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荷载振动频率对冻结兰州细砂蠕变特性的影响

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摘要　通过一系列不同振动频率下的蠕变试验，分析冻结兰州细砂的蠕变变形特性以及频率对蠕变变形和蠕变破坏的影响。发现较高的频率对冻土的蠕变变形、应变速率影响较大；当动荷载应力幅值较大时，荷载大小的影响大于频率的影响，当应力幅值较小时，必须考虑频率的影响；当振动频率增加时，冻土更容易发生破坏，破坏时间变短；在此次试验条件下，土体的破坏应变较小，为2.8%～5.1%，破坏应变时大时小，总体上呈现变小的趋势；当最大加载应力不变而频率增加时，最小蠕变速率的变化幅值不大，都在一个量级范围内，当最大加载应力为4.5 MPa时，最小蠕变速率为2.2×10－5～4.2×10－5 s－1，而当最大加载应力为3.0 MPa时，最小蠕变速率为2.9×10－6～6.8×10－6 s－1；频率变化时，破坏振动次数并非单一地变化，存在临界频率，此时破坏振动次数最大。

关键词　土力学；冻结兰州细砂；荷载振动频率；蠕变变形；蠕变破坏

分类号

IMPACT OF LOAD VIBRATION FREQUENCY ON CREEP CHARACTERISTICS OF FROZEN LANZHOU FINE-SAND

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Abstract

The creep characteristics of frozen Lanzhou fine-sand and the impact of load vibration frequency on creep strain and creep failure are examined through a series of creep tests with different vibration frequencies. The tests illustrate that both creep strain and creep strain rate are influenced by the frequency of vibrating load，in particular，by higher frequencies. When the stress amplitude of the load has a large value，the load puts more impact on the creep stain and its rate than frequency does. When the stress amplitude of the load becomes small，the impact of the vibration frequency of the load has to be taken into account. With the increase of the frequency，the failure time decreases. The failure strain of frozen Lanzhou fine-sand is relatively small under this test condition，varying from 2.8% to 5.1%. As frequency increases，the failure strain presents a decreasing trend on the whole，though it fluctuates during those processes. With a constant vibrating load，the minimum creep strain rate varies within a small range in response to frequency increment. However，the minimum creep strain rate would be in different orders of magnitude when the soils bear various maximum vibrating loads.

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The test shows that the minimum creep strain rates vary from 2.2×10−5 to 4.2×10−5 s−1 with a maximal load of 4.5 MPa，while 2.9×10−6 s−1 to 6.8×10−6 with 3.0 MPa. When the frequency of the vibrating load varies，failure vibration time reacts in a non-monotonic manner. There exists a critical frequency under which the failure vibration time reaches to its maximum.

Key words soil mechanics；frozen Lanzhou fine-sand；load vibration frequency；creep deformation；creep failure

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