

学术论文

钢管超高强石渣混凝土轴压短柱静力性能试验研究

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摘要:

通过14个钢管超高强石渣混凝土短柱试件的轴压试验, 考察其破坏形态, 分析混凝土强度、试件的直径、径厚比等参数对其力学特性的影响。试验结果表明: 以较低的水泥消耗量配制的超高强石渣混凝土填充至钢管内, 钢管与核心混凝土界面密实, 没有脱空的现象; 在试验参数范围内, 试件的套箍指标和混凝土强度是影响其静力特性的主要因素, 试件的峰值荷载、低谷荷载及二次峰值荷载与核心混凝土的名义承载力 ($f_c A_c$) 之比基本与套箍指标成线性关系, 但变化规律有别; 试件的荷载-轴向平均应变曲线可以分为四个阶段, 即弹性阶段、弹塑性阶段、荷载下降阶段和荷载回升阶段; 套箍指标较小时, 弹塑性段较短, 下降段陡峭, 峰值荷载后荷载下降幅值较大; 套箍指标较大时, 弹塑性上升段和荷载下降变形曲线较平缓, 峰值荷载后荷载下降幅值较小; 所有试件都呈剪切型的破坏特征, 有较高的残余承载力和良好的延性; 最后, 给出了经回归分析得到与试验结果比较吻合的钢管超高强石渣混凝土短柱轴心受压承载力的计算公式。

关键词: 钢管超高强混凝土短柱 超高强石渣混凝土 静力试验 承载力 延性

Experimental study on behavior of short steel tubular columns filled with ultra-high strength concrete mixed with stone-chip subjected to axial load

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Abstract:

Based on the experimental studies of 14 short steel tubular columns filled with ultra-high strength concrete mixed with stone-chip (abbreviated as SSTCFUSCMS), this paper describes the failure mode of this type of short columns subjected to axial load. The influences of the concrete strength, diameter and diameter-thickness ratio of the steel tube on the static properties of the specimens are also analyzed. It is found that it is possible to eliminate the disengaging at the interface of steel tube and the core concrete by filling ultra-high strength concrete mixed with stone-chip (abbreviated as USCMS) with reduced consumption of cement. Within the scope of the test parameters, both the confinement index and the concrete strength have great influence on the features of the SSTCFUSCMS specimens subjected to axial load. The respective ratios of the peak load, the lower yield load and the peak load in the ascent process of its carrying capacity to the nominal bearing capacity (i.e. $f_c A_c$) of the core concrete are almost linearly proportional to the confinement index of the specimens following different rules. Experimental results show that the load versus average strain curves of the specimens should be divided into four stages: the elastic deformation stage, the elasto-plastic deformation stage, the descent stage and the recovery stage of the loading carrying capacity. The specimens with lower confinement index exhibit a rapid softening process in the post-peak region with a towering peak and a shorter incremental portion plus the weak recovery in the forth stage. The specimens with higher confinement index exhibit a gradual softening process in the post-peak region with a chubby curve and a longer incremental portion plus the strong momentum of recovery in the forth stage. The experimental observations indicate that all specimens have high residual load carrying capacity and excellent ductility. Then the formula for predicting the ultimate load carrying capacity is developed by regression analysis based on the experimental results. The calculated results have a good agreement with the experimental results.

Keywords: short steel tubular columns filled with ultra-high strength concrete mixed with stone-chip (abbreviated as SSTCFUSCMS) ultra-high strength concrete mixed with stone-chip (abbreviated as USCMS) load-bearing capacity static properties ductility

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