

*UCLA Mechanical and Aerospace Engineering 154B*

*Design of Aerospace Structures*

*Preliminary Design Review*

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# Introduction

## Project Description

This project intends to serve as an educational design project in the development of aerospace structures: specifically, a subsonic airfoil. The project will begin by evaluating aerodynamic values for a common NACA 2412 airfoil flying at subsonic speeds. These will include angles of attack, two and three-dimensional lift and drag coefficients, lift curve slope data and maximum lift coefficients. These values will be used to determine wing loading estimates for a sample aircraft. With the load distributions for the given wing, shear and moment structural analysis will be done to calculate the failure criteria for the initial wing design. Based on the shortcomings of the baseline structural design, optimization techniques will be used to determine the best wing possible. This optimization will account for both the theoretical engineering calculations for safety and reliability, and realistic flight weights and costs. The flow chart below captures this design process, and the primary project steps.



Figure 1: Project Description Procedure Outline

## Description of Tasks and Milestones

This Preliminary Design Review will have tasks outlined as shown below.

|  |  |
| --- | --- |
| ***Airfoil Aerodynamic Analysis*** | Prescott Rynewicz |
| ***Total Load Aerodynamic Analysis*** | Prescott Rynewicz |
| ***Wing Force Distribution Determination*** | Jordan Robertson |
| ***Shear and Moment Calculations*** | Lukas Kramer |

Table 1: Task Descriptions

## Milestones

The table below covers the milestones of the project completed in this report. The left hand is consistent with the left hand column of table 1, while the right hand column describes the milestones associated with the task.

|  |  |
| --- | --- |
| ***Airfoil Aerodynamic Analysis*** | Using a numerical airfoil analysis solver, xFoil, the aerodynamics of a NACA 2412 will be determined. This will include angle of attack, Lift and Drag Coefficients, Moment coefficients, and flow Reynolds number. |
| ***Total Load Aerodynamic Analysis*** | Using the data collected in the airfoil analysis, the total aerodynamic forces applied to the wing will be calculated. This includes lift and drag, along with the normal and parallel force components relative to the wing structure. |
| ***Wing Force Distribution Determination*** | Using the total force parameters found in the total load analysis, these values will be used to shape the load distributions in vector form for the entire wing. |
| ***Shear and Moment Calculations*** | The vector form load distributions are numerically integrated in order to achieve numerical shear and moment values, which will be used in the future to find failure criteria of the structure. |

# Aerodynamic Generated Total Loads

# Wing Loading Distributions

# Wing Shear and Bending Moments