

University of Wales Trinity Saint David

Wales Institute of Science and Art



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Project Planning

Engineering Management

ACHA5012 / ACMA5007

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1. Introduction to the project

The project aims to design, simulate, and construct an advanced active rear wing for the Morgan Plus 4. This innovative wing is engineered to adjust its position dynamically in response to varying driving conditions, enhancing the vehicle's overall performance by carefully modulating downforce and reducing drag.

Our objective is to develop a wing system that is not only lightweight and cost-effective but also highly aerodynamically efficient, ensuring compliance with strict technical regulations concerning its travel range, actuation methods, and positioning mechanics.

To achieve this, the design will integrate a sophisticated and responsive control system that reacts seamlessly to real-time data, optimising the vehicle's handling and stability. This development aims to significantly improve performance during high-speed driving and competitive scenarios, ensuring that the Morgan Plus 4 excels in speed and agility.

2. Team Members, Roles and Responsibilities

Team Member	Role	Responsibilities
Alexander Cook	Project Management Structure and Materials Manufacturing	Project manager role - Ensure the team meets the specified deadlines, works effectively and maintains good communication throughout the project. Structural role - Aid in the design and FEA testing of the wing supports, along with taking on the prototyping and additive manufacturing of the scale model.
Alexander White	Control Systems and Mechatronics	To design the code and electrical wiring/motors required to automatically operate the active rear wing via the motors based on factors such as G-force and speed
Dylan Brierley	Vehicle Dynamics	To build an accurate simulation model and run effective simulation tests to evaluate new designs to see the difference in performance.
Scott Holden	Vehicle Dynamics Control Systems and Mechatronics	Determine sufficient electrical systems and code needed to operate the rear wing as decided by the team. Develop filters within the system in

		order to operate the wing within pre-determined parameters (Initial parameters will be based on speed, with the idea of using additional sensors to maximise the wing under different loads)
Mathew Starke	Structural and Materials	To follow up on the Aero team's results to provide a suitable structural base for the wing. Taking forces and regulations into account.
Conor Jenkins	Structural and Materials	Conduct a structural analysis and design a durable mounting system for the Morgan Plus Four's rear wing, using SolidWorks and Ansys to optimise integrity and select suitable materials.
Oliver Wilson / Nathan Evans	Aerodynamics Development	To provide a base CFD run with appropriate data, to develop the shape of the wing and test using CFD, and to Provide accurate data that matches the wind tunnel.

3. Skills and Personality Traits Required for My Role

Belbin's model has helped me analyse my role in our group project on an active rear wing for a Morgan Plus 4. It reveals my strengths and areas for development, aligning my skills with the technical challenge. Using my Belbin Self-Perception Inventory results, I can pinpoint where I excel and where I need to improve to contribute to the team.

My Key Strengths

The Belbin self-assessment showed I scored above average in the Resource Investigator, Monitor Evaluator, Team Worker, and Plant roles, highlighting valuable strengths for our project.

1. **Resource Investigator:** Scoring high as a Resource Investigator showcases my ability to explore new ideas and seek resources for our materials and structures. I enjoy researching alternative materials and networking for specialised information, which helps me bring innovative suggestions to the team and stay informed about emerging technologies that could enhance our design.
2. **Monitor Evaluator:** My role requires objectivity and logical decision-making when evaluating materials and structural options. As a Monitor Evaluator, I focus on balanced decisions, ensuring we select practical and reliable materials within project constraints. This analytical approach allows me to contribute level-headed assessments that guide the team toward practical solutions.
3. **Team Worker:** I excel in the Team Worker role, valuing cooperation and team harmony. I build positive relationships and foster cohesion, ensuring open communication and encouraging contributions from all members, which helps maintain a productive environment.

My Growth Areas

My self-assessment revealed strengths, but I scored lower in the roles of Implementer, Completer-Finisher, Shaper, and Coordinator. These areas present growth opportunities to improve my effectiveness in the structured aspects of "Structure and Materials."

