



# RAMCO INSTITUTE OF TECHNOLOGY

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## Department of Mechanical Engineering Academic Year 2021 – 2022 (Odd Semester)

**Degree, Semester & Branch:** VII Semester B.E. Mechanical  
**Course Code & Title:** ME8072 Renewable Sources of Energy  
**Name of the Faculty member(s):** Mr.R.Arun Kumar, AP/Mechanical

### Innovative Practice Description

- **Unit / Topic:** Unit III / Wind Energy
- **Course Outcome:** CO3
- **Topic Learning Outcome:** TLO9
- **Activity Chosen:** Virtual Laboratory Utilization
- **Justification:** For explaining the concept of site selection parameters and to compare the performance of a same turbine at three different locations and to analyze the performance of a turbine by adjusting parameters for same location the virtual lab was used
- **Time Allotted for the Activity:** Spent first 10 minutes in explaining the virtual lab and the comparison parameter was spent with 10 minutes and then the theoretical concept was correlated with theoretical content. Then a week time was given to the students to execute the task given and submit the same as a report
- **Details of the Implementation:**

For the topic “Site selection criteria for Wind farm installation”, to make the students to understand better, the virtual laboratory “3M Wind Energy” developed by Young Scientist Laboratory was used. The tool enabled to design a wind farm in three different locations: a. Off – shore b. On – shore plains c. Hills

The virtual lab also enabled to select the other design parameters including blade length, blade pitch, blade twist, tip shape, airfoil shape, height of turbine and 3M materials. Selection of these parameters at different locations helps to understand the impact of selection criteria in installing a wind turbine.

To make the students to understand better, an assignment was given in which the students have to submit a report by practicing the experiment. The practicing was in such a way that the students have to keep 7 parameters fixed and alter any one parameter to generate three different results. This makes them to have a better clarity in selection criteria.

- **PO / PSO mapping:**

Innovative Practice	PO5 (Modern Tool Usage)	PO7 (Environment and Sustain.)	PO10 (Communication)	PO12 (Lifelong learning)	PSO3 (Design thermal system)
	3	2	3	2	3
<b>Justification for correlation</b>	Timely submission and plagiarism were checked for the report submitted	Role of wind turbine in environment protection is explained to the students	In report technical information will be interpreted in basic level and the same will be presented as a report. So, PO is mapped at level 3	Report enables students to analyze viability through technical content	Students will design a wind system for the given location by analyzing various implementation parameters

(1 – Low      2 – Moderate      3 – High)

- **CO – PO / PSO mapping:**

CO	PO1	PO2	PO5	PO7	PO8	PO9	PO10	PO12	PSO3
CO3	2	1	3	2	1	3	3	2	3

(1 – Low      2 – Moderate      3 – High)

- **Images / Screenshot of the practice:**

- **Reflective Critique:**

- ❖ *Feedback of practice from students and other stakeholders:*

Based on the oral feedback collected from the students, they felt easy to understand the different parameters and the site location for installing a wind turbine

- ❖ *Benefit of the practice:*

Students analyzed different parameters of consideration for designing a Wind Turbine

**References:** 3M Wind Energy Virtual Lab developed by Young Scientist Lab

<https://www.youngscientistlab.com/sites/default/files/interactives/wind-energy/>

*CO3: Student will be able to analyze different parameters of consideration for designing a Wind Turbine*

**TO UNDERSTAND THE EFFICIENCY OF WIND TURBINE BY  
CHANGING AIRFOIL SHAPE**

**ME8072**

**RENEWABLE SOURCES OF ENERGY**

**ASSIGNMENT WORK**

**Submitted by**

**J R JERLIN NAFEL**

**In partial fulfillment for the award of the degree**

**of**

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**RAMCO INSTITUTE OF TECHNOLOGY, RAJAPALAYAM**

## PROBLEM STATEMENT

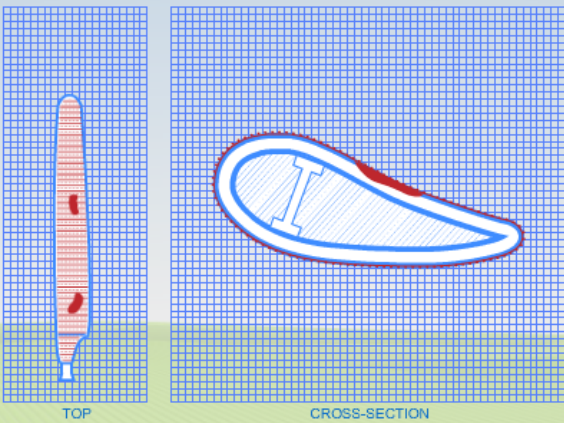
To understand the efficiency of wind turbine by changing airfoil shape

