



The Study of a Vaned Interstage Pipe for a Back-to-Back (B2B) Centrifugal Compressor

Carrier Corporation:

Carrier has a long history of innovation, beginning with Willis Carrier's invention of the first air conditioning system in 1902. Carrier offers products and services designed to improve energy efficiency and reduce environmental impact. Their solutions are used to provide comfort and safety to millions of people through residential, commercial, and industrial applications. Carrier's research and development has led to numerous innovations, including high-efficiency HVAC systems and advanced refrigeration technologies.



Figure 1: Carrier's Centrifugal B2B Compressor

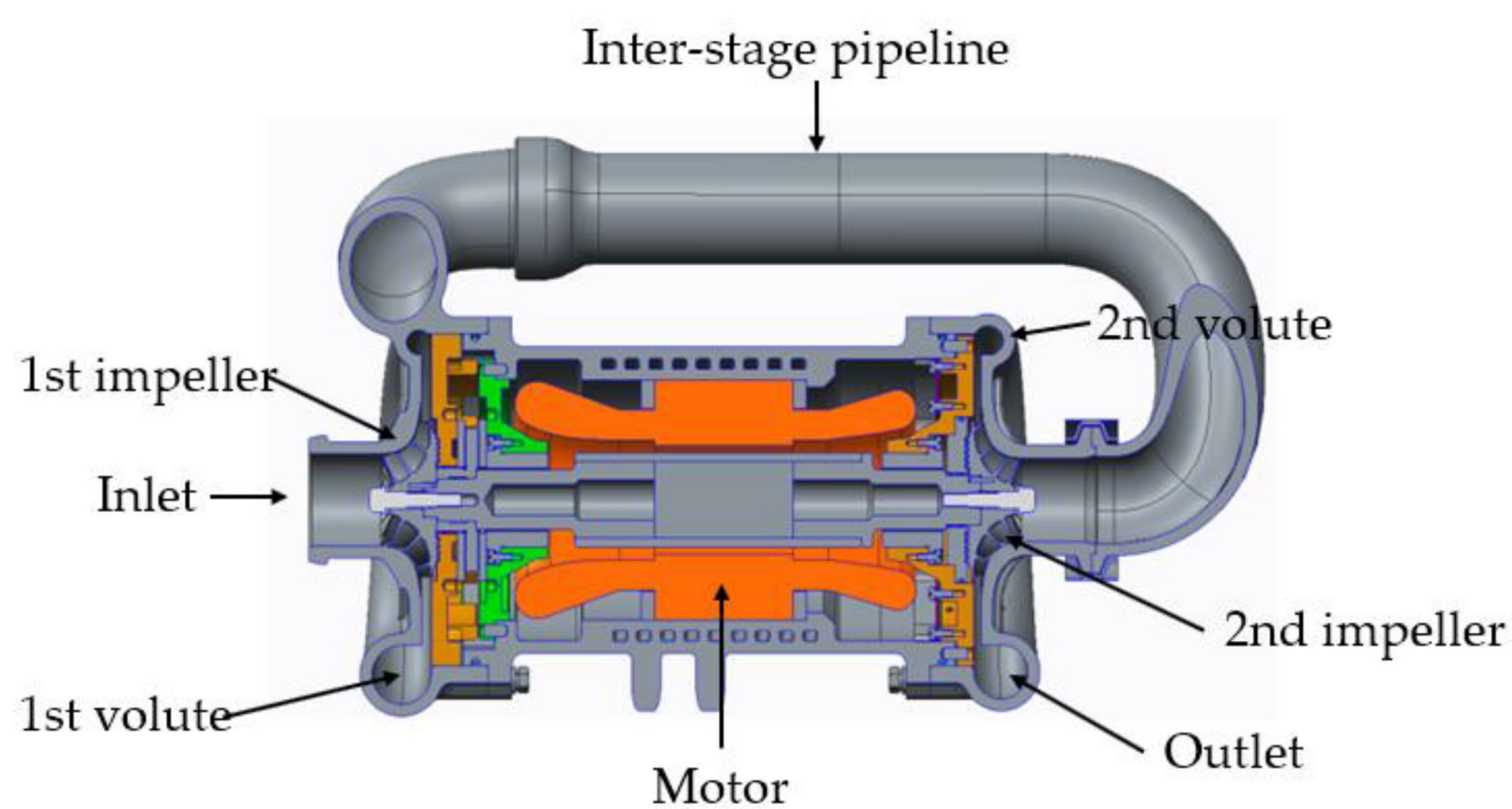


Figure 2: Cross-section of B2B Centrifugal Compressor

Project Description:

We will design a vane to go inside the interstage pipe (for the back-to-back centrifugal compressor) to reduce pressure loss and improve the flow uniformity across the 2nd stage inlet. We must find the key vane parameters that will result in a 0.5% increase in efficiency, ultimately saving millions of dollars in compressor power costs. With our final results, we will perform a detailed numerical study to prove these performance benefits.

Early Design Concept(s):

There are three basic flow straighteners (shown in Figure 3) that we considered. These are examples of current designs in industry. With the chosen vane design, we will determine the optimal location inside the interstage pipe to put the vane. Another concept was to install multiple vanes; however, this will cause even more pressure loss throughout the system. The last concept was to change the dimensions of the interstage pipe, but that is outside the scope of this project.

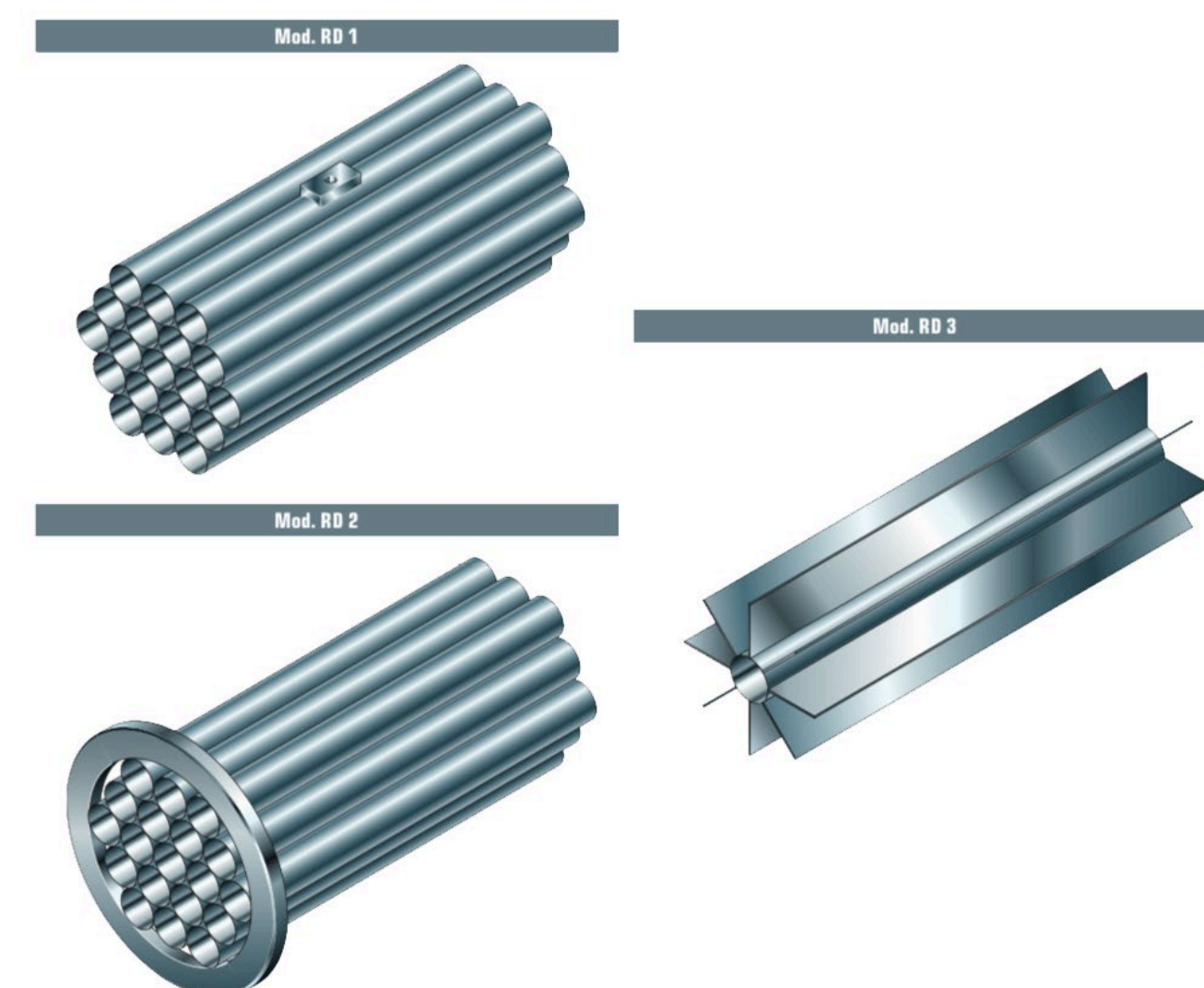


Figure 3: Basic Flow Straighteners



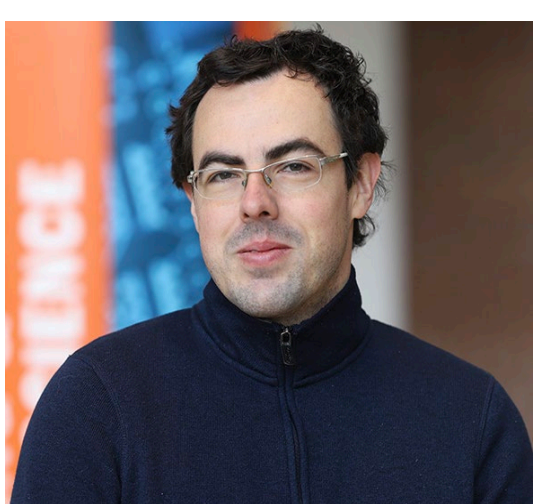
