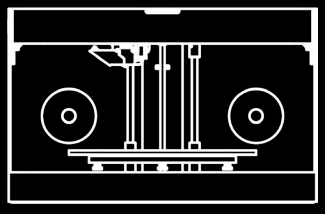
The Hong Kong Polytechnic University

Case Study



Industry: Education
Application: Air One Saddle
Technology: Mark Two™
Materials: Onyx® + CCF

Markforged

The Challenge

A leading Hong Kong tertiary institution has engineered a monolithic printed bicycle saddle that leverages industrial 3D printing to streamline production while unlocking full customization to customise saddles to meet the specific needs of individual riders.

While other printed saddles exist in the market, the Air One saddle, developed by the Activewear Design Team at the Hong Kong Polytechnic University, is the first in the world to be produced as a single unibody unit, obviating the need to assemble various components as part of the manufacturing process. The groundbreaking design earned a prestigious international Red Dot design award.

Team leader, Dr. Ho Chu Po, has a background in textile design and wanted to explore the possibility of creating industrial products based on a 3D looping knitted structure. The team's chosen project was a bicycle saddle designed to be printed in one piece, substantially reducing the time required to manufacture existing printed saddles.

The first primary engineering challenge was to meet the need for strength in the rails of the saddle – the main load-bearing components – without sacrificing lightness, a critical requirement in the end product. Discussions with Markforged determined that the existing printers in the University's industrial sub-centre were not suitable for the high-strength materials that would be required for the project.

The decision was made to deploy a Markforged Mark Two™ printer capable of Continuous Fiber Reinforcement (CFR) with Onyx® to meet the demanding strength requirements.

> "The innovative one-piece design substantially reduces the time required to manufacture existing printed saddles."

— Dr. Ho Chu Po
Team Leader, The Hong Kong Polytechnic University



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The Solution

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Designed in CAD and sliced using Markforged Eiger™ software, the prototype saddle was extensively tested on road for more than 1,000 kilometres by another team member, a keen cyclist, to test its durability and comfort.

Dr. Ho confirmed the Markforged continuous carbon fiber rails had delivered the required strength while maintaining the ultralight profile required for high-performance riding.

> "At just 171g, the Air One saddle is lighter than most commercially-available saddles, while meeting all the required strength criteria."
>
> — Dr. Ho Chu Po
> Team Leader, The Hong Kong Polytechnic University

> "The basic design of the saddle can easily be modified to suit individuals' special requirements."
>
> — Dr. Ho Chu Po
> Team Leader, The Hong Kong Polytechnic University

"An additional benefit is that, thanks to the flexibility of composite 3D printing, the basic design of the saddle easily adapts to suit rider ergonomics, for example by modifying the shape of the saddle or the hardness of the inner structure, including shell geometry or internal lattice density.

"We are now examining ways to apply this continuous fiber approach to other sporting applications, including protective gear," he said.



Air One saddle printed on the Markforged Mark Two.

Markforged and Education

Richard Elving, Markforged's Vice President Sales, Asia Pacific, said the project was an excellent example of bridging the gap between academic learning and real-world manufacturing applications.

> "Universities and polytechnics play an important role in preparing the next generation of engineers, designers and manufacturing professionals."
>
> — Richard Elving,
> Vice President Sales Asia Pacific, Markforged

"Collaborations of this kind help students appreciate the role of additive manufacturing in designing, producing and testing functional parts, tooling and end-use applications, rather than simply learning about the technology theoretically.

They provide hands-on experience with the industrial AM techniques, materials and workflows they will encounter in modern manufacturing environments," he said.

To assist tertiary institutions in this process the company offers Markforged University, a multi-day certification program accessible to engineering students that accelerates understanding and mastery of the company's composite and metal 3D printing technology. The program enables students to learn proven workflows and advanced design for AM developed from "real world" experience from professional designers and manufacturers world-wide.

"We're actively seeking more co-operative ventures of this nature throughout the region," said Mr. Elving.

Markforged's Asia-Pacific region spans Australia, New Zealand, India, Japan, China, Singapore and Korea, where literally thousands of the company's printers are now in daily use.



3D printing facility at The Hong Kong Polytechnic University.