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论文

卸载状态下深埋黏土层冻结壁与周围土体共同作用理论研究

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摘要：

根据Mises屈服准则、冻土的流变理论及偏张量虎克定律，推导出了卸载状态下考虑冻结壁-周围土体共同作用的非线性黏弹塑性冻结壁的应力场和位移场的解析表达式，并得到了冻结壁外载和接触应力的计算公式以及确定黏塑性区大小的方程。结合工程实例，分析了冻结壁外荷载、接触应力、黏塑区、径向位移的发展规律，得到：① 冻结壁承受的土体压力小于土体的原始水平应力；② 地压较大时冻结壁开始产生黏塑区和黏塑区扩展到外部边界的时间极短；③ 黏塑区范围越大，径向位移随时间的变化越剧烈，黏塑性变形是导致冻结管断裂的主要原因。该模型能更好地反映冻结壁力学性质的本质。

关键词： 卸载状态；深埋冻结壁；黏弹塑性；共同作用；冻土流变

Interaction mechanism of deep-buried frozen soil wall and surrounding earth mass in excavation unloaded state

Abstract:

Based on Mises yield criterion，rheological theory of frozen soils and Hooke’s law of deviatoric tensor of equivalentstress-equivalent strain，the analytical formula of stress field and displacement field of nonlinear viscoelasto-plastic frozen wall under the interaction of frozen wall and surrounding earth mass in unloaded state were derived.The formulas for load of frozen soil wall and contact stress were also obtained.The equation of the visco-plastic zone was also deduced and presented.Combined with engineering case，the developing of frozen soil’s load，contact stress，viscoplastic zone and radial displacement were analyzed.The results can be derived as below：① The load of frozen wall is less than the virgin horizontal earth pressure.② The time that visco-plastic zone appears and extends to the external border of frozen wall is very short.③ The change of radial displacement with time is more intense with lager visco-plastic zone.The visco-plastic deformation is the important reason that leads to the rupture of the frozen pipes.This analytical model can better reflect the nature of mechanical properties of frozen wall.

Keywords: unloaded state； deep-buried frozen wall； viscoelasto-plastic； interaction； rheological property of frozen soils

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