

s. SPS 321.16

Frost-Protected Shallow Footings

In lieu of frost walls, the code recognizes frost-protected shallow foundations designed per ASCE 32, "Design and Construction of Frost-Protected Shallow Foundations". The department also recognizes the similar design standards of U.S.HUD "Design Guide for Frost-Protected Shallow Foundations", available for free download from www.huduser.org/publications/dstech/desguide.html and summarized below. Consult it or the ASCE standard for full design and installation information, including a more flexible, detailed design method that should be used for heated buildings with attached, unheated garages.

Note that both standards offer design methods for both heated and unheated buildings. For heated buildings, the designs rely upon containing the building's heat under the footings to avoid frost heaving. In the case of unheated buildings, the designs rely upon containing the earth's natural warmth under the footings and slab by the use of more extensive insulation. (For both design approaches, compliance with their frost-protection requirements is not necessarily the same as compliance with the ch. 22 Energy Conservation standards for slab-on-grade designs.)

Because the simplified heated building design methods rely upon buildings, including attached garages, with at least a 63 degree internal temperature, it is important the building designer consult with the owner regarding their intended use. Even if the initial owner plans to keep the building heated throughout the winter, future owners may use it otherwise. Therefore, the designer should be sure to communicate the operational needs of the building through means such as building placarding, notating the Rescheck Energy Report, and/or recording relevant information on the property deed. **Failure to do so may cause severe structural damage to the building if future owners do not keep the building heated.**

An acceptable Stormwater Operation and Maintenance Plan should be based on the following outline:

- I. Introduction and general information
 - A. Contact information
 - B. Overview of site
- II. Practices (BMPs) utilized on the site
 - A. Construction
 - B. Plans and narrative of stormwater management
- III. Normal Operating Procedures
 - A. Relationship of one practice to another
 - B. Effectiveness of functioning practices
- IV. Maintenance
 - A. Contact information for responsible maintenance person or persons
 - B. Copies of any agreements for maintenance or easement
 - C. Description of routine maintenance
 - D. Sample inspection and monitoring protocol
 - E. Description of replacement plans or repair procedures for failed practices

Unheated Building Design Minimum Ground Insulation Requirements¹

Air Freezing Index (°F-days) ³ (see map)	D _g -Insulation Width from Edge of Foot- ing ^{4, 5}	Mean Annual Temperature ^{2, 6} (see map)			Minimum Footing Depth ^{7, 8}	
		38	40	≥41	D- Concrete & Insulation Depth	G-Granular Base Thickness
2,250 or less	63"	R-13.6	R-11.4	R-10.2	10"	6"
2,251-3,000	79"	R-18.2	R-15.3	R-14.2	10"	6"
3,001-3,750	91"	R-22.7	NA	NA	10"	6"

1 Also see s. SPS 322.26 for additional slab-edge insulation requirements.

2 Units are degrees Fahrenheit. See estimate provided on Mean Annual Temperature Contour Map.

3 Air freezing index shall be based on maximum year expected for a 100-year return period. See estimate provided on AFI Contour Map.

