NORFOLK DISTRICT
US Army Corps of Engineers

EPACT 2005

Matt Hinson PE
North Atlantic Division,
NAD Regional Technical Specialist,
Mechanical Engineering

757-201-7302
matt.hinson@us.army.mil

Handouts of this presentation available

Guidance Impact on Army MILCON

- In current Army MilCon Transformation (MT) RFPs:
  - 30% better requirement which requires analysis of baseline building, determination of design energy target, and analysis of as-designed building for each project
  - Building envelope tightness requirement (0.25 cfm/ft^2 of envelope area at 0.3 inch wg (75Pa))
  - Requirement to perform blower door test and thermography on completed construction
  - Results from Army EPACT study (discussed next) for UEPH and TEMF

Army EPACT Study

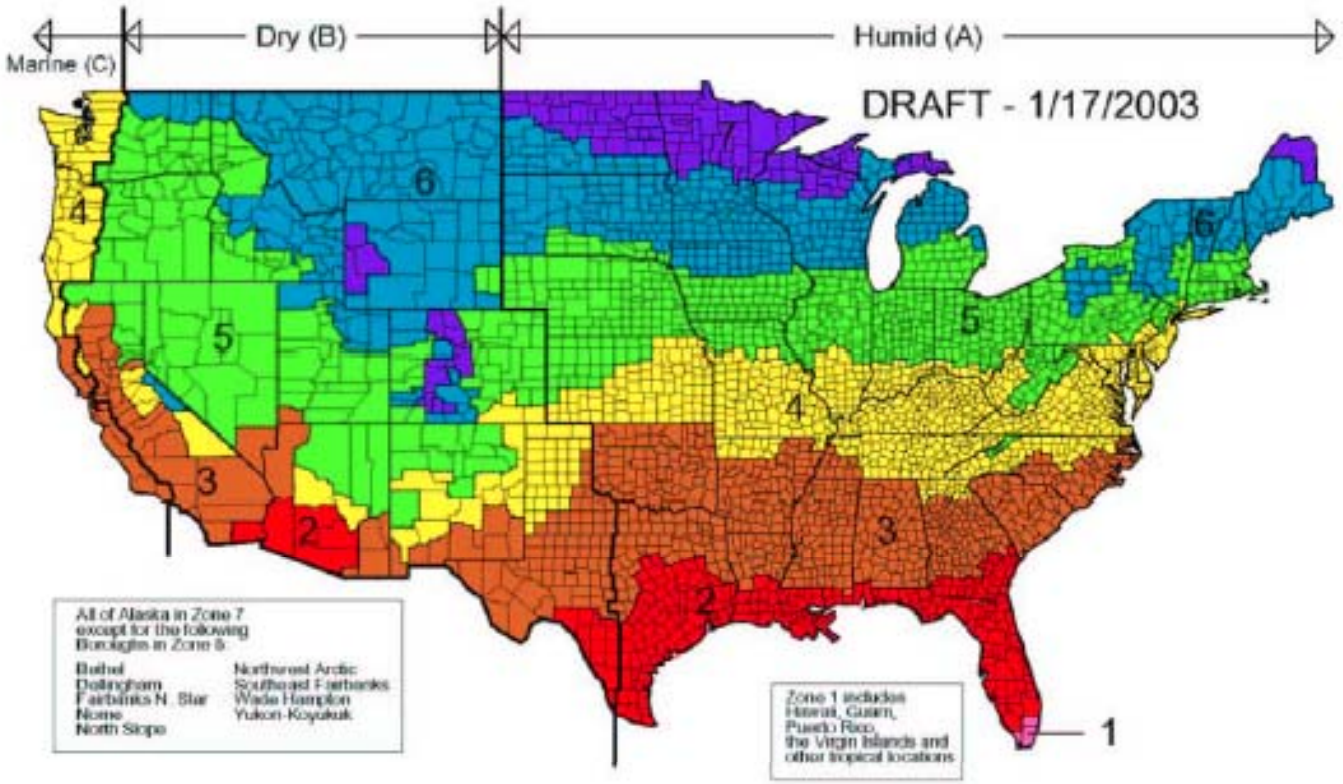
- Funded by OACSIM
- Being performed by partnership of HQ USACE, Corps District COSs, ERDC/CERL, NREL, and ASHRAE
- Goals:
  - To develop specific Army RFP guidance on compliance with EPACT 2005 for Tier 1 Army facilities
    - Original funded project is for UEPH, Training Barracks, BHQ, and TEMF
    - Follow-on project now funded for DFAC, CDC, COF, Reserve Centers
  - To ensure effective/easy compliance with EPACT 2005 in all Army MILCON projects

Army EPACT Study

- Developing “Design Energy Targets” and “Design Guides” to achieve 30% savings compared to ASHRAE Standard 90.1-2004 in fifteen climate locations for the eight most common new Army facility types currently being constructed (UEPH, Training Barracks, BHQ, TEMF, DFAC, CDC, COF, and Reserve Centers
- Based on energy consumption NOT energy cost

DOE U.S. Climate Zones

Figure 3-1: Climate Zone Map



Locations

Climate Zone	City	HDD (Base65ºF)	CDD (base 50ºF)
1A	Miami, FL	200	9474
2A	Houston, TX	1599	6876
2B	Phoenix, AZ	1350	8425
3A	Memphis, TN	3082	5467
3B	El Paso, TX	2708	5488
3C	San Francisco, CA	3016	2883
4A	Baltimore, MD	4707	3709
4B	Albuquerque, NM	4425	3908
4C	Seattle, WA	4908	1823
5A	Chicago, IL	6536	2941
5B	Colorado Springs, CO	6415	2312
6A	Burlington, VT	7771	2228
6B	Helena, MT	7699	1841
7A	Duluth, MN	9818	1536
8A	Fairbanks, AK	13940	1040

Expected Results For Each Facility Type

- Table of Design Energy Targets that specify the energy consumption (in BTU/Ft^2-yr) to achieve 30% reduction compared to a 90.1-2004 design for each facility type and location
- A table (design guide) showing one prescriptive path for achieving at least a 30% energy savings in an LCC effective manner for each facility type and location
- MT RFP language to implement above

Original EPACT “30% Better Compliance Path

- Perform energy and LCC analysis for both a baseline (just meets minimums of ASHRAE 90.1-2004) facility and the specific custom designed facility and show that the required 30% energy reduction is achieved in LCC effective manner

Two New Compliance Paths for A Specific MILCON Project

- Perform energy and LCC analysis for specific custom design and show that the specified design energy target is achieved in LCC effective manner

Or

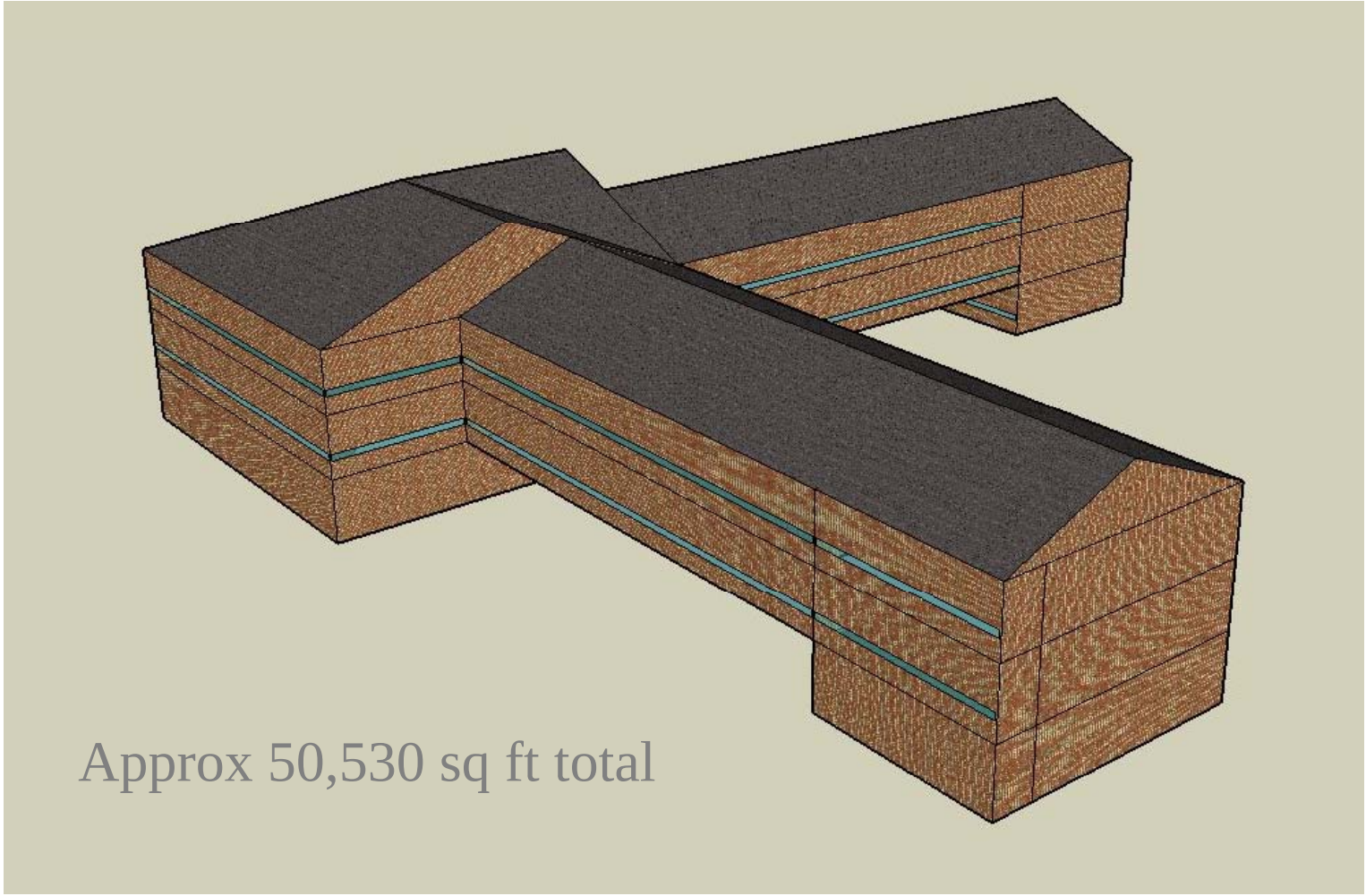
- Follow prescriptive table for the building type/location and no further analyses required

