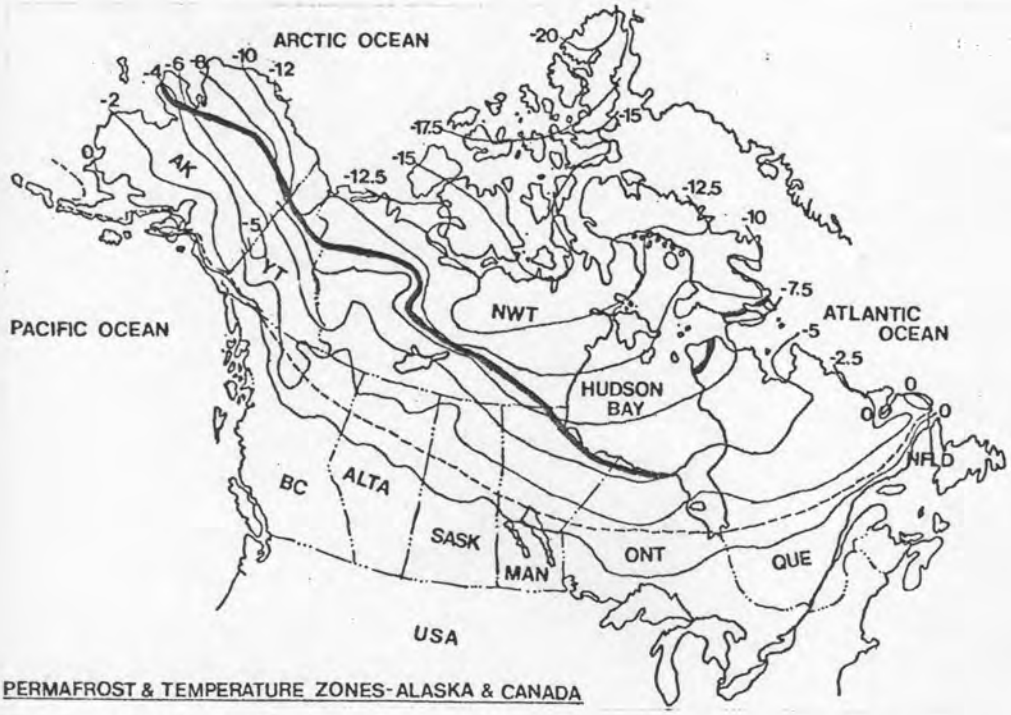
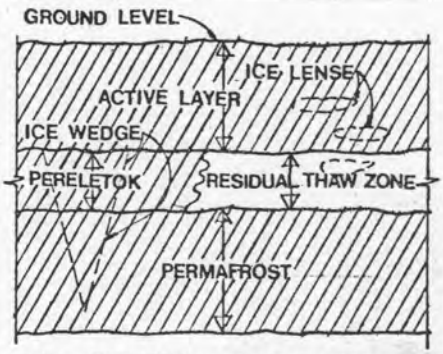


PERMAFROST & TEMPERATURE ZONES-ALASKA & CANADA

KEY: MEAN ANNUAL AIR TEMPERATURE, C° | PROVINCE BOUNDARY | SOUTHERN LIMIT-DISCONTINUOUS PERMAFROST | SOUTHERN LIMIT-CONTIN. PERMAFROST | COUNTRY BOUNDARY

