PROJECT ONE: MILESTONE 4 – COVER PAGE

Team Number: TUES -24

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Yasmine Elkhouly	Elkhouy
Taaha Atif	AtifT
Pritika Thevakanthan	thevakap
Borna Sadeghi	sadegb1

MILESTONE 4 (STAGE 1) – FINALIZED DESIGN: ESTIMATE THICKNESS REQUIREMENT

Document the results of your materials selection and ranking on the following page.

→ Each team member is required to complete this on the *INDIVIDUAL* worksheet document, and then copy-and-paste to this document

We are asking that you submit your work on both worksheets**.** It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their estimation of deflection with the **Milestone Four Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into the **Milestone Four Team Worksheets** document allows you to readily access your team member's work
    - This will be especially helpful when completing ***Stage 2*** of the milestone

Team Number:	Tues-24

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Yasmine Elkhouly	Elkhouy

1. The title of the scenario

Scenario 4: A Pioneer in Clean Energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	CFRP, epoxy matrix (isotropic)	109.5 GPa	800 MPa

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**15-mm**
Estimated deflection δ (mm)	26.87375087mm

$$\delta = \frac{PbL^4}{4EI}$$

$P = 0.003\,MPA$
$E = 109.5\,GPA$
$b = 0.375\,m$
$a = 0.189\,m$
$L = 8.5\,m$

$$I = \frac{\pi}{4}\left[(0.189\,m)^3(0.375\,m) - (0.189\,m - 0.015\,m)^3(0.375\,m - 0.015\,m)\right]$$

$$= 4.989141577 \times 10^{-4}\,m^4$$

$$\delta = \frac{(3000\,Pa)(0.375\,m)(8.5\,m)^4}{(1.095 \times 10^{11}\,Pa)(4.989141577 \times 10^{-4}\,m^4)(4)}$$

$$= 0.02687375087\,m$$

$$= 26.87375087\,mm$$

Team Number: Tues-24

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Taaha Atif	AtifT

1. The title of the scenario

Scenario 4: A Pioneer in Clean Energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	CFRP, epoxy matrix (isotropic)	109.5 GPa	800 MPa

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**30-mm**
Estimated deflection δ (mm)	14.9 mm

$p = 0.003\,MPa \longrightarrow 3000\,Pa$

$E = 109.5\,GPa \longrightarrow 1.095 \times 10^{11}\,Pa$

$b = 0.375m \qquad a = 0.189m \qquad L = 8.5m$

t provided as $30mm \therefore t = 0.03m$

$$I = \frac{\pi}{4}\left[(0.189)^3(0.375m) - (0.189-0.03)^3(0.375-0.03)\right]$$

$$I = 8.98 \times 10^{-4}\,m^4$$

$$\delta = \frac{pbL^4}{4EI}$$

$$= \frac{(3000)(0.375)(8.5)^4}{4(1.095 \times 10^{11})(8.98 \times 10^{-4})}$$

$$\delta = 0.014931\,m$$

$$\boxed{\delta = 14.93\,mm}$$

Team Number: Tues-24

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Borna Sadeghi	sadegb1

1. The title of the scenario

Scenario 4: A Pioneer in Clean Energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	CFRP, epoxy matrix (isotropic)	109.5 GPa	800 MPa

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**50-mm**
Estimated deflection δ (mm)	10.3 mm

Insert calculation or photo of hand calculation.

$$\delta = \frac{pbL^4}{4EI}$$

$$I = \frac{pbL^4}{4E\delta}$$

$$I = \frac{\pi}{4}\left(a^3b - (a-t)^3(b-t)\right)$$

$$I = \frac{\pi}{4}\left((0.189\,m)^3(0.375\,m) - (0.189 - 0.050\,m)^3(0.375 - 0.050\,m)\right)$$

$$I = 1.3029 \times 10^{-3}\ m^4$$

$$\delta = \frac{(0.003\,MPa)(0.375\,m)(8.5\,m)^4}{4\,(109.5 \times 10^3\,MPa)(1.3029 \times 10^{-3}\,m^4)}$$

$$\delta = 0.0103\ m$$

$$\boxed{\delta = 10.3\ mm}$$

Team Number: Tues-24

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Pritika Thevakanthan	thevakap

