CHAPTER 16

STRUCTURAL LOADS

(This Chapter is entirely unique to Massachusetts)

780 CMR 1601.0 GENERAL

1601.1 Scope: The provisions of 780 CMR 16 shall control the structural design of all buildings and structures, or portions thereof, hereafter erected.

780 CMR 1602.0 DEFINITIONS

1602.1 General: The following words and terms shall, for the purposes of 780 CMR 16 and as used elsewhere in 780 CMR, have the meanings shown herein.

Load: Forces or other actions that arise on structural systems from the weight of all permanent construction, occupants and their possessions, environmental effects, differential settlement and restrained dimensional changes.

Dead load: The weight of all permanent structural and nonstructural components of a building, such as walls, floors, roofs, ceilings, *stairways* and fixed service equipment.

Duration of load: The period of continuous application of a given *load*, or the aggregate of periods of intermittent applications of the same *load*.

Earthquake load: The assumed lateral *load* acting in any horizontal direction on the structural frame due to the dynamic action of earthquakes.

Impact load: The *load* resulting from moving machinery, elevators, craneways, vehicles and other similar forces and kinetic *loads*.

Internal load: The forces resulting from the restraint of movement of construction materials or differential movement of a combination of materials caused by the effects of expansion or contraction due to temperature changes, shrinkage, moisture changes, creep, differential settlement or combinations thereof.

Lateral soil load: The lateral pressure in pounds per square foot (psf) (kilograms per square meter [kg/m^2]) due to the weight of the adjacent soil, including due allowance for hydrostatic pressure and possible surcharge from fixed or moving *loads*.

Live load: Those *loads* produced by the occupancy of the building, not including environmental *loads* such as *wind loads*, snow *loads*, *earthquake loads* or *dead loads*.

Wind load: The lateral pressure on the building or structure in pounds per square foot (psf) (kilograms per square meter [kg/m^2]) due to wind blowing in any direction.

Panel (part of a structure): The section of a floor or wall comprised between the supporting frame of two adjacent rows of columns and girders or column bands of floor construction.

Wall

Loadbearing wall: A wall supporting any vertical load in addition to its own weight.

Nonloadbearing wall: A wall which does not support vertical *loads* other than its own weight.

780 CMR 1603.0 CONSTRUCTION DOCUMENTS

1603.1 General: *Construction documents* shall show the size, and relative locations of all structural members with foundation, floor and roof levels, column centers and all offsets dimensioned. The design loads and other information pertinent to the structural design required by 780 CMR 1603.2 through 1603.7 shall be clearly indicated on the *construction documents* for all parts of the building or structure.

1603.2 Floor live load: The uniformly distributed floor *live load* utilized in the design shall be indicated for all floor areas (780 CMR1606.0). *Live load* reduction (780 CMR 1608.0), if utilized, shall be indicated.

1603.3 Roof live load: The roof *live load* utilized in the design shall be indicated for all roof areas (780 CMR 1609.0).

1603.4 Roof snow load: The basic snow *load* shall be indicated.

1603.5 Wind load: The following information related to *wind loads* shall be indicated, regardless of whether *wind loads* govern the lateral design of the building:

1. Wind Load Zone. If more than one wind direction is exposed, the applicable wind direction shall be indicated
2. Wind pressure, P.
3. Special exposures

1603.6 Earthquake design data: Where *earthquake loads* are applicable, the following earthquake design data shall be indicated on the *construction documents*:

1. The Seismic Hazard Exposure Group in accordance with 780 CMR 1612.2.5;
3. The soil-profile type in accordance with Table 1612.4.1;
4. The basic structural system and seismic-resisting system in accordance with Table 1612.4.4;
5. The response modification factor (R) and the deflection amplification factor (C_d) in accordance with Table 1612.4.4; and
6. The analysis procedure utilized in accordance with 780 CMR 1612.5 or 1612.6 as applicable.

1603.7 Other loads: Concentrated *loads* (780 CMR 1613.0), *impact loads* (780 CMR 1614.0) and special *loads* (780 CMR 1615.0) which are applicable to the design of the building or structure shall he indicated.

780 CMR 1604.0 DESIGN SAFE LOAD

1604.1 Safe support required: Buildings or other structures, and all parts thereof, shall be designed and constructed to support safely all *loads*, including *dead load*s, without exceeding the allowable stresses (or specified strengths when appropriate *load* factors are applied) for the materials of construction in the structural members and connections.

1604.2 Progressive collapse: Buildings and structural systems shall provide such structural integrity that the hazards associated with progressive collapse are reduced to a level consistent with good engineering practice. Structures shall be able to sustain local damage or failure, with the structure as a whole remaining stable. Compliance with the applicable provisions of ASCE 7 listed in ***Appendix A*** shall be deemed to meet the requirements of 780 CMR 1604.0.

1604.3 In-situ load tests: The code official is authorized to require an engineering analysis or a load test, or both, of any construction whenever there is reason to question the safety of the construction for the intended occupancy. Engineering analysis and load tests shall be conducted in accordance with 780 CMR 1707.0 or 1709.0.

