differentiated way<sup>41</sup>. Furthermore, other aspects such as the construction type (e.g., wall/floor framing material, robustness of basement levels) and geometry of the building (e.g., floor area per story) could also be taken into account when defining the required level of progressive collapse design.</p>

<sup>39</sup> “Alternate Path Analysis & Design Guidelines For Progressive Collapse Resistance,” 6.

<sup>40</sup> For example, the 1973 Swedish supplementary regulations on the design for the prevention of progressive collapse SBN 22:35 (Swedish Building Standards) developed differentiated requirements for buildings with four stories or less, buildings with more than four but not more than eight stories, and buildings with more than eight stories Burnett, “The Avoidance of Progressive Collapse: Regulatory Approaches to the Problem,” 46–47.

<sup>41</sup> It seems that the Structural Engineering Institute (SEI-ASCE) is currently developing a standard on progressive collapse.

	DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
SUPPORTING DOCUMENTS	<p><b>UFC 4-023-03</b><sup>42</sup></p> <p>C-2.1 THREE STORY REQUIREMENT AND STORY DEFINITION</p>	<p>p. 87: <a href="https://www.wbdg.org/ccb/DOD/UFC/ufc_4_023_03.pdf">https://www.wbdg.org/ccb/DOD/UFC/ufc_4_023_03.pdf</a></p> <p><i>The required minimum height of 3 stories for progressive collapse design is taken from the original DoD guidance (DoD 2001). This requirement was based on a minimum threshold of 12 casualties in a progressive collapse event where it was assumed that the 2 bays on either side of a removed column or wall would collapse on each of 3 floors and that each bay/room would house 2 persons. Thus, <b>the justification for setting the limit at 3 stories was determined by the level of casualties and not by the mechanics of progressive collapse as a function of structural characteristics.</b></i></p> <p><i>As casualties are the key metric, a <b>basement or penthouse structure is defined to be a story if it is occupied.</b> The definition of “occupied” in the International Building Code (IBC) is: “A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes or in which occupants are engaged at labor, and which is equipped with means of egress and light and ventilation facilities.” This definition was adopted in Section 1-2.1. Further, as noted in Section 1-2.1, any story that will not be occupied does not count towards the limit of 3 stories; this may include floors that house mechanical equipment or are used for storage.</i></p> <p>[...]</p>	
	<p><b>GSA GUIDELINES</b><sup>43</sup></p> <p>2.3.2 FSL III &amp; IV</p>	<p>p. 5: <a href="http://www.gsa.gov/portal/media/189799/fileName/GSA_Progressive_Collapse_Guidelines_Final.action">http://www.gsa.gov/portal/media/189799/fileName/GSA_Progressive_Collapse_Guidelines_Final.action</a></p> <p><i>These Guidelines are applicable to FSL III and IV <b>buildings with four stories or more measured from the lowest point of exterior grade to the highest point of elevation.</b> Unoccupied floors such as mechanical penthouses or parking shall not be considered a story.</i></p> <p>[...]</p>	

<sup>42</sup> “Unified Facilities Criteria (UFC) - Design of Buildings to Resist Progressive Collapse,” 87.

<sup>43</sup> “Alternate Path Analysis & Design Guidelines For Progressive Collapse Resistance,” 5.

## “Unified Facilities Criteria (UFC) – Design of Buildings to Resist Progressive Collapse” 2013. UFC 4-023-03.

Department of Defense, United States of America. [https://www.wbdg.org/ccb/DOD/UFC/ufc\\_4\\_023\\_03.pdf](https://www.wbdg.org/ccb/DOD/UFC/ufc_4_023_03.pdf)

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
REVISION SUMMARY SHEET – REASONS FOR CHANGE	<p>p. PDF 4:</p> <p><i>Reasons for Change. UFC 4-023-03 was updated for the following reasons:</i></p> <p>[...]</p> <ul style="list-style-type: none"><li>• <i>Update of <b>example problems</b>;</i></li></ul> <p>[...]</p>	<p><b>THE POLICY SHOULD HAVE A MASONRY EXAMPLE</b></p> <p>UFC 4-023-03 was revised in June 2013. One of the revisions was the update of the design examples detailed in appendices, but it does not provide a design example of a masonry building.</p> <p>According to the engineering firm <i>Protection Engineering Consultants</i> that was engaged by DoD in 2012 to provide an update to the standard, several projects have used the content of the standard in design development since 2009<sup>44,45</sup>. Some of those projects may have been related to masonry structures. DoD should consider adding a design example of masonry building to illustrate progressive collapse analyses, as an additional appendix for example.</p>

<sup>44</sup> The 2009 version of UFC-4-023-03 superseded the previous version dated 25 January 2005.

<sup>45</sup> “Case Studies, Revising the DoD Guidance on Progressive Collapse.”

