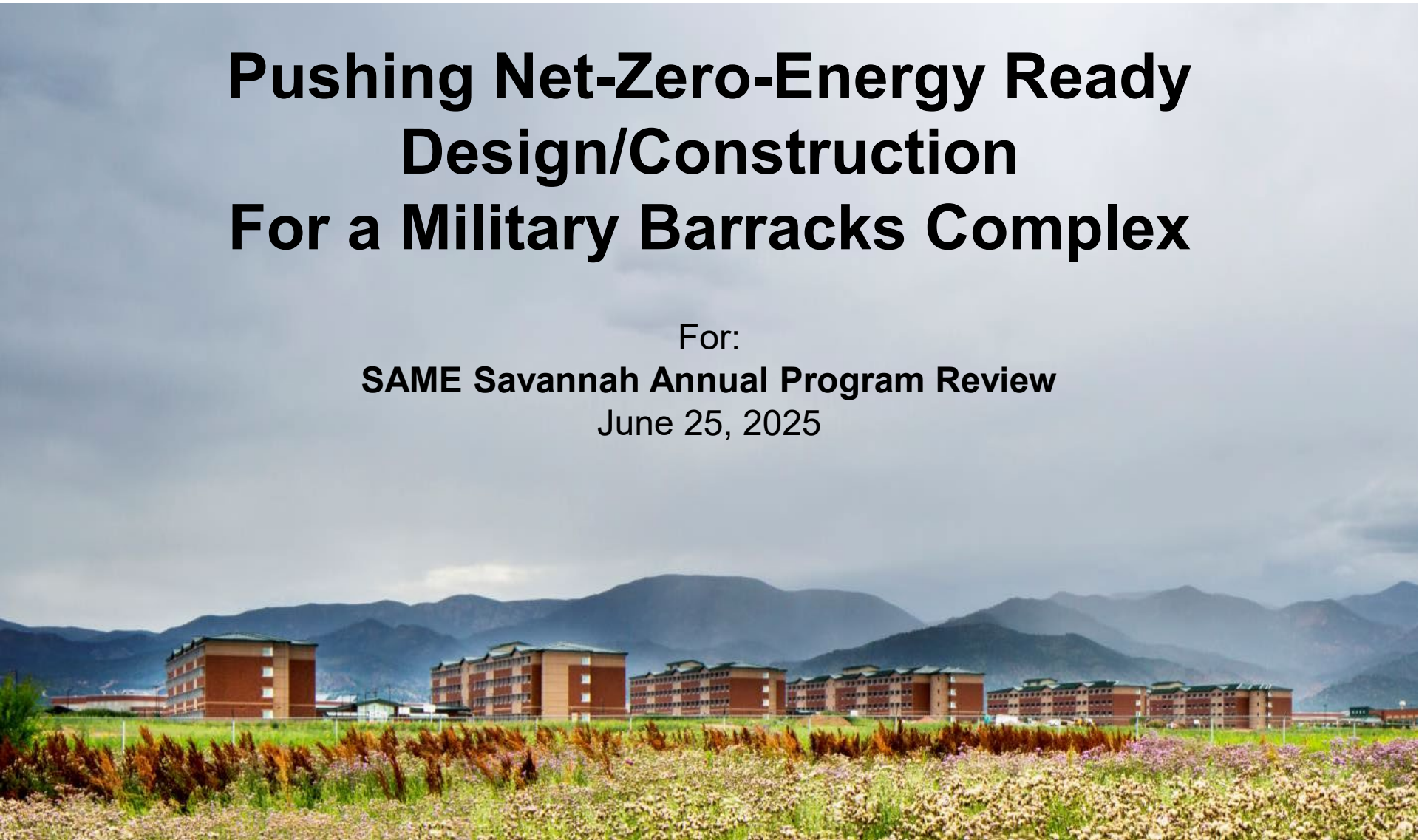


Pushing Net-Zero-Energy Ready Design/Construction For a Military Barracks Complex

For:

SAME Savannah Annual Program Review

June 25, 2025



13th (now known as 4th) CAB Barracks Complex

Fort Carson, CO

Procurement Type:

Design/Build

Design / Construct Agency:

USACE Omaha

Design – Builder:

MORTENSON

Lead Designer of Record:

HDR

Square Footage: 370,156 SF

Design Population: 998 soldiers

Design Start: June 2013

Construction Complete: July 2016

Construction Cost: \$99.6M

LEED Gold Campus





FORT CARSON 4th ID Combat Aviation Brigade



FORT CARSON Net Zero Installation

Net Zero
CAB

Energy Sustainability Net Zero Initiative for the 4ID CAB, Fort Carson

Vision: Plan, design, construct, and operate a NetZero Energy community to encompass the entire Butts Airfield plateau.

Butts Plateau Area Development Strategy: Holistic, integrated approach to energy production and shared efficiency among several buildings

Objective 1: All new vertical construction to be NetZero Ready (or NetZero).

Objective 2: Provide a Central Energy Production Plant and Distribution System (DEP/CEP) as well as other appropriate renewable generation (energy components by facility).

Objective 3: Maximize energy efficiency of existing buildings.

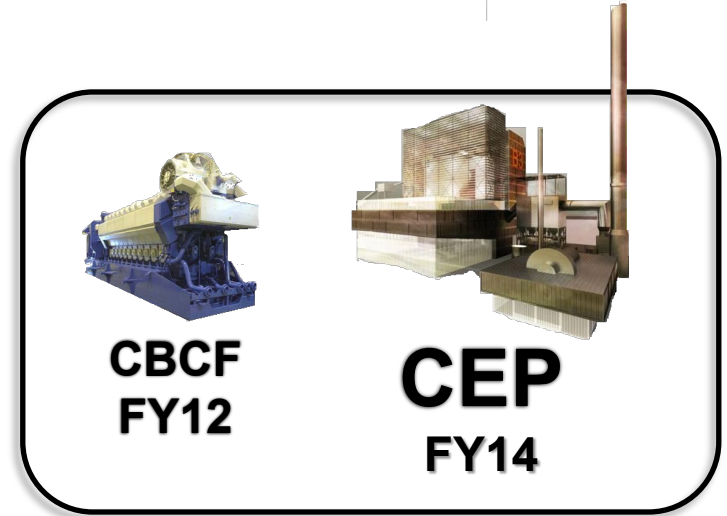
Objective 4: Develop a sustainable community culture.

Expand possible solutions and remove traditional constraints; evaluate solutions that deviate from traditional USACE standards of design.