Three Compliance Paths

<table>
<tr><th>Path 1</th><th>Path 2</th><th>Path 3</th></tr>
<tr><td>ASHRAE Standard 90.1-2004 Mandatory Requirements</td><td>ASHRAE Standard 90.1-2004 Mandatory Requirements</td><td>ASHRAE Standard 90.1-2004 Mandatory Requirements</td></tr>
<tr><td>ASHRAE Standard 90.1-2004 Prescriptive Requirements</td><td rowspan="2">US Army Performance Targets</td><td rowspan="3">US Army Prescriptive Requirements

No calcs required</td></tr>
<tr><td>Achieve 30% Better Performance</td></tr>
<tr><td>ASHRAE Standard 90.1-2004 Appendix G calcs For baseline and Custom facility</td><td>ASHRAE Standard 90.1-2004 Appendix G calcs For Custom facility only</td></tr>
</table>

Training Barracks Analysis



Approx 50,530 sq ft total

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Training Barracks Design Energy Targets

Climate Zone	City	Energy Budget (kBtu/ft^2)	
		ASHRAE 90.1-2004 Building	EPACT 2005 Target Building
1A	Miami, FL	120	84
2A	Houston, TX	119	83
2B	Phoenix, AZ	69	48
3A	Memphis, TN	122	85
3B	El Paso, TX	76	53
3C	San Francisco, CA	96	67
4A	Baltimore, MD	135	95
4B	Albuquerque, NM	93	65
4C	Seattle, WA	117	82
5A	Chicago, IL	146	102
5B	Colorado Springs, CO	111	78
6A	Burlington, VT	159	111
6B	Helena, MT	133	93
7A	Duluth, MN	176	123
8A	Fairbanks, AK	225	158

TRAINING BARRACKS Climate Zone 3A Government Furnished Example Technology Set

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Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Prescriptive Bldg
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Floors	Mass	R-6.3 c.i.	R-10 c.i.
Slabs	Unheated	NR [2]	NR [2]
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa [3]
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.31

TRAINING BARRACKS Climate Zone 3A
Government Furnished Example Technology Set (cont)

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Item	Component	ASHRAE 90.1-2004 Bldg	Gov Furnished Example Bldg
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS $_4$ with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness

TRAINING BARRACKS Climate Zone 3A
Government Furnished Example Technology Set (cont)

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Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Economizer Ventilation		NR	NR
	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
Ducts	Laundry Room		Decoupled [5]
	Sealing		Seal class B
	Location		Interior only
Service Water Heating	Insulation level		R-6 [6]
	Gas storage	80% E_t	90% E_t
	Drain Water Heat Recovery	None	Showers only - 30% effic [7]

Current Status of Army Study

- UEPH and TEMF complete with results implemented in Army MT RFP
- Complete, reviewed results for training barracks and BHQ ready for implementation in MT RFP
- DFAC, COF, CDC, and Reserve center studies in progress

LEED bonus from Study

- All Army facilities must achieve LEED Silver
- Most Army facilities will be self certified
- Current Army RFP guidance says results of EPACT compliance may be used directly for LEED EA1 energy credit determination without further calculations for all self certified facilities

Army Path to meet EPACT 2005 for New Construction

(UEPH and TEMF results included)

Outline

- MT RFP changes/requirements for ALL new Army facilities as a result of EPACT 2005
- Army EPACT Study Overview
- Study results for UEPH and TEMF
- MT RFP revisions to implement alternate Army compliance paths for EPACT 2005 30% Better

EPAct Impact on Army MILCON

In RFPs since FY07 for ALL new Army facilities:

- 30% better requirement
- LEED credit calculation adjustment
- Energy Star equipment requirement
- Building air tightness requirement

In RFPs since FY08:

- Alternate Army compliance paths for 30% better for UEPH and TEMF from Army EPACT study

Coming soon:

- Alternate Army compliance paths for BHQ, Training Barracks, DFAC, CDC, COF, & Reserve Centers

“30% Better” Requirement in RFP

011000 Par 5 General Technical, Section 5.9:

5.9 ENERGY CONSERVATION

5.9.1 Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 30% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

“30% Better” Requirement in RFP

013316 Design After Award, Section 3.5.5:

3.5.5. Energy Conservation:

Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must include calculations which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. The calculation methodology used

“30% Better” Requirement in RFP

for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1-2004, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated

“30% Better” Requirement in RFP

for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Laboratory fume hoods and kitchen ventilation loads are to be included in the energy calculation and are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

LEED Credit Calculation Adjustment

013316 Design After Award, Section 3.5.4:

3.5.4 LEED Documentation

3.5.4.1 EPACT Compliance Calculations

EPACT compliance is measured as a percentage reduction in energy use. LEED Optimize Energy credit points are earned based on percentage reduction in energy cost. If the project DOES NOT require USGBC certification, it may substitute the EPACT energy use reduction percentage for energy cost reduction percentage to determine the LEED Optimize Energy points earned and it may substitute EPACT calculations for LEED calculations for this credit.

LEED Credit Calculation Adjustment

If the project DOES NOT require USGBC certification and Section STATEMENT OF WORK includes a prescriptive path option for EPACT compliance for a building type, each building of that type that complies fully with its prescriptive path option may take the LEED Optimize Energy points that correspond to the energy use reduction percentage stated by the prescriptive path and LEED supporting calculations are not required. Projects that require USGBC certification must earn Optimize Energy points in accordance with LEED and must provide LEED supporting calculations (energy cost reduction) for this credit.

Energy Star Equipment Requirement

011000 Par 5 General Technical, Section 5.9.2:

The contractor shall purchase Energy Star or FEMP designated products. The term “Energy Star product” means a product that is rated for energy efficiency under an Energy Star program. The term “FEMP designated product” means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

Building Air Tightness in RFP

In current RFPs for ALL new Army facilities:

- Continuous air barrier requirement
- Requirement to perform pressure test on completed construction to verify building envelope air tightness is .25 cfm/ft^2 of envelope area at 0.3 inwg (75Pa) or less
- Requirement to perform thermography on completed construction to verify envelope integrity

Building Air Tightness in RFP

011000 Par 5 General Technical, Section 5.5.2:

BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT. Design and construct the building envelope for office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings.

Building Air Tightness in RFP

011000, Section 5.5.2 (cont):

- Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints.
- The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3” wg [0.02 L/s.m2 @ 75 Pa] when tested in accordance with ASTM E 2178
- Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.
- Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure.

Building Air Tightness in RFP

011000, Section 5.5.2 (cont):

- Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly.
- The air barrier must be durable to last the anticipated service life of the assembly.
- Do not install lighting fixtures with ventilation holes through the air barrier
- Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers such as at elevator shafts .

Building Air Tightness in RFP

011000, Section 5.5.2 (cont):

- Damper and control to close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc when leakage can occur during inactive periods.
- Compartmentalize garages under buildings by providing air-tight vestibules at building access points.
- Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

Pressure Testing in RFP

011000, Section 5.5.2.12:

Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

(a) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25 cfm/ft2 at a pressure differential of 0.3” w.g.(75 Pa) in accordance with ASTM’s E 779 (2003) or E-1827-96 (2002). Accomplish tests using either pressurization or depressurization or both. Divide the volume of air leakage in cfm @ 0.3” w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building,including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3” w.g. (L/s.m2 @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

Thermography Testing in RFP

011000, Section 5.5.2.12 (cont):

(b) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above.

