May 1980 – Closed Book

In the corner of a building, an el-shaped member A0B is mounted in a horizontal plane by rigidly fixing the ends A & B in the respective walls. Angle AOB is a right angle in the unloaded configuration. The two arms of the “el”, A0 & B0, are identical, each having length L, circular cross-section of diameter d, Poisson’s ratio v and Young’s modulus E. At point 0, the two rods are rigidly welded together.

A vertical load P is applied at the corner 0 of the elbow.

1. What is the vertical deflection, δ, at point 0?
2. How much more (or less, whichever is the case) deflection would have been obtained had the structural connection at point 0 been realized as a single ball and socket joint instead of a weld? Express this in ratio form: \( \frac{\delta_{\text{welded}}}{\delta_{\text{ball joint}}} \)