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# The Contact between a Rigid Substrate and a Thick Elastic Layer

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**Abstract :** Although contact mechanics has been widely focused on the study of contacts between half-space, it has been recently pointed out that in presence of finite thickness elastic layers the results of the contact problem show significant difference in terms of the main contact quantities (e.g. contact area, penetration, mean pressure, etc.). Actually, there exist a wide range of industrial application demanding for this kind of studies, such as seals leakage prediction or pressure-sensitive coatings for electrical applications. In this work, we focus on the contact between a rigid profile and an elastic layer of thickness h confined under two different configurations: rigid constrain and applied uniform pressure. The elastic problem at hand has been formalized following Green's function method and then numerically solved by means of a matrix inversion. We study different contact conditions, both considering and neglecting adhesive interactions at the interface. This leads to different solution techniques: Adhesive contacts equilibrium solution is found, in term of contact area for given penetration, making stationary the total free energy of the system; whereas, adhesiveless contacts are addressed defining an equilibrium criterion, again on the contact area, relying on the fracture mechanics stress intensity factor KI. In particular, we make the KI vanish at the edges of the contact area, as peculiar for adhesiveless elastic contacts. The results are obtained in terms of contact area, penetration, and mean pressure for both adhesive and adhesiveless contact conditions. As expected, in the case of a uniform applied pressure the slab turns out much more compliant than the rigidly constrained one. Indeed, we have observed that the peak value of the contact pressure, for both the adhesive and adhesiveless condition, is much higher for the rigidly constrained configuration than in the case of applied uniform pressure. Furthermore, we observed that, for little contact area, both systems behave the same and the pull-off occurs at approximately the same contact area and mean contact pressure. This is an expected result since in this condition the ratio between the layers thickness and the contact area is very high and both layer configurations recover the half-space behavior where the pull-off occurrence is mainly controlled by the adhesive interactions, which are kept constant among the cases.

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