

3D-printed metal bike frame is light but strong

February 10 2014, by Nancy Owano



The entire bike frame was arranged in sections with the seat post bracket on one build plate and fabricated in one go

(Phys.org) —As a bicycle newsmaker, you can file this under 3D-printed projects and you can flag it as a uniquely light yet strong 3D-printed titanium bicycle frame. The frame, announced earlier this month, was

manufactured out of a collaboration between two UK companies, Renishaw, a manufacturer of a metal-based additive manufacturing machine that prints metal parts, and Empire Cycles, a bicycle design and manufacturing company. The design is based on Empire's MX-6 [mountain](#) bike but optimized. Renishaw leveraged its 3D printed materials and technology process to deliver a light but sturdy frame. The key words in all this are "3d printing" and "metal." Quoted in *Dezeen*, Chris Williams, managing director of Empire Cycles, noted that while some carbon fiber bikes are light, this 3D printed frame is both light and more robust. "The durability of carbon fiber can't compare to a metal bike," he said.

Renishaw enabled the bike frame to be additively manufactured in [titanium alloy](#) in sections and then bonded together to create the titanium alloy frame. Renishaw's notes on titanium alloys point to high Ultimate Tensile Strength (UTS) of more than 900 MPa when processed using [additive manufacturing](#), and, the company said, "near perfect densities of greater than 99.7 percent are achieved."

The frame was made according to a process called topological optimization—This is an approach that optimizes material layout within a given design space, for a given set of loads and boundary conditions so that the result meets performance targets. The implications for 3D printing are mentioned in *solidThinking*, which said that [topology](#) optimization "could be a critical motivator to create industrial designs specifically for additive manufacturing."

Renishaw also described the optimization process:

"Topological optimization software is the term given to programs that are used to determine the 'logical place' for material – normally using iterative steps and finite element analysis. Material is removed from areas of low stress until a design optimized for load bearing is evolved."

The resulting model is light and strong. By working together, Renishaw and Empire Cycles were able to eliminate many of the downward facing surfaces that would otherwise have needed wasteful support structures.



Complete bike with 3D printed titanium alloy frame and seat post bracket

According to Renishaw, testing of the completed bicycle frame will continue, both in the laboratory and on the mountainside using portable sensors in partnership with Swansea University. The potential performance has not been completely explored yet, said the company, which hopes to continue to develop the project. "As no tooling is required, continual design improvements can be made easily; and as the component cost is based on volume and not complexity, some very light parts will be possible at minimal costs."

More information: [www.renishaw.com/en/first-meta ... aw-for-empire-cycles](http://www.renishaw.com/en/first-meta-...-aw-for-empire-cycles)—24154
[www.dezeen.com/2014/02/07/world ... inted-bicycle-frame/](http://www.dezeen.com/2014/02/07/world-...-inted-bicycle-frame/)

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