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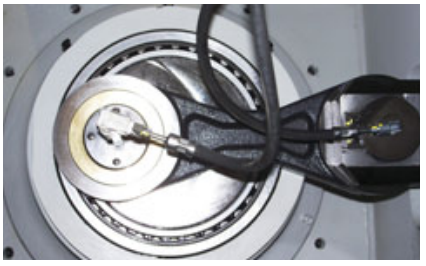
Features



Commentaries

Departments

The Past, Present and Future of Die Design

Back in the day, high-tech die design was an electric eraser to go along with your drafting machine. By the early '90s, 2D CAD programs became prevalent, as did specialized die-design-specific software packages for these programs. Where are we today? Read on…

BY RAYMOND PROEBER

I began in this trade as a tool and die apprentice more than 30 yr. ago, when dies were laid out by hand and punches and die sections were milled and ground. This was a time of combination squares, carbide-tipped scribers, height gauges, transfer screws and lots of Dykem layout fluid. Because the tool and die maker controlled the entire process, he also would often work without a formal design, creating his own sketches for the die.

To build more complex dies, an experienced die designer, who in most cases was previously a tool and die maker, would sometimes provide drawings developed on a drafting machine and drawing board; for really complex dies, the designer would even add some dimensions to his design. As digital readouts started appearing on Bridgeport mills, more components were detailed on the drawing board, typically of perishable components.

In the late 1980s and into the early 1990s, the vast majority of die design moved from the drawing board to 2D CAD.

Raymond Proeber is president of Accurate Die Design, Inc., New Berlin, WI, a provider of 3D software, training and support to the tool and die and metal stamping industries, and the U.S. Technical Center for Logopress3: 262/938-9316; www.accuratediedesign.com.

During this same timeframe, U.S. die designers had at their disposal a couple of different die-design software packages that operated within AutoCad. Those that added these specialized software packages to their 2D CAD software enjoyed significant increases in productivity.

Since that time, die making has gradually evolved into much more of an assembly-line process. As a result, tool and die makers have become less prepared to become die designers, and less able to create dies without a design provided to them.

3D CAD Goes Mainstream

In 1995, the first parametric-based 3D CAD package able to run on a personal computer was released. The software only offered solid-modeling functionality, without any surfacing or assembly capability. Over time it was developed to include these capabilities, and became known as a hybrid system.

2D CAD is comprised primarily of lines and circles, so it matured rapidly; parametric-based 3D CAD took longer to evolve. Over the past decade, 3D CAD software has become common in tool and die companies. Why? Productivity—it is practically unheard of for any product design to be developed using 2D as opposed to 3D software. Therefore, there are solid or surface models available for most of the parts for which dies will be designed.

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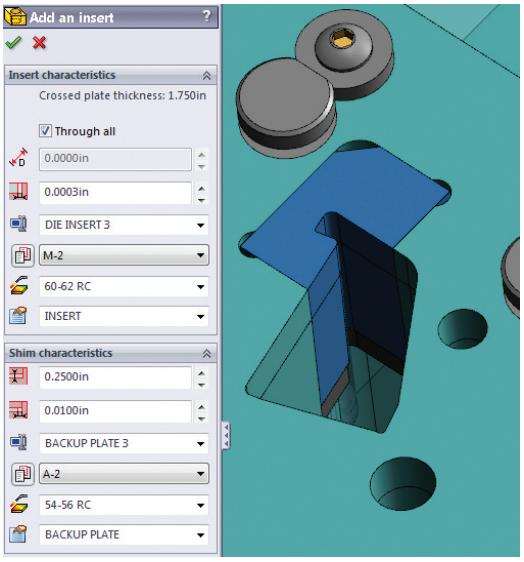
Die-Design Timesavers

Designers find that when adding specialized 3D die-design software to their 3D CAD software, they can dramatically reduce design time—by as much 30 to 50 percent depending on die size and complexity.

One immediate timesaver is the ability to flatten complex-shaped 3D stamped parts using finite-element-analysis (FEA) software. Some companies include FEA in their die-design software packages, while others offer it as an option. And, some FEA software goes beyond flattening and can automatically generate models for the intermediate part forms based on user input.



In less than 5 min., an insert can be added to a plate along with a shim or backup plate, with proper clearances for both, along with various corner treatments for the cavity in the plate receiving the insert.

