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# The influence of beam kinematic assumptions in a beam contact benchmark

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We present a benchmark to help validating simulation codes for contact problems involving beams and discuss the influence of different kinematic hypotheses on the solution. Closed form expressions are derived and the comparison is made with a finite element implementation that uses the mortar method for enforcing the contact constraints [1]. The test case consists in the static analysis of a semi-infinite cantilever beam clamped at a finite distance from a fixed rigid wall and subjected to a constant distributed load. It is shown that in the case of the Euler-Bernoulli beam the distributed frictionless contact force is equal to the load all along the contact region except at the boundary where a point load appears. On the contrary, a distributed reaction takes place on the Timoshenko beam which decays exponentially from the first contact point. The rate of decay depends on the magnitude of the shear deformability. For both models the distributed contact force is discontinuous. Moreover, whereas in the first case the shear force is discontinuous, it becomes continuous when allowing for shear deformation. It is shown that the numerical value of the total contact force converges to the analytic solution when the finite element mesh is refined. Our observations are consistent with the results found in [2, 3] in other beam contact problems. Yet, richer beam models, that allow for transverse deformation of the cross section, would lead to continuous distributed contact forces.

## REFERENCES

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