Appendix E-1f: Small Building Methodology for Pre-SB2030 Projects

Prescriptive Bundle Option Method for Office Buildings less than 30,000 GSF

- This section describes energy strategy requirements for three different *Prescriptive Bundle Options* for use in meeting energy performance compliance for *office building* projects less than 30,000 gross square feet. Project designs using this approach are required to select and implement one of the three bundle options in its entirety. **Note that projects entering schematic design (SD) phase after August 1, 2009 are not eligible to use this method. All projects entering SD after that date are subject to energy standards defined in Minnesota Sustainable Building 2030 (www.mn2030.umn.edu).**
- As an alternative to using the Prescriptive Bundle Option method, projects less than 30,000 gross square feet or non-office projects less than 30,000 GSF may use the comparative analysis method defined for larger buildings in part A (guideline E.1a). Project teams may also contact the Department of Commerce for additional options.
- The Prescriptive Bundle Options represent three different objectives to meet the energy performance goals of this section. The options defined provide a range of energy strategy solutions based on building design parameters and preferences of the Design Team and Building owner. The three bundles are grouped by building system focus below:

Bundle 1 - Lighting dominates performance	**Bundle 3 – Balanced** Lighting and HVAC balance performance	**Bundle 2 – HVAC** dominates performance
Focuses implementation of Daylight, and lighting control and design high performance strategies	Focuses implementation of a balanced approach between lighting and HVAC design and control high performance strategies.	Focuses implementation of HVAC system and control high performance strategies.

- Each Prescriptive Bundle Option identifies which strategies are required and or a minimum level of strategy component performance for the following four building system sections:
  - Envelope Requirements based on building envelope metrics
  - Calibrated Daylight Control Requirements based on building metrics and the Prescriptive Bundle Option selected.
  - Lighting Control and Design Requirements based on Prescriptive Bundle Option selected
  - HVAC Control and Design based on Prescriptive Bundle Option selected.

Envelope Requirements

Intent: To reduce the thermal heating and cooling load of the building envelope.

- The Prescriptive Bundle Option Method requires the calculation of the following building envelope design metrics:

BUILDING ENVELOPE METRIC	RATIO	BUILDING COMPONENT	SQUARE FEET
Ratio of window + skylight area (ft^2) to building gross floor area (ft^2)		[1] Window and skylight area	
		[4] Gross floor area	
Ratio of above grade wall area (ft^2) to building gross floor area (ft^2)		[2] Above grade wall area	
		[4] Gross floor area	
Ratio of roof area (ft^2) to building gross floor area (ft^2)		[3] Roof area	
		[4] Gross floor area	

Note 1: Area calculated for glazed rough opening areas for all windows and skylights

Note 2: Area calculated for all gross wall surfaces above grade including window and door area, excluding parapets

Note 3: Area calculated for all gross roof surface area including rough opening skylight areas

Note 4: Area calculated from the outside of exterior perimeter walls for all conditioned spaces

- Design the building envelope to meet the thermal characteristics for all window, wall, and roof areas identified in the table below based on the envelope area metrics calculated:

Ratio of Window + Skylight area to Floor area	**0 to 0.10**	**0.10 to 0.20**	**Over 0.20**
Unit U-Factor[1] (btuh/sf*F^o)	< 0.46	< 0.42	< 0.38
Solar Heat Gain Coefficient[2] (dimensionless)	< 0.56	< 0.38	< 0.30
Visible Light Transmittance[3] (dimensionless)	> 0.45	> 0.45	> 0.40
Ratio of above grade Wall area to floor area	**0 to 0.25**	**0.25 to 0.50**	**Over 0.50**
Wall Insulation R-Value[4] (btuh/sf*F^o)	> R-11	> R-14	> R-18
Ratio of Gross Roof area to Roof area	**0 to 0.45**	**0.45 to 0.65**	**Over 0.65**
Roof Insulation R-Value (btuh/sf*F^o)	> R-26	> R-30	> R-32

1 Unit U-factor is the U-factor of the glass and frame assembly together. The unit U-factor of the glass and frame assembly is typically higher than the center-of-glass U-factor only. Lower U-factors reduce heat loss.

