

同时考虑结构性和初始应力影响的双参量土体本构模型

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AN ELASTO-PLASTIC MODEL SYNCHRONOUSLY CONSIDERING STRUCTURE CHARACTERS AND ORIGINAL STRESS FOR CLAY SOILS

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摘要 原状土的结构性和初始应力状态对土的力学效应影响比较显著,在应力水平较小的情况下,原状土的力学行为与重塑土有很大的差异。目前,在描述土体应力应变的本构模型中,绝大多数模型都是基于重塑土在实验的基础上构建的,没有充分考虑土的结构性和初始应力状态的影响。本文在经典的弹塑性理论的大框架下,以桂林岩溶区分布的饱和软黏土为研究对象,结合室内试验的成果,依据前人已建的模型,考虑了土的结构性和初始应力的影响,在充分发挥修正剑桥模型优点的基础上对其进行改进,构建了一种新的饱和软黏土的弹塑性本构模型,并对模型作了分析和比较,初步表明了模型的合理性和有效性,进一步的工程验证研究还在进行之中。该模型的构建可使桂林岩溶区分布的饱和软黏土的应力应变计算更加趋近于实际,并且,对于桂林岩溶区高速公路饱和软基填土过程中,控制加载速率和控制分级荷载的大小具有重要的现实意义。

关键词: [软黏土](#) [微观结构](#) [初始应力](#) [弹塑性模型](#)

Abstract: The mechanical characteristics of natural soils are significantly affected by their structure and original stress. As undisturbed soil and remolded soil possess different structural features, they demonstrate different mechanical properties in the case of minor stress. At present, lots of structural models have been established by remolded soil and experimental conditions without considering structure and original stress. Under the classical theories of elasto-plastic, based on soft clay in Guilin areas, combine with test indoor, according to the former model, an elasto-plastic constitutive model has been established to synchronously consider the structural characters and the original stress state based on the Modified Cam Clay. The comparison and analysis of various calculated results have shown the rationality and validity of the model. The applications of the model expressions make the strain result more correspond to the engineering practice. They have important significance for controlling not only rate of loading but also size of load grade during highway filled soil in Guilin areas.

Key words: [Soft clay](#) [Microstructure](#) [Original stress](#) [Elasto-plastic model](#)

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[1] 刘恩龙, 沈珠江. 结构性黏土研究进展[J]. 岩土力学, 2005, 26 (增1): 1~8.

[2] Liu Enlong, Shen Zhujiang. Advance in researches on structured clay. Rock and Soil Mechanics, 2005, 26 (S1): 1~8.

[3] 王国欣, 肖树芳. 土结构性本构模型研究现状综述[J]. 工程地质学报, 2006, 14 (5): 620~626. 浏览





Wang Guoxin, Xiao Shufang. Review on current situation of soil structural constitutive models. Journal of Engineering Geology, 2006, 14 (5): 620~626. 浏览

