THE INS AND OUTS OF EXTRUSION BENDING

A little knowledge can go a long way

By George Winton, P.E.

EXTRUSIONS are everywhere—in conveyor systems, scaffolding, playground equipment, swimming pools, and furniture. They also are key components in architectural windows and automotive window trim. We are surrounded by bent extrusions and their close cousins, bent rolled formed sections.

Managing the flow of an extrusion within the bend zone is at the heart of making a good bend. Die clearance, die material, die hardness, and die surface finish can all align to produce quality bends.

The bend radius and the compressive forces within the workpiece are inversely proportional. In other words, as the bend radius decreases, the compressive force increases. This influences bender choice. Large-radius bends generally are well-suited to either a roll bender or a stretch bender. Tight-radius bends often require a rotary draw bender.

The compressive forces also influence die design. As the compressive forces increase, the tooling requirements become more critical because the forces tend to cause thin cross sections to buckle. The tooling's design often is the most critical factor.

COMMON DIE DESIGNS

Consider a simple L channel with a leg-out bend (see **Figure 1**). As the L channel is drawn around the bend die, the outer section of the leg is in tension.

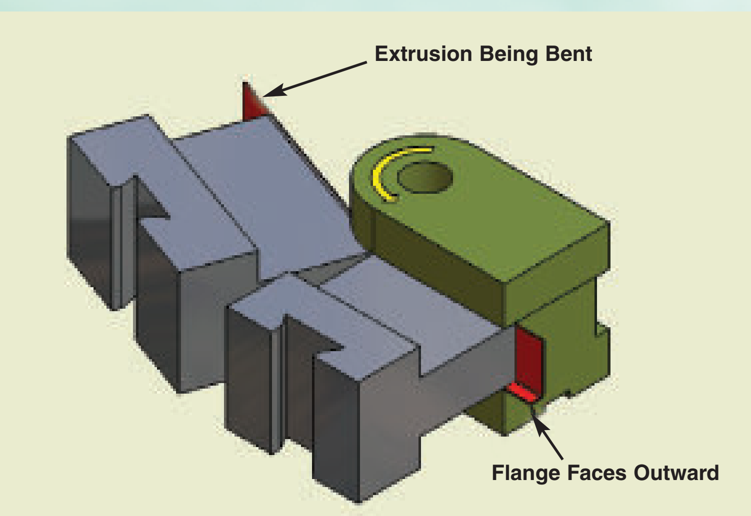

Figure 1
In a leg-out bend, the extrusion's flange points toward the outside of the bend. The bending process puts tension on the leg's outer fibers.

Now take the same cross section and turn the leg in (see **Figure 2**). In this case, the inner fibers of the leg are in compression and have a tendency to buckle as the bend radius becomes smaller.

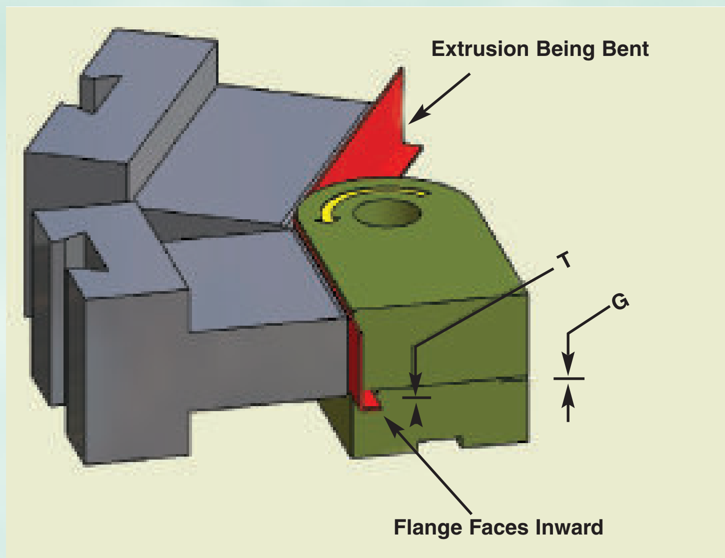

Figure 2
In a leg-in bend, the extrusion's flange points toward the inside of the bend. The bending process compresses the leg's inner fibers.

Too much clearance in the gap (G) can lead to buckling. Too little clearance prevents the extrusion from flowing freely in the die as it rotates through the bend. As the material thickness (T) decreases, the tolerance of the gap becomes more critical.

Even with the right gap, the surface finish of the die can start to break down, resulting in galling. As the abrasiveness of the workpiece increases, the likelihood of breakdown and galling also increases.

