Stretching vs. bending in thin plates: the decay of transverse curvature in curved strips

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If one compares the energy cost of stretching vs. bending for a thin elastic plate, one finds that the stretching deformations are orders of magnitude above the bending deformations (typically 10^6 for a paper sheet). As a consequence, the Rayleigh principle states that such thin objects will deform *under ordinary circumstances* (in the words of Rayleigh) without stretching deformations. The family of deformations without stretching are the isometric or the developable transformations.

In this presentation, I will discuss some situations in which pure bending deformations are not observed for thin elastic plates. I will present a simple experiment (see figure 1) in which a flat elastic strip is pressed against a circular cylinder. Although a cylinder is a developable surface, the strips does not follow it, and after a finite distance of the cylinder, the strip is flat.

Figure 1. Side view a rectangular elastic strip (length 30 cm, width 20 cm, thickness 3 mm) pressed against a circular cylinder of radius 10 cm.

I will present a 1D-model that predicts quantitatively the finite persistence length of the curved region. This model describes the sheet surface by the transverse curvature function $c(x)$.

References

1. T. Barois, L. Tadrist, C. Quilliet & Y. Forterre, How a Curved Elastic Strip Opens, *Phys. Rev. Lett.*, (2014).