

## Introduction to Focus Stacking by Philip Smithies

One of the difficulties of photographing small objects is that the depth-of-field (the amount of an image which is *acceptably* sharp) decreases as you get closer to the subject. Depth-of-field can be increased by using a smaller aperture (higher f-number) but you still will not be able to produce a close-up image which is sharp from front to back with a single picture.

In Figs 2A – 2D, sequence of photographs of a model tram which is two inches high and seven inches long and photographed from about six inches away, you will see how depth-of-field increases as the aperture gets smaller (i.e. as the f-number gets higher). To ensure the amount of light hitting the model is constant, the shutter speed has to be increased to compensate and hence a tripod or firm support is essential. In each case, I focused on the centre of the tram.



Fig 1A



Fig 1B



Fig 1C



Fig 1D

Even at f/32, the image isn't completely sharp: in Fig 1D the front and back of the tram are still not completely in focus although this may not be obvious in a small picture..

Note: A lens typically produces its sharpest images (**NOT** the same as depth-of-field) at the so-called "Sweet Spot" around f/8 or f/11 so you may see a slight degradation of images at the highest f-numbers.

See <https://www.picturecorrect.com/tips/whats-your-lens-sweet-spot/> for a fuller explanation.

For a graphic representation of the relationship between aperture, shutter speed and depth-of-field, Fig 2 on the next page may help.

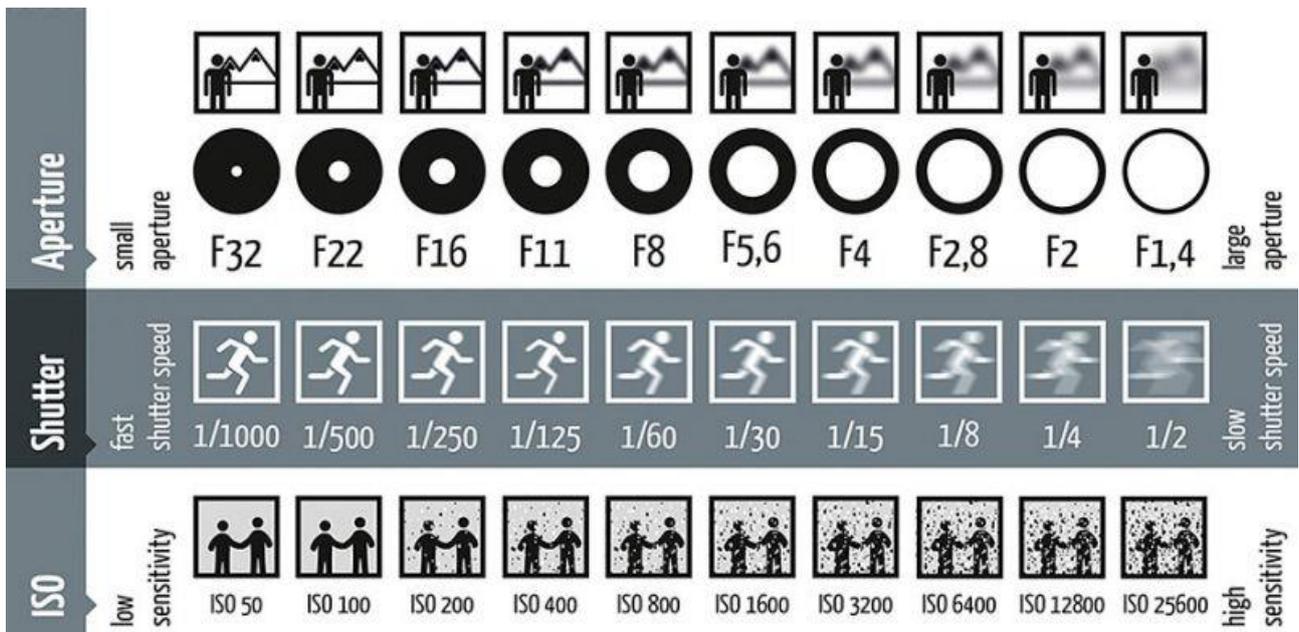


Fig 2

Focus-stacking is a way round the problem of insufficient depth-of-field. You take a series of images from **exactly** the same position using **exactly** the same settings (it's best therefore to use "Manual" exposure) but focusing on different parts of the image each time. In this case, I focused on points about 1½ inches apart but as you get closer, the focusing points would need to be millimetres apart.

You then "focus-stack" or "stack" them in Photoshop (or dedicated standalone software) as summarised below. This is a process which combines the sharpest part of each image to produce a final "stacked" image which is sharp throughout

Figs 3A - 3D show four examples of the twelve images I took to create the stack



3A Focused on front of tram



3B Focused on middle of tram



3C Focused on end of tram



3D Focused on far distance

Once you have your images, you process them in Photoshop:

- 1 **EITHER** Open all images in Camera Raw, make global adjustments if necessary, and then open in Photoshop  
**OR** Open all the images directly in Photoshop.
- 2 Open the Layers Palette by pressing F7.
- 3 Go to File→Scripts→Load Files into stack. In the dialogue box that appears select “Add Open Files” then click OK. (**DON'T** tick “Attempt to Automatically Align Source Images”.)
- 4 In the Layers Palette on the right-hand side of the screen, you will now see thumbnails of all the individual images.
- 5 Click on the first thumbnail and “Shift + click” on the last to select them all.
- 6 Go to Edit→Auto Align Layers. In the dialogue box which appears, select “Auto” and then “OK”. (Because the lens moves slightly as it focuses on different parts of an image, the layers are not naturally perfectly aligned. This stage addresses that problem.) This can take ten minutes or more if there a lot of layers.
- 7 Go to Edit→Auto Blend Layers. In the dialogue box which appears, select “Stack” and ensure “Seamless Tones and Colours” is ticked. Then click “OK”. This stage selects the sharpest parts of each image.
- 8 Each thumbnail will now appear in black-and-white with the white part indicating the sharpest part of each image and the black indicating what has been masked.
- 9 Go to Layers→Merge All (or CTRL + E). This combines the sharp parts of each image.
- 10 Crop any blank and/or superfluous areas round the image.
- 11 The stacking may not always be 100% accurate so a little extra work may be needed to address any remaining defects.
- 11 Save the final file – as a .tiff or .psd if you’re likely to do further editing; as a .jpeg if not. If you want to save the image at an intermediate point (e.g. after stage 7) where you still have lots of layers, you may find that Photoshop can’t save it as a .psd because the file is too large. In that case, save it as a .tiff which also preserves layers.

The final stacked image is shown below in Fig 4.



Fig 4 Stacked

If you don't have Photoshop, there are two main standalone products, Zerene and Helicon, which are much easier and quicker to use than use and in many ways more flexible. The results are superb and the products are very reasonably priced. You may find these sites useful:

<http://zerenesystems.com/cms/stacker>

<http://www.heliconsoft.com/>

At the time of writing, there is currently no way to focus-stack in Photoshop Elements.

It's worth bearing in mind that no product produces perfect results and will you probably find it necessary to do some tweaking.

Below and on the next page, you'll some other examples of stacked images



Fig 5 – the depth of field is over two feet.

(Continued below on next page)



Fig 6 – not a great picture but with a depth-of-field of four feet (model by Malcolm Bulpitt)