FORT CARSON

Net-zero Energy Ready Framework

- Employ Passivhaus Standards to Building Envelopes reducing external heat gain/loss
- Seal building envelope reducing infiltration
- Employ high-mass building components
- Install high-efficiency HVAC systems



- Reduce lighting load and plug load through Energy Star appliances
- Employ Renewables after primary energy needs are minimized
- Require 30% Solar Domestic Hot Water and Photovoltaic Panels
- Supply remainder of energy use with Combined Heat and Power Central Energy Plant (CEP) using renewable fuels (biomass, wood waste, digester gas, liquid biofuel)

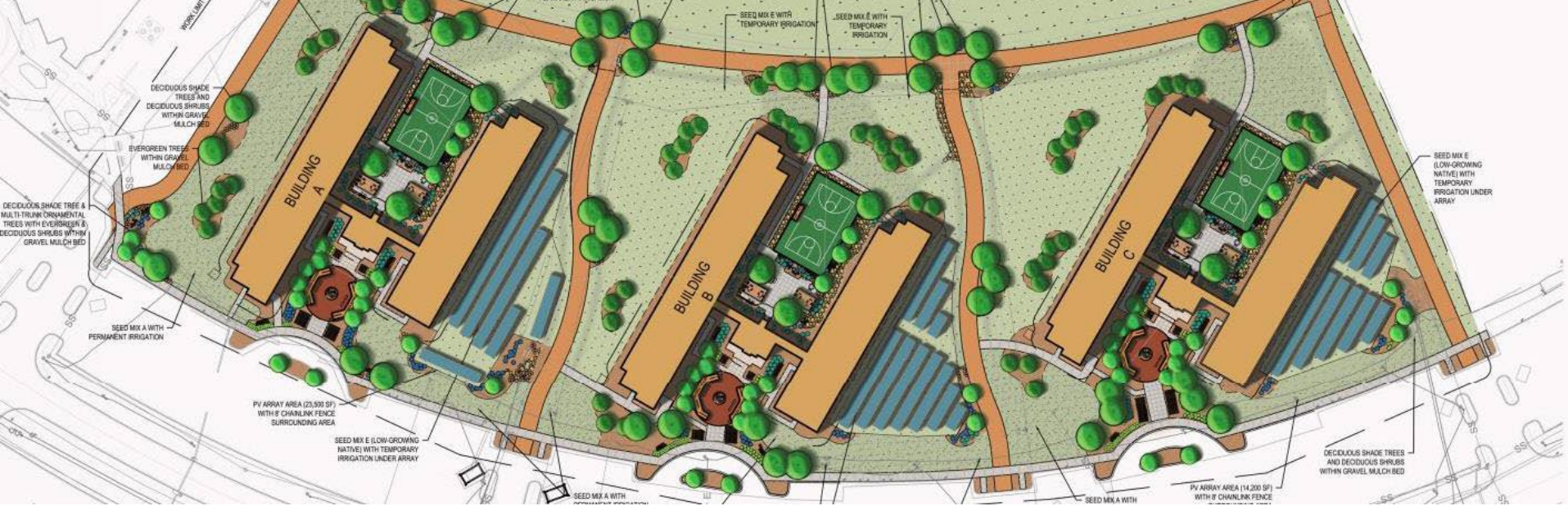


Compliance with Energy Independence and Security Act (EISA) of 2007 target of a 65 percent fossil fuel-generated energy reduction by 2015

“For this study, the German Passivhaus (passive house) standards were used to go beyond the current ASHRAE standards and develop ultra-low energy buildings.”

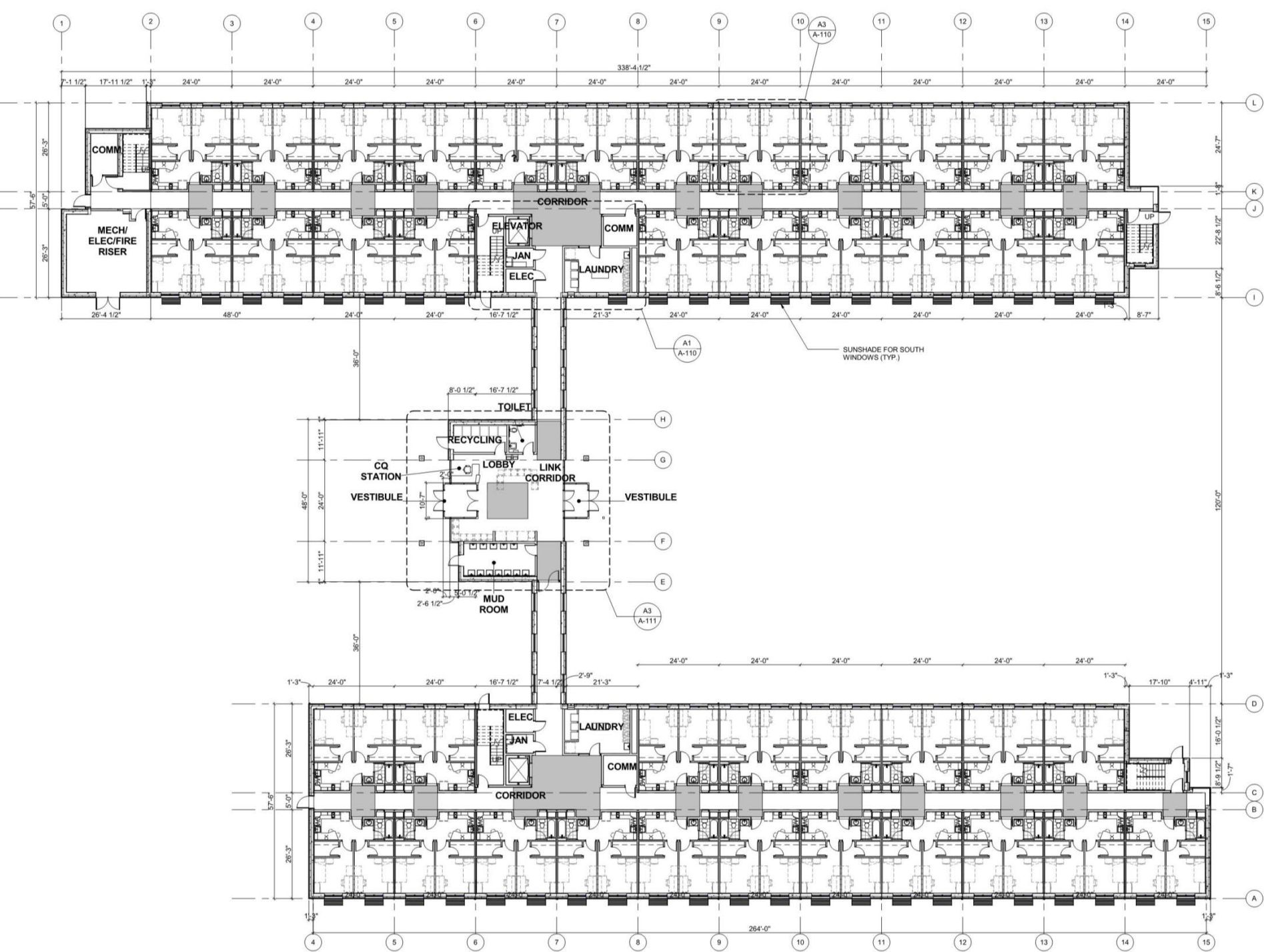
Reduce HVAC loads by:

