

CFD Analysis of a Printed Circuit Heat Exchanger

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Introduction: Printed Circuit Heat Exchangers (PCHEs) are advanced diffusion bonded compact heat exchangers with chemically etched flow channels, a model of which is shown as Figure 1. This study completed a CFD analysis of a simplified PCHE model aimed to accurately predict previously obtained experimental results.

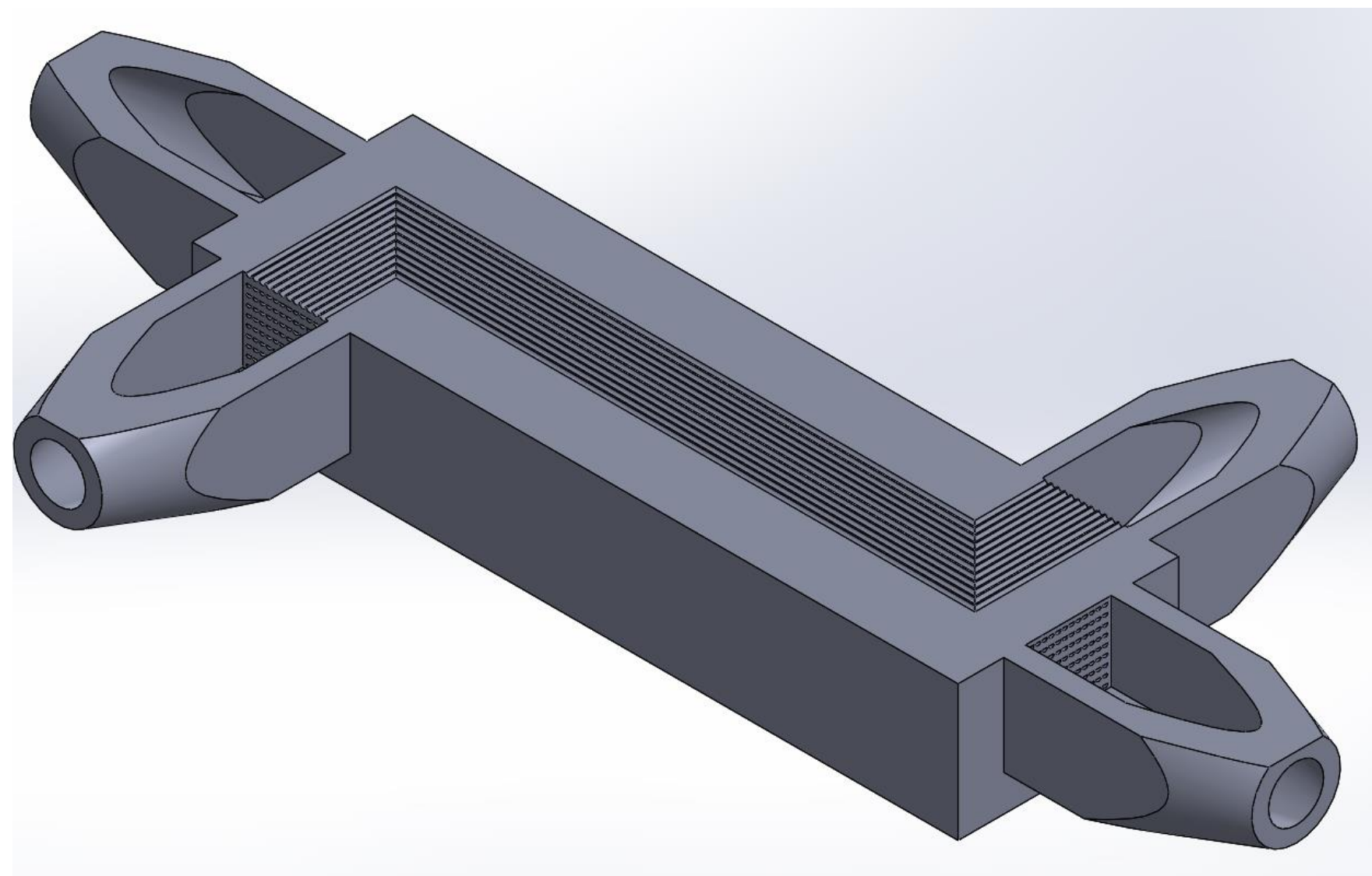


Figure 1. Section View of Experimental PCHE Solid Model

Computational Methods: Experimental data used for comparison had Reynolds number values ranging from 800 – 3000. Thus, both laminar and $k-\omega$ turbulent flow physics interfaces were used with the conjugate heat transfer interface. The model was