780 CMR 1605.0 DESIGN DEAD LOAD

1605.1 Weights of materials and construction: In estimating *dead loads* for the purposes of structural design, the actual weights of materials and constructions shall be utilized, but not less than the unit *dead load*s prescribed in Appendix G, or ASCE 7 listed in ***Appendix A***. In the absence of definite information, any values assumed by the designers shall be subject to the approval of the code official.

2. The Seismic Performance Category in accordance with 780 CMR 1612.2.7;

1605.2 Weight of fixed service equipment: In estimating *dead load*s for the purposes of design, the weight of fixed service equipment such as plumbing stacks and risers, electrical feeders, heating, *ventilating*, air conditioning and *fire protection systems*, shall be included.

1605.3 Partition load: In offices and other buildings in which subdividing partitions are subsequently erected, rearranged or relocated, provisions shall be made to support the actual weight of such partitions where the partitions occur, or for an equivalent uniform *load*, which shall be assumed to be not less than 20 psf (97.64 kg/m^2) of floor area in addition to the specified uniforrnly distributed *live load*. Provisions for partition weight shall be made whether or not partitions are shown on the *construction documents*, unless the specified *live load* exceeds 80 psf (390.56 kg/m^2).

780 CMR 1606.0 UNIFORMLY DISTRIBUTED LIVE LOADS

1606.1 Uniform live load: The minimum uniformly distributed *live load* in pounds per square foot shall be as provided for in Table 1606.1, and for all concentrated *loads* wherever such *loads* occur as provided for in 780 CMR 1613.0. The *live loads* in Table 1606.1 are the minimum *loads* to be used for the occupancies listed. Where the building will be subjected to greater *live loads*, such *loads* shall be utilized for design.

1606.1.1 Trucks and buses: Minimum *live loads* for *garages* having trucks or buses shall be in accordance with lane *loads* of AASHTO HB- 15 listed in ***Appendix A***, but shall not be less than 50 psf (244 kg/m^2).

1606.1.2 Residential attics: All *live load* shall be applied to joists or to bottom chords of trusses or trussed rafters only in those portions of *attic* space having a clear height of 42 inches (1067 mm) or more between joist and rafter in conventional rafter construction; and between bottom chord and any other member in trusses or trussed rafter construction. However, joists or the bottom chords of trusses or trussed rafters shall be designed to sustain the imposed *dead load* or ten psf (49 kg/m^2), whichever is greater, uniformly distributed over the entire span.

A further ceiling dead-load reduction to a minimum of five psf (24 kg/m^2) or the actual *dead load*, whichever is greater, applied to joists in conventional rafter construction or to the bottom chords of trusses or trussed rafters is permitted under either or both of the following conditions:

1. Where the clear height is not over 30 inches (762 mm) between joist and rafter in conventional construction and between the bottom chord and any other member for trusses or trussed rafter construction.

2. Where a clear height of greater than 30 inches (762 mm), as defined in 780 CMR 1606.1 item 1, does not exist for a horizontal distance of more than 12 inches (305 mm) along the member.

Table 1606.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS

Occupancy	Live load (psf)[a]
Apartments (see Residential)	
Armories and drill rooms	150
Assembly areas & theatres:	
Fixed seats	60
Movable seats	100
Platforms (assembly)	100
Stage floors	150
Balcony, decks (exterior)	100
One-and two-family dwellings only	60
Bowling centers, poolrooms and billiard rooms	75
Cornices	60
Corridors, except as otherwise indicated	100
Dwellings (see Residential)	
Fire escapes	100
Single-family residential buildings only	40
Garages:	
Passenger cars	50
Trucks and buses - see also 780 CMR 1606.1.1	50
Grandstands (see Reviewing stands)	
Gymnasiums, main floors and balconies	100
Hospitals	
Operating Rooms Laboratories	100
Private Rooms	40
Wards	40
Corridors above first floor	80
Hotels (see Residential)	
Institutional - residential care (see Residential)	
Libraries:	
Reading Rooms	60
Stack rooms (books and shelves @ 40 pcf but not less than)	150
Manufacturing	
Light	125
Heavy	150
Marquees	75
Office buildings:	
Offices	50
Lobbies	100
Corridors, above first floor	80
File and computer rooms require heavier *loads* based upon anticipated occupancy	
Penal Institutions:	
Cell Blocks	40
Corridors	100
Residential:	
Attics - see 780 CMR 1606.1.2	20
Multiple - family dwellings:	
Dwelling units	40
Public rooms	100
Corridors	80
One-and two-family dwellings (areas other than sleeping rooms)	40
Sleeping rooms	30
Decks, balconies, etc.	60
Hotels:	
Guestrooms	40
Public rooms	100
Corridors serving public rooms	100
Corridors	80
Reviewing stands, grandstands and bleachers - see 780 CMR 1615.5	100
Schools	
Classrooms	50
Corridors	80
Flexible open plan areas	100
Sidewalks, vehicular driveways, subject to trucking	250
Skating rinks	100
Stairs and exits	100
Storage areas:	
Light	125
Heavy	250
Stores:	
Retail - 1st floor	100
Retail - upper flloors	75
Wholesale	100
Yards and terraces, pedestrians	100

Note a. 1 psf = 4.882 kg/m^2.