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
2.1.2 Generate Alternatives – Step 2	<p>p. 14</p> <p>[...]                      For example, consider the case where only the first two of the three feasible alternatives were evaluated.</p> <p style="padding-left: 40px;">Alt (A) Renovate Facility                      Alt (B) Private Lease                      Alt (C) Construct New Facility</p> <p><i>Alternative (A) Renovate Facility was recommended as the lowest net present value cost alternative. However, Alternative (C) Construct New Facility was not evaluated because its initial construction cost seemed too high. Further investigation showed that due to unique design features, Alt (C)'s operations and maintenance costs were so small that Alt (C) was really the lowest life cycle cost (present value) option. Should this alternative have been brought to the management's attention?</i></p> <p><i>The answer, of course, is YES! All feasible alternatives should be considered. The role of the EA is to develop the facts relating to every feasible alternative.</i></p> <p>[...]</p>	<p><b>SECTION 2.1.2 SHOULD PROVIDE MORE INFORMATION ABOUT HOW TO FRAME ALTERNATIVES</b></p> <p>Section 2.1.2 is very general in nature and should provide additional specific guidance for military construction. The guidance should clearly state how to frame alternatives. The one example given may inadvertently signal that new construction will typically result in a significantly lower operating cost than renovation.</p> <p>The Study Team recommends adding language along the lines of the following:</p> <p>For renovation, modernization, and/or recapitalization projects, the EA should consider and evaluate the following set of alternatives;</p> <ul style="list-style-type: none"> <li>• <b>Status Quo/Sustainment.</b> A life-cycle cost analysis of a set of improvements that are budgeted for less than \$750,000. This alternative may result in maintenance of an existing building in its current condition with necessary repairs, minor improvements that may include replacement of some (but typically not all) building systems with some degree of building performance improvement.</li> <li>• <b>Restoration/Modernization.</b> A life-cycle cost analysis of a restoration or modernization of an existing structure that includes replacement of most if not all existing building systems, achieving LEED Silver or better building performance in the case of modernization. This scenario would have a budget of \$750,000 or more and be subject to the MILCON funding process.</li> <li>• <b>Private Lease.</b> A life-cycle cost analysis of a lease of space in a privately-owned building that achieves LEED Silver or better building performance.</li> <li>• <b>New Construction.</b> A life-cycle cost analysis of new construction that achieves LEED Silver or better building performance.</li> </ul>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>2.2.1 Fundamental Planning Analysis</p>	<p>p. 18-20</p> <p>[...]  <i>There are several types of FPA’s used by NAVFAC and Commander Navy Installations Command (CNIC). Two include Return on Investment (ROI) and Mission Requirement (MR) economic analyses. There is also the energy decision model, electronic Return on Investment (eROI) that includes an economic analysis spreadsheet and complements the Energy Life Cycle Cost Analysis (LCCA) workbook that is used to initially screen projects.</i></p> <p><i>In general, these alternative methods may include MILCON and non-MILCON funding options. The FPA is the appropriate forum for the evaluation of alternatives to solve the overall objectives.</i></p> <p><i>MILCON projects are not the cure to all facility problems. It is important that all possibilities be exhausted before recommending a MILCON. If the MILCON alternative is the most cost effective option available to the NAVY, formal economic justification and substantiation for the Navy request to Congress must be provided before the MILCON is programmed.</i></p> <p><i>Sometimes only “one” Alternative to the Status Quo is considered. If this is the case, ensure there is a discussion about why other alternatives are not possible and consider the Status Quo as the second alternative....</i></p>	<p><b>SECTION 2.2.1 SHOULD SPECIFICALLY ADDRESS REUSE OF PRE-WAR HISTORIC PROPERTIES AS PART OF FPA SCREENING PROCESS</b></p> <p>This section should state that project alternatives for FPA screening that call for onsite construction should be consistent with the installation Real Property Master Plan.</p> <p>The Study Team recommends adding language along the lines of the following:</p> <p>(new paragraph)</p> <p>Project alternatives contemplating MILCON funding should be formulated in accordance with the installation’s Real Property Master Plan with due consideration given to alternatives proposing new infill construction, reuse and modernization of historic properties, and transit-oriented development as the plan may specify.</p>
<p>2.2.2 Value Engineering</p>	<p>p. 20-21</p> <p><b>2.2.2 VALUE ENGINEERING</b>  <i>The second class of economic analysis is used once a decision has been made to procure a given facility via the MILCON funding route (usually determined by the results of a Fundamental Planning Analysis). This type of analysis is used during the design phase of the project to analyze design alternatives. The design alternatives to be analyzed vary, and are project specific.</i></p> <ul style="list-style-type: none"> <li>• <i>One-level versus multi-level construction,</i></li> <li>• <i>Wood siding versus concrete masonry exterior,</i></li> <li>• <i>Steel versus concrete frame,</i></li> <li>• <i>Double-glazed glass versus single-glazed glass windows,</i></li> <li>• <i>Alternative physical orientations of a proposed structure,</i></li> <li>• <i>Alternate heating and cooling systems for a building, and</i></li> <li>• <i>R-19 versus R-30 insulation</i></li> </ul>	<p><b>SECTION 2.2.2 VALUE ENGINEERING GUIDANCE APPEARS TO BE ORIENTED TO NEW CONSTRUCTION.</b></p> <p>This section should be applicable to both existing and new construction projects but reads as if primarily for new construction.</p> <p>The Study Team recommends adding the following to the second sentence: “...to analyze design alternatives [ADD: for restoration, modernization, and new construction alternatives].”</p> <p>The Study Team recommends adding language along the lines of the following to the list of bulleted items:</p> <ul style="list-style-type: none"> <li>• Cost-effectiveness of retaining a structure’s original design features such as high ceilings versus adding drop ceilings</li> <li>• Cost-effectiveness of alternative treatments for ATEP and seismic compliance for existing buildings</li> </ul>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>2.4.2.c Lessons Learned</p>	<p>p. 22-23</p> <p><i>c. Consider viable alternatives: Each EA should document feasible alternatives, if applicable, from the following categories:</i></p> <ul style="list-style-type: none"> <li>▪ <i>Status Quo</i></li> <li>▪ <i>Modification of Existing Assets: Renovation, Conversion, Upgrade, Expansion, or other forms of improvement. Consider facilities at other DOD bases nearby, as well as on base. Go beyond the activity and installation, considering what exists within the region or other regions and taking into account the enterprise and warfare provider objectives as presented in the latest Global Shore Infrastructure Plans</i></li> <li>• <i>(GSIPs), Strategic Lay Down efforts or force structure changes.</i></li> <li>▪ <i>Leasing</i></li> <li>• <i>New Acquisition</i></li> </ul>	<p><b>SECTION 2.4.2C LESSONS LEARNED SHOULD MORE CLEARLY DIFFERENTIATE LEVELS OF IMPROVEMENTS FOR EXISTING FACILITIES</b></p> <p>The text related to modification of existing assets mentions various levels of improvement to existing buildings and introduces the idea of utilizing existing facilities at other nearby DoD bases. However, the terminology does not match the well-defined terms used by DoD Financial Management for Sustainment, Restoration, and Modernization that would apply to existing facilities (See DoD Financial Management, Vol. 2B, Chapter 8, Section 080150).</p> <p>To make more clear the scope of potential alternatives to consider, the Study Team recommends adding language along the lines of the following:</p> <p>Each EA should consider, evaluate, and document feasible alternatives, if applicable, from the following categories:</p> <ul style="list-style-type: none"> <li>• <b>Status Quo/Sustainment.</b> The project objective is met by utilization of an existing building under a Sustainment level of repair and maintenance.</li> <li>• <b>Restoration.</b> The project objective is met by utilizing an existing building with a level of improvements that restore the original building’s function. This may or may not be a MILCON project depending on estimated cost.</li> <li>• <b>Modernization.</b> The project objective is met by adaptively reusing an existing building with upgrades to and/or replacement of most if not all existing building systems and/or building elements, achieving significantly improved building operational functionality and performance. This alternative would typically have a budget equal to or greater than \$750,000 and be subject to the MILCON funding process.</li> <li>• <b>Host/Tenant Agreement.</b> Use of existing buildings at a nearby DoD base or other building operated by a federal agency.</li> <li>• <b>Private Lease.</b> A lease of space in a privately-owned building that achieves LEED Silver or better building performance.</li> <li>• <b>New Construction.</b> A life-cycle cost analysis of new construction that achieves LEED Silver or better building performance.</li> </ul>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>Section 3.2 Determining the Economic Life</p>	<p>p. 25</p> <p>[...] <i>For energy projects and the design of new buildings, the United States Code (Fully Amended) Title 42 - The Public Health and Welfare, Chapter 91 - National Energy Conservation Policy, Subchapter III - Federal Energy Initiative, Part B - Federal Energy Management, Section 8254 – Establishment and use of life cycle cost methods and procedures established an increase in the Period Of Analysis (POA) for energy projects and the design of new federal buildings from 25 to 40 years unless the expected life of the energy system is less than 40 years where the POA would then equal the life of the energy system.</i></p> <p><i>For special projects economic analyses that have an alternative with significant improvements in energy efficiency, it is important to do a sensitivity analysis on the POA and if the results are sensitive, highlight this finding in the Executive Summary. Furthermore, if increasing the POA to 40 years changes the least cost alternative to the one that has the most energy efficiency, then emphasize this feature of the economic analysis and consider increasing the POA to 40 years. CNIC in the eROI scoring model for energy projects allows economic lives up to 40 years or the life of the system whichever is shorter.</i></p>	<p><b>SECTION 3.2 DETERMINING ECONOMIC LIFE</b></p> <p>The section of 42 USC 91 cited, Section 8254, does not specifically mention new construction and would appear to apply to both new construction and restoration, or modernization of existing buildings. There may be a presumption in the text that the economic life of a restored or modernized historic structure would be shorter than for a newly constructed building and this is often not the case, especially for Pre-WWII buildings.</p> <p>The Study Team recommends revising the first sentence to start “For energy projects and the design of new buildings or the restoration or modernization of existing buildings, the United States Code...”</p>
<p>4.4.1 Residual or Terminal Value</p>	<p>p. 60</p> <p><i>Residual values should be calculated for alternatives which have assets (buildings, equipment, structures, etc.) which will still have useful value at the end of the period of analysis...Most facilities can assume a physical life of 67 years.</i></p>	<p><b>SECTION 4.4.1 RESIDUAL OR TERMINAL VALUE</b></p> <p>This section should provide specific guidance related to how to calculate residual or terminal value of historic properties versus new construction. Historic buildings, particularly Pre-WWII structures often have been constructed with highly durable materials that permit use of the building through many restorations or modernizations.</p> <p>The Study Team recommends modifying the last sentence to read:</p> <p>“Most facilities, including a full restoration or complete modernization of an existing building (particularly historic structures), can assume a physical life of 67 years.”</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>4.4.2 Recurring Annual Costs</p>	<p>p. 61-62</p> <p>[...]  <i>In the absence of better cost estimating information, sustainment cost for repair versus new construction will be assumed to be equal. For status quo versus new construction or repair, sustainment costs should be 25% of status quo for new construction or repair in years 1 to 5 50% of Status Quo for years 6 to 10 and 75% of status quo for years 11 to 15 and be equal to status quo for the remaining life of the project. This adjustment is designed to account for the age difference in facility components resulting in differences in sustainment cost. New or repaired facilities tend to be designed to reduce sustainment costs and all or many components are new and therefore require less maintenance than some of the components in the Status Quo alternative.</i></p> <p><i>Other Support Costs are those costs that may not be the same for all alternatives. These costs may include custodial, grounds maintenance, IT and other service contracts, furniture rentals, additional security for leasing off base, ATFP requirements, building code requirements associated with conversions and re-use, and the cost of parking or transportation costs if adjacencies and other efficiencies are lost. An example is the construction of a new barracks building which will not affect the size of the base fire department, but the costs of operating the fire department may be included if additional manning is required in the fire department due to student population increases. Thus, only the variable components (with respect to the alternative under consideration) and not the fixed components of support cost should be included. (When a change in cost is due to the change of a single unit of output, it is referred to as marginal cost.)</i></p>	<p><b>SECTION 4.4.2 RECURRING ANNUAL COSTS</b></p> <p>There is a reference in the first line to “repair versus new construction” but repair is really not the correct term. An alternative that calls for a full restoration or modernization that includes replacement or upgrading of building systems will often have sustainment costs for repair similar to new construction. Repair should be referring to a status quo alternative where no major investment is made in an existing facility.</p> <p>The Study Team recommends revising the paragraph along the lines of the following:</p> <p><i>“In the absence of better cost estimating information, sustainment cost for full restoration or modernization versus new construction will be assumed to be equal. For status quo versus new construction, restoration, or modernization, sustainment costs should be 25% of status quo for new construction, restoration, or modernization in years 1 to 5 50% of Status Quo for years 6 to 10 and 75% of status quo for years 11 to 15 and be equal to status quo for the remaining life of the project. This adjustment is designed to account for the age difference in building components resulting in differences in sustainment cost. Fully restored, modernized and new facilities tend to be designed to reduce sustainment costs and all or many components are new and therefore require less maintenance than some of the components in the Status Quo alternative.”</i></p> <p>The following text is not appropriate for this paragraph: “ATFP requirements, building code requirements associated with conversions and re-use...” since these costs are not recurring annual costs but one-time capital costs associated with a restoration or modernization alternative. These costs would already have been included in the capital budget for the alternative.</p> <ul style="list-style-type: none"> <li>• The Study Team recommends striking this portion of the sentence in this paragraph.</li> </ul>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>5.4 Cost Estimating Methodologies and Hierarchy</p>	<p>p. 70-73</p> <p><i>Use the most accurate method for the amount of information shown when preparing the estimate... The Facility Unit Costs for Military Construction Table 2 found in the DoD Facility Pricing Guide (UFC 3-071-01) supports a Square Foot/Meter Estimating method as described below, and is generally acceptable during the planning phase of a project. When additional information allows a more detailed estimate using the Parametric or Quantity-Take-Off methods, the unit costs in the DoD Facility Pricing Guide should not govern the estimate.</i></p>	<p><b>SECTION 5.4 COST ESTIMATING METHODOLOGIES AND HIERARCHY – MORE GUIDANCE NEEDED FOR PRE-WWII BUILDINGS</b></p> <p>This section of the manual should address the appropriate cost methodology when a construction project contemplates comparing the restoration or modernization of a historic structure (particularly Pre-WWII historic buildings) with new construction. A finding of the ESTCP SI-0931 study (page II-15) is that RSMMeans Costworks software package is the best estimating tool for historic structures since it can accommodate non-standard features and is suitable for working with new construction as well.</p> <p>RSMMeans Costworks is accepted by NAVFAC as an accepted cost estimating tool (see NAVFAC’s 2013 Cost Estimating Policy and Procedures, section 1.1).</p> <p>This section of the manual should also require that cost estimates be prepared by qualified architects and engineers with significant experience with historic buildings when such buildings are indicated as project alternatives.</p>
<p>6.1.4 Non-Quantifiable Output Measures</p>	<p>p. 87</p> <p><i>Non-quantifiable Output is not easily quantified in dollars or other quantifiable measures. They can have a very significant effect on the economic analysis even though they are descriptive in nature. A few examples are identified below:</i></p> <ul style="list-style-type: none"> <li>• <i>Funding for a Special Project might be more readily available than a MILCON resulting in more certainty that the project will be funded and an earlier completion or BOD</i></li> <li>• <i>New construction floor plans may have a more efficient layout than the renovation alternative</i></li> <li>• <i>Morale and quality of life issues</i></li> </ul> <p><i>Historical building may have a better aesthetic value or ambience</i></p>	<p><b>SECTION 6.1.4 NON-QUANTIFIABLE OUTPUT MEASURES</b></p> <p>The terminology should reflect the sustainment, restoration, modernization, and new construction pattern. Also, the restoration or modernization of an historic property meets DoD’s responsibilities under NHPA to take historic properties into consideration under Section 106 of the NHPA.</p> <p>The Study Team recommends revising the second bullet to read:</p> <p>New construction floor plans may have a more efficient layout than the restoration or modernization alternatives.</p> <p>The Study Team recommends adding an additional bullet as follows:</p> <ul style="list-style-type: none"> <li>• Restoration or modernization of a historic structure results in protection and preservation of an important cultural resource in furtherance of DoD’s obligations under the National Historic Preservation Act.</li> </ul>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>7.1 Types of Non-Monetary Considerations</p>	<p>p. 88</p> <p>[...] <i>The following while not a complete list; highlights items to be evaluated when preparing nonmonetary considerations of an economic analysis (Note that these non-monetary considerations can be positive benefits as well as negative costs):</i></p> <ul style="list-style-type: none"> <li>• <i>Health: Air, Drinking Water, Ambient Sound, Recreation Opportunities, Healthy Stores and Restaurants</i></li> <li>• <i>Safety: Sidewalks, Streetlights, Planned Development, Security Systems</i></li> <li>• <i>Environmental: Green Belts, Green Space, Green Structure</i></li> <li>• <i>Aesthetics: Appealing Architecture, Landscape Architecture, Pleasant Views</i></li> <li>• <i>Morale: Floor Plan Layout, Surface Finishes, Windows, Building Orientation</i></li> <li>• <i>Building Systems: Differences in Building Systems Benefits provided by Electrical Wiring, Fire Sprinkler Systems, Ventilation Systems, Elevators, Guard Rails</i></li> <li>• <i>Buffer Zones: Demilitarized Zones, Border Zones, AICUZ, Easement Zones (when not purchasing land or easements)</i></li> <li>• <i>Externalities: Outputs involuntarily received or imposed.</i></li> </ul>	<p><b>SECTION 7.1 TYPES OF NON-MONETARY CONSIDERATIONS</b></p> <p>Given DoD’s large inventory of historic structures, this list should reference National Register historic properties, historic districts and cultural landscapes.</p> <p>The Study Team recommends adding a bullet to read:</p> <ul style="list-style-type: none"> <li>• Legacy: Landmark Buildings, Historic Districts, and Cultural Landscapes.</li> </ul>