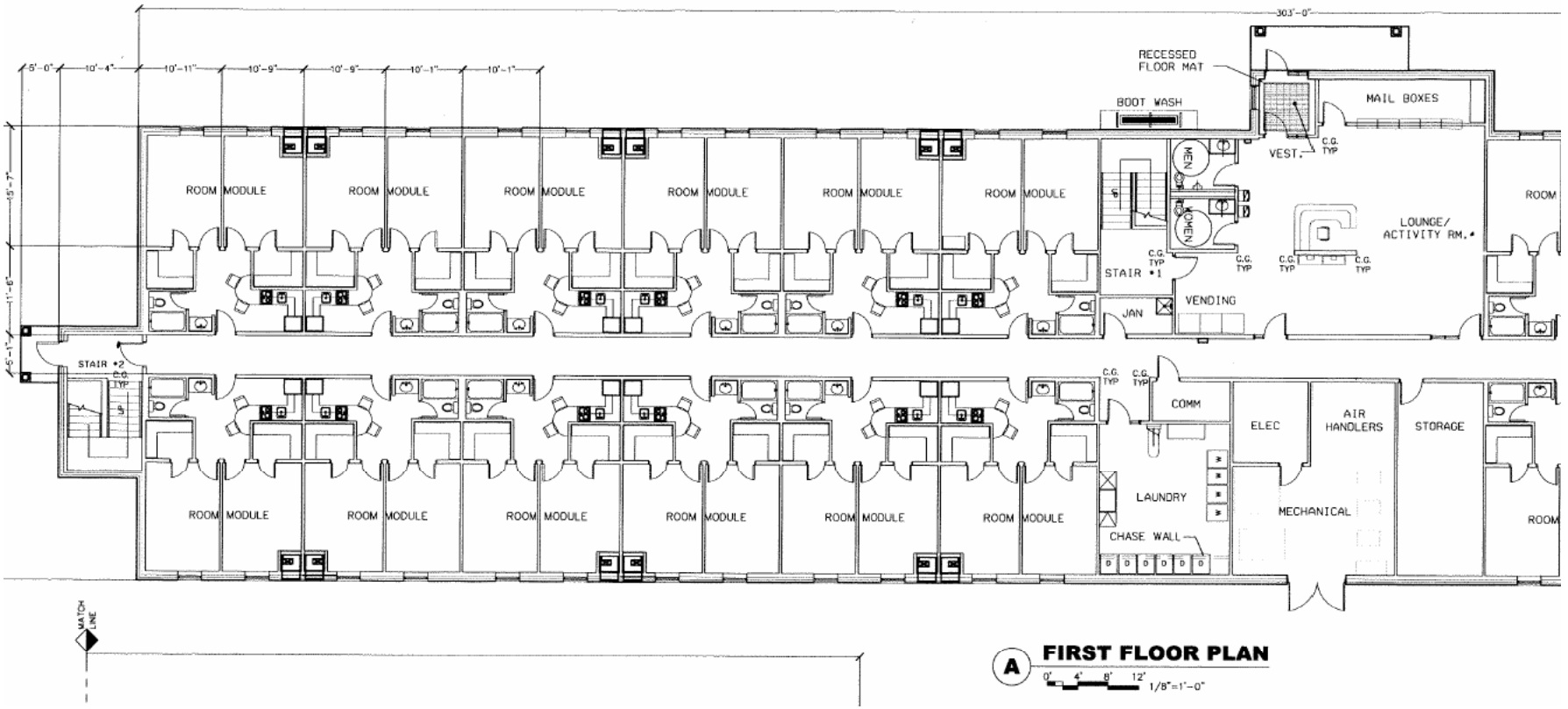
(c) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

UEPH Analysis

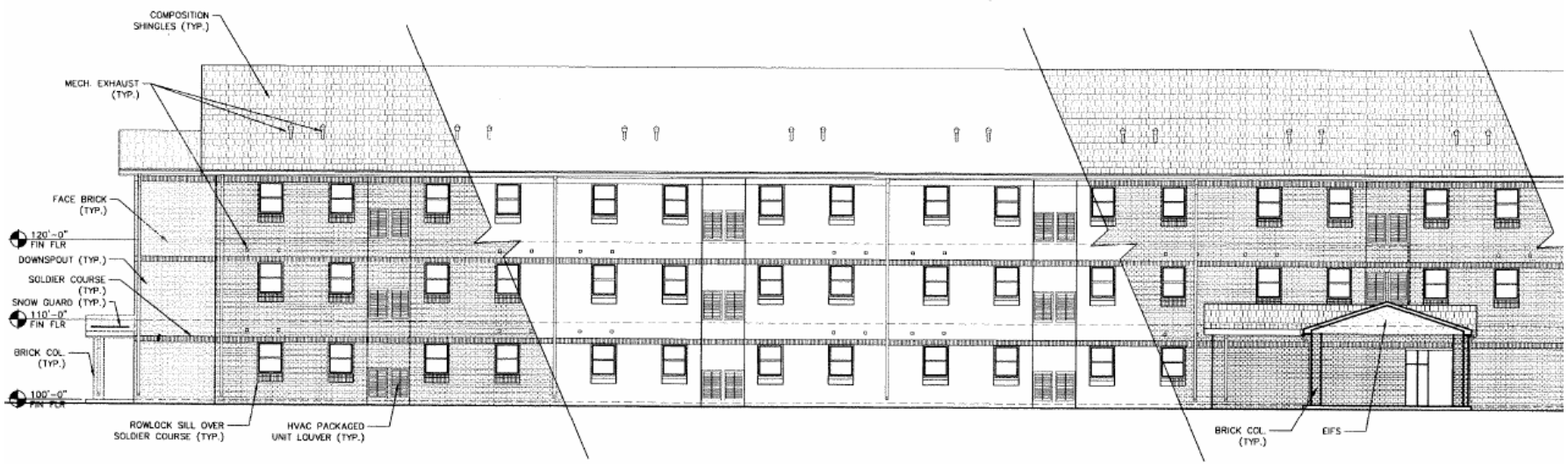
Unaccompanied Enlisted Personnel Housing

- Standard UEPH Design provided by Corps Center Of Standardization - Ft Worth District
- Baseline (90.1-2004) assumptions provided by ASHRAE advisory committee
- Schedule assumptions and new technology suggestions provided by ERDC-CERL
- Analyses performed by NREL using EnergyPlus

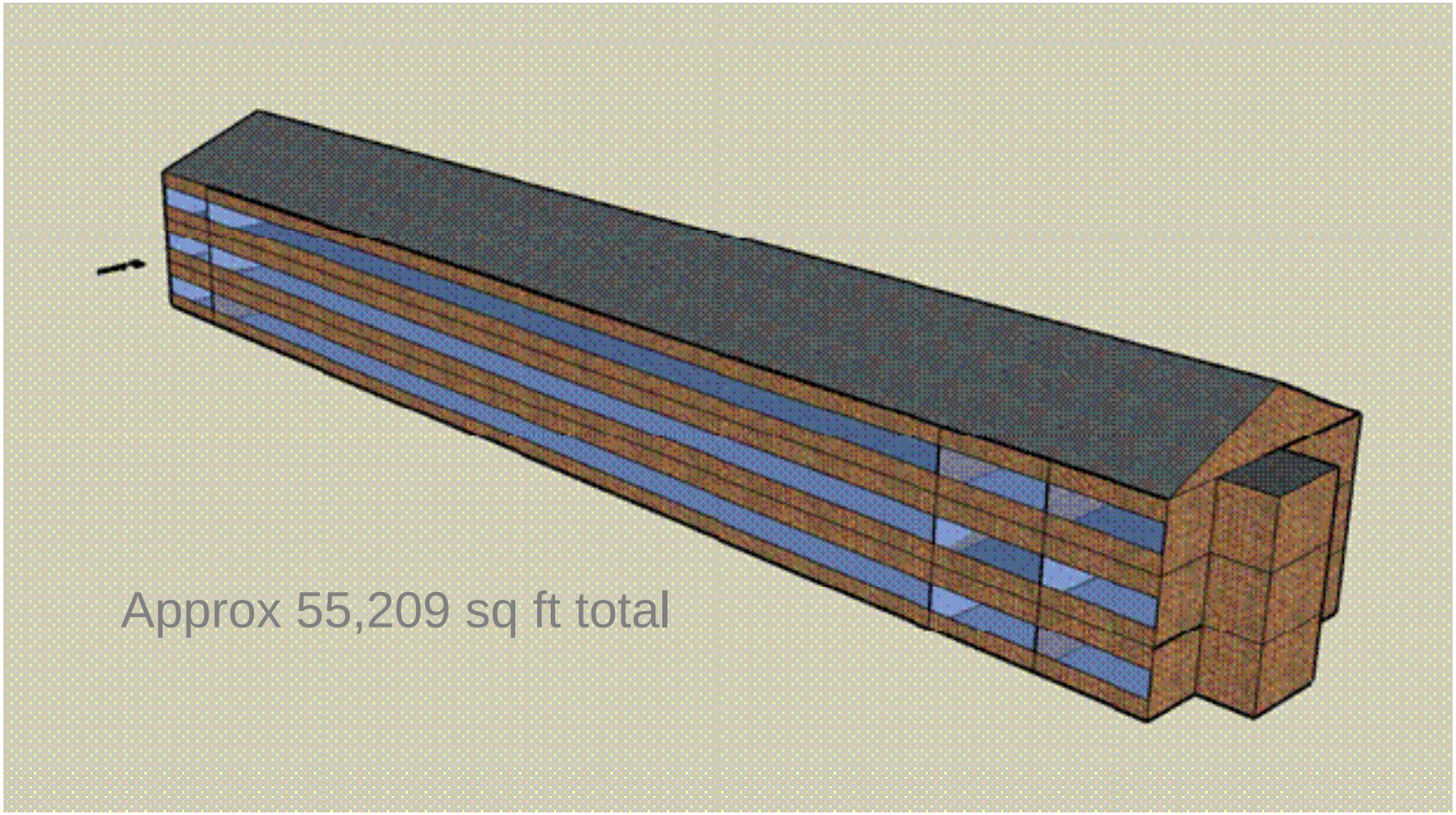
UEPH First Floor Plan



UEPH Elevation



UEPH EnergyPlus Rendering



Model Assumptions

Parameter	Baseline Model	Energy Efficient Model
Orientation	Set to 0º	Same as baseline
Windows	20% window-to-wall ratio	Same as baseline
Wall Construction	Steel frame	Same as baseline
Roof Construction	Flat roof with insulation entirely above deck	Naturally vented attic with the insulation at the ceiling level
Infiltration	0.4 cfm/ft^2 @ 75 Pa (proposed Standard 90.1 -2004 addendum Z)	0.25 cfm/ft^2 @ 75 Pa (proposed Army standard)
Ventilation	Make up for bathroom exhaust at 90 cfm plus flow for building pressurization to 5 Pa at the baseline infiltration rate	Make up for bathroom exhaust at 90 cfm plus flow for building pressurization to 5 Pa at the proposed Army infiltration rate

