

The Recent Developments of the Metal Forming Modules in LS-PrePost[®] (1) - The EZSetup and 3D-Drawbead Modules

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Abstract

New functions have been continuously implemented into LS-PrePost to enhance the metal forming analysis with LS-DYNA. In this paper, two important updates – the EZSetup and the 3D Drawbead - will be introduced. The EZSetup module, which has been used in the production simulations, is further enhanced now by incorporating springback compensation, lancing operation as well as the multi-stage simulation setup with unlimited sets of processes and tools. The 3D Drawbead module, as a newly added metal forming module, can be used to generate the mesh of the real beads given the corresponding line beads. Therefore the accurate simulation with the real beads can be performed readily when the feasibility analysis with the line beads is completed. These modules will be under constant development to meet the requirement of our metal forming users.

Keyword: Metal Forming; LS-PrePost; EZSetup; Lancing; Springback Compensation; Real Bead Mesh Generation

Introduction

Two important updates of the metal forming modules will be presented as following. The EZSetup module, which has been used in the production simulations, is further enhanced by incorporating new processes: springback compensation, the lancing operation as well as the multi-stage simulation setup. The 3D Drawbead module can be used to generate the mesh of the real beads for the accurate simulation after the feasibility analysis with the line beads.

New processes added in the EZSetup

Springback Compensation

The springback compensation features of LS-DYNA[®] are developed for the metal forming users to automatically modify the stamping tools to minimize the deviation of the formed part from its intended design. As shown in Fig. 1, the iterative procedures will be needed to accomplish the compensation process.

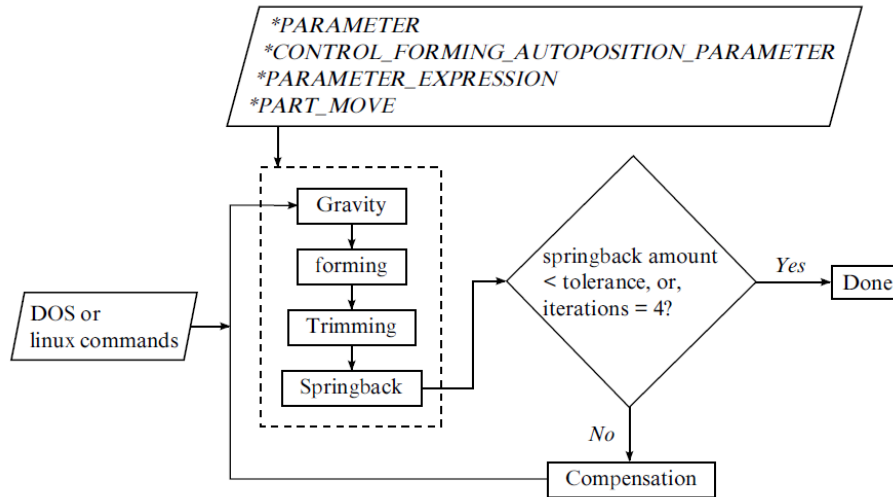


Fig. 1 the compensation process of EZSetup

In order to facilitate the setup and automate this process, the Compensation process is added in the available process list in the EZSetup. When Type1 compensation (global/localize) is selected, the processes that may be needed (gravity, forming, trimming and springback) will automatically added (some can be removed if not needed, e.g. trimming). When the baseline simulation is properly set up (i.e. the stamping simulations), one can define the compensation process as show in Fig. 2.