<p>7.2 Examples of Non-Monetary Considerations</p>	<p>p. 89</p> <p><i>Non-monetary examples are often corrections or improvements to various health, safety, and life codes as well as enhancements to the environment or aesthetics. Be factual; make the discussion strong but not offensive, by relating all the information known. The following examples are provided for enhanced understanding of non-monetary considerations.</i></p> <ul style="list-style-type: none"> <li>• <i>Unaccompanied Housing (UH) located near a Regional Park offers exceptional recreation opportunities for the sailor residents.</i></li> <li>• <i>An on-base MILCON alternative offers better security than renovating USMC barracks located outside the WNY.</i></li> <li>• <i>Location near the Anacostia River offers exceptional views. The frequency of flooding has been increasing. The following historical data is available to show the trend. In there were five floods, and since 2010 there have been two floods.</i></li> <li>• <i>MILCON alternative offers better safety due to adherence to current building codes while renovation may not bring building up to current code.</i></li> <li>• <i>Art Deco Architecture of the Repair alternative has classic visual appeal.</i></li> <li>• <i>While current electrical requirements would be met by the Repair alternative, due to better configuration and all new materials, the MILCON alternative will have approximately 50% more reserve electrical capacity.</i></li> </ul>	<p><b>SECTION 7.2 EXAMPLES OF NON-MONETARY CONSIDERATIONS</b></p> <p>The fourth bullet appears to introduce bias against the use of existing structures by introducing compliance with modern building codes as offering “better safety” when it may not be correct. For a building to be habitable, it must meet basic life-safety standards, even under the Status Quo alternative. Under a full restoration or modernization alternative If the level of investment reaches a certain dollar or square foot threshold, the alternative must meet current codes (the <i>International Existing Buildings Code</i> for historic structures) and safety would be one of the items covered by the current code. Hence safety should not be an issue.</p> <p>The Study Team recommends deleting the fourth bullet.</p> <p>This section also refers to a “repair alternative” when restoration or modernization is probably what is meant.</p> <p>The sixth bullet also appears to introduce bias against a restoration or modernization alternative since a new, higher capacity electrical system could be specified under these alternatives if that were a requirement.</p> <p>The Study Team recommends deletion of the sixth bullet.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>7.3 Quantifying Non-Monetary Considerations</p>	<p>p. 90</p> <p>2) <i>Ratio - A comparison between two things frequently expressed as a fraction. Ratios and Percents frequently are used to compare how one alternative stacks up to another one. For example the MILCON alternative is estimated to provide about ½ (or 50%) less CO2 emissions than the Repair alternative. Another perhaps more effective way to express this is to use the ratio 2 to 1 or twice and say the Repair alternative CO2 emissions are expected to be around twice that of the MILCON alternative.</i></p> <p>3) <i>Percent - A percent means how much out of 100. It is expressed as a number with the % symbol. It is a ratio that is normalized to have a denominator equal to 100. Example provided in number 2) above.</i></p> <p>4) <i>Frequency Pattern of expected occurrence of a notable benefit or cost. Frequencies are often used to compare expected events. Suppose that the Repair alternative has an asphalt roof that needs to be repaired or replaced every 20 years. The MILCON alternative has a metal roof that is expected to be repaired or replaced every 35 years. Thereby the MILCON roof has the benefit of longer periods of maintenance free service.</i> [...]</p>	<p><b>SECTION 7.3 QUANTIFYING NON-MONETARY CONSIDERATIONS</b></p> <p>Again, the reference to a “Repair” alternative is not consistent with DoD terminology and restoration and modernization should be used.</p> <p>The example of CO2 emissions savings introduces a bias against restoration and modernization alternatives that were shown in ESTCP Project SI-0931 to be equivalent or better performing than new construction.</p> <p>The Study Team recommends use of another example to illustrate the use of ratios.</p>
<p>13.3.B Lessons Learned from Program Budget Reviews</p>	<p>p. 143-144</p> <p><i>B. LESSONS LEARNED FROM PROGRAM BUDGET REVIEWS</i> <i>Budget reviews of the MILCON economic merits. Following is a summary of economic lessons learned from these reviews:</i></p> <p>[...]</p> <p>4. <i>In general, when the cost of facility renovation exceeds 70 percent of the new construction cost, it probably is a better value to use the new construction alternative. However, there may be reasons for pursuing renovation even when the cost exceeds 70</i></p> <p>5. <i>Alteration projects should not exceed 70% of new construction costs. If it does, ASN approval will be required and the economic analysis will be needed.</i></p>	<p><b>SECTION 13.3.B LESSONS LEARNED FROM PROGRAM BUDGET REVIEWS</b></p> <p><b>Subsection 4</b> Subsection 4 provides a rule of thumb that introduces a bias against restoration and modernization by presuming that new construction is “probably better” than “renovation” when renovation exceeds 70 percent of the new construction cost. The Study Team has not found a basis to substantiate this presumption. The findings from the ESTCP SI-031 report suggest that modernization of Pre-WWII structures can be competitive with new construction in terms of LCC and energy performance --often at lower total life-cycle cost. The term ‘renovation’ is not consistent with the earlier use of “repair” and in any event should refer to restoration and modernization to be generally consistent with DoD funding terminology. The Study Team recommends striking subsections 4.</p> <p><b>Subsection 5</b> Subsection 5 states that an economic analysis will be needed if ‘alteration projects exceed 70 percent of new construction costs’. An economic analysis would be required in any situation when any of the construction costs under any alternative exceed \$750,000. If this subsection is meant to address projects for which the military planner anticipates the range of costs under any of the alternatives, including new construction, to be less than \$750,000, then this 70 percent rule of thumb would appear to introduce a bias, which is inconsistent with the NHPA. The Study Team recommends striking subsection 5.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>13.3.B Lessons Learned from Program Budget Reviews</p>	<p>p. 143-144</p> <p><i>B. LESSONS LEARNED FROM PROGRAM BUDGET REVIEWS</i> Budget reviews of the MILCON economic merits. Following is a summary of economic lessons learned from these reviews:</p> <p>9. When developing project and alternatives be sure to include all costs. If repair or renovation exceeds 50% of the replacement cost, all building codes and some ATFP requirements will need to be met and included in the cost of the project. If ATFP requirements are not met for repair or new construction, be sure to include hardening costs as appropriate. [...]</p>	<p><b>SECTION 13.3.B LESSONS LEARNED FROM PROGRAM BUDGET REVIEWS, CONTINUED</b></p> <p><b>Subsection 9</b> This subsection also uses the terminology “repair” and “renovation” which is inconsistent with the well-defined terms used in DoD financial guidance documents.</p> <p>The Study Team recommends use of “repairs under Status Quo,” “Restoration” and “Modernization.”</p> <p>The Plant Replacement Value (PRV) should be referred to here in this section. This section should also state that the analyst should ensure that the PRV for a historic building is updated and accurate prior to relying upon it for design and cost estimating of a project alternative involving full restoration or modernization. Interviews with military planners indicated that oftentimes the PRVs are highly dated and/or inaccurate and this triggers expensive code upgrades that would not be required were an accurate PVR entered into the property record.</p>
<p>14.G Business Case Analysis, Utilities</p>	<p>p. 155</p> <p><i>...For new construction the reduction for the proposed alternative is often greater than the repair alternative...</i></p>	<p><b>SECTION 14.G BCA - UTILITIES</b></p> <p>The statement in this Section G is not consistent with the findings of ESTCP SI-0931 and introduces bias in the BCA analysis.</p> <p>The Study Team recommends new language along the lines of the following:</p> <p>In a BCA, energy conservation measures and new energy-saving building system treatments should be specified for not only new construction but also for the Restoration and Modernization alternatives to ensure that the BCA provides an objective analysis of the alternatives. For energy projects and the design of restoration or modernization of existing buildings, including historic properties, standards may be found in ASHRAE 100 (Energy Efficiency in Existing Buildings), GSA PBS-P100 Facilities Standards for the Public Buildings Service.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>Appendix A B. Economic Life</p>	<p>p. 152</p> <p><b>Energy Projects Period of Analysis:</b> <i>For all energy projects and the designs for new buildings, the Energy Independence Security Act (EISA) of 2007, SEC. 441, PUBLIC BUILDING LIFE-CYCLE COSTS states that Section 544(a) (1) of the National Energy Conservation Policy Act (42 U.S.C. 8254(a) (1)) was amended by increasing the period of analysis (POA) for energy projects and the design of new federal buildings from 25 to 40 years unless the expected life of the energy system is less than 40 years where the POA would then equal the life of the energy system.</i></p>	<p style="text-align: center;"><b>APPENDIX A SECTION B/ ECONOMIC LIFE</b></p> <p>The wording referring to “and the designs for new buildings” is unnecessary since the statutes cited are not exclusively applicable to new construction but would also apply to restoration and modernization. Given that great gains in energy efficiency can be obtained from fully restored or modernized Pre-WWII buildings (a finding from the ESTCP SI-0931 study), this wording should be changed. The Study Team recommends substituting “and the designs for restored or modernized, or new buildings” for “designs for new buildings.”</p>
<p>Appendix A G. Utilities</p>	<p>p. 155</p> <p>[...]</p> <p><i>When preparing an economic analysis for utility systems, the utility costs should be reduced for the proposed alternative as compared to the status quo situation. For new construction the reduction is most often greater than the repair alternative. For example, the repair alternative could have a 10% reduction of the status quo utility costs and the new construction alternative could have a 25% reduction over the status quo alternative. For an extensive repair project where the repair alternative is similar to the new construction alternative, the utility cost savings might be 25% for both the repair and the new construction alternatives.</i></p> <p><i>Use these guidelines of 10 to 25 percent savings unless detailed estimates are feasible. Work with the Energy Manager to determine the most likely reduction. This estimated reduction, will end up being measured and actual reduction in funding for utilities will be impacted, so ensure the number is achievable.</i></p>	<p style="text-align: center;"><b>APPENDIX A SECTION G/ UTILITIES</b></p> <p>The sentence “For new construction the reduction is most often greater than the repair alternative” may be accurate when compared to a Status Quo/Sustainment alternative but not accurate when compared to a fully restored or modernized Pre-WWII building. The Study Team recommends revising this sentence to read: “Project alternatives involving full restoration or modernization of a historic building or new construction, the reduction is most often greater than the Status Quo/Sustainment alternative.”</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>Sections 3.2 Economic Life, Section 5.3 Inflation References, 5.7 Simple Linear Regression Analysis and High Low Estimates, and 14.7 Modernization Requirement,</p>	<p>Various Pages</p> <p><b>3.2 DETERMINING THE ECONOMIC LIFE</b>  <i>The nine year time frame in figure 3-1 is referred to as the economic life of the alternative. In general, the economic life of an alternative is the period of time during which it provides a positive benefit.</i></p> <p><b>5.3 INFLATION REFERENCES</b>  <i>...Table 4-3: PRV Escalation Rates is used to escalate replacement unit costs that are made using the PRV formula and replacement unit costs shown in the DOD FPG to bring costs to the desired program year purchasing power.</i></p> <p><b>5.7 Simple Linear Regression Analysis and High Low Estimates</b>  <i>Simple linear regression is a widely used and effective technique to calculate the relationship between two variables. The High Low Method is a simple approximation of simple linear regression. Both methods can be used to get a more accurate estimate of a true cost when there is historical information that can be obtained to derive estimated costs.</i></p> <p><b>14.7 MODERNIZATION REQUIREMENT</b>  <i>The Plant Replacement Value (PRV) = \$N can be calculated by using this embedded calculator. Double click on calculator to open. In order to keep a facility up to modern standards, a modernization requirement can be used to estimate the Restoration and Modernization (R&amp;M) that will be needed each year. By using the Restoration and Modernization (R&amp;M) factor of N, the Modernization Requirement Savings would thereby be R&amp;M Factor x PRV = N x PRV = \$N/YR.</i></p>	<p><b>PLANT REPLACEMENT VALUE (“PRV”)</b></p> <p>The role of the PRV in determining code and ATFP compliance costs as part of project alternatives formulation is not clearly presented. Instead the PRV is shown for determining economic life and annual restoration and modernization requirements. PRV inflation references are provided and PRVs are also introduced in a section on simple linear regression for making high low cost estimates.</p> <p>The Study Team recommends that this document should introduce the PRV early in Section 2.1.2, for example, and direct analysts to prepare a new project-specific PRV estimate (and not rely upon PRVs previously entered into a real property database) for any alternative involving restoration or modernization.</p> <p>This recommendation is supported by UFC 3-701-01 that specifically indicates in Section 3-2.2 that replacement unit costs used to formulate a PRV should not be used for individual project estimates.</p> <p>The Study Team also recommends that Section 14.7 be revised to be clear that annual requirement is for sustainment (e.g., repair and maintenance). The use of the terms “Restoration and Modernization” can be confusing.</p>
<p>Appendix A  H. Anti-Terrorism Force Protection</p>	<p>p. 156</p> <p><i>c. LEED: Projects should include measure to be able to certify the projects as LEED silver. Congressional requirements dictate that no more than LEED Silver can be planned or executed. The DOD Facility Pricing Guide (FPG) UFC 3-701-01 provides estimated unit costs LEED certifiable facilities. Sustainable design and energy efficiency are currently not included in the FPG unit costs.</i></p>	<p><b>APPENDIX A, SECTION H (C) LEED</b></p> <p>This section should also indicate that LEED for existing buildings should be used for alternatives with full restoration and modernization treatments of historic structures.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
Appendix A I. Reasonable Alternatives	p. 157  <i>All reasonable alternatives should be considered and compared in the economic analysis. Those that are not feasible must be explained in the Alternatives Considered section of the analysis. The following provides a list of alternatives that should be considered:</i> 1. <i>As Is or Status Quo (Current Operations).</i> 2. <i>Other Facilities on Base.<sup>1</sup></i> 3. <i>Repair or Renovate Existing Facility.</i> 4. <i>Renovation/New Construction Mix.</i> 5. <i>New Construction.</i> 6. <i>Variable Housing Allowance / Basic Allowance for Housing</i> 7. <i>Leasing<sup>2</sup>.</i> 8. <i>Other DOD or Federal Agency Facilities.</i> 9. <i>Contracting Out (Services Only).</i> 10. <i>Privatization or Privatizing Usually DOD Operations.</i> 11. <i>Public Private Venture.</i> 12. <i>Enhanced Use Lease (EUL).</i> 13. <i>Community Utilization (Use of Private Facilities).</i> 14. <i>Combination of the Above Alternatives.</i> 15. <i>Other Innovative Alternative.</i>  <sup>1</sup> <i>Note that reuse involving conversion from one function to another will require additional building code compliance and will typically be considered new construction, UFC 3-701-01 and OPNAVINST 11010.20H.</i>	<p style="text-align: center;"><b>APPENDIX A.I REASONABLE ALTERNATIVES</b></p> <p>The terminology in this section should be revised to be more consistent with DoD controller funding terms that offer well-defined definitions. There is no mention of modernization in this list of reasonable alternatives. The note in this section is really referring to modernization and that is not the same as new construction. The citations to UFC 3-701-01 and OPNAVINST 11010.20H are not relevant to this question (e.g. they do not directly state that modernization is the same as new construction).</p> <p>The Study Team recommends revising the numbered items as follows:</p> <ol style="list-style-type: none"> <li>1. As is or Status Quo with a Sustainment level of investment</li> <li>3. Full restoration of existing building to original use that meets the mission requirement</li> <li>4. Modernization of existing building (adaptive reuse)</li> <li>6. Mix of restoration, modernization, or new construction.</li> </ol> <p>Renumber from item old no. 6 and on.</p>
<b>SUPPORTING DOCUMENTS</b>	UFC 3-400-01 Energy Conservation	
	UFC 4-010-01 DOD Minimum Standards for Buildings	
	UFC 3-701-01 DOD Facilities Pricing Guide	p. 7 <i>...Plant replacement value represents the cost to design and construct a national facility to current standards to replace an existing facility at the same location...Replacement unit costs should not be used for individual project estimates.</i>

