



*Innovation for Our Energy Future*

# IEA Annex 46 Baseline Buildings and HVAC Systems

**Kyle Benne**

**Energy Efficient Retrofit Measures for Government Buildings Workshop**

**Hyatt Regency Dallas**

**August 14, 2010**

# Baseline Building Permutations

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## Medium Size Office Building

- 23,250 ft<sup>2</sup> (2,160 m<sup>2</sup>)
- 4 floors

## Barracks Facility

- 28,965 ft<sup>2</sup> (2,691 m<sup>2</sup>)
- 40 - 2 bedroom apartment units, lobby, laundry facility
- 3 floors

31 International Locations - US, Canada, and Europe

## 62 Distinct Baseline Buildings

- EnergyPlus models developed for each building
- Models have mixed origins

# Locations

## US

- Miami
- Houston
- Phoenix
- Memphis
- El Paso
- San Francisco
- Baltimore
- Albuquerque
- Seattle
- Chicago
- Boise
- Burlington
- Helena
- Duluth
- Fairbanks

## Canada

- Vancouver
- Edmonton
- Ottawa

## Italy

- Milan
- Naples
- Palermo
- Rome

## France

- Marseille
- Lyon
- Nantes
- Paris

## UK

- London

## Germany

- Stuttgart

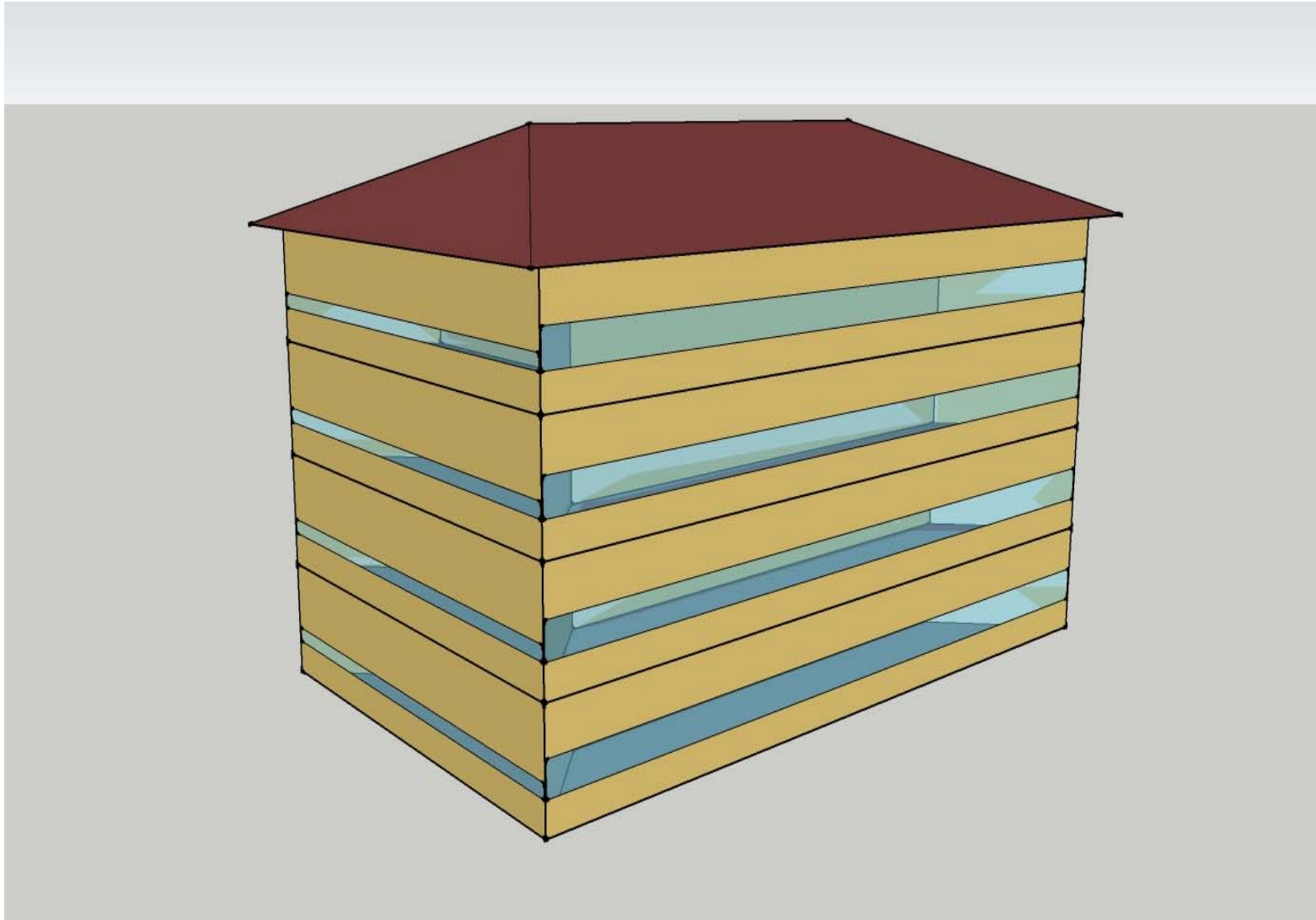