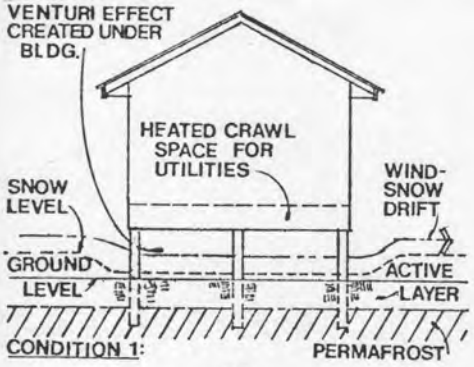


KEY: FROZEN GROUND | UNFROZEN GROUND

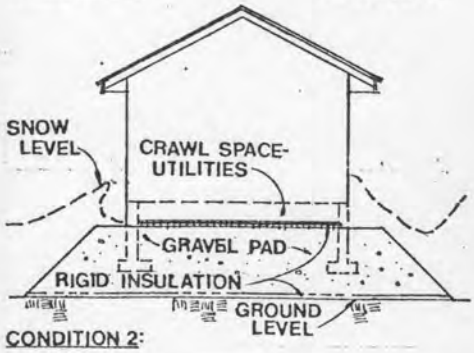
TYPICAL PERMAFROST GROUND SECTION

TEXT- A

CONDITIONS OF BUILDING ON PERMAFROST



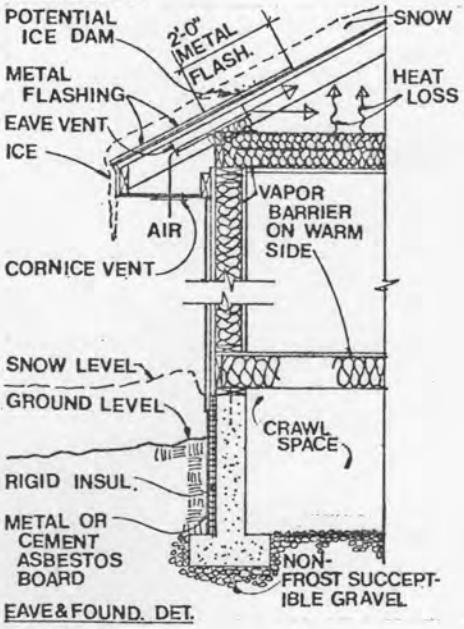
CONDITION 1:



CONDITION 2:

TEXT-B

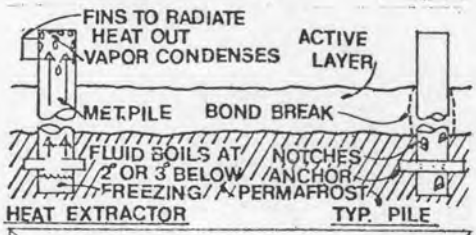
EAVE & FOUND. DET. IN NON-PERMAFROST CONDITIONS



EAVE & FOUND. DET.

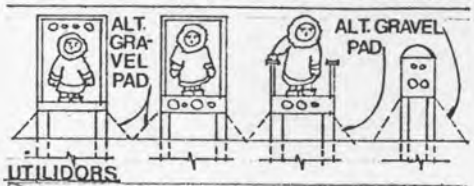
TEXT-D

PILES



HEAT EXTRACTOR TYP. PILE

TEXT-C



UTILIDORS

TEXT-E

A. PERMAFROST, ICE WEDGES AND LENSES, AND FROST HEAVE

Definition of Permafrost: Ground of any kind which stays colder than the freezing temperature of water throughout several years.

TERMS:

Active Layer: Top layer of ground subject to annual freezing and thawing.

Frost Heaving: Lifting or heaving of soil surface created by the freezing of subsurface frost-susceptible material.

Frost-Susceptible Soil: Soil which has enough permeability and capillary action (wickability) to expand upon freezing.

Ice Lense (Taber Ice): Pocket of ice.

Ice Wedge: Wedge-shaped mass of ice within the soil. Wedges range up to 3 or 4 meters wide and to 10 meters deep.

Pereletok: Frozen layer at the base of the active layer which remains unthawed during cold summers.

Residual Thaw Zone: Layer of unfrozen ground between the permafrost and active layer. This layer does not exist where annual frost extends to the permafrost, but exists during warm winters.

B. CONDITIONS OF BUILDING ON PERMAFROST:

CONDITION 1: Building elevated on piles allows for the dissipation of building heat to help prevent the ground from thawing. Added benefits include winter refreezing of ground by cold winter air and prevention of snowdrift buildup.