“Unified Facilities Criteria (UFC) – Installation Master Planning.” 2012. UFC 2-100-01.

Department of Defense. [http://wbdg.org/ccb/DOD/UFC/ufc\\_2\\_100\\_01.pdf](http://wbdg.org/ccb/DOD/UFC/ufc_2_100_01.pdf)

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY																														
1-2 Purpose and Scope	p. 1 [...] <i>Affiliated design and programming professionals shall refer to the Master Plan as they prepare site-specific design proposals.</i> [...]	<b>THE POLICY SHOULD REQUIRE CONSISTENCY WITH MASTER PLAN</b>  Language in Section 1-2 is hesitant and should be revised to reflect industry planning practices. Instead of “shall refer” language should be stronger to reflect that proposals are <b>consistent</b> with the Master Plan as they prepare site-specific design proposals (“shall indicate <b>consistency with</b> ”). If consistency can’t be met, then Section 1-2 should also indicate that funding requests for SRM or MILCON requests should be for projects that are consistent with the installation Master Plan. This consistency requirement would also need to be stated in DoD Instruction 4165.70 (Real Property Management).																														
Appendix E Planning Principles RP1-RP9	p. 74 <table border="1"> <thead> <tr> <th colspan="2">NATURAL AND CULTURAL RESOURCE PRESERVATION (RP)</th> <th>5 Max</th> </tr> </thead> <tbody> <tr> <td>RP1</td> <td>Imperiled Species and Ecological Communities*</td> <td>R</td> </tr> <tr> <td>RP2</td> <td>Wetland and Water Body Conservation*</td> <td>R</td> </tr> <tr> <td>RP3</td> <td>Floodplain Avoidance*</td> <td>R</td> </tr> <tr> <td>RP4</td> <td>Range and Training Land Conservation</td> <td>R</td> </tr> <tr> <td>RP5</td> <td>Steep Slope Protection*</td> <td>1</td> </tr> <tr> <td>RP6</td> <td>Site Design for Habitat or Wetland and Water Body Conservation*</td> <td>1</td> </tr> <tr> <td>RP7</td> <td>Restoration of Habitat or Wetlands and Water Bodies*</td> <td>1</td> </tr> <tr> <td>RP8</td> <td>Long-term Conservation Management of Habitat or Wetlands and Water Bodies*</td> <td>1</td> </tr> <tr> <td>RP9</td> <td>Minimized Site Disturbance in Design and Construction*</td> <td>1</td> </tr> </tbody> </table>	NATURAL AND CULTURAL RESOURCE PRESERVATION (RP)		5 Max	RP1	Imperiled Species and Ecological Communities*	R	RP2	Wetland and Water Body Conservation*	R	RP3	Floodplain Avoidance*	R	RP4	Range and Training Land Conservation	R	RP5	Steep Slope Protection*	1	RP6	Site Design for Habitat or Wetland and Water Body Conservation*	1	RP7	Restoration of Habitat or Wetlands and Water Bodies*	1	RP8	Long-term Conservation Management of Habitat or Wetlands and Water Bodies*	1	RP9	Minimized Site Disturbance in Design and Construction*	1	<b>THE POLICY SHOULD MORE SPECIFICALLY ADDRESS CULTURAL RESOURCES</b>  The header for this section is “Protection of Natural and Cultural Resources” but there is no mention of cultural resources. These are two distinct fields and the Study Team recommends splitting this section into two; cultural resource protection could be “CRP”. For cultural resources, the Study Team recommends adding:  CRP1 Minimized adverse impacts to Historic Districts CRP2 Restoration of Inherently Energy Efficient Building Features CRP3 Protection of Contributory Features CRP4 Historic Building Restoration/Modernization CRP5 Cultural Landscape Preservation
NATURAL AND CULTURAL RESOURCE PRESERVATION (RP)		5 Max																														
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DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
2-3 Natural, Historic and Cultural Resource Management	p. 11 [...] <p><i>Planner will coordinate planning decisions with installation cultural and natural resource managers early in the planning process to avoid project delays and additional funding needs from the inadvertent discovery of historic, cultural and natural resources within proposed project areas.</i></p> [...]	<p><b>THE POLICY SHOULD STRENGTHEN THE ROLE OF CULTURAL RESOURCE MANAGERS</b></p> <p>Since the sustainment, restoration, and modernization of historic buildings are potential alternatives for a construction project, this UFC should mandate a greater role for CRMs in master planning. The UFC text gives cultural resource managers an advisory role only. In addition, the presumption in the text is that historic resources would not be used to meet mission requirements but only present sources of potential project delays.</p> <p>The Study Team recommends that the Natural, Historic and Cultural Resource Management chapter be split into one for natural resources and another for historic and cultural resources. The new section on historic and cultural resources should mandate that the planner confer with the CRM early in the master planning process to identify potential existing buildings to meet future mission requirements. This sign-off requirement would give CRMs a more significant role in master planning.</p> <p>This could also include identifying, on a preliminary and general basis, preferred treatments to reuse historic buildings to meet the installation mission. If an installation has historic or cultural resources, the UFC should require that the CRM sign off on proposed construction projects as consistent with the installation master plan.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>2-3.3. Management of Historic and Cultural Resources</p>	<p>p. 12</p> <p>[...]</p> <p><i>The DoD is required to take into account the potential effects of its actions on historic properties that are eligible for or listed in the National Register of Historic Places, and areas that are considered sacred sites by Federally recognized Native American tribes. When historic properties have the potential to be affected, planning will comply with the requirements of the National Historic Preservation Act (16 USC, 470). In accordance with Section 106 of the NHPA, codified in 36 CFR Part 800, Federal agencies will take into account the potential effects of their proposed actions on historic properties, and avoid, minimize, reduce or mitigate any adverse effects to historic properties in consultation with the State Historic Preservation Office, Native American Tribes, and other relevant consulting parties. Effects to historic properties can be direct (e.g. - demolition) or indirect (e.g.-adverse impacts to the setting or viewshed of a historic district). It is recommended that the planner involve the installation’s Cultural Resource Manager as early in the planning process as possible to avoid delays.</i></p> <p>[...]</p>	<p><b>THE UFC SHOULD CONSIDER THAT EXISTING BUILDINGS ARE A POTENTIAL RESOURCE TO MEET MISSION FACILITY REQUIREMENTS</b></p> <p>Section 2-3.3. does not affirm that historic properties are a resource to be analyzed and utilized in the master planning process. The text appears to treat historic buildings/properties as a compliance box to check.</p> <p>The Study Team recommends text that should say something along the lines of the following: “Planners should evaluate and incorporate to the extent feasible the restoration and/or modernization of existing buildings into meeting the mission requirements as part of the Master Plan formulation process. In many cases, the utilization of existing historic properties can help the installation meet many of the planning principles related to a healthy community, compact development, low impact development, energy efficiency, walkability, and transit-oriented development.”</p>
<p>2-7 Area Development Planning</p>	<p>p. 18</p> <p>[...]</p> <p><i>As part of the master planning process, installations will be divided into identifiable and connected districts based on geographical features, land use patterns, building types, and/or transportation networks. An Area Development Plan (ADP) should then be prepared for each district. This leads to developing the Master Plan in logical planning increments.</i></p> <p>[...]</p>	<p><b>THE LANGUAGE DOES NOT ADDRESS HISTORIC DISTRICTS</b></p> <p>The basis for dividing installations omits historic districts which would be a natural definition for a planning district in the master planning process. The Study Team recommends adding “historic districts” to the string of examples in the first sentence.</p>
<p>2-9 Form-Based Planning</p>	<p>p. 18</p> <p><i>Form-based planning guides construction by identifying the form for installation development (building types, height, set-backs, circulation patterns, landscaping, land use, etc.) and translating that form into a set of specific planning directives. The directives use products typically developed by planners, including illustrative plans, land-use plans, and street, building, and landscape standards to flexibly guide development. The form that this approach supports reflects mission needs, program requirements, environmental constraints and opportunities, and other development factors...</i></p>	<p><b>UFC APPEARS ORIENTED TO NEW CONSTRUCTION ONLY</b></p> <p>Section 9 presents form based planning and provides good guidance for new construction. The UCF should also contain a section that similarly presents guidance for planning the restoration or modernization of historic buildings. Such a section would indicate the importance of formulating and adopting design guidelines that would apply to new construction within a historic district as well as set forth basis principals for the design of restoration and modernization treatments. The Study Team recommends a new section that could be titled “Section 2-X PLANNING FOR HISTORIC PROPERTIES”.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>3-4 Products</p>	<p>p. 27</p> <p><i>At a minimum, the Master Plan should include the following products:</i></p> <p><i>a. Vision Plan – includes a statement of the planning vision, planning goals, and planning objectives as well as an overall constraints and opportunities map(s), a developable area map, a framework plan for the entire installation, a land pattern matrix if applicable, and a summary future development plan.</i></p> <p><i>b. Installation Development Plan – includes Area Development Plans (including detailed constraints and opportunities maps, Regulating Plans, Illustrative Plans, Implementation Plans, capacity analysis, and supporting sketches and renderings), as well as appropriate Network Plans.</i></p> <p><i>c. Installation Planning Standards – installation standards for development.</i></p> <p><i>d. Development Program - overall installation strategy for using and investing in real property; includes list of current known projects needed to support installation missions.</i></p> <p><i>e. Plan Summary – an executive summary of each the above planning products.</i></p>	<p><b>THE POLICY DOES NOT INCLUDE PRODUCTS RELATED TO HISTORIC BUILDINGS</b></p> <p>The Study Team acknowledges that this section of the UFC is meant to be high level but it should include historic properties since many installations have historic properties and/or historic districts.</p> <p>Item c. should be revised to read: “Installation Development Standards – installation standards for development <u>and design guidelines for historic buildings and cultural landscapes.</u>”</p>
<p>3-5.5 Planning Objectives</p>	<p>pp. 28-29</p> <p><i>“Planning objectives support the goals and vision and are derived from both the planning process and the planning strategies described in Chapter 2. The objectives define how the goals in the vision can be achieved. Each objective is specific and measurable, which enables planners to determine whether or not each objective (and ultimately the supported goal and planning vision) has been achieved. In the sample vision statement, the goal of a sustainable community can in part be achieved through planning objectives of compact, mixed-use, multi-story development. The rationale for the selection of specific objectives is based on consideration of the installation mission and analysis of on- and off-post conditions. In addition, the ten DOD planning strategies discussed in Chapter 2 will be incorporated into the planning objectives. Other objectives are selected based on installation design themes, developmental opportunities and constraints, potential encroachment situations, and consideration of community planning agencies, groups, businesses, and affected individuals’ views and plans.”</i></p>	<p><b>THE POLICY DOES NOT REFER TO HISTORIC BUILDINGS</b></p> <p>The policy states: “In the sample vision statement, the goal of a sustainable community can in part be achieved through planning objectives of compact, mixed-use, multi-story development.” Even though the context is an example, it omits the contribution that reuse of historic buildings and historic districts can play to achieve the example vision statement.</p> <p>The Study Team recommends that this sentence be re-written to read: ““In the sample vision statement, the goal of a sustainable community can in part be achieved through planning objectives of compact, mixed-use, multi-story development and reuse of historic properties.”</p>
<p>3-5.8 Framework Plans</p>	<p>p. 32-33</p> <p><i>The Framework Plan is created as part of the planning visioning process. The Framework Plan is a map of the entire installation that shows the identified ADP districts, key transportation and land use concepts, and other significant features that will influence development patterns. The plan can also be used to graphically represent the priority ADP districts. To establish ADP boundaries, planners should use geographic features, key transportation systems, open space networks, and existing land-use patterns, and boundaries of any identified historic districts if appropriate. Note that a district for the purposes of this UFC may incorporate one or more identified historic districts.</i></p>	<p><b>THE POLICY FOCUS IS ON NEW CONSTRUCTION</b></p> <p>While the body of text refers to historic districts, Figure 3-4 only indicates new construction projects and not reuse of historic properties as part of a development plan. This contributes to an impression that installation master planning process is primarily about new construction.</p> <p>The Study Team recommends revising the figure to show a modernization project as well as new construction as an example of a framework plan.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>3-6.1.6 Regulating Plan</p>	<p>p. 36-37</p> <p><i>The Regulating Plan provides specific information on permitted development for each building parcel within a district and acts like an enhanced land-use plan. This plan designates the locations where different uses or building form standards apply. But instead of specifically defining only uses, as land use plans do, this method defines building form (e.g. height and frontage) while allowing for a range of possible uses.</i></p>	<p><b>THE POLICY DOES NOT REFER TO HISTORIC BUILDINGS</b></p> <p>This section refers to building parcels but does not address historic buildings. Although the building form would apply to new construction, other elements of the regulating plan, such as parking, roadway improvements, and public spaces, would also apply to historic buildings and/or historic districts. A regulating plan could also identify the reuse potential of historic buildings and set forth design standards or common treatments to prepare historic buildings for new uses.</p>
<p>3-6.1.7. Illustrative Plan</p>	<p>p. 39</p> <p>[...] <i>c. Capacity Analysis. Effective plans identify future requirements and provide room for notional facilities or even specific facilities that have not yet been programmed. Capacity analysis also accounts for the carrying capacity of the land and developable area on an installation. A capacity analysis should be calculated and shown on illustrative plans as “notional buildings designated for potential future growth.” Additional square footage of future facilities will be calculated to indicate the potential capacity of an area.</i></p>	<p><b>THE POLICY DOES NOT REFER TO HISTORIC BUILDINGS</b></p> <p>This section refers to carrying capacity of land and developable area but does not address historic buildings.</p> <p>To be consistent with the regulating plan, an illustrating plan should also refer to historic buildings that can be reused to contribute to meeting future mission requirements.</p>
<p>3-6.2. Implementation Plans</p>	<p>p. 40</p> <p><i>Implementation plans depict sequencing of key relocation, demolition, and construction actions required to move the installation from its current state to the final state shown on the Illustrative Plan.</i></p>	<p><b>THE POLICY DOES NOT REFER TO HISTORIC BUILDINGS</b></p> <p>This section refers to “relocation, demolition, and construction actions” but should also refer to “restoration and modernization” actions as well.</p> <p>Text in Section 3-6.2. is oriented only to new construction. The Study Team recommends adding restoration and modernization to the string of actions.</p>
<p>3-7 Installation Planning Standards</p>	<p>p. 42</p> <p>[...] <i>These standards are developed to 1) meet sustainability and energy efficiency requirements; 2) promote visual order and architectural consistency; 3) enhance the natural and man-made environments through consistent architectural themes and standards; and 4) improve the functional aspects of the installation.</i> [...]</p>	<p><b>THE POLICY DOES NOT REFER TO DESIGN GUIDELINES FOR HISTORIC BUILDINGS</b></p> <p>Section 3-7 does not acknowledge DoD’s NHPA obligations to consider historic properties in project planning. The Study Team recommends adding to the list of four items the following: (X) promote the restoration or modernization of existing buildings, particularly historic properties, which are on or eligible for the National Register and subject to the NHPA;</p> <p>Also this section refers to “3-7.1 Building Envelope Standards,” “3-7.2 Street Envelope Standards”, and “3-7.3 Landscape Standards” but does not refer to design guidelines for historic buildings.</p>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
<p>3-8.2 Program Development</p>	<p>p. 44</p> <p><i>A portion of new programming requirements on military installations will likely be focused on recapitalization, sustainment, and restoration of existing infrastructure and adapting this into existing real estate, given environmental concerns and other obstacles to "new" site considerations and limited funding for new construction.</i></p>	<p><b>THE POLICY DOES NOT REFER TO MODERNIZATION</b></p> <p>While this section mentions “recapitalization, sustainment, and restoration,” it omits modernization. The Study Team recommends adding modernization to the sentence.</p>
<p>3-11 Project Requirements and the Regulating Plan</p>	<p>p. 27</p> <p><i>Requirements for construction projects must be succinct, clear, and in conformance with the Master Plan. The Regulating Plan provides the required regulatory guidance to ensure that the installation’s vision for development is met. It applies to all forms of acquisition that are used to implement the Master Plan. The Regulating Plan and supporting Building, Landscape, and Street Standards that apply to a proposed construction project will be included in any solicitation and subsequent contract documents for design and development of a project. Additionally, if single-line drawings (floor plans, elevations, etc.) are developed as part of an ADP, these should also be included to illustrate a way to meet the intent of the Regulating Plan. Project designs shall be evaluated in part on how well they conform to the Regulating Plan and supporting standards.</i></p>	<p><b>THE POLICY SHOULD REFERENCE DESIGN GUIDELINES FOR HISTORIC PROPERTIES</b></p> <p>This section would need to be revised to reflect the references to design standards for historic buildings that would be added to the sections elsewhere related to Regulating Plans, Illustrative Plans, and Implementation Plans.</p> <p>The Study Team Recommends revising “<i>The Regulating Plan and supporting Building, Landscape, and Street Standards that apply to a proposed construction project will be included in any solicitation and subsequent contract documents for design and development of a project</i>” to read “<i>The Regulating Plan and supporting Building, Design Guidelines for Historic Properties, Landscape, and Street Standards that apply to a proposed construction project will be included in any solicitation and subsequent contract documents for design and development of a project.</i>”</p>
<p>Appendix B-4.3 Composition of the IPB</p>	<p>p.65</p> <p><i>The IPB is comprised of members or alternates, appointed on orders, and organized as follows:</i></p> <p><i>a. Chair. The chair is designated by each service and could be the senior commander or garrison/base/installation commander.</i></p> <p><i>b. Voting Members:</i></p> <p><i>The Chair</i></p> <p><i>Military or civilian commanders of civil engineering, public works, or appropriate equivalent. This individual will also serve as the executive secretary of the board.</i></p> <p><i>The director/chief of each principal and special staff section of the organization, the environmental coordinator or NEPA Planner, and other staff members designated by the IPB Chair.</i></p>	<p><b>THE POLICY SHOULD SPECIFY CRM MEMBERSHIP</b></p> <p>This section does not specifically mention CRMs as potential voting members though they may be included if designated by the IPB Chair. The policy should include voting membership for the CRM for installations with historic districts or significant historic property inventories.</p>

# National Fire Protection Association 914 Code for Fire Protection of Historic Structures (last updated 2015)

<http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards?mode=code&code=914>

DOCUMENT SECTION(S)	DOCUMENT QUOTATION(S)	STUDY TEAM COMMENTARY
Chapter 7 Process; Chapter 8 Prescriptive Based Approach	<p>p. 49-50:</p> <p><b>1.1 Scope. 1.1.1</b> <i>This code describes principles and practices of fire safety for historic structures and for those who operate, use, or visit them.</i></p> <p><b>7.2 Process</b> <i>The owner or governing body shall identify a project team to oversee the application of the code to the historic building.</i></p> <p><b>7.2.2</b> <i>The team shall include persons with expertise in historic preservation, fire protection and security.</i></p> <p><b>7.3</b> <i>A detailed assessment or survey of the fire safety features and the historic integrity of the structure, site or both shall be completed.</i></p> <p><b>7.3.4.1</b> <i>The building survey shall determine the relative importance of identified fire safety issues.</i></p> <p><b>7.3.4.2</b> <i>Where approved by the authority having jurisdiction (AHJ) historic buildings that are acceptable using a fire risk indexing method shall be considered to be in compliance with applicable fire codes.</i></p> <p><b>8.1 Prescriptive Based Approach</b></p> <p><b>8.1.3.1</b> <i>The AHJ shall approve other fire safety approaches, systems, methods or devices that are equivalent or superior to those prescribed by this code, provided that adequate documentation is submitted to demonstrate equivalency.</i></p> <p><b>8.1.3.2</b> <i>Approaches, systems, methods or devices approved as equivalent by the AHJ shall be recognized as being in compliance with this document.</i></p>	<p><b>THIS POLICY SHOULD BE MORE WIDELY IMPLEMENTED</b></p> <p>National Fire Protection Association</p> <p>The NFPA 914 Process provides for an alternative compliance process for meeting fire code requirements but the alternative solution must be signed off by the local fire safety administrator. According to the Code, NFPA 914 uses a prescriptive approach as well as a performance based approach to finding solutions to the life safety and fire safety problems in historic structures. The 2015 Code includes a process whereby those individuals responsible for managing the fire protection plan for a building could be considered as part of the overall fire protection plan for the building.</p> <p>During interviews for this project, service representatives reported that, despite repeated attempts, the local installation fire department (the authority having jurisdiction or AHJ) would not approve other fire safety approaches, systems or devices as provided for in the code.</p>

# Code Commentary - RPAD

## Commentary on the Real Property Asset Database

In this section, the Study Team provides a narrative description of their attempt to best define the 'universe' of Pre-WWII masonry buildings on all DoD installations.

## Requesting the Data

In support of Legacy Project 14-735, the team requested from DoD a subset of RPAD to best define the Pre-WWII inventory. The information was received by the Study Team on 20 May 2016, and included information within the following parameters:

## Data Elements Requested

Installation Name	Predominant Current Use FAC Title
Service	RPA Predominant Design Use FAC Code
RPA (Real Property Asset) Name	Predominant Design Use FAC Title
State	RPA Predominant Current Use Category Code (CAT CODE)
RPUID (Real Property Unique Identifier)	Category Short Name
RPA Historic Status Code	Facility Condition Index
Facility Built Date	Construction Type
FAC Class	Construction Material
RPA Predominant Current Use FAC Code	Facility Number

## Data Parameters

Include US- and Territories Only	All components + Washington HQ Services
Date range: earliest record available up to and including 12/31/1991	Include Guard and Reserve
	Include owned and leased
	Source: most recent year data (FY15)

Final, corrected data received by the team included **320,721 total assets**, through 12-31-1991.<sup>46</sup> According to the 2015 Base Structure Report,<sup>47</sup> DoD’s full portfolio includes 561,975 assets (including overseas installations).

## Processing the Data

The Study Team sorted the data in order to arrive at a “universe” of assets relevant to this effort. Actions are shown below in ***bold italics***. The new total after each action is **bold underlined**.

### General Sorting

***Delete***: all entries constructed on / after 1-1-41.

**New total: 18771**

### Facility Types

***Sort by***: FAC Class and Predominant Current Use CATCODE; delete all non-building entries such as

Under “Operations and Training” (1xxx FAC codes) ***delete*** all aprons, runways, open storage, training areas, impact areas, concrete pads, covered storage (canopies), etc. Other facility types removed from consideration include piers, berths, fuel storage, rail lines, bridges, culverts, revetments, dry-docks, etc.

***Remove*** from list: all Ammunitions Storage under FAC Code 42xx – these are purpose built igloos that, while permanent, are not subject to the project. This is due to their unique and specific construction; specific rules and guidance for siting, location, and applicability of DoD policies, to include previously completed 100% historic preservation compliance in perpetuity for this class.

Under “Housing & Community” (7xxx FAC codes): ***delete*** all pavilions, outdoor pools, playgrounds, recreational areas, tennis courts, monument/memorials, cemeteries, etc.

“Utility & Ground Improvements” (8xxx FAC codes): ***delete*** all non-building entries (fences, sidewalks, runways, electric / water / sewer lines, etc. ***keep*** – utility plants, pump houses, etc.)

**New Total: 10202**

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<sup>46</sup> In order to save staff time on data requests, the Study Team requested the wider date range to cover the needs for this and two other Legacy-funded efforts.

<sup>47</sup> Available at <http://www.acq.osd.mil/eie/Downloads/Reports/Base%20Structure%20Report%20FY15.pdf>.

