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## **Foundations in Frozen Soil**

It is very important that appropriate frost free materials are used in construction in the conditions of discontinuous permafrost or permafrost. Obviously, it is vitally critical to choose the right type of foundation because avoiding heaving is the main task in this process.

Broadly speaking, it is essential not to permit the penetration of warm air beneath the foundation. It is achieved by different means.

Firstly, it can be achieved very simply by providing shade during the summer so that less of the sun's energy reaches the soil surrounding the structure. But it is not available in all regions.

Secondly, active cooling or refrigeration to the foundation area should be provided to reinforce and strengthen the permafrost. Next step is to set footing below the active layer penetration. Insulation around a footing or foundation wall must be used with care. The structure can be built on a well prepared, nonfrost-susceptible pad, so the heat from the building can be removed before it reaches the permafrost by actively cooling the pad.

Obviously, the permafrost is protected, and the structure gets a solid foundation. It is evident that when the pad is properly constructed and it is adequately cooled, any type of foundation may be used, spread footing, slab on grade, or whatever the application requires. There are several alternatives available to cool the pad. Firstly, thermosyphons are placed in the pad at strategic locations and must be monitored on a regular basis to establish a temperature history of the foundation. Secondly, convection loops are two thermosyphons connected together, both at the bottom buried end and at the top end, and then filled with a liquid working fluid. Lastly, air ducts have been used to actively cool foundations for many years.

The term "ventilated pad" is frequently used for this type of active cooling. They are simply large tubes that run through the pad and provide a passage for cold air to circulate through and remove heat.