1. **Implementer:** The Implementer role focuses on creating organised plans and executing ideas systematically. Scoring lower in this area indicates a need to improve structured workflows and adherence to processes. My adaptability might overshadow the importance of a step-by-step approach. Since the Structure and Materials role demands systematic planning, I'm enhancing my organisational skills to ensure efficient wing construction to specifications.
2. **Completer-Finisher:** A lower score indicates I am less inclined to focus on details, which are vital for a high-quality product. The Completer-Finisher role emphasises meticulousness and consistent standards. To improve, I'm working on my attention to detail, particularly in measurements and quality checks, to catch potential issues early and ensure the final wing meets quality and safety standards.
3. **Shaper:** The Shaper role focuses on overcoming obstacles and guiding the team toward goals. Scoring lower indicates I might not always lead when facing challenges or maintaining focus. Increasing my assertiveness and focus on progress could enhance my contributions, especially during deadlines. Developing a Shaper mindset would help me add momentum to the team and better manage setbacks.

Reflection and Next Steps

Belbin's model helped me identify strengths and areas for improvement. I plan to leverage my Resource Investigator and Monitor Evaluator skills for innovative materials and structure options,

while my Team Worker and Plant qualities will promote collaboration. To enhance my contribution, I aim to develop my Implementer, Completer-Finisher, and Shaper traits to maintain motivation and high standards, especially when tackling technical challenges for the Morgan Plus 4's rear wing.

4. Overall Group Tasks and Associated Timings

Group Tasks	Duration (Hours)	Start Date	Finish Date
Allocating roles and responsibilities to each group member.	3	30/09/2024	14/10/2024
Consolidate a communication platform to ensure all information associated with the project is conveyed accurately.	3	30/09/2024	4/10/2024
Familiarising the group with the regulations associated with the project.	4	7/10/2024	21/10/2024
Begin the initiation phase of the project. Using initial ideas begin producing a plan for different wing concepts and mounting solutions.	8	21/10/2024	25/10/2024
All departments begin listing tasks involved with each specific role that need to be completed throughout the project.	8	28/10/24	4/11/2024
Software related to each role (i.e. FEA, VI Grade and ANSYS). Begin the initiation process by generating ideas for each role.	8-15	14/10/2024	4/11/2024- 18/11/2024
Reconvene and discuss work and ideas completed by each department. Ensure that all ideas are considered. Summarise and discuss further the route/idea the group wants to develop towards.	8	18/11/2024	22/11/2024

Each department produces work to be organised into a presentation for the interim VIVA.	20	25/11/2024	10/12/2024
Evaluate and review all work completed prior to assignment and VIVA submission.	20	10/03/2025	28/03/2025
Pre-presentation meetings to ensure all aspects of the project are understood before the final VIVA and all departments have work presented.	20	17/03/2025	30/03/2025

5. My Tasks

Task	Hours Required	Task Duration	Start Date	End Date
Familiarise with project regulations	4	2 Weeks	7/10/24	21/10/24
Detailed research on potential materials	6	1 weeks	7/10/24	14/10/24
Determine which software to use, e.g. (ANSYS/ SolidWorks)	2	1 Week	7/10/24	14/10/24
Learn FEA software (SolidWorks)	20	5 Weeks	14/10/24	18/11/24
Analyse the Morgan to determine initial suitable mounting locations for the wing	2	1 Week	21/10/24	28/10/24
Perform a structural analysis and develop initial ideas for the mounting system of the rear wing	8	2 Weeks	28/10/24	11/11/24
Perform the first FEA analysis on the wing profile	6	1 Week	11/11/24	18/11/24
Design initial concepts for the wing mounting system	8	2 Weeks	11/11/24	25/11/24
Align with Control Systems on actuation	2	1 Week	18/11/24	25/11/24

