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非对称开采矿柱失稳的突变理论分析

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摘要 正确求得非对称开采岩梁弯矩方程和挠曲线方程，采用Maple9.5符号运算软件，通过由能量守恒原理导得的总势能函数微分形式途径，建立非对称开采岩梁－(狭窄)矿柱系统动力失稳的突变模型，以分析形式给出矿柱失稳临界条件、矿柱失稳起始点和终止点位置，给出失稳瞬间岩梁的弹性能释放量；采用Matlab软件绘出的矿柱失稳性状图解形式蕴涵了丰富的信息量，对了解岩梁－矿柱系统各形变阶段的行为规律和识别岩梁沿某方向的等效刚度问题上有重要作用。分析结果表明，对称开采时岩梁等效刚度最大，非对称开采减小岩梁的等效刚度。非对称开采时矿柱受偏压，因此又减小了矿柱刚度即冲击倾向，其综合效果会使其失稳的强度要小于对称开采时矿柱的失稳强度。

关键词 采矿工程；矿柱；折迭突变；能量输入率；弹性势能变化率；能量释放量；非对称开采

分类号

ANALYSIS OF CATASTROPHE THEORY FOR PILLAR DESTABILIZATION IN DISSYMMETRIC MINING

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Abstract

The equations of bending moment and deflection line of rock beam in dissymmetric mining are deduced. Using the symbolic operation software Maple9.5，the catastrophe model of dynamic buckling in rock beam—pillar system，is established through the way that the differential form of total potential function is deduced by principle of conservation of energy. The critical condition，positions of start point and end point of pillar destabilization are analyzed，and the elastic energy releasing amount of rock beam at destabilization instant is also given. The diagrammatic form of the behavior of pillar destabilization，which is protracted by the software Matlab，contains rich information. It

has important effect on the problem of realizing the behavior rule in every deformation phase of rock beam—pillar system，and it distinguishes the equivalent stiffness of rock beam in a certain direction. The analytical results show that the equivalent stiffness of rock beam is the largest in symmetric mining，and that dissymmetric mining lessens the equivalent stiffness of rock beam. The pillar surfers eccentric compression in dissymmetric mining，so it lessens the stiffness of pillar，i.e. impact tendency. The resultant effect shows that the destabilization intensity of pillar is smaller than that of symmetric mining.
Key words mining engineering；pillar；fold catastrophe；energy importing rate；rate of elastic energy change；energy releasing amount；dissymmetric mining

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