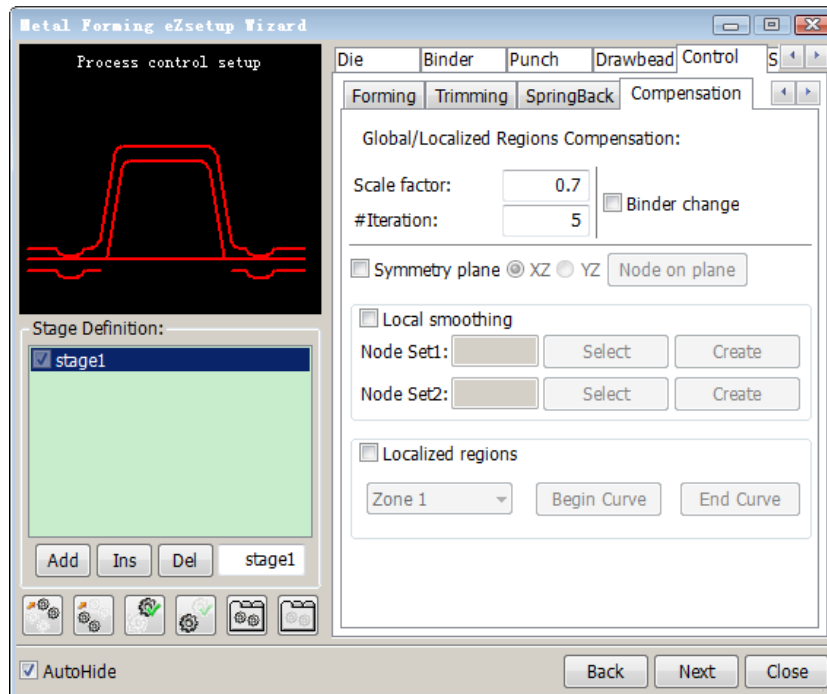


Fig. 2 the global/localized compensation setup

In the setup tab, the default values of the scale factor and the iteration numbers have been set but the user can modify these values if necessary. A few important options are briefly introduced as below:

- By enable the “Binder change” option, the binder modification will be taken into compensation iterations; otherwise, the binder would not be modified and the change will be

limited inside the addendum region.

- The local smooth options will use the original tools to improve the smoothness of the defined zones in the newly compensated tool mesh.
- By enable “Localized regions” option and defining two enclosing curves with one inside the other, a local region can be defined for the localized regions compensation so only the selected region will be modified without changing other regions of the forming tools.

The springback compensation process of Numisheet 2005 Benchmark 2^[2] is given in Fig. 3. It is shown that after 3 iterations, the section profiles of the final springback part are much closer to the design intent.

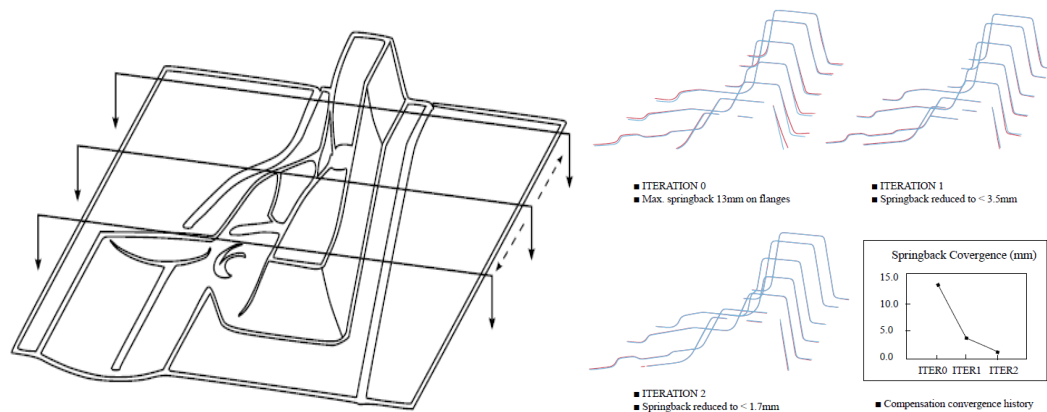


Fig. 3 the springback compensation of Numisheet 2005 BM2

If Type 2 is selected when the compensation is added in the beginning, the trim die compensation set up will be enabled as shown in Fig. 4. In contrast to Type 1 compensation (Global/Localized Region), this simulation does not require an iteration procedure. The trim die compensation of Numisheet 2005 Benchmark 2^[2] is given in Fig. 5.

