Turbulent Flow Over a Surface-Mounted Rib

In 1994, Computational Dynamics Ltd. (CD) collaborated with the Danish Maritime Institute (DMI) in an EEC-sponsored project aimed at evaluating the performance of various commercial CFD codes. Under this collaboration, DMI provided the test data and CD performed the CFD simulations. This validation case simulates two-dimensional turbulent flow past a surface-mounted obstacle (such as a fence or rib) that extends across the width of a channel. Based on the mean inlet velocity of air and the obstacle height, the Reynolds numbers were ranged between 1,500 to 3,000. The mesh contained 16,000 cells.

The following screenshot shows the DMI test case of the crossflow over a surface-mounted rib: the computational mesh (a) and an enlarged view of locally refined mesh (b).

Four turbulence models were compared:
- The standard K-Epsilon turbulence model with high-$y^+$ wall treatment
- The realizable K-Epsilon turbulence model with high-$y^+$ wall treatment
- The two-layer variant of the realizable K-Epsilon turbulence model with...
The experimental data files supplied by DMI contained the velocity profiles of the first- ($U$ and $V$), second- and higher-order moments, plus information related to the experimental arrangements. Only the data obtained at $Re = 3,000$ were used for this validation. Comparisons of the normalized $U$-velocity profiles at four locations, $x = -2.5, 1.25, 7.5$ and $13.0$, are shown in the following screenshots:

- $x/h = -2.5$
• $x/h = 1.25$

![Graph of $x/h = 1.25$]

• $x/h = 7.5$

![Graph of $x/h = 7.5$]
- $x/h = 13.0$