SUMMER RESEARCH INTERNSHIP IN SUSTAINABILITY

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Introduction

In the Summer of 2023, I was a research intern at Suzlon India. During my 10 day internship with them, I spent two thirds of my time at the Research and development Department focusing on the design of WInd turbines for their upcoming project in the rural Saurashtra region of the Western Ghats. I was also involved in the R&D department at their child company Sorigin, where I observed the structural designing and fixing of Mono and polycrystalline solar panels for their solar parks.
Apart from this department I was with the Asset management team at these companies where I studied the logistics to fix and maintain these complex sustainable enerGY SOURCES.

SUZLON

Suzlon Energy Limited is a leading renewable energy company specializing in wind power solutions. It is headquartered in Pune, India. With 20+ experience, Suzlon is an established global player in the wind energy and sustainability industry. The company designs, manufactures, and installs wind turbines and provides comprehensive wind energy services. Suzlon's advanced turbine technology includes models like the S66, S76, and S97, known for their efficiency and reliability. Most of its windmills are found in the rural areas of the western ghats of India.

Suzlon's commitment to sustainable energy aligns with India's growing renewable energy goals, contributing significantly to the nation's clean energy transition. Its ideals with the company's innovative approach and dedication to sustainability make it a prominent player in the global wind energy sector.

Personally, it was an exciting and collaborative environment to intern in with many young professionals dedicated to its vision.

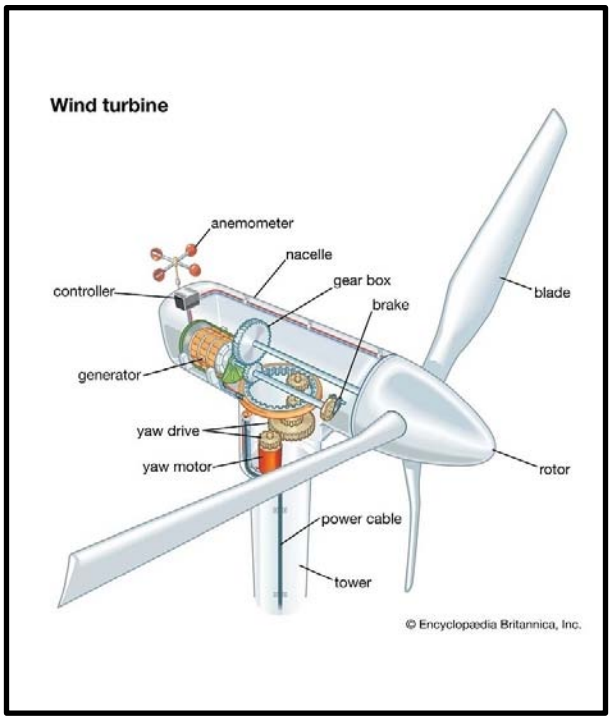
WIND TURBINES WITH STRUCTURE

- WHAT ARE WIND TURBINES

  Wind turbines are mechanical devices that harness wind energy to produce electrical energy through rotation of a wind turbine, this converts kinetic energy to electrical energy. Windmills have been present since medieval times, however modern technology is used to convert the energy to electrical energy and store it. To achieve this the wind turbine comprises various components, they are - :

  1. Blades: Aerodynamically designed glass or carbon fiber rotor blades harness wind energy. As wind flows over and around the blades, it creates lift force, causing the blades to spin. They vary in number, however the most common are triple bladed wind turbines.

  2. Rotor: The blades are connected to a pivotal hub that forms a rotor. The rotor's rotation transfers mechanical energy to the generator.



3. The internal part of the rotor is attached to a gearbox that rotates with the rotor, this is used with a brake to control the motion of the windmill, in the event of extremely turbulent winds the brake is used to mitigate any damage uncontrolled motion may cause.

4. Generator: The generator converts mechanical energy into electrical energy. It uses the principle of electromagnetic induction to produce alternating current (AC).
5. Control System: An electrical control system adjusts the blade angle and turbine orientation to optimize power output while protecting the turbine in adverse conditions. This is another safety measure involved in the structure of the turbine.

