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# BEAM-TO-BEAM CONTACT WITH ROTATIONAL FRICTION/ADHESION

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While simulating a 3D network of bonded fiber by beam-to-beam contact, we expect to reach considerable torsional and bending moments at the contact region. For example in simulating paper or paper board, such moments will arise not only due to relative motion of the fibers but also due to coupling between translational and torsional motion in the fibers themselves. Having a helical structure, the wood fibers twist upon tensioning. This effect was found to be important for formulating appropriate bond failure criteria [1].

In this paper we extend the existing non-linear finite element beam-to-beam contact formulations [2, 3] to account for the moments arising at the fiber bonding sites during the straining of the fiber network. We also propose a criterion for the bond failure.

We used virtual work principle for beams in contact and enhanced it with rotational friction/adhesion constraints. The formulation can be applied to beams with arbitrary shape functions.

We implemented contact element in the fiber network model [4]. We used penalty formulation for the contact and Timoshenko beam elements to discretize the fibers. We solved several test examples emulating the fiber bond measurements setup demonstrating the importance of the included terms.

Using this formulation allows us to model a complicated network of fibers without resolving the contact area and as a result it is possible to analyze networks with larger sizes with the same computational resources.

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