PROJECT ONE: MILESTONE 4 – COVER PAGE

Team Number: Tues-36

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

Full Name:	MacID:
Rahul Mahesh	maheshr
Luigi Quattrociocchi	quattrl
Tuong Minh Doan	doant6

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
  - o This will be especially helpful when completing ***Stage 2*** of the milestone

Team Number: | Tues-36 |
|---|

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Tuong Minh Doan	doant6

1. The title of the scenario

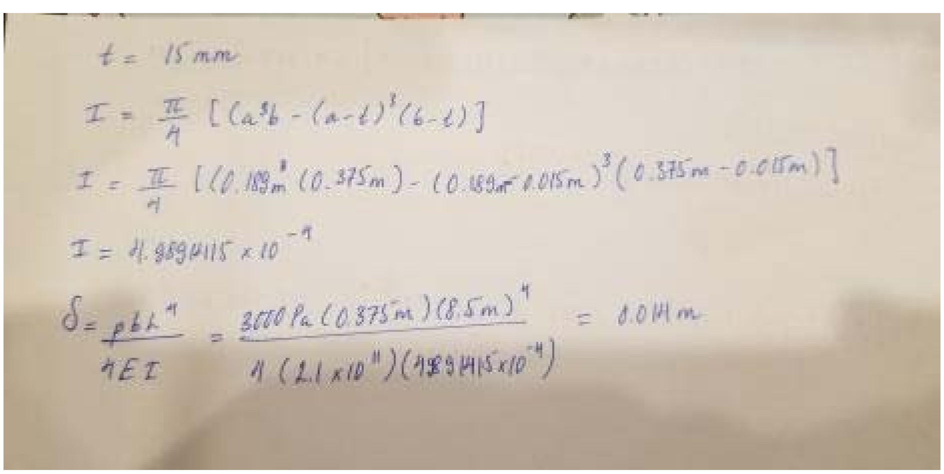
A Pioneer in Clean Energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	Steel	210	295

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**15-mm**
Estimated deflection δ (mm)	14.01 mm



$t = 15\,mm$

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

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

$I = 4.9894115 \times 10^{-4}$

$\delta = \frac{\rho b L^4}{4EI} = \frac{3600\,Pa\,(0.375m)(8.5m)^4}{4\,(2.1\times10^{11})(4.9894115\times10^{-4})} = 0.014\,m$

Team Number: Tues-36

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Rahul Mahesh	maheshr

1. The title of the scenario

A pioneer in Clean energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	Steel	210	295

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**30-mm**
Estimated deflection δ (mm)	7.8

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

$$I = \frac{\pi}{4}(0.001144)$$

$$I = \frac{0.003593}{4}$$

$$\boxed{I = 0.00089}$$

$$\delta = \frac{3000 \times 0.375 \times (8.5)^4}{4 \times 2.1 \times 10^4 \times 0.00089}$$

$$\delta = \frac{5872570.31}{746600000}$$

$$\boxed{\delta = 0.0078}\ m$$

$$\boxed{\delta = 7.8\ mm}$$

Team Number: | Tues-36

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Luigi Quattrociocchi	quattrl

1. The title of the scenario

A pioneer in clean energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	Steel	210	295

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**50-mm**
Estimated deflection δ (mm)	5.37

$$\delta = \frac{pbL^4}{4EI} \qquad I = \frac{\pi}{4}\left[a^3 b - (a-t)^3 (b-t)\right] \qquad p = 0.003\,\text{MPa} = 3000\,\text{Pa}$$

$$\delta = \frac{(3000\,\text{Pa})(0.189\,\text{m})(8.5\,\text{m})^4}{4(2.1\times10^{11}\,\text{Pa})\,I} = 0.00537\,\text{m} = 5.37\,\text{mm} \qquad E = 210\,\text{GPa} = 2.1\times10^{11}\,\text{Pa}$$

let $t = 50\,\text{mm} = 0.05\,\text{m}$ $\qquad \rho = 7.8\times10^3\,\text{kg/m}^3$

$$I = \frac{\pi}{4}\left[(0.189\,\text{m})^3(0.375\,\text{m}) - (0.189\,\text{m} - 0.05\,\text{m})^3(0.375\,\text{m} - 0.05\,\text{m})\right]$$

$$= 0.019785\,\text{kgm}^2$$

$b = 0.375\,\text{m}$, $a = 0.189\,\text{m}$, $L = 8.5\,\text{m}$

Team Number: Tues-36

Copy-and-paste from the INDIVIDUAL worksheet

Full Name:	MacID:
Michael	Shadoff

1. The title of the scenario

A pioneer in clean energy

2. Chosen Material

	Material Name	Young's Modulus (GPa)	Yield Strength (MPa)
Chosen Material	Steel	210	295

