

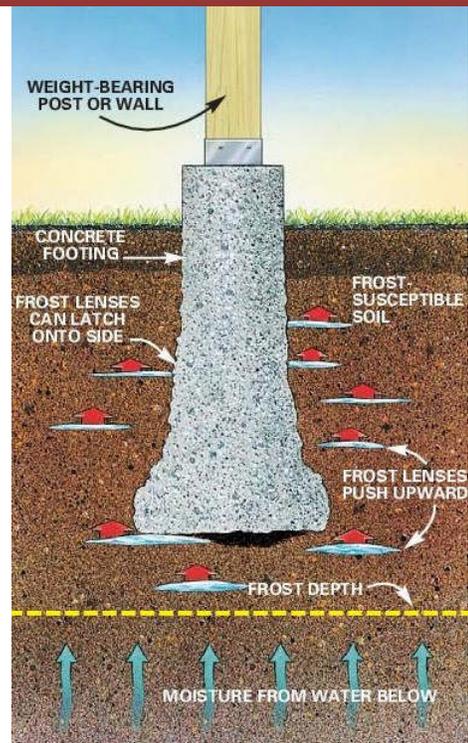


FROST HEAVE DECK AND PORCH FOOTINGS

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Building Safety Division

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This handout is intended only as a guide to the subject matter covered herein and is based in part on the 2015 Minnesota State Building Code. While every attempt has been made to insure the correctness of this handout, no guarantees are made to its accuracy or completeness. Responsibility for compliance with applicable codes and ordinances falls on the owner or contractor. For specific questions regarding code requirements, refer to the Minnesota Building Code or contact your local Building Safety Division.

Decks and porches constructed on concrete pier footings can experience movement when certain conditions exist even though the footings were installed in accordance with the Minnesota State Building Code.

Pier footings will heave if soil moisture conditions and freezing temperatures occur in the right combination to exert force on either the bottom or sides of a concrete pier.

Homeowners should be aware that pier foundations are a compromise from the traditional continuous spread foundation used as the primary support for the dwelling. Why is that? Pier footings:

- Are typically loaded to their design maximum leaving little room for error if soil bearing conditions are not carefully considered.
- Allow independent movement of individual footings since they have no structural connection between them.
- Are susceptible to “soft spots” in the soils that may be bridged by continuous strip foundations.
- Are isolated far from the dwelling which permits frost to surround the pier and deeply penetrate adjacent soils increasing the likelihood of frost heave.
- Place tension loads on the concrete in the pier when certain frost actions occur, a condition that exploits an inherent weakness in concrete. Concrete is at its strongest in compression.

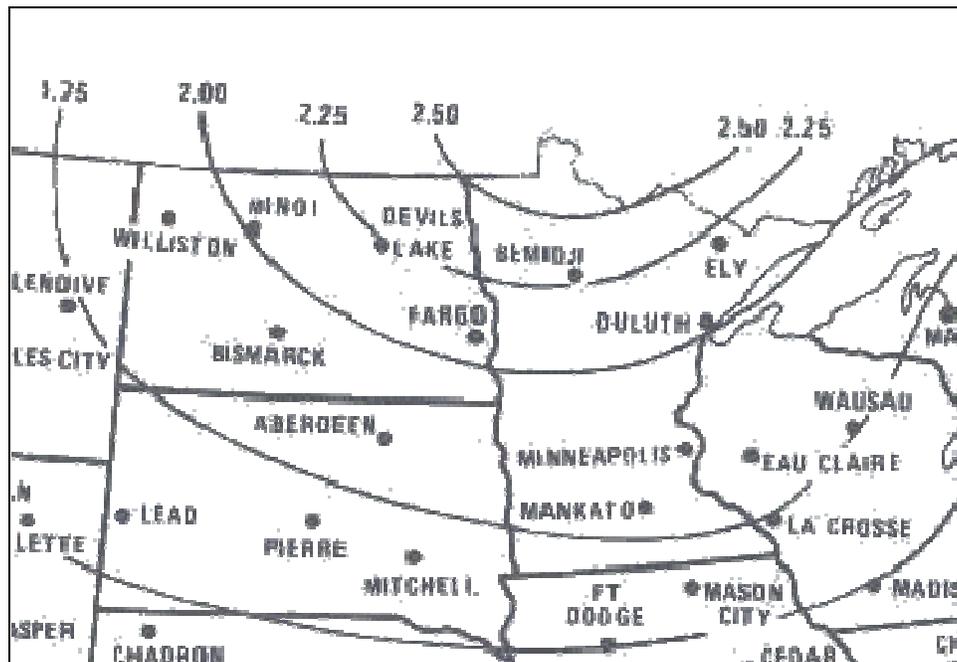
It is the susceptibility to frost heave and its impacts that is the focus of this handout.