### INPUTS IN DESIGN 1

- Location :Plains
- Blade Length: 37m
- Blade Pitch : 5°
- Blade Twist : Yes
- Tip shape : wide
- **Airfoil Shape: Thin**
- Turbine Height:80m
- 3M Material: resin, riblets, filler

The screenshot displays a simulation interface for wind turbine blade design. It is divided into several sections:

- BLADE DESIGN:** Features two visualizations: a 'TOP' view of a white blade on a grid and a 'CROSS-SECTION' view showing a blue airfoil profile with red streamlines. Text below reads: "Choose variables below, then test to see how many watts are produced and the efficiency factor of your turbine. You can test additional designs after applying materials."
- TURBINE PERFORMANCE:** A vertical panel on the right showing results:
  - WATTS PRODUCED: 238977
  - EFFICIENCY FACTOR: 0.34
  - WATTS / UNIT COST: 0.21
  - HOMES POWERED: 159 (indicated by an upward arrow)
- BLADE VARIABLES:** A control panel with dropdown menus for:
  - Blade Length: 37m
  - Blade Pitch: 5°
  - Blade Twist: Yes
  - Tip Shape: Wide
  - Airfoil Shape: Thin
  - Turbine Height: 80m
- Navigation:** Buttons for 'BACK', 'TEST', and 'NEXT' are located at the bottom.



**Apply 3M Materials**

Improve your blade design by choosing materials below. Then test to see watts produced, efficiency factor and cost. You can test up to three designs.

**TURBINE PERFORMANCE**

**WATTS PRODUCED**  
233978

**EFFICIENCY FACTOR**  
0.33

**WATTS / UNIT COST**  
0.21

**HOMES POWERED** 156

You can design and run another test or go directly to review.

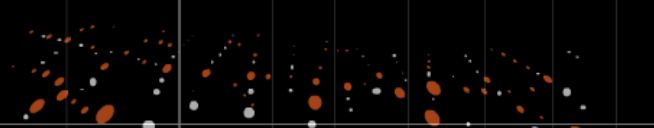
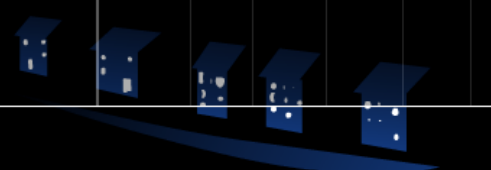
**NEXT**

**3M MATERIALS SELECTION**

3M Matrix Resin <input checked="" type="checkbox"/>	3M Wind Blade Protection Tape <input type="checkbox"/>
3M Riblets Film <input checked="" type="checkbox"/>	3M Wind Blade Bonding Adhesive <input type="checkbox"/>
3M Filler <input checked="" type="checkbox"/>	

BACK
TEST

## OUTPUT OF DESIGN 1

	INPUTS								OUTPUTS						
	Location	Blade Length	Blade Pitch	Blade Twist	Tip Shape	Airfoil Shape	Turbine Height	3M Material	Watts Produced	Swipe Area	Air Density	Air Velocity	Eff. Factor	Watts/Unit Cost	Homes Powered
<b>DESIGN 1</b> <span style="background-color: white; color: #4a7ebb; padding: 2px 5px; border-radius: 3px; margin-top: 5px;">REVISE</span>	Plains	37m	5°	Yes	Wide	Thin	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	233978	4301	1.2	6.5	0.33	0.21	156
<b>DESIGN 2</b> <span style="background-color: white; color: #4a7ebb; padding: 2px 5px; border-radius: 3px; margin-top: 5px;">REVISE</span>															
<b>DESIGN 3</b> <span style="background-color: white; color: #4a7ebb; padding: 2px 5px; border-radius: 3px; margin-top: 5px;">REVISE</span>															

