

Progress

- **Natural Convection in a square cavity**

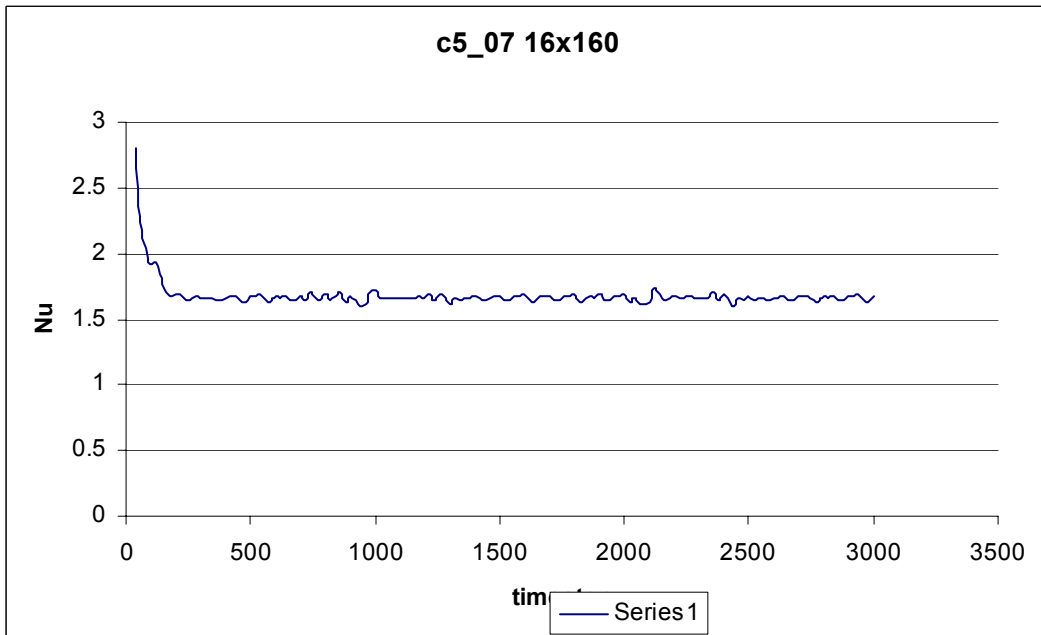
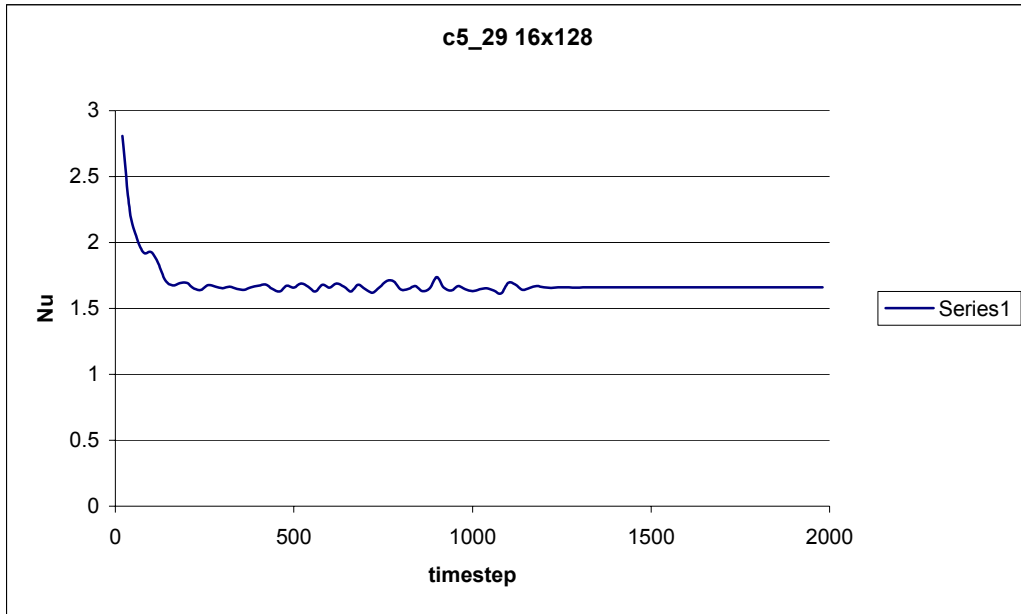
Natural Convection in a square vertical cavity has been modeled with the Rayleigh Number at 1000, 10000, 100000, 1000000. Dimensionless parameters are used in the solution process. Results are compared with Fidap Example Manual and presented in the technical report.