780 CMR 1607.0 DESIGN LIVE LOAD

1607.1 Required live load: The *live loads* to be assumed in the design of buildings and structures shall be the greatest *load* produced by the intended occupancy, but not less than the minimum uniformly distributed unit *loads* required in 780 CMR 1606.0 for specific use groups.

1607.2 Loads not specified: The code official shall approve the required *live load* for any occupancy not specifically provided for in Table 1606.1.

1607.3 Partial loading: The full intensity of the appropriately reduced live load applied only to a portion of the length of a structure or member shall be considered if such applied load produces a more unfavorable effect than the same intensity applied over the full length of the structure or member.

780 CMR 1608.0 LIVE LOAD REDUCTION

1608.1 General: The design live loads specified in 780 CMR 1607.0 may be reduced as permitted and

specified herein, except that the design live load shall not be reduced on the following types of structural members:

1. One-way precast or cast-in-place solid, ribbed and hollow core concrete slabs.

   Exception: Ribs of ribbed or hollow core slabs may be treated as individual beams, and **Exception**: live load may be reducted on slab panels if there are beams on all sides of the panels, and load is transferred to the columns from these beams entirely by "beam shear".

3. Hangers

1608.2 Design live loads of 100 psf or less: Except for places of public assembly (as defined in 780 CMR 210.) garages, and open parking structures, a structural member having a tributary area A_T that is greater than A_B may be designed for a reduced live load determined by the following formulas:

N = the largest of the following:

1. 1 - 0.0008 (A_T - A_B)
2. 0.75 - 0.20 (D_o/L_o)
3. 0.50 for members supporting load from more than one floor, or 0.60 for members supporting load from one floor only, in which:

L = reduced design live load for the member

L_o = basic design live load

D_o = dead load on the member

A_T = loaded area tributary to the member, square feet

A_B = basic tributary area, square feet, defined as follows:

A_B = 100 square feet for members supporting load from more than one floor

A_B = 250 square feet for members supporting load from one floor only

1608.3 Design live loads greater than 100 psf and design live loads for garages and open parking structures: Structrual members supporting load from more than one floor may be designed for a reduced live load equal to 80% of the design live load.

1608.4 For determination of the number of floors supported by a member in 780 CMR 1608.1, 1608.2 and 1608.3 a roof may be considered to be a floor if the design live load of the roof is equal to or greater than the design live load of the floor below.

780 CMR 1609.0 ROOF LOADS

1609.1 General: The structural supports of roofs and marquees shall be designed to resist *wind* (see 780 CMR 1611.0) and, where applicable, snow (see 780 CMR 1610.0) and *earthquake loads* (see 780 CMR 1612.0) in addition to the *dead load* of construction and the appropriate *live loads* as prescribed in 780 CMR 1609.0, or in Table1606.1

live load may be reduced on the ribs the same as for beams.

2. Two-way concrete flat slabs and grid slabs, with or without capitals or drop panels.

1609.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 1609.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Fabric awning: A fabric awning is an architectural projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid or retractable skeleton structure over which a fabric cover is attached.

Fabric canopy: A fabric canopy is an architectural projection that provides weather protection, identity or decoration and is ground supported in addition to being supported by the building to which the canopy is attached. A canopy is comprised of a lightweight skeleton structure over which a fabric cover is attached. A fabric canopy is not a primary structure or a roof.

1609.3 Minimum roof loads: Ordinary roofs, either flat, pitched or curved, shall be designed for the *live loads* as specified in Table 1609.3 or the snow *load*, whichever is greater.

1609.4 Overhanging eaves: In other than occupancies in Use Group R-3, and except where the overhang framing is a continuation of the roof framing, overhanging eaves, cornices and other roof projections shall be designed for a minimum uniformly distributed *live load* of 60 psf (292.92 kg/m^2).

Table 1609.3

MINIMUM ROOF LIVE LOADS[a]

Roof slope	Tributary loaded area in square feet[b] for any structural member		
	0 to 200	201 to 600	Over 600
Flat, or rise less than 4 inches per foot (1:3)			
Arch or dome with rise less than _ of span	20	16	12
Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1)			
Arch or dome with rise _ of span or less than _ of	16	14	12

span			
Rise 12 inches per foot (1:1) and greater			
Arch or dome with rise _ of span or greater	12	12	12

Note a: *loads* are expressed in pounds per square foot of horizontal projection

Note b: 1 square foot = 0.093 m^2, 1 psf = 4.882 kg/m^2

1609.5 Ponding: Roofs shall be designed for the maximum possible depth of water that would pond thereon as determined by the relative levels of roof deck and overflow weirs, scuppers, edges or serviceable drains in combination with the deflected structural elements. In determining the maximum possible depth of water, all primary roof drainage means shall be assumed to be blocked.

1609.6 Special purpose roofs: Where occupied for incidental promenade purposes, roofs shall be designed for a minimum *live load* of 60 psf (292.92 kg/m^2); and 100 psf (488.20 kg/m^2) where designed for roof gardens or assembly or educational occupancies.

1609.6.1 Landscaped roofs: Where roofs are to be landscaped, the uniform design *live load* in the landscaped area shall be 20 psf (97.64 kg/m^2). The weight of the landscaping materials shall be considered as *dead load* and shall be computed on the basis of saturation of the soil.

