You Can 3D Print and Build This 164mm f/2.5 Lens for Less Than $15

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Photographer Felix Steele has created a design for a 3D-printed 164mm f/2.5 lens that has no fasteners or screws, uses affordable glass elements, and can be built at home for less than $15.

Steele created the design as the first major project of his online resource for open-source photography projects called *Pixels and Prisms*. The build features 23 “significant parts” as well as 15 pegs and is held together with nothing more than glue. Despite the simple

design, the lens has a focusing mechanism and a fully adjustable aperture that houses elements in fixed tubes.

“Every photographer has different needs when it comes to lenses — in price, speed, and focal length. The *Pixels and Prisms* 163mm f/2.5 telephoto lens is a customizable optical system that offers a low-cost, open-source alternative to commercial lenses through 3D-printing,” Steele explains.

“As a photographer, the experience of building this lens was a valuable method of connecting with the principles which underlie much of my work. When a change in lens design affects your depth of field or sharpness, you develop an acute understanding of, and appreciation for, the equipment and techniques that you employ.”

The finished lens features coverage for a full-frame camera with an aperture range between f/2.5 and f/11 via a 12-bladed aperture diaphragm and is made for the EF mount.

“For under $15, *Pixels and Prisms* is a viable low-weight lens option for travel, portrait, or street photographers, as well as a cost-effective entry point into telephoto photography. The aperture and zoom system can even be modified to work with any lens element, so long as an extender is added to the front of the optic,” he continues.

Stelle says that because of its flexibility, the lens design can serve as a means of providing an accessible way to get to specialized focal lengths — like 600mm — that doesn’t require a large investment. He says he plans to iterate on the design in the future and will be working on making the form factor more convenient as well as improving the optical quality.

“The process of designing and creating this telephoto lens was a three-month endeavor that started with the creation of an optical formula. The print files… are open for you to download — and the following will allow you to source and fit a lens element to go with them,” he explains.

The only parts of the lens that can't be 3D printed are the glass optics, and for this Steele used Surplus Shed to acquire achromatic (two-part) lenses. He says that eBay is another option, but to make this particular lens builders will need one with a diameter of about 65mm.

"The Surplus Shed website features a focal length alongside each lens, and often, Ebay sellers include similar information. You will need to perform your own measurement for completely reliable results, though," he says.

"First, balance the lens upright (on its edge) on a table or desk. Then, position a light source on the other side of the room, and direct it towards the lens element. The lens will focus the light at some point above your surface. The exact point is easily located by moving a sheet of paper to and from the lens: a halo will appear that drifts in and out of focus as you move the paper. Finally, mark the point of sharpest focus and measure the distance from the lens

element. This is your focal length (although I would recommend double-checking your calculation),” he continues.

“The result is a measurement that can be used to create a simple lens casing, to test image clarity and focusing before moving on to the finished project. Shift your lens into focus in front of your camera until you are satisfied by the quality of your element. Alternatively, slide your lens element along a tube of cardboard. Any part that will allow you to test the performance of your lens by making adjustments in distance to the sensor should work here. Once you’re satisfied that you have an acceptable lens, set it aside and begin 3D-printing.”

Steele says that the free online tool Optical Ray Tracer is also helpful in understanding the principles behind the lens.

