<u>ABSTRACT</u>

Firstly, natural convection heat transfer from a 3D thick hollow horizontal cylinder placed on the ground is studied numerically. Numerical simulations are performed in the laminar regime by varying the length to outer diameter ratio (*L/D*) and thickness ratio (*d/D*). It is observed that with an increase in thickness, *Nu* decreases at low *L/D* ($L/D \leq 2$), whereas at higher *L/D*, a reverse trend is observed. It has also been observed that at a particular *L/D* and *d/D*, the contribution to heat transfer rate from inner surface increases with *Ra*, whereas a reverse trend is observed for the outer and side flat surface. Subsequently, a comparative study on conjugate natural convection heat transfer from a cylinder placed on the ground or suspended in air is reported. It is noticed that the average *Nu* for a cylinder suspended in air is more than for cylinder placed on the ground up to *Ra* of 10^6. However, for $Ra=10^7$ and $d/D \geq 0.8$, the average *Nu* for cylinder placed on ground is marginally more for cylinder in air up to $L/D=0.8$. Later on, numerical simulations are performed for a thick hollow vertical cylinder suspended in air by changing the length to outer diameter ratio (L/D_o) and thickness ratio (D_i/D_o) within the laminar regime. It has been observed that the average *Nu* of a thick hollow cylinder increases with L/D_o, attains a peak and then decreases to a minimum and then again increases with L/D_o. It has also been observed that the non-dimensional mass-flow rate increases with *L/Do*, attains a peak and then decreases for all *Ra*. Subsequently, a comparative analysis of heat transfer rate and flow field pattern around a thick hollow vertical cylinder placed on ground or suspended in air is performed. Cooling time for the cylinder placed in air or on ground have been described precisely. Finally, a correlation for the average *Nu* as a function of all the pertinent parameters has been proposed that can be useful for industrial and academic purposes.

Keywords: thick hollow cylinder, natural convection, Nusselt number, mass-flow rate, thickness ratio, steel roll cooling, cooling time curve