1609.6.2 Fabric awnings and canopies: Where awnings and canopies are covered with a *fabric* material, such awnings and canopies shall be designed for a uniform *live load* of 5 psf (24.4 kg/m^2) as well as for snow *loads* and *wind loads* as specified in 780 CMR 1610.0 and 1611.0.

1609.6.3 Special purpose roofs: Roofs to be utilized for other special purposes shall be designed for appropriate *loads*, or as otherwise approved.

780 CMR 1610.0 SNOW LOADS

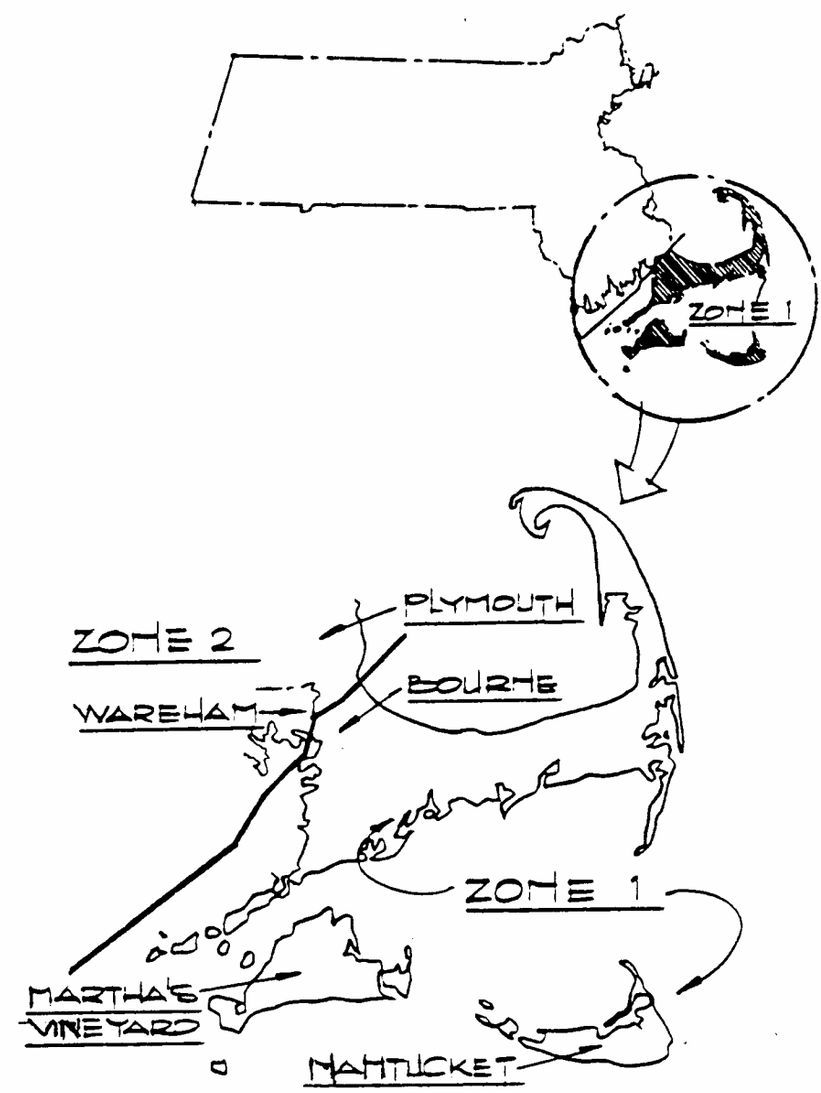
1610.1 General: Design snow *loads* shall be determined in accordance with 780 CMR 1610.0 and shall be applied to the roof and open decks of all buildings and other structures.

1610.1.1 Application of loads: Buildings and other structures shall be designed for the greater of the effects from either a uniform snow load over the whole roof or open deck (balanced snow load) or an unbalanced snow load on the roof or open deck (partial snow load). Buildings and other structures shall also be designed for the additional effects of drifting snow at changes in roof elevation and at roof projections, and for the additional effects of sliding snow. Snow loads acting on a sloping surface shall be considered to act on the horizontal projection of that surface. When establishing unbalanced snow loads or drifting snow loads, the effects of wind from any direction shall be considered.

1610.2 Basic snow load: Figures 1610.1A, 1610.1B, 1610.1C, and 1610.1D define four snow load zones in the state. The basic snow load for each zone shall be a uniformly distributed load, P_f, in pounds per square foot of horizontal projection, as follows:

