

# A Full Multigrid Method Applied to Turbulent Flow using the SIMPLEC Algorithm Together with a Collocated Arrangement

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**ABSTRACT** An implementation of a multigrid method in a three-dimensional SIMPLEC code based on a collocated grid arrangement is presented. The multigrid algorithm is FMG-FAS, using a V-cycle described by Brandt [1,2].

The coarse grid is obtained by merging eight fine grid cells in 3D, and four in 2D. Restriction and prolongation of field quantities are carried out by a weighted linear interpolation, and restriction of residuals by a summation. All variables and all equations, including the pressure correction equation, are treated in the same way

To stabilize the solution process, a fraction of the multigrid sources is included in the diagonal coefficient  $a_p$ , and a damping function is used on negative corrections of the turbulent quantities to prevent them from being negative.

The multigrid method was shown to be relative insensitive to the choice of under-relaxation parameters. Therefore 0.8 or 0.7 is used for all equations, except for the pressure correction equation where 1.5 is used.

Both turbulent and laminar calculations are presented for a 2D backward facing step, a 2D ventilated enclosure, and a 3D ventilated enclosure. The turbulent calculations are made with a two-layer low-Reynolds  $k - \epsilon$  model.

Different discretization schemes for the convective schemes are used including the first order hybrid scheme and two higher order schemes (QUICK and a van Leer TVD scheme).

## 4.2 2D VENTILATED ENCLOSURE

MODEL	LAMINAR		LOW-RE $k - \epsilon$			
RE	100		9000			
SCHEME	HYBRID		HYBRID		QUICK + VAN-LEER	
	WU	SPEEDUP	WU	SPEEDUP	WU	SPEEDUP
10x10	41	1.0	119	1.0	169	1.0
20x20	54	0.9	67	1.7	84	1.6
40x40	100	1.7	51	6.0	59	6.2
80x80	95	5.2	39	52.0	44	44.9
160x160	87	22.6	34	153.6	43	118.1
320x320	134	50*	30	600*	45	450*

TABLE 3. Convergence data for the 2D ventilated enclosure

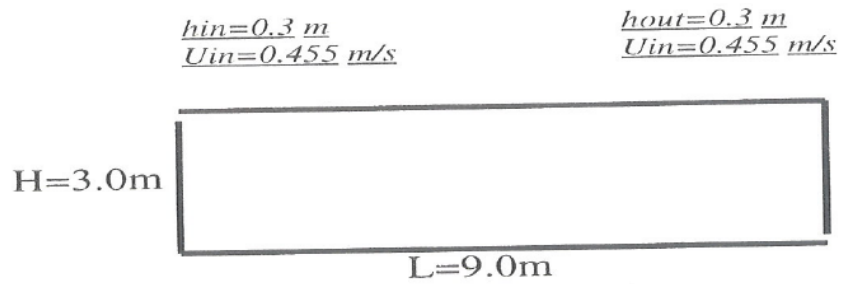


FIGURE 3. The 2D ventilated enclosure