## Finland

- Helsinki
- Tampere

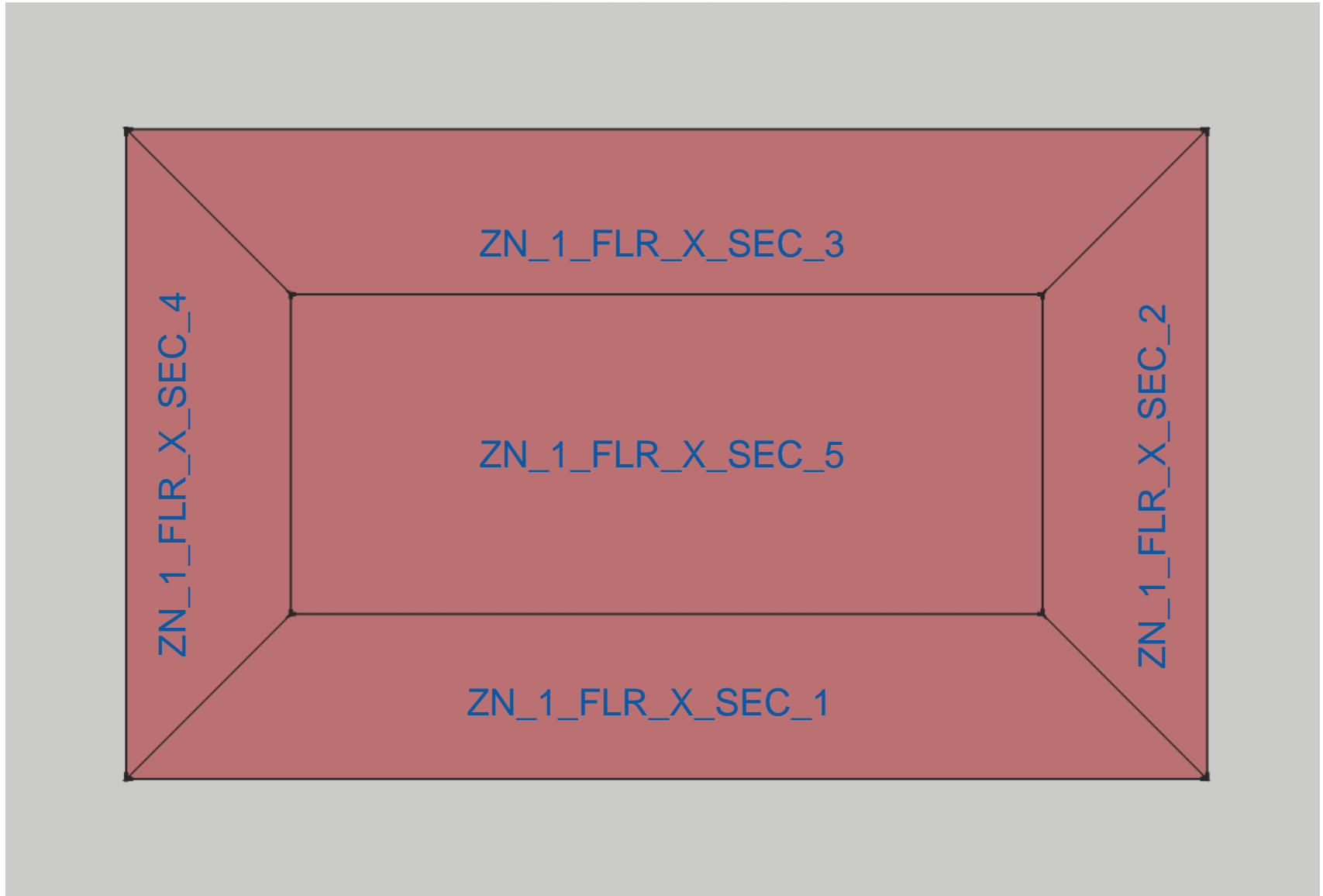
## Denmark

- Copenhagen

# Office Building



# Office Floor plan



# Office Building Envelope

Building Component	Component Description
Area	23,250 ft <sup>2</sup> (2,160 m <sup>2</sup> )
Floors	4
Foot print shape	Rectangle
Fenestration type	Standard 90.1-1989
Wall construction	Steel frame with brick exterior
Wall insulation	Standard 90.1-1989, mass wall
Roof construction	Sloped metal roof with insulation at roof level
Roof insulation	Standard 90.1-1989, with attic
Infiltration	1 cfm/ft <sup>2</sup> of shell area
Window-to-wall ratio	Total – 23.44% North – 30.00% East – 12.51% South – 30.00% West – 12.51%

\* European models have some variations in envelope construction.

# Office Building Internal Loads

Zone	Max Occupants		Lighting Power Density		Electric Equipment Power Density	
	(ft <sup>2</sup> /Person)	(m <sup>2</sup> /Person)	(W/ft <sup>2</sup> )	(W/m <sup>2</sup> )	(W/ft <sup>2</sup> )	(W/m <sup>2</sup> )
ZN_1_FLR_1_SEC_1	229	21	1.8	19.4	0.75	8.1
...	...	...	...	...	...	...
ZN_1_FLR_3_SEC_5	229	21	1.8	19.4	0.75	8.1