Snow Load Zone	P_f
1	25 psf
2	30 psf
3	35 psf
4	40 psf

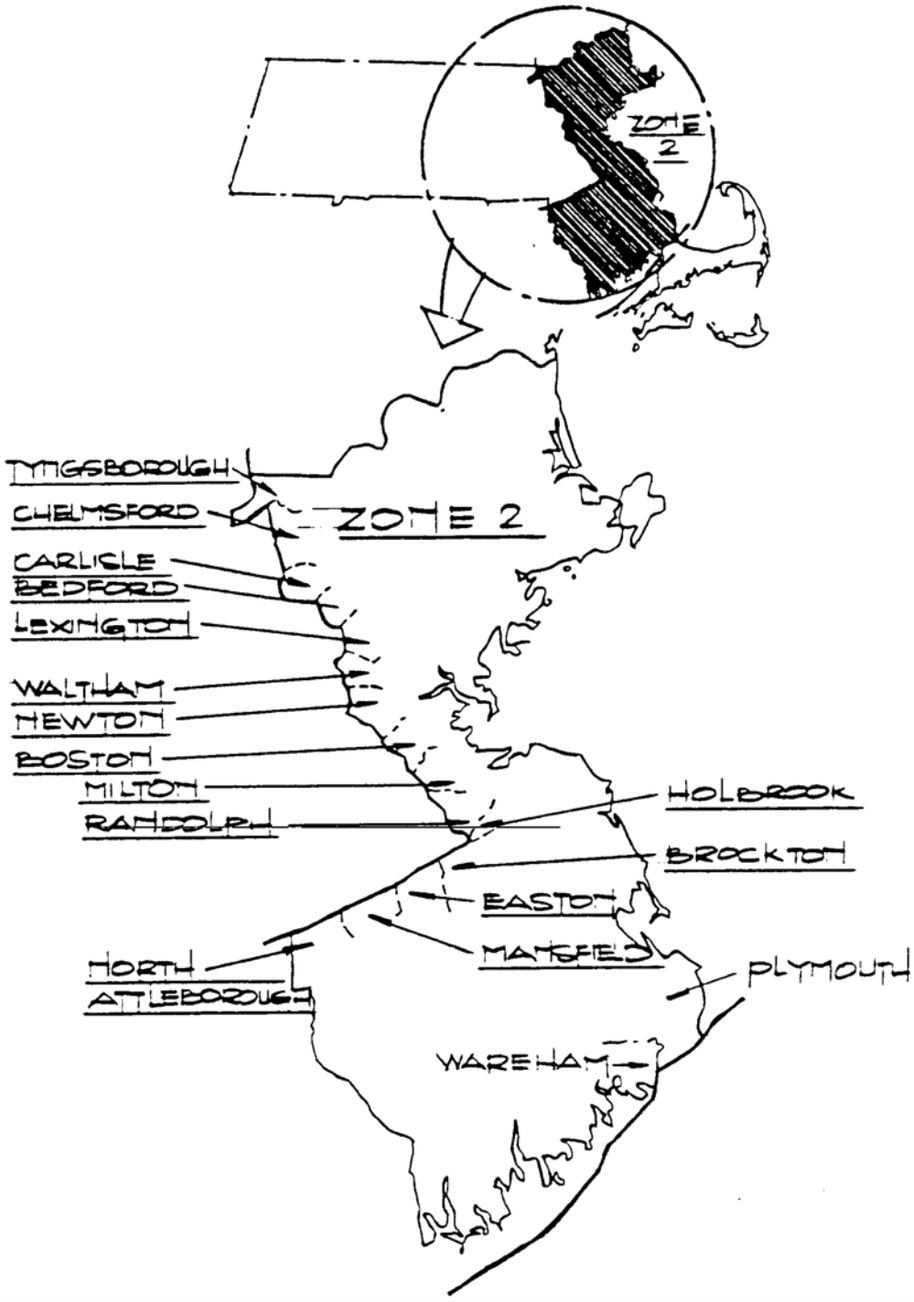
Figure 1610.1A
SNOW LOAD MAP - ZONE 1



List of Towns in Minimum Uniform
Snow Load Zones Zone 1

Barnstable	**G**ay Head	**S**andwich
Bourne	Gosnold	
Brewster		**T**isbury
	Harwich	**T**ruro
Chatham		
Chilmark	**M**ashpee	**V**ineyard Haven
Dennis	**N**antucket	**W**ellfleet
		West Tisbury
Eastham	**O**ak Bluffs	
Edgartown	Orleans	**Y**armouth
Falmouth	**P**rovincetown	