Figure 4: Ansys Simulation of Flow Swirling in Pipe

Project Deliverables:

1. 3D models of the vane design iterations
2. Calculations/CFD simulations for each vane design iteration
3. Final performance analysis as a final report

CAD Models and Testing Simulations:

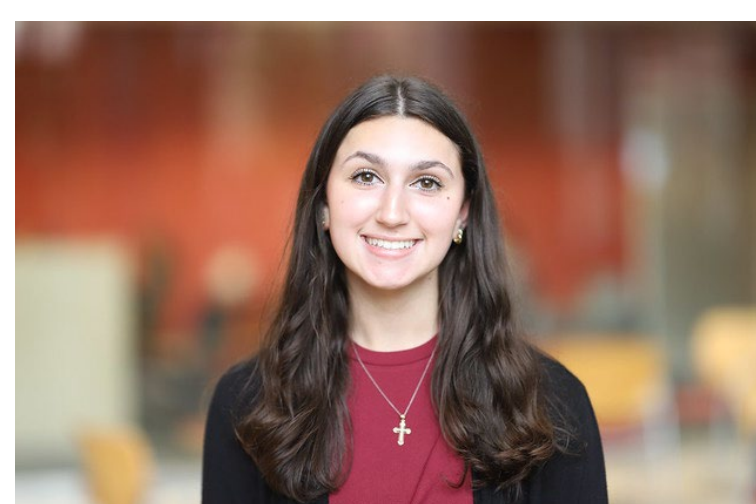
- Carrier will provide an initial model of the centrifugal B2B compressor, including the interstage pipe.
- Based on the pipe dimensions, we will calculate the theoretical pressure loss of the interstage pipe.
- Using the model, we will run an initial CFD simulation using Ansys CFX and compare the results to the theoretical value to verify the accuracy of the simulation.
- After the initial simulation, we will begin designing multiple vane iterations to put in the pipe.
- We will run the updated designs through Ansys CFX to find the new pressure loss due to the addition of the flow straightener and compare it to the theoretical value.
- After running the simulations, we will evaluate the vane iterations and determine the most optimal design.



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