CONDITION 2: Building elevated on nonfrost-susceptible gravel pad. Benefits include lessening of snowdrift problems and retards the permafrost thaw. Existing ground cover can remain as insulation. Rigid insulation can also be used.

C. PILES:

In the arctic, piles are popular because it is a simple way of providing thermal isolation of heated structures, minimizes disturbance of existing thermal regime, permits flow of flood waters, and prevents the buildup of drifting snow. However, frost heaving can force the piles upward during the freeze season without allowing the piles to return to the original level when the soil thaws.

Solutions to the problem of pile heaving are:

1. Anchor the pile against uplift by placing anchors or notches on the pile within permafrost zone.
2. Break the bond in the active layer. (Use bond-breaking plastic wrap or grease pile in the active layer.)
3. To avoid thaw of the surrounding soil, there are three main one-way heat extractors: (1) The gaseous flow system (basically the one shown above), (2) The liquid system - using tubes with "Venturi" funnels to allow warm liquid to rise and cold liquid to sink, and (3) A mechanical refrigeration system. The designer must be careful not to allow heat transfer from the building to the pile (thereby thawing the permafrost).

D. EAVE AND FOUNDATION DETAILING IN COLD CLIMATES:

Snow buildup on the roof is warmed by heat loss from the building. The melting snow flows down the roof and is refrozen at the eave because of the eave's cold condition. The use of a cornice vent and insulation to create a "cold roof" help reduce the problem of ice damming. When an ice dam is created, the water backs up, leaking under roofing materials. The placement of metal flashing on the roof at least 2'-0" up from the wall line causes the snow and ice

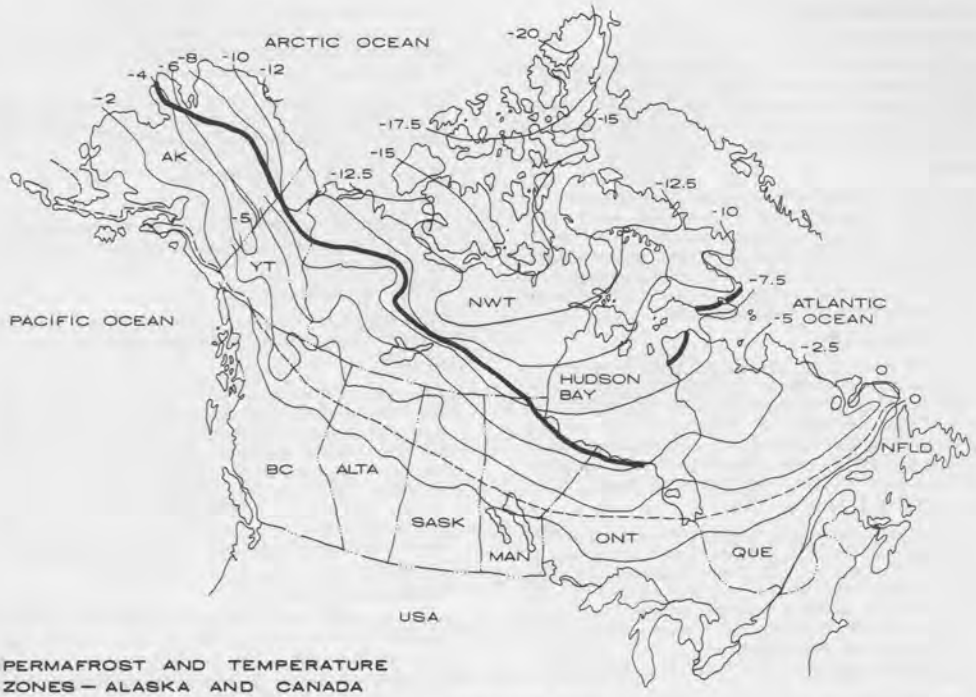
to slide off and also protects from moisture penetration.