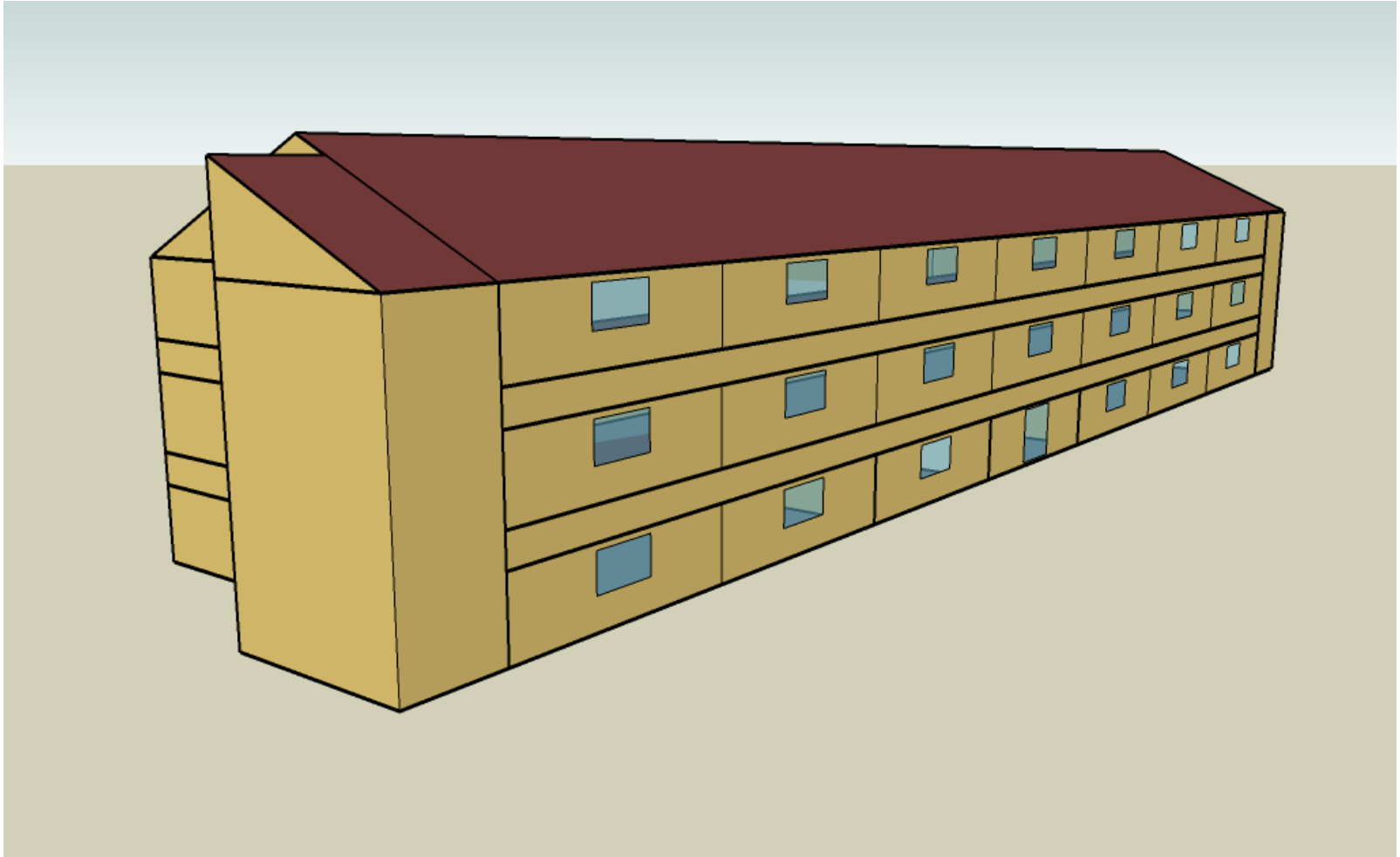
# Office Building HVAC

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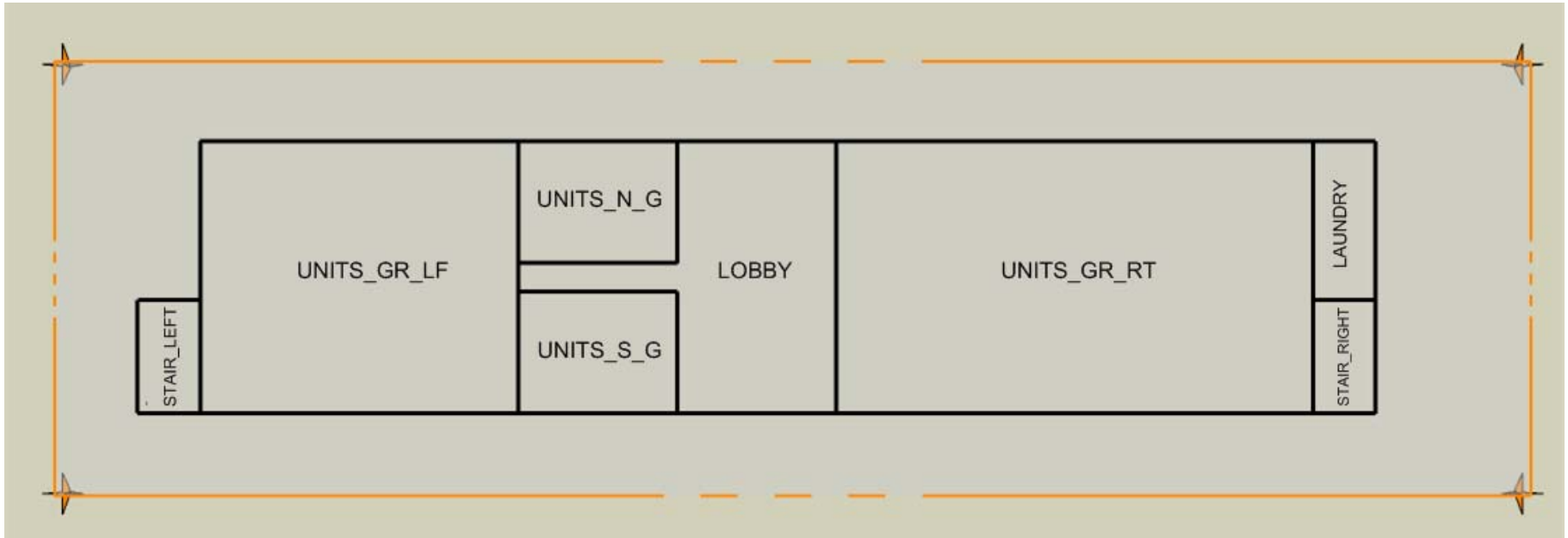
- VAV Air system serving each floor
- Air cooled chiller with COP 4.5
- Central gas boiler with 0.8  $E_t$
- Natural gas boiler serving small service hot water load
- European and Canadian locations
  - Packaged single zone units
  - Cooling COP 3.0
  - Gas furnace heating efficiency 0.8



