In this work, the finite element analysis has been used to predict the temperature distribution in Nd:YAG laser rod; double end-pumped by two methods Gaussian or top hat beam. The rod is cooled by water passing through annular, which sur-rounds the active media. The temperature distribution has been used to predict numerically, the nodal displacements, strain and stress based on the principle of virtual work. The main task is to determine the temperature distribution in Nd:YAG laser rod, the subsequent value and location of maximum tensile hoop stress associated with the two types of the double end pumping for different ab-sorption power. Some conclusions are obtained; as the radius pumping ratio in-creases the location of maximum hoop stress will move toward the periphery and vice-versa. Small reduction is observed in the location of maximum hoop stress when pumping method change from the top-hat beam to Gaussian beam, espe-cially at low radius pumping ratio and high absorption power. Top hat beam end pumping will cause more intense tension hoop stress at the facets of the rod than that of Gaussian beam even the later may produce high center temperature. This work may be important for designer while choosing the type of pumping, maximum produced tensile hoop stress and its location, especially when hoop stress is ultimate.