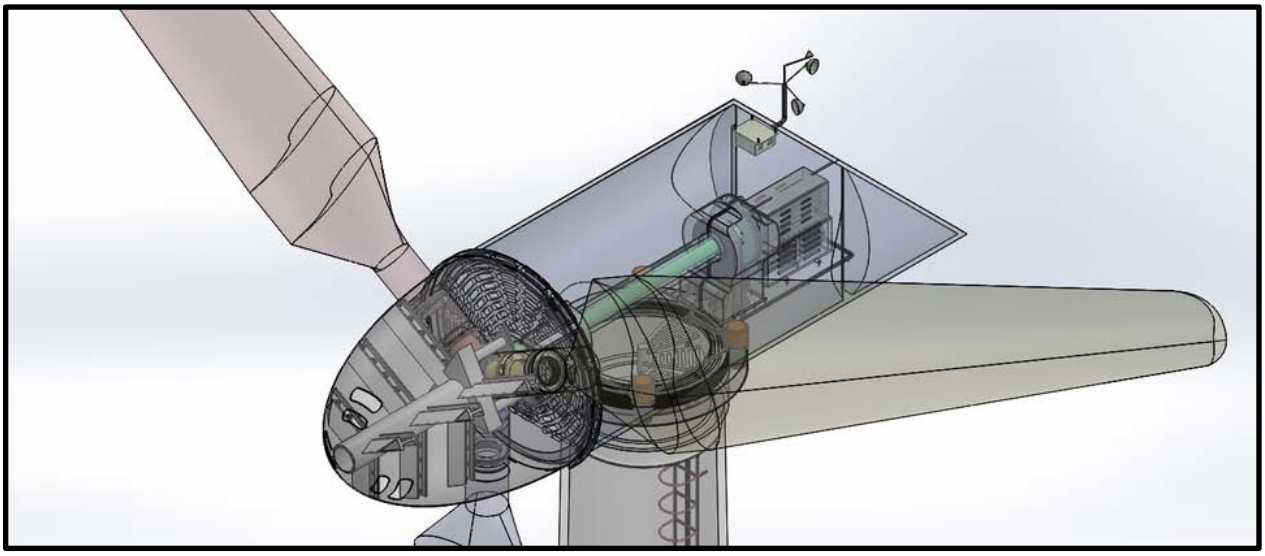
6. Tower: Wind turbines are mounted on tall poles to capture higher wind speeds at greater heights.

7. Power Grid: The generated electricity is then fed into the power grid for distribution to homes and businesses, contributing to clean and sustainable energy production. Through net metering regulations in India, it is possible for a firm/business to produce and utilize electrical energy from two different locations.

At Suzlon, I worked primarily on the design of these Turbines using 3D CAD technology. The process for production of these turbines has 3 main processes.

CAD DESIGN

Here I observed the use of Auto CAD 3D designing software to create.



Designing a wind turbine using AutoCAD software involves multiple technical steps. First, the Design engineers created a detailed 2D sketch of the turbine's components, including blades, tower, and generator. They defined the precise dimensions, angles, and tolerances of each part as per the requirements of the client. Depending on the requirements of the production engineering department these designs are finalized and a blueprint for the wind turbine is created.

After this, these 2D sketches are transformed into 3D models, using AutoCAD's 3D modeling tools. Engineers incorporate various materials, the weight distribution, and aerodynamic profiles to optimize turbine performance and minimize cost of production. Finite element analysis (FEA) is often applied to

assess structural integrity and stress points. Additionally, AutoCAD allows for simulations of wind flow patterns to fine-tune blade design. The final design is rigorously reviewed for safety, efficiency, and adherence to industry standards before production. If this model fails the simulation the idea is sent for reworking back to the Development department.

PROCUREMENT AND MANUFACTURING

I had little involvement in this department, however in my time there this process was explained to me in detail.

First, Suzlon's wind turbine parts manufacturing and procurement involve a streamlined process to minimize any lapse between design and output . Raw materials, such as high-quality steel and carbon fibers, are sourced from local vendors. Then, machining and fabrication techniques using German technologies are employed to create components. Frequent quality checks ensure durability and performance.

ASSEMBLY

The last part of turning the design into a reality is the assembly.

1. The assembly of the hub, gear box, and rotor occurs in the workshop. These parts are the fragile components of the wind turbine and are responsible for effective generation of electrical energy. Hence, skilled professionals are required to fix each of these components on the S66, S76, and S97 turbines.
2. The rest of the assembly, fixing the turbine and blades and the head of the windmill to the tower occurs on site under the supervision of one production and design engineer to ensure safe and correct placement and fixing of the windmill.

This concludes the process of the wind turbine.

