Blade Design

Name

Institutional Affiliation

Blade Design

Introduction

Energy demand around the world has been on the rise, and thus there is a need to develop other forms of energy production to cater to the growing demand. One way to realize this is through the use of green energy that many countries have been encouraged to integrate into their energy sector. One such renewable energy type is wind energy, which is possible to collect wherever wind is in plenty. However, most of the power plants involved are large scale plants with power production of up to fifty thousand megawatts possible. There have been a few attempts already to design a small scale wind turbine to cater to the needs of a household. Thus, the design and analysis of a small wind plant will be carried out to determine its efficiency at a height of seven meters and with particular wind parameters.

Results and Discussions

Figure 1: Airfoil design in QBlade

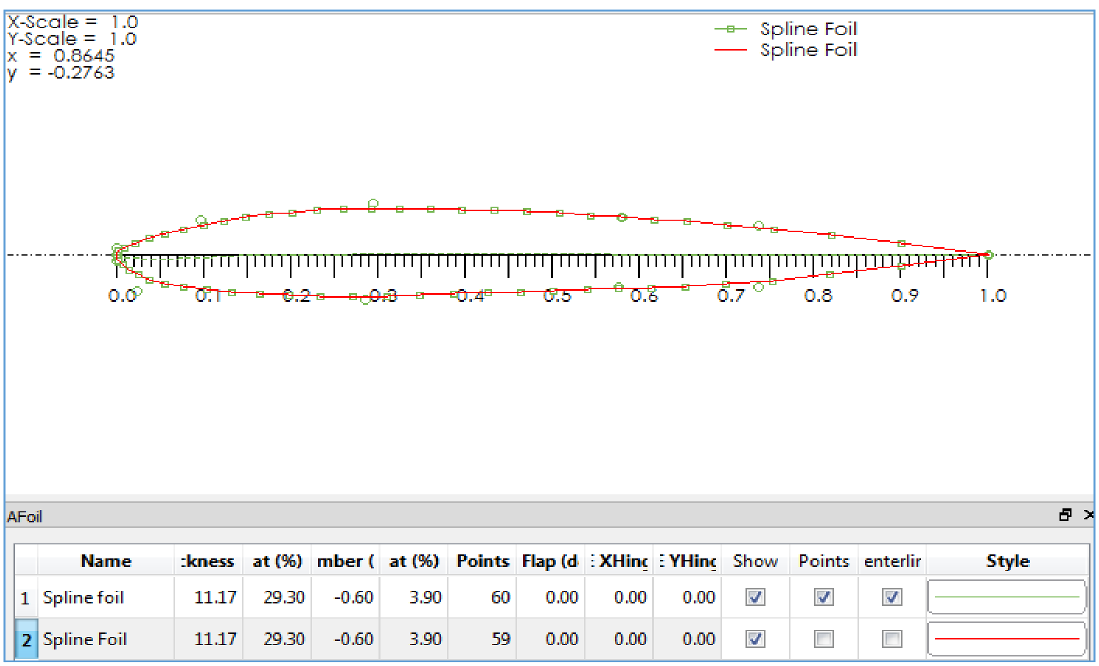


Figure 2: Cl/Cd versus angle of attack

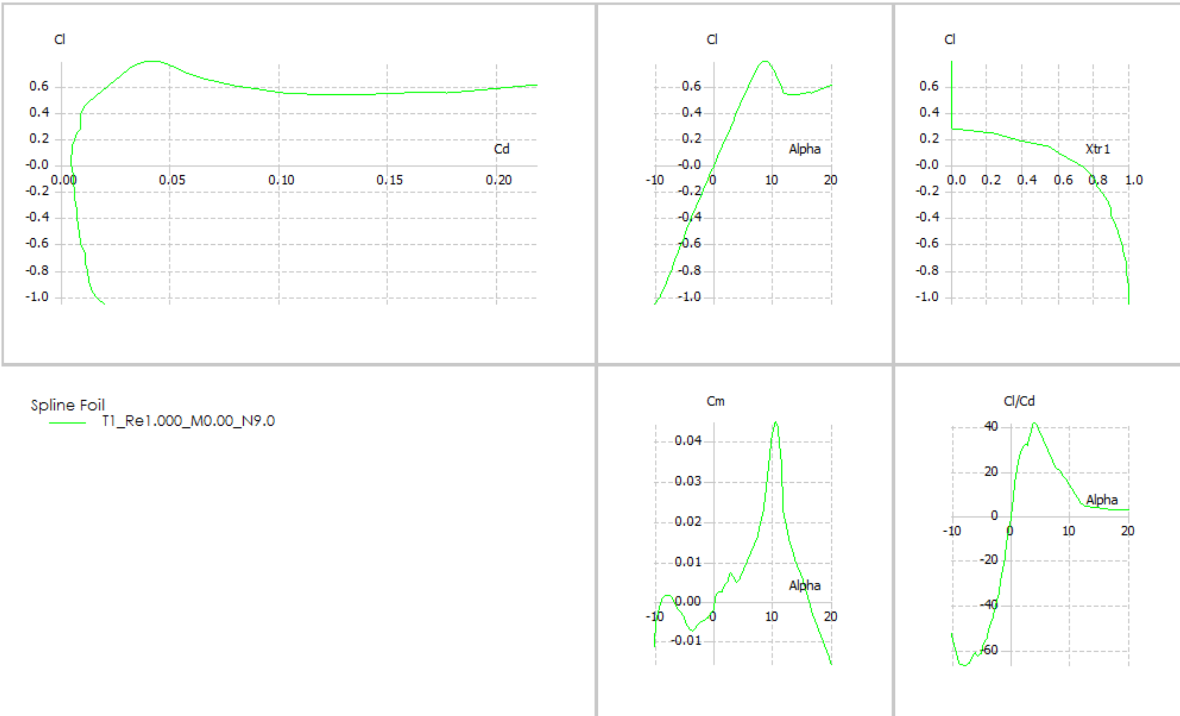


Figure 3: Boundary layer and the pressure produced