Figure 1610.1B
SNOW LOAD MAP - ZONE 2

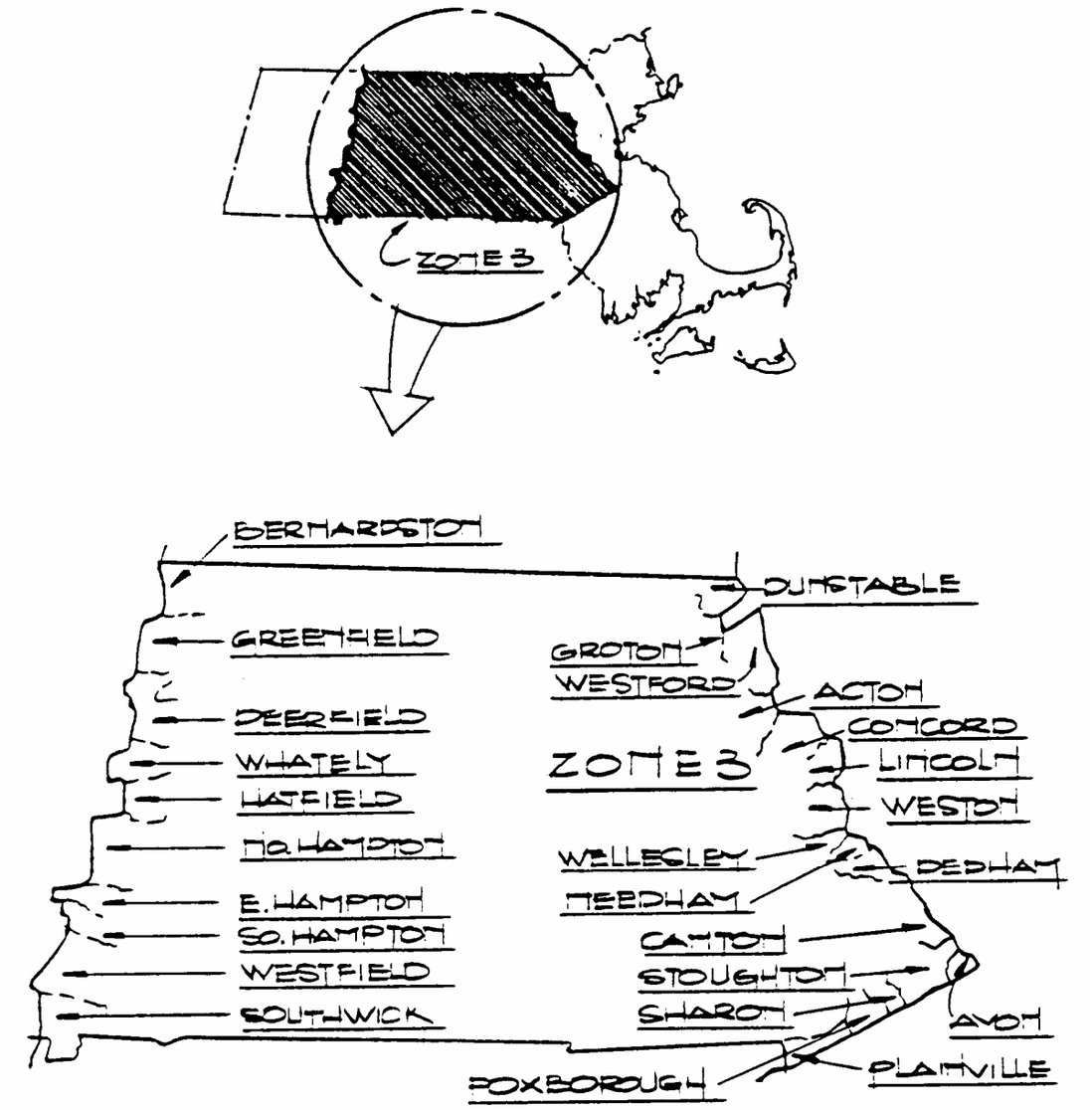


List of Towns in Minimum Uniform Snow Load Zones Zone 2

Abington	**C**ambridge	Freetown	Lawrence	Milton	**R**andolph	**T**aunton
Acushnet	Carlisle		Lexington		Raynham	Tewksbury
Amesbury	Carver	**G**eorgetown	Lowell	**N**ahant	Reading	Topsfield
Andover	Chemlsford	Gloucester	Lynn	New Bedford	Rehoboth	Tyngsborough
Arlington	Chelsea	Groveland	Lynnfield	Newbury	Revere	
Attleboro	Cohasset			Newburyport	Rochester	**W**akefield
		Halifax		Newton	Rockland	Waltham
Bedford	**D**anvers	Hamilton	**M**alden	N. Andover	Rockport	Wareham
Belmont	Dartmouth	Hanover	Manchester	N. Attleboro	Rowley	Watertown
Berkley	Dighton	Hanson	Mansfield	N. Reading		Wenham
Beverly	Dracut	Haverhill	Marblehead	Norton	**S**alem	W. Bridgewater
Billerica	Duxbury	Hingham	Marion	Norwell	Salisbury	W. Newbury
Boston		Holbrook	Marshfield		Saugus	Westport
Boxford	**E**. Bridgewater	Hull	Mattapoisett	**P**eabody	Scituate	Weymouth
Braintree	Easton		Medford	Pembroke	Seekonk	Whitman
Bridgewater	Essex	**I**pswich	Melrose	Plymouth	Somerset	Wilmington
Brockton	Everett		Merrimac	Plympton	Somerville	Winchester
Brookline		**K**ingston	Methuen		Stoneham	Winthrop

Burlington	**F**airhaven		Middleborough	**Q**uincy	Swampscott	Woburn
	Fall River	**L**akeville	Middleton		Swansea	