requirements on the mounts				
Collaborate with the Aerodynamics team for the loading data of the rear wing	2	1 Week	25/11/24	2/12/24
Create a mounting solution for the wing	10	2 Weeks	6/1/25	20/1/25
First FEA of the mounting system	6	1 Week	13/1/25	20/1/25
Analysis of FEA to determine strengths and weaknesses of mounts	4	1 Week	20/1/25	27/1/25
Optimise design for weight and strength	8	2 Weeks	20/1/25	3/2/25
Produce final Mount Design	20	4 Weeks	20/1/25	17/2/25
Produce slides for interim VIVA presentation	3	1 Week	18/11/24	25/11/24
Interim VIVA presentation	1	1 Week	9/12/24	16/12/24
Create a presentation for the final VIVA	10	4 Weeks	17/2/25	17/3/25
Final VIVA	1	1 Week	31/3/25	7/4/25
Pre presentation meetings	20	2 Weeks	17/3/25	30/3/25
Weekly Group Meetings	25 Hours	25 Weeks	7/10/24	31/3/25

6. Project Milestones

Milestones	Associated planned completion dates
Given the technical brief on the assigned project	9/30/2024

Assignment of all roles within the project	10/7/2024
Completed Baseline CFD simulation on the Morgan to gain data for vehicle simulation.	10/10/2024
Completed vehicle simulation test of the Morgan on a track to attain baseline performance.	27/10/24
Finalised rear wing concept designed on CAD	11/17/2024
Complete CFD of the chosen wing profile	24/11/2024
Run FEA on the chosen wing profile and mounts	12/1/2025
Attain data/ results of the chosen wing profile on the Morgan plusfour.	30/01/2025
Produce a prototype to test in the wind tunnel	09/02/2025
Complete a wind tunnel test of the rear wing concept. Use the data gathered from the test and compare against CFD results.	16/02/2025
Finalise control system	2/27/2025
Develop prototype and manufacture using additive manufacturing processes.	16/03/2025

Interim VIVA	10/12/2024 or 11/12/2024
Final VIVA	01/04/2025 or 02/04/2025
Upload final write up document	30/03/2025 @ 10pm

7. My Gateway Objective

Gateway Objective: Structural Integrity Validation - Factor of Safety (FOS) of 1.25 for Rear Wing Mounting System

Objective Description:

In my role within the Structure and Materials section, my primary focus is to ensure that the rear wing mounting system achieves a Factor of Safety (FOS) of 1.25 under maximum aerodynamic loading conditions. This FOS requirement is essential for validating the reliability and structural integrity of the mounting system, particularly in dynamic and high-speed scenarios. By meeting the FOS standard of 1.25, we ensure that the system has a safety margin of 25% beyond the maximum anticipated load. This approach provides a robust safety cushion without excessive over-engineering, optimising performance and efficiency.

Performance Criteria:

Technical Performance:

Factor of Safety (FOS): The rear wing mounting system must exhibit a minimum factor of safety of 1.25, which means it must be capable of withstanding 125% of the maximum aerodynamic forces it will encounter during operation. This specification is crucial in ensuring the structural integrity of the mounting system, as it provides a buffer against potential overloading conditions. By adhering to this FOS requirement, we can significantly mitigate the risk of structural failure, thus enhancing the safety and reliability of the vehicle under both normal driving circumstances and extreme conditions, such as high-speed manoeuvres or adverse weather. Continuous assessment and

testing of the mounting system's performance will be necessary to ensure compliance with this safety factor.

Testing and Validation:

Finite Element Analysis (FEA) with FOS Verification: I will undertake comprehensive Finite Element Analysis (FEA) simulations to thoroughly evaluate the structural performance of the mounting system in response to maximum anticipated loads. These simulations will be meticulously configured to ascertain that the design meets or exceeds the requisite FOS of 1.25. Should any mounting system components not meet this standard, I will implement design modifications, e.g. altering geometrical configurations or material specifications, to enhance the system's performance and ensure compliance with the necessary safety factor.