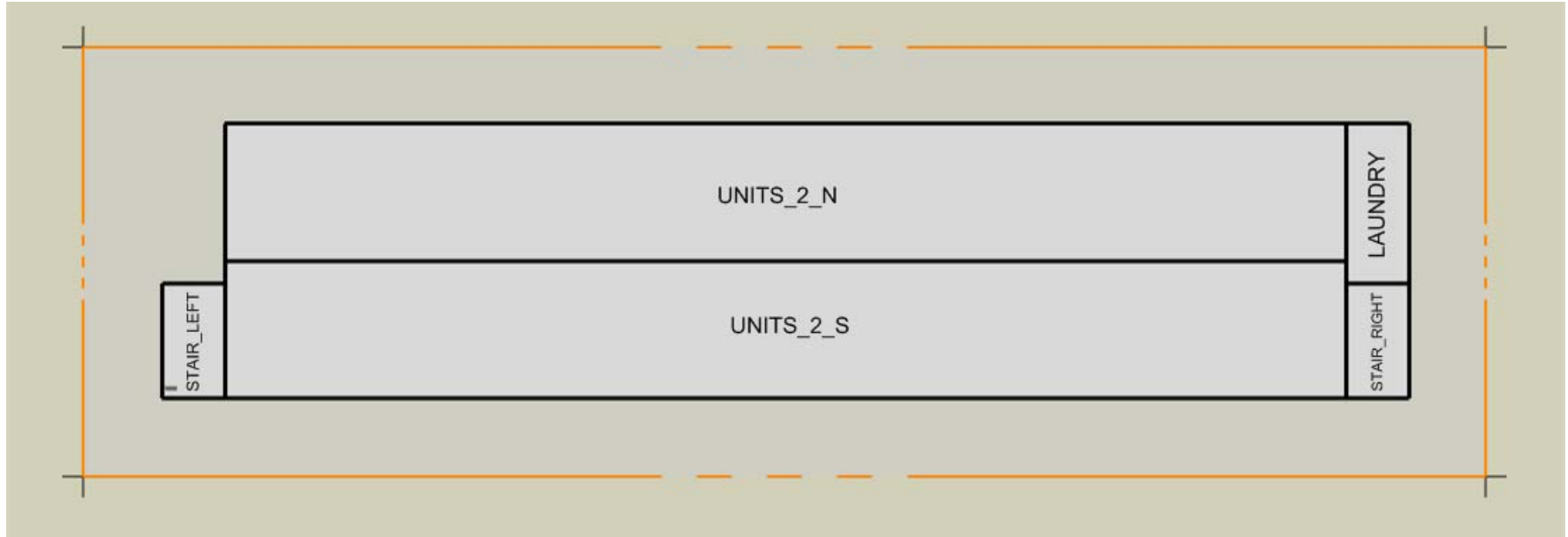
# Barracks Facility



# Barracks Facility Floor 1



# Barracks Facility Floor 2 and 3



# Barracks Facility Envelope

Building Component	Component Description
Area	28,965 ft <sup>2</sup> (2,691 m <sup>2</sup> )
Floors	3
Foot print shape	Rectangle
Fenestration type	Standard 90.1-1989
Wall construction	Wood frame with brick exterior
Wall insulation	Standard 90.1-1989, mass wall
Roof construction	Sloped metal roof with Insulation at roof Level
Roof insulation	Standard 90.1-1989, with attic
Infiltration	1 cfm/ft <sup>2</sup> of shell area
Window-to-wall ratio	Total – 6.88% North – 8.91% East – 0.00% South – 9.38% West – 0.00%

\* European models have some variations in envelope construction.

