节理岩体模型单轴压缩破碎规律研究

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CHARACTERISTICS OF FRAGMENTS OF JOINTED ROCK MASS MODEL UNDER UNIAX COMPRESSION

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摘要 为进一步研究节理倾角和节理连通率这2个参数对岩体单轴压缩下破碎特征的影响，对这些试件试验后的碎屑进行筛分试验。碎屑按照粒径d≥10 mm，5 mm≤d<10 mm，0.075 mm≤d<5 mm和d<0.075 mm分为粗粒、中粒、细粒和微粒4个粒级。计算各粒级碎屑的质量百分比、各粒径范围内碎屑的频数、碎屑比表面积和碎屑尺度－质量分布的分形维数。研究结果表明，粗粒碎屑的质量百分比随着节理倾角的增加先增大后减小，在45°附近有最大值。而其他粒级的碎屑的质量百分比、各粒径范围内碎屑的频数、碎屑比表面积和碎屑尺度－质量分布的分形维数随节理倾角的变化规律则相反，在45°附近有最小值，这与强度和弹性模量随节理倾角的变化规律相似。与各节理倾角下试件强度和弹性模量随节理连通率增加而单调减小的规律不同，试件碎屑的统计参数随节理连通率的变化规律较为复杂。总体上，节理倾角为0°，15°，75°和90°的试件，碎屑的粗粒质量百分比较无节理完整试件的低，而碎屑的中粒、细粒和微粒的质量百分比、各粒径范围内的频数、比表面积、分形维数都较无节理完整试件的要高，表明节理的存在使得其破碎程度提高，能量耗散增多；而节理倾角为30°，45°和60°的试件则有相反的规律。这是由于前一组节理倾角试件的破坏模式除包含有无节理试件的劈裂破坏模式外，还伴随有压碎或转动破坏模式，其破裂面数和能量耗散总量要高于后一组节理倾角试件的压剪破坏模式，其中节理倾角为45°的试件仅沿对角线形成一个剪切贯通面，破裂面数和能量耗散最小。

关键词： 岩石力学 节理岩体模型 筛分试验 单轴压缩 节理连通率 节理倾角

Abstract： To investigate the dependence of the characteristics of rock mass fragments upon the two joint geometrical parameters，i.e. joint inclination angle and joint continuity factor，sieve tests were carried out for fragments of gypsum specimens with one set of discontinuous open joints after uniaxial compression tests. The fragments are classified into four size groups，i.e. large-sized，medium-sized，small-sized and fine，whose diameter are larger than 10 mm，5－10 mm，0.075－5 mm and smaller than 0.075 mm，respectively. The mass percentages of fragments in each size group，numbers of fragments in each size range，the specific surface area and fractal dimensions of size-mass distribution are calculated. It is found that mass percentage of large-sized fragments first decreases and then increases when the joint orientation angle increases and the minimum value appears at around 45°. On the contrary，mass percentages of other fragments，numbers of fragments in each size range，the specific surface area and the fractal dimensions first increase and then decrease when the joint orientation angle increase and the maximum values appear at around 45°，which is similar with peak strength and Young?s modulus vs. joint orientation angle. Though the peak strength and Young?s modulus decrease gradually with the increase of joint continuity factor，the variation of the above parameters of fragments vs. joint continuity factor is more complicated. In general，for specimens with joint orientation angles of 0°，15°，75° and 90°，the mass percentage of large-sized fragments is larger than that of the intact specimen while the mass percentages of other fragment groups，the numbers of fragments in each size range，the specific surface area and the fractal dimensions are smaller than those of the intact specimen. Therefore，the existences of joints in this joint orientation angle group cause more cracks and more energy dissipation. For specimens with joint orientation angles of 30°，45° and 60°，it is versus. This can be attributed to the different failure modes of the two joint orientation angle groups. Axial cleavage failure which observed in the intact specimen，combined with crushing and rotation failure in the former group，will create larger number of new fractures and continuous failure surfaces，and dissipate higher energy than the shear failure in the later group. Among all specimens，the specimen with joint orientation angle of 45° has the least number of continuous failure surfaces，which only fractures along the diagonal plane.

Keywords： rock mechanics jointed rock mass model sieve test uniaxial compression joint continuity factor joint inclination angle