While these FEA tools prove very handy, they will not replace dedicated FEA forming-simulation software packages, which prove particularly useful when working with complex stamped parts. These dedicated FEA programs allow the designer to simulate forming and predict numerous outcomes including wrinkling, failure and springback—tasks that challenge even the most experienced tool and die maker—with incredible accuracy.

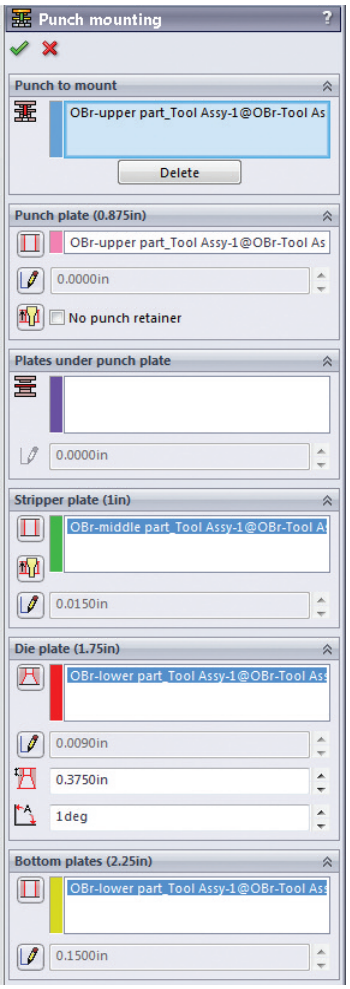
When designing dies for parts that have only linear bends, often the 3D CAD package alone cannot unbend the parts, but the die-design unbending software can. When the software unbends a part, it also can automatically calculate each bend's k-factor. After parts are flattened or unbent, the software then can generate a strip layout, with punches, often in just a few minutes.

Die-design-specific software packages also feature unique tools and utilities that significantly shorten the design process, such as the ability to quickly create cutting and forming punches. The software then will automatically cut all of the cavities through all plates in the die, applying the correct clearances and tapers. In less than 5 min., an insert can be added to a plate along with a shim or backup plate, with proper clearances for both, along with various corner treatments for the cavity in the plate receiving the insert.

Some die-design software packages also include tools specifically for round parts. A designer can accurately process the intermediate steps for a round part and lay out a strip in just 10 to 15 min., including the stretch webs that carry the part. Also available: a graphical preview of one part overlaid on the previous part, or a preview of the part as it enters and makes initial contact with the die cavity.

Standard Component Libraries

The standard component libraries included with die-design software house specifications for several different brands of components and nearly every type of component you might need in a die, including pierce punches and pilots, springs and nitrogen cylinders, guide posts and bushings. No longer must the designer download specific models from a vendor website, and then cut the holes for them, since the software creates the models on the fly. And, in the case of a nitrogen cylinder, the proper stroke length is automatically applied to the solid model of the cylinder; tonnage force is automatically calculated; the hole is cut for the cylinder and all plates it crosses though; and, finally, the screws that retain the cylinders are automatically created and inserted. All of this happens with a single mouse click after the designer has set the parameters, and the user can see the graphical representation of the cylinder before this mouse click.



The software will automatically cut all of the cavities through all plates in the die, applying the correct clearances and tapers.

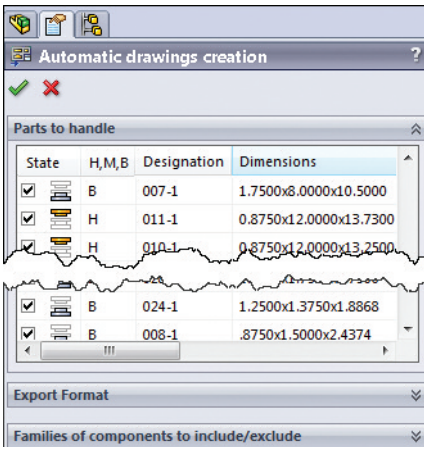
Automating 2D Drawings

Most companies still require 2D drawings on their manufacturing floor. There are specific tools in die-design software for automating the creation of these drawings as well as for automatically filling in all title blocks in the drawings.

