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Matrix Cooling for Gas Turbine Blades

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Abstract

The present study conducts a computational investigation of turbulent flow and heat transfer characteristics within a latticework cooling structure operating under a turning flow configuration, using OpenFOAM v2312 with the SST k–ω turbulence model. The turning flow configuration is particularly relevant to trailing-edge cooling applications in gas turbine blades, where coolant flow undergoes a significant directional change before entering the latticework region. The computational domain comprises a smooth inlet channel followed by a latticework section with inclined ribs, generating multiple subchannels and complex flow turning with vortex interactions. Simulations are performed for mass flow rates ranging from 0.0139 kg/s to 0.0669 kg/s to evaluate total Nusselt number distributions, pressure losses, and velocity fields. The analysis examines the effects of flow turning on heat transfer enhancement, flow distribution between upper and lower subchannels, and the associated pressure losses. The results provide detailed insights into the relationship between nonuniform flow distribution, vortex dynamics, and thermal performance, supporting the optimisation of trailing-edge cooling designs in gas turbine blades.