1. The title of the scenario

Scenario 4: A Pioneer in Clean Energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	CFRP, epoxy matrix (isotropic)	109.5 GPa	800 MPa

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**150-mm**
Estimated deflection δ (mm)	6.8 mm

GIVEN:

$E = 109.5\ GPa$ $\quad E \geq 100\ GPa$; FOLLOW STIFF MATERIAL PROPERTIES

$= 1.095 \times 10^{11}\ Pa$

$P = 0.003\ MPa$

$= 3.0 \times 10^{3}\ Pa$

$b = 0.375m$

$a = 0.189m$

$L = 8.5m$ $\quad t = 150mm = 0.15m$

CALCULATE MOMENT OF INERTIA

$$I = \frac{\pi}{4}[(a^3)(b) - (a-t)^3(b-t)]$$

$$= \frac{\pi}{4}[(0.189m)^3(0.375m) - (0.189m - 0.15m)^3(0.375m - 0.15m)]$$

$$= 0.0019779303l\ m^4$$

CALCULATE DEFLECTION

$$\delta = \frac{(3.0 \times 10^3 Pa)(0.375m)(8.5m)^4}{(1.095 \times 10^{11} Pa)(1.9779 \times 10^{-3} m^4)(4)}$$

$$= 0.00678m$$

$0.00678m = 6.78mm$

*If you are in a team of 5, please copy and paste the above on a new page

MILESTONE 4 (STAGE 2) – FINALIZED DESIGN: REFINE THICKNESS REQUIREMENT

Team Number: Tues-24

1. Calculate Thickness Requirement Based on Deflection Simulation

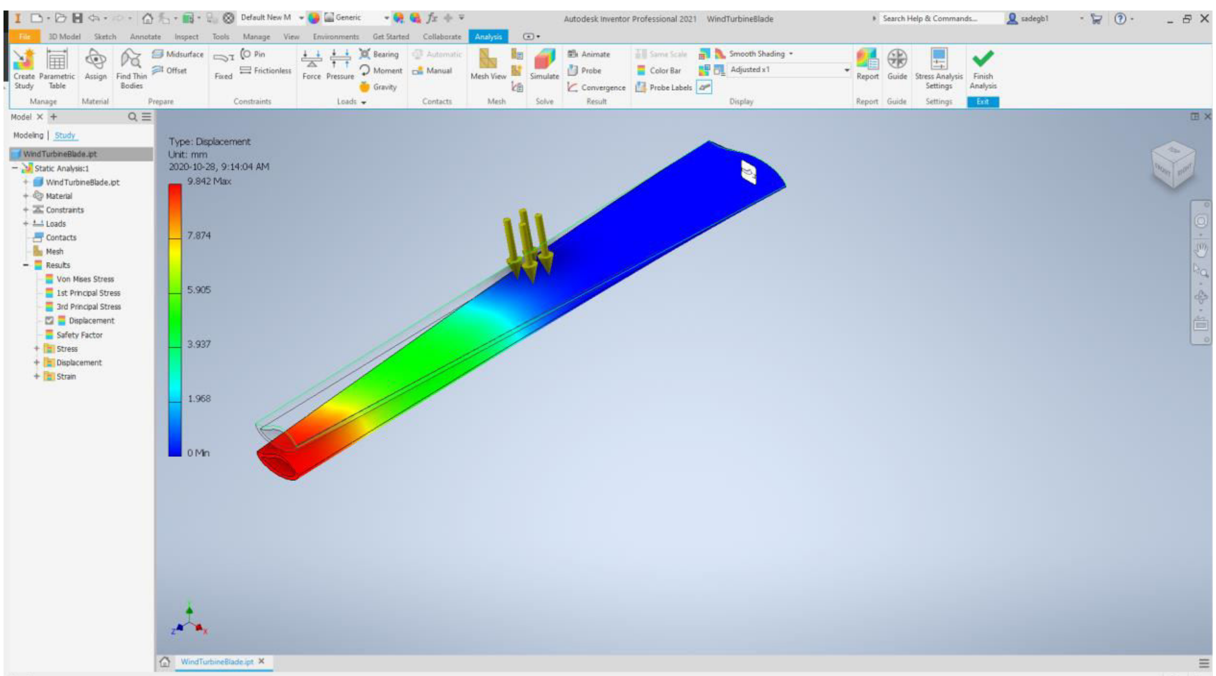
Initial Thickness range, obtained from stage 1 (e.g. 30mm < t < 50 mm):	50mm <t<150mm

