SECTION 141 – PERMAFROST ZONE IN SUMMER

3028. **Soil Features.** Areas suitable for traffic when frozen or snow-covered may be impassable in summer. Interface with the permafrost table nearly always causes trouble, and soil in the frost-active layer is often unstable when it thaws. Detailed reconnaissance and soil survey are essential.

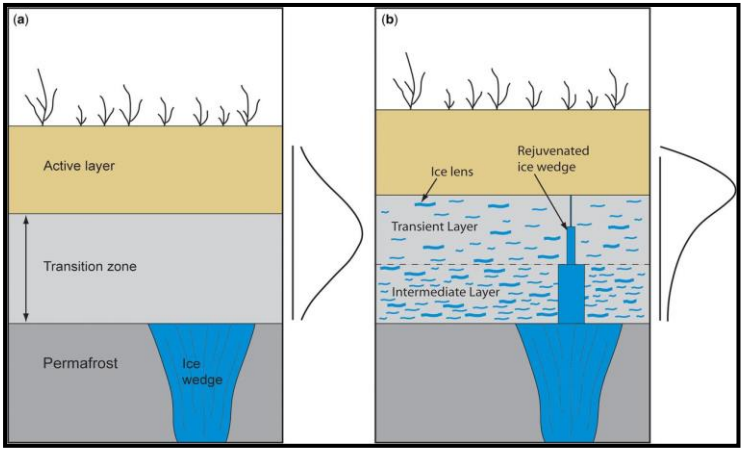


Figure 30-8 (a): Typical Soil Features In The Permafrost Zone

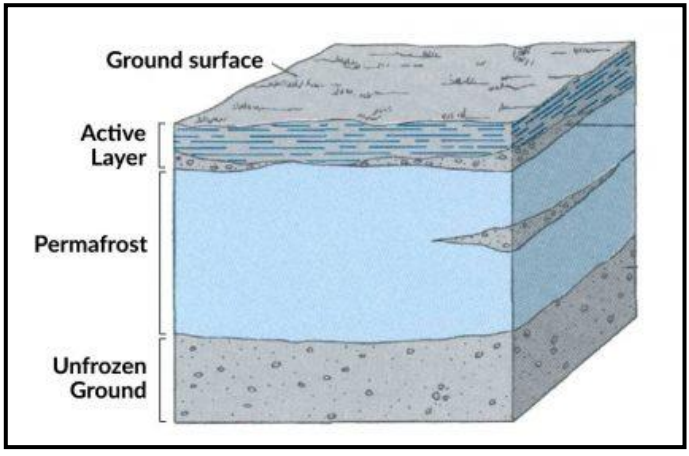


Figure 30-8 (a): Typical Soil Features In The Permafrost Zone

3029. **Physical Features.** Maps are often inadequate, and air photographs may be useless in subarctic forest areas or because of snow cover. Ground conformation and vegetation are important guides:

a. Areas of rugged relief tend to have a well-marked and fairly efficient drainage system, and they usually contain soils that are not frost-active.

b. Flood plains of rivers often indicate a silty association of sand and gravel.

c. Braided channels often denote stratified sands and gravel.

d. Soil polygons are surface marking, akin to the cracked mud of a dried-up pond. They vary in size from 20 to 200 ft across, and their centers may be either raised or depressed. They occur in areas affected by frost action, and generally indicate saturated silts and fine grained soil, with a very shallow permafrost table. Those with depressed centers are found in low, flat, wet areas and area sure sign of ground unsuitable for construction.

e. Frost mound are caused by swelling ground ice, and their presence may be revealed by groups of outward leaning trees. They are a reliable indication of water trapped between the frozen crust and the permafrost table.

f. In treeless localities, thick moss and hummocky tundra indicate a water-bearing layer above a high permafrost table.

g. White spruce and paper birch usually show that the permafrost table is at least 6 ft down. Willow often grows on moist coarse-grained soils with a depth of about 30 ins above the permafrost table: if permafrost is nearer the surface, willow growth will be stunted.

3030. **Location.** A coarse-grained, non-frost-active subgrade should always be sought. This will often be the overriding factor in location.
Drainage is also most important (see para 743).
Gradients and curves must be eased considerably for icy or snow-covered surfaces.

Design and Construction

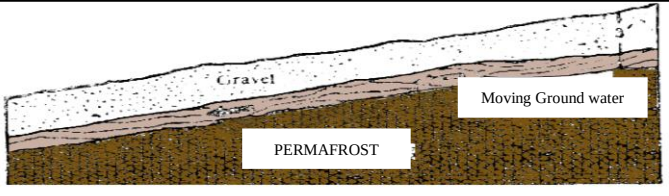
3031. **Principles.** It is essential to avoid interference with the underlying permafrost. Practical points are:

a. If the surface soil is non-frost-active, conventional design will be satisfactory.