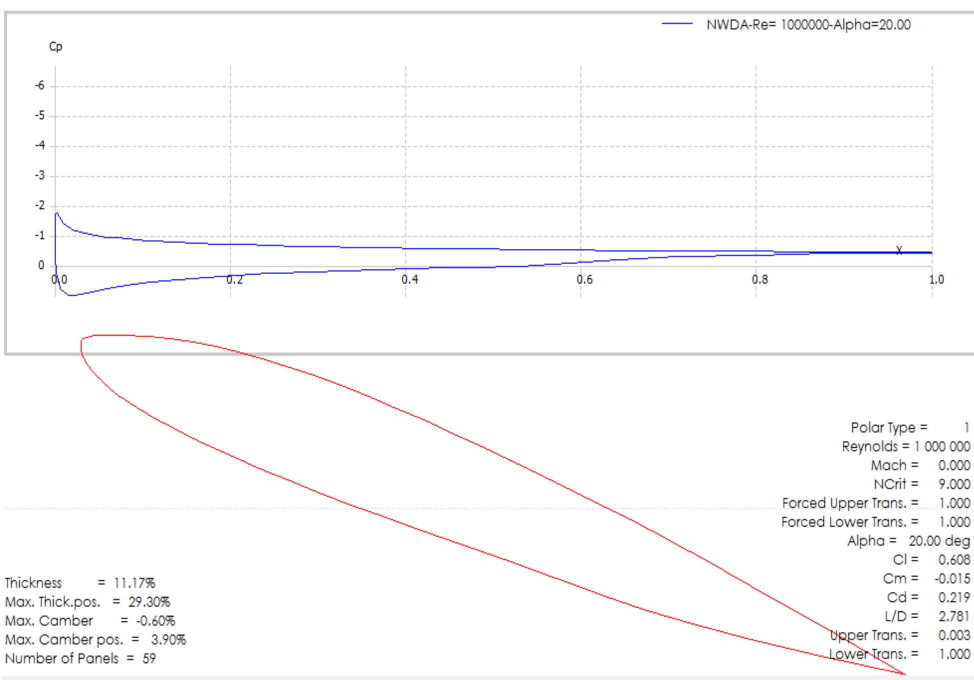


Figure 4: 360 degrees polar extrapolation

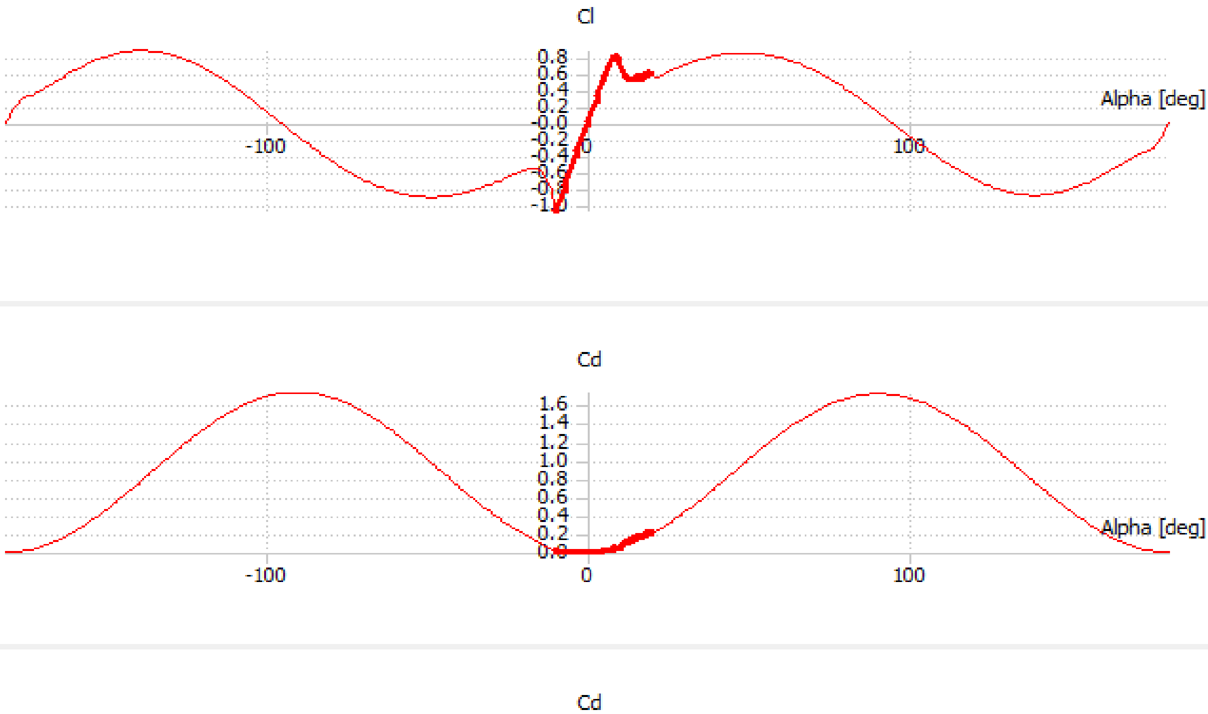


Figure 5: Noise analysis of the blade

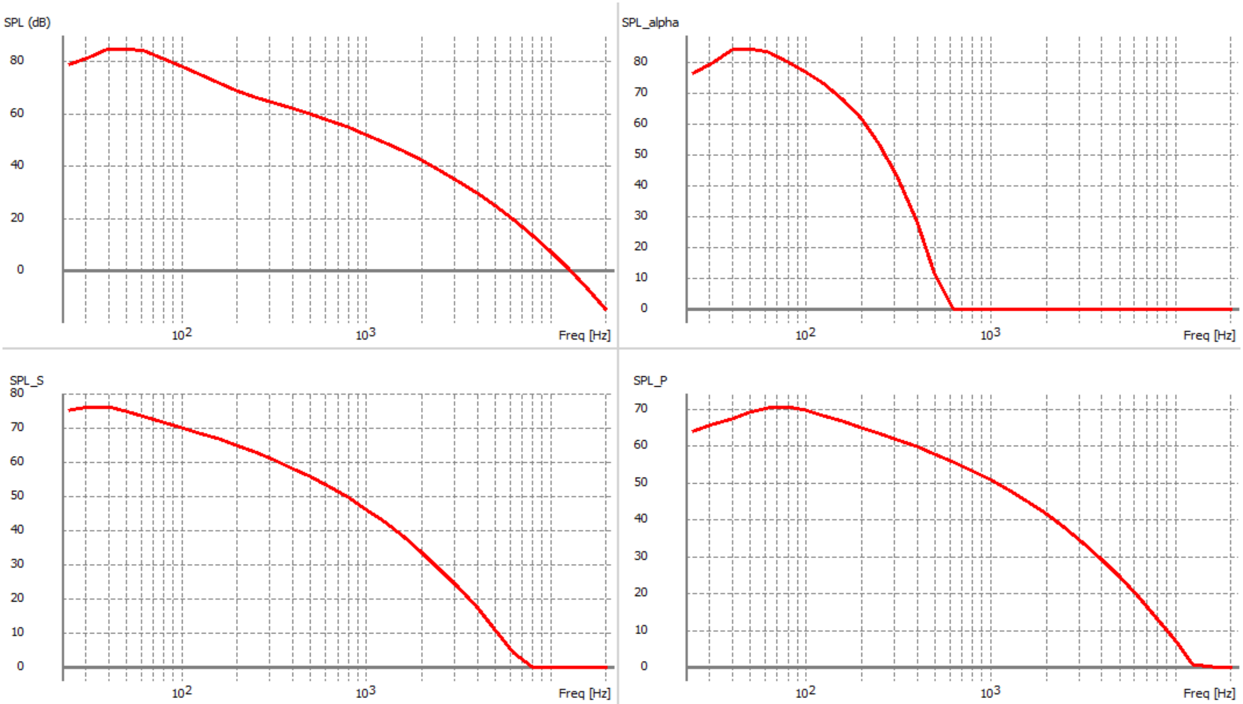


Figure 6: Thread at centerline using basic blade design

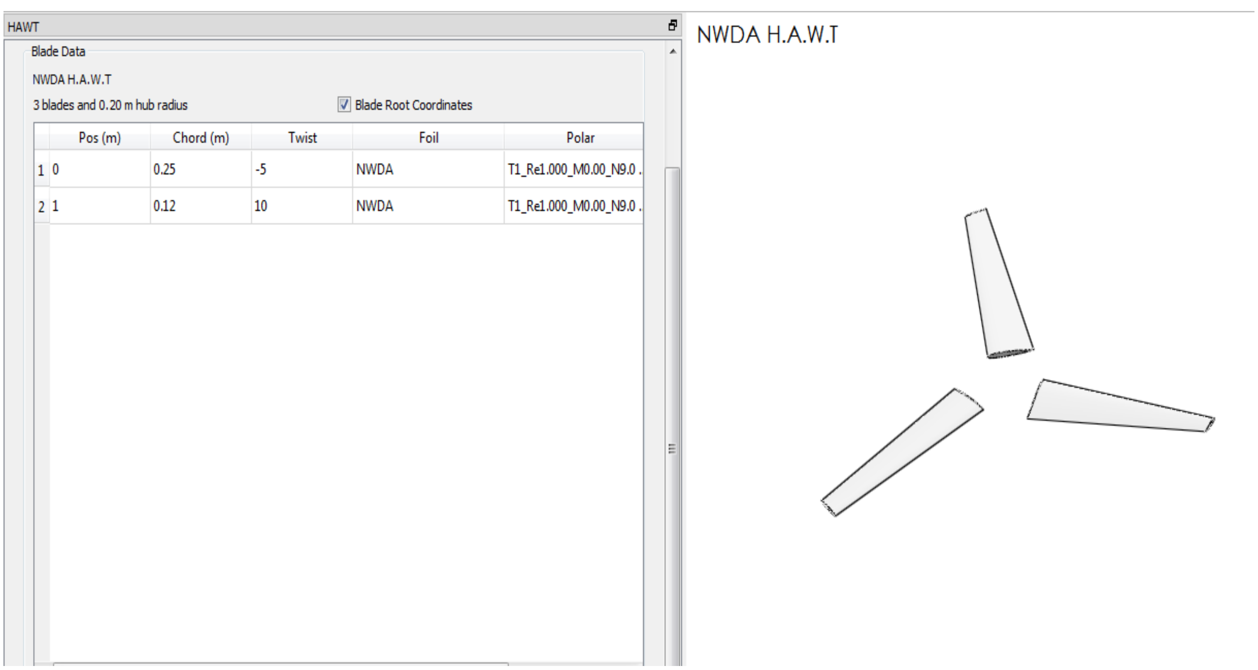


Figure 7: Cp, Ct vs. Tip speed ratio and axial induction factor vs. radial position