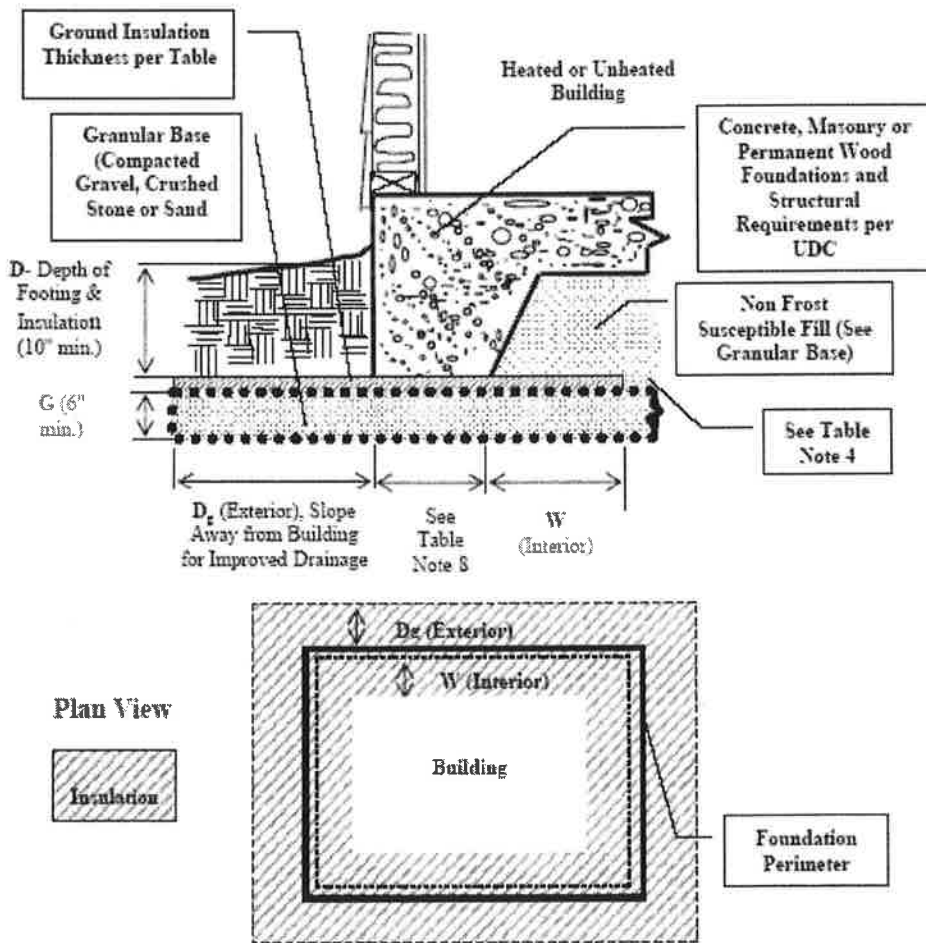
4 Ground insulation to the building interior can be extended beneath the entire slab where it is desired to protect the entire slab from frost heave action.

5 Ground insulation to the building interior can be in one horizontal plane (as shown in the detail) and covered with non frost-susceptible fill or the insulation maybe placed directly beneath the slab.

6 Insulation thickness recommendations are for extruded polystyrene (XPS) insulation.

7 The minimum depth of concrete footing and horizontal insulation is 10". A 6" drainage layer is required under the insulation.

8 Insulation placed directly beneath the footing shall be Type IV or Type VI XPS in accordance with ASTM C578. Maximum deadload placed on the Type IV insulation shall be 1200 pounds/square foot. Maximum deadload placed on Type VI shall be 1900 psf.

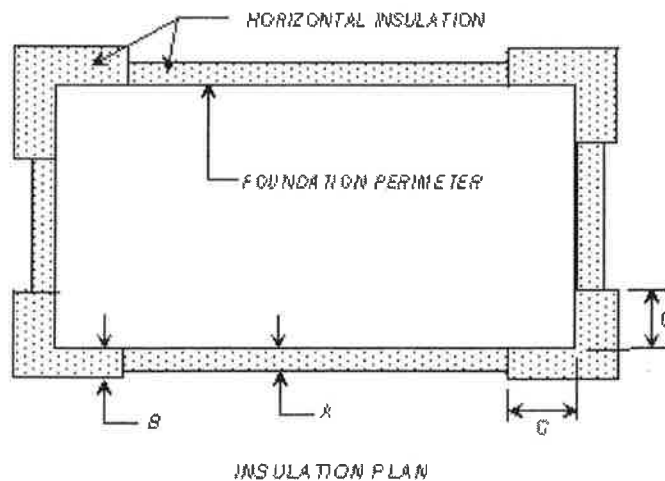
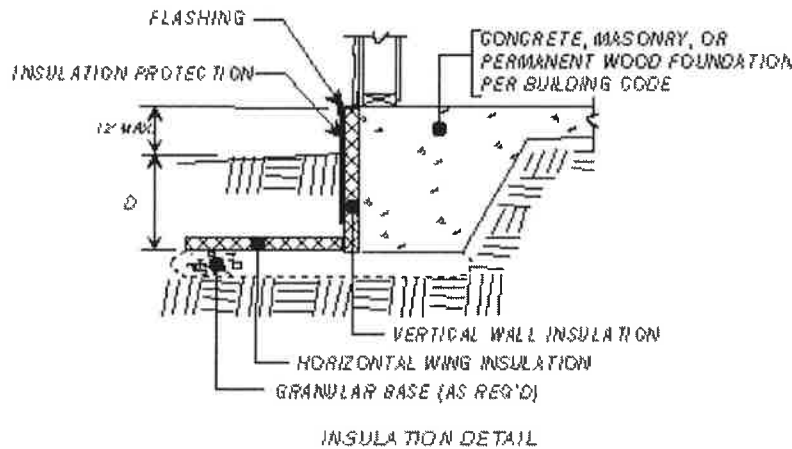