- *Superinsulate building*
- *Optimal orientation and envelope*
- *Minimize glazing areas*
- *Minimize infiltration*
- *Reduce fan energy*
- *High thermal mass*
- *Radiant heating and cooling*



13th CAB Master Plan





Radiant Heating/Cooling Was Best

14

Table 8. UEPH Energy Efficiency Measures Results (I-P)

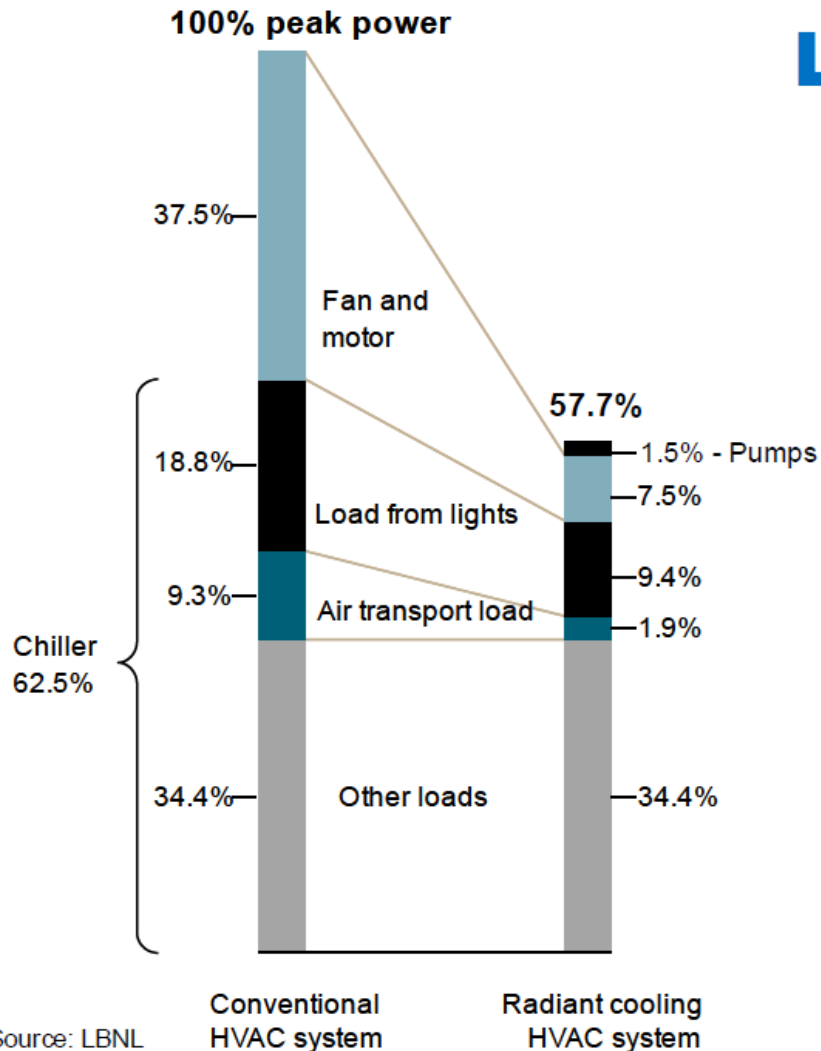
ERV and Radiant with V4

Weather Region	2003 CBECS Dormitory/Fraternity/Sorority Total Source Fuel	EISA 2007 Fossil Fuel Source Energy Target	EISA 2007 Source Target Energy Budget	Baseline Energy Budget	Lighting Load and Electric Power Load Density Reduction EPD from 1.67 W/ft ² to 0.835 W/ft ²	Passive House Insulation Specification; Increased Insulation and Air Tightness; Reduce OA Pressurization Air to 65 dm ³ /s to Air Tightness	Increase Chiller and Boiler Efficiencies and All Variable High Efficiency Pumps and Fans	Reduce HW with 1.5 GPM Shower Heads	Energy Recovery (ERV) with V4	Indirect Evap Pre-Cooling with V4	Radiant Heating and Cooling with V4	ERV and Radiant with V4	ERV and Indirect Evap Pre-Cooling with V4	ERV, IDEC, and Radiant with V4	GSHP and ERV with V4	Reduction in Equipment Loads with Premium Equipment in Soldiers Rooms, Added to GSHP and ERV (V11) (0.5 W/ft ²)	Reduction in Equipment Loads with Premium Equipment in Soldiers Rooms, Added to ERV, IDEC, and Radiant (V10) (0.5 W/ft ²)
	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²	kBtu/ft ²
1A_Miami_FL	208	180	73	209	151	133	113	111	110	103	108	108	103	99	111	99	87
2A_Houston_TX	194	158	68	195	143	124	108	106	104	99	102	101	98	95	108	97	83
2B_Phoenix_AZ	195	131	68	186	132	115	101	100	96	89	95	92	88	84	101	89	72
3A_Memphis_TN	176	130	62	188	138	120	106	103	99	99	99	96	95	91	106	95	80
3B_ElPaso_TX	172	126	60	171	119	107	97	95	92	90	91	89	88	84	100	88	72
3C_SanFrancisco_CA	150	116	52	152	107	98	91	88	87	88	85	84	87	84	95	85	73
4A_Baltimore_MD	178	123	62	183	138	117	105	102	96	99	98	93	93	90	108	98	79
4B_Albuquerque_NM	164	94	57	170	121	108	99	96	91	92	92	87	88	84	104	92	73
4C_Seattle_WA	159	90	56	162	120	104	96	93	88	92	90	85	88	85	97	87	74
5A_Chicago_IL	185	118	65	187	143	121	109	105	96	103	101	93	94	90	104	94	80
5B_ColoradoSprings_CO	167	114	59	172	125	111	102	99	91	96	95	88	90	86	106	95	75
6A_Burlington_VT	203	130	71	186	144	121	109	105	95	104	102	92	93	90	111	101	80
6B_Helena_MT	182	107	64	179	136	115	105	102	92	100	98	89	91	87	108	97	77
7A_Duluth_MN	206	116	72	193	153	126	114	110	96	109	103	93	95	92	116	106	82
8A_Fairbanks_AK	237	136	83	215	178	142	127	123	102	122	119	100	102	99	117	107	90