2 Solar Heat Gain Coefficient is the ratio of the amount of solar radiation transmitted through the glass compared to the amount of exterior radiation incident on the glazings exterior surface. Lower SHGC values reduce cooling loads.

3 Visible light transmittance is the ratio of the amount of light radiation transmitted through the glass compared to the amount of light striking the glazing's exterior surface. Higher values provide more daylight.

4 Wall and Roof insulation R-values include the entire opaque wall and roof envelope construction assembly including air films.

Daylight Control Requirements

Intent: To reduce the electric lighting energy consumption within areas of the building design where daylight can provide a substantial amount of the required illumination during the day.

- For the building design calculate the Total Ratio of Daylight floor area to building gross floor area.

Space type Daylight floor area	**Square feet**
Open Office Daylight floor area (ft^2)	
Private Office Daylight floor area (ft^2)	
Lobby/Circulation Daylight floor area ($ft^{2)}$	
Sum of Total Daylight floor area (ft^2) above	
Gross Building Floor Area (ft^2)	
Ratio of Total Daylight floor area (ft^2) to building gross floor area (ft^2)	

- Calculation method to determine Daylight floor area by space type

Space Type Area		Depth of zone		Length of zone
Open Office Daylight floor area (ft^2):	=	(Window head height from floor in ft.) x (**2.0**)	X	Space length (ft) where the window area equals more than **20%** of the zone depth per linear foot of wall
Private Office Daylight floor area (ft^2)	=	(Window head height from floor in ft.) x (**1.8**)	X	Space length (ft) where the window area equals more than **15%** of the zone depth per linear foot of wall
Lobby/Circulation Daylight floor area (ft^2)	=	(Window head height from floor in ft.) x (**1.5**)	X	Space length (ft) where the window area equals more than **15%** of the zone depth per linear foot of wall

- Design the building lighting system to meet the bundle option selected for the building design.

Calibrated Daylight Controls	**Bundle 1 Lighting**	**Bundle 2 Balanced**	**Bundle 3 HVAC**
Total Ratio of Daylight floor area (ft^2) to building gross floor area (ft^2)	**> 0.50**	**> 0.35**	**> 0.20**
Calibrated Stepped Daylight controls in all Daylight floor areas for, Lobby / Vestibule / Circulation areas. Requirements: Use interior or exterior photo sensors or astronomical time-clock to control electric light relay for ½ of all lamps in each daylight zone.	Yes	Yes	Yes
Continuous Dimming Daylight Control in all Daylight floor areas for Perimeter Open office areas. Requirements: Use dimming ballasts with interior photo sensor for each Open office space.	Yes	Yes	Yes
Strategic Switching controls in all Daylight areas for Perimeter Private office areas. Requirements: Use two manual wall switches per private office space. o. One switch located by the door to control ½ the lamps in each fixture of the room, The second switch is located away from the door and controls the other lamps within the fixture.	Yes	Yes	Yes

Electric Lighting and Control Strategies

Intent: To reduce the electric lighting load within the building utilizing lighting design and lighting control strategies that reduce consumption.

- Design the building lighting system to meet the bundle option selected for the building design.

LIGHTING CONTROL REQUIREMENTS BY SPACE TYPE	BUNDLE 1 LIGHTING	BUNDLE 2 BALANCED	BUNDLE 3 HVAC
Open Office	OS	N/R	N/R
Private Office	OS	OS	OS
Conference Rooms	OS	OS	OS
Circulation	OS	N/R	N/R
Toilets	OS	OS	OS
Storage Rooms	OS	OS	N/R

Notes:
OS: Occupancy sensor control
N/R: No occupancy sensor controls required

LIGHTING DESIGN MINIMUM POWER DENSITY BY SPACE TYPE	BUNDLE 1 LIGHTING	BUNDLE 2 BALANCED	BUNDLE 3 HVAC
Open Office connected (W/ft^2)	< 0.90	< 1.10	< 1.25
Private Office connected (W/ft^2)	< 1.10	< 1.30	< 1.50
Conference Rooms connected (W/ft^2)	< 1.35	< 1.55	< 1.75
Circulation connected (W/ft^2).	< 0.65	< 0.75	< 0.80
Toilets connected (W/ft^2)	< 0.65	< 0.75	< 0.80
Storage rooms connected (W/ft^2)	< 0.65	< 0.75	< 0.80
Mechanical Rooms connected (W/ft^2)	< 0.65	< 0.75	< 0.80

Notes:
Lighting design power densities to be increased by area factor calculation in Minnesota Energy Code.

