

# Lighten Up

**L**ightweighting is one of the most important trends in the aerospace industry today, as jet manufacturers and their suppliers work to reduce the overall weight of planes and improve their fuel efficiency. But little attention has been paid to reducing the weight of the cargo carried by planes every day.

Carbon Freight — a startup based in Pittsburgh, U.S.A. — is attacking this issue with flexible, lightweight cargo pallets that are 18 percent lighter than traditional pallets. “There hasn’t been much innovation in the air cargo industry, certainly not compared to the aerospace leaders’ focus on new materials and production processes that reduce weight,” notes CEO Glenn Philen. “Since cargo can represent a significant percentage of a fully loaded jet’s weight, it only makes sense to look at historic cargo storage and transportation product designs — which have been in use for decades — and ask how we can adapt them for the challenges of today.”

Philen founded Carbon Freight after graduating from Carnegie Mellon University as a mechanical engineer and completing internships with Boeing. “I worked with plastic composite materials at Boeing and began to ask myself, ‘Could these materials be used to transform cargo carrying operations?’ It seemed a logical extension of the industrywide lightweighting initiative,” says Philen.

Measuring 8 feet by 10½ feet, freight cargo pallets have typically been constructed of aluminum. By integrating composites into the materials mix, Carbon Freight has been able to achieve a significant reduction in overall weight. This weight reduction allows a typical cargo plane to carry up to 1,365 pounds in additional freight, and it enables passenger flights to carry more people by reducing cargo load.





While Carbon Freight's innovative design decreases weight, at the same time it actually increases a pallet's strength and durability significantly, compared with existing lightweight options. "Durability is a key characteristic for cargo pallets, because they need to fit together as closely as possible in the hold of an aircraft, in order to optimize all available space," explains Philen. "But they also take a lot of abuse and they need to have some give. We've found that composite pallets initially present some durability challenges, but there are actually opportunities for increased durability over other options. They actually deliver a lot of positive performance characteristics that go beyond lower weight."



The close proximity of pallets to one another, coupled with constant movement and handling, has created some engineering challenges for the Carbon Freight team. Says Philen, "We not only have to consider the loading stresses on our products created by the cargo, but also a wide range of contact stresses that occur as pallets are lifted, transported and packed together. There is a diverse set of complex forces that our design team needs to consider, in order to deliver the best product durability over time."



**John Dieser**

President and COO, The Carbon Freight Company

**Glenn Philen**

CEO, The Carbon Freight Company

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**WILL IT MESH?**



Carbon Freight's product development team has relied heavily on engineering simulation to understand and manage these diverse physical stresses. "Simulation has helped us model and understand our pallet structures to improve their overall strength and flexibility, while minimizing their potential for damage," notes Philen. "We've been able to test different material thicknesses and fiber orientations without the time and expense of creating physical prototypes. When we do get to the physical testing stage, we're really happy with the accuracy of our simulations. Our engineers have been able to predict actual real-world performance with a very high degree of fidelity."

Simulation has also been able to help Carbon Freight manage one of its biggest business challenges: securing regulatory approvals from the Federal Aviation Administration and other organizations. "One of the reasons that traditional aluminum pallets are so entrenched is that it's difficult to secure approvals for a new product design," Philen points out. "Everything that goes into an aircraft must be stringently tested and proven to be safe. As passengers, we want and need that high degree of confidence. But the numerous approvals present challenges that a startup like

Carbon Freight has to overcome to compete in the global aerospace industry. Established companies have an advantage in navigating the approval process."

By visually demonstrating how its pallets will perform under everyday stresses — and verifying their safe performance over time — engineering simulation has helped Carbon Freight progress through the regulatory approvals process. According to Philen, "Simulation via ANSYS has saved 50 percent in development time and hundreds of thousands of dollars in physical testing." The company launched its pallets to the global marketplace in early 2017.

Despite the fact that simulation has helped reduce product weight by 18 percent, Carbon Freight executives recognize that there will be challenges involved in breaking into the global market. "Composite materials are more expensive than aluminum, which means a higher price point for our pallets. However, the new lightweight design of our products has the potential to save significant fuel costs and add revenues over their lifetime. We're offering passenger airlines and freight carriers a very attractive value proposition, and we believe Carbon Freight has a bright future ahead," concludes Philen. 