Maximum Compression Loading of Flexures

The theoretical maximum buckling load of a column, clamped at one end is given by
$P_1 = 2\pi^2 E I / L^2$

where E is the elastic modulus of the column material
I is the area moment of inertia of its cross section
L is its length

For a rectangular cross section of width w and thickness h, $I = wh^3/12$

giving $P_1 = 2\pi^2 E w h^3 / 12L^2$

For two flexures in compression with an exactly vertical load distributed perfectly evenly between them, given a flexure width of 1/2", thickness of 0.002” and length (spacing) = 0.012” with an elastic modulus of $29x10^6$ PSI we obtain the buckling load

$P_1 = 2\pi^2 \cdot 29E6 \cdot 2 \cdot 0.5 \cdot (0.002)^3/(12 \cdot (0.012)^2) = 2650$ lb

Bear in mind that in practice the true maximum compressive load will be less, as the load will not always be exactly vertical, or perfectly distributed between the two flexures, but in any case it will be much larger than the weight of a typical boom.

Note that at the theoretical buckling load, the compressive stress on the flexures will be $2650 /(2 \cdot w \cdot h) = 1{,}325{,}000$ PSI, well above the stress limit for their material.

If we assume a maximum allowable compressive stress of 50,000 PSI (we will assume that the flexures are made of steel) then the maximum load

$P_{max} = 50{,}000 \cdot 2 \cdot 0.5 \cdot 0.002 = 100$ lb

and for materials weaker than steel it will be lower.

Conclusion: For a gap of 0.012’ the maximum compressive load on the flexures is not determined by buckling, but by the maximum compressive stress. This will be true in this example, even for 0.001” thick steel flexures, which have a buckling load of 331 lb and a max (50,000 psi) compressive load of 50 lb.