Among consequences that can be induced by a non-uniform distribution of the stress and other causes during the drilling process is the elliptical shape of the well and consideration of this effect would improve the accuracy of the drilling fluid hydrodynamics prediction. In the present work, the elliptical shape of the annular space is simplified to apply the slot model taking into account the rotation of the inner cylinder. Moreover, the Slot model results are compared with the experimental data, as well as, with the CFD outcomes where a reasonable concordance is observed, especially for low ratios of the major and minor semi-axis. Also, the CFD results are validated with the experimental data from the flow loop setup. We concluded that the increase of the major and minor semi-axis ratio of the elliptical annulus results in a linear increase of the Ostwald-de Waele frictional pressure loss in the laminar regime for all considered rotation speeds of the inner cylinder. In addition, the increase of the eccentricity from 0 to 0.75 has a positive effect where the frictional pressure loss is decreased by almost 28% for all rotation speeds for the elliptical annulus ((Formula presented.))