Figure 1610.1C
SNOW LOAD MAP - ZONE 3

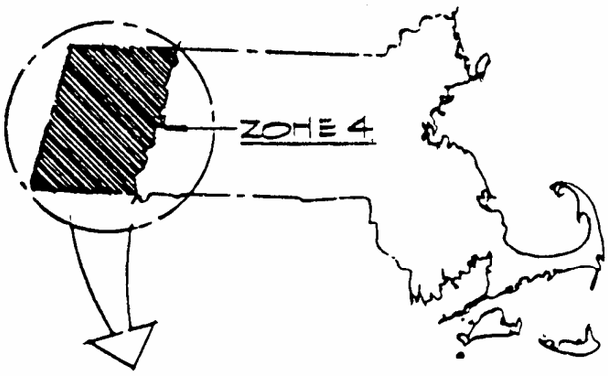


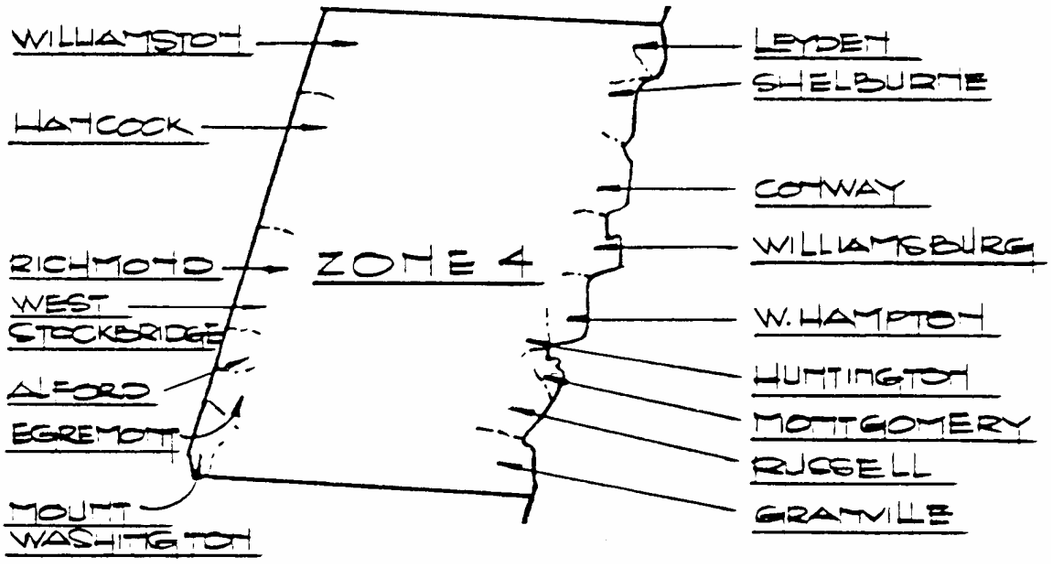
List of Towns in Minimum Uniform Snow Load Zones Zone 3

Acton	Chicopee	Greenfield	Lunenburg	**O**akham	Sunderland	Wendell
Agawam	Clinton	Groton		Orange	Suttton	West Boylston
Amherst	Concord		**M**arlborough	Oxford	Sharon	West Brookfield
Ashburnham		**H**adley	Maynard		Sherborn	W. Springfield
Ashby	**D**edham	Hampden	Medfield	**P**almer	Shirley	Westborough
Ashland	Deerfield	Hardwick	Millbury	Paxton	Shrewsbury	Westfield
Athol	Douglas	Harvard	Millville	Pelham	Shutesbury	Westford
Auburn	Dover	Hatfield	Medway	Pepperell	S. Hadley	Westminster
Avon	Dudley	Holland	Mendon	Petersham	Southampton	Weston
Ayer	Dunstable	Holliston	Milford	Phillipston	Southborough	Westwood
		Holden	Millis	Plainville		Wilbraham
Barre	**E**. Brookfield	Holyoke	Monson	Princeton	**T**empleton	Winchendon
Belchertown	Easthampton	Hopedale	Montague		Townsend	Whately
Bellingham	E. Longmeadow	Hopkinton		**R**oyalston		Worcester
Berlin	Erving	Hubbardston	**N**atick	Rutland	**U**pton	Wrentham
Bernardston		Hudson	Needham		Uxbridge	
Blackstone	**F**itchburg		New Braintree	**S**outhbridge		
Bolton	Foxborough	**L**ancaster	New Salem	Southwick	**W**ales	
Boylston	Framingham	Leicester	Norfolk	Spencer	Walpole	
Boxborough	Franklin	Leominster	North Brookfield	Springfield	Ware	

Brimfield		Leverett	Northampton	Sterling	Warren
Brookfield	**G**ardner	Lincoln	Northborough	Stoughton	Warwick
	Gill	Littleton	Northbridge	Stow	Wayland
Canton	Grafton	Longmeadow	Northfield	Sturbridge	Webster
Charlton	Granby	Ludlow	Norwood	Sudbury	Wellesley

Figure 1610.1D
SNOW LOAD MAP - ZONE 4





List of Towns in Minimum Uniform Snow Load Zones Zone 4

Adams	Colrain	**H**ancock	Monterey	Plainfield	**T**olland
Alford	Conway	Hawley	Montgomery		Tyringham
Ashfield	Cummington	Heath	Mount Washington	**R**ichmond	
		Hinsdale		Rowe	**W**ashington
Becket	**D**alton	Huntington	**N**ew Ashford	Russell	W. Stockbridge
Blandford			New Marlborough		Westhampton
Buckland	**E**gremont	**L**anesborough		**S**andisfield	Williamsburgh
		Lee	North Adams	Savoy	Williamstown
Charlemont	**F**lorida	Lenox		Sheffield	Windsor
Cheshire		Leyden	**O**tis	Shelbourne	Worthington
Chester	**G**oshen			Stockbridge	
Chesterfield	Granville	**M**iddlefield	**P**eru		
Clarksburg	Great Barrington	Monroe	Pittsfield		

