CHAPTER 1

GENERAL

1-1. Purpose and scope.

This manual contains criteria and methods for calculating the depths of freeze and thaw in soils, with consideration of the effects of other adjacent materials, for the design of military facilities in seasonal frost, arctic and subarctic regions. The contents are applicable to both Army and Air Force construction in arctic, subarctic and seasonal frost areas. The data presented in this manual relate to arctic and subarctic facility design presented in the other manuals of the Arctic and Subarctic Construction series.

1-2. References and symbols.

Appendix C lists the references for this manual; appendix A contains a list of symbols.

1-3. Background.

a. The depths to which soils may freeze and thaw is very important in the design of pavements, structures and utilities in areas of seasonal frost and permafrost. Methods of calculating such depths, based on heat-transfer principles, are presented here. For derivation of basic equations, and the underlying theory, see appendix C and the bibliography.

b. Heat transfer in soils involving phase change of pore water is an extremely complex process and many problems defy rigorous mathematical treatment. The methods presented here are simplified procedures developed for the solution of engineering design problems.

c. Several assumptions have been made in developing practical methods of calculating depths of freeze or thaw in soils. It is assumed that each layer of material is homogeneous and isotropic, and that the average thermal properties of frozen and unfrozen soils are applicable. Unless specific data are available, it is also assumed that all soil water is converted to ice, or all ice is converted to water, at a temperature of 32°F. This latter assumption is substantially correct for coarse-grained soils but only partially true for fine-grained soils.

d. The services of the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL), Hanover, New Hampshire, are available to assist in the development of solutions for heat-flow problems in soils.