## Construction Types

With shorter list of 'buildings only' - **Sort** by "Construction Type":

Permanent Facility (Expected to be used for more than 25 years): 8989 buildings

Semi-permanent Facility (Expected to be used 5 to 25 years): 813 buildings

Temporary Facility (Expected to be used less than 5 years): 400 buildings

## Material details for each Construction Type

The following Construction Materials for buildings are available choices<sup>48</sup> in the RPAD data as provided:

Anchored Brick Veneer

Asphalt

Brick Veneer

Combination of Wood and Masonry Frame

Concrete Block

Concrete Moment Frames, Concrete Shear Walls, Concrete Frame with Infill Shear Walls, Precast/Tilt-up Concrete Walls with Lightweight Flex, Precast Concrete Frame with Concrete Shear Walls, and Pavement

Curtain Walls to include Aluminum Glass, Stone and Metal Panel, Precast Concrete

Does Not Apply

Earth (Stabilized)

Earth (untreated)

Includes Steel Moment Frame, Steel Braced Frame, Steel Light Frame, Steel Frame with Concrete Shear Walls, and Steel Frame with Infill Shear Walls

Metal (Steel, aluminum, copper, or other metal, e.g., Quonset Hut)

Other

Other Local Indigenous Materials (Reed, Branches, Ice, etc.)

Plastics, synthetic materials, etc.

Prefabricated/Modular

Reinforced Masonry Bearing Walls with Wood or Metal, Reinforced Masonry Bearing Walls with Precast Concrete, and Unreinforced Masonry Bearing Walls

Rock

Wood Light Frame and Wood

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<sup>48</sup> These values are a subset of the full 25 choices available in the data dictionary for RPAD (called the Real Property Information Model, or RPIM).

(None listed)

Next, the following Construction Materials were *deleted* from the RPAD data:

Asphalt

Concrete Moment Frames, Concrete Shear Walls, Concrete Frame with Infill Shear Walls, Precast/Tilt-up Concrete Walls with Lightweight Flex, Precast Concrete Frame with Concrete Shear Walls, and Pavement

Curtain Walls to include Aluminum Glass, Stone and Metal Panel, Precast Concrete

Earth (Stabilized)

Earth (untreated)

Includes Steel Moment Frame, Steel Braced Frame, Steel Light Frame, Steel Frame with Concrete Shear Walls, and Steel Frame with Infill Shear Walls

Metal (Steel, aluminum, copper, or other metal, e.g., Quonset Hut)

Plastics, synthetic materials, etc.

Prefabricated/Modular

Wood Light Frame and Wood

**Based on the sorting as described, and the information as provided, the working inventory number for this project is 9027 Pre-WWII masonry buildings.**

## Policy Discussion

Based on the initial data, the Study Team noted a potential flaw in the data collection approach used in the RPIM and RPAD, specifically in the “Construction Materials” field. This is reflected by the apparent ability for a user to enter no value (shown as “None Listed”) in the field. Additionally, the presence of “Other” is problematic, as it does not provide any information on the actual construction materials of a given asset.

The Study Team notes that there is an inherent program inefficiency in the RPAD approach. ‘Construction Materials’ data in the RPAD will potentially be inaccurate, primarily because ‘no entry’ is an allowable option in populating the database. This makes it difficult or impossible to get an accurate accounting of Pre-WWII facilities worthy of retention and attention vis-a-vis this project’s analysis and recommendations.

## Installation Data in RPAD

In analyzing this issue, the Study Team contacted three DoD installations to ‘field check’ their data. Each installation was provided with its data subset from the **9027** assets as described above, and asked to spot correct entries as needed, with a particular emphasis on the ‘Construction Materials’ field.

### Example Army Installation – RPAD Data

- 355 buildings in all Construction Types / Materials prior to 1-1-41.

- 313 Permanent / 40 Semi-Permanent / 2 Temporary
- Mix of construction materials: Brick Veneer, Other, Does Not Apply, etc.

#### Example Air Force Installation - RPAD Data

- 107 buildings in all Construction Types / Materials prior to 1-1-41.
- 106 Permanent / 1 Semi-Permanent / 0 Temporary
- Of Permanent, only 4 are categorized as anything other than ‘Reinforced Masonry...’

#### Example Navy Installation - RPAD Data

- 76 buildings in all Construction Types / Materials prior to 1-1-41.
- 43 Permanent / 33 Semi Permanent / 0 Temporary
- All entries use ‘Does Not Apply’ as the Construction Material type.

The Study Team provided the lists to the Installations to refine and correct. For example, many of the Semi-permanent buildings at the Army Installation are listed as ‘Metal.’ These should be deleted. Also at the Army Installation – many entries have ‘Other’ for a material type; this should be updated to reflect actual construction types. For the example Navy Installation – all entries indicate an incorrect Construction Material (‘Does not Apply’) and should be updated.

### Installation Corrections

All three installations returned **corrected data** as follows:

#### Example Army Installation – Corrected Data

- **365** buildings in all Construction Types / Materials prior to 1-1-41 were corrected by the installation. This includes the addition of 10 buildings not in the RPAD list.
- All corrections made noted the appropriate construction material in lieu of ambiguous data in the RPAD, such as Other, Does Not Apply, etc.

#### Example Air Force Installation - Corrected Data

- No changes

#### Example Navy Installation - Corrected Data

- **45** buildings in all Construction Types / Materials prior to 1-1-41 were updated by the installation.
- These **45** entries were updated with correct Construction Material type to replace the incomplete description of ‘Does Not Apply’ as shown in the RPAD.

## Business Rules and Definitions for RPAD

Based on this exercise and discussions with Installation personnel about this topic (see next section), the Project Team asked OSD to provide the business rules for RPAD concerning Construction Material Type. These rules are contained in the Real Property Information Model (RPIM), maintained by Business Systems & Information (BSI) Office<sup>49</sup> in OASD (EIE). As reported by BSI via the DoD DFPO, there is a requirement to populate 'Construction Material Type' for all assets unless the Operational Status Code of the asset equals 'To Be Assessed' (TBA). As none of the assets under consideration were shown as TBA, all assets within the data should have the 'Construction Material Type' value field populated.

During this discussion, the Study Team also asked to see a full list of choices for 'Construction Material' in the RPIM; the information provided showed 25 "picklist" choices including 'NA / Does Not Apply' and 'Other.' An empty field – no value populated – was not in the RPIM picklist; despite this, the RPAD data provided for this project included several assets with blank fields for 'Construction Material Type.' Both the absence of data, and some of the picklist choices (NA or Other) being imprecise are problematic and present impediments to obtaining a DoD-wide inventory of Pre-WWII masonry buildings.

The Study Team also requested a definition for each of the 25 Construction Material Types and was told that none exists at the OSD beyond the basic picklist explanation (example: 'Combination of Wood and Masonry Frame'). The DFPO encouraged the Study Team to follow up with the Military Services to see what, if any, definitions they maintain for Construction Type. As this project aimed to assess the DoD-wide approach to inventory management, the Study Team did not pursue this approach. The potential for varied approaches to defining Construction Material at the Service level is another impediment to creating a single DoD inventory of Pre-WWII masonry buildings.

More information concerning the RPAD can be found in the Findings and Recommendations section.

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<sup>49</sup> The RPIM is access controlled and not openly available online. More information on BSI can be found at [http://www.acq.osd.mil/eie/BSI/BEI\\_RPA.html](http://www.acq.osd.mil/eie/BSI/BEI_RPA.html).

# Code Commentary – Installation Interviews

## Code Commentary Based on Installation Interviews

In this section, the Study Team provides comments and issues relayed to them by DoD installation personnel as part of a series of interviews conducted in support of the project.

Individuals from the Navy, Army and Air Force, representing one region (Navy) and two installations (one each Army and Air Force) participated in the interviews via telephone, with follow up responses and clarification by e-mail.

The order of presentation is determined by the amount of input from each service,

Navy .....	51
Army. ....	58
Air Force.....	62

**NOTE:** The recommendations derived from these interviews are the work solely of the Study Team and may not reflect the intent of the installation representatives.

Commentary based on Interviews with Installation Personnel

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<p><b><u>Mission Dependency Index (MDI)</u></b>                      Part of the P-78 Navy Planning Manual) The P-78 Navy Planning Manual (Manual) determines if reuse of a property is in the best interest of the Navy to use it for mission critical uses.                      All buildings are assigned an index number between 1-100 which is called the MDI Index                      It is recorded on the Real Estate Property Card. The MDI is used to prioritize the use of money for existing buildings at the installation.</p> <p><b><u>References:</u></b>                      Naval Shore Infrastructure Installation Development Consistency Guide, November 2013                      UFC 3-701-01, DoD Facilities Pricing Guide</p>	<p>The MDI has caused a number of buildings to be vacant for more than 5 years, or puts up hurdles, most of which are compliance with ATFP, which prevent the building from being used. A lot of existing buildings (Pre- WW II Masonry) have a low MDI Index. Most Pre-WW II buildings are not classified as mission critical but used for storage and offices. NAVY will not invest money until the MDI for building is VERY LOW. At that point, it is too late for a competitive justification for the building because 50% of the plant replacement value, (PRV) Level 3 alteration improvements required by the International Existing Building Code and ATFP requirements kick in and the costs to rehabilitate the building are very high. The Public Works Offices prioritize the budgets for spending money on existing buildings and the priority is for keeping buildings with high MDI numbers high.</p>	<p>The Plant Replacement Value for Pre-World War II buildings is out of date and inaccurate. This affects the cost of the repair or modernization of the building because if the cost is more than 50% of the PRV it triggers Level 3 code and ATFP compliance increasing costs. It is not clear how or who applies the criteria for determining Mission Deficiency Index ratings, configuration ratings, and condition ratings for Pre-World War II masonry buildings at the installations. The buildings should be identified by the MDI assessment as good candidates for mission use.</p>

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<u>MDI, continued</u>	<p>A Navy Asset Management Team stated that the majority of time the condition rating and configuration rating are not accurate and that if the condition and configuration scores are in the 60's or lower a project has a higher chance of being funded.</p> <p>The installations throughout the region are having a problem with "demolition by neglect." Historic buildings have too small a footprint for offices and are not located in a controlled area. The buildings at one installation are located in an annex and off the beaten path.</p>	(See above)
Navy	<p><u>The definition of Plant Replacement Value (PRV):</u></p> <p>(Facility quantity) x (Construction cost factor) x (Location factor) x (Planning and design factor) x (Historical factor) x (Contingency factor) x (SIOH [Supervision, Inspection, Overhead]) x (Inflation)</p>	<p>One of the root causes of demolition / avoiding reuse of Pre-WWII masonry buildings is an inaccurate and very low PRV for these assets. The PRV is not accurately captured and no tools are provided to make an accurate determination. Typically, because an inaccurate and low PRV, the cost for reuse of an unreinforced masonry building is 100% of the PRV making the project not competitive for MILCON funding.</p>	<p>The PRV for Pre- WW II masonry buildings needs to be accurately measured and used to best determine the percentage of costs required for modernization of these existing buildings.</p>

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<p><b><u>PRV, continued</u></b></p> <p><b><u>Reference:</u></b> DoD Financial Management Regulation, June 2007, Vol. 2B, Chapter 8, pg. 8-3</p>	<p>If a project cost is over 50% of the PRV, then the building must undergo ATPF upgrades causing a huge increase in the cost of reusing the building. A Navy installation conducted an actual PRV study of a Pre-World War II masonry building in anticipation of a reuse project. The results showed a much higher PRV than was originally assumed, and the results helped the project receive MILCON funding.</p>	<p>Accurately determining the PRV for pre-World War II masonry buildings is likely to keep required rehabilitation costs below 50% of PRV and so enable the project to be competitive for funding.</p>
Navy	<p><b><u>New Footprint MILCON Moratorium</u></b> Memo from Admiral J. W. Greenert, U.S. Navy September 19, 2010</p>	<p>Though the memorandum requires to “Pursue, as a matter of policy, recapitalization of existing facilities in lieu of New Footprint MILCON” it also requires to “Program, at a minimum, a 2:1 equivalent infrastructure reduction for the Commander, Navy Installations Command” waived New Footprint MILCON meaning- the project proponent has to demolish twice as much square footage to build a new building.</p>	<p>This policy is known at the installations as the 2 for 1 demo requirement. The use of low PRV values for Pre- WWII masonry buildings make recapitalization of existing facilities in lieu of New Footprint MILCON rarely a feasible option.</p>

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<u>Space Utilization</u>	Base facility and space utilization requirements may be impacting reuse. It is difficult to utilize buildings such as barracks, former hospital buildings that have a set configuration that is integrated with the structural system of the buildings. In these cases, there is difficulty converting the floor plans into open space	A Navy installation in the northeast conducted an actual assessment of DoD space utilization in historic buildings but it was not finished in time to be included in this report. The study found that the configuration and open plan of Pre- World War II buildings are not being considered for meeting space needs.
Navy	<u>Directive favoring Design/Build over Design/Bid/Build</u>	Design/Build is very problematic for Pre-WW II buildings because the full scope of the work and its adverse effects is not known at the beginning of the project. Design/Bid/Build is preferable.	Incorporate reference to the use of an historic architect in RFPs for both Design/Build and Design/Bid/Build.
Navy	<u>National Fire Protection Association (NFPA)914 Code for Fire Protection of Historic Structures</u>	All services reported that the local installation fire safety administrator will not use NFPA 914 and the authority having jurisdiction (AHJ) will not sign off on alternative methods for meeting fire safety requirements.	The Installation AHJs should use NFPA 914 to increase the ease of reuse and decrease the cost of reuse of Pre- WW II masonry buildings.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	The <b>NFPA 914</b> Process provides for an alternative compliance process for meeting fire code requirements but the alternative solution must be signed off by the local fire safety administrator.	The greatest problem is with fire rated stairs so the project is forced to build a second set of stairs or exterior staircase at additional expense.	This would encourage prescriptive/ performance based approaches to find solutions to life and fire safety problems in Pre- WW II masonry buildings as provided for in the code.
Navy	<b><u>DD1391; Naval Shore Infrastructure Installation Development Consistency Guide, November 2013 (pg. 20); NAVFAC P-442, Section 2.1.2; Section 13.3 B Subsection 4,5, and 9</u></b>	The authors of 1391s are not familiar with cultural resource issues. Often, project analysis forms are marked as having no cultural resource issues when the project involves listed historic properties. There is not enough information provided to DD1391 authors to guide the design or determine what actually needs to be done on the building.	The NAVFAC P-442 should be updated to remove a bias against restoration and modernization of certain buildings in Section 13.3 B, Subsection 4, which states “new construction is probably better than renovation when renovation exceeds 70 % of the new construction cost.” Subsection 5 states, in error, that an economic analysis would be needed if “alteration projects exceed 70 percent of new construction costs.”

