# Team 6 Summary

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The goal of our team was to complete the mission requirements set in the Bronze Propellor competition.That mission being to design an aircraft that can successfully fly five laps around a 400 x 100-ft flying course while an onboard flight system autonomously drops a payload of tennis balls into a designated 40x40-ft or 20x20-ft target area for extra points at any moment after the second lap is completed. Critical elements for successfully completing the mission would be the ability of the aircraft to take off using a hand launch method as well as the ability of the aircraft to structurally handle a belly landing while considering the open cavity on the fuselage. The most critical aspect of this mission would be the payload release mechanism and the method it will employ in ensuring the accurate and timely release of the payload.

Key requirements and constraints were also used throughout the design process as a guide for our design. A few of those being: the entire aircraft must fit within a 11x7x35-in box, and all wood used to construct the aircraft must be 1/32, 1/16, or 3/32 inches thick. The aircraft must also be easy to assemble, as it will need to be assembled (payload and all) within five minutes after removal from the box. The aircraft must also be sturdy enough to withstand a belly landing with little to no damage, as it will need to be able to fly multiple times and do multiple landings. It was also decided to use a payload size of 8 tennis balls and a cruising speed of 70 ft/s was used to ensure the flight does not last longer than 1 minute; the design also couldn’t be too fast or else a ball release time that was slightly off could cause all balls to miss. These two decisions were dependent on optimizing our mission score.

First in the design process was to pick a concept best suited to our mission. The group considered ten different configurations of aircraft when deciding which style aircraft to select for the mission. The group chose to design a cargo tanker style aircraft such as the C-130 to perform this mission since it scored best at payload space and payload accessibility. This allowed us to carry more balls and allow more room for easier installation, increasing our mission score and helping with the installation time requirement. Using the straight wing and flat fuselage edges made the design easy to assemble and the design consisted almost entirely of common balsa wood.

The next step in our design was to do a proper sizing for our mission. This included finding realistic estimates of wing loading and thrust to weight ratio that would execute the mission safely and efficiently. To get a well informed understanding of the wing loading and thrust to weight required to complete the mission the group analyzed the different wing loading and thrust to weight requirements at various different flight conditions. Using the most critical value of each we could find a desirable design point by staying under the minimum wing loading requirement and above the maximum thrust to weight requirement. It was through this process that a wing loading of 0.72 and a thrust to weight ratio of 0.61 was chosen.

Conceptual Design was the next task and each person concentrated their efforts to their own functional area. It was in this step that members used simple analysis methods to find a design that would meet their specifications. Through this process we were able to design a simplified model that would be able to complete the mission and meet all technical and non technical requirements and constraints. Following the first iteration, the group attempted to optimize the conceptual design by iterating the same analytical process to mitigate weight where at all possible.

The group was next tasked with conducting preliminary design following the conceptual aspect. This required each member analyzing and optimizing the most critical aspects of their respective areas in order to mitigate risk of failure. This also required a higher level of analysis and higher degree of detail to complete. Software tools were extremely helpful in predicting and modeling the performance of our aircraft for this step. This allowed less time trying to analyze the performance and more time to optimize the design.

Lastly the group had to complete the detailed design phase. It was in this phase that the group was tasked with completing CAD drawings for the design. This included layout drawings for all parts of the aircraft, as well as, the layout drawings for all tooling that will go into holding the aircraft parts in place while the bond sets. It was the primary goal of the group to minimize the total number of pieces. Another goal was to design the aircraft with adequate room inside for easy accessibility. Both of these goals were made with the purpose of making our design easier to build and assemble post build.

The group concluded early on that the most critical aspect of the design effort would be the payload release mechanism since the device would be a key contributor in whether the design passes or fails the mission. When deciding what method would be best the group used 2 strategies. The first being to carry as many balls as possible and still meet all other requirements and constraints. In our case we chose 8 tennis balls. The second strategy was being able to accurately drop the entire payload into the 20x20 foot target zone. Both of these decisions were influenced by optimizing our potential mission score.

The mechanism that will hold the payload in place consists of two parallel rods above the open cavity that slide side-to-side to hold and release two rows of four tennis balls. For the method of activation of the payload mechanism, we believe a small barometric pressure indicator is best for the task as it is the most reliable when it comes to unforeseen circumstances such as inclement weather. This altimeter paired with a programmed time delay will guarantee deployment of the balls does not happen prior to the landing leg of the aircraft’s flight path. All of these electrical components will be controlled by an Arduino computer that will be loaded with a program capable of executing the commands to complete the mission.