CH-12-008

ENERGY EFFICIENCY

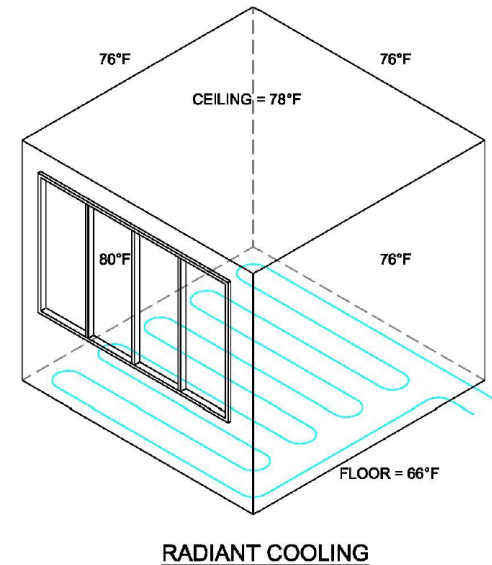
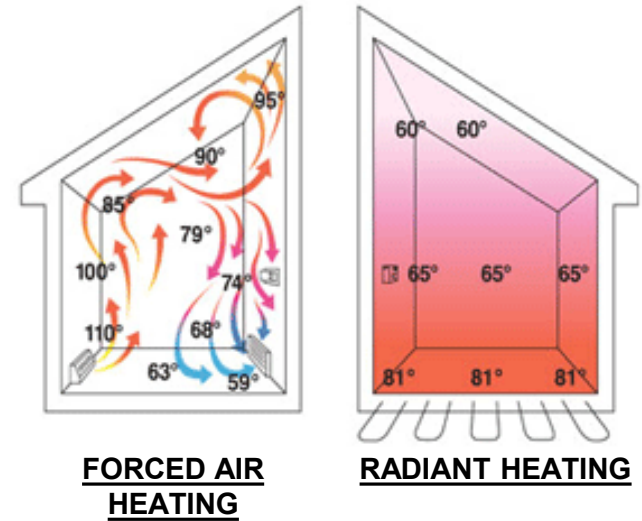
LBNL Findings:



Depending on the climate, a radiant cooling system in conjunction with a dedicated outside air system (DOAS) could save between 17% - 42% over the baseline VAV system

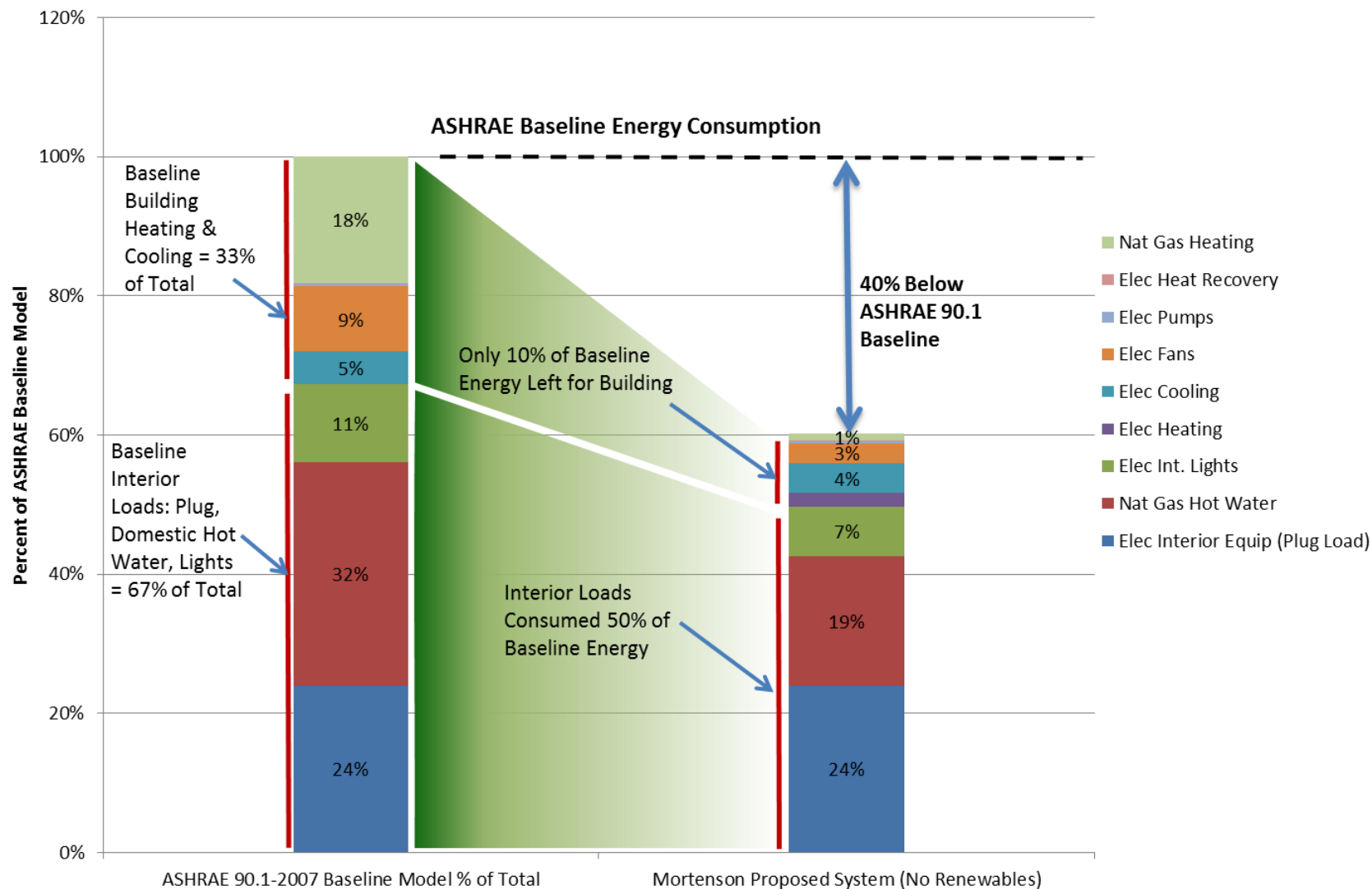
Radiant Heating and Cooling System Advantages

