BENDING OF SURFACES, BIFURCATIONS, DYNAMICAL SYSTEMS AND STABILITY OF SHELLS

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A family of polyhedra possessing unusual deformation properties is found. On one hand, models of these polyhedra allow large continuous free reversible bendings without visual distortions of material. On the other hand, the polyhedra themselves are rigid and don't allow any continuous bendings according to O.Cauchy. The found polyhedra are called "model flexors" in order to distinguish them from "theoretical flexors" of R.Connelly. Bendings of the models are good approximated by bendings of polyhedra, they represent a nonrigid, either soft or slow loss of stability that coresponds to the loss of stability "in small" accordingly to L.Euler. The nonrigid loss of stability is followed by ordered over-critical deformations. This new phenomenon in mechanics of deformable bodies may be studied only by methods of V.Arnold analytic theory of dynamic systems, by methods of A.V.Pogorelov geometric theory of thin shells stability and by techniques of linear bendings of surfaces. The family of polyhedra under consideration is generated by the well-known right star-like pyramids constructed earlier by A.D.Alexandrov and S.M.Vladimirova.

The existence of model flexors well confirms a conjecture by A.L.Goldenweiser: the geometric rigidity is not sufficient to evaluate the stability of a real material shell. By the way, we state that in fact the stability of a rigid loaded construction is intimately related to how it could loss the stability. In considered situation, the respective criterion is the kind of linear bendings of shell's middle surface. By construction, the family of model flexors represented by star-like pyramids may be also viewed as an original geometric model of catastrophe. It naturally supplements the physical machine of catastrophe proposed by E.C.Zeeman and T.Poston.

The phenomenon of nonrigid loss of stability can be applied in the engineering for create constructions with changing geometric forms, in theoretical study of non-linear transient processes, in geophysics to explain the causes of global deformations of the earth-crust, so on.

References

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