

STEVE CAPLIN'S **A** TO **Z** OF DESIGN

B: Bézier curves

Steve Caplin walks us through the concepts essential to success for any jobbing or aspiring designer.



ABOUT THE AUTHOR

Steve Caplin is a designer and illustrator working for a range of national newspapers. His best-selling *How to Cheat in Photoshop*, now in its fourth edition, is published by Focal Press.
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PIERRE BÉZIER

Pierre Bézier was a designer at the Renault car company from 1933 to 1975. In 1962, he was looking for a way to describe a curve with mathematical precision that would enable it to be scaled and copied without loss of accuracy. Although he used a 3D form of the curve to specify a solid car body model, it's the 2D version that has become the mainstay of computer graphics applications.

Bézier curves are the building blocks

of graphic design. They're used in vector applications such as Adobe Illustrator for drawing shapes, in page layout applications such as InDesign and QuarkXPress for reshaping picture boxes and fine-tuning text runarounds, in 3D modelling applications for defining revolve profiles, and even in pixel editing applications such as Photoshop for creating clipping paths. Indeed, without Bézier curves, it would be impossible to create the rich and varied designs with which we're familiar.

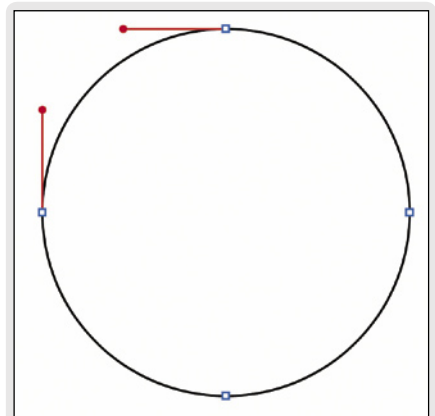
And yet few technologies cause as much consternation among designers. Unlike most design tools, which are becoming ever more intuitive, Bézier curves are difficult to control unless you take the trouble to learn how to use them. Here, we'll look at where they come from and how they work, and show you how to manipulate them to get the best out of them.

Bézier curves describe a curve by first specifying the end points of each section, known as 'end points', 'anchor points' or sometimes 'nodes'. These are the fixed locations that mark where a curve begins or where it changes direction. The shape of the curve between any pair of points is defined by 'control handles', which mark both the direction and the strength of the curve as it leaves the anchor point. The greater the distance from the anchor point to the handle, the more pronounced the curve that follows it will be.

When drawing Bézier curves, it's important to remember that the line between the handle and the anchor point always forms a tangent to the curve at that point – that is, it's as if the handle forms the end of a stick resting on the curve, which touches it at the anchor point but doesn't cross it. (There are special cases where the curve can change direction at an anchor point so

that the handle does indeed cross it, but it forms a tangent on either side.)

In general, the handles of a curve should extend roughly one third to one half of the way to the next anchor point. This is clear when we look at a segment of a circle, which may be drawn in any graphics application. Here, the hollow blue squares are the anchor points and the red dots mark the handles (01). When a circle is drawn in, say, Illustrator or XPress, it's formed of Bézier curves automatically. Selecting any of the component arcs will display the controls with which the curve has been created.



▲ 01 When a circle is drawn in InDesign or QuarkXPress, it's automatically made up of Bézier curves. Selecting any of the component arcs will display the various controls.

MANIPULATING BÉZIER CURVES

There are several ways to manipulate Bézier curves. We'll examine the methods with reference to this simple diagram (02), which shows a curve drawn between two anchor points (hollow blue squares), which has been specified using the control handles (red dots). Note how the red lines that connect the dots to the anchor points form tangents to the curve.

One way to adjust the curve is to drag a control handle. Here, we've shortened the length of the handle, dragging it from point A to point B (03). The original curve is shown in pale blue: note how the new curve is much shallower near the anchor point that has been adjusted.

(04) As well as changing the length of a handle, you can also change its direction. Here, dragging the handle from A to B makes the curve rise rather than fall as it leaves the anchor point. The handle still forms a tangent to the curve, which is reshaped accordingly.

(05) Bézier curves can also be adjusted by dragging the curve itself: you can grab it anywhere and pull it to a different location. Here, moving or dragging an arbitrary point A on the curve to point B has the effect of changing the length of the control handles. Note, however, how dragging a curve in this way doesn't alter the direction of the handles, just their strength.

The final way to adjust a curve is to drag one of the anchor points. The direction and strength of the handles remains the same – the curve here has been shortened, and skewed up slightly (06), but it's essentially the same curve.

A FIELD GUIDE TO BÉZIER CURVES

This simple illustration (07) uses a variety of different anchor points. Point A shows a tangent to the curve, with equal-length handles either side. B is a tangent on either side, but the curve crosses over at the anchor point. C is a corner point, with two handles defining the curves on either side. At the corner point D, the curve to the right of it is defined by a control handle; the one above it is defined solely by the handle leaving the anchor point above it.

The corner point E has no handles; the curves touching it are both defined by the control handles on the anchor points on either side.

