目　次

美国Cypress高架桥地震倒塌的仿真分析

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摘要　取美国Cypress高架桥的地震倒塌来验证如下结构倒塌分析模型：建立基于广义函数的单元混合铰模型，来描述倒塌过程中的不连续位移场，参照当前无应力构形建立控制方程，引入拉格朗日乘子来分析倒塌过程中的接触碰撞。输入该桥的结构参数和Emeryville处的地面强震记录，经程序分析输出各个时刻各构件的端点坐标，再通过可视化动态演示系统直观地再现Cypress高架桥倒塌的全过程。结果与加州大学伯克莱分校地震工程研究中心等推测的倒塌过程吻合，证明了结构倒塌分析模型的正确性和实用性。最后讨论了该桥倒塌的原因、构件碰撞引起的层加速度突变以及强震持时对结构薄弱层的影响等问题。

关键词　　地震工程　Cypress高架桥　地震　倒塌　碰撞

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COLLAPSE SIMULATION AND ANALYSIS OF CYPRESS VIADUCT DURING LOMA PRIETA EARTHQUAKE

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Abstract

  The collapse of the Cypress Viaduct is employed to test the following structural collapse analysis model：a mixed hinge model based on generalized functions is proposed to describe discontinuous displacements；the governing equations are built in the current unstressed configuration；a Lagrange multiplier approach is adopted for the analysis of collisions. After both the viaduct parameters and the ground acceleration recorded at Emeryville are input to the corresponding program，the changing coordinates of each member end during the collapse process are obtained. Visualized clearly by the Visualization of Dynamic Demo Show，the collapse process is consistent with the speculation of the Earthquake Engineering Research Center from UC Berkeley，which proves the validity and utility of the present models. Based on the results，some issues，such as the reason of the collapse，sharp changes of the frame accelerations when collisions happen，and the effects of earthquake lasting times on the weak parts of the structures，are discussed.

Key words　　seismic engineering　Cypress Viaduct　earthquake　collapse　collision

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