Abstract
Title of Thesis: Effect of Initial Curvature of Printed Wiring Board on Vertical Stresses in Interconnects
Mark Mifsud, Master of Science, 2015
Thesis directed by: Professor Abhijit Dasgupta
Department of Mechanical Engineering

During the solder reflow process used for attaching surface mount packages to printed wiring boards (PWBs), the possibility exists for the PWB and component to warp and therefore exhibit some concave or convex curvature once the process has been completed. If the PWB is then straightened during the assembly process, the act of straightening the PWB can cause pre-stresses to develop in the interconnects between the PWB and the component package. It is important to understand these pre-stresses because unaccounted for interconnect pre-stresses can result in premature wear-out failures or unexpected overstress failures of the assembly.

An analytic model for area array components (ball grid array, column grid array, stud grid array) is developed, guided by numerical (finite element) results. The analytic model utilizes the Rayleigh-Ritz variational approach and represents the component as an equivalent shell and the interconnects as shear deformable beams. This analytic model is used to study the effect that straightening the PWB can have on the pre-stresses present in surface mount interconnects. As a simplification, any initial warpage of the component has been neglected in this study. The finite element models used to verify the analytic methodology utilize two different approximations: a simplified model that utilizes the same shell idealization as the analytic model and a more detailed 3D solid model. This analytic model provides a faster, more versatile alternative to FEA and can be used to estimate the interconnect stresses caused by PWB warpage under a variety of thermomechanical, vibration, and shock/drop loading conditions.