3. Estimate of Deflection - Analytical Model

Assigned thickness, *t* from Table 1 (mm)	**150-mm**
Estimated deflection δ (mm)	3.54

$a = 0.189\,m \quad t = 0.15\,m$

$b = 0.375\,m$

$L = 8.5\,m$

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

$$= \frac{0.003\,MPa\,(0.375)(8.5^4)}{4(210000\,MPa)(0.001977)}$$

$$= \frac{5.872570}{1660.68}$$

$$= 0.003536$$

$$= 3.54\,mm$$

$$I = \frac{\pi}{4}\left((0.184)^3(0.375) - (0.189-0.15)^3(0.375-0.15)\right)$$

$$= \frac{\pi}{4}\left((0.00675)(0.375) - (0.039)^3(0.225)\right)$$

$$\frac{\pi}{4}\left((0.00253) - (0.000059)(0.225)\right)$$

$$= \frac{\pi}{4}\left((0.00253 - (0.0000133)\right)$$

$$= \frac{\pi}{4}(0.002517)$$

$$= 0.001977$$

*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-36

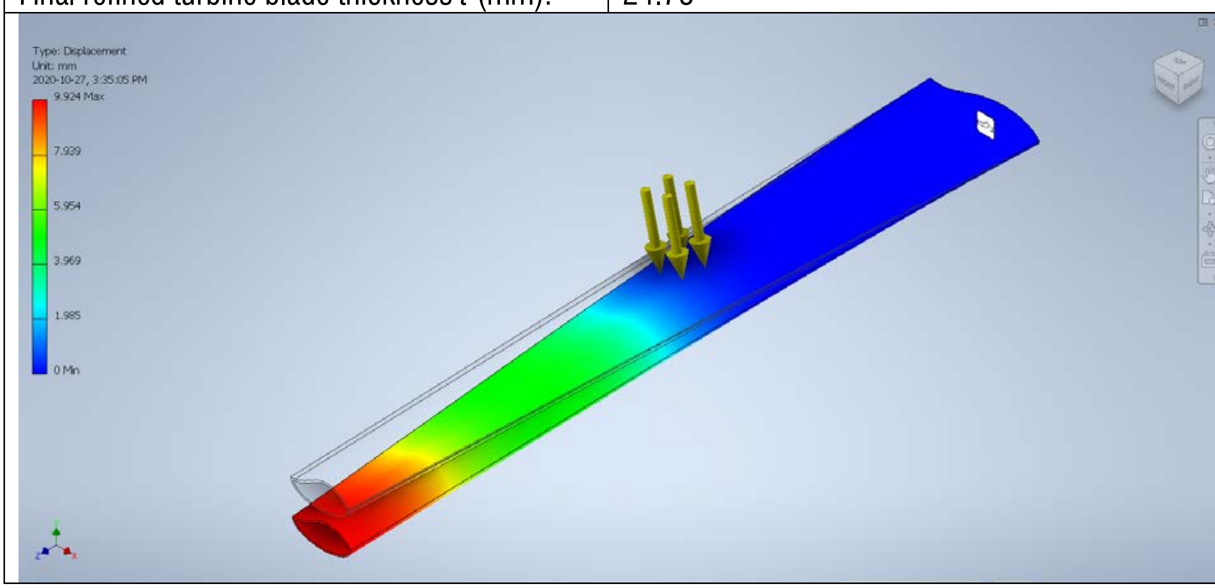
1. Calculate Thickness Requirement Based on Deflection Simulation

Initial Thickness range, obtained from stage 1 (e.g. 30mm < t < 50 mm):	15mm < t < 30mm

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)**
21	10.91
22	10.46
23	8.61
24	10.56
25	9.43
24.5	9.75
24.75	9.92

Final refined turbine blade thickness *t* (mm):	24.75



MILESTONE 4 (STAGE 3) – PEER INTERVIEW

Team Number: Tues-36

1. Peer Interview Notes

Peer Scenario: Renewable Energy for a Large Population
Objectives: Primary - MPI for Mass, Secondary - MPI for Volume
Density was weighted the highest, followed by young's modulus, resistance to weather, … cost.
CFRP was the selected material over steel and titanium.
The chosen thickness value for the blade was approximately 60 mm.

What was learned from other group:

- CFRP was the optimal material in terms of mass and volume
- The differing objectives resulted in vastly different material selection results between the two groups.

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