- Superior human comfort
- Greater architectural freedom
- No fan energy
- Simple and quiet
- Low maintenance
- Direct radiant transfer to human body

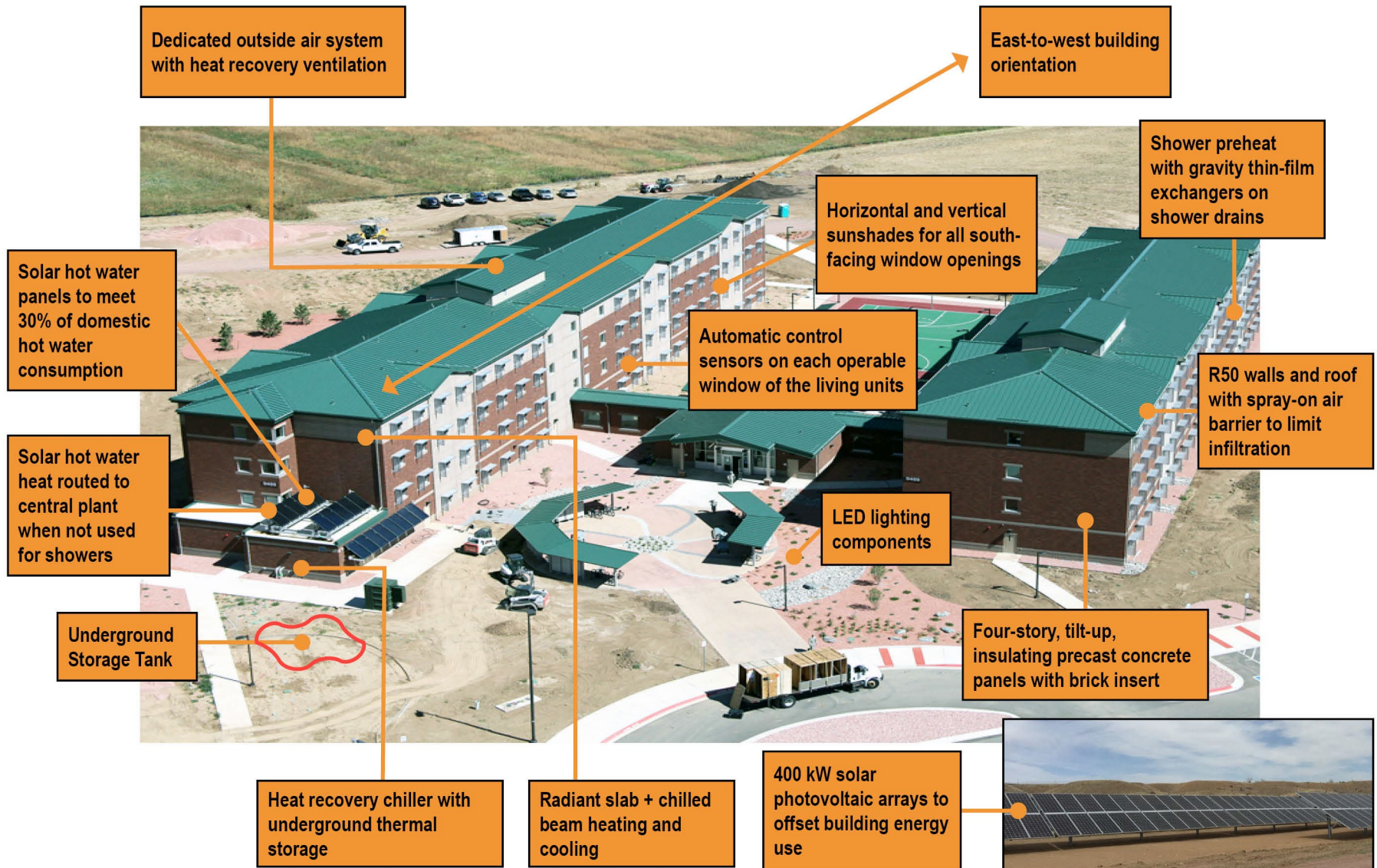


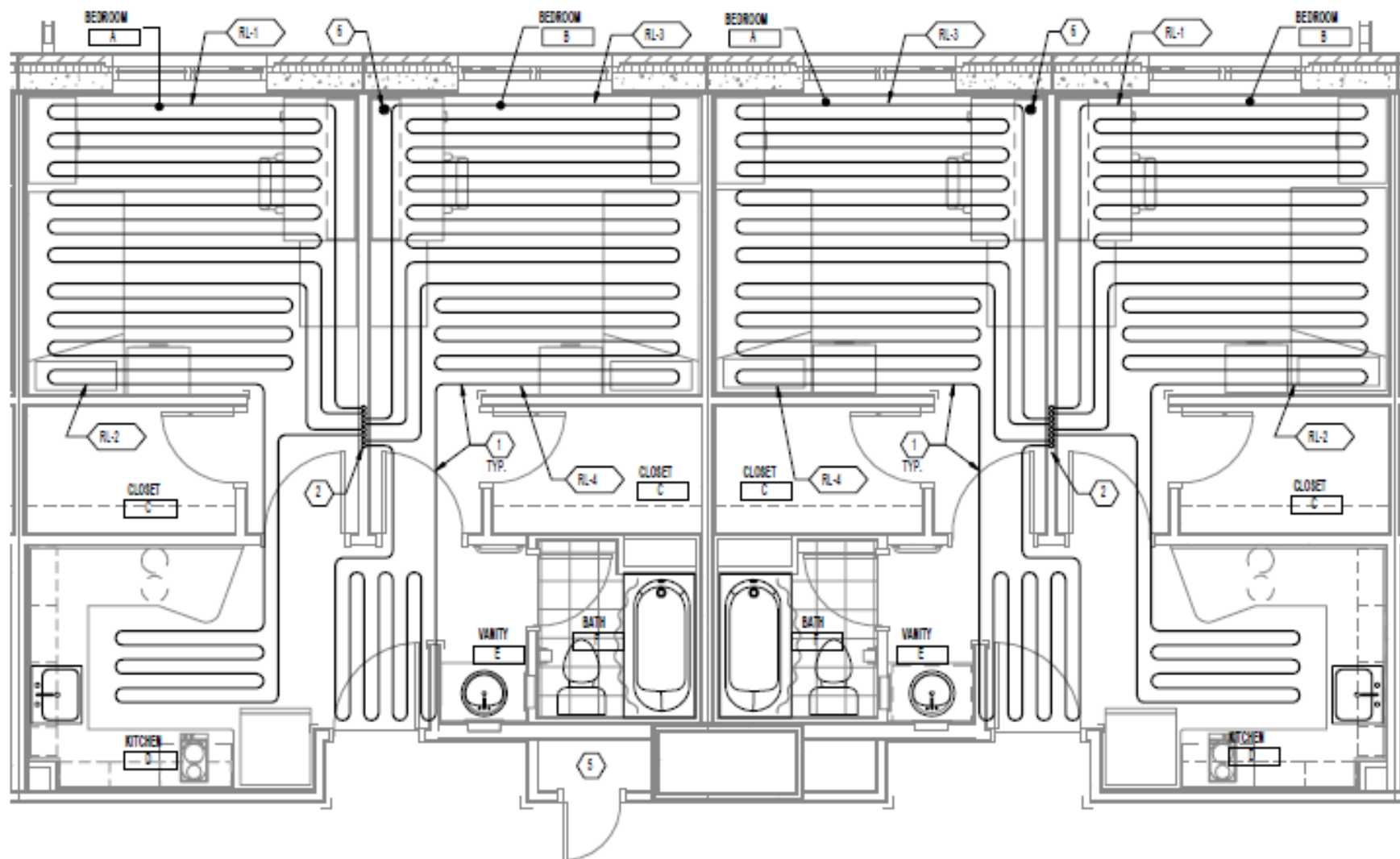
Fort Carson Combat Air Brigade Barracks

ASHRAE 90.1 Baseline vs. Proposed System



SUSTAINABLE DESIGN FEATURES EMPLOYED





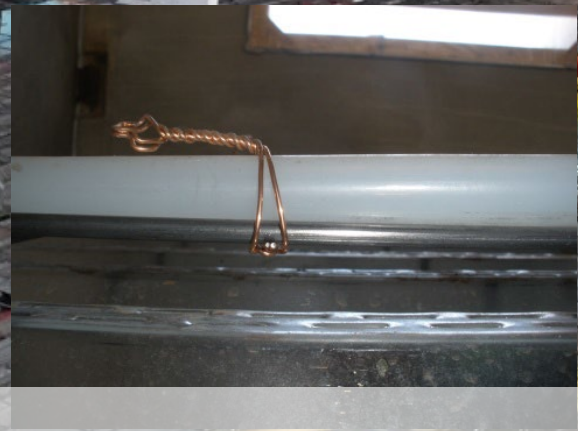
ENLARGED RADIANT SLAB TUBING TYPICAL UNIT PLAN

2

SCALE: 1/4" = 1'-0"

1/4" = 1'-0"