Physical Load Testing for Final Verification: Following the validation of the FEA results, a physical prototype of the mounting system will be fabricated. This prototype will undergo rigorous testing to simulate the maximum aerodynamic forces it would face in real-world scenarios. This experimental phase confirms that the mounting system reliably meets the FOS of 1.25 under actual operational conditions. We can support the assurance of design integrity by addressing discrepancies between the simulation results and real-world behaviour.

Gateway Success Requirement:

The successful implementation of this gateway will hinge on our ability to consistently achieve a Factor of Safety (FOS) of 1.25 in both FEA simulations and subsequent physical load testing procedures. This critical requirement serves as a benchmark for evaluating the structural integrity of the rear wing mounting system. Achieving this specified FOS indicates that the mounting system is structurally sound and possesses the necessary robustness to reliably withstand the aerodynamic loads exerted by the wing during operation.

In particular, the mounting system must endure various demanding conditions, including high-speed manoeuvres where forces can dramatically increase and turbulent airflow that can create unpredictable loads. These factors are crucial, as they significantly determine the performance and safety of the entire aerodynamic setup.

By consistently meeting the FOS of 1.25, we can proceed with confidence, fully assured of the mounting system's performance, reliability, and safety throughout its operational lifespan. This level of validation is not just a formality; it is essential for confirming that the design performs as intended under real-world scenarios, resisting potential failure points that could arise from expected and unforeseen loads.

8. Two Areas of Concern Within My Section of The Project

Concern 1: Delays in Material Selection and FEA Analysis

Potential Risk: A significant issue is the delay in determining material selections and concluding FEA. These delays can interfere with the overall schedule for structural design. This risk might arise from difficulties obtaining trustworthy material property data, unforeseen FEA outcomes requiring additional simulations, or delays in receiving precise load data from the aerodynamics and control teams.

Strategies to mitigate risk:

Early Data Collection and Pre-Screening: I intend to start with a list of pre-assessed materials that include detailed mechanical property data to avoid unnecessary delays. This strategy enables me to transition to an alternative option if a material fails to satisfy FEA standards.

Parallel Work Streams: I recognise the significance of depending on other teams for load information. As a result, I will collaborate closely with the aerodynamics team to determine load values at the beginning of the process. This strategy will allow me to conduct initial simulations based on cautious assumptions, which can be refined later as more precise data is obtained.

Concern 2: Structural Integrity Issues During Prototype Testing

Potential Risk: A further issue is guaranteeing that the prototype operates consistently during testing. Structural vulnerabilities or even failures may emerge during evaluations if the initial load assumptions are incorrect or if there are unexpected flaws in the mounting design. Such problems could postpone results and diminish the time left for final modifications.

Strategies to mitigate risk:

Progressive Testing Approach: Instead of immediately testing the prototype under full load, I could begin with controlled static load tests to evaluate its preliminary structural integrity. After these static assessments are successful, the load parameters will be increased to gradually mimic dynamic stresses. Before advancing to more comprehensive wind tunnel evaluations, I would start with low-risk indoor testing.

