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Y-Tec

# Y-Tec manufactures an ultra high strength steel bumper with PAM-STAMP 2G's springback correction

## THE CHALLENGE

For vehicle crash active parts, ultra high strenght steels (UHSS) are used more and more. However with these materials, the increase in crash performance comes with more difficult formability and more complex springback behavior. In this case, after several physical trials with real prototype dies, Y-Tec failed to reach the required dimensional accuracy. Side walls were warped and the part was not curved enough along its length.

## THE BENEFITS

- PAM-STAMP 2G allowed Y-Tec to identify phenomena that could not be seen with physical prototype tools,
- Springback calculation of 980 MPa UHSS was made possible with PAM-STAMP 2G and the Yoshida-Uemori material model.

*"Using the Yoshida-Uemori model in PAM-STAMP 2G improves the accuracy of springback prediction to a point where it becomes possible to determine effective qualitative countermeasures. By analyzing the stress and strain accumulated during forming, we were able to determine and eliminate the cause of poor dimensional accuracy. Thanks to PAM-STAMP 2G, we reduced the number of modifications on the stamping tool even in cases where the parts' formability was challenging, such as Ultra High Strength Steel parts."*

Hiroki Kondo, Deputy Manager, Advanced Press Engineering Group/Dept. Y-Tec Corporation

Y-Tec cooperates with MAZDA on their new vehicle developments from an early design stage, in order to minimize lead time and production costs for stamped parts.

Y-Tec usually relies on PAM-STAMP 2G to check the formability of a part virtually before manufacturing. They optimize the die design and analyze the springback behavior to compensate the die and determine the appropriate countermeasure to reduce springback.

For this specific example, they were summoned to manufacture for MAZDA a bumper reinforcement part of 980 MPa ultra high strength steel, and they encountered unexpected challenges. They failed the trials on their physical prototype die. After several die modifications for the bumper reinforcement part, Y-Tec looked for other solutions.

## Spingback with PAM-STAMP 2G's Yoshida-Uemori material model

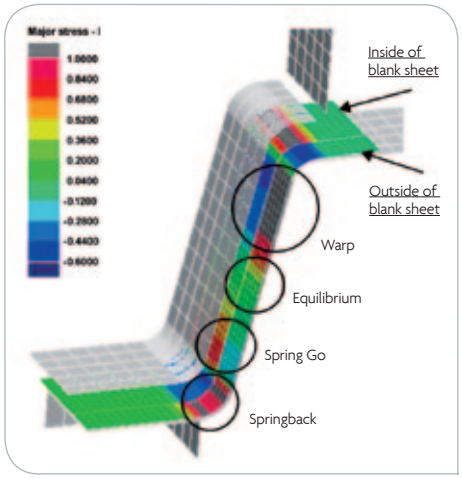
Following advice from ESI Japan, they decided to try PAM-STAMP 2G with the Yoshida-Uemori material model (Y-U model). The Y-U model is optimized for usage on high strength and ultra high strength steels and can capture special effects such as the Bauschinger effect.

After more simulations and analysis of the results, they found cyclic bending and unbending deformations in the side walls which induced significant warp. In addition, they detected insufficient stretching that lad to loss in curvature in length direction.

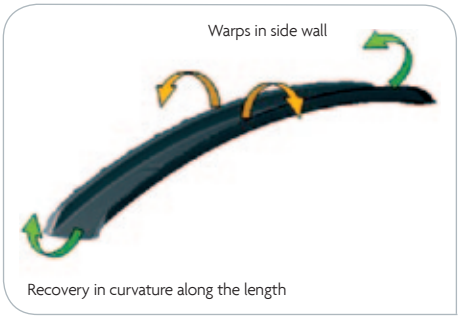
By using the Y-U model within PAM-STAMP 2G, they found that the accuracy of the springback prediction was clearly improved, which helped them find the right design for the stamping tools. On the bumper reinforcement part for MAZDA, results from PAM-STAMP 2G were compared with the real part. The comparison showed good correlation when using the Y-U model in PAM-STAMP 2G, now being within tolerances whilst the deviation before had a value of 4mm without the usage of the Y-U model.

## Springback reduction on bumper reinforcement parts

With the use of PAM-STAMP 2G, Y-Tec discovered that an adjustment of the contact timing between the upper tool and the side walls would reduce the warp, and higher force on the lower pad would reduce the loss in curvature after springback.

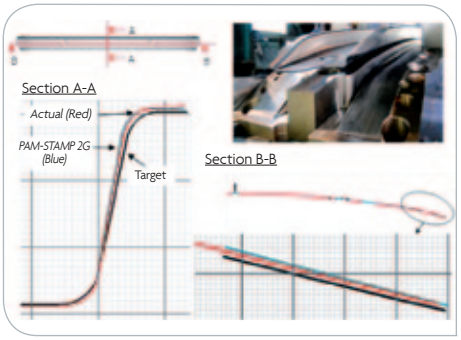



Stress components which cause springback




Effects of springback on the bumper

As a result, Y-Tec built their mass production tools taking into account the identified countermeasures, and the part geometry proved to be close to the targeted CAD model of the part.



