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Inner Temperature Scaling for Combined Convection Turbulent Boundary Layers ASHISH JAISWAL, XIA WANG, Oakland University — New inner length and temperature scalings are derived for the combined convection turbulent boundary layer. These new scaling are not obtained by the convectional dimensional analysis, but by considering the analogy of the driving and drag force between the momentum and thermal transport phenomena inside a turbulent boundary layer flow. The new thermal length scale and temperature scale are therefore derived using the known classical length and the velocity scale of the turbulent boundary layer. Using the experimental data from T. Tsuji and Y. Nagano (1990) and Blackwell (1972), it has been observed that the temperature profiles combine to form into a single curve when scaled by the new scalings. The inner temperature scaling derived are also compared with the existing natural convection scalings derived by George and Capp (1978) and the forced convection scaling by Wang and Castillo (2003). The existence of Grashoff Number and Stanton number in the inner scalings clearly indicates the possibility of domination of the buoyancy force or the possible effect of forced convection over the natural. A new dimensional less number has been found which consist of the Stanton number and the Richardson number based on which a clear judgment can be done on the type of convection that dominates the combined convection. Hence the new derived scalings appear to give more information regarding the type of flow. Efforts are made to verify the same scalings with a variety of thermal data.

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