

ACMA6000 Coursework Feedback

Student	Joseph James
Student ID	2320115
Assessment	Manufacture of Wind Turbine Blade
Final mark	76 / 100

1. Engagement with Literature Skills — 16/20

The report demonstrates strong independent reading across small-scale wind-turbine design, BEM principles, NACA 4412 aerodynamics, composite materials, fatigue behaviour and manufacturing. The literature base includes peer-reviewed journal papers and established wind-turbine materials research, and the sources are generally used to support specific design decisions rather than only providing background information. The chord and twist discussion is supported by published blade-design literature, while the composite material and manufacturing decisions are connected to established wind-blade research. The Granta EduPack evidence also supplements the literature with material-property and environmental data. The mark is limited because the literature coverage is narrower in some areas than the strongest submissions, particularly ceramic materials and processes and structural verification.

2. Knowledge and Understanding Skills — 21/30

The submission demonstrates good understanding of rotor sizing, NACA 4412 geometry, chord taper, spanwise twist, material behaviour and composite manufacturing. The farmhouse energy demand is converted into a required average power and then into a rotor radius using stated wind-speed, air-density and power-coefficient assumptions. The blade is then developed through five radial sections with a justified finite tip chord and a BEM-informed twist distribution. The student also demonstrates clear understanding of CFRP, GFRP and aluminium behaviour and the trade-off between stiffness, strength, density, fatigue, environmental impact and cost. A significant limitation is that the assignment asks for metals, ceramics and polymer composites, whereas the detailed material and manufacturing investigation focuses mainly on aluminium and fibre composites, with no equivalent ceramic route developed. The structural analysis is also incomplete because bending stress, torsional stress and safety factors are not calculated.

3. Cognitive and Intellectual Skills — 15/20

There is clear evidence of engineering judgement and comparison. The weighted decision matrix uses explicit weighting for density, strength and stiffness, fatigue, environmental impact, cost and manufacturability. CFRP ranks highest and the final choice is then justified through the mechanical-performance priorities of the blade. The report also recognises the important disadvantage of CFRP: high embodied energy and poor recyclability. Manufacturing selection similarly weighs process quality, complexity and scale before selecting vacuum bagging rather than automatically adopting VARTM. The main limitation is that the engineering decisions are not fully tested by quantitative structural verification, and the final selection would be stronger if the calculated loads were carried through to stress, safety factor and redesign.

4. Practical Application Skills — 16/20

The submission contains substantial evidence of completed practical work. It includes rotor sizing, five calculated blade sections, NACA 4412 coordinate generation, lift and drag calculations, spanwise twist, Granta charts, a weighted decision matrix, manufacturing comparison, cost spreadsheet work and extensive SolidWorks modelling. The CAD evidence is particularly strong: five calculated NACA 4412 sections are positioned on reference planes, lofted, twisted and developed into the final blade model, with multiple engineering drawings and section views. This fully satisfies the intended CAD requirement, and there is no deduction for the absence of internal blade structures. The main limitation is the mechanical analysis. A root bending moment is estimated from the section lift forces, but the work stops there and does not calculate

design-specific bending stress, torsional stress or safety factors. The cost evaluation is also based on a nominal material assumption rather than a mass derived directly from the actual CAD blade geometry.

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

The report is very well organised and professionally presented. It has a clear contents structure, list of figures and tables, substantial appendices, Granta evidence, Excel calculations, CAD screenshots and engineering drawings, making the design process easy to follow. The report also distinguishes appropriately between preliminary work and validated engineering design, explicitly recognising that the aerodynamic analysis is simplified and that further BEM optimisation and structural simulation would be necessary. The final recommendations are relevant and specific. Minor presentation issues and the disproportionate amount of appendix evidence relative to some underdeveloped technical analysis prevent the highest marks, but overall communication is strong.

Mark Summary

Assessment category	Maximum mark	Mark awarded
Engagement with Literature Skills	20	16
Knowledge and Understanding Skills	30	21
Cognitive and Intellectual Skills	20	15
Practical Application Skills	20	16
Transferable Skills for Life and Professional Practice	10	8
Total	100	76

Overall Feedback

This is a strong and well-presented submission with particularly good evidence of independent material selection, Granta analysis, NACA 4412 geometry development, spanwise twist, CAD modelling and professional engineering drawing. The CFRP/vacuum-bag recommendation is supported by a structured decision process and the student appropriately recognises its environmental disadvantages. The main limitations are the absence of a comparable ceramic material and manufacturing investigation, the use of a nominal rather than design-derived blade mass in the cost estimate, and most importantly the incomplete structural analysis. The strongest improvement would be to take the existing aerodynamic loads through to bending stress, torsional stress and material-specific safety-factor calculations and then use those results to validate or refine the final blade design.