Low free-stream turbulence in test sections through packed beds and fibrous mats

Schmid, R.a , Stuff, R.a , Klein, U.K.A.b , Jamjoon, F.A.b , Al-Suwaiyan, A.

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Abstract: At low speeds the free-stream turbulence in test-sections of water channels and wind tunnels can hardly be suppressed with a conventional set of screens in the settling chamber. In many cases the friction of screens is not high enough to quench the turbulence created by compressors, orifices, bends, diffusers, and nozzles. Without creating new turbulence the kinetic energy of already existing turbulence can only be eliminated by laminar friction somewhere upstream of the test-section. This laminar friction can be provided by packed beds and fibrous mats. Due to the small size of pellets or strands and due to the low speed in the settling chamber the corresponding Reynolds number may be low enough to achieve laminar or near laminar flow. An additional bonus may be obtained from the suppression of flow separation in the diffuser, if the packed bed or the fibrous mats are arranged downstream of the diffuser with a minimum required drag, whereas the drag of screens would be below this required minimum. The used water channel and the wind tunnel were not custom-made to the specifications for low free-stream turbulence. Even though, it was possible to get the free stream turbulence down to 0.063% with a packed bed and to 0.037% with fibrous mats. However, in comparison with the fibrous mats, the drag coefficient of the packed bed was almost ten times higher.