simplified, and a scaled model of the simplification is shown in Figure 2. Mass flow rate and pressure were specified for the inlets and outlets in the fluid flow interface. Temperature and outflow were specified for the inlets and outlets in the heat transfer interface. A symmetric boundary condition was applied to the side walls of the model, and a periodic heat condition was applied to the top and bottom.

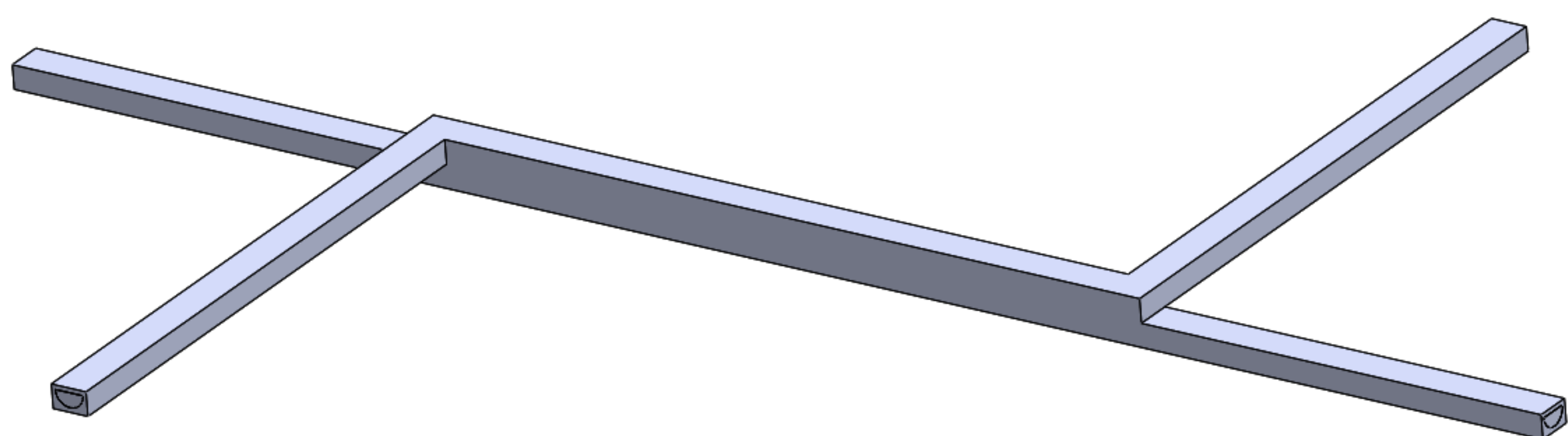


Figure 2. Scaled Simplified Geometry used in Simulation

Results: Parametric sweeps were run for subsets of the experimental data. Figures 3 and 4 show the resulting Nusselt number and friction factor plot comparisons. The simulation results indicate an early flow transition also observed in the experimental data.

