The need for cleaner and more fuel efficient means to produce electricity is growing steadily. Advancements in cooling technologies contribute to the improvements in turbine efficiency and are used for gas turbines and for power generation in automotive, aviation, as well as in naval applications, and many more. Studies introducing turbulators on walls of internal cooling channels, which can be applied to hot gas components and in recuperative heat exchangers, have been reviewed for their ability to promote heat transfer in the channel while observing pressure loss caused by adding the features. Several types of turbulators have been studied; ribs, pin fins, dimples, wedges, and scales are some examples of features that have been added to walls of internal cooling channels or heat exchangers to increase heat transfer.

This study focuses on two types of wedge turbulator designs, a full symmetrical wedge and a half, or non-symmetrical right-triangular wedge for the purpose of disrupting the thermal boundary layer close to hot walls without causing large-scale mixing and pressure drops. There are two sizes of the wedges, the first set of full and half wedges have an e/Dh=0.10 with the second at e/Dh=0.40, a feature that fills the height of the boundary layer. There are six cases studied, two one-wall and four two-wall cases in a 2:1 aspect ratio channel at Reynolds numbers of 10,000, 20,000, 30,000, and 40,000. Two experimental setups are utilized: a segmented copper block and transient TLC, along with numerical simulation for computational flow visualization. Wall temperature data is collected from all four walls for the copper experimental setup and three walls on the transient TLC setup. The fourth wall of the acrylic test section for the transient TLC tests is utilized for pressure testing, where static pressure ports are placed along the side wall.

Although the small features did not show large influence in heat transfer on the side walls as much as the larger features or as high of heat transfer on the featured walls, the minimal pressure loss in the channel kept overall thermal performance of the small two wall full wedge features very high. The case of the large half wedge on two walls also showed very high thermal performance, having pressure loss values nearly half of the same sized (length and height) full wedge feature while having the ability to incorporate side walls into the overall heat transfer enhancement. The results found in the experimental setups are supported by the visualization of flow characteristics from the numerical testing. Comparing the initial wedge study to recent full rib studies show the wedges have similar improvements in heat transfer to the full rib cases with friction augmentations 5 to 10 times lower than the full rib cases. Further improvements to wedge heat transfer and pressure drop can be done by determining optimal wedge size and orientation.

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The public is welcome to attend.