SOLAR PANELS WITH STRUCTURE

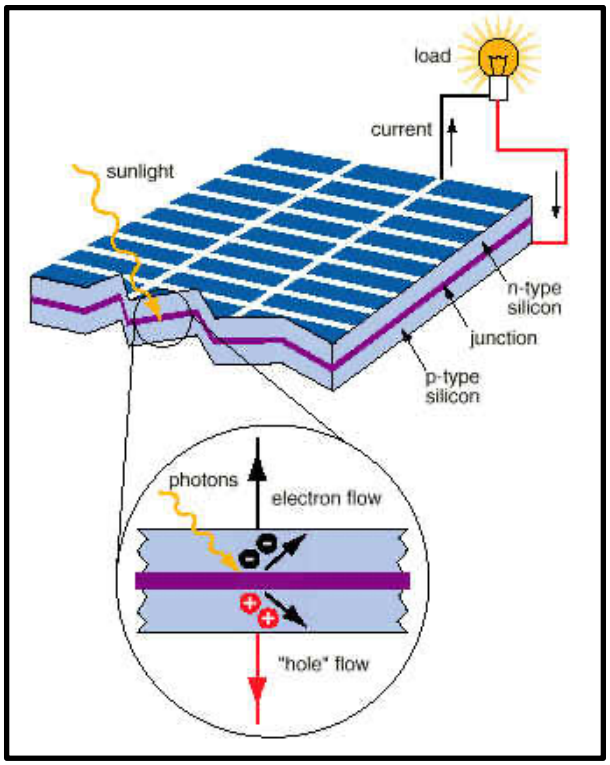
- WHAT ARE solar panels

  Solar panels are photovoltaic devices that convert sunlight into electricity using semiconductor materials like silicon and gallium, generating a direct electrical current (DC).

  The process involved in this process are explained below

  1. Photovoltaic Cells: Solar panels consist of numerous photovoltaic cells, usually made of silicon; the cell contains two layers of semiconductor material.

  2. Absorption of Photons: When sunlight, composed of photons (particles of light), strikes the solar panel, some of these photons are absorbed by the semiconductor material. Photons are understood as discrete quantum particles of energy and are used to create a potential difference.



3. Electron-Hole Pairs: The absorbed photons transfer their energy to electrons in the semiconductor's atoms, freeing them from their normal positions. This creates electron-hole pairs, this potential difference creates a flow of charge carriers.

4. Electrical Circuits: Electrical conductors in the solar panel collect this generated electric current and channel it into insulated wiring. This direct current (DC) electricity is then ready for use..

5. Inverter: To make the electricity usable in homes and businesses, an inverter is often employed a few hundred feet away at the edge of the solar park. It is used to convert the DC electricity into alternating current (AC).

6. Grid Connection: The generated AC electricity can be used on-site or fed into the electrical grid, allowing it to power homes and businesses. A meter checking the electrical energy is attached here to measure the input into the grid.

At Sorigin, I briefly worked with the Design department that focused on designing the structure of the solar panel and its placement for optimizing the solar energy received.

Like Suzlon, Sorigin’s designers used AutoCad to create a blueprint of the solar panels and their positions in the solar park. These positions were dependent on the data received by the onsite research team - this team found a year's data of the weather, wind, and solar intensity conditions of that patch of land. With this they also considered the average cloud cover on the land.
Using this data they were able to optimize the solar power generated and minimize the cost of assembly and procurement as per the clients needs.
Sorigin does not manufacture their own solar panels, they procure them from local vendors and Vendors in the Southeast Asian Market. The assembly , however, is done by them - they also offer maintenance, financial, and logistical services for the upkeep of such solar plants.

CONCLUSION

To conclude, my experience with both Sorigin and Suzlon was an eye opening experience. It gave me first hand experience with the world of sustainable energy, the future of mankind.
I gained invaluable insights into renewable energy, enhancing my understanding of engineering and passion for sustainability. It reaffirmed my commitment to contributing to a greener future.
It was very beneficial observing the daily problems faced by such large firms. This research internship did not only grow my technical knowledge on the subjects of Wind and Solar energy, but also conditioned my view on the industry as a whole. It showed me that despite the money involved the ideals and quality of an organization is what makes it a long-laster in today's competitive market.

I must say this experience did truly blow me away.

BIBLIOGRAPHY

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- Solar panels picture - 600 × 350
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