

Effects of Weight on Aircraft and Aviation

New Mexico

Supercomputing Challenge

Final Report

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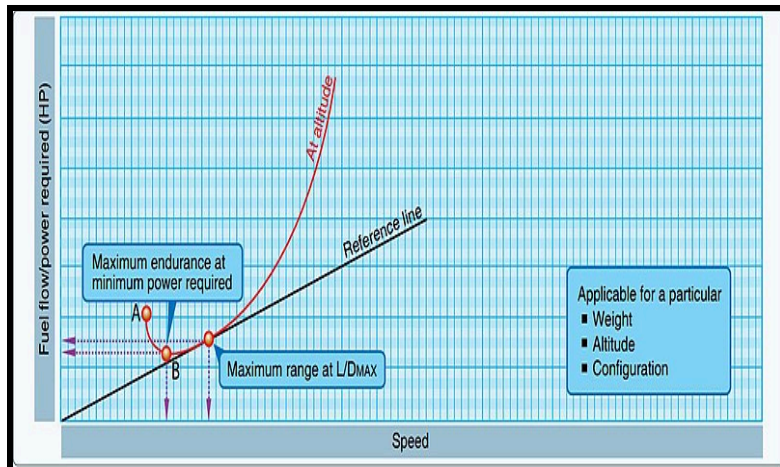
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Executive Summary

Aviation as a science is still a very modern topic. As little as a century ago, the first plane was making its debut. While the Wright brothers were working on their new invention they must



have had to make precise calculations on weight. Weight has always played a major role in aviation. From planes to helicopters, weight is a constant that must always be accounted for. Aircraft require measurements to see how much fuel consumption

will occur from a flight. This has massive implications as fuel reserves dry up and fuel prices skyrocket. This program is designed to allow us to observe fuel weight, and its effect on flight characteristics within aircraft. The plan of this project is to portray an aircraft flying to a destination. There will be accurate inputs for weight, fuel, and a sped up time frame. This will give a clear cut picture of what goes into flying aircraft over a certain distance.

In the picture you see that a delicate balance must be put into order for the plane to fly correctly.

While we do not plan on including balance into our simulation it does play a part in flight characteristics.

Problem Statement.

The problem this project seeks to solve is allowing people an easy way to observe the effects of fuel weight and consumption on aircraft. While many people know at least to a basic extent that weight plays a role on aircraft, many people do not have a clear cut understanding of the impact on fuel consumption it has. This will give a better



understanding of what goes into keeping these machines airborne. This could also be a way for



people who dream of working in the aviation industry to gain some knowledge in fueling on aircraft. It is something every pilot, ground crew, or mechanic needs to know.

Method

To accomplish this we planned to make a program that is able to show how long a plane will be able to maintain its flight pattern based on the numbers that you input into the weight and fuel. This program will have a display that shows a plane flying. The plane will fly in a straight line until the plane runs out of the imputed amount of fuel where it will then end, showing you how far the plane was able to get using the fuel with the additional weight affecting it.

Evidence

Through our research we have been able to find out approximately how far a plane without the additional weight of cargo and passengers is able to fly. Using this we were able to use these numbers to show how additional weight is likely to affect the aircraft.

We have also identified the possible need for a visual display for those who aren't familiar with how aircraft work and how the weight of cargo and passengers could cause planes to need more or less fuel.

Results

The results of our research and software lead to an unfinished simulation of a plane's path with the effect of weight. With our greatest achievement being the development of our simulation. We are close to what we wanted to accomplish with this program but we were not able to finish it due to our ambition being greater than our ability. We have however made great improvements from the previous versions of the program. We plan to finish and expand this project after the Supercomputing challenge is over. The expansion would include the effect of weight distribution and balance of aircraft.

Conclusion

Our research has allowed for us to have a basic if unfinished version of what we wanted to accomplish. Through our program we have a visual representation of the aircraft's fuel efficiency being influenced by weight.

Sources

FAA handbook chapter 10

“PHAK Chapter 10.” *Federal Aviation Administration*,

https://www.faa.gov/sites/faa.gov/files/12_phak_ch10.pdf. Accessed 10 April 2024.

National Air and Space museum Weight and Strength

“Weight and Strength | How Things Fly.” *for How Things Fly*,

<https://howthingsfly.si.edu/structures-materials/weight-and-strength-0>. Accessed 10 April 2024.

Cirium Aviation Analytics Navigate Aviation Fuel Demand Volatility

With Effective Forecasting

“Navigate aviation fuel demand volatility with effective forecasting.” *Cirium*, 13 April 2022,

<https://www.cirium.com/thoughtcloud/navigate-aviation-fuel-demand-volatility-with-effective-forecasting/>. Accessed 10 April 2024.

Cessna

“Cessna Caravan.” *Cessna Aircraft*, <https://cessna.txtav.com/en/turboprop/caravan>.

Accessed 10 April 2024.

FAA Pilot’s Handbook of Aeronautical knowledge

“Pilot’s Handbook of Aeronautical Knowledge.” *Federal Aviation Administration*, 3 November 2023,

https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak. Accessed 10 April 2024.

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