

Feedback Report – ACMA6000

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Assignment: Manufacture of Wind Turbine Blade

1. Engagement with Literature Skills – 17/20

This submission shows engagement with a wide range of relevant and credible literature. The brief states that marks are awarded for “in-depth research into wind turbine blade design, with clear referencing of credible sources such as academic journals, textbooks, and industry reports,” and also encourages visual presentation through tables and graphs. The report does this in several places. It draws on textbooks and recognised sources such as Abbott and von Doenhoff, Anderson, Burton et al., Ashby, Callister and Rethwisch, Jonkman et al., and industry-linked sources such as Ansys Granta, Vestas, Gurit and MatWeb. This is visible throughout the literature review and later technical sections, for example in the discussion of the NACA 4412 aerofoil, TSR ranges, and materials properties.

The strongest feature here is that the literature is not confined to a narrow textbook base. The student supports the work with visuals and comparative source-based material, such as the aerofoil comparison table, the examples of Vestas V164 and the NREL 5 MW reference turbine, the materials property tables, and the Granta selection charts. That matches the brief’s expectation to “use visuals (e.g., graphs, tables) to summarise findings.”

There are signs of inconsistency in source quality and referencing precision. A number of sources are credible and appropriate, but some web-based references are less academically strong than journal or standards-based sources, and a few citation details and formatting elements are uneven. There is also limited critical evaluation of the sources themselves. The report tends to use literature to support statements well, but not often to compare the reliability or relevance of one source against another.

To improve this section significantly, the student should reduce weaker commercial or general websites where possible and replace them with more journal papers, standards, and technical reports. The mark would also rise if the literature review included a more critical comparison of sources, for instance contrasting different published TSR values, C_p expectations, or composite property ranges and explaining why one source is more applicable to this blade design than another. Additional academically grounded figures, such as a referenced C_p –TSR graph from a journal source rather than a generic web figure, would also strengthen this criterion.

2. Knowledge and Understanding Skills – 24/30

The brief requires “systematic knowledge of wind turbine blade design, including aerodynamic, structural, and material considerations,” and asks for concepts such as “lift-to-drag ratio, chord length taper, and aerodynamic profiles (e.g., NACA 4412)” to be explained and related to real-world applications. The report demonstrates reasonably extensive, coherent and detailed knowledge, which aligns most closely with the very good descriptor in the generic criteria rather than the full excellent band.

The student shows sound subject understanding in the literature and design sections. For example, the report explains that “the NACA 4412 creates relatively good lift at low Reynolds numbers and has gentle stall characteristics,” and links this to wind turbine use. It also explains why TSR matters, how taper and twist support aerodynamic performance, and why composites are preferred for large blades on the

basis of strength-to-weight ratio, fatigue resistance and environmental durability. The work also includes relevant design parameters such as wind speed, air density, C_p , TSR and blade length, and presents material property information for metals, ceramics and composites. This is clearly consistent with the assignment requirements in Tasks 1 and 4.

The knowledge base is strongest where the student moves from literature into engineering context, for example in linking composite anisotropy to flap-wise and edgewise loading, or in explaining how wind variability, turbulence, wind shear and exposure affect blade performance. That shows understanding beyond simple definition.

While the report is knowledgeable, it does not consistently discuss uncertainty or competing views in depth. Some parts of the design section also appear underdeveloped or partially incomplete in presentation, especially around the parameter definition and equation display, where some expressions are not cleanly communicated in the extracted text. That weakens the impression of a fully secure and comprehensive understanding.

To improve, the student should explain more explicitly why particular values were chosen rather than merely presented. For example, the rationale for selecting the final blade dimensions, C_p target, and section positions could be justified more fully against the literature reviewed earlier. A short discussion of the limitations of simplifying assumptions in blade theory, material property ranges, and aerofoil applicability across the span would also move the work closer to the excellent descriptor.

3. Cognitive and Intellectual Skills – 17/20

This criterion concerns critical thinking, analysis, synthesis, evaluation, logic, argument and judgement. The assignment brief specifically states that marks here are awarded for the student's methodology in calculating cost for three material sets, and for critical evaluation of trade-offs such as cost, performance and environmental impact, with evidence-based conclusions and practical suggestions.

James's report shows sound critical thinking, analysis and evaluation, placing it in the very good band rather than the top excellent band. The report does not simply list material options; it compares them, constructs a weighted decision matrix, weighs mechanical performance, fatigue, cost, environmental impact and manufacturability, and reaches a justified material recommendation. The same applies in the manufacturing section, where vacuum infusion, RTM, prepreg lay-up and filament winding are compared in terms of production cost, time, scalability and environmental impact.