For every iteration, include your thickness and observed deflection in the table below. Only include as many rows as needed until you get a deflection of 10 mm (Do not over-design the turbine blade. i.e., if your deflection is less than 8.5 mm, it is over-designed). Add more rows, if needed:

Thickness (mm)	Observed deflection (mm)
50	10.67
52	10.01
53	9.842

Final refined turbine blade thickness *t* (mm):	53 mm

Insert print screens of deflection simulation and provide evidence that the deflection satisfies the design constraint.



MILESTONE 4 (STAGE 3) – PEER INTERVIEW

Team Number: Tues-24

Peer Interview Notes

1. Peer Interview Notes

Evaluation of Scenario 3: The Roof Generator

Overall Objective:

- The group's overall objective was to design a suitable wind turbine that can be installed on roofs for homeowners
- Space Considerations must be made for residential areas

Summarized Notes of Objective Tree of the Roof Top Turbine

- Visually Appealing for homes
  - Colour
  - Compact Size
    - Short Height
- Easy Installation
  - Clear instructions for homeowners to install wind turbines
  - Lightweight; must be installed on the roofs of homes
- Must be inexpensive since it is being installed on the roofs of houses, costs should be minimized
  - Inexpensive material should be utilized
  - Material should last long as homeowners are installing wind turbines to minimize electricity costs for a long period of time

Summarized Notes of Objective Tree of the Roof Top Turbine Blade

- Low Cost
  - Turbine blade should be made of cost-efficient materials
  - Long lasting for homes
    - Low maintenance; low upkeep
  - Easy installed for homeowners to install wind turbines
- Lightweight since it is being installed on roofs of houses
  - Turbine blade should be made of durable materials
  - High yield strength to withstand high winds
- Maximize surface area in contact with wind
  - Maximize efficiency
    - To maximize conversion of kinetic energy into mechanical energy
  - Compact size for turbine blade
    - Small blade diameter

Summarized Notes of Material Selection

Objectives:

- Minimize Mass
  - The turbine must be lightweight since it is being installed on roofs of the houses
    - Must not damage the roof of the house
- Minimize Cost
  - Must be low costs since it is being installed on the roofs of houses; costs should be

minimized
    - Homeowners are installing wind turbines to minimize electricity costs for a long period of time

Criteria Ranking for Roof Top Turbine:

- Cost Efficient
- Strong
- Lightweight
- Resistance to heat
- Minimize carbon footprint

Material Finalists:

- CFRP, epoxy matrix
- **High Carbon Steel**
- Medium Carbon Steel

The group narrowed their material finalists and decided to use **High Carbon Steel**

- CFRP, epoxy matrix is too costly for their overall objective; must be affordable as it must minimize energy costs for the average consumer
- High Carbon Steel had an overall better ranking for each MPI compared to Medium Carbon Steel

Note: Please be mindful that you are expected to write a short reflection on what you have learned from the other team in your final deliverable