DOWNLOAD PDF FROZEN GROUND ENGINEERING

Chapter 1 : Permafrost - Wikipedia

Course covers the nature of frozen ground, thermal properties and classification of frozen soils, physical and mechanical properties of frozen soils, subsurface investigation of frozen ground, thaw settlement and thaw consolidation, slope stability and principles of foundation design in frozen ground.

Contraction crack ice wedge polygons on Arctic sediment. Cracks forming at the edges of the Storflaket permafrost bog in Sweden. Carbon cycle in permafrost[edit] The permafrost carbon cycle Arctic Carbon Cycle deals with the transfer of carbon from permafrost soils to terrestrial vegetation and microbes, to the atmosphere, back to vegetation, and finally back to permafrost soils through burial and sedimentation due to cryogenic processes. Some of this carbon is transferred to the ocean and other portions of the globe through the global carbon cycle. The cycle includes the exchange of carbon dioxide and methane between terrestrial components and the atmosphere, as well as the transfer of carbon between land and water as methane, dissolved organic carbon , dissolved inorganic carbon , particulate inorganic carbon and particulate organic carbon. The consequence is thawing soil, which may be weaker, and release of methane, which contributes to an increased rate of global warming as part of a feedback loop. At the Last Glacial Maximum , continuous permafrost covered a much greater area than it does today, covering all of ice-free Europe south to about Szeged southeastern Hungary and the Sea of Azov then dry land [38] and East Asia south to present-day Changchun and Abashiri. Thermokarst Permafrost thaw ponds on peatland in Hudson Bay , Canada in Frozen ground is that which is below the freezing point of water, whether or not water is present in the substrate. Ground ice is not always present, as may be the case with nonporous bedrock, but it frequently occurs and may be present in amounts exceeding the potential hydraulic saturation of the thawed substrate. By definition, permafrost is ground that remains frozen for two or more years. Since frozen soil, including permafrost, comprises a large percentage of substrate materials other than ice, it thaws rather than melts even as any ice content melts. In aggregate, the food thaws but does not melt. Melting implies the phase change of all solids to liquid. One visible sign of permafrost degradation is the random displacement of trees from their vertical orientation in permafrost areas. It is expected that the high number of structural failures is due to permafrost thawing, which is thought to be linked to climate change. Permafrost thawing is thought to have contributed to the Val Pola landslide that killed 22 people in the Italian Alps. As climate warms, permafrost thaws, which results in a less stable mountain structure, and ultimately more slope failures. Ice within the soil melts, causing loss of soil strength, accelerated movement, and potential debris flows. Instability of slopes in permafrost at elevated temperatures near freezing point in warming permafrost is related to effective stress and buildup of pore-water pressure in these soils. They extended the use of effective stress concept to partially frozen soils for use in slope stability analysis of warming permafrost slopes. The use of effective stress concept has many advantages such as ability to extend the concepts of "Critical State Soil Mechanics" into frozen ground engineering. Ecological consequences[edit] In the northern circumpolar region, permafrost contains billion tons of organic material equaling almost half of all organic material in all soils. The amount of carbon sequestered in permafrost is four times the carbon that has been released to the atmosphere due to human activities in modern time. Secondary effects impact species dependent on plants and animals whose habitat is constrained by the permafrost. One of the most widespread examples is the dominance of Black Spruce in extensive permafrost areas, since this species can tolerate rooting pattern constrained to the near surface. The number of bacteria in permafrost soil varies widely, typically from 1 to million per gram of soil. The Arctic region is one of the many natural sources of the greenhouse gas methane. Permafrost and clathrates degrade on warming, thus large releases of methane from these sources may arise as a result of global warming. Arctic methane release According to IPCC Fifth Assessment Report there is high confidence that permafrost temperatures have increased in most regions since the early s. It is thought that permafrost thawing could exacerbate global warming by releasing methane and other hydrocarbons , which are powerful greenhouse gases. Arctic temperatures are expected to increase at roughly twice the global rate. Estimates vary on how many tons of greenhouse gases are emitted from thawed permafrost soils. One estimate suggests that â€”

billion tons of CO2 equivalents about half from carbon dioxide and the other half from methane will be emitted by , and â€" billion tons by For comparison, the anthropogenic emission of all greenhouse gases in is approximately 48 billion tons of CO2 equivalents. It convenes International Permafrost Conferences, undertakes special projects such as preparing databases, maps, bibliographies, and glossaries, and coordinates international field programmes and networks. Among other issues addressed by the IPA are: Problems for construction on permafrost owing to the change of soil properties of the ground on which structures are placed and the biological processes in permafrost, e. Construction on permafrost[edit] Building on permafrost is difficult because the heat of the building or pipeline can thaw the permafrost and destabilize the structure. Three common solutions include: Permafrost may necessitate special enclosures for buried utilities, called " utilidors ". Modern buildings in permafrost zones may be built on piles to avoid permafrost-thaw foundation failure from the heat of the building. Heat pipes in vertical supports maintain a frozen bulb around portions of the Trans-Alaska Pipeline that are at risk of thawing. Above-ground utility lines in a permafrost zone avoid thawing of ground. Pile foundations in Yakutsk , a city underlain with continuous permafrost. Revival of organisms preserved in permafrost[edit] In , Russian researchers proved that permafrost can serve as a natural repository for ancient life forms by reviving of Silene stenophylla from 30, year old tissue found in an Ice Age squirrel burrow in the Siberian permafrost. This is the oldest plant tissue ever revived. The plant was fertile, producing white flowers and viable seeds. The study demonstrated that tissue can survive ice preservation for tens of thousands of years.

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