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流变性软黏土的弹黏塑性边界面本构模型

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摘要 基于准前期固结压力的概念并引入边界面理论，在吸取国际上具有代表性的流变本构模型优点的基础上，建立一个新的边界面弹黏塑性本构模型。该模型以引入形状参数的修正剑桥模型为边界面，采用滞后变形的概念，将滞后变形分为体积蠕变和剪切蠕变2部分。体积蠕变采用在工程界广泛应用的Taylor公式来计算，剪切蠕变可通过合适的方法由体积蠕变反算得到。该模型不仅可以描述正常固结土的流变，还可以描述超固结土的流变，且模型参数物理意义明确，数量较少，仅比一般边界面模型多一个次固结系数。通过多组试验结果的模拟，表明所提出的本构模型具有较好的预测能力和较为广泛的适用性。

关键词 土力学；软黏土；流变特性；本构模型；数值模拟

分类号

BOUNDING SURFACE ELASTO-VISCOPLASTIC CONSTITUTIVE MODEL FOR RHEOLOGICAL BEHAVIORS OF SOFT CLAYS

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Abstract

An elasto-viscoplastic constitutive model for creep behaviors of soft clays is developed with the theoretical framework of bounding surface plasticity based on the idea of quasi-preconsolidation and critical state concepts. Several important developments on soil creep modeling are proposed together within the model as follows：(1) the concept of delayed volumetric strain from the Taylor secondary compression law；(2) the idea of viscous flow or over-stress loading function；and (3) the theory of time-dependent bounding surface plasticity. The delayed strain was divided into volumetric creep strain and deviatotic creep strain. The volumetric creep strain rate was directly computed from the Taylor secondary compression law；and deviatotic creep strain rate was derived from volumetric creep strain ratio under the concept of over-stress function. In addition，a variable considering implicitly creeping time is adopted in the model，which is determined through the method introduced by Borja. With the introduction of the bounding surface plasticity，the model was capable of simulating the creep behaviors of both normally consolidated clays and over-consolidated clays. The parameters of this model were fewer than other those of creep models，only one parameter—the coefficient of secondary compression was added. The constitutive model proposed is verified by several test results. The good predictions show the rationality and validity of the proposed model.

Key words soil mechanics；soft clays；creep behaviors；constitutive model；numerical simulations

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