Model Assumptions

	0.4 cfm/ft^2	0.25 cfm/ft^2
ACH at 75 Pa	1.51	0.62
ACH at 5 Pa	0.22	0.09
Excess ventilation flow at 5 Pa (cfm)	2,950	1,211
Excess ventilation flow at 5 Pa (L/s)	1,392	572

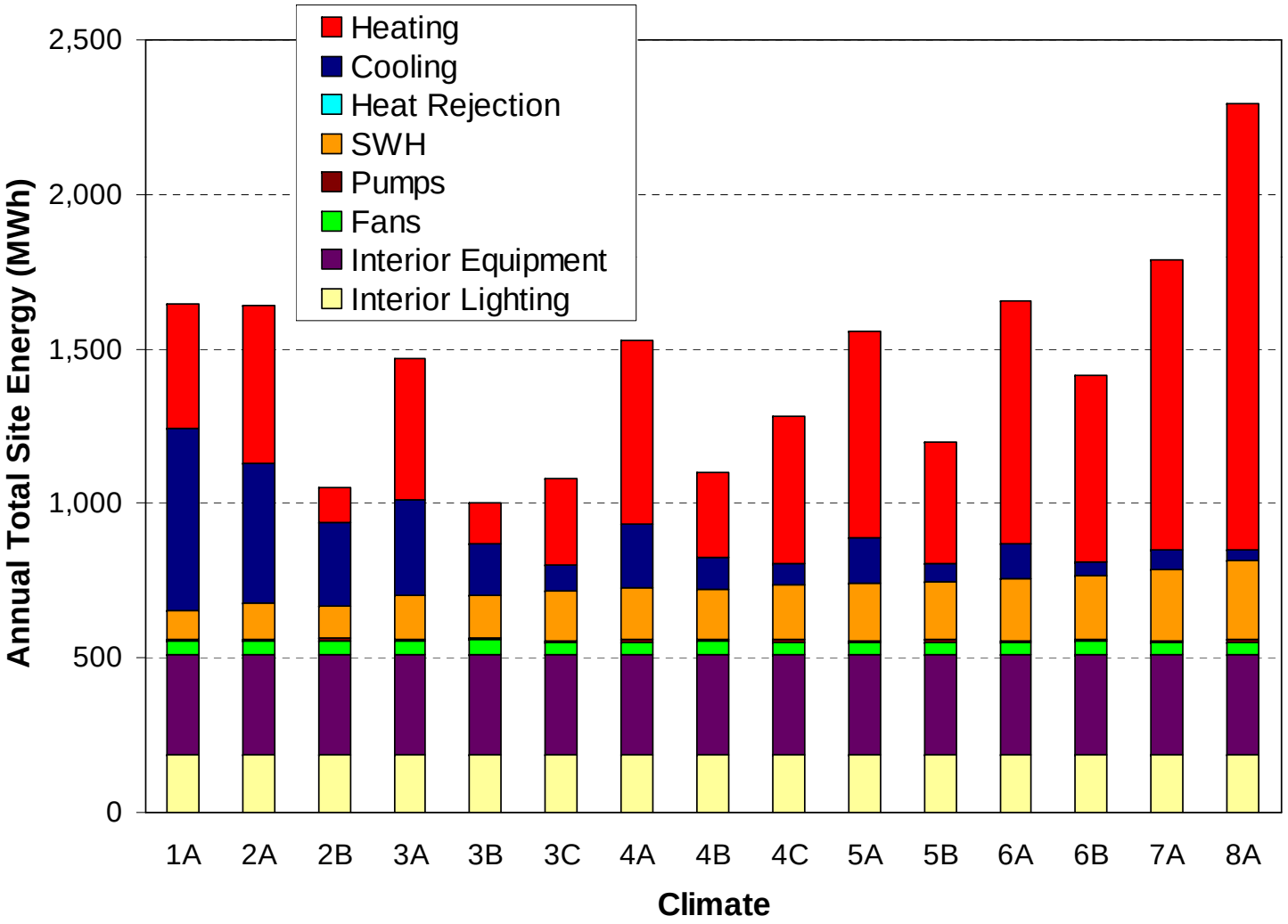
Model Assumptions

Parameter	Baseline Model	Energy Efficient Model
Temp set points	70 heating; 75 cooling with no setback	Same as baseline
Humidity Control	Zone humdistat at 50% RH	Humidity controlled with DOAS with room cooling coil temperature control
Interior Lighting	1.1 W/ft^2 in the rooms, 0.5 W/ft^2 in the corridors	0.9 W/ft^2 in the rooms, 0.45 W/ft^2 in the corridors
Plug loads	1.7 W/ft^2 plus refrigerator and range (See schedules in Appendix A)	Same as baseline
Hot Water Load	See calculations in report	Same as baseline with grey water heat recovery
Schedules	See Tables in RFP	Same as baseline

UEPH Design Energy Targets

Climate Zone	City	Energy Budget (kBtu/ft^2)	
		ASHRAE 90.1-2004 Building	EPACT 2005 Target (no plug loads)
1A	Miami, FL	82	58
2A	Houston, TX	82	57
2B	Phoenix, AZ	45	32
3A	Memphis, TN	71	50
3B	El Paso, TX	42	30
3C	San Francisco, CA	47	33
4A	Baltimore, MD	75	52
4B	Albuquerque, NM	48	34
4C	Seattle, WA	60	42
5A	Chicago, IL	77	54
5B	Colorado Springs, CO	54	38
6A	Burlington, VT	83	58
6B	Helena, MT	68	47
7A	Duluth, MN	91	64
8A	Fairbanks, AK	123	86

UEPH Energy Consumption by End Use



Energy Conservation Measures

	Baseline Models	Efficient Models
Wall Insulation	Standard 90.1-2004	Higher R-Values (see RFP)
Roof Insulation	Standard 90.1-2004	Higher R-Values (see RFP)
Roof Solar Reflectance	0.08	0.27
Window-to-Wall Ratio	20%	20%
Window Construction	Standard 90.1-2004	ASHRAE AEDG 30% Small Offices
Infiltration	0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa
Ventilation	Exhaust plus make-up air for infiltration at 5 Pa	Same as baseline but reduced make-up air for the tighter building

Energy Conservation Measures

	Baseline Models	Efficient Models
Lighting	1.1 W/ft^2 in rooms, 0.5 in corridors, 0.6 in stairwells	0.9 W/ft^2 in rooms, 0.45 in corridors, 0.54 in stairwells
SWH Boiler Efficiency	80%	95%
Grey water heat recovery	None	Assumed 30% savings on shower hot water
HVAC Systems	Packaged Single Zone with DX coil (3.05 COP) for cooling and natural gas coil (80% efficient) for heating	DOAS with DX coil (3.5 COP) and ERV (75%-70% sensible effectiveness) and hot water coil, 4-pipe fan coil with central chiller and boiler

Energy Efficient Solution Results

Zone	City	ASHRAE 90.1-2004 Building Energy Budget (kBtu/ft^2)	EPACT 2005 Building Energy Budget (kBtu/ft^2)	Government Furnished Example Technology Solution SET to meet EPACT 2005	
				Energy Budget (kBtu/ft^2)	Energy Savings Versus ASHRAE Bldg
1A	Miami, FL	82	58	40	51%
2A	Houston, TX	82	57	37	55%
2B	Phoenix, AZ	45	32	32	30%
3A	Memphis, TN	71	50	35	51%
3B	El Paso, TX	42	30	30	30%
3C	San Francisco, CA	47	33	26	45%
4A	Baltimore, MD	75	52	32	57%
4B	Albuquerque, NM	48	34	29	40%
4C	Seattle, WA	60	42	27	55%

Energy Efficient Solution Results

Zone	City	ASHRAE 90.1-2004 Building Energy Budget (kBtu/ft^2)	EPACT 2005 Building Energy Budget (kBtu/ft^2)	Government Furnished Example Technology Solution SET to meet EPACT 2005	
				Energy Budget (kBtu/ft^2)	Energy Savings Versus ASHRAE Bldg
5A	Chicago, IL	77	54	32	58%
5B	Colorado Springs, CO	54	38	28	48%
6A	Burlington, VT	83	58	32	61%
6B	Helena, MT	68	47	29	57%
7A	Duluth, MN	91	64	33	64%
8A	Fairbanks, AK	123	86	42	66%

UEPH Climate Zone 3A
Government Furnished Example Technology Set

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Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Floors	Mass	R-6.3 c.i.	R-10 c.i.
Slabs	Unheated	NR [2]	NR [2]
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa [3]
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.31