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<u>Real Property Inventory / iNFADS</u>	iNFADS does not reliably capture information about construction type and dates for older buildings. The cultural resource managers have accurate information on construction type and dates in the architectural surveys but often it is not used. Cultural resource managers do not have access to the Real Estate Property Accountability Officer.	iNFADS Data is based on the MDI, Condition Index rating, Configuration rating, capacity rating etc. The IPL (Integrated Priority List) is the application that installation and regions use to submit their MILCON projects to higher headquarters and receive money for construction projects. Projects only appear in the IPL after the Installation has linked a DD 1391 from EPG to the IPL. It is not clear how or who applies the criteria for determining MDI ratings, configuration ratings, and condition ratings for Pre- WWII masonry buildings at the installations. The buildings should be objectively considered by the MDI assessment as candidates for mission use.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<u>UFC 4-010-01 2010</u> <u>PDC TR-06-08</u> <u>PDC TR-06-01</u>	When the installation tries to reuse unreinforced masonry buildings the cost is so high that funding does not get awarded to the project.	Existing masonry walls are often unreinforced and non-ductile in Pre-WW II masonry buildings but have substantial mass which can be exploited in blast analysis and mitigation strategies. Other analysis methodologies such as the non-linear dynamic degrees of freedom can include multiple degrees of freedom and account for geometrical and material non-linearities.
Navy	<u>International Existing Building Code - 503.1 Level 1 Scope Requirements;</u> <u>504.1 Level 2 Scope Requirements</u> <u>DoD Financial Management Vol. 2B Chapter 8, Section 080150</u>	Lack of maintenance and completion of minor repairs is driving up the cost of reuse.	The FMR defines sustainment, restoration, and modernization, but these are not being used to differentiate levels of improvements for Pre-WWII buildings. Numerous minor repairs are being used as a way to avoid reaching a Level 3 code trigger under the International Existing Building Code (IEBC) which is deferring modernization of these buildings.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Navy	<u>UFC 1-200-01</u> <u>ASCE 24 Flood Resistant Design and Construction</u> <u>E.O. 13690</u> <u>E.O. 11988</u> <u>Naval Shore Infrastructure Installation Development Plan Consistency Guide, Nov, 2013</u>	<p>The minimum elevation and freeboard required for existing buildings depends on the Flood Design Category (i.e. Design Class, Risk/occupancy category of the building and the flood zone where the building is located. ASCE 24 gives minimum elevation to the lowest floor in A zones and minimum elevation of the bottom of the lowest horizontal structural member for Coastal A zones and V zones. This does not account for any sea level rise.</p>	<p>The DoD policy for managing buildings in flood plains is stated in EO 13690. It recommends considering different scenarios to determine free board and Base Flood Elevation (BFE) to get a Design Flood Elevation (DFE) that considers Sea Level Rise (SLR)</p>
Army	<u>IEBC - Alteration. Any construction or renovation to an existing structure other than a repair or addition; Scope 503.1 Level 1; Scope 504.1 Level 2, and Scope 505.1 Level 3.</u>	<p>Work on Pre-WW II masonry buildings is categorized under the IEBC as Level 1, 2 or 3. Level 3 alterations apply when the work area exceeds 50% of the aggregate area of the building or 50% of the Plant Replacement Value. Level 3 code compliance requires everything to be brought up to code; abatement of lead-based paint, ATFP, progressive collapse requirements, and handicapped accessibility which usually requires the addition of an elevator.</p>	<p>Facilities managers are avoiding the Level 3 trigger requiring full modernization by doing piece meal work. By avoiding modernization of these Pre-WWII masonry buildings, the installations are not able to benefit from the cost and energy saving benefits shown in ESTCP SI-0931, reduce MILCON footprint or reduce maintenance costs. When a low PRV causes the cost of a modernization to exceed 50% of the PRV, the project has difficulty competing with new construction projects.</p>

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Army	<u>ICC International Existing Building Code; Scope for Level 1 is in 503.1, and Scope for Level 3 is in 505.1. (IEBC)</u>	Every renovation is being done piecemeal if at all. The leadership does not see these buildings as valuable. They believe that they cannot invest enough money to get the building’s windows to function, abate asbestos and lead based paint, etc. There were over 300 service requests placed for work on Building 1 to avoid triggering Level 3 code requirements under IEBC.	Piece meal work is being done at the direction of the highest level of leadership to avoid project costs that would exceed 50% of the aggregate area of the building and so trigger AFTP and Level 3 code requirements. This would seem to be an inefficient use of funds, avoidance of comprehensive modernization of these buildings and a lack of effective use and application of energy conservation strategies.
Army	<u>UFC 2-100-01 Installation Master Planning Real Property Assessment</u>	A land use study was just performed by the Real Property office and a visual inspection of all buildings was conducted for the master plan. The evaluators from the Real Property office did a cursory condition assessment and chose those that “did not look good visually” for demolition. The evaluators are not trained in assessing the condition of buildings.	It is not clear how or who applies the criteria for determining MDI ratings, configuration ratings, and condition ratings for Pre- WWII masonry buildings at the installations.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Army	<u>UFC 2-100-01, etc. continued</u>	This Army installation has a comprehensive program through a Programmatic Agreement (PA) with two State Historic Preservation Officers to identify historic properties which are 45 years old or older. All pre-World War II buildings are evaluated for eligibility for the National Register under the PA. This process could inform the master planning process.	(see above)
Army	<u>UFC 02-42-91 Removal and Salvage of Historic Construction Materials</u>	If a building is demolished 60% of the building material must be diverted from the landfill. Brick masonry building volume is much greater than that of wood. Demolition of lower volume frame buildings could work in favor of brick building reuse.	Increased use of Pre-WWII masonry buildings could greatly contribute to the diversion of building material from the landfill as directed in UFC 02-42-91.
Army	<u>DD 1391 Tab J Paragraph 3-14 and Design/Build vs Design/Bid/Build</u>	Historic comments are included in this section (Tab J) of the 1391 Process. We are in the process of adding cradle to grave valuations. The Design/Build process moves too quickly. Roughly 65% of the plans do not include the necessary historic preservation requirements (such as the Secretary of the Interior's Standards to avoid an adverse effect) if it is an historic building. CRM staff prefers Design/Bid/Build because all elements are included in the specifications. The key is to get in on the ground floor and make sure the requirements for historic preservation are in Tab J.	This Army installation has Historic Preservation Compliance Monitors which monitor construction projects and may be very beneficial for all service installations.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Army	<u>DD1391</u>	The statements in the 1391 surrounding lead based paint and asbestos are important. Has it been mitigated, not mitigated but tested?	Those completing 1391s for older building renovation are often not familiar with rehabilitation of those older buildings.
Army	<u>Space Utilization Requirements</u> <u>Change of Use</u> <u>UFC 4-610-01 Administrative Facilities</u> <u>UFC 2-100-01 Installation Master Planning</u>	Master Planning deals with and approves a change of use for a building. A change of use triggers Level 3 code compliance for ADA, lead based paint, ATFP and even creating a secure conference room causing the project to be too expensive to be funded for change of use.	
Army	<u>National Fire Protection Association: NFPA 914 Code for Fire Protection of Historic Structures; Chapter 7 Process; Chapter 8 Prescriptive Based Approach</u>	Local installation fire officials are unwilling to use alternative methods for meeting fire/life safety codes for renovation of historic buildings even though we have attempted to use the NFPA 914 Process. The installation has a small stone building which has been empty for over a dozen years because the doors do not meet the standard door height.	The NFPA 914 process provides an alternative compliance process for meeting fire code requirements but the alternative solution must be signed off by the local fire safety administrator. NFPA 914 uses a prescriptive approach as well as a performance based approach to finding solutions to the life safety and fire safety problems in historic structures.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Army	<u>NFPA 914, etc. continued</u>	(See above.)	The 2015 Code includes a process whereby those individuals responsible for managing the fire protection plan for a building could be considered as part of the overall fire protection plan for the building.
Air Force	<u>National Fire Protection Association (NFPA)914 Process</u>	The NFPA 914 Process provides for an alternative compliance process for meeting fire code requirements but this must be signed off by the local fire safety administrator (Authority having jurisdiction- AHJ). One goes through a process of comparable levels of protection, and the Air Force protection unit will not sign off. The process takes a lot of time and could be made easier and less expensive. Building materials found in 1970's buildings burn faster and easier. A lot of historic material does not burn / burn as hot. It has a different fire spread; plaster does not burn.	The Service AHJs should consider using NFPA 914 prescriptive/performance based approaches to find solutions to life and fire safety problems in Pre- WWII masonry buildings. Use of NFPA 914 could decrease costs and increase the reuse of Pre-WWII masonry buildings.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Air Force	<p><u><b>UFC 1-200-02 High Performance and Sustainable Building Requirements American Society of Heating Refrigeration and Air Conditioning Engineers, Inc., ASHRAE Standard 90.1 –Energy Standard for Buildings Except Low-Rise Residential Buildings.</b></u></p>	<p>This UFC states that a project on an existing building must beat ASHRAE by a particular energy performance. This directive means that installations will rip out plaster walls to react to the ASHRAE requirements. Calculations are always in R value and never account for the U values. They do not account for the value of a masonry wall. The directive is using models that do not take into account other measures of efficiency. Plaster walls are removed and furred out for insulation. One has more luck keeping windows than keeping plaster because of this UFC.</p>	
Air Force	<p><u><b>UFC 2-100-01, Installation Master Planning</b></u></p>	<p>Planning can be an impediment to the reuse of Pre-WWII masonry buildings. There is a perception that one cannot build in the historic district, even though new development is needed closer and next to the district. New construction would energize the old buildings and provide more amenities and more critical uses to historic buildings. There has been little investment in infrastructure. There are critical needs.</p>	<p>The Study Team recommends that installation leadership ensure that all staff involved with the operations of historic buildings - to include cultural resources and facilities managers - are required to meet on a regular basis. This will ensure that all involved are aware of the roles and responsibilities pertaining to the successful management of those historic properties. The Study Team has completed 'Quick Facts' sheets with information for both facilities managers and cultural resources managers to accompany this report. Those</p>

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Air Force	<u>UFC 2-100-01, continued</u>	Planners are avoiding the historic district. Childhood development and fitness facilities are set apart from the district because planners are fearful of Section 106 or have a misunderstanding that they cannot build in the district. We have only 3 unoccupied buildings. There is a Facilities Excellence Plan with design guidelines which are already codified, have scale, massing, fenestration.	‘Quick Facts’ encourage the same cooperative approach.
Air Force	<u>UFC 4-010-01 2010</u> <u>Single degree of Freedom (SDOF)</u> <u>Structural Response Limits for</u> <u>Antiterrorism Design 2008. PDC TR-</u> <u>06-08</u> <u>PDC TR-06-01</u>	The entire historic district is in a guarded perimeter- especially for the windows. The Protective Design Center should test Pre-WWII masonry buildings to understand the seismic retrofit of these buildings. We should highlight this heritage and provide more education about certain treatments.	Existing masonry walls are often unreinforced and non-ductile in Pre-World War II masonry buildings but have substantial mass which can be exploited in blast analysis and mitigation strategies. Other analysis methodologies such as the non-linear dynamic degrees of freedom (NDFEM) can include multiple degrees of freedom and take geometrical and material non-linearities into account.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Air Force	<u>DoD Financial Management Regulation, June 2007, Volume 2B Chapter 8 P. 8-3 Plant Replacement Value (PRV)</u>	<p>The project reviewers require that if a project goes above the 50% PRV than the project is not competitive. What is the true plant replacement value of a Pre-WWII building? When an actual plant replacement value was done on a housing unit at this installation, it was found to be \$750,000. The project reviewers were using a PRV of \$200,000 for the unit which was based on a contemporary structure and a per sq. ft. formula not on the actual PRV value of the Pre-WWII building.</p>	<p>The PRV for Pre-WWII masonry buildings should be accurately measured on a project by project basis. Accurately determining the PRV for Pre-WWII buildings is likely to keep required rehabilitation costs below 50% of PRV and enable the project to be competitive for MILCON funding.</p>
Air Force	<u>Demonstrating the Environmental and Economic Cost benefits of Reusing DoD's Pre- World War II Buildings ESTCP SI-0931 UFC 1-300-01 Criteria Format Standard</u>	<p>I agree that searching out and tweaking each bit of adverse technical guidance is a worthwhile thing, but that only gets you off square one. You still need firm goals and explicit measures to track compliance. If this effort could be pitched under the energy sustainability umbrella, with that Assist Sec as champion, it might have a shot.</p>	<p>The Whole Building Design Guidelines lists the availability of new construction UFCs for a broad number of building types at DoD installations including but not limited to Golf Club Houses, Bowling Center Standards and Outdoor sports and recreation facilities.</p>
Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight

Air Force	<u>ESTCP SI-0931, etc., continued.</u>	Here we are dealing with a whole cadre of engineers and planners whose reward system is geared to new construction and development, not sustainable anything, including historic preservation. Once LEED was perceived as 'good' under the leadership paradigm, firms moved toward it and boasted of their record to competitors and the public. Something similar for HP is needed.	Rather than make a series of revisions to numerous existing DoD documents, the team recommends the development of a new UFC for the modernization of specific types of Pre-WWII masonry buildings. The new UFC would follow the UFC 1-300-01 format to provide guidance in planning, design, construction, sustainment, restoration and modernization for the modernization of Pre-WWII masonry buildings at all service installations.
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Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Air Force	<u>DD1391</u>	I like the idea of tweaking the DD1391 and 1391-C cert to make it something other than a pencil whip exercise. Under CE Transformation in AF, the whole responsibility for the legitimacy of the 1391 is now with the base, i.e., no real oversight. I haven't seen one since 2011. To my knowledge, no one in CZ reviews them either. In an era of 'let's eliminate the checkers checking the checkers', it will be difficult to find adult supervision and internal controls that are worth anything.	The DoD FMR provides definitions for sustainment, restoration, and modernization, but these are not being used to clearly differentiate levels of improvements for Pre-WWII buildings. Minor repairs are being used as a way to avoid triggering a Level 3 code compliance under the IEBC which is deferring modernization of these buildings.
Air Force	<u>Military Housing Privatization Initiative</u> <u>The USAF Family Housing Guide (August 2004)</u> <u>UFC 4-711-01 Family Housing.</u>	The USAF Family Housing Guide (August 2004) has requirements throughout, that in many circumstances Pre-WWII housing just can't meet. It would be very interesting to see the cumulative effects of the loss of so many historic housing units across the DoD. Fortunately, the Air Force Manual 32-1084 "Civil Engineering Facility Requirements" was revised in April 2012 and continues to be scrutinized by the Whole Building Design Guide (WBDG) Historic Preservation Subcommittee. Lots of great information there.	This study does not include a review of military housing.

Service	Issue and / or Reference Document(s)	Service Comment	Study Team Comment / Policy Insight
Air Force	<u>Space utilization</u> <u>E.O 12072</u>	<p>One of the issues at hand affecting reuse of Pre-WW II Brick Quarters units is space requirements. There are specific space allotments for various officer and enlisted ranks that have changed, mostly increased, over the years. Many of the housing units today are either too small or too large to comfortably fit the current housing requirements dependent on rank. Some proposed renovations would actually create units that are much larger than allowed for even general officers (conversion of duplex units to single).</p>	<p>This study does not include a review of military housing.</p>

# Findings and Recommendations

## Illustrated Recommendations

The following pages detail the findings and recommendations from the project in the following areas:

### Structural

Masonry Walls ..... 70

Blast Resistance Analysis..... 71

Applicability of Progressive Collapse Requirements ..... 72

Construction Types and Materials ..... 73

### Economic Analysis

Formulating Project Alternatives ..... 74

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Residual or Terminal Value ..... 78

DD1391 Cost Estimation ..... 79

Non-Quantifiable Output Measures ..... 80

Installation Master Planning ..... 81

Inventory..... 82

# Masonry Walls

## DoD Practice

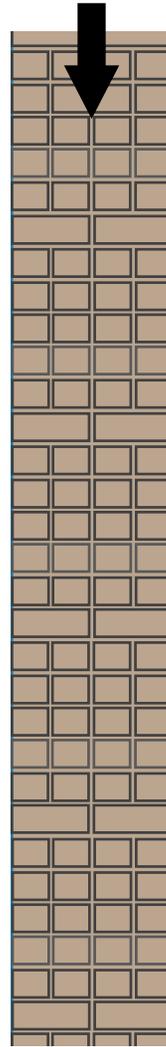
Neglects  
Compressive Load



6" Thick

## Recommended

Actual Compressive Load  
Increases Lateral Strength



12" Thick Minimum

17" + Common

Actual Bond Pattern  
Dramatically Affects  
Performance

UFC requirements are based on the interpretation that masonry walls are secondary structural components, effectively only 6" thick, without axial compressive loads, and not taking into account the bond pattern of the masonry. All of these are essential considerations in structural performance.

The UFCs appear to underestimate the wall thicknesses of Pre-WWII masonry buildings. Masonry walls of historic buildings are often primary structural components since they directly support other structural members such as floors. The blast resistance of brickwork is increased for brick bonds having a larger percentage of header courses.

