SUSTAINABLE CAPSTONE PROJECTS (SCAP)
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WIND TUNNEL DESIGN AND TESTING

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INTRODUCTION

Wind tunnels play a crucial role in the study and analysis of wind turbine performance. Designing an efficient wind tunnel requires careful consideration of various factors, including size, shape, and airflow control mechanisms. This project aims to explore the key components and design considerations involved in constructing a wind tunnel for wind turbine testing. Wind tunnel design and testing is important as it allows engineers and researchers to simulate and analyze various aerodynamic conditions in a controlled environment. Some common usage areas include aerospace industry, automotive industry, civil engineering and architecture, education and research and environmental research.

The motivation behind wind tunnel design and testing is to improve performance, ensure security and reliability, validate theoretical models, and promote effective research and development. The project includes various steps, including determining the size and shape of the wind tunnel, designing the tunnel using Solid Works software, constructing the frame, installing necessary components, running experiments, and analyzing the obtained data.

MATERIALS USED IN CONSTRUCTION

Re-Used/Recycled Materials:

- PVC pipes
- Monitor screen
- Old cupboard hinges
- Clothes drying rack
- Wood
- Cardboard

Other Materials:

- Hot glue
- Celotape
- Wooden skewers

FINAL PRODUCT

The wind tunnel frame serves as the structural support system for the entire setup. Materials such as wood pieces can provide a cost-effective solution for constructing the frame. Ensuring stability and integrity of the frame is crucial to maintain accurate testing conditions and prevent undesired vibrations that may affect experimental outcomes. Incorporating a clear window in the middle of the wind tunnel frame allows researchers to visually observe the wind turbine during testing. This visual feedback is essential for capturing real-time data and evaluating the turbine's performance. Mounting the wind turbine at the center of the clear section within the wind tunnel is a critical step in wind tunnel design. Proper and secure mounting, along with ensuring the correct orientation of the turbine blades facing into the airflow, allows for realistic testing conditions. This setup closely resembles the actual operating conditions of wind turbines in the field. To control and optimize airflow within the wind tunnel, a diffuser is constructed at the outlet section gradually expanding the airflow and reducing its velocity. Measurement equipment is essential for gathering data during wind turbine testing. An anemometer is installed at the tunnel's inlet to measure wind speed, providing valuable input for performance analysis. Additionally, a tachometer is used to measure the rotational speed of the wind turbine, enabling assessment of power output and efficiency. These measurements contribute to a comprehensive understanding of the turbine's performance characteristics.

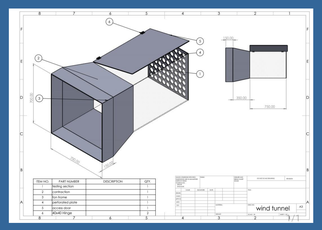

Figure 1 Design on SolidWorks

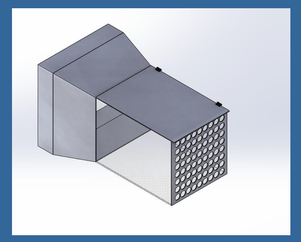

Figure 2. Design on SolidWorks

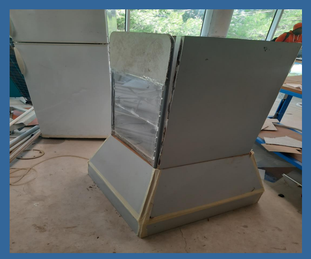

Figure 3. Construction of the Wind Tunnel

RESULTS AND DISCUSSION

By determining the appropriate size and shape, employing SolidWorks software for design, constructing a sturdy frame, installing necessary components, conducting experiments, and analyzing collected data, we can optimize wind turbine performance and contribute to the development of more efficient and sustainable energy solutions.

CONCLUSIONS

We will continue our efforts to design and optimize wind tunnels for wind turbine testing. We have explored the essential components and design considerations involved in constructing a wind tunnel for wind turbine testing. By determining the appropriate size and shape, employing SolidWorks software for design, constructing a sturdy frame, installing necessary components, conducting experiments, and analyzing collected data, we can optimize wind turbine performance and contribute to the development of more efficient and sustainable energy solutions. By embracing these future-oriented approaches, we can contribute to the ongoing development of wind turbine technology, enhance our understanding of wind turbine performance, and pave the way for larger-scale wind turbines for renewable energy production.

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