UEPH Climate Zone 3A
Government Furnished Example Technology Set (cont)

DRAFT

Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Interior Lighting	Lighting Power Density (LPD)	1.1W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS [4] with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness

UEPH Climate Zone 3A
Government Furnished Example Technology Set (cont)

DRAFT

Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Economizer Ventilation		NR	NR
	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
Ducts	Laundry Room		Decoupled [5]
	Sealing		Seal class B
	Location		Interior only
Service Water Heating	Insulation level		R-6 [6]
	Gas storage	80% E_t	90% E_t
	Drain Water Heat Recovery	None	Showers only - 30% effic [7]

MT RFP Changes for UEPH in Zone 3A

Section 011000 Par 3 SOW-UEPH, added:

3.3 COMPLIANCE WITH THE ENERGY POLICY ACT OF 2005 (EPACT 2005)

3.3.1 EPACT 2005 REQUIREMENT

The building, including the building envelope, HVAC systems, service water heating, power, and lighting systems shall be designed to achieve an energy consumption that is at least 30% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004 (see paragraph 5.9 Energy Conservation)

MT RFP Changes for UEPH in Zone 3A

011000 Par 5 General Technical, Section 5.9:

5.9 ENERGY CONSERVATION

5.9.1 Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 30% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

MT RFP Changes for UEPH in Zone 3A

Section 011000 Par 3 SOW-UEPH, added:

3.3.2 Target Energy Consumption Budget

The target energy consumption budget for this UEPH is 50 kBTU per ft2 per year or less.

3.3.3 Prescriptive Path (Use of Technology Solution Set)

The technology solution set shown in the table below achieves the above energy performance and life cycle cost effectiveness requirements for a UEPH facility in the indicated DOE climatic zone.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Floors	Mass	R-6.3 c.i.	R-10 c.i.
Slabs	Unheated	NR [2]	NR [2]
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45
Infiltration		0.4 cfm/ft^2 @ 75 Pa	0.25 cfm/ft^2 @ 75 Pa [3]
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%	10% - 20%
	Thermal transmittance	U-0.57	U-0.45
	Solar heat gain coefficient (SHGC)	0.37	0.31

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Interior Lighting	Lighting Power Density (LPD)	1.1 W/ft^2	0.9 W/ft^2
	Ballast		Electronic ballast
HVAC	Air Conditioner	PSZ-AC 12.0 SEER (3.05 COP)	4-Pipe Fan Coil with central chiller and boiler plus DOAS [4] with 14.0 SEER DX coil (3.52 COP) and HHW coil on central boiler SAT control 55ºF – 62ºF with OAT 75º – 54ºF
	Gas Furnace	80% E_t	none
	ERV	None	70% - 75% sensible effectiveness

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

Item	Component	ASHRAE 90.1-2004 Bldg [1]	Gov Furnished Example Bldg
Economizer Ventilation		NR	NR
	Outdoor Air Damper	Motorized control	Motorized control
	Demand Control	NR	NR
Ducts	Laundry Room		Decoupled [5]
	Sealing		Seal class B
	Location		Interior only
Service Water Heating	Insulation level		R-6 [6]
	Gas storage	80% E_t	90% E_t

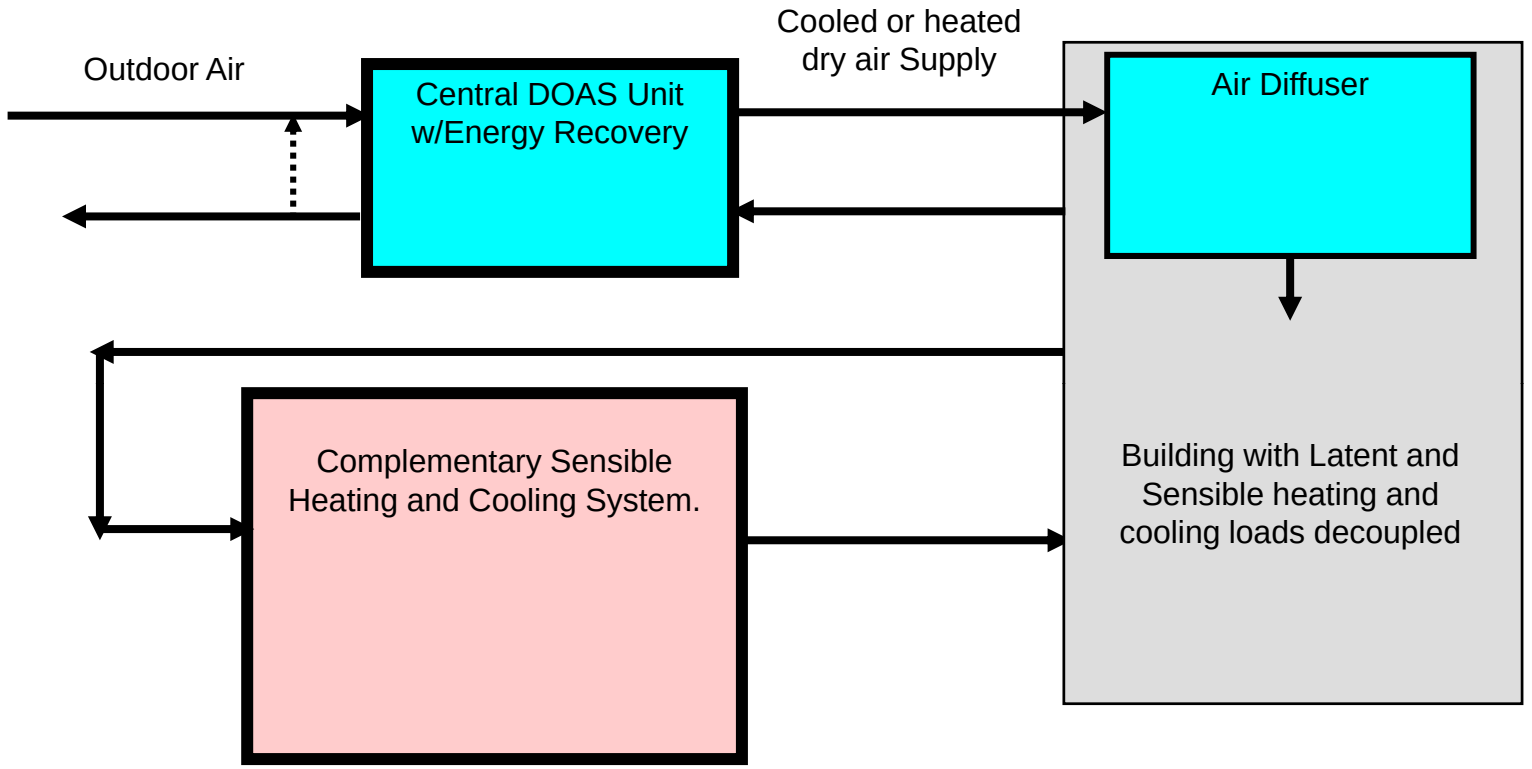
UEPH Climate Zone 3A
Prescriptive Technology Solution Set

Notes:

1. Baseline requirements are from ANSI/ASHRAE/IESNA Standard 90.1-2004.
2. NR means there is no requirement or recommendation for a component in this climate.
3. Increased Building Air tightness. Building air leakage (measured in cfm/ft2) is the average volume of air(measured in cubic feet per minute) that passes through a unit area of the *building envelope* (measured in square feet) when the building is maintained at a specified internal pressure (measured in Pascals). Testing requirements are specified in Chapter 5.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

4. Dedicated Outdoor Air System. A central dedicated outdoor air system (DOAS), provides:
   a) outside air for building indoor air quality and humidity control, (the amount needed is typically less than the amount exhausted from the bathroom and kitchen)
   b) make-up air for bathroom and kitchen exhausts
   c) building pressurization to prevent infiltration which allows for reduction of heating/cooling and moisture loads on the system.



DOAS Schematic

Note: Central DOAS does not provide sensible heating or cooling. Sensible loads are provided by a complementing heating and cooling system.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

5. Decoupling exhaust and supply systems for laundry rooms. To reduce unneeded energy use for heating and cooling of the make-up air and for air transportation of supply and exhausted air from the dryers, laundry exhaust and supply systems are separated in the efficient building model from the rest of the building exhaust and supply systems. Laundry exhaust system and corresponding make-up systems operate only when dryers are operating.
6. The duct and pipe insulation values are from the ASHRAE Advanced Energy Design Guide for Small Offices.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

All design features of this example EPACT 2005 compliant UEPH not described above will be in accordance with the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004, including conformance with paragraph 5.9.2, which requires purchase of Energy Star and FEMP designated products.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

3.3.4 Compliance Path

When the “Compliance Path” is selected, the facility design shall include a uniquely developed technology solution set which can be shown by the design analysis (using facility energy simulation software) not to exceed the target energy consumption budget stated in 3.3.2 above and meet all the criteria in the DOE interim final rule: “Energy Conservation Standards for New Federal Commercial and Multi-Family High-Rise Residential Buildings and New Federal Low-Rise Residential Buildings”.

UEPH Climate Zone 3A
Prescriptive Technology Solution Set

3.3.4.1 SCHEDULES

If a unique technology solution set method of compliance is chosen then the following facility schedules must be used in all facility energy simulations for purposes of showing compliance with 3.3.4. Additionally, for simulation of a baseline building model, the “baseline values” for each component shown in the “Prescriptive Technology Solution Table” shall be used.