Radiant Tubing Installation



Completed Tubing Installation



Concrete Topping Over Tubing



Completed Radiant Slab

Solar Domestic Hot Water System





**Gravity film heat exchangers
save 34% on domestic hot
water heating energy**



**Chilled beam air distribution
supplements radiant slab**

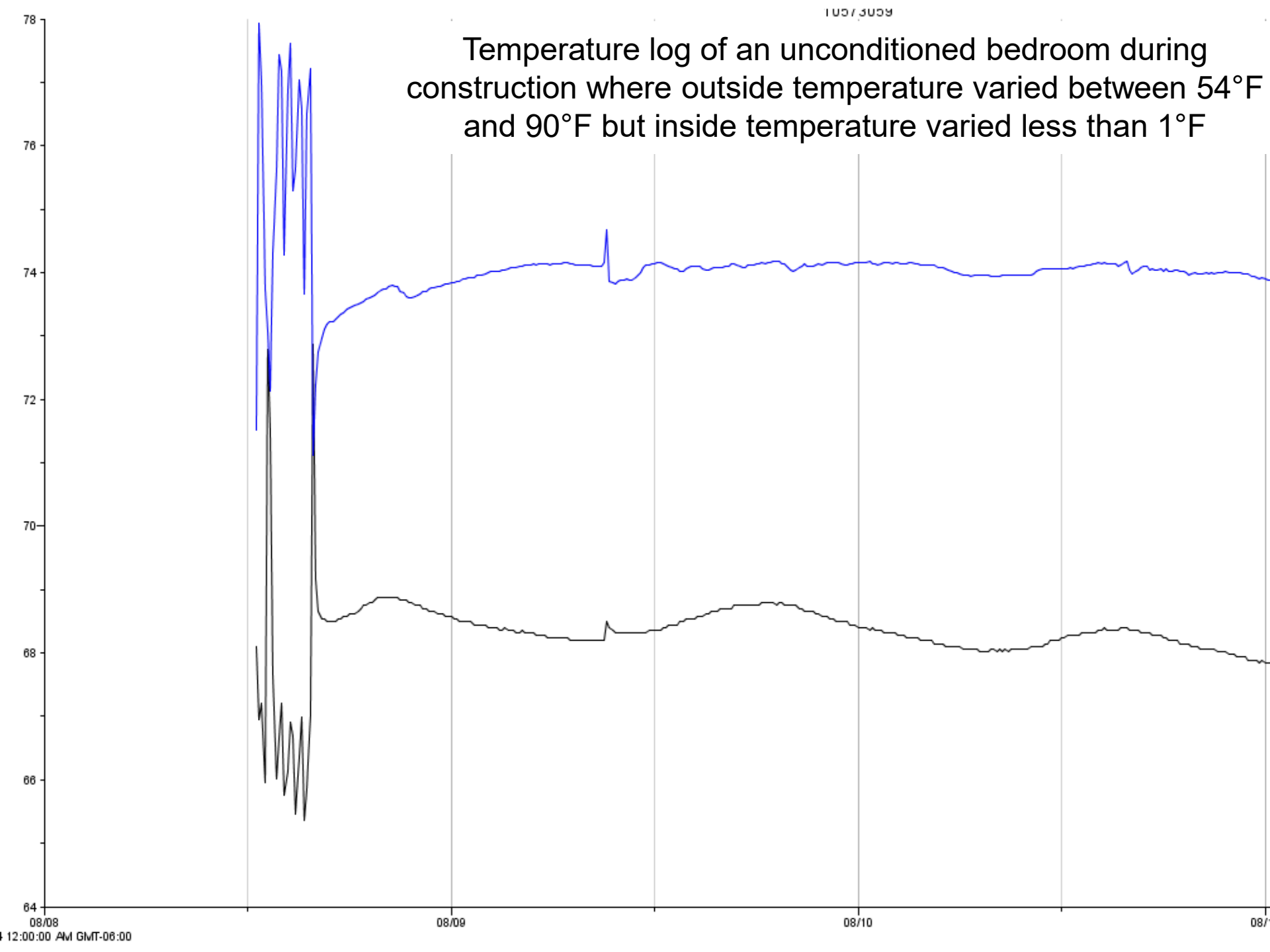


Insulated Load Bearing Precast Panels

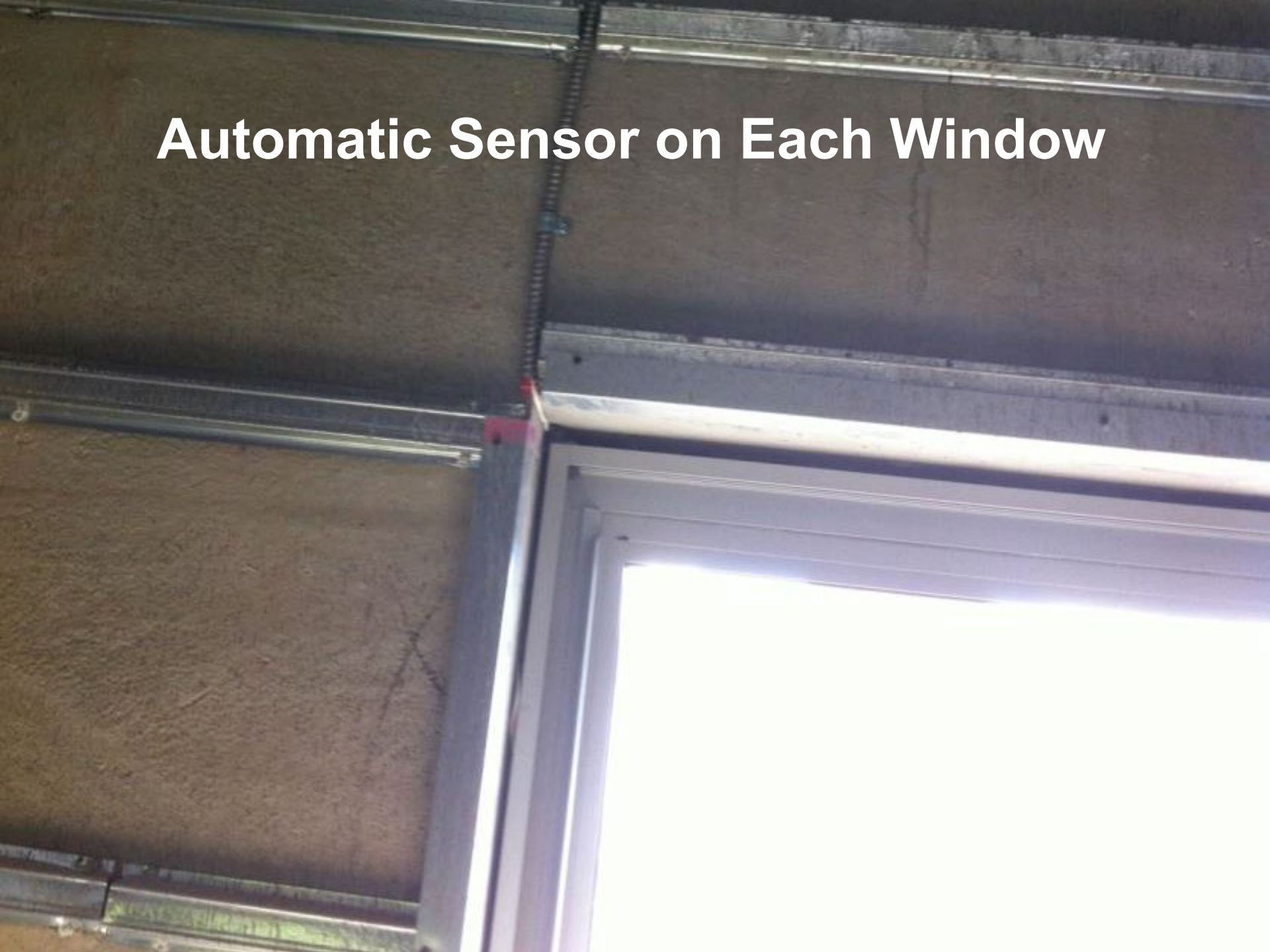


Insulated Load Bearing Precast Panels

Temperature log of an unconditioned bedroom during construction where outside temperature varied between 54°F and 90°F but inside temperature varied less than 1°F