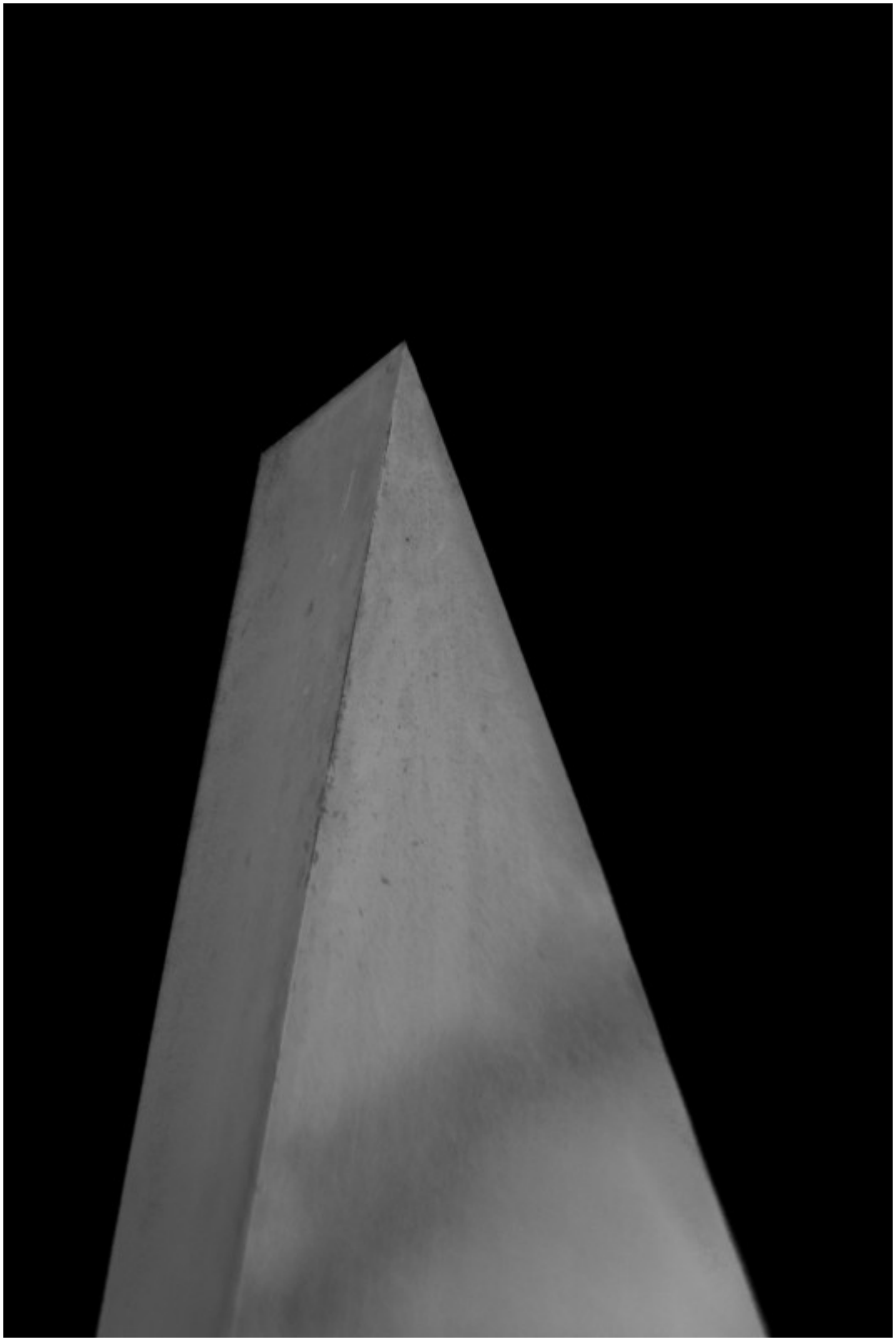
“The software allows you to free-draw lenses and beams of light, among other functions. It allows you to create loose models of aperture and focal length – but a feature which visualizes the focusing mechanisms that you will be working with is Zoom Lens, a preset stored in their ‘Examples’ library.”