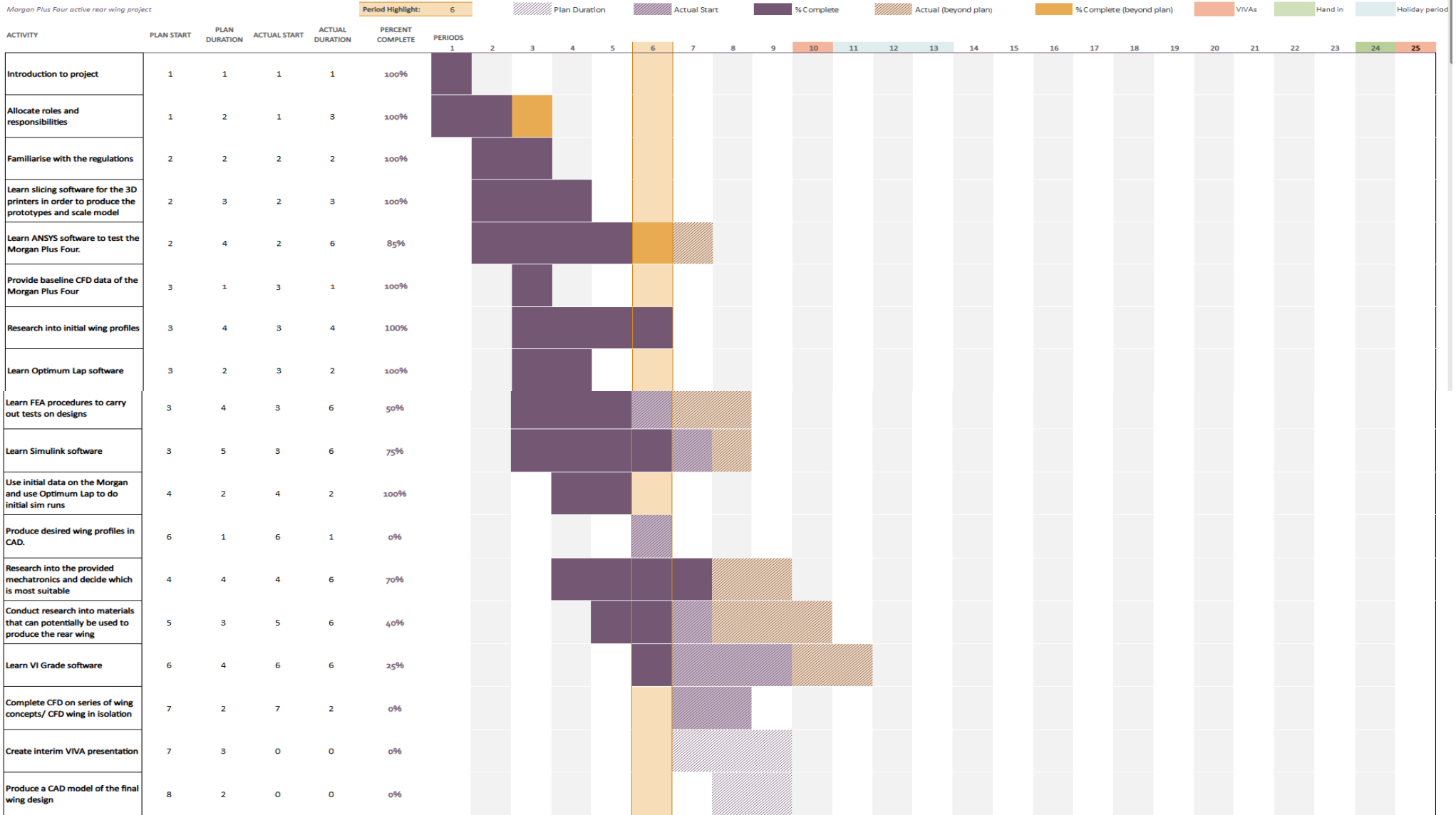
FEA Correlation with Real-World Data: I can use the preliminary tests' findings to enhance my FEA models, guaranteeing that the simulated results correspond with the data we gather. This method lets me spot inconsistencies early on, implement required changes, and ensure the ultimate prototype testing accurately reflects our anticipated load behaviours.

