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Computational Investigation of Secondary Flow Losses in Linear Turbine Cascade by Modified Leading Edge Fence

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Abstract : It is well known that secondary flow loses account about one third of the total loss in any axial turbine. Modern gas turbine height is smaller and have longer chord length, which might lead to increase in secondary flow. In order to improve the efficiency of the turbine, it is important to understand the behavior of secondary flow and device mechanisms to curtail these losses. The objective of the present work is to understand the effect of a stream wise end-wall fence on the aerodynamics of a linear turbine cascade. The study is carried out computationally by using commercial software ANSYS CFX. The effect of end-wall on the flow field are calculated based on RANS simulation by using SST transition turbulence model. Durham cascade which is similar to high-pressure axial flow turbine for simulation is used. The aim of fencing in blade passage is to get the maximum benefit from flow deviation and destroying the passage vortex in terms of loss reduction. It is observed that, for the present analysis, fence in the blade passage helps reducing the strength of horseshoe vortex and is capable of restraining the flow along the blade passage. Fence in the blade passage helps in reducing the under turning by 7⁰ in comparison with base case. Fence on end-wall is effective in preventing the movement of pressure side leg of horseshoe vortex and helps in breaking the passage vortex. Computations are carried for different fence height whose curvature is different from the blade camber. The optimum fence geometry and location reduces the loss coefficient by 15.6% in comparison with base case.

Keywords : boundary layer fence, horseshoe vortex, linear cascade, passage vortex, secondary flow
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