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## 学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称 博士(工学) 氏名 張 媛

### 学 位 論 文 題 名

Deformation-strength Characteristics of Unsaturated Granular Subbase Course Material under  
Monotonic and Cyclic Loading

(単調および繰返し载荷を受ける不飽和粒状路盤材の変形-強度特性に関する研究)

Throughout a year, climatic changes highly influence the degree of saturation of subbase course layer inside pavement structures in cold snowy regions, such as Hokkaido, Japan. Besides, pavements have to transfer traffic loads from the asphalt-mixture layer to the subbase course layer. Accordingly, it is necessary to understand the mechanical behaviors of the subbase course layer effected by seasonal variations of degrees of saturation and traffic loads. In this study, a series of monotonic and cyclic triaxial compression tests was performed to measure the deformation-strength characteristics of the unsaturated granular subbase course material (called C-40) using the newly developed medium-size triaxial apparatus. The suction-controlled laboratory element test method for unsaturated soils in this study is based on the axis translation technique using the triaxial apparatus with special design on cap and pedestal, which can control pore water pressure and pore air pressure separately, thereby reducing the total testing time. To begin with, the soil water characteristic curve (SWCC) test was carried out to obtain the relationship between the matric suction and the degree of saturation. The water-air-particle systems in unsaturated soils are introduced to describe the transition of water and air inside soils. Second, the influences of degree of saturation and strain rate on the strength characteristics of unsaturated C-40 were evaluated through monotonic triaxial compression tests. The experimental results implied that the degradation in shear strength of C-40 specimen, with the increment in degree of saturation and decrement in strain rate, was found under monotonic loads. The effects of degree of saturation and strain rate on the total internal friction angle appear to be negligible, while the total cohesion can be affected by the degree of saturation and the strain rate. More specifically, the failure surface drawn through the failure envelope with respect to the matric suction is curved surface. Finally, to examine the effect of degree of saturation on resilient modulus ( $M_r$ ) for C-40, the cyclic triaxial compression tests, i.e., the modulus resilient tests (MR tests), were performed on C-40 specimens with different degrees of saturation pursuant to AASHTO T307-99 (2007). The test results indicated that the degree of saturation of the specimen and the applied stress level have a considerable influence on the resilient deformation characteristics of C-40 in MR test. The testing results obtained from monotonic and cyclic triaxial compression tests indicate that the degree of saturation and the strain rate influence the deformation-strength characteristics of the unsaturated granular subbase course material C-40 strongly. Therefore, to rationalize a design method for pavement structures better suited to the climatic conditions in cold snowy regions, the laboratory element tests under monotonic and cyclic loading, which take the influences of above-mentioned two factors into account, should be employed.