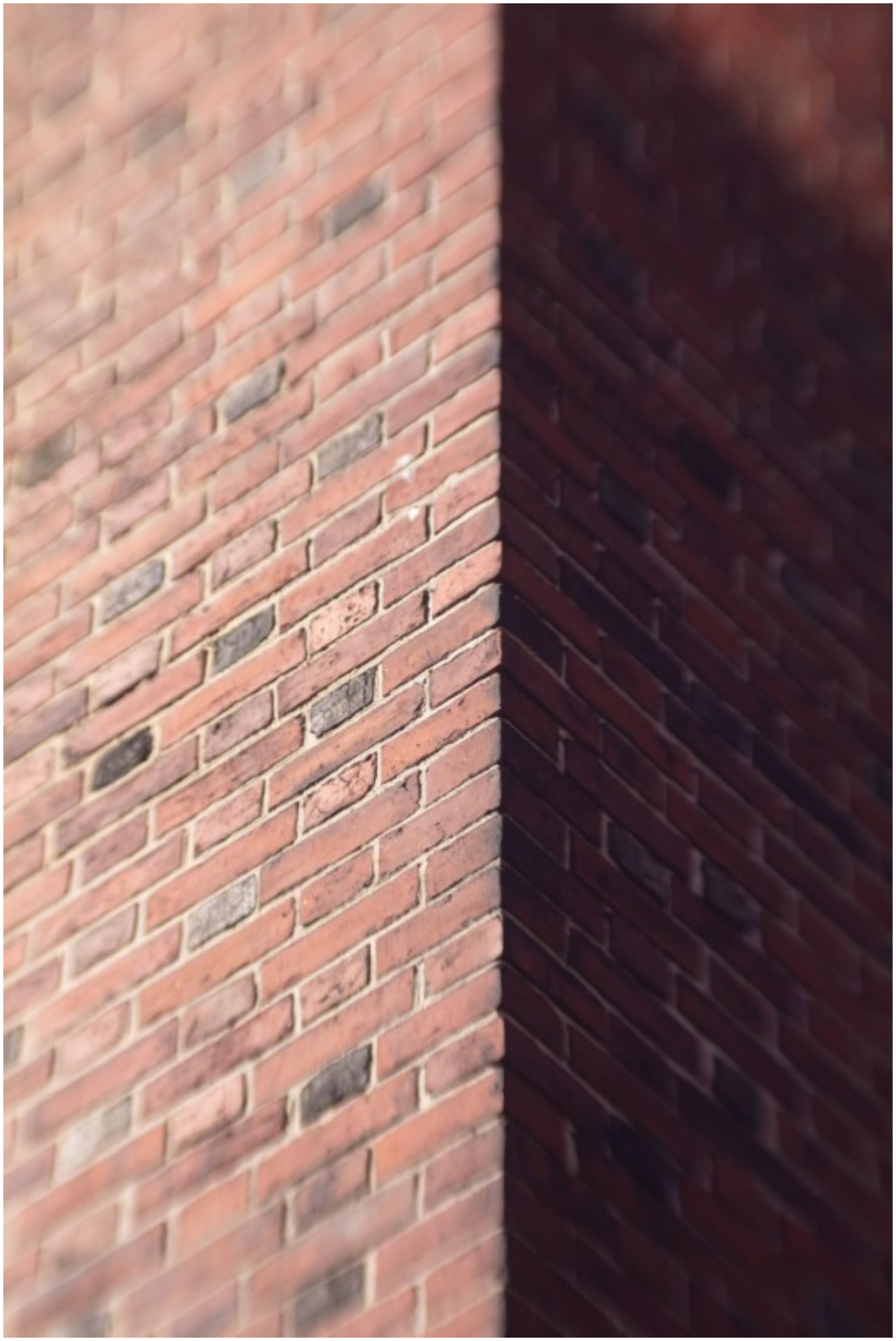
“I chose a sample portfolio of seven images that illustrate the lens’s technical and creative potential and its excellent optical qualities,” he says.