UEPH Common Area Internal Load Schedules

Hr	Occupancy			Lighting			Washer/Dryer Use			Washer SHW		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-6	0.00	0.00	0.00	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7-10	0.20	0.20	0.20	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
11-18	0.00	0.00	0.00	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.80	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00
20-21	0.20	0.20	0.20	0.80	0.80	0.80	0.50	0.50	0.50	0.50	0.50	0.50
22-23	0.40	0.40	0.40	0.80	0.80	0.80	1.00	1.00	1.00	1.00	1.00	1.00
24	0.20	0.20	0.20	0.80	0.80	0.80	0.50	0.50	0.50	0.50	0.50	0.50
Peak	5 occ/floor			1.0 W/ft^2 (10.8 W/m^2)			8.4 kW/floor			53.3 gal/hr/flr (202 L/hr/flr)		

UEPH Apartment Unit Internal Load Schedules

Hr	Occupancy			Lighting			Plug Loads			Service Hot Water		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-5	0.80	0.75	0.75	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00
6	0.70	0.65	0.75	0.40	0.30	0.20	0.20	0.20	0.20	0.10	0.10	0.10
7	0.60	0.60	0.70	0.70	0.50	0.30	0.40	0.35	0.20	0.40	0.40	0.40
8	0.50	0.50	1.00	0.50	0.50	0.50	0.40	0.40	0.40	0.20	0.20	0.20
9	0.25	0.25	0.00	0.20	0.20	0.20	0.30	0.40	0.40	0.00	0.00	0.00
10-17	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.00	0.00	0.00
18	0.30	0.30	0.30	0.50	0.50	0.50	0.50	0.50	0.50	0.10	0.10	0.10
19	0.50	0.30	0.30	0.70	0.70	0.70	0.50	0.50	0.50	0.10	0.10	0.10
20	0.50	0.50	0.50	0.70	0.70	0.70	0.60	0.50	0.50	0.10	0.10	0.10
21	0.70	0.50	0.50	0.70	0.70	0.70	0.60	0.50	0.50	0.00	0.00	0.00
22	0.70	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00
23	0.80	0.75	0.75	0.40	0.40	0.40	0.40	0.50	0.50	0.00	0.00	0.00
24	0.80	0.75	0.75	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00
Peak	2 occ/unit			1.1 W/ft^2 (10.8 W/m^2)			1.7 W/ft^2 (18 W/m^2)			40 gal/hr (114 L/hr)		

Hr	Refrigerator			Range and Oven		
	Wk	Sat	Sun	Wk	Sat	Sun
1-6	1.00	1.00	1.00	0.01	0. 01	0. 01
7-16	1.00	1.00	1.00	0.04	0.04	0.04
17-18	1.00	1.00	1.00	0.05	0.05	0.05
19-20	1.00	1.00	1.00	0.11	0.11	0.11
21-23	1.00	1.00	1.00	0.10	0.10	0.10
24	1.00	1.00	1.00	0.03	0.03	0.03
Peak	76.36 W/unit			68.95 W/unit		

UEPH Apartment Unit Thermostat Set-Point Schedules

Hr	Heating (°F)			Heating (°C)			Cooling (°F)			Cooling (°C)		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-24	68	68	68	20	20	20	75	75	75	24	24	24

UEPH Unoccupied Zones (ie stairwells) Thermostat Set-Point Schedules

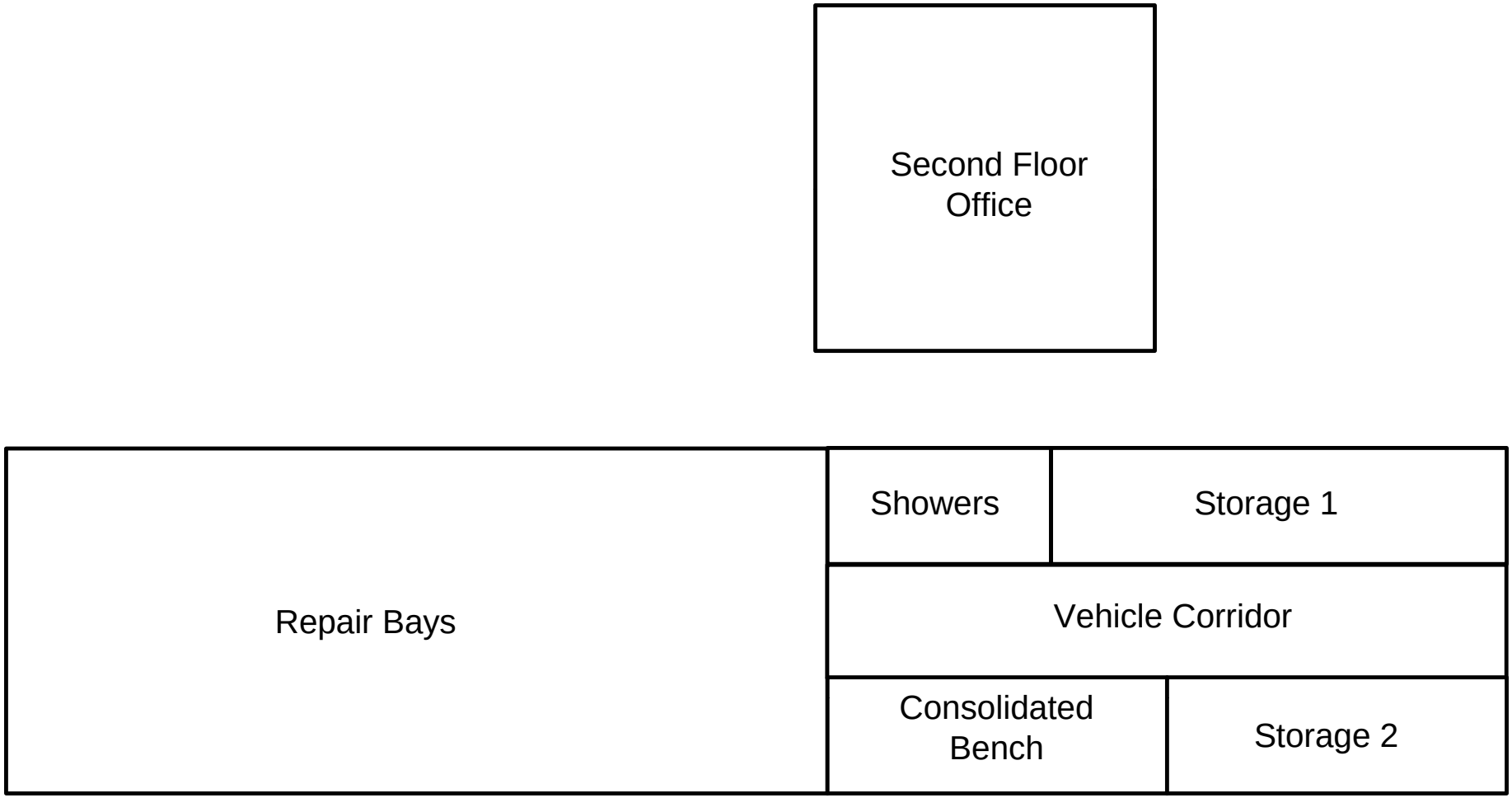
Hr	Heating (°F)			Heating (°C)		
	Wk	Sat	Sun	Wk	Sat	Sun
1-24	55	55	55	12.8	12.8	12.8

TEMF Analysis

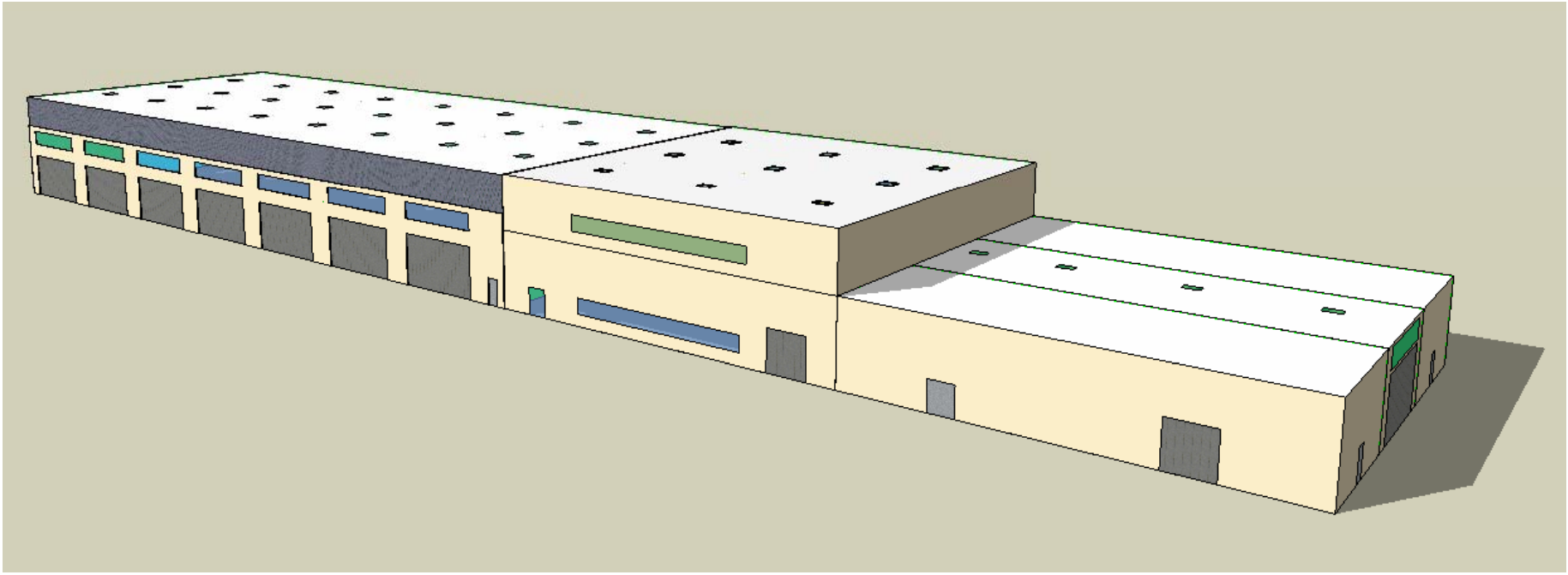
Tactical Equipment Maintenance Facility

- Standard TEMF Design provided by Corps Center Of Standardization - Savannah District
- Baseline (90.1-2004) assumptions provided by ASHRAE advisory committee
- Schedule assumptions and new technology suggestions provided by ERDC-CERL
- Analyses performed by NREL using EnergyPlus

