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DOERFER Companies

Doerfer engineers use PAM-STAMP 2G to design complex tools right the first time

THE CHALLENGE

Conceive a complex deep-drawn contoured part transfer die right the first time, while avoiding the time-consuming traditional "cut and hope" method.

THE STORY

Doerfer faced the challenge of designing a transfer die for a deep, contoured part. In the past, the company's engineers would have produced an initial concept design based on intuition and experience, built and run the die, and then gone through a process of re-cutting and re-running the die until it worked as intended. Instead, the company's engineers used PAM-STAMP 2G software from ESI Group to simulate the drawing and forming process. **The simulations identified thinning problems that the engineers were able to correct directly on a software prototype, prior to building the die.** The simulation was also used to determine the trim line.

THE BENEFITS

"Using simulation instead of the conventional build and try method saved significant time and money on this project. The customer was very impressed with the result, and it helped pave the path for additional work."

Bobby Veach
Manager of Tool and Die Business,
Doerfer Companies

In the past, to design a transfer die for a part, Doerfer's engineers would have produced an initial concept design based on intuition and experience and iterated until it worked as intended.

The part described here is approximately 75x90 cm and has a contoured shape with multiple levels, making it difficult to produce.

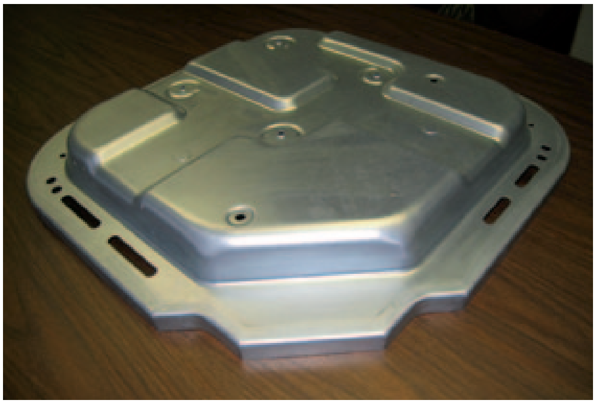
Doerfer engineers initially developed a four-station die design. The first operation is the critical drawing operation where the basic contours of the part are formed. The second trims away excess material. The third re-strikes and forms the part to its final shape. The fourth involves standard and cam punching. The combination of a deep draw and tight material allowance makes it difficult to absorb the stretch during the drawing operation without considerable thinning.

"The traditional approach for designing this type of complex die is to shoot from the hip and hope it works," says Bobby Veach, Manager of the Tool and Die Business. *"We would machine the die to the part print dimensions and mount it in the press for a trial run.* ***It's nearly impossible to build a die this difficult right the first time,*** *most often because the part wrinkles or tears in certain areas. Based on the trial results, we would estimate the changes needing to be made. We would take the die out of the press, make changes and hit it again. This process might be repeated several times, driving up the cost of the die and delaying the start of production."*

"The tool and die business has grown more competitive during the past decade," Veach said. *"Parts have become more complex, delivery times have gotten tighter and we have to be price-compe titive on a global basis. Several years ago, we decided that we needed to find a better way to design and build dies. We hired several consulting companies to simulate some of our more difficult dies. These companies used different types of simulation software, giving us a chance to check out the differences between them.* ***We concluded that PAM-STAMP is the best for the kinds of complex dies that we typically build. This simulation software is easy to use; it can simulate virtually every type of operation in our business, and its predictions match the real world very closely.****"*

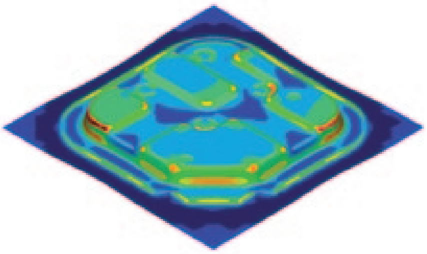
On this project, Doerfer engineers exported the tool geometry of the initial die configuration from Pro/ENGINEER Computer-Aided Design software into PAM-STAMP 2G using the IGES file format. The first simulation iteration immediately identified areas where the die would stretch the part beyond the capabilities of the material and cause tearing.