**USACE should refine its data based on actual blast load tests to develop appropriate standoff distances for realistic wall thicknesses.**

**Standoff distances should reflect actual wall mass, bond pattern, and axial loads.**

Research and testing on the blast behavior of existing masonry structures is ongoing in Canada.

UFC 01-001-01

UFC 02-001-

# Blast Resistance Analysis

## DoD Practice

Single Degree  
Of Freedom

PDC TR-06-08  
PDC TR-06-01

Often Appropriate  
Can Be Too Conservative

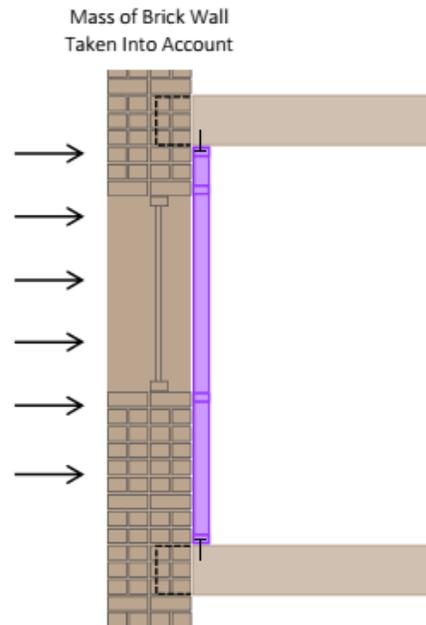
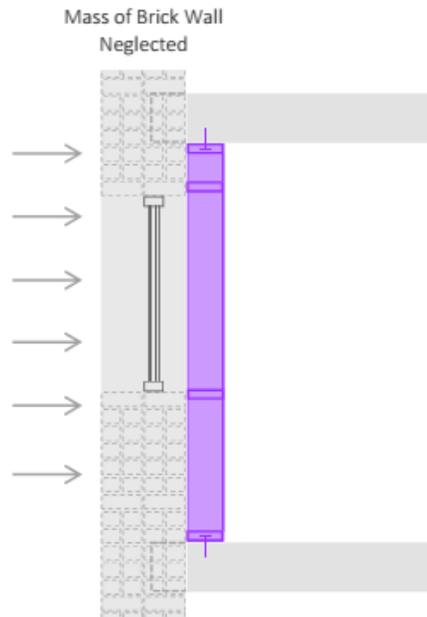
## Recommended

Non-Linear Dynamic  
Finite-Element

Refined Results  
Reduced Redundancy  
Higher Computational Costs

Use **NDFEM** and take advantage of the mass of existing unreinforced masonry walls in blast mitigation retrofits **to optimize the structural upgrade of:**

Interior Load-Transfer Framing  
Window Connections  
Window Frame



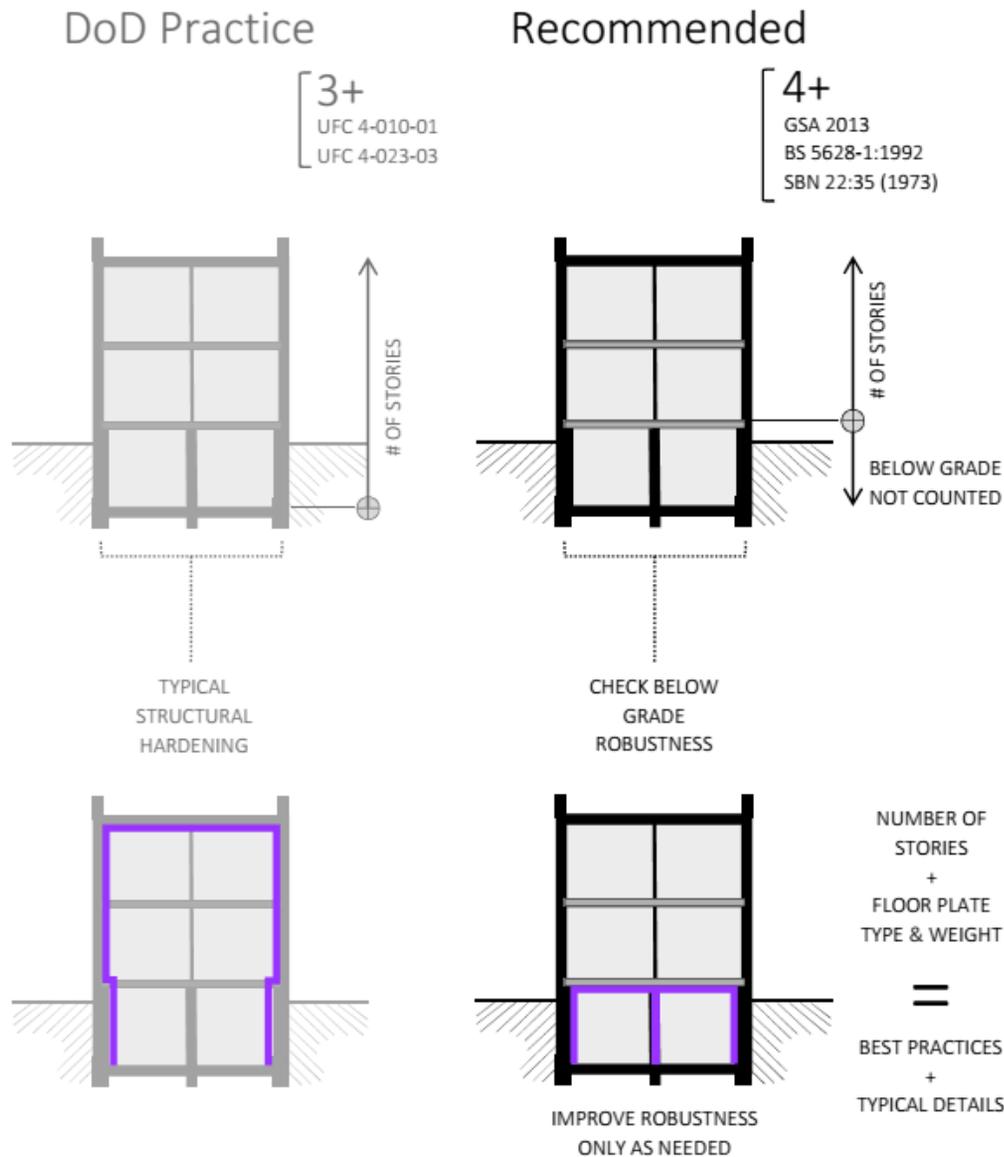
The single degree of freedom (SDOF) process is the prevalent method used by the DoD to evaluate the blast resistance of existing buildings. The Protective Design Center (PDC) of USACE automated the SDOF process into the SBEDS workbook, which is an Excel-based tool for structural engineering designers.

The SDOF method is often appropriate but it can result in too conservative solutions or inadequate representations of system structural behavior in some cases. Other analysis methodologies such as the non-linear dynamic finite-element method (NDFEM) can include multiple degrees of freedom and take geometrical and material non-linearities into account. NDFEM analyses require higher computational costs but can lead to more refined results. Integrated analyses permit the optimization of the cross section of interior hardening framing and/or replacement windows for instance (when required). Existing masonry walls are often unreinforced and non-ductile but have substantial mass to be exploited in blast analysis and mitigation strategies.

**Over-conservative structural hardening design should be avoided as it can irreversibly affect the historic fabric.**

**Exploit the mass and strength of the masonry in the analysis.**

# Applicability of Progressive Collapse Requirements



An existing inhabited building<sup>50</sup> that is three stories or more has to comply with UFC 4-023-03 on progressive collapse (PC), regardless of the standoff distance. Family housing with 12 or fewer units are exempt from compliance while they may be occupied by more than 11 DoD personnel. Applying the number of stories threshold before the occupancy category criterion seems inappropriate in some cases<sup>51</sup>. The calculation of the number of stories includes basement levels<sup>52</sup>, regardless of their robustness, and is more restrictive than other standards<sup>53</sup>. The required level of PC resistance is independent of essential parameters including the floor plate type and weight, the floor area per story, and the robustness of basement levels.

The DoD should consider using a more refined approach integrating the geometry, the materials, and the strength of the building when defining the required level of PC resistance.

It would be worth developing best practices guidance to help decision makers.

<sup>50</sup> Required to comply with UFC 4-010-01.

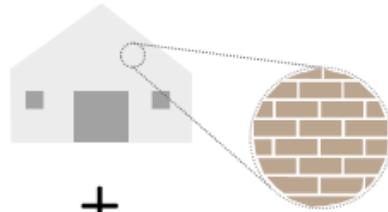
<sup>51</sup> E.g., two-story high occupancy building.

<sup>52</sup> If they meet the definition of occupiable spaces per IBC 2012.

<sup>53</sup> For instance, the threshold is defined at 4 stories or more in GSA 2013, British standards BS 5628-1:1992 and Swedish standards SBN 22:35 (1973).

# Construction and Materials

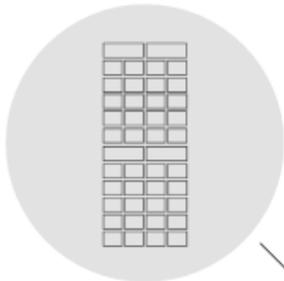
Building Shape



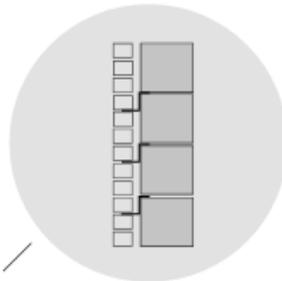
+

Construction Type

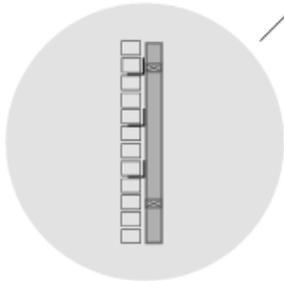
MULTI-WYTHE  
UNREINFORCED MASONRY



CMU WITH BRICK VENEER

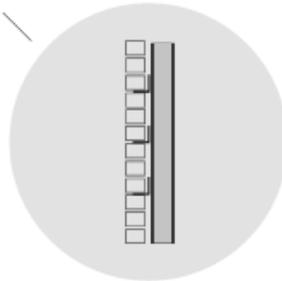


WOOD STUD FRAMING  
WITH BRICK VENEER



≠

STEEL FRAMING WITH  
BRICK VENEER



DoD personnel might not have the necessary background information to identify the construction type of existing masonry facilities. Inaccurate assessments may bias the content of the Real Property Asset Database (RPAP) that is used by military planners for modernization project management purposes.

**It is essential to distinguish building types from construction types.**

In fact, buildings having a similar shape may belong to different construction types. Masonry walls can be either load-bearing or non-load-bearing (e.g., infill, veneer). Masonry units can be of different materials (sand lime, clay, concrete, etc.) and shapes (e.g., solid, hollow), can be bonded or anchored, and can be reinforced or unreinforced.

The following references provide a clear definition of construction types and masonry materials:

[\*FEMA Structure Types Definitions\*](#)

[\*IBC 2012 Sections 202, 602, 2103\*](#)

[\*ACI 530-05 and ASCE 5-05 Section 1.6\*](#)

# Formulating Project Alternatives

## DoD Practice

Lack of specificity in guidance and lack of consistent terminology for generating alternatives

### NAVFAC Example



- Renovate facility
- Private lease
- Construct new facility

## Recommended

Provide additional guidance with terminology consistent with likely funding sources

### New Suggested Prototypes



- Status Quo/Sustainment of facility
- Private lease
- Restoration/modernization of facility
- Construct new facility

NAVFAC P-442 Sections 2.1.2 and 2.4.2(c) and Appendix A offer examples of project alternatives that refer to ‘repair,’ ‘renovation,’ and ‘conversion.’ This is confusing since the terms used in these sections do not track concepts set forth by the DoD Controller related to sustainment (e.g., repairs to keep a structure operational and habitable), restoration (an investment to restore the original use) or modernization (an investment for adaptive reuse).

Further, Section 2.1.2 should set forth a clear set of prototypical alternatives using consistent terms. It is important to clearly articulate prototypes early in the guidance so that analysts formulate realistic project alternatives by including, for example, new energy efficient HVAC systems or restoring original design features that contribute to energy efficiency in a restoration or modernization project (as shown in the ESTCP SI-0931 study).

**The Study Team recommends revising these NAVFAC sections per our commentary and other similar sections in other DoD economic analysis guidance documents so that they clearly set forth typical project alternatives using well-defined and consistent terminology.**

*NAVFAC P-442 Economic Analysis Handbook 2013*

# Equal Analytic Footing

Pre-WWII Buildings need equal analytic footing with new construction in these sections:

<b>NAVFAC P-442</b>	Value Engineering (Section 2.2.2)
	Determining Economic Life (Section 3.2)
	Recurring Annual Costs (Section 4.4.2)
	Non-Monetary Considerations (Section 4.4.2)
	Examples of Monetary Considerations (Sections 7.2 and 7.3)
	Lessons Learned from Budgetary Reviews (Section 13.3.B)
	Business Case Analysis (Section 14.G)
Appendix A, Section G Utilities	

Throughout the NAVFAC guidance document there are numerous instances of text that present analytic guidance only in the context of new construction (when such guidance might also apply to Pre-WWII buildings as well) or that presume that new construction will be preferable to restoration or modernization project alternatives. These sections are analyzed in detail in the commentary on economic analysis.

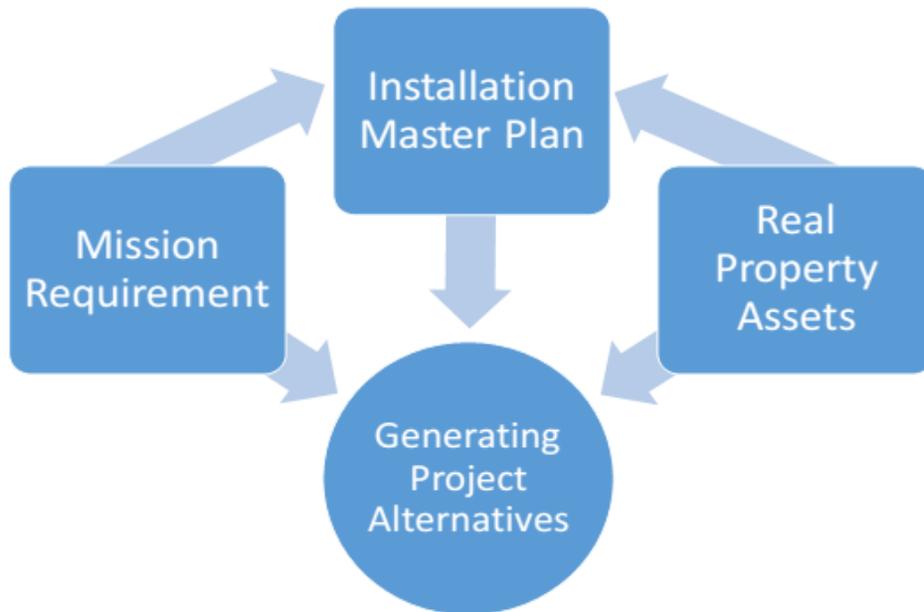
Of most concern is a statement in Section 13.3.B that states “...when the cost of a facility renovation exceeds 70 percent of the new construction cost, it probably is a better value to use the new construction alternative.” This rule of thumb appears to be offered as an opinion and it is based only on construction costs, not life-cycle costs.

DoD should consider revising this handbook as suggested in the commentary and reviewing similar guidance documents issued by other services to ensure that restoration and modernization alternatives of Pre-WWII buildings are given greater visibility and equal footing as potentially viable project alternatives.