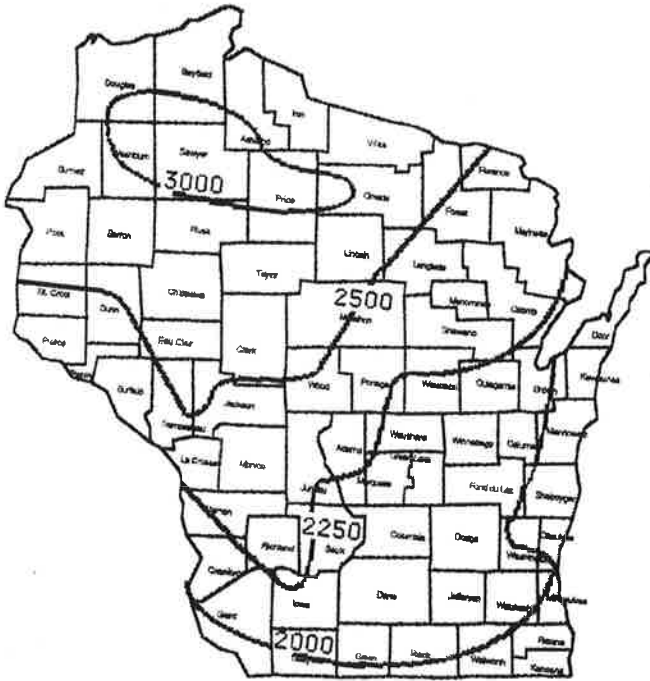
Heated Building Design

Minimum Insulation Requirements for Frost-Protected Footings in Heated Buildings¹
(Simplified Method)

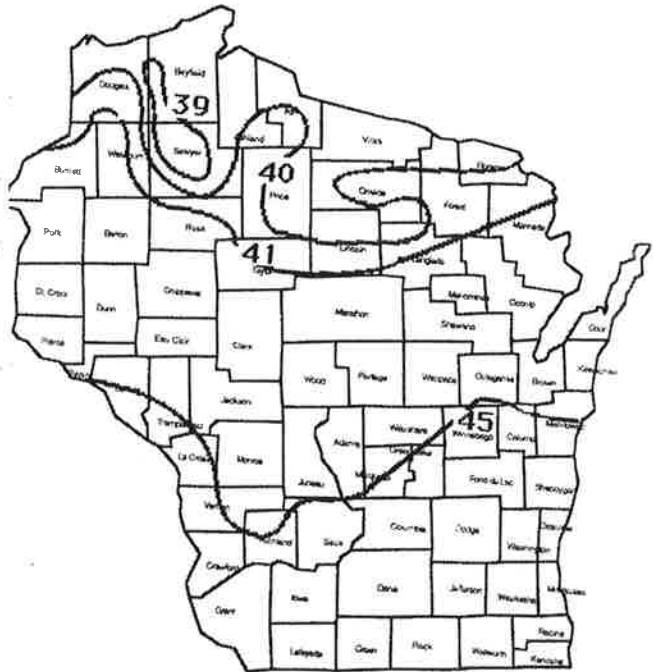
Air Freezing Index (°F days) ² (see map)	Vertical Insulation R-Value ^{3, 4}	Horizontal Insulation R-Value ^{3, 5}		Horizontal Insulation Dimensions per Figure Below (inches)			Minimum Footing Depth (inches)
		Along walls	At corners	A	B	C	
2,000 or less	5.6	NR	NR	NR	NR	NR	14
2,500 or less	6.7	1.7	4.9	12	24	40	16
3,000 or less	7.8	6.5	8.6	12	24	40	16
3,500 or less	9.0	8.0	11.2	24	30	60	16