The results pinpointed the areas of the part that were thinning in the die. Most of these were located around small radii in the initial part design. The engineers performed additional simulations with adjustments in drawing depth, pressure on the binder and other parameters but were unable to correct the problem. Consequently, they tried increasing the size of these radii and re-ran the simulation. This improved the situation but did not completely eliminate the tearing. A number of additional simulations involving tweaks in the part design were necessary until the part was perfect.



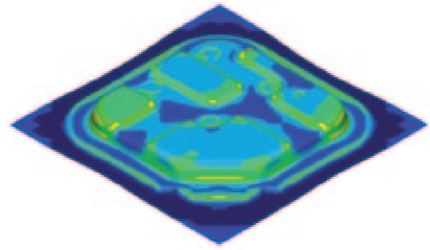
Physical part obtained right the first time based on simulation work

Since Doerfer could not change the part design without the customer's consent, the simulation results were presented to prove the need to increase specific radii. Convinced by the demonstration, the customer approved the changes to the part and the engineers got back to the task of designing the rest of the die.



Thinning (in orange/red) and tearing (in black) are identified in several regions of the original design.

The next step was to determine a developed trim line for the second operation. The goal was to leave sufficient material to make the trim feasible but as little as possible to reduce material costs. Since the third operation actually formed the part to its final shape, it was necessary to jump ahead to this operation to see how narrowly the part could be trimmed in the previous operation. The engineers used the PAM-STAMP 2G inverse solution feature that estimates the blank size based on the finished part size. *"The inverse solution feature does not provide 100% accuracy but it is **much more accurate than the traditional method**,"* Veach acknowledged. The engineers then completed the second operation according to the trim line they determined by inverse simulation from the third operation. No simulation was required for the fourth operation.



Result after tuning the tool design and softening the part design (radii): Thinning and tearing has been dramatically reduced.

"Instead of building and testing the die to see if it works, we simulate a number of different potential designs and pick the one that meets our customer's requirements. We can frequently improve the efficiency of the forming operation by reducing the number of stations and determining exactly what size the die needs to be. We can also sometimes reduce material costs by simulating the stamping operation with different types of materials. In many cases, we find that a lesser grade of material than the one originally selected by the customer will work. We can also reduce material consumption by optimizing the size of the blank."

"On this application," Veach continued, *"We determined the process, developed the initial blank, controlled the flow of material during the first draw form and monitored thinning percentages before we even started building the die. The result was that the die worked perfectly the first time we hit it. There's no way to know exactly how much money and time was saved by not having to re-cut and re-test the die. It all depends on how quickly we would have been able to find a solution using the cut and hope method. But **I am confident that we have earned projects because the savings through simulation has made us more competitive**."*

DOERFER COMPANIES (WRIGHT INDUSTRIES, INC.)

Headquartered in Iowa and working from facilities in Nashville, Tenn., Greenville, SC, Waverly, Iowa and Moline, Ill., Doerfer Companies designs, manufactures and integrates factory automation systems for the unique process and product manufacturing needs of the healthcare industry, as well as automotive, aerospace, defense, consumer, healthcare and nuclear industries. Doerfer's team of more than 700 meets manufacturing challenges by leveraging significant applications experience in assembly, packaging, nuclear, controls, testing, and inspection systems.

ABOUT ESI GROUP

ESI is a world-leading supplier and pioneer of digital simulation software for prototyping and manufacturing processes that take into account the physics of materials. ESI has developed an extensive suite of coherent, industry-oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and to evaluate the environment's impact on product performance. ESI's products represent a unique collaborative and open environment for Simulation-Based Design, enabling virtual prototypes to be improved in a continuous and collaborative manner while eliminating the need for physical prototypes during product development. The company employs over 750 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris. For further information, visit www.esi-group.com.

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