The University of Alaska Fairbanks Sustainable Village is a demonstration of affordable, low-energy housing in Interior Alaska and a testing ground for cold climate building and energy research. Two of the four homes have a super-insulated foam foundation that rests directly on ground with permafrost. Permafrost under these homes starts at 2–3 feet deep in the summer and stretches down. (Soils are frozen all the way to the surface in the winter.) To prevent the permafrost from melting, the foundations were designed with a thick raft of insulation to prevent heat from the homes from leaking into the soil. Temperature sensors were installed underneath the homes to allow researchers to monitor ground temperatures throughout the year and ensure the permafrost isn’t melting.

The advantage of the raft foundation over other permafrost foundations is that it lies directly on the ground, keeping interior floors warmer and reducing the cost of building on driven pilings, the most durable type of permafrost foundation. The foundation consists of steel floor joists elevated from the ground on wood structural beams, and filled in with soy-based polyurethane foam insulation. The foam provides a continuous thermal break between the heated indoor space and the ground.

Temperature strings were installed underneath the center of each house. Sensors under the Birch (NW) house were located at depths of 4 feet and 24 feet. All temperatures have either remained stable or risen less than 5°F over the 2-year study, indicating that the raft foundation is working as expected.

At the Spruce house (SW), sensors were located inside the floor of the house and at 2 feet, 4 feet, 8 feet, and 10 feet deep. Underground, the temperature at 8 feet has remained steady and temperatures at 10 feet and 2 feet deep have risen by less than 5°F. Inside the foam, higher temperatures were seen during the summer and lower temperatures during the winter, due to the proximity to the surface.
An experimental cooling system was used to lower the temperature underneath the homes. A small in-line fan was installed in an empty pipe running through the raft foundation, which circulated cold air through the foam in the winter in an effort to further cool the ground.

The cooling system was only installed in the Spruce home the first year and in both homes the second year. The fan was activated in early winter and turned off in spring, when daily temperatures began to rise above freezing. No effect on ground temperature was recorded.

Ground temperatures will continue to be monitored until 2017, and the fans will continue to be used each winter as a preventative measure.