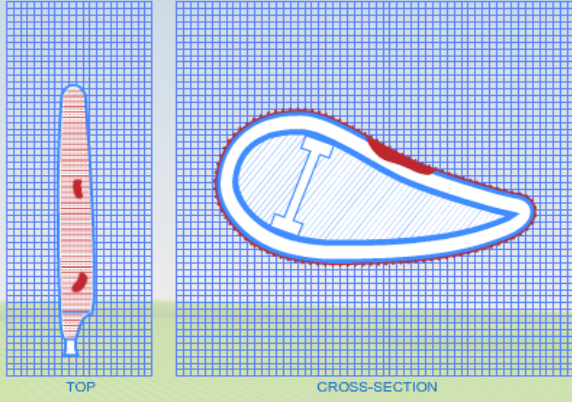
BACK
START NEW DESIGN
EXPORT
PRINT

## INPUTS IN DESIGN 2

- Location :Plains
- Blade Length: 37m
- Blade Pitch : 5°
- Blade Twist : Yes
- Tip shape : wide
- **Airfoil Shape: Thick**
- Turbine Height:80m
- 3M Material: resin, riblets, filler

The screenshot displays a software interface for turbine blade design. It is divided into several sections:

- BLADE DESIGN:** Contains two visualizations: a 'TOP' view of a single blade and a 'CROSS-SECTION' view showing the airfoil profile and internal structure. Below these is a text box: "Choose variables below, then test to see how many watts are produced and the efficiency factor of your turbine. You can test additional designs after applying materials."
- BLADE VARIABLES:** A grid of dropdown menus for adjusting parameters:
  - Blade Length: 37m
  - Blade Pitch: 5°
  - Blade Twist: Yes
  - Tip Shape: Wide
  - Airfoil Shape: Thick
  - Turbine Height: 80m
- TURBINE PERFORMANCE:** A sidebar on the right showing results:
  - WATTS PRODUCED: 225701
  - EFFICIENCY FACTOR: 0.32
  - WATTS / UNIT COST: 0.2
  - HOMES POWERED: 150 (indicated by an upward arrow icon)
- Navigation:** Buttons for 'BACK', 'TEST', and 'NEXT' are located at the bottom of the interface.



TOP                      GROSS-SECTION

### Apply 3M Materials

Improve your blade design by choosing materials below. Then test to see watts produced, efficiency factor and cost. You can test up to three designs.

### 3M MATERIALS SELECTION

3M Matrix Resin	<input checked="" type="checkbox"/>	3M Wind Blade Protection Tape	<input type="checkbox"/>
3M Riblets Film	<input checked="" type="checkbox"/>	3M Wind Blade Bonding Adhesive	<input type="checkbox"/>
3M Filler	<input checked="" type="checkbox"/>		

### TURBINE PERFORMANCE

**WATTS PRODUCED**  
220979

**EFFICIENCY FACTOR**  
0.31

**WATTS / UNIT COST**  
0.19

**HOMES POWERED** 147

You can design and run another test or go directly to review.

BACK
TEST
NEXT

## OUTPUT OF DESIGN 2

3M Discovery **SCIENCE OF EVERYDAY LIFE**
Introduction   Location   Design   **3M Material**   Review   Wind Power

	INPUTS							OUTPUTS							
	Location	Blade Length	Blade Pitch	Blade Twist	Tip Shape	Airfoil Shape	Turbine Height	3M Material	Watts Produced	Swipe Area	Air Density	Air Velocity	Eff. Factor	Watts/Unit Cost	Homes Powered
<b>DESIGN 1</b> <span style="background-color: #007bff; color: white; padding: 2px 5px; border-radius: 5px;">REVISE</span>	Plains	37m	5°	Yes	Wide	Thin	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	233978	4301	1.2	6.5	0.33	0.21	
<b>DESIGN 2</b> <span style="background-color: #007bff; color: white; padding: 2px 5px; border-radius: 5px;">REVISE</span>	Plains	37m	5°	Yes	Wide	Thick	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	220979	4301	1.2	6.5	0.31	0.19	
<b>DESIGN 3</b> <span style="background-color: #007bff; color: white; padding: 2px 5px; border-radius: 5px;">REVISE</span>															

BACK
START NEW DESIGN
EXPORT
PRINT



## INPUTS IN DESIGN 3

- Location :Plains
- Blade Length: 37m
- Blade Pitch : 5°
- Blade Twist : Yes
- Tip shape : wide
- **Airfoil Shape: Super Thin**
- Turbine Height:80m
- 3M Material: resin, riblets, filler

3M Discovery  
**SCIENCE OF EVERYDAY LIFE**

Introduction Location **Design** 3M Material Review Wind Power

**BLADE DESIGN**

Choose variables below, then test to see how many watts are produced and the efficiency factor of your turbine. You can test additional designs after applying materials.