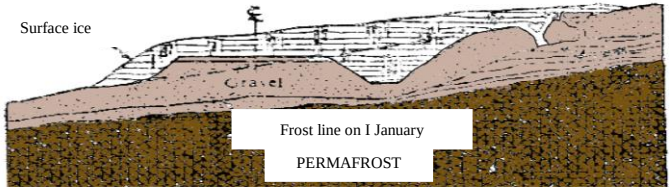
b. If is frost-susceptible, the insulation of the underlying permafrost must be maintained.

c. In all cases, the natural cover outside the limits of the roadway must be preserved.

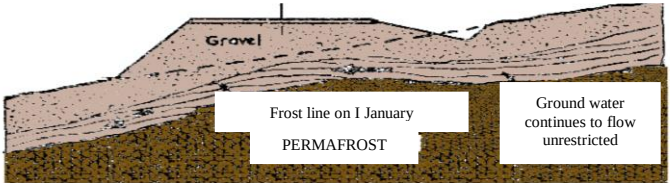
3032. **Building-up Method of Insulation (see Figure 30.9).** If the frost-active layer is well graded, place a "blanket" of fill material over the undisturbed ground surface, designing the base to allow for reduce strength during thaw. Place 18 ins of fill by pushing forward from previously completed work, and increase the thickness in 6-in lifts. A thickness of 3 ft is normally required.



(a) Section showing natural ground conditions in summer



(b) Normal construction method lowers frost table in winter and restricts flow of subsoil water which bursts through the frozen layer and forms



(c) By placing on adequate blanket of fill material the thermal regime is

Figure 30-9 – Insulating Method of Constructing a road on a Hillside.

3033. **Replacement Method of Insulation (see Figure30.10).** If the surface soil is poorly graded as well as frost-active remove it and replace by sufficient gravel or sand to maintain insulation. Six feet of gravel may be needed to replace tundra and 2 ft of silty loam, but for emergency work 2 ft of gravel will often suffice if continuous maintenance work is carried out.

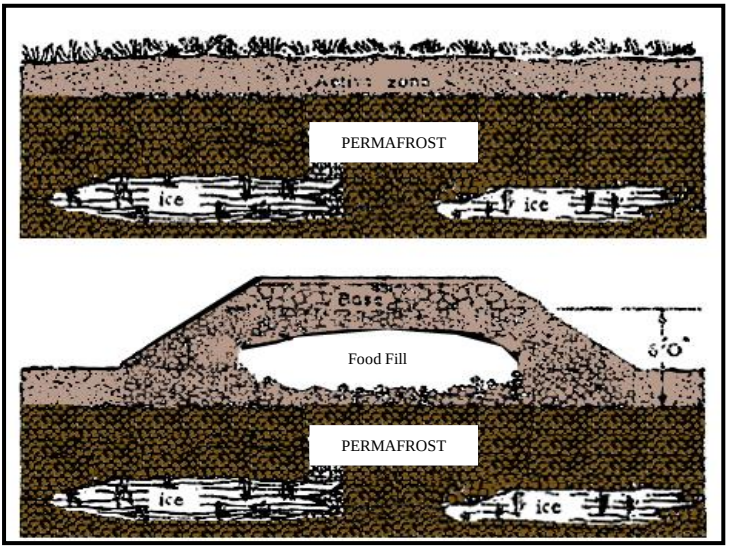


Figure 30-10 – Use of Composite fill to Insulate Permafrost

Drainage in The Permafrost Zone.

3034. Faulty construction work in the summer may cause trouble in freezing temperature, as the reduction of natural insulation may allow frost to penetrate more quickly and more deeply, and to impede the flow of underground water. This may lead to surface icing (see Figure 30.9). The aim is never to interfere with the natural movement of water.

3035. **Surface Drainage.** The bulk of surface water comes from melting snow and ice. In the subarctic rain also falls. The rate of snow-melt is unlikely to exceed the maximum precipitation in one hour (see para 98).

Drainage principles are the same as in other climates but the following points are important:

a. Make ditches and culverts narrow and deep (see para 837).
b. Site open drains well away from the edges of construction.
c. Allow room for storing snow removed from the road surface in winter.
d. Do everything possible to lower the water table.

3036. **Subsoil Drainage.** If the mean annual temperature is below freezing point, subsoil drains and French drains are usually ineffective. Natural subsoil water will continue flowing unless frost penetrates sufficiently to prevent it.

The best solution is to use coarse, granular, non-frost active material both for fills and for base construction, and to reduce the amount of water held in it, so as to minimize maintenance.

3037. **Surface Ice Control.** Surface ice may hinder movement more than water, snow, or even subgrade failure. It may be caused by fault summer construction (see para 743), or by the freezing of small natural runnels through moss or undergrowth. Potential sources should be diverted, or impounded by ponding to induce freezing at a safe distance from the road. Once formed, surface ice can often be removed only by stream jet equipment.