

Natural Lighting and Ventilation Calculations 2024

In the State Housing Code, sections 105 CMR 410.220 and 410.440 both refer to requirements for Natural Lighting and Ventilation.

410.220: Natural and Mechanical Ventilation

(A) Habitable rooms, and rooms with a toilet, bathtub or shower shall have:

(1) Windows, skylights, or doors through the exterior walls or roofs that can be easily opened with a combined opening of at least 4% of the floor area of that habitable room or room containing a toilet, bathtub or shower; or

(2) Mechanical ventilation capable of exhausting air to the outdoors.

(B) When the board of health has determined that natural ventilation is insufficient to remove excess moisture, mechanical ventilation is required.

(C) Mechanical ventilation shall be installed and maintained in accordance with 780 CMR: Massachusetts State Building Code.

(D) Each mechanical ventilation system shall be equipped with a readily accessible means for shut-off, unless such system is designed to run constantly or is barometrically controlled.

410.430: Natural Light and Obstructions

(A) The owner shall provide transparent or translucent glass which admits unobstructed light from the outdoors equal in area to a minimum 8% of the entire floor area in:

(1) Habitable rooms other than a kitchen.

(2) Kitchens which have a floor area greater than 70 square feet.

(B) If any light obstructing structure is located less than three feet from the outside of and extends to a level above the lower level of the transparent or translucent glass, that portion so obstructed shall not be included as contributing to the required minimum total glass area.

To determine compliance with Natural Ventilation or Lighting requirements, calculations are often required involving room square footage and window square footage.

A few general tips to consider when doing these calculations:

- Convert all measurements into inches. I.e. instead of the room being 12 feet long by 10 feet 6 inches wide, use 144 inches for Length and 126 inches for Width.
- Once you have square footage in inches, divide this by 144 which is the number of inches in one square foot (i.e. 12 inches by 12 inches).
- When measuring a window for Ventilation, make sure to use the openable portion of the window. If only half of the window opens (i.e. raising one sash) this is the part that is measured.

Attached are a few examples to aid in this calculation.

Example 1

- A bedroom is 10 feet long by 9 feet wide and has one window. What size window would need to be provided to meet both Natural Ventilation and Natural Lighting requirements?
 - Length - 10 ft x 12 = 120 inches long
 - Width - 9 ft x 12 = 108 inches wide
 - Square footage = Length x Width
 - 120 x 108 inches = 12,960 square inches
 - To get square footage you must divide by 144 (number if inches in 1 square foot)
 - $12,960 / 144 = 90$ square feet → square footage of the room.
- Natural Ventilation requirements note that 4% of the floor area must be provided.
 - $90 \times 0.04 = 3.6$ square feet
 - **It is important to note that if this is a window, the openable portion of the window must be 3.6 square feet or more.**
 - For example, in the image below, if examining a single hung window (left side) the size of the bottom sash, which slides up and down, would need to be at least 3.6 square feet (i.e. the bottom sash would need to be 1.5ft by 2.5ft)
 - If examining a casement window, the entire window opens, and therefore the entire area of the window would need to be 3.6 square feet (i.e. a 1.5ft by 2.5ft window).



Single-Hung



Casement

Example 2

- A bedroom is 8 feet 5 inches long and 9 feet 10 inches wide. There are two windows (Window A and Window B) present in the bedroom with measurements listed below. Is the provided amount of natural ventilation enough to meet the Housing Code requirements?
- Length x Width - 8 feet 5 inches equals 101 inches; 9 feet 10 inches equals 118 inches
 - $101 \times 118 = 11,918$ square inches
 - $11,918 / 144 = 82.76$ square feet
- Natural Ventilation = 4% of floor area
 - $82.76 \times 0.04 = 3.31$ square feet of ventilation needed
- If Window A is 1 foot 6 inches long and 1 foot 6 inches wide, and Window B has an openable area that is 1 foot wide by 2 feet wide, is this enough ventilation?
 - Window A → 1 foot 6 inches = 18 inches long; 18 inches wide
 - $18 \times 18 = 324$; $324 / 144 = 2.25$ square feet of ventilation offered
 - Window B → 1 foot - 12 inches; 2 feet = 24 inches
 - $12 \times 24 = 288$; $288 / 144 = 2$ square feet of ventilation offered
 - Window A ventilation + Window B ventilation = 2.25 square feet + 2 square feet = 4.25 square feet of ventilation provided.
- **Provided ventilation (4.25 square feet) is more than 3.31 square required**

Example 3

- A living room is 12 feet 3 inches long and 11 feet 11 inches wide. How much natural lighting is required to meet the Housing Code?
- Length x Width - 12 feet 3 inches = 147 inches long; 11 feet 11 inches = 132 inches wide.
 - $147 \text{ inches} \times 132 \text{ inches} = 19,404$ square inches
 - $19,404 / 144 = 134.75$ square feet → this is the square footage of the living room.
- Natural Lighting requirement is 8% of the square footage.
 - $134.75 \text{ square feet} \times 0.08 = \mathbf{10.78 \text{ square feet of natural lighting}}$

Other Tips:

- Not every room will be a perfect square. You can always try to break the room up into easily measurable parts and add the square footage of these pieces together, or see if the building department has any plans on file.
- Don't include spaces such as bumpouts (i.e. closets, plumbing covers, etc) in the total square footage.
 - I.e. in the diagram below - Measure the Length and Width of the closet, and subtract the square footage from the total square footage of the room.
 - Room Length - 9 feet, Room Width 8 feet; closet width 1 foot, closet length 2 feet
 - Room (108 inches x 96 inches) - (12 inches x 24 inches) = 10,368 - 288 = 10080 inches / 144 = 70 square feet

