MILESTONE 3A (TEAM) – COVER PAGE

Team Number: Tues-08

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

Full Name:	**MacID:**
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Any student that is ***not*** present for their scheduled Lab-B session will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their P-1 grade.

MILESTONE 3A (STAGE 1) – MATERIAL SELECTION: PROBLEM DEFINITION

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1. Copy-and-paste the title of your *assigned* scenario in the space below.

Pioneer in Clean Energy

2. MPI selection
   → List one primary objective and one secondary objective in the table below
   → For each objective, list the MPI
   → Write a short justification for your selected objectives

	Objective	MPI-stiffness	MPI-strength	Justification for this objective
Primary	Minimize CO2 footprint	$\frac{E}{\rho CO_2}$	$\frac{\sigma_y}{\rho CO_2}$	Best way to build cleanly built blades is to reduce the amount of pollution generated from the production process, as in objective scenario, Sweden aims to reduce Carbon emissions to zero and wants a clean and sustainable implementation of a mass-produced wind farm to power all its population.
Secondary	Minimize Production Energy	$\frac{E}{\rho H_m}$	$\frac{\sigma_y}{\rho H_m}$	Another good way to be cleaner is to use as little amount of energy to create each blade. Again, this is most suitable for our scenario, to create a mass-produced wind farm capable to power the entire population of Sweden, many blades must be produced, reducing production energy per capita, allows for more efficiency.

MILESTONE 3A (STAGE 3) – MATERIAL SELECTION: MATERIAL ALTERNATIVES AND FINAL SELECTION

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Document results of each team member's materials selection and ranking on the table below.

- All different types of steel (carbon steels, alloy steels, stainless steels) have very similar Young's moduli. **For this stage in Project 1, please group all variations of steels into one family as "steel"**. Please put **steel** in your material ranking list only once and indicate in a bracket which steels made the top ranks.

Consolidation of Individual Material Rankings					
	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
MPI 1: $\frac{E}{\rho CO_2}$	Wood Typical Along Grain	Bamboo	Steels (Low carbon steel, High carbon steel, Medium carbon steel, Stainless steel)	Wood Typical Across Grain	Zinc Alloys
MPI 2: $\frac{\sigma_y}{\rho CO_2}$	Wood, typical along grain	Bamboo	Steel (low alloy, high carbon, medium carbon)	GFRP, epoxy matrix (isotropic)	Paper & Cardboard
MPI 3: $\frac{E}{\rho H_m}$	Wood, typical along grain	Steel (high carbon, medium carbon, low carbon, low alloys, stainless steel)	Bamboo	Zinc alloys	Wood, typical across grain
MPI 4: $\frac{\sigma_y}{\rho H_m}$	Wood, typical along grain	Steel (Low alloy, High carbon, Medium	Bamboo	GFRP, epoxy matrix (isotropic)	Paper and cardboard

		carbon, Low carbon, Stainless)			

As a team, fill out the table below and narrow down the possible materials for your assigned scenario by choosing the 3 materials which showed up the most across all MPI rankings in the table above.

- For this stage in Project 1, if **"steel"** is one of your three material finalists, please specify which steel your team chose to continue with, based on which showed up the most in your team's consolidated table.
- Remember to save the datasheets of all 3 material finalists

Narrowing Material Candidate List to 3 Finalists	
Material Finalist 1:	Wood, typical along grain
Material Finalist 2:	Low carbon steel
Material Finalist 3:	Bamboo

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As a team, compare material alternatives and make a final selection based on either a simple decision matrix or a weighted decision matrix (up to your team to decide)

→ As a team, consider *at least* 3 additional criteria that are relevant to your assigned scenario and discuss your 3 materials finalists for each criterion

- Feel free to pause at this stage and do some quick research on the materials finalists
- You may refer to the material finalists' datasheets for any relevant information that will enable your discussion.

Additional Criteria	**Possible question prompt**

Ease of access to material	Is the material easy to source in the country, are there tariffs due to international trade policy?
Chemical, weather and/or corrosion resistance	Will the material degrade over time (e.g. due to chemical resistance, corrosion resistance, fatigue resistance)?
Ease of maintenance	Consider maintenance if the part got damaged. Based on the material, is it easy to fix or will the entire part need replacement?

- To help you come up with your additional criteria, below are some question prompts that you may consider. Please note that you are not limited to these suggestions, and they may or may not be relevant to your assigned scenario

→ Remember that:

- Your MPI ranking takes into consideration both material and mechanical properties relevant to the objectives of your assigned scenario.
- Your additional considerations should not include previously evaluated objectives e.g. If minimizing the carbon footprint was either your primary or secondary objective, then it not be an additional criterion

→ Compare the material alternatives and make a final selection based on either a simple decision matrix or a weighted decision matrix (up to your team to decide)

- *Applies to a weighted decision matrix only:* choose a range for the weighting (e.g., 1 to 5) for each criterion. The higher the number on the weighting, the more important that criterion is.
- Choose a range for the score (e.g., 1 to 5) for each material on each criterion. Give each material a score based on how successfully it meets each criterion. The higher the score, the better the material is for that criterion.
- Add additional rows as needed.
- Add up the total score for each material alternative.

Fill one of the following templates only:

Simple Decision Matrix - Template			
	Material 1:	*Material 2:*	*Material 3:*

Criterion 1			
Criterion 2			
Criterion 3			
…			
TOTAL			

Weighted Decision Matrix							
	Weighting	*Wood, typical along grain*		*Low Carbon Steel*		*Bamboo*	
		Score	Total	Score	Total	Score	Total
Climate resistance	4	2	8	4	16	2	8
Manufacturability	4	4	16	3	12	3	12
Cost	2	4	8	3	8	4	8
Maintenance	4	1	4	4	16	1	8
Ease of transportation	3	4	12	1	3	2	6
	TOTAL		48		**55**		38

→ State your chosen material and justify your final selection

Justification	
Chosen Material:	Low Carbon Steel

Discuss and justify your final selection in the space below (based on the decision matrix results and any other relevant considerations).

We think low carbon steel is the best option out of the three because it ranked the highest in the weighted matrix. It is durable under different weather conditions, catered to our scenario (Sweden is cold and dry), lasts a long time, and is relatively easy to mass manufacture. It is an easy material to source and is inexpensive to transport it to Sweden as many of the manufacturing nations (such as Germany) are close to Sweden. Steel, in general, was ranked number two according to the MPI calculations, making it a stiff and strong material while keeping pollution and manufacturing energy to a minimum.

Summary of Chosen Material's Properties

Material Name	Average value
Young's modulus E (GPa):	210
Yield strength σ_y (MPa):	305
Tensile strength σ_{UTS} (MPa):	455.5
Density ρ (kg/m^3):	7.81 * 10^3
Embodiment energy H_m (MJ/kg)	30.8
Specific carbon footprint CO_2 (kg/kg)	2.325