ABSTRACT

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With computers gaining more processing power during the last decades, Finite Element analysis has become a major tool for understanding the behavior of large-scale and complex engineering systems where multiple components interact through interfaces. Modeling the contact of two bodies across an interface with finite elements presents a number of challenges, especially in the presence of friction, large deformations and inelasticity. It is of critical importance to choose the correct type of elements that have the capability to appropriately emulate the behavior and stress distribution without suffering from surface locking, an issue that occurs when the kinematic field on the contact interface is overly constrained and is therefore not capable of representing the expected deformed state. Furthermore, much of the research on contact modeling has been focused on contact between elements of similar formulations such as solid-to-solid or beam-to-beam contact.

There are, however, cases where it is convenient to use different finite element discretizations for the bodies in contact, as, for example, in the case of piles where the pile itself can be modeled using beam elements while the soil surrounding it is discretized with solid elements. These mixed-element contact scenarios have not received much attention in the literature. The purpose of this thesis is to fill this gap, and to formulate a model for large deformation contact between beam and solid elements, as well as to address the issues of contact-search, discretization, and frictional contact for the interaction of solid and beam elements.