NAVFAC P-442 ECONOMIC ANALYSIS HANDBOOK 2013

# Linking Project Alternatives to IMP

## One or More of the Project Alternatives Should Tie Back to the Installation Master Plan



In its description of the economic analysis process, NAVFAC P-442 in Section 2.1.2 (Generating Alternatives) and Section 2.2.2 (Fundamental Planning Analysis) discuss approaches to generating alternatives. However, missing from this discussion is a statement that would have one or more of the alternatives be based upon the approved Installation Master Plan, or guidance to cross-check proposed project alternatives against the IMP to ensure consistency. Without such a tie, the generation of alternatives may occur in a planning vacuum, potentially leading to inefficient project planning and analysis.

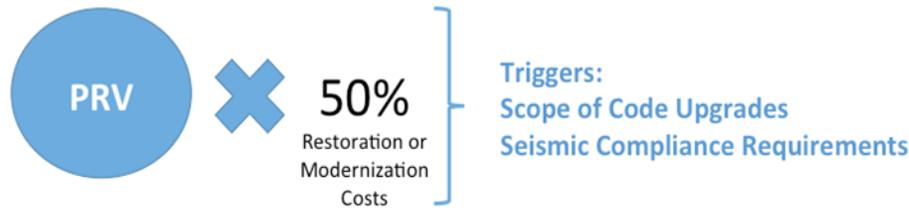
The IMP itself should pre-identify real property assets that can be utilized, re-purposed, or constructed to meet anticipated or new mission requirements based upon a variety of planning principles. The figure to the left illustrates the relationships relative to generating project alternatives under best planning practices.

**The Study Team recommends revising these sections (per commentary) to clearly tie generation of project alternatives back to the IMP and to consider all available real property assets, including Pre-WWII buildings.**

*NAVFAC P-442 Economic Analysis Handbook 2013*

# Plant Replacement Value

Preparing an accurate PRV is critical for preparing project alternatives



The Plant Replacement Value (“PRV”) is a key component of project planning and economic analysis. When restoration or modernization costs exceed 50% of the PRV, code upgrade and ATFP improvements may be triggered, greatly increasing the scope of work and costs for restoration or modernization alternatives. The PRV also factors in an analyst’s determination of the economic life of facility investments. Hence, having an accurate estimate of the PRV is critical to project planning.

Use of PRVs as reported in real property databases may lead to over-estimation of costs for restoration or modernization alternatives since values are often out-of-date (as reported by one Military Service interviewee) and represent macro-level estimating that may be inaccurate for a specific project.

The Study Team recommends expanding the discussion of PRV in economic analysis guidance documents specifically to direct analysts to prepare a new PRV estimate for any existing building contemplated for restoration or modernization.

NAVFAC P-442 Economic Analysis Handbook 2013  
UFC 3-701-01 Facilities Pricing Guide

# Residual or Terminal Value

## Pre-WWII Buildings are Durable: Building 222 at AF Warren, Cheyenne WY



Guidance for calculating a residual or terminal value for economic analysis should include specific guidance for historic structures. Pre-WWII buildings, like Building 222 at AF Warren (constructed between 1905 and 1910), have greatly exceeded their original useful life through having highly durable building materials and undergoing periodic major reinvestment.

Given the track record of Pre-WWII buildings' demonstrated durability, under a full restoration or modernization alternative for a Pre-WWII building the economic analysis should assume the same useful life (e.g., 67 years) as for new construction for the purposes of determining residual or terminal values.

The Study Team recommends revising NAVFAC P-442 Section 4.4.1 and other service economic analysis guidance documents to include such specific guidance for calculating residual values with a statement such as: "Most facilities, including a full restoration or modernization of a historic building (particularly Pre-WWII buildings), can assume a physical life of 67 years."

*NAVFAC P-442 Economic Analysis Handbook 2013*

# DD1391 Cost Estimation

## Cost Estimation Procedures Should Include More Information for Use of RSMMeans CostWorks

### NAVFAC Guidance



- PACES
- SUCCESS Estimator

### Alternative Guidance



- PACES
- SUCCESS Estimator
- RSMMeans CostWorks  
(with direction for use with Pre-WWII buildings)

Section 5.4 of this handbook should address the appropriate cost methodology when a construction project contemplates comparing the restoration or modernization of a historic structure (particularly Pre-WWII historic buildings) with new construction. Due to the nature of historic structures, parametric cost estimating will most frequently be appropriate. A finding of the ESTCP SI-0931 study (page II-15) is that RSMMeans CostWorks is the best estimating tool for historic buildings since it can accommodate non-standard features and is suitable for working with new construction as well. It is accepted by NAVFAC as a cost estimating tool (see NAVFAC’s 2013 Cost Estimating Policy and Procedures, Section 1.1) but is not featured in detail in Section 2.2.1.

The Study Team recommends inclusion of RSMMeans CostWorks as a preferred tool in this section. The Study Team also recommends that the handbook should also require that cost estimates be prepared by qualified architects and engineers with significant experience with historic buildings when such buildings are indicated as project alternatives. This will ensure that treatments are appropriate, meet standards, and are cost-effective.

NAVFAC P-442 Economic Analysis Handbook 2013  
NAVFAC Cost Estimation Policy and Procedures Handbook Version 07/2013

# Non-Quantifiable Output Measures

## Additional Examples of Non-Quantifiable Benefits related to Historic Buildings



Use of and investment in historic buildings fulfills DoD's compliance with NHPA



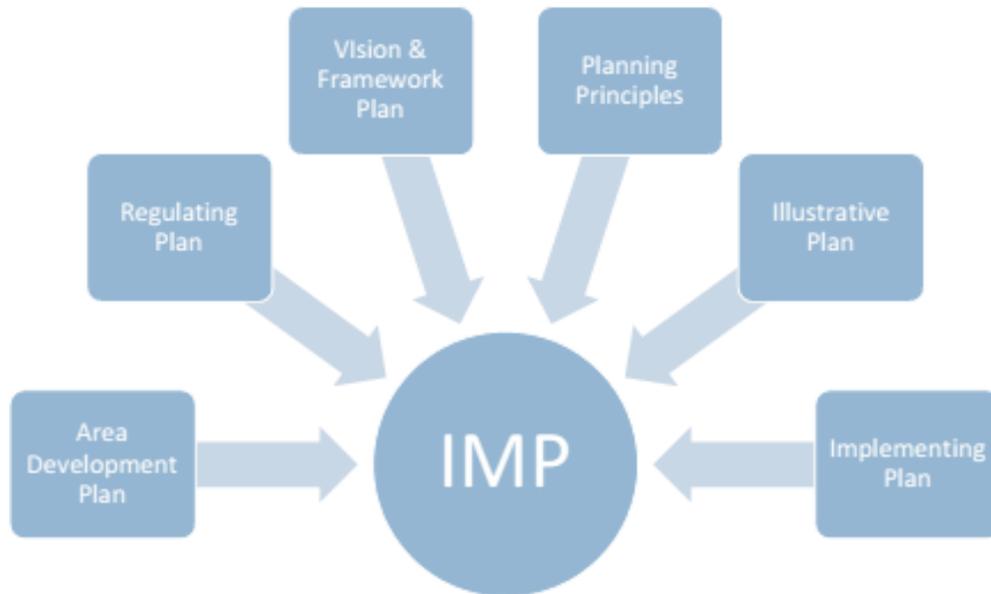
Reinvestment in Pre-WWII Buildings can result in lower construction GHG emissions compared to new construction

Section 6.1.4 of NAVFAC P-442 lists output measures that are not easily quantified. Historic buildings are mentioned as having “better aesthetic value or ambience.” There are additional qualitative outputs other than aesthetics. Reinvestment in historic buildings, particularly Pre-WWII buildings, can result in lower greenhouse gas (GHG) emissions related to construction compared to new construction (as demonstrated in ESTCP SI-0931). Sustainment, restoration, and modernization of historic buildings also ensures DoD compliance with the National Historic Preservation Act (NHPA).

The Study Team recommends adding additional examples of non-quantifiable output measures referring to the potential for lower GHG emissions from construction and compliance with the NHPA.

*NAVFAC P-442 Economic Analysis Handbook 2013*

# Installation Master Planning



UFC requirements for installation master plans (IMPs) appear primarily geared for new construction and do not give adequate visibility and weight to historic buildings as a resource to meet mission requirements.

IMP principles set forth in Appendix E of the UFC combine natural and cultural resources into one section and do not include any principles specifically related to historic buildings or other cultural resources.

In providing guidance for various IMP components, historic buildings and districts are not presented as being resources to incorporate into an IMP to provide mission facilities. Instead, when cultural resources are cited, it is as a planning constraint, not an opportunity to meet a mission requirement.

The role of the Cultural Resource Manager in the IMP process is advisory and insufficient to ensure that historic buildings, particularly Pre-WWII buildings are duly considered for investment under the IMP.

**DoD should consider revising this UFC to include greater guidance for historic buildings as well as designate CRM as voting members of the IMP Board for installations with historic districts.**

*UFC 2012 02-100-01*

# Inventory

The Real Property Asset Database (RPAD) is controlled and maintained by the OSD Office of Business Systems & Information (BSI). This office effects RPAD management through the use of a dynamic data dictionary called the Real Property Information Model (RPIM). The RPIM contains the business and data rules and requirements for all data elements contained in the RPAD.

The RPIM allows for the Military Services to collect data using their own Service-specific databases and processes. The collected information is fed into the RPAD by the Services to comply with several inventory and management requirements. Each Service data collection systems is to comply with RPIM business rules.

The Study Team made note of several issues with the RPIM and the RPAD that make defining a certain subset of the DoD real property portfolio – such as a single list of all DoD Pre-WWII masonry buildings – impossible. One issue is a lack of standardization across the Military Services in defining certain data elements, such as ‘Construction Materials.’ Another issue is in the RPIM itself, which allows for picklist choices like ‘Other’ or ‘Does Not Apply.’

Until the RPIM is strengthened, the RPAD will not be a useful tool to manage a class of property types across the enterprise.

DoD should consider revising the RPIM business rule for ‘construction materials’ to delete some imprecise picklist choices or to only allow certain choices with supporting documentation.

DoD should consider revising the RPIM to include department-wide standardized definitions for ‘construction materials’ instead of allowing different definitions at the military service level.

DoD should consider checking the RPAD system to ensure that all asset ‘construction materials’ value fields are being populated in accordance with the RPIM.

# Recommendations for Further Research

Aside from the key recommendation to consider a new UFC specifically addressing the restoration or modernization of Pre War II masonry buildings;

- 1 The Study Team recommends that DoD consider pursuing additional research into how DoD's structure of funding investments in real property improvements (e.g., SRM and MILCON programs) result in incremental and economically inefficient restoration or modernization of historic buildings by studying recent projects across a larger data set of installations.
- 2 The Study Team recommends that USACE should consider performing blast load analyses on load-bearing unreinforced masonry in order to better characterize its structural behavior. The different wall layouts to be tested should preferably meet typical wall thicknesses and realistic bond patterns. The test results would help refine the data of Table 2-3 in UFC 4-010-01 constituting the base for Tables B-1 and B-2 on conventional construction standoff distances. Also, it is worth noting that a study will likely be launched by the Canadian Government, in partnership with US institutions, on the blast behavior of existing masonry walls/structures in the near future.
- 3 The Study Team recommends DoD develop guidelines on "best rehabilitation practices" to help decision makers define adequate and less intrusive design strategies. The guidelines could include for instance: the identification of the construction materials and load-bearing system(s), knowledge on typical weaknesses, understanding of existing building deficiencies and distress, practical examples of recommended rehabilitation/strengthening design (i.e., drawings/sketches), a list of relevant sources related to the topic and providing "best practices" recommendations.
- 4 The Study Team recommends that DoD perform additional research on how to refine the applicability procedure of UFC 4-010-01 Standard 6 on progressive collapse. It would be worth considering existing parameters in a more differentiated way (standoff distance, number of stories, occupancy category) and possibly integrating additional parameters to the applicability procedure (e.g., construction type, building geometry).

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# Appendix 1 – Documentation

Appraising the condition, intrinsic features and rehabilitation potential of existing Pre-WWII masonry buildings can be challenging to DoD decision makers. Therefore, we gathered the following non-exhaustive list of useful DoD and non-DoD references:

## 1. DoD standards, policies, guidance and publications:

### Defense Authorization Acts

### Defense Technical Information Center

Publications, conference papers, etc.

<http://dtic.mil/dtic/services/resources.html>

### DoD Issuances

DoD Directives, DoD Instructions

<http://www.dtic.mil/whs/directives/corres/ins1.html>

### DoD Forms Management Program

<http://www.dtic.mil/whs/directives/forms/index.htm>

### PDC Technical Reports

<https://pdc.usace.army.mil/library/tr/>

### Real Estate Procedural Manual

[http://www.navfac.navy.mil/products\\_and\\_services/am/about\\_us/resources.html](http://www.navfac.navy.mil/products_and_services/am/about_us/resources.html)

### Real Property Inventory Procedures Manual

[http://www.navfac.navy.mil/content/dam/navfac/Asset%20Management/PDFs/final\\_P78\\_%20july\\_08\\_%20for\\_%20posting.pdf](http://www.navfac.navy.mil/content/dam/navfac/Asset%20Management/PDFs/final_P78_%20july_08_%20for_%20posting.pdf)

# Appendix 1 – Documentation

## UFCs

WBDG Document Library

[https://www.wbdg.org/ccb/browse\\_lib.php?l=6](https://www.wbdg.org/ccb/browse_lib.php?l=6)

## 2. Non-DoD standards, policies, guidance and publications:

### ASCE 41 Seismic Rehabilitation of Existing Buildings

#### Centre for the Protection of National Infrastructure

Bomb Blast Curtains (and other interesting data)

<http://www.cpni.gov.uk/advice/Physical-security/ebp/In-Depth-Bomb-blast-curtains/>

#### DHS FEMA Risk Management Series

<http://www.fema.gov/media-library/resources-documents/collections/3>

#### DOI – NPS – Technical Preservation Briefs

<http://www.nps.gov/tps/how-to-preserve/briefs.htm>

#### DoD Interagency Security Committee Policies, Standards and Best Practices

ISC; standards and best practices for buildings and all non-military Federal facilities

<http://www.dhs.gov/isc-policies-standards-best-practices>

#### Energy Independence and Security Act 2007

<https://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>

#### GSA EO 13423

<http://www.gsa.gov/portal/content/102452>

# Appendix 1 – Documentation

## GSA EO 13693

[http://www.gsa.gov/portal/mediaId/228287/fileName/KK\\_EO\\_13693\\_to\\_GBAC\\_4-23-15\\_Mtg.action](http://www.gsa.gov/portal/mediaId/228287/fileName/KK_EO_13693_to_GBAC_4-23-15_Mtg.action)

## Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding

[https://www.whitehouse.gov/sites/default/files/docs/determining\\_compliance\\_with\\_the\\_guiding\\_principles\\_for\\_sustainable\\_federal\\_buildings\\_february\\_2016.pdf](https://www.whitehouse.gov/sites/default/files/docs/determining_compliance_with_the_guiding_principles_for_sustainable_federal_buildings_february_2016.pdf)

## Historic Masonry Structures, Conference papers

<http://www.hms.civil.uminho.pt/ibmac/>

## HPS Standards and Guidelines

<http://www.nps.gov/tps/standards/four-treatments.htm>  
[http://www.nps.gov/history/local-law/arch\\_stnds\\_8\\_2.htm](http://www.nps.gov/history/local-law/arch_stnds_8_2.htm)

## International Building Codes

<http://publicecodes.cyberregs.com/icod/index.htm>

## NHPA 1966

<http://www.achp.gov/nhpa.html>

## SOI's Standards and Guidelines for the Rehabilitation of Historic Properties

<https://www.nps.gov/tps/standards.htm>

## Protective Glazing Council

<http://protectiveglazing.com/resources/110-2/>