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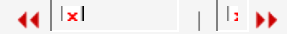
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### 结构钢材循环荷载下的本构模型研究

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### STUDY ON CONSTITUTIVE MODEL OF STRUCTURAL STEEL UNDER CYCLIC LOADING

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- 摘要
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#### 摘要

在抗震分析中, 钢材在循环荷载下的一维本构模型是结构抗震设计时进行结构弹塑性地震响应分析的基础. 为了更为准确地模拟结构的抗震反应, 并能够在实际工程中应用, 该文提出了结构钢材Q235B、Q345B 在循环荷载下的单轴简化本构模型, 其中包括: 单调加载曲线、循环骨架曲线以及滞回准则, 通过建立数学模型对钢材循环荷载作用下的反应进行描述. 根据提出的模型并基于大型通用有限元软件 ABAQUS 提供的用户子程序接口UMAT, 开发了适用于结构分析的钢材单轴循环本构模型. 通过与多种加载制度下钢材反应的试验数据进行对比, 进而证明该文所提出模型的正确性以及适用性, 保证其用于钢结构体系在地震作用下弹塑性时程分析时的精度和可行性. 分析结果表明: 钢材在循环荷载下的反应与在单调荷载下的反应有很大的差别, 循环荷载下的骨架曲线对于准确的数值模拟起到重要作用; 钢材在循环荷载下的滞回准则也与现通用有限元软件中的本构模型有较大区别, 这对于抗震计算设计的准确性有一定的影响.

关键词: 循环荷载 钢材本构模型 骨架曲线 滞回准则 UMAT

#### Abstract:

In the aseismic analysis, the one-dimensional constitutive model of structural steel under cyclic loading is the basis for seismic response analysis in aseismic design. In order to simulate the seismic response more accurately and be able to apply to practical engineering, a uniaxial and simplified constitutive model of structural steel under cyclic loading is proposed in this paper which includes: monotonic loading curve, hysteresis skeleton curve and hysteresis criteria and the model describes the seismic reaction through establishing the mathematical models of structural steel under cyclic loading. According to the model and UMAT provided by the user subroutine interfaces, based on finite element software ABAQUS, a steel uniaxial hysteresis constitutive model is developed for the structural analysis. It is proved correct and applicable of the model proposed in this paper through comparing with the reaction of test data under a variety of loading systems and the accuracy and feasibility of nonlinear time history analysis is ensured for the steel structure system under earthquake. The results show that: the responses of steel under cyclic loading and the monotonic loading are quite different. Therefore, the skeleton curve under cyclic loading plays an important role for accurate numerical simulation; the hysteresis criteria of structural steel under cyclic loading is also very different from the one used in constitutive models of finite element software which has great effect on the accuracy of the aseismic design and calculation.

Key words: cyclic loading constitutive model of structural steel hysteresis skeleton curve hysteresis criteria UMAT

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