**TURBINE PERFORMANCE**

**WATTS PRODUCED**  
199148

**EFFICIENCY FACTOR**  
0.28

**WATTS / UNIT COST**  
0.17

**HOMES POWERED** 133

Now improve your design and apply 3M Materials to your blade design.

**BLADE VARIABLES**

Blade Length: 37m  
Blade Pitch: 5°  
Blade Twist: Yes  
Tip Shape: Wide  
Airfoil Shape: Super Thin  
Turbine Height: 80m

BACK TEST NEXT



3M Discovery  
**SCIENCE OF EVERYDAY LIFE**

Introduction Location Design **3M Material** Review Wind Power

**Apply 3M Materials**  
Improve your blade design by choosing materials below. Then test to see watts produced, efficiency factor and cost. You can test up to three designs.

**TURBINE PERFORMANCE**

**WATTS PRODUCED**  
194982

**EFFICIENCY FACTOR**  
0.28

**WATTS / UNIT COST**  
0.17

**HOMES POWERED**

You can design and run another test or go directly to review.

**3M MATERIALS SELECTION**

3M Matrix Resin  3M Wind Blade Protection Tape   
 3M Riblets Film  3M Wind Blade Bonding Adhesive   
 3M Filler

BACK

TEST

NEXT

### OUTPUT OF DESIGN 3

3M Discovery  
**SCIENCE OF EVERYDAY LIFE**

Introduction Location Design **3M Material** Review Wind Power

**INPUTS**

**OUTPUTS**

	Location	Blade Length	Blade Pitch	Blade Twist	Tip Shape	Airfoil Shape	Turbine Height	3M Material	Watts Produced	Swipe Area	Air Density	Air Velocity	Eff. Factor	Watts/Unit Cost	Homes Powered
<b>DESIGN 1</b> <a href="#">REVISE</a>	Plains	37m	5°	Yes	Wide	Thin	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	233978	4301	1.2	6.5	0.33	0.21	
<b>DESIGN 2</b> <a href="#">REVISE</a>	Plains	37m	5°	Yes	Wide	Thick	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	220979	4301	1.2	6.5	0.31	0.19	
<b>DESIGN 3</b> <a href="#">REVISE</a>	Plains	37m	5°	Yes	Wide	Super Thin	80m	Resin:Yes Riblets:Yes Filler:Yes WPT:No WPA:No	194982	4301	1.2	6.5	0.28	0.17	

## **INFERENCE**

When comparing the three different airfoil shapes, the **THIN AIRFOIL** has the highest efficiency.

Thicker airfoils do not experience flow separation until considerably higher angles of attack, resulting in more lift and less drag as the angle of attack increases but Thin airfoils encounter flow separation over the top surface, resulting in significantly increased drag and a loss of lift.

By increasing the airfoil thickness, the leading edge radius increases becoming smoother, and leading the laminar bubble to resist to full flow separation at higher angles of attack. So thin airfoil is high efficiency

Submitted: Nov 27 at 6:10pm

Student Viewed Document: Nov 30 at 2:51pm

Submitted Files: (click to load)

[J.R.JERLIN NAFEL\\_RSE\\_ASSIGNMENT.pdf](#)

**Assessment**

Grade out of 15

15

[View Rubric](#)

Some Rubric	
Criteria	Ratings
Timely Submission	<p><b>Excellent</b> Submitting on or before time <b>Comments</b> Good efforts Jerlin.</p> <p style="text-align: right;">2 / 2 pts</p>
Utilizing the 3M lab and including screenshots (PI 5.2.2)	<p><b>Excellent</b> Presenting all the three conditions' screenshots <b>Comments</b> Great efforts</p> <p style="text-align: right;">4 / 4 pts</p>
Plagiarism (PI 8.1.1)	<p><b>Excellent</b> Students not copying content of others <b>Comments</b> Excellent efforts pa</p> <p style="text-align: right;">1 / 1 pts</p>
Content of the assignment (PI 9.3.1 & 12.3.1)	<p><b>Excellent</b> Justification for all three conditions is given in an understandable way with result screenshot <b>Comments</b> Justification is pleasing and convincible. Excellent</p> <p style="text-align: right;">5 / 5 pts</p>
Presentation (PI 10.1.3)	<p><b>Excellent</b> Impressive presentation with properly aligned content with title page <b>Comments</b> Impressive presentation with good alignment</p> <p style="text-align: right;">3 / 3 pts</p>
<b>Total Points: 15</b>	

**Assignment Comments**

Good efforts Jerlin

× `_(javascript:void 0;)`  
 Arun Kumar R, Dec 1 at 4:08pm

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