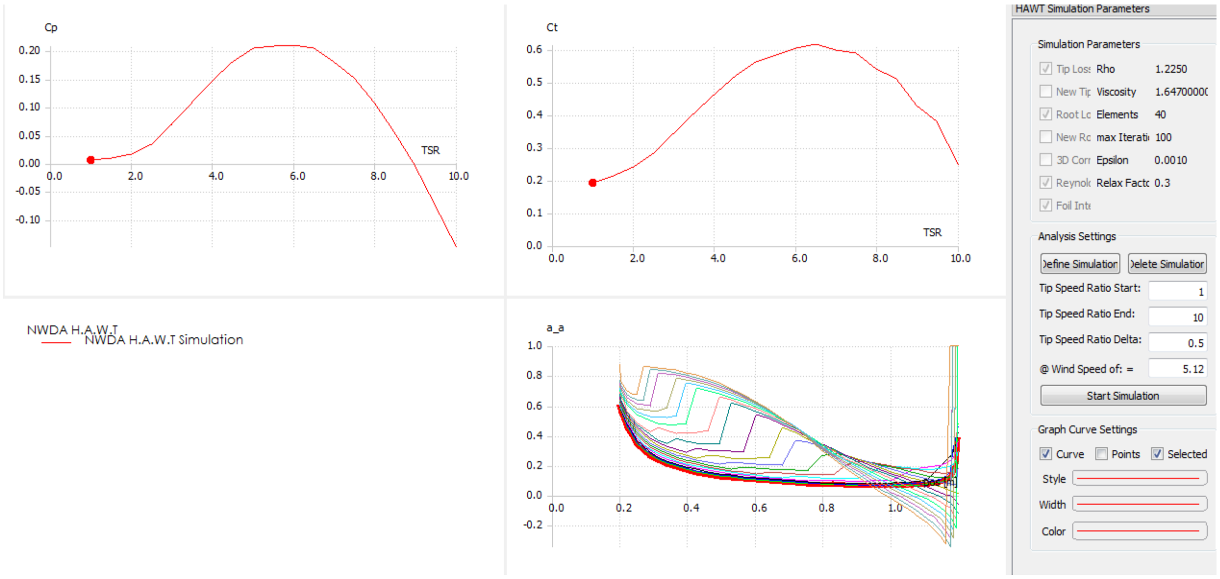
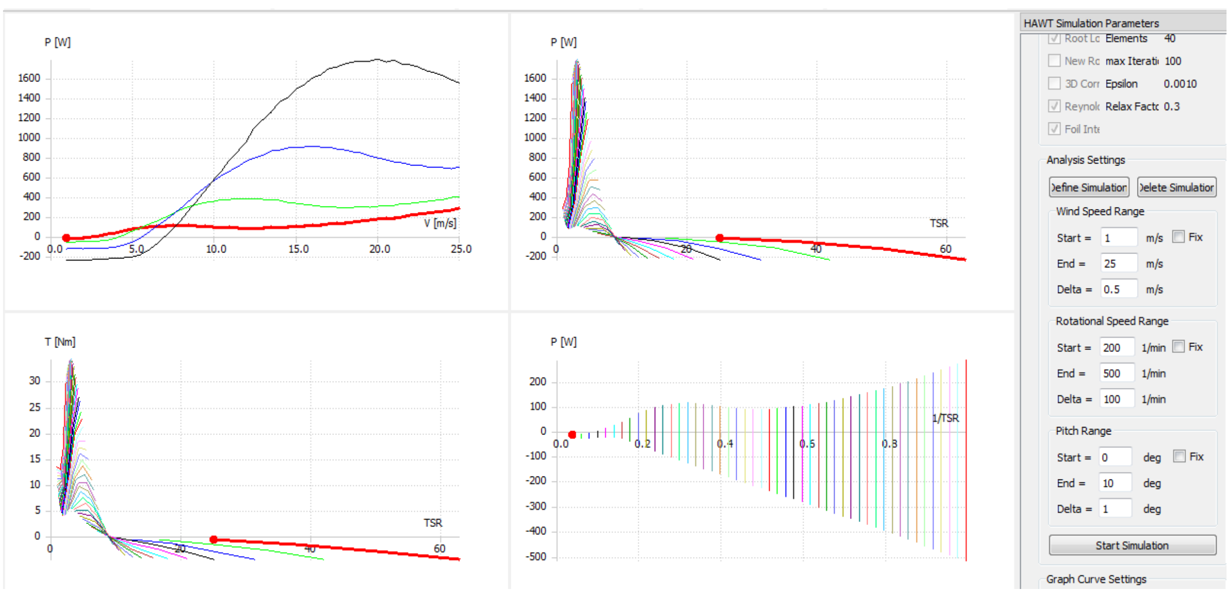


Figure 8: Multi-parameter BEM simulation results



Conclusion

This paper seeks to determine and optimize the design of a small wind turbine that will be used to power homes. The design will also include the optimization of the parameters to achieve maximum efficiency. A horizontal axis wind turbine was chosen because of its numerous advantages. Such a wind turbine includes towers, which ensure that the blade falls into the path of the wind and that the overall system has high efficiency, since the blades lie perpendicular to the wind direction. The material used in the design of the blade was aluminum because of its considerable strength and low weight, thus allowing it to be easily rotated even by the slightest wind. From the graphs, the maximum value of Cl/Cd was found to be when the angle of attack is approximately 4^{O}. When the tip speed ratio is 6.5, the turbine operates at the highest efficiency and functions at an optimal performance.