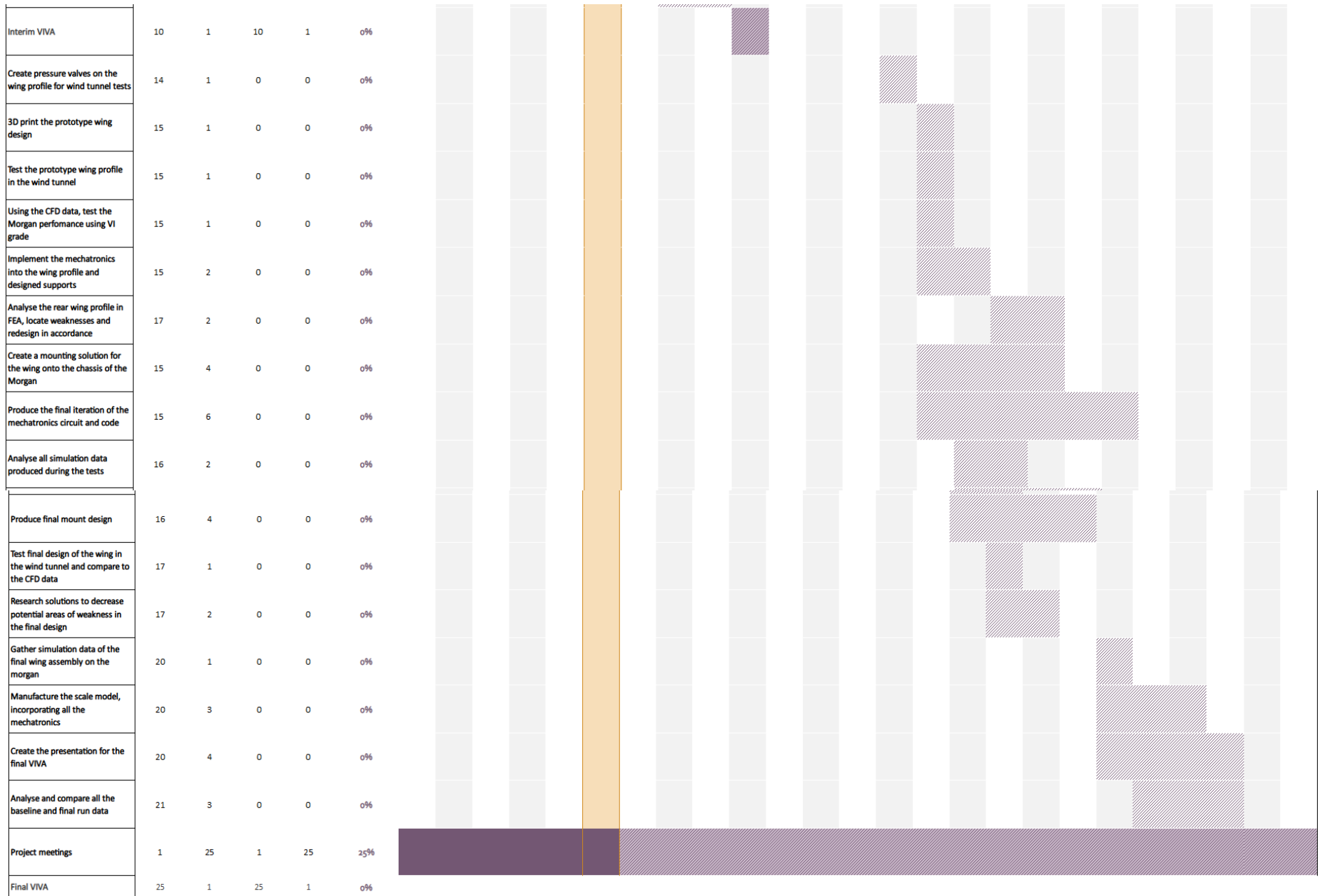
By adopting these strategies, I plan to effectively address risks associated with material choices and structural strength, ensuring that our project remains on schedule and achieves the performance objectives for the Structure and Materials section.

9. Group Gantt Chart

Project Planner

Morgan Plus Four active rear wing project





10. Personal Gantt Chart

Personal
Morgan Plus Four active rear wing planner