USING BÉZIER CURVES AS CLIPPING PATHS

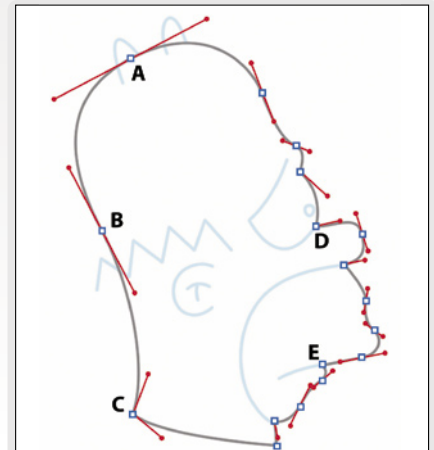
It's standard practice in Photoshop to define a clipping path using Bézier curves, and then to delete the area outside the path to create a cutout object on a white background. The path is maintained even when the image is saved as a flat Jpeg file, so it's easy to load the path and retrieve the cutout later.

The trouble is that when the object is cut out and placed onto a dark background, the anti-aliasing process means that a certain amount of the white background will creep in, creating a white fringe.

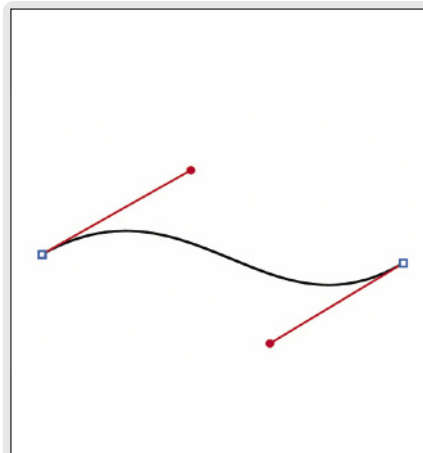
The solution is to draw the path just inside the object's boundary. Turn the path into a selection, and then expand that selection by one pixel before inverting the

selection and deleting the background: this makes a one-pixel fringe outside the pen path area.

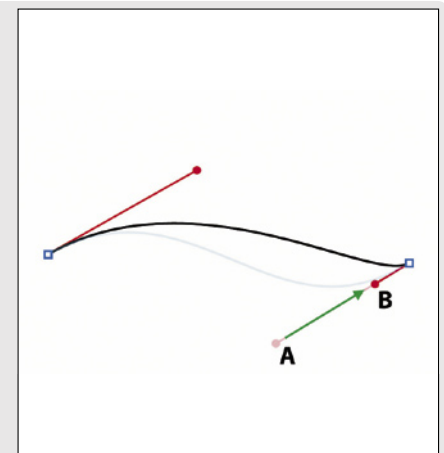
When the object is now cut out again, there will be no white fringe, resulting in perfect cutouts every time.



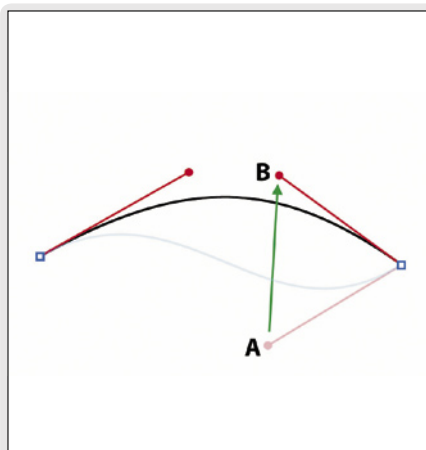
▲ 07 This simple illustration uses a range of different anchor points..



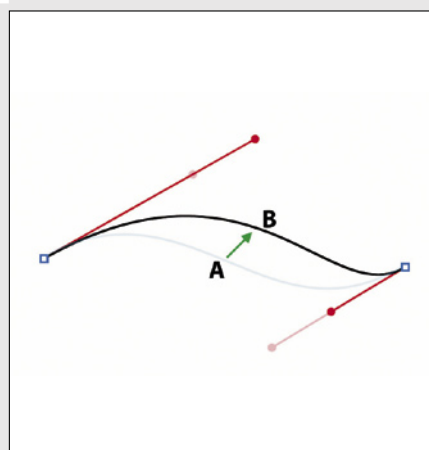
▲ 02 The curve between the two anchor points (hollow blue squares) is specified using the control handles (red dots).



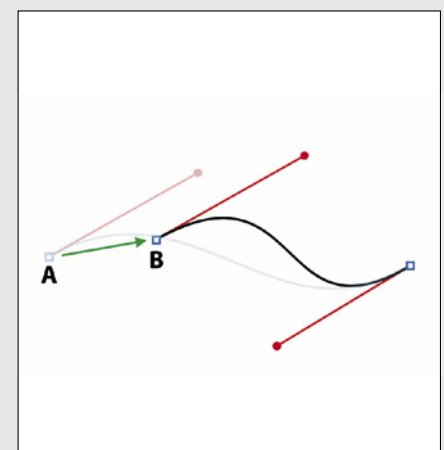
▲ 03 You can adjust the curve by dragging the control handle (the original curve is shown in pale blue).



▲ 04 Dragging the handle from A to B makes this curve rise rather than fall as it leaves the anchor point.



▲ 05 You can adjust Bézier curves by dragging the curve itself, which alters the strength of the handles.



▲ 06 You can also change the shape of the curve by dragging the anchor points.