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#### **Publisher's version / Version de l'éditeur:**

<https://doi.org/10.4224/20353885>

*Technical Note (National Research Council of Canada. Division of Building Research); no. TN-276, 1959-04-01*

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# NATIONAL RESEARCH COUNCIL OF CANADA

## DIVISION OF BUILDING RESEARCH

No.

276

# TECHNICAL NOTE

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PREPARED FOR

DATE April, 1959

SUBJECT Statement of Proposed Field Studies at Inuvik, N.W.T.  
For Summer of 1959

The Northern Building Section of the Division of Building Research has carried out much of its recent permafrost investigation at Inuvik, the new townsite of Aklavik, in the western Arctic. The relocation of this town has provided a unique opportunity to study the effects of occupancy by an entire community on previously undisturbed permafrost. A variety of specific investigations have been initiated, aimed at increasing understanding of the performance of building foundations, roads, and airstrips in permafrost areas. Earlier work has included:

- (1) observations of pile installation techniques and studies of pile refreezing times;
- (2) continuing ground temperature observations under the new airstrip and under roads, buildings and oil tanks;
- (3) observations to determine the effect of natural cover on depth of thaw in areas undisturbed by construction;
- (4) settlement observations on buildings, with special emphasis on the garage and workshop building where the reinforced concrete floor slab has already shown signs of failure;
- (5) general observations on ground movements in the area caused by melting permafrost, such as the bank slump adjacent to the wharf, the borrow pit slumps and some road performance difficulties.

During the conduct of this work, and the earlier soils investigations conducted at the time of the original site survey, much information has been collected on local terrain conditions

in the Inuvik region. A detailed summary of this engineering site information has recently been prepared by the Division and will shortly be available in published form as an aid to those contemplating future construction in the area.

With the foundation phases of the construction at Inuvik nearing completion, it is the intention of the Northern Building Section to concentrate its activities in that area during the summer of 1959 in order to complete the initial phase of these studies and to permit maximum information to be obtained in future years from continuing checks on performance of the various facilities. An outline of the general program of proposed work for 1959 is as follows:

#### FOUNDATIONS FOR BUILDINGS, UTILIDORS AND OIL TANKS

##### Construction History

All possible information will be gathered at the site, on the construction of large buildings, housing units, oil storage tanks and utilidor lines to provide an up-to-date record of the construction history of these facilities. Such information will include construction dates and details of such features as pile steaming and driving, depths of pile embedment etc.

##### Elevations

In recognition of the importance of foundation movement as a measure of the satisfactory performance of a structure, the recording of building elevations is to be established this year on a long-term basis as follows:

- (1) installation of primary bench marks at three locations across the site. These will consist of pipe steamed or drilled at least 50 feet into the permafrost with precautions against frost heaving in the active layer.
- (2) installation of secondary bench marks at several locations across the area to facilitate the tying-in of the elevations taken on individual facilities to the primary bench mark system.

- (3) establishment of levels on the foundations of all major constructions such as the powerhouse, heated oil tanks, school and hostel buildings, hospital, Federal building, Navy buildings and Department of Transport terminal building. In addition, levels will be taken on the foundations of a selected number of smaller buildings such as houses on wood piles and cabins on gravel-pad foundations, when these last are in their final location.

#### Soil Temperatures

Ground temperatures provide a useful record of thermal changes that occur beneath a structure. Some thermocouples have already been installed on piles under buildings in the area; readings of these thermocouples will be continued. In addition, it is planned to locate more elaborate and permanent thermocouple installations on the pile foundations of some of the larger buildings to be constructed this year, to permit temperature observations over a long-term period.

#### Refreezing of Piles

It is planned to include observations of refreezing times of steamed-in piles placed in large pile groups in order to compare the refreezing rate of such piles with those of the smaller pile groups previously studied.

#### Miscellaneous Observations

Observations will be continued on the garage which has already shown signs of failure and on specific structures, such as the Roman Catholic church, which differ in foundation design from the conventional foundation methods used in the area.

### TERRAIN

#### Depth of Thaw

Studies relating to the effect of occupancy on the permafrost will be established on a long-term basis with the selection of three test areas in the townsite representing the three main types of soil and surface cover found at the site. These will be instrumented with thermocouples to depths of 20 feet to measure



temperature increases resulting from construction in the area; changes in surface elevations at these sites will also be recorded. These three sites will represent those most directly affected by occupancy. A fourth or intermediate site will be chosen just outside the main built-up section of the community and a fifth or control site will be located some distance from the townsite in an undisturbed area to provide a basis for comparison with original conditions.

#### Peat Fill Studies

A qualitative appraisal of the insulating effect of peat as a construction-fill material will be attempted at a peat-fill test area prepared in the summer of 1958. This will be done by observing the depth of thaw under various thicknesses of peat fill.

#### Ground Movements

A number of ground slumps and other soil movements resulting from melting of the permafrost have been observed in the area to date, including slumps in the borrow pits as well as a serious bank slump adjacent to the wharf. These have been under general observation. A more detailed survey of the bank slump near the wharf will be carried out in the summer of 1959.

#### Drainage

In view of the importance of drainage on the performance of facilities over permafrost, a drainage map of the entire townsite area will be prepared, on which will be noted the location of all culverts and drainage structures, present and potential drainage courses and areas of retarded drainage.

#### Potential Terrain Problems

A reconnaissance survey of the Inuvik area will be carried out to determine the existence and extent of ice wedges. In addition, field observations will be made on several natural slopes where solifluction is suspected because of deformed trees.

### ROADS

A detailed survey of those sections of road that have evidenced some failure will be conducted this summer and will include cross sections, probings and some drilling to determine permafrost levels and to secure details of soil properties in those specific locations where failure has begun. Elevations of the road surface will be established at intervals along the centre line and tied into the bench mark system. Readings of thermocouples located under or adjacent to roads will be continued.

### AIRSTRIP

Observations on the thermocouples located beneath the airstrip will be continued in co-operation with the Department of Transport. The recording of elevations of the airstrip surface will begin only after the present construction activities are complete.

(N.B. The program is an ambitious one and it may not be possible to complete all the work outlined in this note. As in all northern operations much will depend on shipping schedules and other uncontrollable factors. The continued co-operation of other agencies in the area will be of real assistance and critical comment on any aspect of the program will be welcomed.)