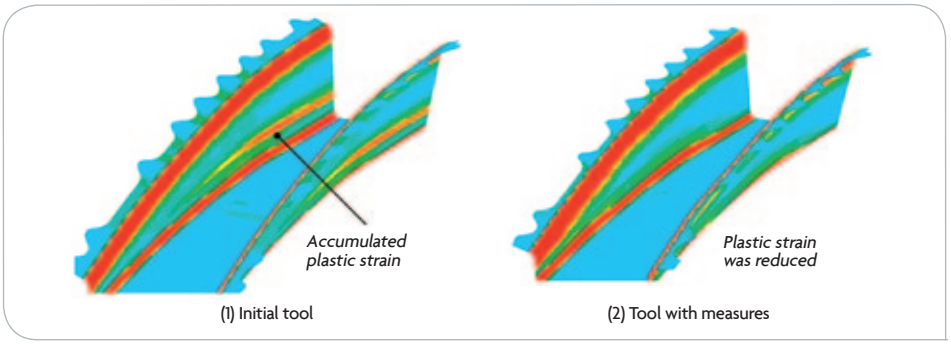

Satisfactory dimensional accuracy in mass production tool

After obtaining such satisfactory results on the first part, Y-Tec decided to test the method on another bumper reinforcement part using again PAM-STAMP 2G with the Y-U model to correct springback. In this second case, optimal contact timing between the side walls and the upper tool could not be used because of limitations of side wall dimensions. A different countermeasure for warp in the side walls was studied. Y-Tec investigated the plastic strain accumulated during cyclic bending and unbending deformation distributed around the center of the model, where the side wall is the deepest.

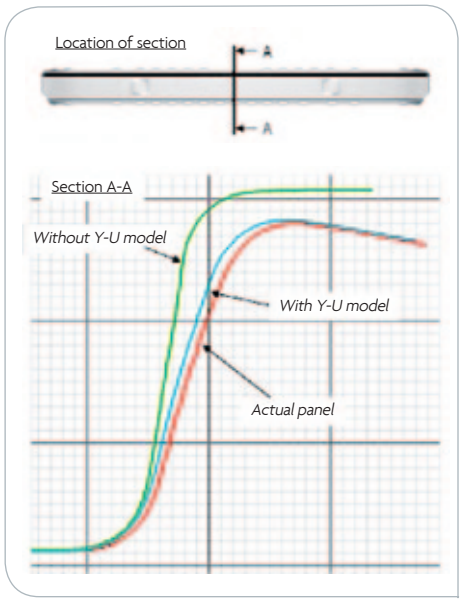
By adding steps in the addendum to optimize bending time in the walls, plastic strain around the center of the model became negligible and hence, springback was reduced in the walls.

## Right dimensional accuracy of the bumper reinforcement part

Even though springback was reduced, additional measures were necessary to achieve full dimensional accuracy. Generally, die compensation can be a solution; but not with this model, since simulation with PAM-STAMP 2G showed that warp in side walls became larger when compensation of the bending angle was applied to the tool. After analysis of the stress distribution on the upper and lower surfaces, it turned out that stress distribution in the side wall area close to punch radius had a negative bending moment, against the springback direction.

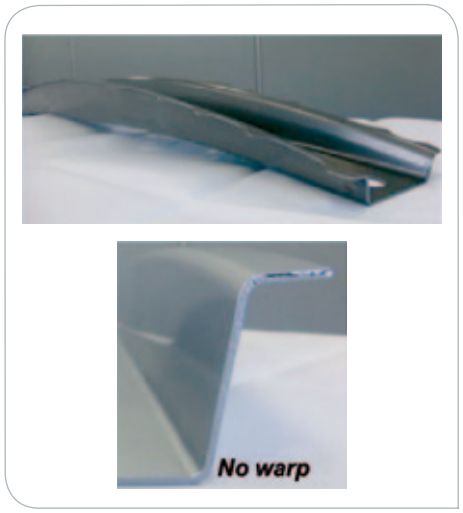



Improvement of springback by reducing plastic strain




Improvement in springback prediction with Y-U model

With the use of PAM-STAMP 2G, Y-Tec could find an optimal shape for the side walls which distributes the negative bending moment on a wider area. As a consequence, dimensional accuracy was significantly improved.




Try-out result after optimization using PAM-STAMP 2G

To find out more about ESI's Sheet Metal Forming Simulation Suite, please visit: www.esi-group.com/metal-forming

### ABOUT Y-Tec

The Y-Tec Corporation was founded in 1960. It's a Japanese company located in Hiroshima. Its main activity relies on car services such as chassis parts for front & rear close member, arms and body parts for rear side frame, bumper reinforcement. In the late 1990's, a group of people started work on formability analysis and developed in 2009 the Yoshida-Uemori material model for mass production of stamping tool. In 2010, the Y-Tec Corporation performed by reaching half a billion Euro (49,2 Billion Yen) with 1460 employees.

### ABOUT ESI GROUP

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