The bill of materials (BOM) also is automatically generated and the BOM as well as the balloons can be automatically sorted for organization. We have one customer that tells us that all of the drawings for a design, including detail drawings, rarely require more than 8 hr. of work to complete.

3D Delivers Downstream Benefits

Several downstream benefits result from the use of 3D die-design-specific software, thanks in part to animation capabilities. Some software animates only the strip itself, while



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other packages provide full animation showing the die operating as if it were in the press, allowing designers to dynamically check for interference as the die is operating. Animation includes motion of stock lifters and pressure pads, stripper travel, die opening and closing, and the strip feeding through the die to its next progression.

During the animation, the designer can apply filters to view only the lower half of the die along with the strip lifting and advancing and forming, or only the upper half and strippers, etc. He can zoom in and out and manipulate the model at will.

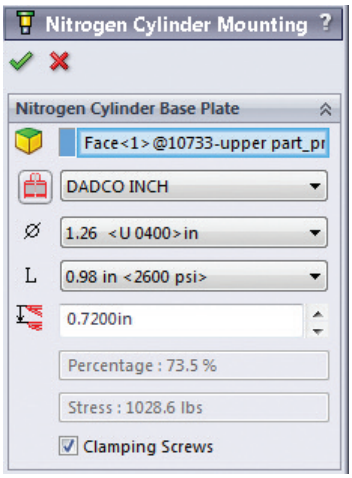
In general, while 3D design adds a great deal to the visualization of a die design, the animation and filtering technology takes die design to a whole new level, helping designers dramatically reduce debug and development time in the press. Also, since the designer's die model includes any 3D form blocks that typically would be modeled by a CAM programmer, the back and forth communication between designer and programmer is eliminated. The entire design can be in one model rather than using a mixture of 2D design and 3D CAM models.

Five years down the road, you won't be searching for the 3D model of the block, because it will be a part of the die design.

Training New Die Designers and Eliminating Mistakes

Understandably, in the days of 2D design, whether on the drawing board or 2D CAD, the die was difficult to visualize. As a result, we endured a lot of mistakes made with 2D designs that we do not see occurring when using 3D designs developed with die-design-specific software. Likewise, it was extremely challenging to train die designers working in 2D. Because 3D design is much more visual, including the use of specialized tools for animating the die and performing dynamic interference detection, the task of training die designers is much less daunting.

While many in the metalforming industry still believe that the best die designers are those that previously were tool and die makers, that qualification is less critical today. In fact, we have one customer who previously worked as a quality manager. In 2 yr., he's become an accomplished die designer using 3D software exclusively, with most of his designs being for complex reel-to-reel electronic parts.



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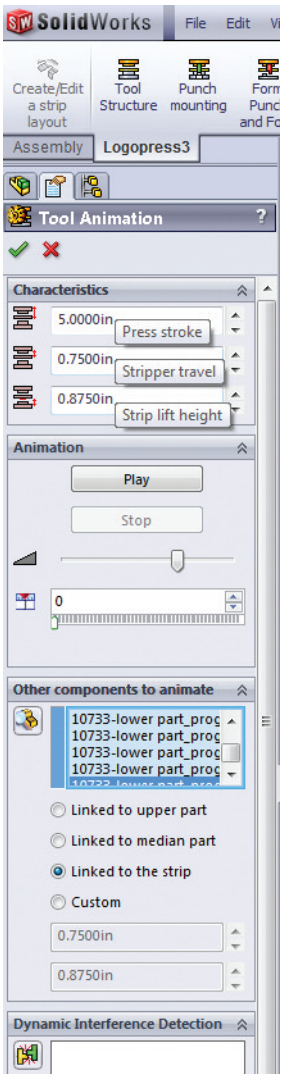
The Future

The capabilities of 3D die-design software might make some in our industry nervous, worried that their jobs could be in jeopardy. One common statement I've heard is:

"Pretty soon we're just going to have to push a button and the computer will spit out a design."

Yes, the software can automate the design of parts that are members of a family of very similar parts, but the vast majority of parts differ enough to require human/designer input. I've also heard discussions of intelligent die-design software that actually will make design decisions. That sounds like science fiction to me. Software doesn't make decisions; it does what it is told, whether by the die designer or by the human developer via the code written in the software.

While it is true that you can bring an incredible amount of automation to software, designers still need to control the software; the software shouldn't control the designer. **MF**



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