岩石力学与工程学报 2008 27 (03): 495 ISSN: 1000-6915 CN: 42-1397/O3

双向激振循环荷载作用下饱和软黏土强度和变形特性研究

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收稿日期 2007-8-23 修回日期 2007-11-27 网络版发布日期 2008-3-18 接受日期 2007-3-15

摘要 通过不排水循环三轴试验分别对单、双向激振下各向同性与各向异性固结的杭州软黏土的动力特性进行研究。研究结果表明，随着径向循环应力比的增加，循环应变幅与孔压幅值增加速度加快，导致土样在较小循环次数发生破坏。双向激振下，随着初始剪应力的增加，峰值孔压以及孔压幅值未见明显变化，这与单向激振的结果不同。双向激振下，饱和软黏土还存在着门槛径向循环应力比。当径向循环应力比小于该值时，双向激振循环荷载不能加速土体的破坏。随着径向循环应力比的增加，在半对数坐标下双向激振下饱和软黏土的转折应变近似线性增加，以该应变为破坏标准可得到双向激振下土体的动强度曲线。随着径向循环应力比的增加，土体的动强度降低。与单向激振循环荷载相比，双向激振下的动强度曲线更为陡峭，土体强度衰减更快。由此可知，在实际的抗震设计中，如果忽略双向振动对土体强度的影响，显然是不安全的。

关键词 土力学；初始剪应力；动强度；孔压；双向激振循环荷载

分类号

STUDY ON STRENGTH AND DEFORMATION BEHAVIORS OF SOFT CLAY UNDER BIDIRECTIONAL EXCITING CYCLIC LOADING

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Abstract

A laboratory study is presented for the dynamic behaviors of isotropic and anisotropic consolidated Hangzhou soft clay subjected to unidirectional and bidirectional exciting cyclic loading using GDS bidirectional dynamic testing system. It is observed that the cyclic strain amplitude and excess pore water pressure increase with the increase of radial cyclic stress ratio. Compared with the strain，excess pore water pressure increases more significantly. Under unidirectional cyclic loading，the excess pore water pressure amplitude decreases with the increase of initial shear stress. However，the effect of initial shear stress on excess pore water pressure is less distinctly under bidirectional cyclic loading. There is a threshold radial cyclic stress ratio under bidirectional cyclic loading. When the radial cyclic stress ratio is lower than it，bidirectional cyclic loading cannot accelerate the failure of clay. The turning strain of -lgN curve is defined as an alternative failure criterion for clay. A significant feature of this criterion is that it is not a constant value but approximately linearly increases as the radial cyclic stress ratio increases or the failure cycle decreases. The dynamic strength of soft clay degrades slowly with the number of failure cycles under unidirectional cyclic loading. However，the dynamic strength degrades more rapidly under bidirectional cyclic loading. It also can be observed that the dynamic strength decreases significantly as radial cyclic stress ratio increases. This observation implies that for the stability problems of slopes involving seismic loading，the effect of radial cyclic stress on strength should also be considered. The strength determined in tests without considering the effect of radial cyclic stress is an unsafe estimation.

Key words soil mechanics；initial shear stress；dynamic strength；pore

pressure；bidirectional exciting cyclic load

DOI:

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