1610.3 Symbols and notations: The following symbols and notations apply to the provisions of 780 CMR 1610.0.

a = roof slope expressed in degrees

A = coefficient for amount of sliding snow

A_d= crossectional area of drift surcharge, expressed in square feet

C_S = slope factor (See 780 CMR 1610.5)

D = density of snow, expressed in pounds per cubic foot (pcf)

h_b =height of uniform snow load on lower roof or deck, expressed in feet

h_d =maximum height of drift surcharge, expressed in feet

h_{dr} = reduced height of drift surchargfe, expressed in feet

H_{dl} = potential height of drift surcharge from snow blown from lower roof, expressed in feet

H_{dur}=reduced height of drift surcharge from snow blown from upper roof, expressed in feet

h_r = difference in height between the upper and lower roof or deck, expressed in feet

L_T =the dimension of an upper roof or projecting element perpendicular to the wind flow (perpendicular to (W bu and W bl), expressed in feet

P_f = basic uniform snow load, expressed in pounds per square foot (psf)

P_s = intensity of sloped roof snow load, expressed in pounds per square foot (psf)

P_{ds} = maximum intensity of surcharge load from sliding snow, expressed in pounds per square foot (psf)

S = horizontal separation between adjacent structures, expressed in feet (See Figure 1610.7)

W_a = horizontal dimension, in feet, of upper sloping roof (See Figure 1610.10)

W_{bu} =horizontal dimension, in feet, of upper roof normal to the line of change in roof level (See Figure 1610.4)

W_{bl} =horizontal dimension, in feet, of lower roof normal to the line of change in roof level (See Figure 1610.4)

W_d = width of snow drift, expressed in feet (See Figure 1610.4)

W_s = width of sliding snow drift, expressed in feet (See Figure 1610.10)

H_{dlr}=reduced height of drift surcharge from snow blown from lower roof, expressed in feet

H_{du} =potential height of drift surcharge from snow blown from upper roof, expressed in feet

1610.4 Uniform Snow Loads

1610.4.1 Uniform snow load for flat and low-sloped roofs with planar panels: the snow load on a flat roof or on a roof with planar panels which have a slope less than 30 degrees shall be equal to the basic snow load, P_f.

1610.4.2 Uniform snow load for sloped roofs with planar panels: The sloped roof snow load on roofs having a slope greater than 30 degress shall be calculated using the following formula:

(Equation 1)

where "C_S" is determined by the following formula:

(Equation 2)

and "a" is the slope of the roof expressed in degrees.

1610.4.3 Uniform snow load for convex curved roofs: Where the tangents to the surface of a convex curbed roof have slopes greater than 70 degrees, the point at which the slope of the tangent exceeds 70 degrees shall be considered the effective eave. The surface of a convex curved roof below the effective eave shall be considered free of snow. The snow load on a convex curved roof shall be determined by Equation 1, with "a" equal to the effective roof slope in degrees. The effective roof slope is equal to the slope of a chord from the eave or effective eave to the crown of the roof.

1610.4.4 Uniform snow load for concave curved roofs: The effective loaded area of a concave curved roof shall be that area of the surface of the roof where the tangents to the surface have a slope of 50 degrees or less. The total load on a concave curved roof shall be the basic snow load, P_f, multiplied by the total horizontal projected area of the roof. This total load shall be applied uniformly over the effective loaded area of the roof.

1610.4.5 Uniform Snow Loads for multiple roofs: For multiple folded-plate, sawtooth, and barrel vault roofs, the snow *load* shall be equal to the basic snow *load*, P_f, regardless of the slope of the roof.

1610.5 Unbalanced Snow loads: Except as otherwise specifically provided in 780 CMR 1610.5.1 through 780 CMR 1610.5.3, unbalanced snow loads shall be applied in patterns of 100% of the uniform snow *load* alternating with 50% of the uniform snow *load*. The location and extent of the loadings in the patterns shall be such as to maximize the various structural effects.

1610.5.1 Unbalanced snow load for hip and gable roofs: For hip and gable roofs with slopes between 15 degrees and 70 degrees, the structure shall be designed to sustain an unbalanced

uniform snow load on the leeward side of the roof equal to $1.5P_S$, where P_S is determined in accordance with 780 CMR 1610.4.2. The windward side of the roof shall be considered free from snow.

1610.5.2 Unbalanced snow load for convex curved roofs. For convex curved roofs with effective roof slopes between ten degrees and 60 degrees, determined in accordance with 780 CMR 1610.4.3, unbalanced snow *loads* shall be determined in accordance with the loading diagrams of Figure 1610.2. In all cases, the windward side shall be considered free of snow, and any portion of the leeward side of the roof where the slope of the tangent to the roof surface is greater than 70 degrees shall also be considered free from snow. If the ground or another roof abuts a Case-II or Case-III (see Figure 1610.2) convex curved roof structure at, or within three feet of its eave, the snow load distribution shall be in accordance with the dashed lines on Figure 1610.2.