CONCLUSION AND RECOMMENDATIONS
### CHAPTER-8

**CONCLUSIONS AND RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Sub Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>Introduction</td>
<td>171</td>
</tr>
<tr>
<td>8.1</td>
<td>Performance</td>
<td>172</td>
</tr>
<tr>
<td>8.2</td>
<td>CFD Analysis</td>
<td>173</td>
</tr>
<tr>
<td>8.3</td>
<td>Recommendations</td>
<td>174</td>
</tr>
</tbody>
</table>
CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.0 INTRODUCTION

This chapter summarizes the conclusions drawn from the experiments carried out to improve the efficiency of wind turbine undertaken with different modules. The conclusions from performance, the CFD analysis and recommendations for future work are also presented.

Vertical Axis Wind Turbine rotor testing has been carried out to evaluate the performance of conventional Savonius rotor at low wind speeds of the order of about 4 to 10 m/s. The experimental and the CFD analysis have been carried out to predict the performance of VAWT rotors. It has been found to predict reasonably the performance of known conventional VAWT rotor and has been used to predict the performance of conventional VAWT rotor with moving blade type rotor that exhibit superior characteristics at low wind speeds. Results reveal that the moving blade VAWT rotors are reliably self-starting:

A physical model has been designed, fabricated and tested and validated with a mathematical model for wind reducer rotors. A satisfactory accord has been attained between experimentally calculated as well as systematically envisaged performance characteristics.
Moving blade VAWT model simulated in CFD, star-CD analysis software, for moving blade rotors. An acceptable agreement has been obtained and analytically predicted performance characteristics.

**8.1 PERFORMANCE**

In the experimental investigations carried out on the VAWT rotor with various slopes of wind reducers and moving blades, the following performance related conclusions are drawn.

1. It is observed that maximum efficiency is obtained at the slope of 30° which may be identified as optimized configuration of the VAWT rotor as it is evident from figure 7.7. After this value of slope of wind reducer, the speed and torque reduces because of reduction in area available for the wind flow.

2. At from 10° to 30° slopes the rotor is of simple in construction and has more torque at low speeds, this is due to an optimum range of slope which is enhancing the wind in the direction of wind velocity.

3. As the slope increases beyond the optimum value the effective surface of wind turbine blades reduces thereby the force exerted by the wind decreases and hence there is decrease in torque and speed of the rotor.

4. With variation in wind speed, output increases almost exponentially. The exponent is almost 3(three). This value tallies with the physics of the problem. The variation of output power is cube of wind velocity.
5. Moving blade vertical axis wind turbine has more torque at low speeds this is due to the resistance of the other blade which is not facing the wind in the direction of wind velocity.

6. The rotor is simple in construction and has more torque at low velocities this is due to the resistance of the other blade which is not in front of the wind in the path of wind velocity.

7. With variation in wind speed, output increases almost exponentially. This value tallies with the physics of the problem. The variation of output power is cube of wind velocity.

8. It is finished that VAWT with the enhanced self-starting and low velocity torque characteristics explained in this theory have significant possible in stand-alone, direct automatic drive type wind turbine rotor applications.

9. It is observed that the maximum efficiency is obtained at the slope of $30^\circ$ with two slant curtains of $15^\circ$ and $45^\circ$ which may be identified as optimized configuration of the VAWT rotor. It is concluded that VAWT with the improved self-starting and low speed torque characteristics described in this thesis have considerable potential in stand alone, direct mechanical drive type wind turbine rotor applications.

8.2 CFD ANALYSIS

1. Rotor speed is increased by significantly using moving blade vertical axis wind turbine and power increased by significantly and rotor speed is increased by considerably and power increased by 100% in the case of Air foil (multiple moving) blade system.
2. The magnitude of efficiency of the rotor and blade twist angle match well. There is a variation of about 5% in CFD values and experimental values. The values show that the CFD trend and magnitude closely match with experimental results.

3. Velocity variation and pressure distribution in the flow domain of the control volume as compared. Undisturbed flow distribution is observed in the upstream wind section and has about 5 m/s velocity. Wind velocity in the region, which is outside the swept area increases to a great extent.

8.3 RECOMMENDATIONS

Most of the areas in India have low to medium wind speeds. Hence, to cater the needs of electric power for domestic use Vertical Axis Wind Turbines are more suitable. These turbines of smaller capacity coupled with efficient electric generator can be installed in rural and urban areas for electricity generation. This piece of work essentially gives the better design of VAWT rotor for low wind speed applications.

India which is facing a massive power crunch should urgently put together a comprehensive policy and regulations to fast-forward the growth of this sector. Wind energy in general and small wind turbines in particular are boon for supplying decentralized power in rural areas.