ABSTRACT

An elasto-plastic finite element analysis is presented for axisymmetric rod extrusion, compound extrusion of rod and tube, and extrusion forging problems. Work material is assumed to follow von Mises yield criterion and the associated flow rules. The nonlinear material behaviour in the elasto-plastic range of the deforming billet has been incorporated in the general purpose FEM package "FEMEX : Finite Elements for Metal Extrusion" developed for the purpose. The problems undertaken are analysed by using 8-noded Serendipity quadrilateral isoparametric elements and 2X2 Gauss quadrature interpolations. The efficiency of computation has been greatly enhanced by employing automatic mesh generation schemes and presenting the results through the computer graphics. The developed interactive computer aided graphics package "GRAFIX-MEX : Graphics for Metal Extrusion" has been successful in presenting the FE results. It depicts the metal flow behaviour by revealing the elastic-plastic boundary (EPB), the gradual development of plastic zone with load increment, isostress contours and the detailed distribution of stress components in the deforming billet.

Solutions are obtained with regard to the effect of geometrical parameters and the die-billet interfacial friction conditions on the spread of plastic zone and, in turn, on the load requirement. Finite element results compare well with the slip line and visioplasticity methods. The average relative pressures have further been obtained by the upper bound analyses and compared. The higher estimation of load by UB method is mainly due to the assumed approximate shape of the EPB. Some experiments have been conducted on lead billets and results compare well with those of FEM.