Now consider adding another leg. This is a U channel (see **Figure 3**). Bending the U channel with legs in highlights the importance of material growth during bending. As the material rotates about the bend die, the height (H) of the extrusion grows noticeably

Some extrusions need more than one bend radius in a single part. This requires several bender setups or a bender that supports more than one bend radius. Some CNC benders are

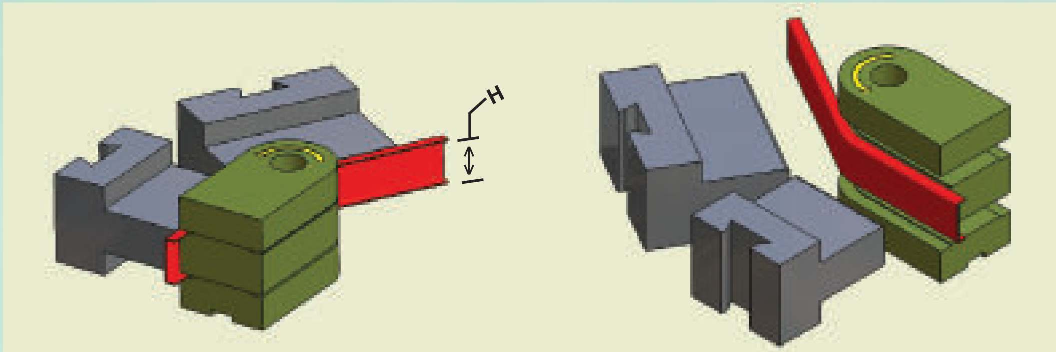

Figure 3
Bending causes the height (H) to increase. If the die design doesn't accommodate this growth, getting the extrusion out of the die after bending can be difficult. A split die actuator maintains the geometric gaps during bending; when the bend is finished, it opens, or splits, easing part removal.

equipped for these sorts of bends — they have right-hand and left-hand bending capability and use a dual-radius split die actuator.

MATERIAL HANDLING

In some cases—especially long, thin sections with several bends—the material's stiffness isn't sufficient to support the weight of the bent material after it exits the bender. The material acts like a wet noodle and requires continuous support. Support systems vary from very simple, a table, to complex, such as a microprocessor-controlled material handling system integrated with the bender's controller (see **Figure 4**).

PROGRAMMING BENDS

Programming a simple one- or two-bend part doesn't take long. However, programming a complex part with several bends can take quite a bit of time. Some modern software tools can simplify the programming.

For example, back-to-back bends usually require a 180-degree plane rotation between the bends. Many extrusions are flimsy, making this an awkward and occasionally difficult task. A right-hand/left-hand bender can bend in both directions, which makes bending easier. However, the programming isn't any easier.

A bender that can read the extrusion's profile directly from a CAD program nearly eliminates programming time. Importing a STEP file derived from a solid model can program the bender in less than a second. After importing the length, rotation, and angle (LRA) data and centerline radius information, the software identifies the CLR of a specific bend, sets up the tooling, determines bend direction, and queries its database of similar materials to try to predict the springback percentage.

The operator then selects a standard tool package from a software library. A tool package might include the pressure die length, clamp die length, bend die information, material handling setup information, and various pressure settings.

DISADVANTAGES

The initial cost to bring online the software tools for programming can be a limiting factor for some shops. Also, investing in a machine that doesn't have a dual stack feature can increase the time it takes to see a return on an investment.

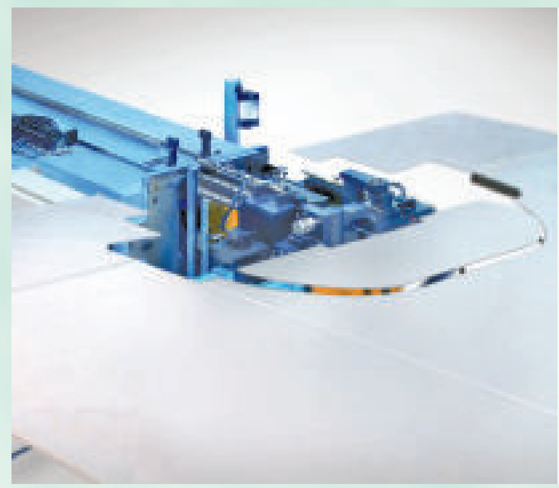

Figure 4
A microprocessor-controlled material handling system supports an extrusion during bending. The programmable door in front of the bend head moves up and down to facilitate bending.

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George Winton, P.E., is the founder and president of Winton Machine Co.,
300 Shawnee North Drive, Suite 100
Suwanee, Georgia USA 30024-2191
+1-888-321-1499
gwinton@wintonmachine.com
www.wintonmachine.com.