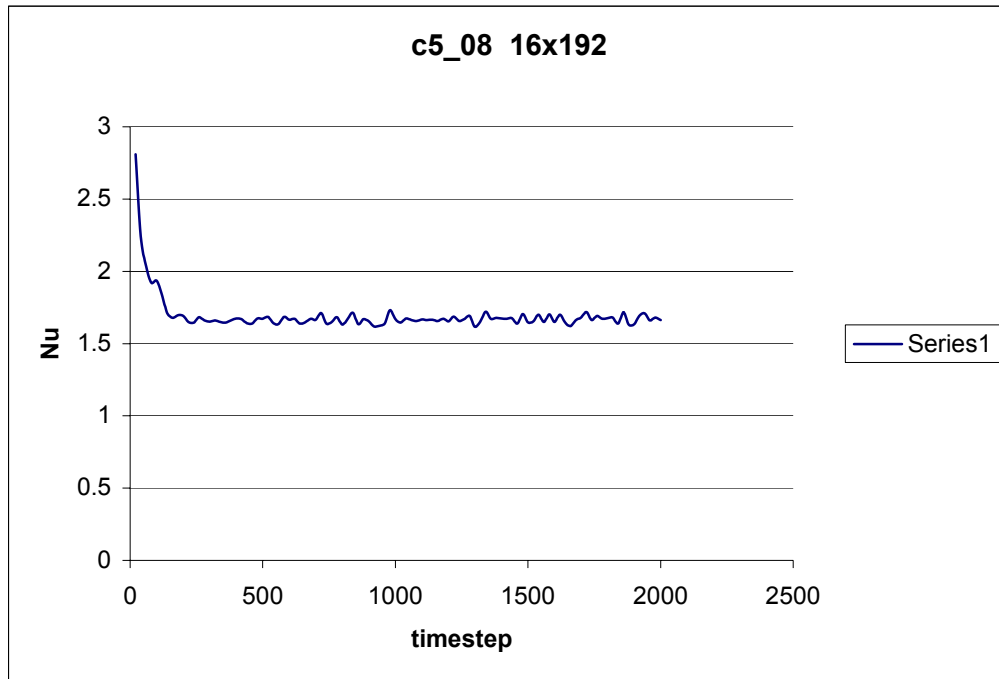
- **Modeling of Seven IGU cavities from Condensation Resistance Validation Project**

7 IGU rectangular cavities from Condensation Resistance Validation Project have been modeled. Among the seven vertical IGU cavities, six of them belong to the conduction regime, while the other one is in boundary layer regime. Average Nusselt Number and local Nusselt Number are got. For cavities 1, 2, 3, 4, 6 and 7, time-independent solution method is used. (For cavity 4, incremental loading solution is used.) The results for local Nu from Fidap are in the attached file 7cav.xls.

For cavity 5 with aspect ratio 25.5 and Rayleigh number 22052, time-dependent solution method is used. A number of runs are performed, using different mesh density, total simulation steps, and different time intervals. Small dimensionless time intervals 0.1, 0.2 and 0.3 are used and it is found that changing this factor doesn't effect the result since the values are small enough to make the solution converge. But the mesh density has some influence on the results, especially on the local Nu. Some figures of average Nu

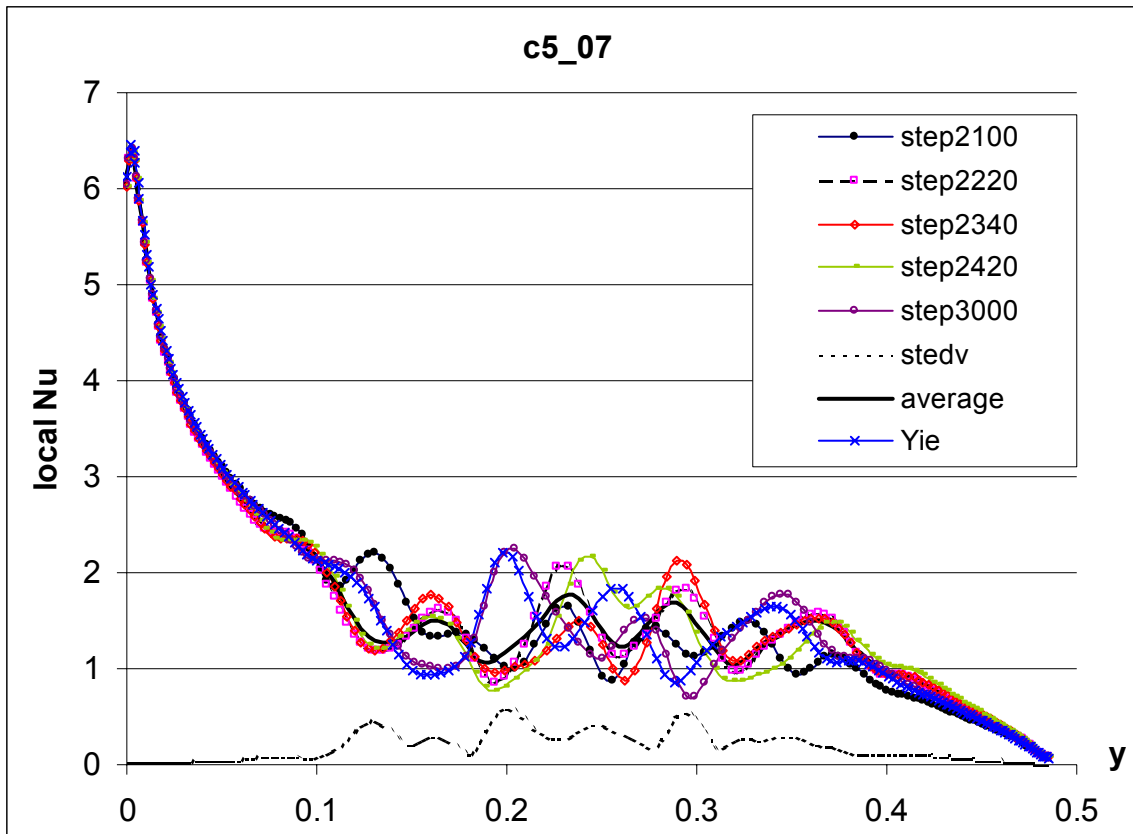
versus timestep are listed. (c5_29, c5_07 and c5_08 are file names; 16x128, 16x160 and 16x192 are mesh density.)