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- [4] KH Roscoe, AN Schofield & A Thurlairajah. Yielding of clays in states wetter than critical. *Geotechnique*. 1963, 13 (3): 211~240.
- [5] KH Roscoe, JB Burland. On the Generalized Stress-Strain Behavior of "Wet Clay" in Engineering Plasticity. Cambridge: Cambridge Univ. Press, 1968. 
- [6] 屈智炯. 土的塑性力学[M]. 成都: 成都科技大学出版社, 1987.
- [7] Qu Zhijiong. Soil Plastic Mechanics. Chengdu: Chengdu Technology University Press, 1987.
- [8] 章根德. 土的本构模型及其工程应用[M]. 北京: 科学出版社, 1995.
- [9] Zhang Gende. Soil Constitutive Model and Engineering Application. Beijing: Science Press, 1995.
- [10] 雷华阳, 肖树芳. 天津软土的次固结变形特性研究[J]. *工程地质学报*, 2002, 10 (4): 385~389. 浏览
Lei Huayang, Xiao Shufang. Study on secondary-consolidation deformation characteristics of soft soil in Tianjin. *Journal of Engineering Geology*, 2002, 10 (4): 385~389. 浏览
- [11] Zhang Xueyan, Yan Shuwang. Geotechnical Plastic Mechanics. Tianjin: Tianjing University Press, 2003.
- [12] 刘恩龙, 沈珠江. 结构性土的二元介质模型[J]. *水利学报*, 2005, 36 (4): 391~395. 
- Liu Enlong, Shen Zhujiang. Binary medium model for structured soils. *Journal of Hydraulic Engineering*, 2005, 36 (4): 391~395.
- [13] MD Liu, JP Cater. Virgin compression of structured soils, *Geotechnique*, 1999.(1): 43~57.
- [14] MD Liu, JP Cater. Modeling the destructuring of soils during virgin compression. *Geotechnique*, 2000, 50 (4): 479~483. 
- [15] Liu MD, Cater JP. A Structured Cam Clay Model. Research Report No R814, 2002.
- [16] BA Baudet, SE Stallebrass. Modeling the destructuration of soft natural clays. In: *Computer Methods and Advances in Geomechanics*. 2001.
- [17] 谢定义, 齐吉琳. 土结构性及其定量化参数研究的新途径[J]. *岩土工程学报*, 1999, 21 (6): 651~656.
Xie Dingyi, Qi Jilin. Soil structure characteristics and new approach in research on its quantitative parameter. *Chinese Journal of Geotechnical Engineering*, 1999, 21 (6): 651~656.
- [18] 谢定义, 齐吉琳, 张振中. 考虑土结构性的本构关系[J]. *土木工程学报*, 2000, 33 (4): 35~41.
Xie Dingyi, Qi Jilin, Zhang Zhenzhong. A constitutive laws considering soil structural properties. *China Civil Engineering Journal*, 2000, 33 (4): 35~41.
- [19] 肖树芳, 雷华阳, 房后国, 等. 近代海积软黏土结构及弹-塑性模型研究[J]. *工程地质学报*, 2000, 8 (4): 394~399. 浏览
Xiao Shufang, Lei Huayang, Fang Houguo, et al. Study on the structural characteristics and elastic-plastic model of recent marine soft soil. *Journal of Engineering Geology*, 2000, 8 (4): 394~399. 浏览
- [20] YP Yao, T Luo, DA Sun, H Matsuoka. A simple 3-D constitutive model for both clay and sand. *Chinese Journal of Geotechnical Engineering*, 2002, 24 (2): 240~246.
- [21] 罗汀, 路德春, 姚仰平. 考虑应力路径影响下砂土的三维本构模型[J]. *岩土力学*, 2004, 25 (5): 688~693. 
- Luo Ting, Lu Dechun, Yao Yangping. Three-dimensional constitutive model of sand considering stress path. *Rock and Soil Mechanics*, 2004, 25 (5): 688~693.
- [22] 孙德安, 姚仰平, 殷宗泽. 初始应力各向异性土的弹塑性模型[J]. *岩土力学*, 2000, 21 (3): 222~226.
Sun De'an, Yao Yangping, Yin Zongze. An elasto plastic model for soil with initially stress induced anisotropy. *Rock and Soil Mechanics*, 2000, 21 (3): 222~226.
- [23] 刘孟飞. 饱和K₀固结黄土的结构性研究. 西安建筑科技大学硕士论文, 2005, 6.
- [24] Liu Mengfei. The Characteristics of Structure of Saturated K₀ Consolidated Loess. Xi'an University of Architecture & Technology, 2005.
- [25] 李俊连. 饱和结构性K₀固结黄土的变形强度特性研究. 西安建筑科技大学硕士论文, 2004, 6.
- [26] Li Junlian. The Characteristics of Deformation and Strength of Saturated Structural K₀ Consolidated Loess. Xi'an University of Architecture & Technology, 2004.
- [27] 曾玲玲. 软土的结构性及不同应力路径下的力学特性试验研究. 暨南大学硕士论文. 2007.
- [28] Zeng Lingling. Experimental Studies on Structural Properties and Mechanical Behavior under Different Stress Paths of Soft Soil. Guangzhou: Jinan University. 2007.
- [29] 饶为国, 赵成刚, 王哲, 等. 一个可考虑结构性影响的土体本构模型[J]. *固体力学学报*, 2002, 23 (3): 34~39.
Rao Weiguo, Zhao Chenggang, Wang Zhe, et al. Constitutive model considering the influence of soil structure. *Acta Mechanica Solida Sinica*, 2002, 23 (3): 34~39.
- [1] 曹亮, 李晓昭, 赵晓豹, 刘文白, 李家奇, 侯晓亮. 苏州软弱敏感层的土体微观结构定量分析[J]. *工程地质学报*, 2012, 20(3): 419-426.
- [2] 汤斌, 曾哲, 汪洪星, 汪稔. 软黏土卸荷变形特性室内试验研究与数值模拟[J]. *工程地质学报*, 2011, 19(4): 455-459.
- [3] 唐朝生, 施斌, 顾凯. 纤维加筋土中筋/土界面相互作用的微观研究[J]. *工程地质学报*, 2011, 19(4): 610-614.
- [4] 高彦斌|王江锋|叶观宝|李伟|徐超. 粘性土各向异性特性的PFC数值模拟[J]. *工程地质学报*, 2009, 17(5): 638-642.

- [5] 王宝勋, 李夕兵, 杜东菊, 杨爱武. 应用碱性水泥外掺剂固化天津海积软土的试验研究[J]. 工程地质学报, 2009, 17(3): 426-433.
- [6] 赵安平, 王清, 李杨, 车茜. 长春季冻区路基土微观孔隙特征的定量评价[J]. 工程地质学报, 2008, 16(2): 233-238.
- [7] 王清, 董宏志, 陈慧娥, 迟洋. 水泥固化软土的微观结构特性[J]. 工程地质学报, 2007, 15(S2): 117-121.
- [8] 唐朝生, 施斌, 高玮. 聚丙烯纤维和水泥对粘性土强度的影响及机理研究[J]. 工程地质学报, 2007, 15(1): 108-113.
- [9] 王暄, 张家生, 刘学鹏. 龙滩水电站航道座滑边坡平面有限元模拟研究[J]. 工程地质学报, 2006, 14(4): 481-487.
- [10] 张加桂, 曲永新. 三峡库区泥灰质岩石溶蚀作用的微观研究[J]. 工程地质学报, 2005, 13(1): 12-17.
- [11] 叶为民, 杨林德, 黄雨, 唐益群, 董炳炎. 上海软土微观空隙各向异性特征及其成因分析[J]. 工程地质学报, 2004, (S1): 84-87.
- [12] 涂新斌, 王思敬, 岳中琦. 香港风化花岗岩细观结构研究方法[J]. 工程地质学报, 2003, 11(4): 428-434.
- [13] 汪益敏, 张丽娟, 苏卫国. ISS加固土的微观结构及其强度特征[J]. 工程地质学报, 2002, (S1): 460-463.
- [14] 雷华阳, 肖树芳. 天津软土的次固结变形特性研究[J]. 工程地质学报, 2002, 10(4): 385-389.
- [15] 施斌. 粘性土微观结构研究回顾与展望[J]. 工程地质学报, 1996, 4(1): 39-44.

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