- 1 Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissible.
- 2 See AFI Contour Map for Air Freezing Index values.
- 3 Insulation materials shall provide the stated minimum R-values under long-term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene – 2.4R per inch; Types IV, V, VI, VII extruded polystyrene – 4.5R per inch; Type IX expanded polystyrene – 3.2R per inch. NR indicates that insulation is not required.
- 4 Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.
- 5 Horizontal insulation shall be extruded polystyrene insulation.



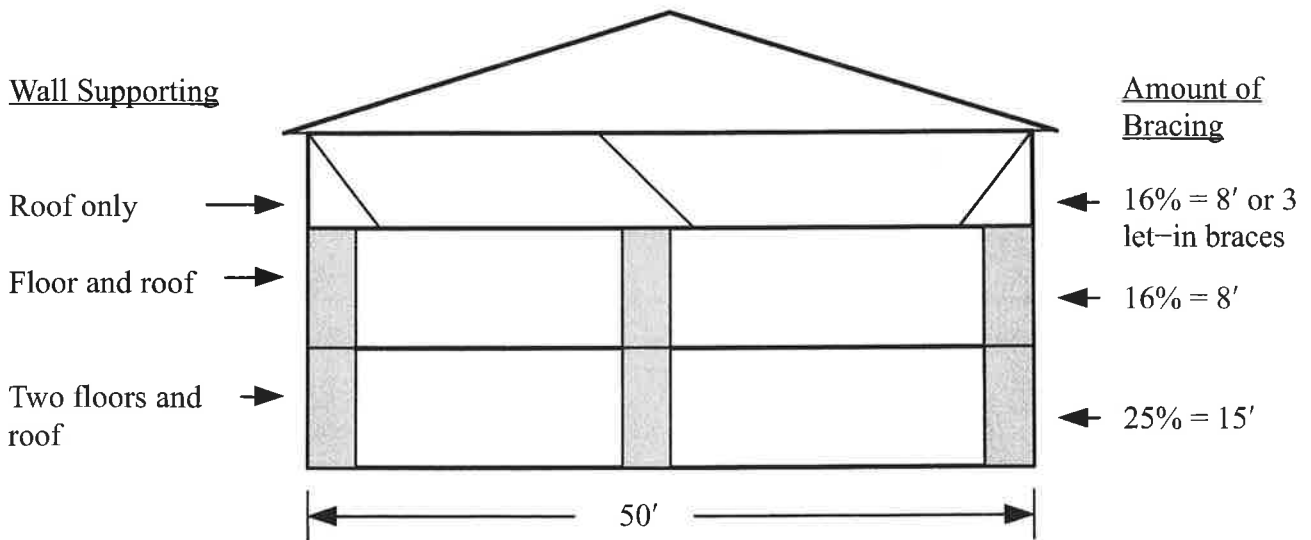


Air-Freeze Index Contour Map

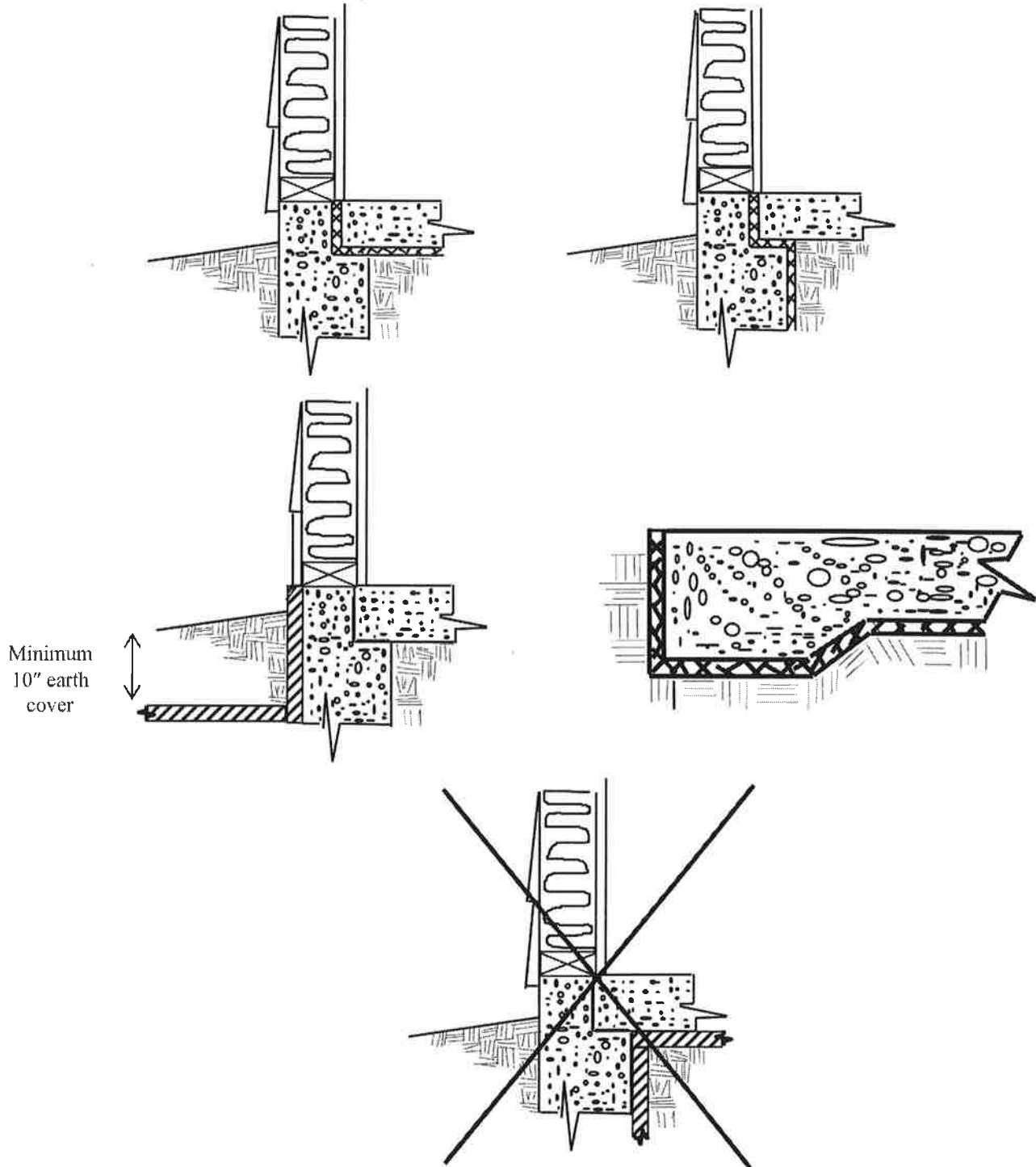


Mean Annual Temperature Contour Map

Appendix Fig. 321.25-E
 Wall Bracing Example
 (Wood Panel Sheathing and Let-in Bracing)



s. Comm 22.33
Slab-On-Grade Insulation Details



Insulation shall extend vertically and horizontally for a total of 48". In all cases the insulation shall insulate to the top edge of the floor perimeter. The last diagram is not an acceptable method. Additional insulation may be necessary to comply with the structural stability requirements of s. Comm 21.16 for frost-protected shallow foundations.

SPS 323.02 (1) Outdoor Design Temperatures

Zone 1	25° below zero F
Zone 2	20° below zero F
Zone 3	15° below zero F
Zone 4	10° below zero F

