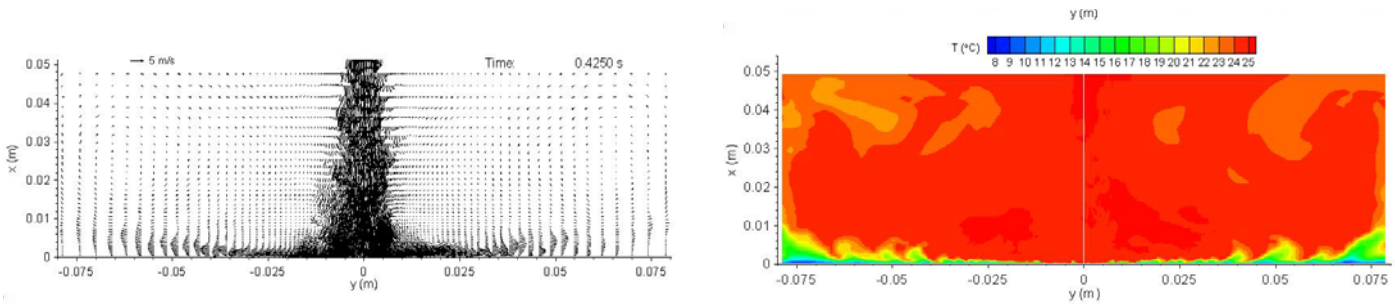

Fig.1 Instantaneous Flow and Temperature Fields for an Impinging Circular Jet

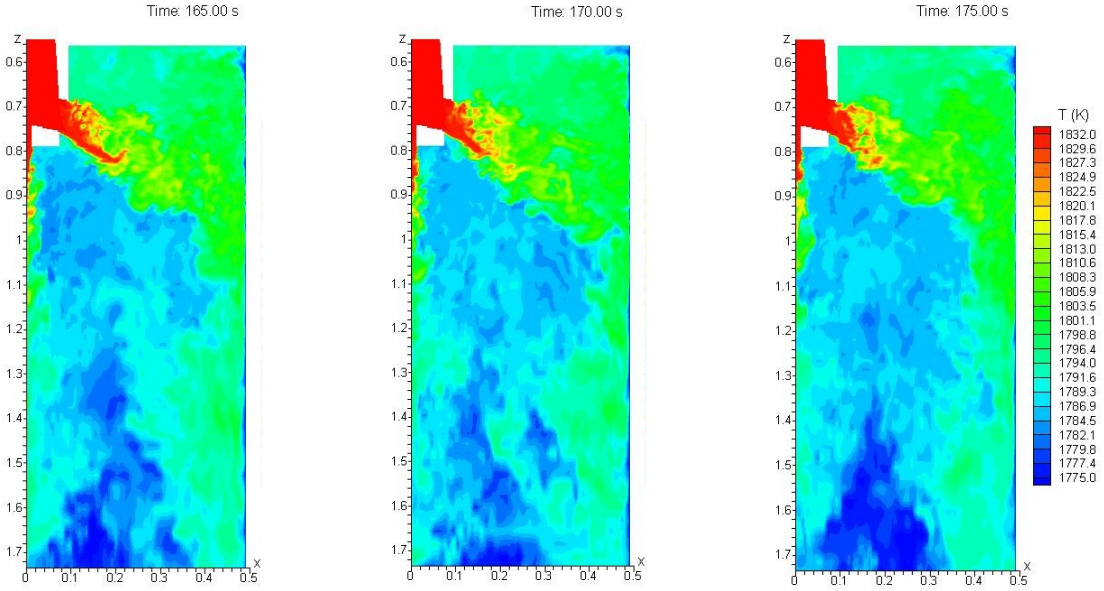

Fig. 2 Instantaneous Temperature Fields in the Mold region of a Continuous Caster of Steel

Transient Flow and Temperature Transport in Continuous Casting of Steel Slabs

B. Zhao[1], B.G. Thomas[1], S. P. Vanka[1] and R. J. O'Malley[2]

[1] Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign,

[2] Nucor Steel, PO Box 2249, Decatur, AL 35609

The above pictures show the flow and temperature fields in an impinging circular jet and temperature fields in a continuous caster of steel slabs. These pictures were obtained from Large Eddy Simulations using very fine grids, and show instantaneous snap shots. These calculations used approx. 800,000 control volumes for the impinging jet and 1.6 million volumes for the caster simulations. The instantaneous flow structures and temperature contours show the complex turbulence structures that exist in the caster. These temperature fields are important to the understanding of the production of defects in steel casting, and in predicting heat transfer rates to the solidifying region. A classic double-roll flow pattern is confirmed for this 132×984mm slab caster at 1m/min casting speed. The results show that temperature in the top of the molten pool is about 30% of the superheat temperature difference. About 12 percent of the superheat is extracted from the narrow face, where the peak heat flux averages almost 750 kW/m^2 and instantaneous peaks exceed 1500 kW/m^2. Two thirds of the superheat is removed in the mold. The jets exiting the nozzle ports are shown to fluctuate, producing temperature fluctuations in the upper liquid pool of ±4 ^{o}C and peak heat flux variations of ±350 kW/m^2.