For the average Nu, we can take the average for all the timesteps. The standard deviation of average Nu for any 5 time steps which are picked freely from the file c5_07 is calculated, and the value is 0.018.

However, there is still no conclusion how to decide the local Nu. It is found that the mesh density has great influence on the results of local heat flux. The following figure shows the local Nu along the hot wall of the cavity at different timestep for the file c5_07. Average and standard deviation at each location along the wall are calculated. We can see big difference among these timesteps. So, the question is from which timestep we take the local heat flux.



Average Nusselt number results from Eckert and Carlson, and from Fidap modeling are presented in the attached file Nuave.xls; Results from fidap modeling are in the attached file Table 1 lists some parameters and the Average Nusselt Number results. (Note: when I calculated average Nu using eqn. from Eckert&Carlson, I used the property values listed in this table; The Ra number I used for fidap modeling are same from Zhao's report.)

Average Nu(Eckert&Carlson)

	Cav. 1	Cav. 2	Cav. 3	Cav. 4	Cav. 5	Cav. 6	Cav. 7
T1	259.45	259.45	260.05	258.25	259.45	272.55	271.65
T2	280.55	280.55	278.45	284.35	280.45	284.45	283.45
Tm	270	270	269.25	271.3	269.95	278.5	277.55
viscosity	1.7E-05	1.7E-05	1.69E-05	1.7E-05	1.696E-05	1.74E-05	1.73E-05
density	1.303392	1.303392	1.307023	1.297147	1.303633832	1.263612	1.267937
Cp	1005.704	1005.704	1005.693	1005.723	1005.702924	1005.828	1005.814
conductivity	0.023866	0.023866	0.023806	0.02397	0.023862032	0.024545	0.024469
expansion coeff.	0.003704	0.003704	0.003714	0.003686	0.00370439	0.003591	0.003603
thermal diffusivity	1.82E-05	1.82E-05	1.81E-05	1.84E-05	1.82004E-05	1.93E-05	1.92E-05
L	0.0127	0.0127	0.00635	0.0127	0.01905	0.0127	0.00635
H	0.485775	0.482475	0.485775	0.485775	0.485775	0.485775	0.485775
RaL	6625.467	6625.467	731.6949	8012.812	22274.3228	3230.459	406.8958
RaL(from zhao's report)	6559.7	6559.7	722.9	7955.1	22052	3441.8	405.8
GrL	9269.081	9269.081	1023.342	11215.74	31161.33936	4534.269	570.9144
aspect ratio A	38.25	37.99	76.5	38.25	25.5	38.25	76.5
Results					1.918570569		
NuL	1.156083	1.157151	1.011092	1.18463	1.680145747	1.083041	1.006594
NuL_zhao	1.1556	1.1567	1.011	1.1845	1.6785	1.0881	1.0066

Average Nu(from Fidap)

	Cav. 1	Cav. 2	Cav. 3	Cav. 4	Cav. 5	Cav. 6	Cav. 7
Nu	1.1321	1.133	1.0003	1.1627	1.6584 (from c5_07)	1.0643	1.0012
Nu_Zhao	1.1308	1.1317	1.0034	1.1606	1.6794	1.0728	1.0013