All vapor barriers in cold and arctic conditions must be on the warm side to avoid condensation in the insulation. Use of rigid insulation on the exterior of the foundation wall (with a metal or cement asbestos board cover for protection) creates a heat bank and keeps the utility space from freezing.

E. UTILITIES IN COLD CLIMATE AND ARCITC CONDITIONS:

Utilidors are one of the most common ways to ensure protection, easy access, and insulation of utility lines with a minimum disturbance to the thermal regime.

Human waste at isolated facilities may be handled by compost privies (waterless toilets) and chemical toilets - commonly referred to as "honey buckets." Disposal systems include incineration and sewage lagoons.



PERMAFROST AND TEMPERATURE ZONES — ALASKA AND CANADA

KEY: ——— MEAN ANNUAL AIR TEMPERATURE, C°
—— SOUTHERN LIMIT CONTINENTAL PERMAFROST
—·—·— PROVINCE BOUNDARY
— — — COUNTRY BOUNDARY
- - - - SOUTHERN LIMIT-DISCONTINUOUS PERMAFROST

PERMAFROST, ICE WEDGES AND LENSES, AND FROST HEAVE

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TERMS

ACTIVE LAYER: Top layer of ground subject to annual freezing and thawing.

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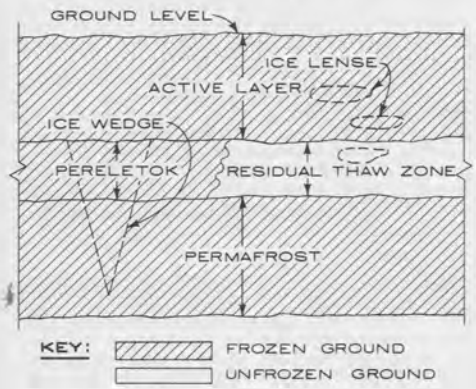

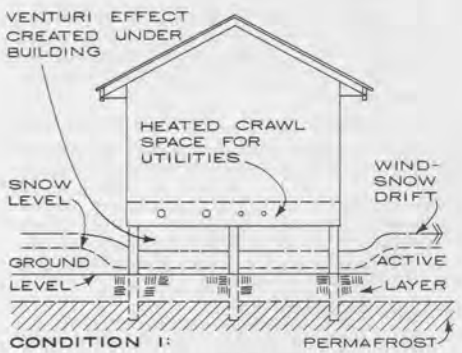

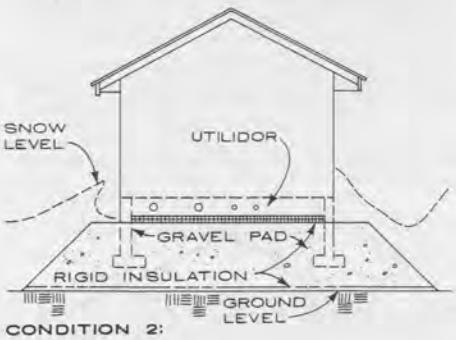

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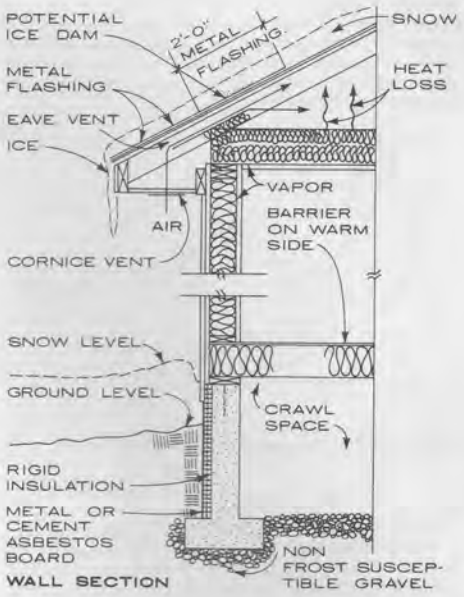

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CCC/HOK; Anchorage, Alaska