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Scalings and Decays of Fractal-generated turbulence JOHN CHRISTOS VASSILICOS, DARYL HURST, Imperial College London — 21 planar fractal grids from 3 fractal families have been used in 2 wind tunnels to generate turbulence. This turbulence and its homogeneity, isotropy and decay properties are strongly dependent on the grid's fractal dimension $D_f \leq 2$, the effective mesh size M_{eff} (which we introduce and define) and the ratio t_r of largest to smallest bar thicknesses, $t_r = t_{max}/t_{min}$. With blockage ratios as low as $\sigma = 25\%$, these grids generate turbulent flows with higher turbulence intensities and Reynolds numbers than higher blockadge ratio classical grids in similar wind tunnels and wind speeds U. The scalings and decay of the turbulence intensity u'/U in the x-direction along the tunnel centre line are (in terms of the normalised pressure drop $C_{\Delta P}$ and with similar results for v'/U and w'/U): (i) for fractal cross grids ($D_f = 2$), $(u'/U)^2 = t_r^2 C_{\Delta P} fct(x/M_{eff})$; (ii) for fractal I grids, $(u'/U)^2 = t_r (T/L_{max})^2 C_{\Delta P} fct(x/M_{eff})$ where T is the tunnel width and L_{max} is the maximum bar length on the grid; (iii) for $D_f = 2$ fractal square grids, the turbulence builds up till a distance x_{peak} from the grid where the turbulence intensity peaks and then decays exponentially, $u'^2 = u'^2_{peak} exp[-(x-x_{peak})/l_{turb}]$ where u'^2_{peak} increases linearly with t_r, $x_{peak} \propto t_{min} T/L_{min}$ (L_{min} being the minimum bar length on the grid) and $l_{turb} \propto \lambda^2 U/\nu$ (ν being the air's kinematic viscosity and λ being the Taylor microscale); λ and the longitudinal/lateral length-scales remain approximately constant during decay at $x \gg x_{peak}$.

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