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考虑滑移的空间弹性节点"模糊"精化分析及其在送电线路铁塔中的应用

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"FUZZY" PRECISION ANALYSIS OF SPACE FLEXIBLE JOINT WITH SLIPPAGE AND ITS APPLICATION IN TRANSMISSION LINE TOWER

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摘要 基于模糊数学的隶属度概念,从节点的弹性位移着手实现节点的模糊转角,推导了空间弹性梁单元的单刚矩阵,给出了模糊转角位移的隶属度与弹簧刚度的映射关系。同时考虑了连接节点的滑移,导出了有滑移杆件的轴向刚度。借助MATLAB 软件,编制了考虑滑移的空间弹性节点模型(SFJS)源程序。利用该程序分析了JJ3 型送电线路铁塔在支座不均匀沉降作用下主材和斜材的轴向力分布规律,数值计算结果与足尺铁塔试验结果吻合良好。相比传统的刚架模型,考虑滑移的空间弹性节点模型计算结果更能准确地反映地表变形作用下送电线路铁塔杆件的内力。分析结果可以为采动区送电线路铁塔的设计、计算和保护提供理论依据。

关键词: 送电线路铁塔   空间弹性节点   连接滑移   模糊转角   地表变形

Abstract： Based on the fuzzy membership degree theory, fuzzy rotation angle of joint is provided in terms of its flexible displacement. The element stiffness matrix of space flexible beam and the relationship between fuzzy rotation and spring stiffness were derived based on the concept of fuzzy rotation angle of joint. The axial stiffness of truss member was presented considering the effect of connection slippage. Program of space flexible joint model with the function of analyzing slippage of joints (SFJS) was developed in MATLAB. SFJS is used to obtain the axial force of legs and diagonals of JJ3-type transmission line steel tower. The numerical results and full-scale test results matched fairly well. By means of the space flexible joint model with slippage, the internal force distribution in the bar of transmission line steel tower can be solved more accurately than the traditional space frame model. The SFJS provides theoretical foundation for design, calculation and protection of transmission line steel tower located in mining areas. Compared with the traditional modal of space truss, SFJS can calculate more accurately the internal force of truss members induced by the deformation of foundation

Key words: transmission line steel tower   space flexible joint   connection slippage   fuzzy rotation   surface deformation

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