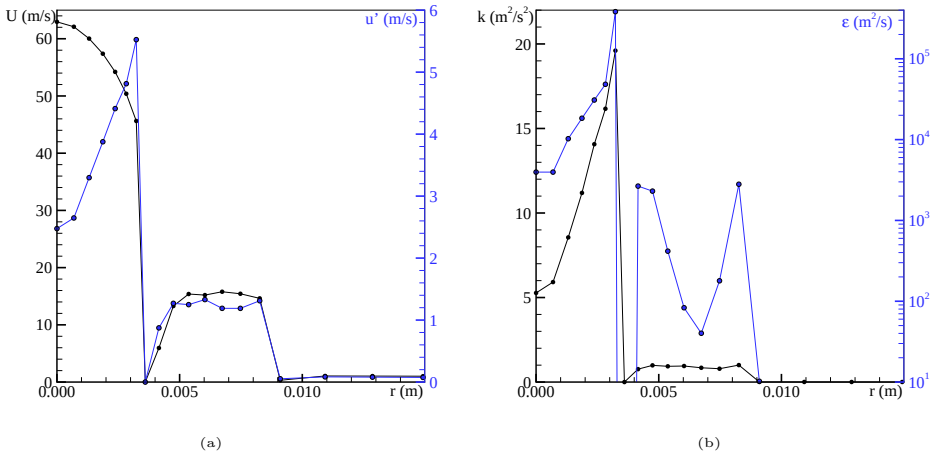


**Figure 4.3:** Inlet boundary conditions from [8]. (a) Axial velocity and axial velocity fluctuation; (b) Turbulent kinetic energy and dissipation of turbulent kinetic energy.

see [31, 42, 43].

The piloted flame has been discretized as follows. Several zones with different grid nodes distributions are defined (Fig. 4.4). The number of nodes corresponding to each zone is indicated in terms of the grid parameter $n$ ($n = 1, 2, 4, 8$ and 16), and the direction of the intensified distribution is indicated by a solid triangle. A tanh-like function is used to concentrate the mesh. At the outlet of the inner tube, the number of grid nodes in the radial direction is concentrated close to the axis since the gradients are higher due to the jet outlet effects. Mesh distribution in the radial direction is more regularly distributed as the outlet of the computational domain is achieved taking into account the un-confined flow structure and the flame shape. Otherwise, in the axial direction a soft concentration is adopted at the outlet of the inner tube.

Due to the parabolic structure of the flow, the domain is decomposed in six subdomains in the axial direction. The computational behaviour of the parallel multiblock algorithm confirms this strategy [31, 32]. The distribution of the zones with the subdomains is defined in Fig. 4.4. The use of the multiblock discretization allows the definition of 3 macro zones, identified in the figure with different colours, characterised by having the same grid-nodes distribution in r-direction.

All the numerical simulations have been performed on a *Beowulf cluster* composed by 40 standard PCs (AMD XP 2600+ (K7) CPU and 1024 Mbytes) with a

conventional network.

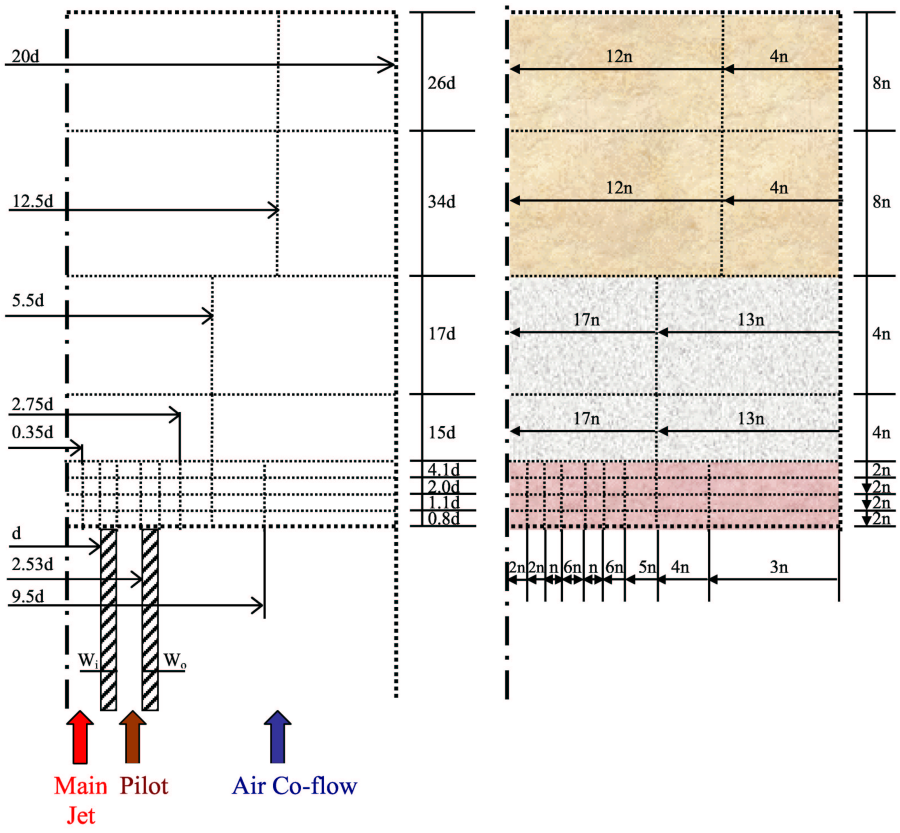


**Figure 4.4:** Piloted non-premixed methane/air turbulent flame. Left: Burner idealised geometry and definition of the different zones for the non-equispaced cylindrical grid; Right: Definition of macro zones and their mesh nodes distribution.

### Flamelet library integration

The laminar flamelet library is generated using the same methodology described in section 3.4 with the corresponding boundary conditions of the actual flame. Mixture fraction coordinate is discretized with 160 nodes concentrating the mesh around $Z{=}Z_{st}$. The beta pdf expressed in Eq. 4.43 requires the variance of the mixture fraction $\widetilde{Z''^2}$. In the present thesis, a number of 25 discrete values of $\widetilde{Z''^2}$ in the range $0-0.25$ and concentrated at the lower limit are taken into account. The integration of