The HeartQuest LVAD features a compact, magnetically suspended impeller that was designed through a mathematical optimization process. The suspension requires only one active axis and permits virtually-zero-power control to minimize power consumption. All magnetic suspension and motor components in the rotor reside within an annular hub 6 mm high with 47 mm outer diameter. The corresponding stator components occupy an additional 3 mm axial cavity. The innovative configuration required advanced magnetic suspension theory to facilitate an efficient numerical optimal design process that leads to maximized stiffnesses within geometric limits. To this end, we contributed to existing theories such as those based on the dipole model (Yonnet J-P, IEEE Trans Magn, 1981, 1169-1173) to include design problems where small air gap, non-square magnet cross section, and stacks of a finite number of magnets are involved. We developed analytical asymptotic approximations of force and stiffness, which are well adapted to spreadsheets. These approximations were verified through finite element analyses and experiments on a number of practical constructional components and assemblies. Of them, the experiments with the inner suspension component, which is formed of stacks of sintered NeFeB magnet rings at small curvature, demonstrated less than 10% difference from the predicted stiffnesses. Therefore, the design optimization model has provided a powerful tool for the rapid design and development of maglev blood pumps.