

THE RHEOLOGY OF FROZEN SOILS

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ABSTRACT:

The rheological behaviour of frozen soils depends on a number of factors and is complex. Stress and temperature histories as well as the actual composition of the frozen soil are only some aspects that have to be considered when analysing the mechanical response. Recent improvements in measuring methods for laboratory investigations as well as new theoretical models have assisted in developing an improved understanding of the thermo-mechanical processes at play within frozen soils and representation of their response to a range of perturbations. This review summarises earlier work and the current state of knowledge in the field of frozen soil research. Further, it presents basic concepts as well as current research gaps. Suggestions for future research in the field of frozen soil mechanics are also made. The goal of the review is to heighten awareness of the complexity of processes interacting within frozen soils and the need to understand this complexity when developing models for representing this behaviour.

ZUSAMMENFASSUNG:

Das rheologische Verhalten von gefrorenen Böden hängt von einer grossen Anzahl verschiedener Faktoren ab und ist äusserst komplex. Druck- und Temperaturgeschichte, sowie die Zusammensetzung des gefrorenen Bodens sind nur einige Aspekte, welche betrachtet und berücksichtigt werden müssen, wenn man die mechanischen Eigenschaften analysiert. Neue Messtechniken bei Laborversuchen, sowie neue theoretische Modelle haben zu einem verbesserten Verständnis der mechanischen Prozesse gefrorener Böden beigetragen. Dieser Artikel fasst frühere Arbeiten sowie die gegenwärtige Forschung auf diesem Gebiet zusammen. Mit diesem Artikel soll das Bewusstsein der Komplexität gefrorener Böden geweckt werden. Es werden Konzepte der gegenwärtigen Forschung vorgestellt sowie die Richtung zukünftiger Forschungsaktivitäten aufgezeigt. Dem Leser soll bewusst gemacht werden, dass bei der Formulierung von Modellen für gefrorene Böden jeder Situation speziell Rechnung getragen werden muss.

RÉSUMÉ:

Le comportement rhéologique des sols congelés dépend d'un grand nombre de facteurs et est complexe. L'histoire des tensions et des températures ainsi que la composition réelle du sol congelé sont seulement quelques aspects qui doivent être considérés en analysant la réponse mécanique. Les améliorations récentes des méthodes de mesure pour les essais en laboratoire ainsi que de nouveaux modèles théoriques ont aidé à développer une meilleure compréhension des processus thermomécaniques en jeu dans les sols congelés et la représentation de leur réponse à un certain nombre de perturbations. Cet article récapitule les précédents travaux et l'état actuel des connaissances dans le domaine de la recherche sur les sols congelés. De plus, il présente des concepts de base aussi bien que des lacunes présentes dans la recherche actuelle. Des suggestions pour la recherche future dans le domaine de la mécanique des sols congelés sont également faites. L'objectif de l'article est d'intensifier la prise de conscience de la complexité des procédés interactifs agissant dans les sols congelés et de la nécessité de comprendre cette complexité en développant des modèles pour représenter ce comportement thermo-mécanique.

KEY WORDS: frozen soil, permafrost, soil testing, shear strength, creep

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