There is also evidence of judgement in the cost-performance discussion. The report reasons that while CFRP offers better stiffness and strength, its high cost limits its applicability, and therefore GFRP with vacuum infusion becomes the more balanced solution for large-scale blade production. That is more than description; it is evaluative judgement built on the evidence assembled earlier. Similarly, the conclusion proposes future improvement through non-linear taper and twist based on blade element theory, showing some ability to think beyond the immediate task.

However, the report does not consistently reach the excellent descriptor of "ability to investigate contradictory or incomplete information and make strong, persuasive arguments and sophisticated judgements," with "some evidence of independent thought and ability to see beyond the question." Much of the report is still linear and confirmatory: the literature generally supports the final recommendation rather than being interrogated critically. The weighted decision matrix, while useful, would be stronger if the chosen weights were defended in more depth, and if alternative scoring

scenarios were explored. Likewise, the environmental and defect discussions are relevant but not pushed into deeper comparative critique.

To improve this criterion, the student should interrogate assumptions more directly. For example, a sensitivity check on the weighted decision matrix would show whether the final recommendation remains stable if cost or fatigue is weighted differently. A more critical comparison of GFRP versus hybrid composite options, or a clearer discussion of why one manufacturing route is rejected despite certain advantages, would strengthen the intellectual quality of the argument. A comparative graph such as weighted score contribution by criterion, cost-performance trade-off chart, or material performance radar chart would also make the analysis more persuasive.

4. Practical Application Skills – 18/20

This section is especially important in this coursework because the brief expects “detailed aerodynamic, structural, and cost analyses,” together with a blade drawing showing chord lengths, thickness profiles and spanwise sections. James performs well here and demonstrates a very good application of a range of methods, materials, tools and techniques.

The strongest evidence comes from the use of design calculations, material selection tools, comparative manufacturing tables, cost modelling and blade profile drawings. The student includes aerodynamic equations, chord and camber/thickness equations, Granta materials selection outputs, a weighted decision matrix, manufacturing route comparison tables, and cost breakdowns including labour, equipment, waste, energy and quality control. The report also includes multiple blade section profiles and coordinates, which directly addresses the “Key Points for Drawing the Blade” and the deliverables checklist in the brief.

This criterion also rewards the ability to relate theory to practice in complex contexts. James does this in several sections, especially when linking composite material choice to offshore corrosion resistance, fatigue loading, and manufacturability, and when linking vacuum infusion to the scale of real blade production. The discussion of processing-induced defects such as voids and dry spots, and the identification of mitigation needs, also supports this.

However, some of the practical analytical presentation is still incomplete or insufficiently transparent. The brief explicitly asks students to “provide detailed aerodynamic, structural, and cost analyses” and to “draw the required graphs for each section based on your calculations, and include the blade graphs generated using MS Excel.” James includes the section drawings and several figures, but the core mechanical calculations are not always presented as clearly and fully as they could be, and the report would benefit from more explicit worked steps and cleaner engineering outputs. There are many figures, which is a strength, but some are more illustrative than analytical. In other words, the student has clearly applied methods and techniques well, but the application does not yet “extend beyond established conventions” in the way described for the excellent band.

To improve this section significantly, the student should add more engineering-output figures rather than only illustrative images. The most valuable additions would be a lift force versus radial position graph, a drag force versus radial position graph, a bending stress distribution chart, and a clear CAD blade shell screenshot from several views with labelled dimensions. A flowchart of the design methodology, from literature inputs to equations, Excel plots, CAD generation, material selection and cost recommendation, would also strengthen the sense of applied project work. More material

selection screenshots from Granta, especially filtered stages rather than only final property charts, would further raise marks.

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

The report is generally well structured and professionally presented, which fits the brief's requirement for a "professionally written, logically structured, and easy to follow" report using "clear headings, labelled figures and tables." The submission includes a title page, abstract, table of contents, section headings, references, and numerous labelled figures and tables. The report reads as coherent and organised overall, and it is clearly aimed at a technical audience.

The strongest aspect here is organisation. The report follows the suggested structure closely: introduction, literature review, design specifications, material selection, manufacturing routes, cost evaluation, mechanical analysis, comparative analysis, blade drawing, conclusion, and references. This shows good professional discipline and makes the work easy to navigate. The inclusion of many figures and tables also improves readability.

The written expression and presentation, while good, are not consistently polished to the standard of "communicate professionally, confidently and consistently in a suitable format" with work that is "coherent, very fluent and presented professionally." There are a number of phrasing, grammar and formatting issues across the report, and some equation presentation is not fully clean. These do not undermine the substance of the submission, but they do affect professional finish.

To improve, the student should proofread more carefully for grammar and sentence flow, ensure equation formatting is consistent, and refine figure captions so they do more than label the image by briefly stating the analytical significance of the figure. A concise summary table at the end of the comparative analysis section would also improve communication further.