The analytical solution of transient temperature distribution and Tresca failure stress in cw end- pumped laser rod has been derived using integral transform method. The analytical result is compared with numerical solutions presented by other works and good agreement has been found. Analytical solution with its clear physical meaning and its explicit form permits to predict the influence of various factors on the solution. The optical path difference which gives a valuable means to quantify the optical properties of laser material such as designed beam quality, will converge to a constant value as steady state temperature distribution is reached. One can obtain the dominate factors which affect the laser response to bring the laser rod to the thermal equilibrium; it has been found that fast response can be achieved by reducing pumping power, increasing extracted heat from the rod , choosing a crystal having high thermal diffusivity and decreasing laser rod radius while its volume remains constant. One final advantage of the analytical solution is that a fast result can be obtained where the numerical solution usually is a time consuming technique.