Building Envelope Assessment Guidelines

General Building Assessment Procedure

1. Collect architectural and construction drawings to determine the layout of the internal zones and construction of all exterior surfaces; walls, floors, roof, ceiling, etc.
2. Sketch out the current building envelope layout and internal zone layout.
3. Walk around the building and look for noticeable infiltration.
   - Record temperatures in different locations and note the size of obvious infiltration points.
4. During the site assessment, record information on the following:
   - Roof:
     - Roof construction and insulation thickness
     - Roof age and warranty
     - Roof condition including signs of leaks, membrane holes, or damaged insulation
   - Walls:
     - Wall construction and insulation thickness
     - Wall condition and noticeable infiltration points that can be sealed
   - Windows:
     - Window to wall ratio on each façade
     - Window size and dimensions
     - Window framing and type of thermal break
     - Window type (double pained, single pained, etc.)
       - Record visible transmittance
       - Solar heat gain coefficient
       - Tinting and tint color
     - Center of glass U value
     - General window condition
     - Window operation
     - External window shades/overhangs
     - Interior window blinds
   - Floors and ceilings:
     - Floor construction
     - Wall construction
5. Light an incense stick and run it slowly along door jams, window frames, and vents to determine the level of air flow. Where there seem to be drafts or a lot of air movement, record this observation on the building sketch.
6. Use a thermal imaging camera to take pictures of building envelop elements and identify locations with insufficient insulation or excess heat loss or gain.
7. Compile a summary of the observations made, documenting all areas of concern with a digital camera.

Site Assessment Tools

1. Use a camera to document areas of concern and record window to wall ratios.
2. Use a thermometer or thermal imaging camera to record temperatures.
3. Use a flashlight and ladder for accessing roof insulation.
4. Use a tape measure to determine the amount of insulation that's been installed.
5. Use an incense stick to determine the direction of air flow.

Building Toolkit	
Tape measure or ruler	Incense stick and lighter
Flashlight	Digital camera
Ladder	Thermometer

Source: NREL

Table 1. Final Energy Savings Recommendations* for Medium Office—Building Envelope[1]

Item	Component		Climate Zone 1 (warmest)	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8 (coolest)
Roof	Insulation entirely above deck	R-value $ft^2 \cdot F \cdot h/Btu$	R-20 c.i.	R-25 c.i.	R-25 c.i.	R-30 c.i.	R-30 c.i.	R-30 c.i.	R-35 c.i.	R-35 c.i.
		R-value $K \cdot m^2/W$	*R-3.5 c.i.*	*R-4.4 c.i.*	*R-4.4 c.i.*	*5.3 c.i.*	*5.3 c.i.*	*5.3 c.i.*	*6.2 c.i.*	*6.2 c.i.*
	Solar reflectance		0.69	0.69	0.69	NR	NR	NR	NR	NR
	Emittance		0.87	0.87	0.87	NR	NR	NR	NR	NR
Walls-exterior	Steel framed	R-value $ft^2 \cdot F \cdot h/Btu$	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-7.5 c.i.	R-13.0 + R-15.6 c.i.	R-13.0 + R-18.8 c.i.	R-13.0 + R-18.8 c.i.	R-13.0 + R-18.8 c.i.
		R-value $K \cdot m^2/W$	*R-2.3 + R-1.3 c.i.*	*R-2.3 + R-1.3 c.i.*	*R-2.3 + R-1.3 c.i.*	*R-2.3 + R-1.3 c.i.*	*R-2.3 + R-2.7 c.i.*	*R-2.3 + R-3.3 c.i.*	*R-2.3 + R-3.3 c.i.*	*R-2.3 + R-3.3 c.i.*
Slabs	Heated	R-value $ft^2 \cdot F \cdot h/Btu$	NR	NR	NR	R-10.0 for 24 in.	R-10.0 for 24 in.	R-15.0 for 24 in.	R-15.0 for 24 in.	R-20.0 for 24 in.
		R-value $K \cdot m^2/W$	*NR*	*NR*	*NR*	*R-10.0 for 24 in.*	*R-10.0 for 24 in.*	*R-15.0 for 24 in.*	*R-15.0 for 24 in.*	*R-20.0 for 24 in.*
Vertical glazing	Thermal transmittance	U-factor $Btu/h \cdot ft^2 \cdot F$	0.51	0.51	0.51	0.44	0.44	0.42	0.31	0.31
		U-factor $W/m^2 \cdot K$	*2.89*	*2.89*	*2.89*	*2.5*	*2.5*	*2.38*	*1.76*	*1.76*
	Solar heat gain coeffi-cient (SHGC)		0.25	0.25	0.25	0.26	0.26	0.35	0.40	0.40
	Exterior sun control (south only)		PF>0.5	PF>0.5	PF>0.5	PF>0.5	PF>0.5	NR	NR	NR

Source: Pacific Northwest National Laboratory

* Implementation of these energy measures could allow a new midsize office building to achieve 50% energy savings relative to a building that just meets ANSI/ASHRAE/IESNA Standard 90.1-2004. Insulation requirements (R-value) increase and the corresponding thermal transmittance (U-factor) decreases as the climate gets colder. Recommendations are based on steel stud construction with curtain wall style windows.