# Barracks Facility Internal Loads

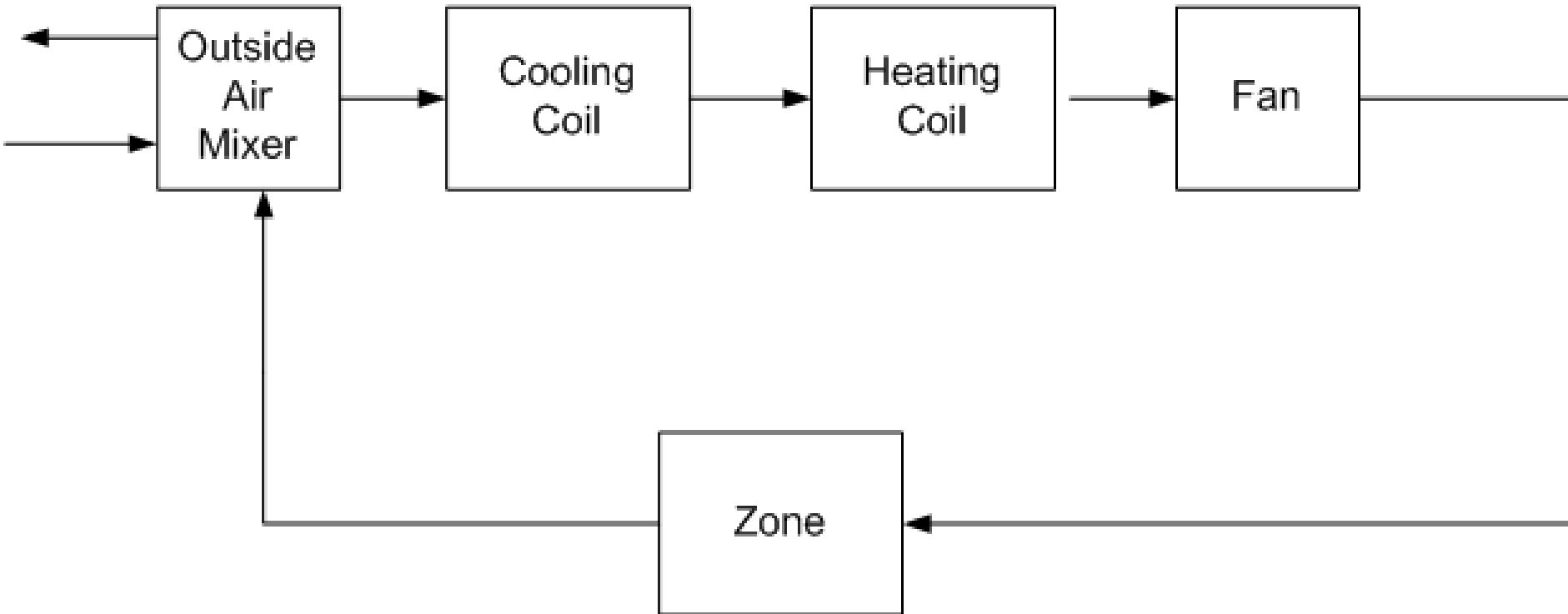
Zone	Max Occupants Per Zone	Lighting Power Density		Electric Equipment Power Density	
		(W/ft <sup>2</sup> )	(W/m <sup>2</sup> )	(W/ft <sup>2</sup> )	(W/m <sup>2</sup> )
UNITS_GR_LF	8	1.1	11.8	1.6	17.2
UNITS_GR_RT	12	1.1	11.8	1.6	17.2
UNIT_S_G	2	1.1	11.8	1.7	18.3
UNIT_N_G	2	1.1	11.8	1.7	18.3
LOBBY	2	1.0	10.8	0.25	2.7
UNITS_2_S	14	1.1	11.8	1.6	17.2
UNITS_2_N	14	1.1	11.8	1.6	17.2
UNITS_3_S	14	1.1	11.8	1.6	17.2
UNITS_3_N	14	1.1	11.8	1.6	17.2
STAIR_LEFT	0	1.8	19.4	0.0	0.0
STAIR_RIGHT	0	1.8	19.4	0.0	0.0
LAUNDRY	1	2.7	29.1	41.0	441.3

# Barracks Facility HVAC

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- US and Canadian Locations
  - Packaged single zone units for each zone
  - DX cooling with COP 2.6
  - Gas furnace with efficiency of 0.8
  - Natural gas boiler serving service hot water load
- European Locations
  - No Cooling
  - Baseboard heat served by 0.8 efficient gas boiler

# Barracks Facility HVAC Schematic



# Caution! Baselines may move at any time!

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## Sometimes for a good reason

- Adding dehumidification
- Consider older generation construction

## Sometimes not

- Chiller performance is overestimated in office building