最大有效力矩准则的理论拓展

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中文摘要:在分析"导致变形带内先存面理或层理发生转动的最大有效力矩与先存面理或层理方向有关"的基础上,对最大有效力矩准则(M_{eff}=0.5(σ_1-σ_3) $L\sin 2\alpha \sin\alpha$)进行理论上的拓展,提出了可以判定任意方向先存面理最大有效力矩的准则——泛最大有效力矩准则($M_{G\text{-}eff}$=0.5 (σ_1-σ_3)$L\sin 2\alpha\sin(\alpha-\theta)$), 其中当先存面理与最大主压应力($\sigma_1$)平行时,则成为最大有效力矩准则.该准则的理论分析表明:1 当先存面理与σ_1平行时,在σ_1左右两侧±54.7° 方向出现2个有效力矩的最大值,形成共轭的变形带,钝角(109.4°)对着σ_1方向;2 当先存面理与σ_1斜交时,在σ_1的另一侧出现1个有效力矩的最大值,从而只出现一个方向的变形带,并随着先存面理偏离σ_1方向,变形带与σ_1的夹角逐渐减小(从θ=0° 时的54.7°,减小到θ=90° 时的35.3°),而与先存面理之间的夹角逐渐增大(从θ=0° 时的54.7°,增加到θ=90° 时的125.3°);3 当先存面理与σ_1垂直时,在σ_1左右两侧±35.3° 方向出现2个有效力矩的最大值,也形成共轭的变形带,但锐角(70.6°)对着σ_1方向.在主应变平面上变形带与先存面理方向及变形带剪切方向(左旋或右旋)已知的情况下,可以确定最大主压应力方向.泛最大有效力矩准则克服了最大有效力矩准则与滑移线理论不相容的问题,可以解释大多膝褶带非共轭发育等多种现象,预期在韧性变形域中具有广阔的应用前景.

中文关键词:最大有效力矩 韧性变形 先存面理 变形带 共轭

THEORETICAL DEVELOPMENT OF MAXIMUM EFFECTIVE MOMENT CRITERION

Abstract: Theoretical analysis shows that the Maximum Effective Moment,which cause pre-existing cleavage or bedding to rotate,is related to the direction of pre-existing cleavage or bedding,and the Maximum Effective Moment Criterion(M_{eff}=0.5 (σ_1-σ_3) $L\sin 2\alpha\sin\alpha$, simplified as MEMC)proposed by Zheng et al is theoretically expanded to General Criterion of Maximum Effective Moment($M_{G\text{-}eff}$=0.5 (σ_1-σ_3) $L\sin 2\alpha\sin(\alpha\text{-}\theta)$,simplified as GCMEM),which can be used to determine the Maximum Effective Moment with any direction of cleavage in this paper. MEMC is a special case of GCMEM when cleavage is parallel to maximum principal compressive stress(σ_1). Theoretical analysis of GCMEM shows that:1 when cleavage is parallel to σ_1,there occur two values of Maximum Effective Moment symmetrically on either side of σ_1 in the direction of ±54.7°,and two conjugate deformation zone are predicted to appear with obtuse angle(109.4°)facing σ_1 direction. 2 When cleavage is oblique to σ_1,one Maximum Effective Moment,along which one deformation zone will appear,is predicted to occur on other side of σ_1,and the angle between deformation zone and σ_1 will decrease(from 54.7° when θ=0° reduced to 35.3° when θ=90°),while the angle between pre-existing cleavage and deformation zone will increase(from 54.7° when θ=0° increased to 125.3° when θ=90°)with pre-existing cleavage deviating from the σ_1 direction. 3 when cleavage is perpendicular to σ_1,there also occur two values of Maximum Effective Moment symmetrically on either side of σ_1 in the direction of ±35.3°,but two conjugate deformation zone with acute angle (70.6°)facing σ_1 direction. When the directions of pre-existing cleavage and deformation zone on principal strain surface and shear direction(sinistral or dextral)are known,the direction of maximum principal stress can be determined. GCMEM overcomes the incompatibility of MEMC with Slip Line Theory,and can be used to explain most of the kink zone development and other non-conjugate phenomena. It is expected to have wide application prospects in ductile deformation field.

keywords: Maximum Effective Moment ductile deformation pre-existing cleavage deformation zone conjugate