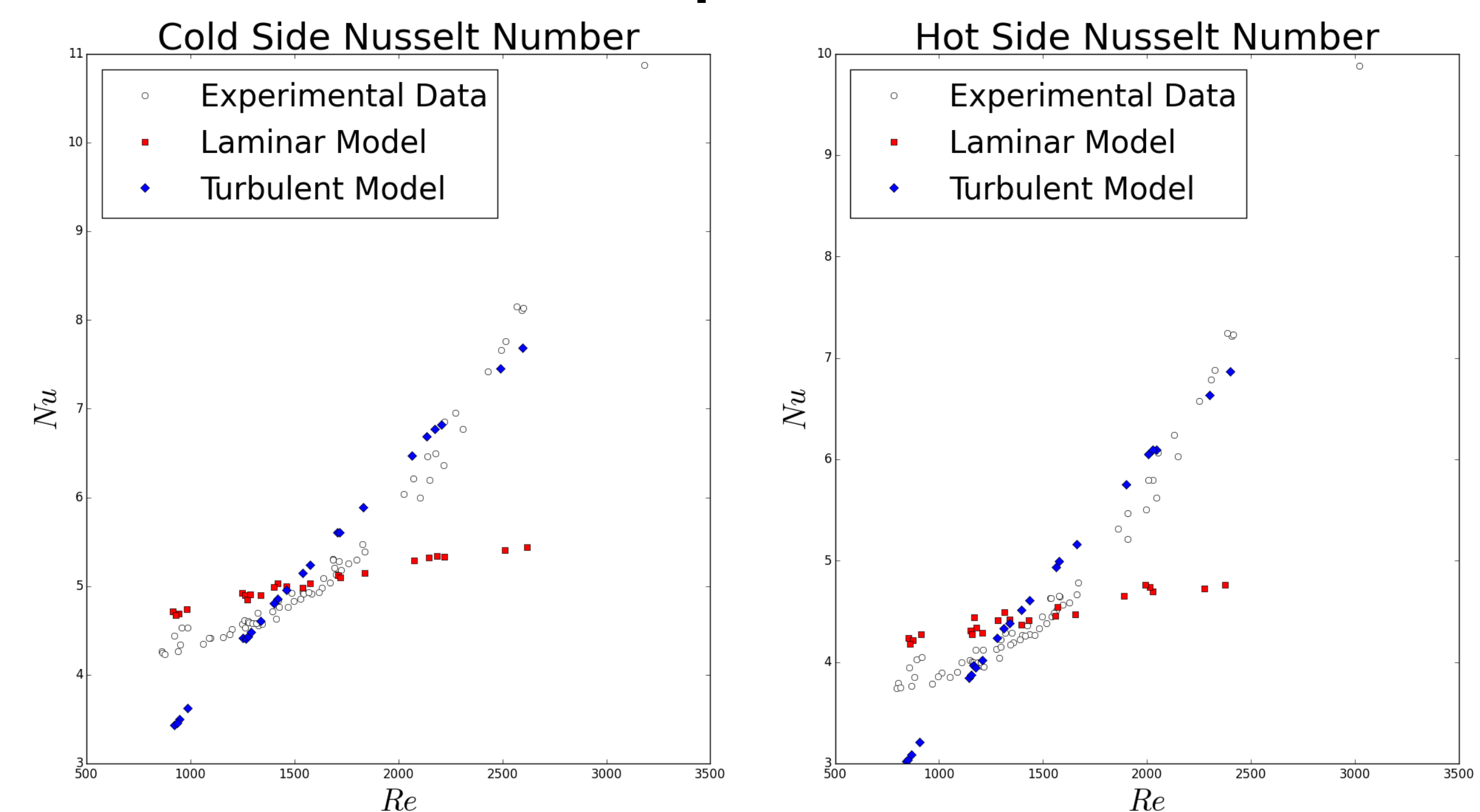


Figure 3. Experimental and Simulation Nusselt Number Comparison

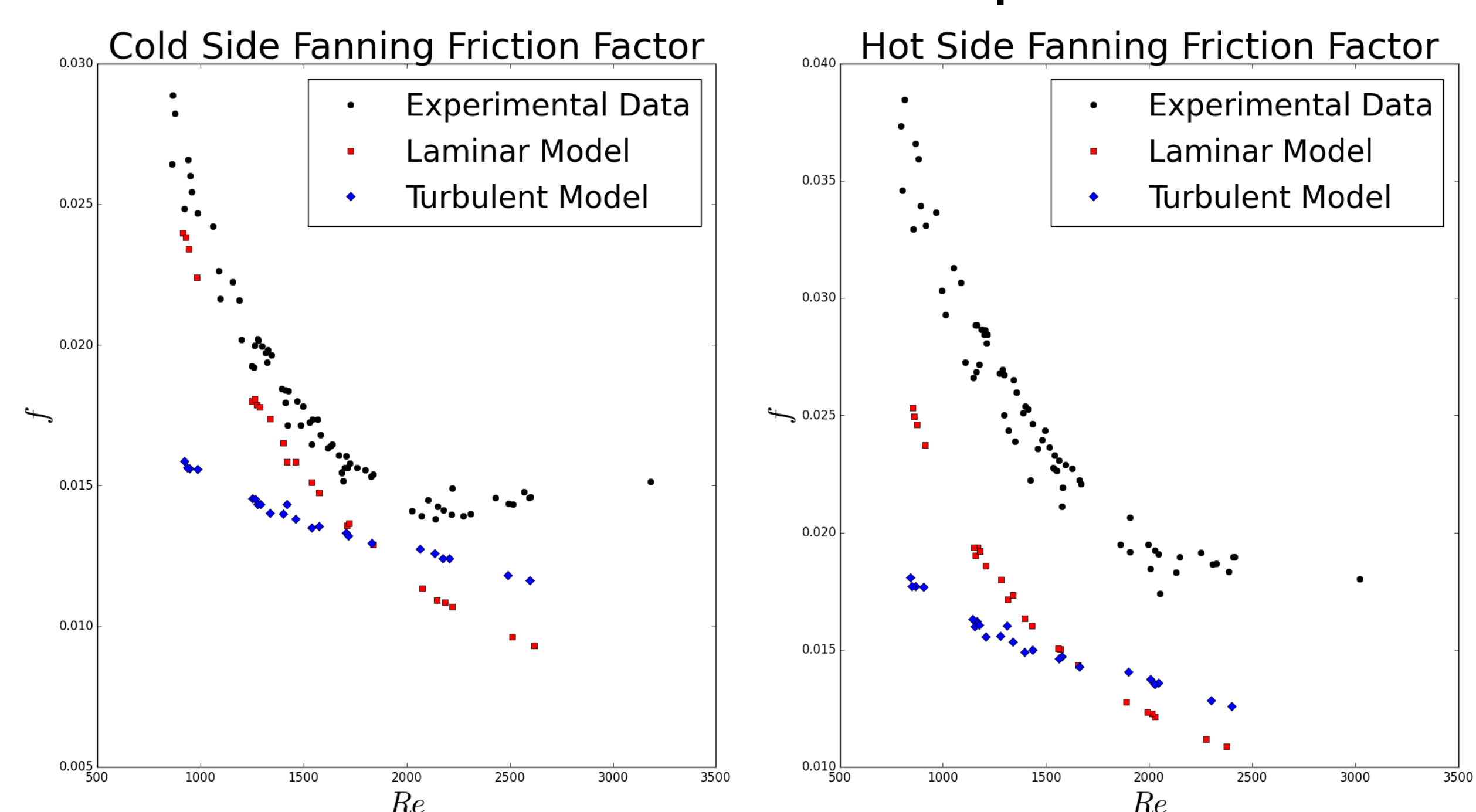


Figure 4. Experimental and Simulation Friction Factor Comparison

Conclusions: The results from this study show accurate simulation of experimental results from a simplified model. Further study and computational power are required to allow for greater mesh density as well as investigation of a full geometry model.

References:

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