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How do bendy straws bend? A study of re-configurability of multi-stable corrugated shells[1] NAKUL BENDE, SARAH SELDEN, Univ of Mass - Amherst, ARTHUR EVANS, University of Wisconsin–Madison, CHRISTIAN SANTANGELO, RYAN HAYWARD, Univ of Mass - Amherst — Shape programmable systems have evolved to allow for reconfiguration of structures through a variety of mechanisms including swelling, stress-relaxation, and thermal expansion. Particularly, there has been a recent interest in systems that exhibit bi-stability or multi-stability to achieve transformation between two or more pre-programmed states. Here, we study the ubiquitous architecture of corrugated shells, such as drinking straws or bellows, which has been well known for centuries. Some of these structures exhibit almost continuous stability amongst a wide range of reconfigurable shapes, but the underlying mechanisms are not well understood. To understand multi-stability in 'bendy-straw' structures, we study the unit bi-conical segment using experiments and finite element modeling to elucidate the key geometrical and mechanical factors responsible for its multi-stability. The simple transformations of a unit segment – a change in length or angle can impart complex re-configurability of a structure containing many of these units. The fundamental understanding provided of this simple multi-stable building block could yield improvements in shape re-configurability for a wide array of applications such as corrugated medical tubing, robotics, and deployable structures.

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