HVAC Requirements

Intent: To reduce heating, cooling, fan, and pump energy consumption and peak electric demand within the building utilizing equipment efficiency and operation control strategies that reduce consumption**.**

Cooling System Efficiency Requirements	**BUNDLE 1 LIGHTING**	**BUNDLE 2 BALANCED**	**BUNDLE 3 HVAC**
Air Cooled Equipment			
Single Package <65,000 Btu/h, SEER	> 10.2	> 10.7	> 11.2
Split System <65,000 Btu/h, SEER	> 10.5	> 11.0	> 11.5
Split System & Single Package >65,000 and < 135,000 Btu/h, EER	> 9.3	> 9.8	> 10.3
Condensing Units > 135,000 Btu/h, EER	> 10.4	> 10.9	> 11.4
Chiller greater than or equal to 150 tons KW/ton	< 1.34	< 1.27	< 1.20
Chiller less than 150 tons KW/ton	< 1.23	< 1.17	< 1.11
Water Source Equipment			
Water Source Heat Pumps < 65,000 Btu/h, Standard Rating Indoor Air (80°F db/65° wb) and Entering Water (85°F) EER	> 9.8	> 10.2	> 10.7
Water Source Heat Pumps < 65,000 Btu/h Standard Rating Indoor Air (80°F db/67° wb) and Entering Water (75°F) EER	> 10.7	> 11.2	> 11.7
Water Source Heat Pumps > 65,000 Btu/h and < 135,000 Btu/h, Standard Rating Indoor Air (80°F db/67° wb) and Entering Water (85°F) EER	> 11.0	> 11.6	> 12.1
Water Source Heat Pumps > 65,000 Btu/h and < 135,000 Btu/h, Standard Rating Indoor Air (80°F db/67° wb) and Entering Water (75°F) EER	> 11.6	> 12.1	> 12.7
Groundwater – Cooled Heat Pumps < 135,000 Btu/h, Standard Rating Entering Water (70°F) EER	> 11.6	> 12.1	> 12.7
Groundwater – Cooled Heat Pumps < 135,000 Btu/h, Low Rating Entering Water (50°F) EER	> 12.1	> 12.7	> 13.2
Water Cooled Equipment			
Centrifugal KW/ ton (non-CFC)	< 0.69	< 0.66	< 0.62
Helical-rotary (screw) KW/ton (non-CFC)	< 0.76	< 0.72	< 0.68
Reciprocating or scroll KW/ton	< 0.88	< 0.84	< 0.79

Heating System Efficiency Requirements	**BUNDLE 1 LIGHTING**	**BUNDLE 2 BALANCED**	**BUNDLE 3 HVAC**
Gas Furnace efficiency	> 0.83	> 0.85	> 0.90
Gas Boiler efficiency	> 0.83	> 0.85	> 0.90
Water Source Heat Pumps < 135,000 Btu/h Entering Water (70°F) COP	> 4.0	> 4.2	> 4.4
Water Source Heat Pumps < 135,000 Btu/h Entering Water (75°F) COP	> 4.1	> 4.3	> 4.5
Ground Source Heat Pumps < 135,000 Btu/h High Temperature Rating Entering Water (41°F)	> 2.8	> 3.0	> 3.1
Ground Source Heat Pumps < 135,000 Btu/h Low Temperature Rating Entering Water (32°F)	> 2.6	> 2.8	> 2.9
Load Responsive Control Requirements	**BUNDLE 1 LIGHTING**	**BUNDLE 2 BALANCED**	**BUNDLE 3 HVAC**
VFD's on VAV supply and return fan motors	YES	YES	YES
VFD's on chilled water pump	NO	NO	YES
VFD's on hotwater water pump	NO	NO	YES
Outside Air Control Requirements	**BUNDLE 1 LIGHTING**	**BUNDLE 2 BALANCED**	**BUNDLE 3 HVAC**
Total energy recovery of exhaust air for VAV systems	NO	NO	YES
Total energy recovery of exhaust air for Constant Volume systems	NO	YES	YES
CO2 control of outside ventilation air	YES	YES	YES
Fan/pump motor Efficiency Requirements	**BUNDLE 1 LIGHTING**	**BUNDLE 2 BALANCED**	**BUNDLE 3 HVAC**
Supply and return fan motors	Premium	Premium	Premium
Chilled water pump motor	Code Level	Code Level	Premium
Hot water pump motor	Code Level	Code Level	Premium

