MEEN 673

Homework 6

Jicheng Lu

525004048

Problem 1: (Fluid squeezed between parallel plates)

Table 1.1 Comparison of finite solution $V_x(x,0)$ with the analytical solution for fluid squeezed between plates; 5x3Q9 and 10x6L4 meshes are used in the penalty model.

	$\gamma = 1.0$		$\gamma = 100$		$\gamma = 10^8$		
X	4-node	9-node	4-node	9-node	4-node	9-node	Exact
1.0000	0.0303	0.0310	0.6563	0.6513	0.7576	0.7505	0.7500
2.0000	0.0677	0.0691	1.3165	1.3062	1.5135	1.4992	1.5000
3.0000	0.1213	0.1233	1.9911	1.9769	2.2756	2.2557	2.2500
4.0000	0.2040	0.2061	2.6960	2.6730	3.0541	3.0238	3.0000
4.5000	0.2611	0.2631	3.0718	3.0463	3.4648	3.4307	3.3750
5.0000	0.3297	0.3310	3.4347	3.3956	3.8517	3.8029	3.7500
5.2500	0.3674	0.3684	3.6120	3.5732	4.0441	3.9944	3.9375
5.5000	0.4060	0.4064	3.7388	3.6874	4.1712	4.1085	4.1250
5.7500	0.4438	0.4443	3.8316	3.7924	4.2654	4.2160	4.3125
6.0000	0.4793	0.4797	3.8362	3.7862	4.2549	4.1937	4.5000

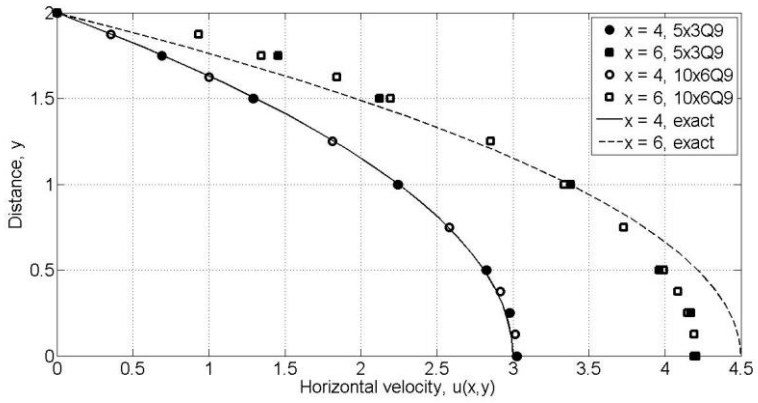

Figure 1.1 Pressure $P(x,y_0)$ versus x for fluid squeezed between parallel plates.

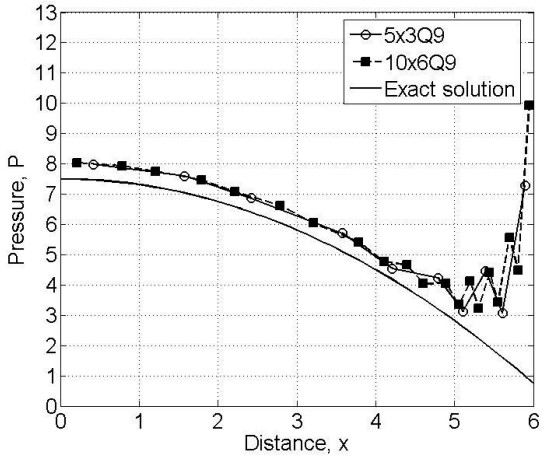

Figure 1.2 Velocity fields $V(x_0,y)$ at x_0=4 and x_0=6 for fluid squeezed between parallel plates (near or at the top plate).

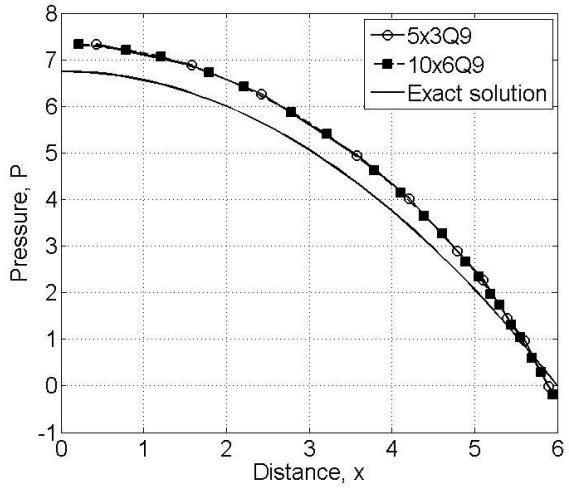

Figure 1.2 Velocity fields $V(x_0,y)$ at $x_0=4$ and $x_0=6$ for fluid squeezed between parallel plates (near or at the centerline of the domain).