[1] Thornton, B.; Wang, W.; Lane, M.; Rosenburg, M.; Liu, B. *Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings*. PNNL-18774. Prepared by Pacific Northwest National Laboratory for U.S. Dept. of Energy. www.pnl.gov/main/publications/external/technical_reports/PNNL-19004.pdf. September 2009.

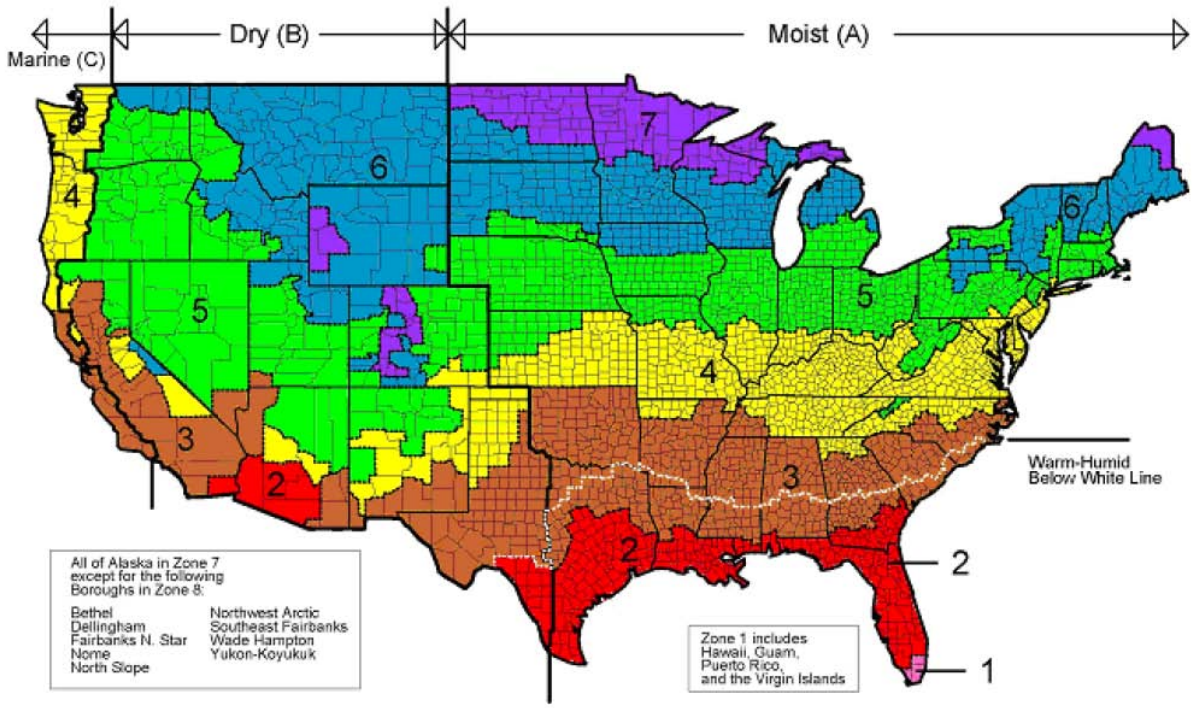

Figure 1. DOE-developed climate zone map.[2] *Illustration from Pacific Northwest National Laboratory*

The sixteen cities representing the climate zones are:

1A: Miami, Florida (hot, humid)
2A: Houston, Texas (hot, humid)
2B: Phoenix, Arizona (hot, dry)
3A: Atlanta, Georgia (hot, humid)
3B-CA: Los Angeles, California (hot, dry)
3B-other: Las Vegas, Nevada (hot, dry)
3C: San Francisco, California (marine)
4A: Baltimore, Maryland (mild, humid)
4B: Albuquerque, New Mexico (mild, dry)
4C: Seattle, Washington (marine)
5A: Chicago, Illinois (cold, humid)
5B: Denver, Colorado (cold, dry)
6A: Minneapolis, Minnesota (cold, humid)
6B: Helena, Montana (cold, dry)
7: Duluth, Minnesota (very cold)
8: Fairbanks, Alaska (extreme cold)

[2] Thornton, B.; Wang, W.; Lane, M.; Rosenburg, M.; Liu, B. *Technical Support Document: 50% Energy Savings Design Technology Packages for Medium Office Buildings*. PNNL-18774. Prepared by Pacific Northwest National Laboratory for U.S. Dept. of Energy. www.pnl.gov/main/publications/external/technical_reports/PNNL-19004.pdf. September 2009.