Footings that have heaved can create significant damage ranging from jammed doors, broken windows, cracked gypsum board, roof leaks, disconnections of plumbing or electrical work, and possible aesthetic implications.

The Minnesota State Building Code requires dwelling additions to be constructed on foundations that extend at least 60 inches below finished grade as protection against frost action. The code is by definition a *minimum* standard. As such, it should be expected that certain extreme conditions may occur from time to time that will negatively impact certain building components.

As mentioned above, pier type footings that are distant from the dwelling are more susceptible to the actions from freezing soils. While designing dwellings to a 60 inch frost depth might be sufficient, it is possible that the same design may not be so conservative for a pier foundation. Soils around conventional foundations benefit from the heat loss from soils below the building and from the building itself that act to reduce frost depths immediately adjacent a dwelling. Piers, on the other hand, allow surrounding soils to fully freeze to depths that might exceed those next to the dwelling.

While the Minnesota Building Code requires foundations to extend at least 60 inches below grade, the National Oceanic and Atmospheric Administration (NOAA) indicates that in extreme cases frost may penetrate to a depth over six feet in the Northern MN areas

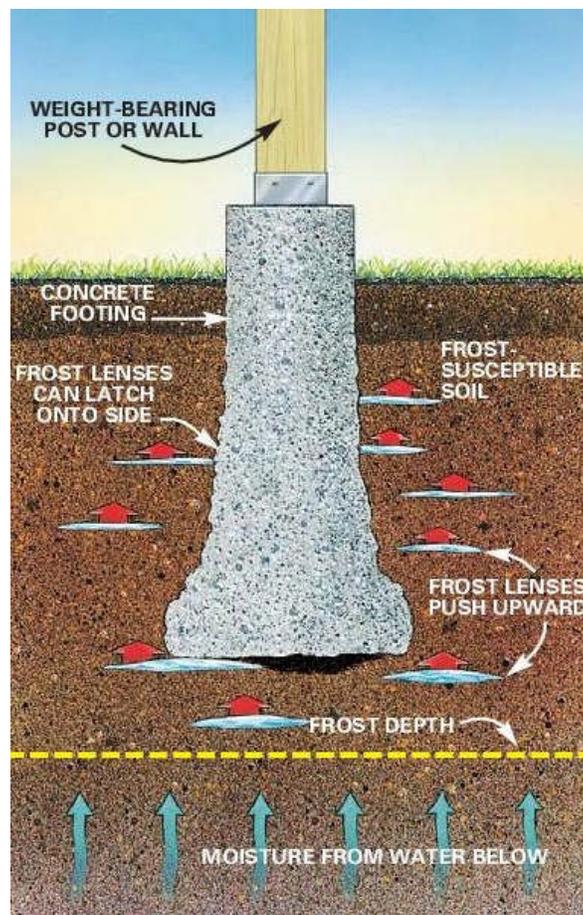


Extreme frost depth potential from the National Oceanic and Atmospheric Administration (given in meters)
1.75 m = 69 inches; 2 m = 79 inches.

The Minnesota Department of Transportation (MNDOT) samples frost depth around the state to address the issue of road restrictions.

From this information, you can see that exposed piers are at risk to damage from frost penetrating below the pier and heaving it.

While frost penetrating below the footing could occur, it is probably not the most likely reason why piers heave. More likely the problem is freezing ground adhering to the upper portion of the pier and lifting it. Water expands about 9% in volume when it freezes. If the soils around the pier retain water late into the fall, freezing temperatures can wreak havoc with the pier. Water channeled to the location of deck and porch piers via sump pump hoses, downspouts, or poor drainage are often the reason for the saturated conditions. Overwatering lawns or adjacent plantings in late fall can also be the cause. Obviously, the homeowner has some control over these conditions. But in some cases, nature takes its course and things occur beyond the control of the homeowner.



What can you do to control this problem?

If you are building a new deck or porch, you may wish to consider the following:

- Consider digging the footing deeper than the 60 inch minimum requirement.
- Use a cardboard form for the upper three feet of the pier.

- Wrap cardboard forms with several layers of heavy plastic to reduce adherence of soils to the form.
- Over-excavate the lower portion of the pier creating a “bell” to resist the pier from being lifted. Rebar should be installed to resist a fracture of the pier.
- Overbore piers and backfill the space between the form and the soil with a coarse granular material such as pea rock
- Take special precautions if you are near a wetland where problems predominate (consult a soils engineer).

Precautions to take or steps that may reduce current problems include:

- Do not allow downspouts and sump pump hoses to drain near piers.
- Avoid heavy fall watering of surrounding soils.
- Consider installation of drain tile where soil moisture content is always high.
- Install subsoil insulation to trap heat around the pier.

There are no guaranteed methods to prevent piers from heaving. Problems can show up 5, 10, or even 20 years after the structure was built. But you can take steps to minimize the potential for problems by taking certain precautions. And remember, the Minnesota State Building Code is only a *minimum* code.

