

ACMA6000 Coursework Feedback

Student	Connor Griffiths
Student ID	221620
Assessment	Manufacture of Wind Turbine Blade
Final mark	87 / 100

1. Engagement with Literature Skills — 18/20

The report demonstrates a strong and well-targeted range of independent research across aerodynamic performance, small wind-turbine design, materials, environmental effects, manufacturing and structural behaviour. The source base includes recent peer-reviewed journal papers, recognised technical literature, NASA material, industry sources and ANSYS Granta EduPack data. Literature is consistently used to support actual design choices, including the 8 m/s design wind speed, NACA 4412 selection, chord geometry, material screening and manufacturing routes. Particularly good use is made of recent sources on ceramics, composites, fatigue and blade design. The mark is limited only by some variation in source type and a small number of references that are more general than the strongest academic sources used elsewhere in the report.

2. Knowledge and Understanding Skills — 25/30

The submission demonstrates very strong understanding across aerodynamics, material behaviour, manufacturing, costing and structural mechanics. Rotor sizing is derived from the 2 kW requirement using stated and sourced assumptions, producing a 2.25 m blade radius. The NACA 4412 profile is then developed through camber and thickness calculations across five spanwise stations before being transferred into CAD. Material understanding is broad and balanced, covering age-hardening aluminium, silicon carbide and GFRP, while manufacturing routes are appropriately investigated for metals, ceramics and polymer composites. The mechanical analysis also demonstrates good understanding of relative wind velocity, lift and drag, bending, torsional loading, von Mises stress, yield strength and fatigue. The principal limitation is that the blade uses a simple linear taper without a developed spanwise twist distribution, so the aerodynamic geometry remains preliminary rather than fully optimised.

3. Cognitive and Intellectual Skills — 17/20

There is strong evidence of critical engineering judgement. The weighted decision matrix gives fatigue the greatest importance and ranks age-hardening wrought aluminium highest at 4.25, ahead of silicon carbide and GFRP. The final material choice is not based on the score alone: the report also considers density, cost, recyclability, brittleness, stiffness and manufacturing practicality before confirming aluminium. The manufacturing recommendation similarly recognises that extrusion cannot directly create the tapered NACA geometry and therefore proposes secondary machining or forming. The structural results are also interpreted appropriately, with the lower fatigue margin identified as more critical than yielding. A higher mark would require a completed design iteration showing how the geometry or structural concept changes in response to these findings rather than leaving the proposed refinements as future work.

4. Practical Application Skills — 19/20

This is an exceptionally strong practical submission. The work includes rotor sizing, five calculated NACA 4412 blade sections, Excel-based camber and thickness coordinates, SolidWorks modelling, Granta material screening, a weighted decision matrix, design-specific raw-material costing, manufacturing comparison, sectional lift and drag calculations, root bending moments, bending stress, torsional moment, torsional shear stress, von Mises stress and both yield and fatigue safety factors. SolidWorks section properties are used directly in the stress calculations, and the blade volume from CAD is used to calculate material mass and comparative raw-material cost. The CAD requirement is fully satisfied through the external blade model and engineering drawing; no internal blade structure was required for this assessment. The main practical

limitation is that the structural model is based on the solid preliminary blade geometry, so the very high safety margins indicate that the design could be further optimised for mass and material use.

5. Transferable Skills for Life and Professional Practice — 8/10

The report is clearly structured and professionally presented, with a logical sequence from literature and design assumptions through geometry, material selection, manufacturing, cost, mechanical analysis, comparative evaluation, CAD and conclusion. Equations, tables, figures and appendices are used effectively and the evidence can be followed from the initial assumptions through to the final material and manufacturing recommendation. The conclusion accurately reflects the calculations and appropriately identifies the preliminary nature of the design. Some equation and spacing presentation is less polished than the technical content, and further editing for concise technical expression would strengthen the overall professional finish.

Mark Summary

Assessment category	Maximum mark	Mark awarded
Engagement with Literature Skills	20	18
Knowledge and Understanding Skills	30	25
Cognitive and Intellectual Skills	20	17
Practical Application Skills	20	19
Transferable Skills for Life and Professional Practice	10	8
Total	100	87

Overall Feedback

This is an exceptionally strong and comprehensive engineering submission. Its main strengths are the quality of independent research, complete coverage of the three material families, structured Granta and weighted material selection, CAD-linked raw-material costing, full aerodynamic loading calculations, completed bending and torsional stress analysis, and both yield and fatigue safety-factor assessment. The selection of age-hardening wrought aluminium is consistently justified through performance, manufacturing, cost and recyclability rather than by a single criterion. The principal limitations are the use of a simple linear blade geometry without a developed twist distribution and the absence of a completed optimisation stage after the high structural safety margins were identified. The strongest next step would be to refine the aerodynamic geometry and investigate a lighter hollow or internally reinforced design, then repeat the structural assessment to demonstrate the benefit quantitatively.