TEMF Zoning


Second Floor
Office
Repair Bays
Showers
Storage 1
Vehicle Corridor
Consolidated
Bench
Storage 2

TEMF EnergyPlus Rendering



Model Assumptions

.	Baseline Building Model	Efficient Building Model
Area	49,920 ft^2 (4,638 m^2)	Same as baseline
Floors	2	Same as baseline
Aspect ratio	4.4	Same as baseline
Fenestration	Standard 90.1-2004	See RFP
Wall construct	steel frame	Metal building
Wall insulation	Standard 90.1-2004 steel frame	See RFP
Roof construct	Flat built up roof	Metal building roof
Roof insulation	Standard 90.1-2004 equal to the “insulation entirely above deck”	See RFP
Roof albedo	0.3	0.65 (CZ 1-5) 0.3 (CZ 6-8)
Infiltration	0.5 ACH	0.5 ACH
Temp set points	70ºF heat; 75ºF cool – set back when unoccupied to 55ºF heating; 91ºF cooling Repair bays, vehicle corridor, and storage 1: 55ºF heating, no cooling	Same as baseline
HVAC	PSZ with DX-AC (3.05 COP) and gas furnace (0.8 E_t); packaged make-up air units for exhaust make-up air and gas fired unit heaters for the repair bays, vehicle corridor, and consolidated bench	See RFP
DHW	Natural gas boiler (0.8 E_t)	Natural gas boiler (0.9 E_t)

Model Assumptions

Zone	Area ft^2 (m^2)	Volume ft^3 (m^3)	People	Lights W/ft^2 (W/m^2)	Equipment W/ft^2 (W/m^2)	Infiltration cfm (m^3/s)
Repair Bay	22,272 (2,069)	757,248 (21,437)	56	0.7 (7.5) 15,590 W	0.75 (8.1) 16,704 W	105 (2.98) 0.5 ACH
Vehicle Corridor	6,144 (571)	122,880 (3,480)	2	0.7 (7.5) 4,300 W	0.25 (2.7) 1,536 W	17.1 (0.483) 0.5 ACH
Showers	2,048 (190)	40,960 (1,160)	4	0.6 (6.5) 1,230 W	0.25 (2.7) 512 W	5.69 (0.161) 0.5 ACH
Storage 1	4,096 (381)	81,920 (2,320)	2	0.9 (9.7) 3,686 W	0.25 (2.7) 1,024 W	11.4 (0.322) 0.5 ACH
Consolidated Bench	3,072 (285)	61,440 (1,740)	12	1.9 (20.5) 5,836 W	1.0 (10.8) 3,072 W	8.53 (0.242) 0.5 ACH
Storage 2	3,072 (285)	61,440 (1,740)	2	0.9 (9.7) 2,765 W	0.25 (2.7) 768 W	8.53 (0.242) 0.5 ACH
Office	9,216 (856)	129,024 (3,651)	36	1.0 (10.8) 9,216 W	0.75 (8.1) 6,912 W	17.9 (0.507) 0.5 ACH
Total	49,920 (4,638)	1,254,912 (35,528)	114	42,624 W	30,528 W	

Baseline Building Outside Air Requirement

Zone	R_p (cfm/person)	R_a (cfm/ft^2)	Total (cfm)	Total (ACH)	Notes
Repair Bay		1.5	33,408	2.6	Exhaust for auto repair room
Vehicle Corridor		1.5	9,216	4.5	Exhaust for auto repair room
Showers		0.25	512	0.8	Exhaust for locker/dressing room
Storage 1		0.12	492	0.4	ventilation for storage room
Consolidated Bench		1.5	4,608	4.5	Exhaust for auto repair room
Storage 2		0.12	369	0.4	ventilation for storage room
Office	5	0.06	733	0.3	ventilation for office space

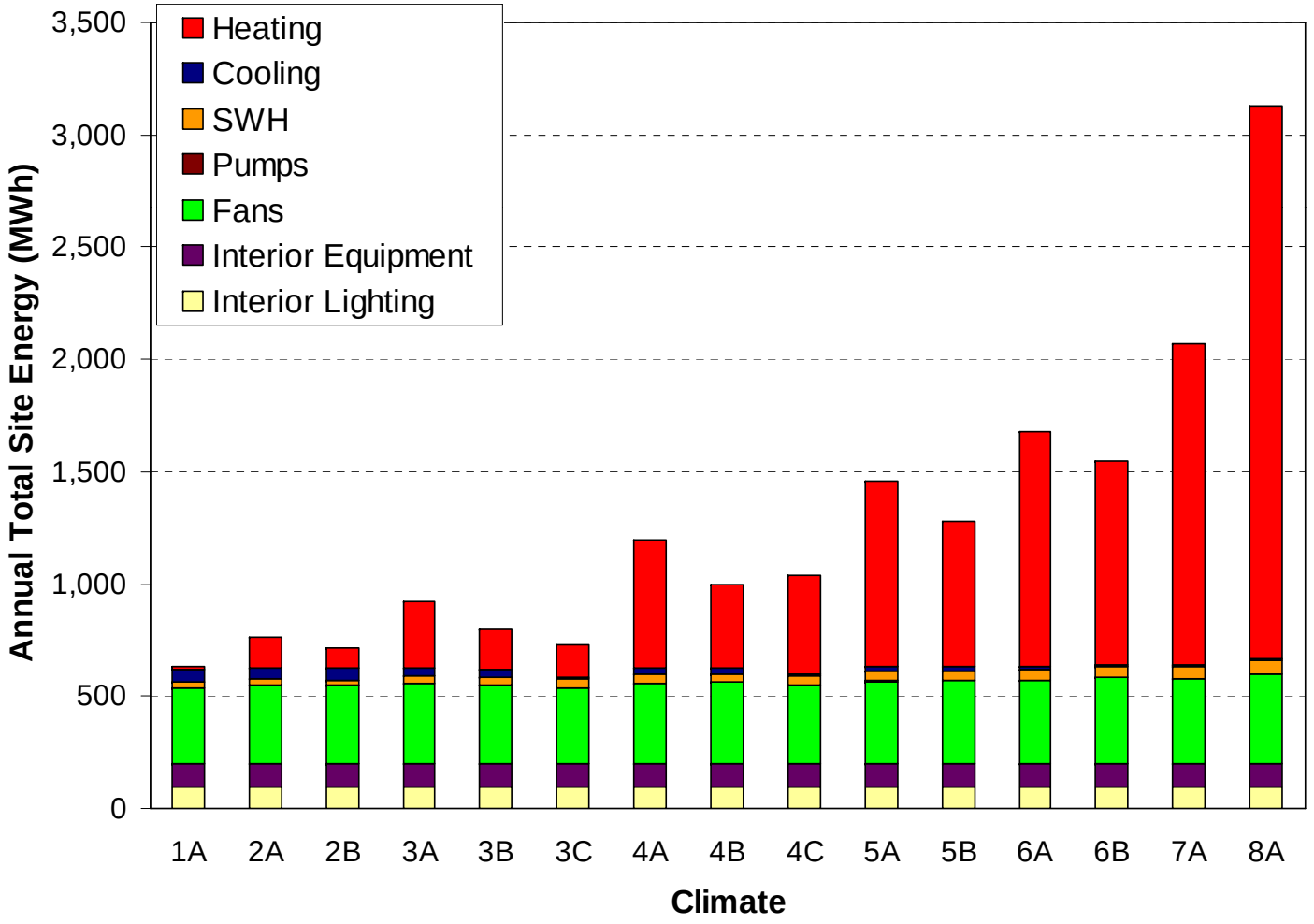
Fan Model Assumptions

System	Flow (m^3/s)	Pressure Rise (Pa)	Baseline Efficiency		Improved Efficiency		ERV Pressure Drop (Pa)
			Fan Motor	Total Fan	Fan Motor	Total Fan	
Repair Bay	15.52	400	0.8	0.27	0.9	0.45	200
Vehicle Corridor	4.28	300	0.8	0.19	0.9	0.45	150
Showers	0.78	250	0.8	0.20	0.85	0.34	
Storage 1	0.54	250	0.8	0.20	0.85	0.34	
Consolidated Bench	2.14	300	0.8	0.19	0.9	0.45	150
Storage 2	1.19	250	0.8	0.20	0.85	0.34	
Office	2.49	250	0.8	0.20	0.85	0.34	
Fan coil units	varies	75	0.8	0.30	0.85	0.34	