Problem 2: (Lid-driven cavity flow)

Table 2.1 Velocity $V_x(0.5,y)$ obtained with linear and quadratic elements and for various values of the Reynolds number (values in parentheses are linear solution).

y	Mesh: 8x8 L4			Mesh: 4x4 Q9		
Re	250	500	750	250	500	750
0.1250	-0.0367 (-0.0579)	-0.0239	-0.0128	-0.0412 (-0.0615)	-0.0131	0.0146
0.2500	-0.0688 (-0.0988)	-0.0502	-0.0320	-0.0851 (-0.1039)	-0.0520	0.0017
0.3750	-0.0944 (-0.1317)	-0.0733	-0.0533	-0.1283 (-0.1394)	-0.1133	-0.0481
0.5000	-0.0911 (-0.1471)	-0.0696	-0.0569	-0.1305 (-0.1563)	-0.1284	-0.1086
0.6250	-0.0176 (-0.0950)	0.0043	0.0020	-0.0437 (-0.1118)	-0.0494	-0.0901
0.7500	0.0470 (0.0805)	0.0414	0.0323	0.0754 (0.0481)	0.1042	0.0549
0.8750	0.2616 (0.4501)	0.1712	0.1207	0.2833 (0.4186)	0.2139	0.1495

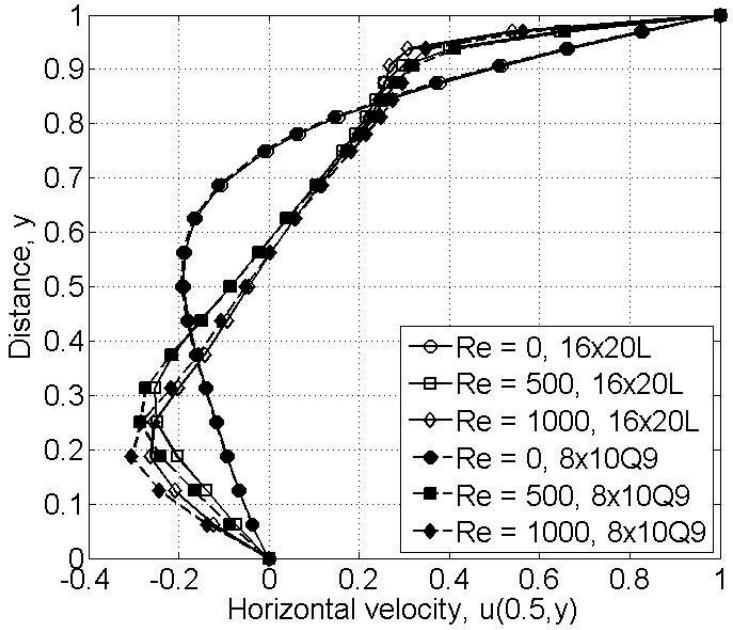

Figure 2.1 Velocity $V_x(0.5,y)$ versus y for Reynolds numbers Re = 0,500, and 1000 (obtained with 8x10Q9 and 16x20L4 meshes)

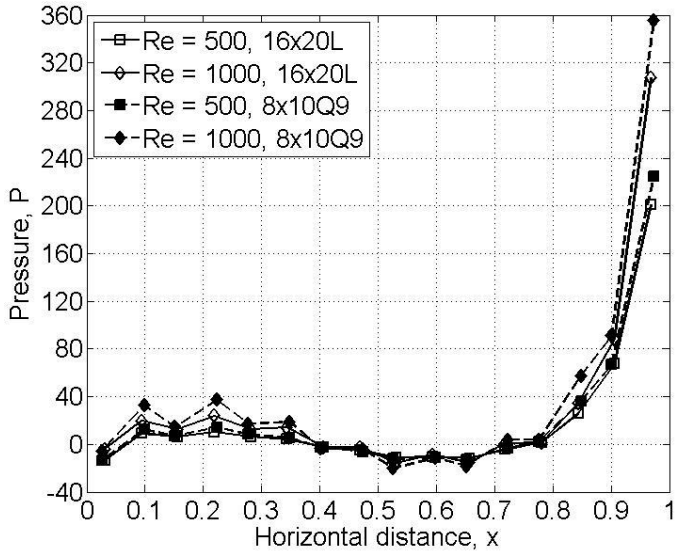

Figure 2.2 Plots of pressure $P(x,y_0)$ along the top wall of the cavity (8x10Q9 and 16x20L4 meshes)