Automatic Sensor on Each Window



South Façade with Sunshades





Sunshade Detail

Complex A Birds' Eye View

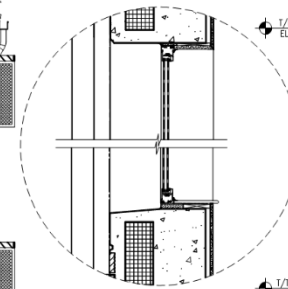


Landscape West of Fort Carson

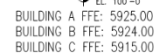




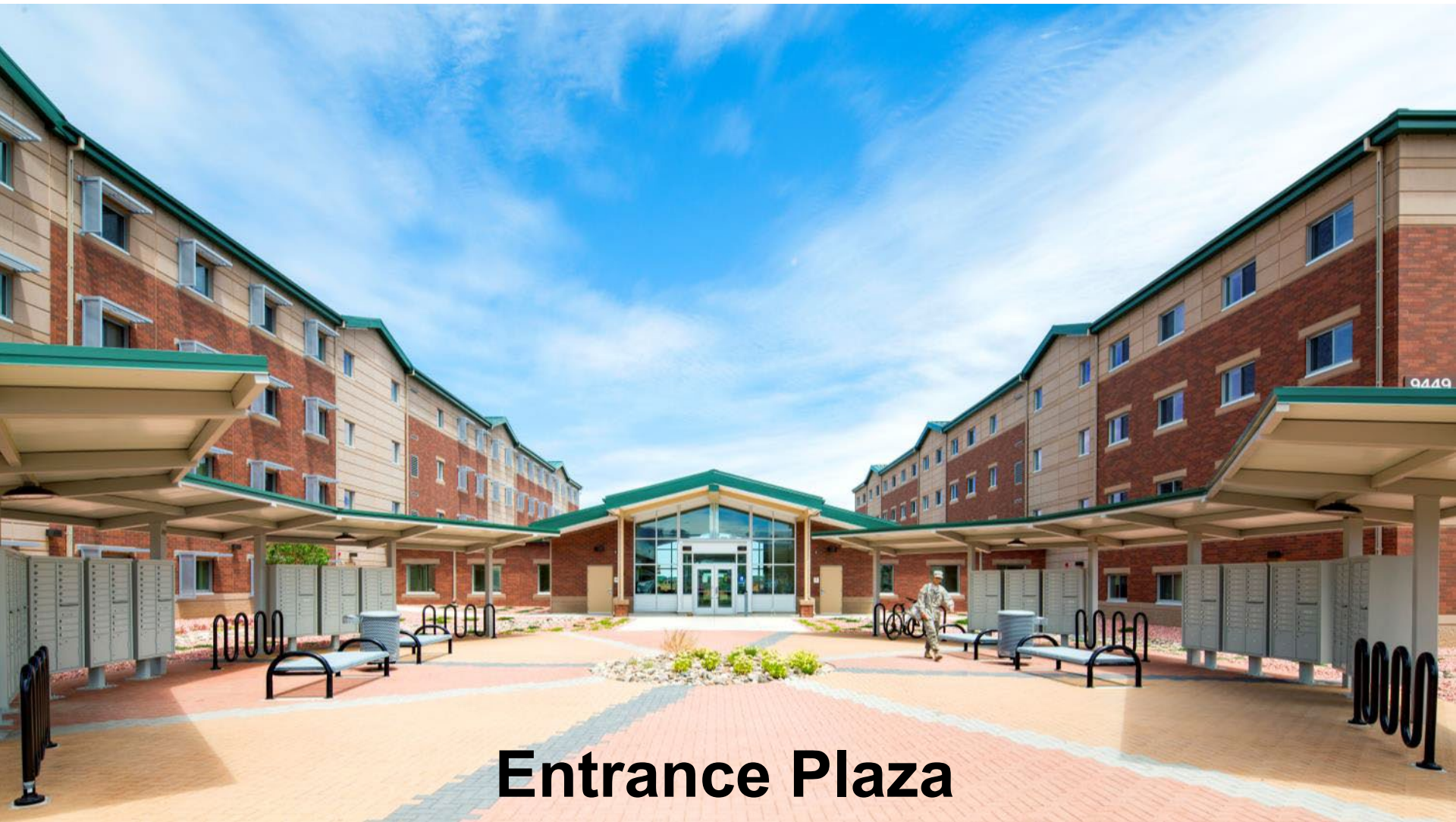
South Facing Façade



(A1) BUILD
1/4" = 1'-0"



A4 WALL
3/8" x 1'-0"



Entrance Plaza



Entrance Pavilion



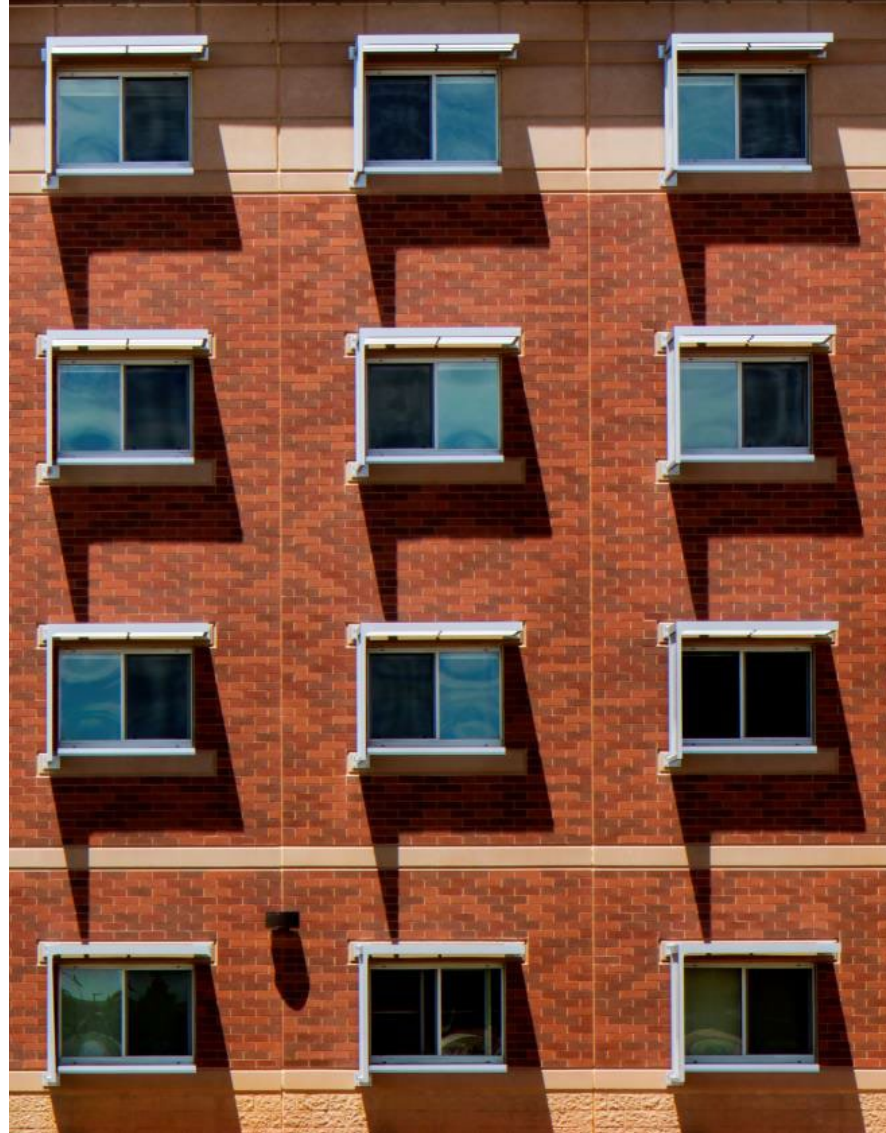
Entrance Lobby



Entrance Lobby

Sport Courtyard





Detail of Exterior Wall Composition



Typical Bedroom

Typical Kitchen



Consolidated Boiler/Chiller Plant





One Football Field of PV and Net Zero Ready!

Questions?

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