Note: Premium efficiency requirements are listed in Table below

Code vs. Premium Motor Efficiencies

All efficiency values are nominal efficiencies.

Horse power	Open drip-proof motors*						Totally-enclosed fan-cooled motors*					
	Code			Premium			Code			Premium		
	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm
1		82.5%	80.0%		85.5%	82.5%	75.5%	82.5%	80.0%	77.0%	85.5%	82.5%
1.5	82.5%	84.0%	84.0%	84.0%	86.5%	86.5%	82.5%	84.0%	85.5%	84.0%	86.5%	87.5%
2	84.0%	84.0%	85.5%	85.5%	86.5%	87.5%	84.0%	84.0%	86.5%	85.5%	86.5%	88.5%
3	84.0%	86.5%	86.5%	85.5%	89.5%	89.5%	85.5%	87.5%	87.5%	86.0%	89.5%	89.5%
5	85.5%	87.5%	87.5%	86.5%	89.5%	89.5%	87.5%	87.5%	87.5%	88.5%	89.5%	89.5%
7.5	87.5%	88.5%	88.5%	88.5%	91.0%	90.2%	88.5%	89.5%	89.5%	89.5%	91.7%	91.0%
10	88.5%	89.5%	90.2%	89.5%	91.7%	91.7%	89.5%	89.5%	89.5%	90.2%	91.7%	91.0%
15	89.5%	91.0%	90.2%	90.2%	93.0%	91.7%	90.2%	91.0%	90.2%	91.0%	92.4%	91.7%
20	90.2%	91.0%	91.0%	91.0%	93.0%	92.4%	90.2%	91.0%	90.2%	91.0%	93.0%	91.7%
25	91.0%	91.7%	91.7%	91.7%	93.6%	93.0%	91.0%	92.4%	91.7%	91.7%	93.6%	93.0%
30	91.0%	92.4%	92.4%	91.7%	94.1%	93.6%	91.0%	92.4%	91.7%	91.7%	93.6%	93.0%
40	91.7%	93.0%	93.0%	92.4%	94.1%	94.1%	91.7%	93.0%	93.0%	92.4%	94.1%	94.1%
50	92.4%	93.0%	93.0%	93.0%	94.5%	94.1%	92.4%	93.0%	93.0%	93.0%	94.5%	94.1%
60	93.0%	93.6%	93.6%	93.6%	95.0%	94.5%	93.0%	93.6%	93.6%	93.6%	95.0%	94.5%
75	93.0%	94.1%	93.6%	93.6%	95.0%	94.5%	93.0%	94.1%	93.6%	93.6%	95.4%	94.5%
100	93.0%	94.1%	94.1%	93.6%	95.4%	95.0%	93.6%	94.5%	94.1%	94.1%	95.4%	95.0%
125	93.6%	94.5%	94.1%	94.1%	95.4%	95.4%	94.5%	94.5%	94.1%	95.0%	95.4%	95.0%
150	93.6%	95.0%	94.5%	94.1%	95.8%	95.4%	94.5%	95.0%	95.0%	95.0%	95.8%	95.8%
200	94.5%	95.0%	94.5%	95.0%	95.8%	95.4%	95.0%	95.0%	95.0%	95.4%	96.2%	95.8%

**Code values are from Energy Policy Act of 1992, also reference NEMA Standard MG1-1998, Revision 2, Section 12.59 and Table 12-11, as tested in accordance with IEEE Standard 112 Method B.*

***Premium values are from NEMA Standard MG1-1998, Revision 2, Section 12.60 and Table 12-12, as tested in accordance with IEEE Standard 112 Method B.*