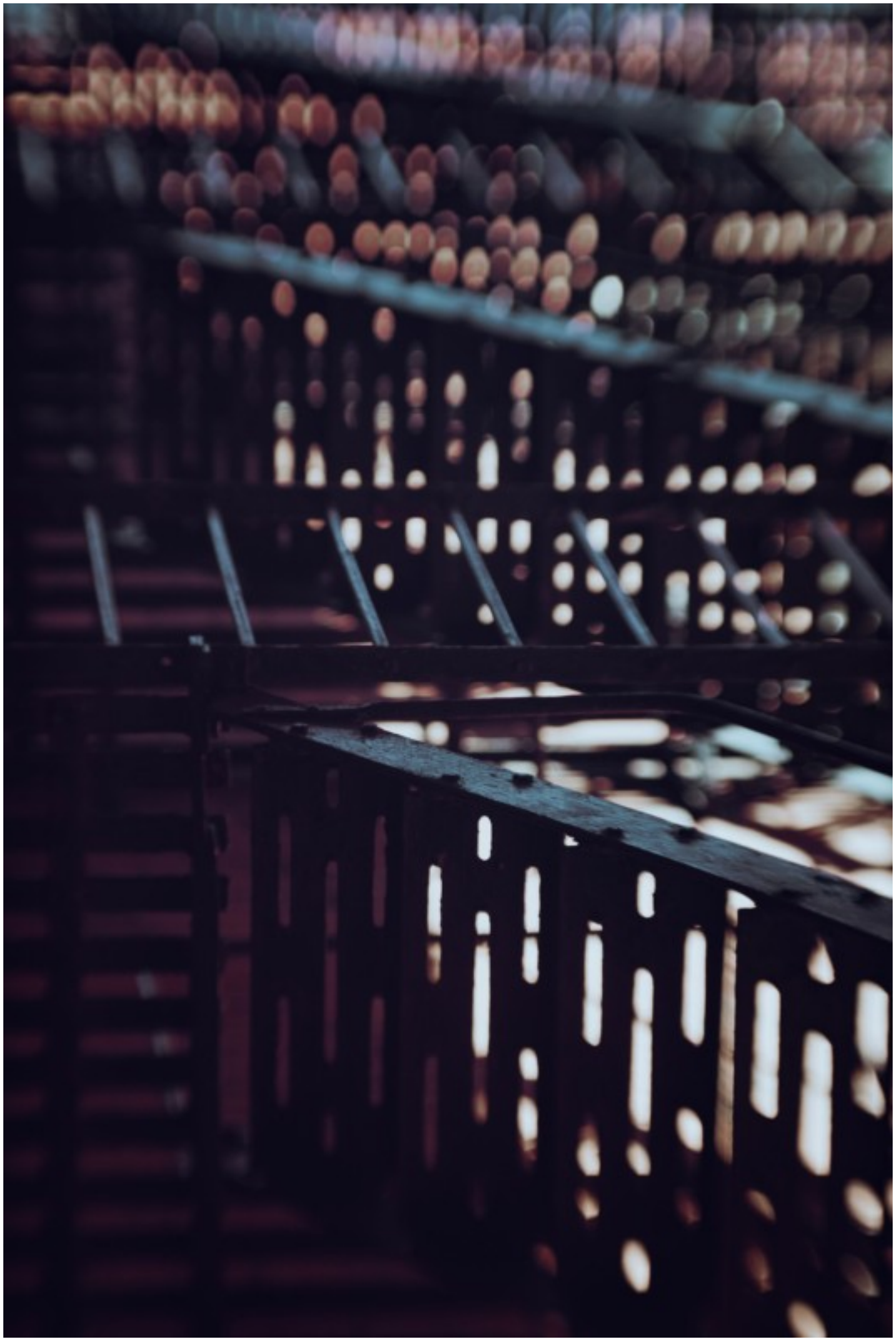
The first is a simple photo of a lawn, which Steele includes with a version that enlarges the middle to showcase the sharpness.


Full view
Enlarged

Below are the other sample images Steele captured with the 3D printed lens:







The full build instructions for the 164mm f/2.5 *Pixels and Prisms* lens are broken into seven parts: the lens mount, the lens barrel, the outer focusing barrel, the inner focusing barrel, the focus ring, the aperture base, the aperture blades, the aperture pegs, and the aperture ring. Afte that, Steele supplies the build order diagram and building tips to make construction as easy as possible.

The 3D print files and all instructions can be found on *Pixels and Prims*.

Image credits: *Felix Steele, Pixels and Prisms*

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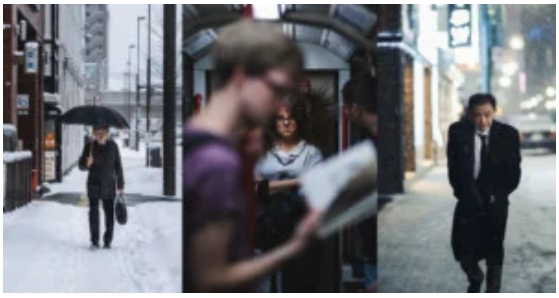

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