

## INTRODUCTION

Whether you're planning to build a home in the north or noticing that your existing home is starting to shift, it's essential to know the problems different kinds of permafrost can cause and who can help you identify and address them. This snapshot will help get you started.

The landscape to the north of Alaska's Brooks Range is dominated by tundra and continuous permafrost, as seen on the right. Interior Alaska, covered mainly by boreal forests, is mostly discontinuous permafrost. Meanwhile, farther south the land is dominated by isolated or sporadic permafrost. In areas of discontinuous permafrost it is often difficult to determine if a site contains permafrost and which foundation strategies should be employed. This snapshot focuses on how to determine if a site in areas with discontinuous permafrost needs permafrost specific mitigation strategies.



Permafrost extent in the northern hemisphere

Illustration from Hugo Ahlenius, UNEP/GRID-Arendal

## SOIL AND PERMAFROST TYPES

Changes in frozen ground can affect your home over time, but not all permafrost behaves similarly. There is a difference between building on ice-poor and ice-rich permafrost. Ice-poor permafrost is thaw stable: if it thaws, it will not move as dramatically as ice-rich permafrost. On the other hand, ice-rich permafrost is thaw unstable: it has more frozen water than can fit in the unfrozen pore space. This means that when the soil thaws, the water flows away, leaving the soil with less mass than in its frozen state (Shurr 2011). Since buildings, roads, and other infrastructure are susceptible to soil subsidence, it is vital to keep ice-rich permafrost frozen to maintain its integrity. Before construction, a site survey will help determine if the site has permafrost and if that permafrost is stable or unstable. A local geotechnical or civil engineer should advise on construction on geologically unstable building sites.

## HOW TO TELL IF YOUR SITE CONTAINS PERMAFROST

In areas of discontinuous permafrost, the conditions below the soil are only sometimes evident at the surface. Visual clues such as depressions from ice-wedge polygons and pingos (hills formed by upward pressure from freezing groundwater) can indicate the presence of ice-rich permafrost. When there has not been any rain, signs of water pooling in areas can suggest that the ice-rich permafrost is degrading. Local vegetation can sometimes indicate the presence of permafrost. Small black spruce, wet moss-covered ground, and areas of leaning trees (called a drunken forest) are clear signs of permafrost. Often, sites lacking these clear signs have ice-rich permafrost, and other survey methods are required. Looking at the existing buildings and roads in the immediate area can also indicate permafrost. Wavy roads or existing buildings on pilings are a good indication of permafrost in the area.

In existing homes, some signs that the ground is moving and affecting the foundation include cracks in walls, doors that do not shut, unlevel steps, floors, and rooflines. If a ball placed on the floor rolls to one side of the house, it might be a sign that the foundation is shifting. The owners of the home pictured (right) had to adjust its foundation because the ground was settling. Note the gap at the bottom of the stairs.



Home shifting due to permafrost

Photo from NREL

A few simple tests can provide information about the ground type for new construction. Frost probing -- also called rodding -- is a quick method to determine if your site has shallow permafrost. This method works best when performed after the active layer has thawed, toward the end of summer. Using your body weight or a heavy hammer, push down on a 1/4" rod until you hear a thud or meet resistance. The site should be probed in many locations. Probing will only show if there is permafrost within the length of the rod. A more comprehensive method is to examine a core sample brought up by an auger or to drill a well and collect a drilling log (Figure below). In areas of discontinuous permafrost, drilling is typically the minimum requirement to assess permafrost conditions. Consult a geotechnical or civil engineer to perform a more comprehensive site survey that maintains the integrity of the site.

A drill rig bringing up a soil sample



Photos from the Cold Climate Housing Research Center, Inc

### Text References

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## SITE SURVEY CHECKLIST

- Observe your area:
  - are the roads wavy?
  - are the buildings level and stable?
  - are there trees, are any leaning in different directions?
  - are the buildings sitting directly on the ground?
  - are there unexplained depressions in the ground?
  - is there pooling water?
- See how far you can stick a rod into the soil at the end of the summer.
- Drill a test hole to verify there is no permafrost at depth.  
 If you cannot avoid permafrost, build in a way that keeps it frozen!
- In areas of discontinuous permafrost you should consult a professional

### Permafrost Resources

[Permafrost Tunnel](#)  
[UAF Geophysical Institute](#)  
[Informational Video on Permafrost, AWI](#)  
[Map of Permafrost in Alaska](#)  
[National Resources Defense Council](#)  
[National Snow and Ice Data Center](#)  
[UN Environment Programme](#)