TEMF Design Energy Targets

Climate Zone	City	With Plug Loads		Without Plug Loads	
		Baseline Energy Budget (kBtu/ft^2)	Target Energy Budget (kBtu/ft^2)	Baseline Energy Budget (kBtu/ft^2)	Target Energy Budget (kBtu/ft^2)
1A	Miami, FL	43	30	36	25
2A	Houston, TX	52	37	45	32
2B	Phoenix, AZ	49	34	42	29
3A	Memphis, TN	63	44	56	39
3B	El Paso, TX	54	38	47	33
3C	San Francisco, CA	50	35	43	30
4A	Baltimore, MD	82	57	75	52
4B	Albuquerque, NM	68	48	61	43
4C	Seattle, WA	71	50	64	45
5A	Chicago, IL	100	70	93	65
5B	Colorado Springs, CO	87	61	80	56
6A	Burlington, VT	115	80	108	75
6B	Helena, MT	106	74	99	69
7A	Duluth, MN	141	99	134	94
8A	Fairbanks, AK	214	150	207	145

UEPH Energy Consumption by End Use



TEMF ECMs

ECM	Description
Envelope	**Wall and roof insulation for metal buildings and fenestration from the ASHRAE Small Office AEDG (ASHRAE 2004b); insulated overhead doors (R-4), high roof reflectivity for climate zones 1-5 (0.65)**
Lower lighting power density (LPD) and daylighting	**Lower LPD in office (0.9 W ft^2) and consolidated bench (1.3 W/ft^2), daylighting in repair bays, office, and vehicle corridor**
High efficiency office HVAC equip	**increased efficiency of the baseline HVAC system to 3.5 COP and efficient fans**
Radiant floor heating	**Radiant floor heating for the first floor using >90% efficient boiler. R-10 (R-15 for climate zone 8) insulation under slab.**
Transpired Solar Collector	**Transpired solar collector on repair bays**
Energy recovery	**energy recovery on repair bay, vehicle corridor, and consolidated bench exhaust systems. Assumed on sensible heat recovery at 70% to 75% effectiveness.**
Improved vehicle exhaust system in repair bays, vehicle corridor, and consolidated bench	**Close exhaust capture from moving and stationary vehicles results in reduced ventilation requirements (from 1.5 to 0.75 cfm/ft^2)**

NORFOLK DISTRICT
US Army Corps of Engineers

Recommended Energy Conservation Measures by Climate Zones

Zone	City	Improved Envelope	Lighting & Daylighting	High Eff HVAC	Rad Floor Heating	Transpired Solar Collector	Energy Recovery
1A	Miami, FL						
2A	Houston, TX						
2B	Phoenix, AZ						
3A	Memphis, TN						VC & CB
3B	El Paso, TX						VC & CB
3C	San Francisco, CA						VC & CB
4A	Baltimore, MD						VC & CB
4B	Albuquerque, NM						VC & CB
4C	Seattle, WA						VC & CB
5A	Chicago, IL						VC & CB
5B	Col Springs, CO						VC & CB
6A	Burlington, VT						VC & CB
6B	Helena, MT						VC & CB
7A	Duluth, MN						RP, VC, CB
8A	Fairbanks, AK						RP, VC, CB

Include Include but low savings Not Included

Energy Savings (w/o plug loads) Using Recommended Set of Technologies

CZ	City	Baseline (kBtu/ft^2)	Final Energy Efficient Solution (kBtu/ft^2)	Energy Savings
1A	Miami, FL	36	15	59%
2A	Houston, TX	45	19	58%
2B	Phoenix, AZ	42	17	59%
3A	Memphis, TN	56	25	56%
3B	El Paso, TX	47	20	58%
3C	San Francisco, CA	43	17	59%
4A	Baltimore, MD	75	35	53%
4B	Albuquerque, NM	61	27	56%
4C	Seattle, WA	64	29	54%
5A	Chicago, IL	93	45	52%
5B	Colorado Springs, CO	80	36	55%
6A	Burlington, VT	108	54	50%
6B	Helena, MT	99	49	50%
7A	Duluth, MN	134	65	51%
8A	Fairbanks, AK	207	105	49%

TEMF Facility Summit

- Results of study briefed at TEMF Facility Summit in Oct 2007.
- Because of productivity and quality of life concerns, Army decided to mandate the use of many of the recommended technologies in all TEMF regardless of EPACT 2005 considerations.

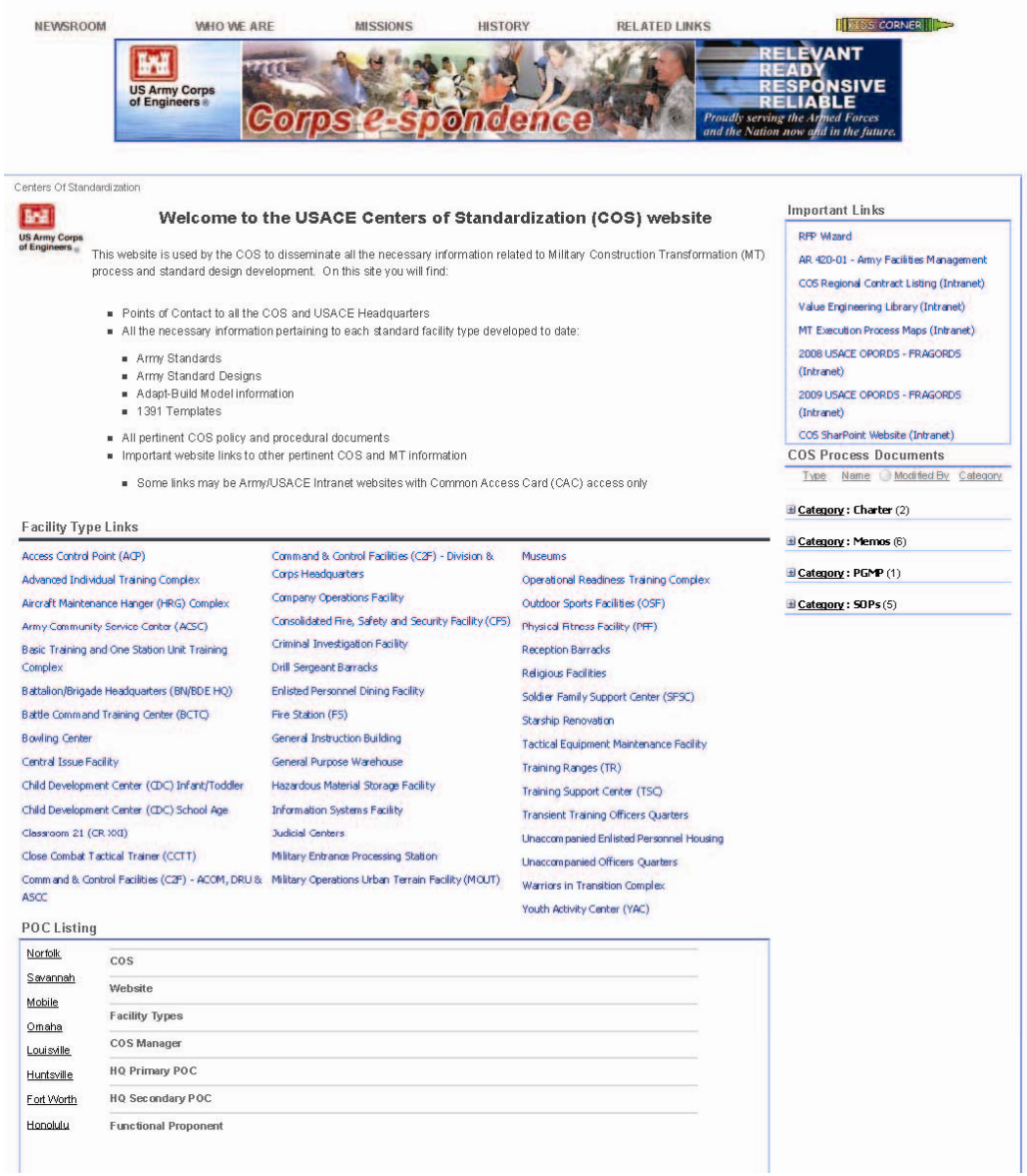
TEMF Facility Summit

- Technologies made mandatory in all new ARMY TEMF included:
  - Improved Vehicle Exhaust Capture
  - Cascading Air Flows From Office to Shop
  - Transpired Solar Collecting “Wall”
  - Radiant Floor Heating
  - Hybrid Lighting
  - Vehicle Entry Vestibule (Preferred)

- Mandatory technologies and EPACT Alternate Compliance Paths for TEMF implemented in RFP in Nov07

- How do I learn more?
  - Local USACE District Office
  - USACE Centers of Standardization

https://eportal.usace.army.mil/sites/COS/Pages/Default.aspx



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Questions?

Matt Hinson PE
US Army Corps of Engineers
Norfolk District
757-201-7302
matt.hinson@us.army.mil

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