Abstract

In today's scenario, structural optimization is very important in construction industry. It is also performed in structural components like machine components and other day-to-day products in order to get optimum designs. Structural optimization reduces the material requirements for the components as well as increases their performance by optimizing the structures according to the given constraints and load distributions. Hence, the optimized designs are quite efficient and economical as well. Shape optimization is a type of structural optimization that aims to integrate geometrical modeling, structural analysis, and optimization into one complete and automated computer-aided design process. It determines the shapes of the boundaries of different structural components for improved strength, stiffness, fatigue life, and weight. Topology optimization is another type of structural optimization that aims to spatially optimizes the distribution of material within a defined domain, by fulfilling given constraints and optimizing some objective functions. Structural components are manufactured with the goal of using the least amount of material possible. In order to achieve this goal, generally first topology optimization is performed and then to smoothen the outer boundary of the design component, shape optimization is used.

This thesis studies optimal designs obtained from shape and topology optimization of a two-dimensional cantilever beam under different types of load distributions (point, uniformly distributed, uniformly decreasing towards free end, and uniformly increasing towards free end). Both the shape and topology optimizations are performed under the same amount of total load in COMSOL Multiphysics software package. In both of the shape and topology optimization, COMSOL Multiphysics inbuilt solver method of moving asymptotes (MMA) is used. Performing the shape optimization, it is found that the material requirement is maximum in the case of point load at the free end of the beam and it is minimum in the case of uniformly decreasing load towards free end of the beam. In topology optimization also, material requirement is maximum in the case of point load at the free end of the beam and it

is minimum in the case of uniformly decreasing load towards free end of the beam. The study would be beneficial for designers in adopting the best designs, considering the requirements and available provisions. Such findings gives an idea about what type of loading should be preferred, if alternating provision are applicable.