The robustness of Timoshenko beam in geometrically non-linear frame analysis

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Tangent Stiffness Method using strict geometrical stiffness gives perfect equilibrium solutions with convergence of unbalanced forces at all nodes. In case of deep beam or dense mesh division, Timoshenko beam elements show better convergence against to the huge load which causes extremely large displacement acts than Euler-Bernoulli beam elements. In this study, some numerical examples of large displacement analyses for 3-D frame structure with finite rotation are shown, and the performance of Timoshenko beam elements is discussed when the flat rectangle cross section is applied.

Keywords: The robustness of Timoshenko, Tangent Stiffness Method, The huge load, finite rotation

Numerical examples of 3-D frame structure analysis
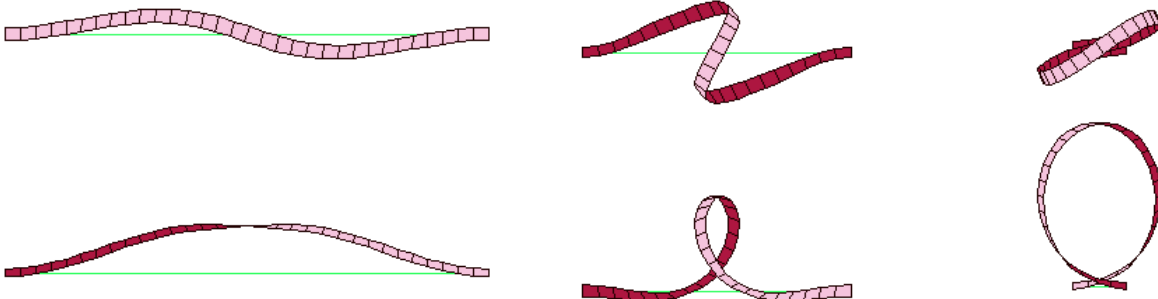
Figure: 3-D behavior of frame, axial twist makes circular shape (greenhill problem)