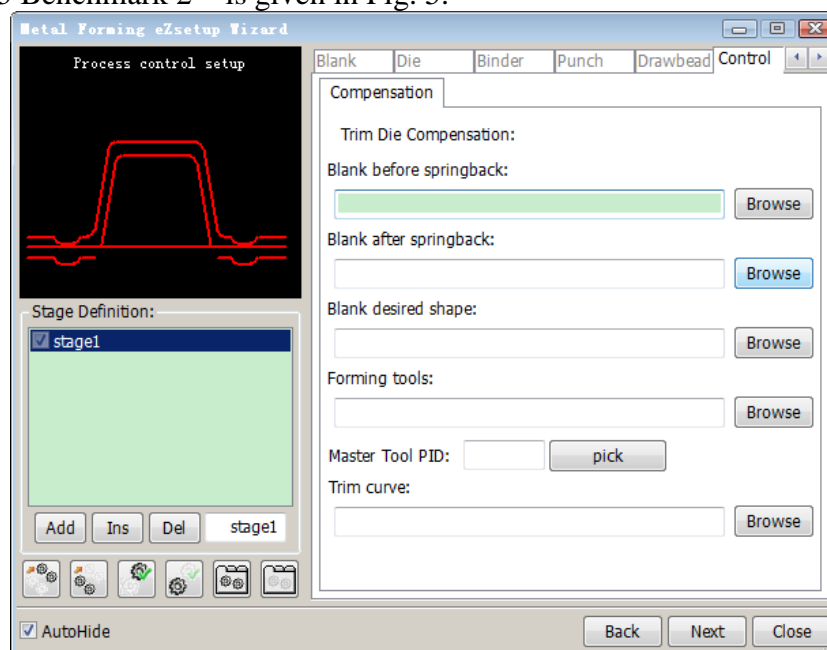


Fig. 4 the trim die compensation setup

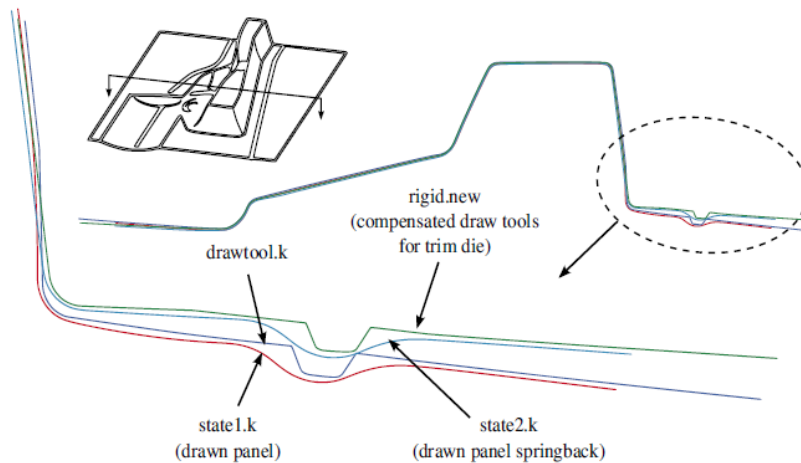


Fig. 5 the trim die compensation setup

More details about the related keywords and the examples can be found in the LS-DYNA Keyword User’s manual Vol. I^[1]:

*INTERFACE_COMPENSATION_NEW and *INCLUDE_COMPENSATION_.

Please note that a double precision solver would be needed for the compensation process.

Lancing

The lancing setup is added in the Punch tab of the Forming Process as shown in Fig. 6. Both the instant and progressive lancing can be simulated. When only the start distance is given, the instant lancing will be simulated and a simple example is given in Fig.7. With the specified starting and ending lancing distance (measured from the home position of the forming tool) and the cutting times, the progressive lancing can be also performed in the forming simulation.

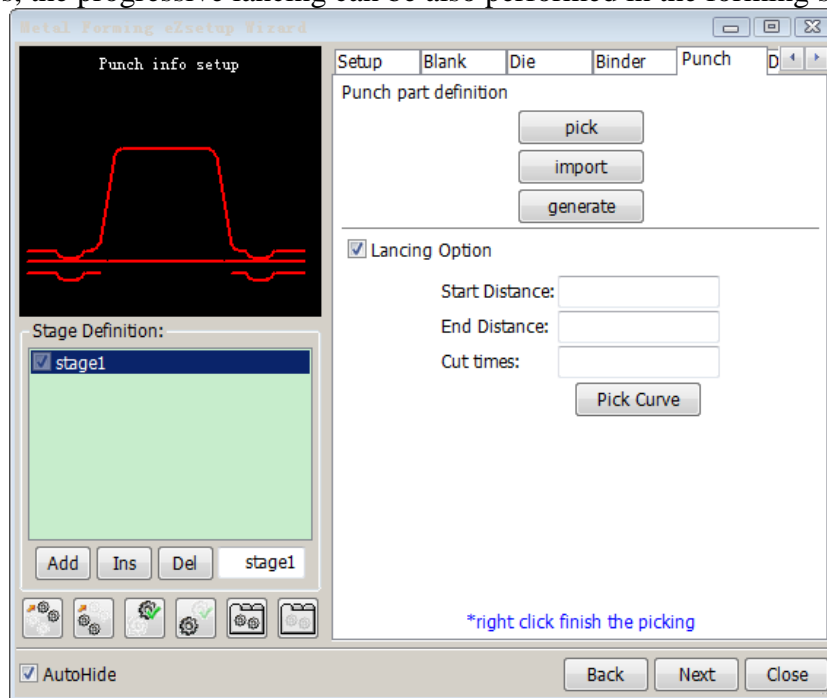


Fig. 6 the lancing setup

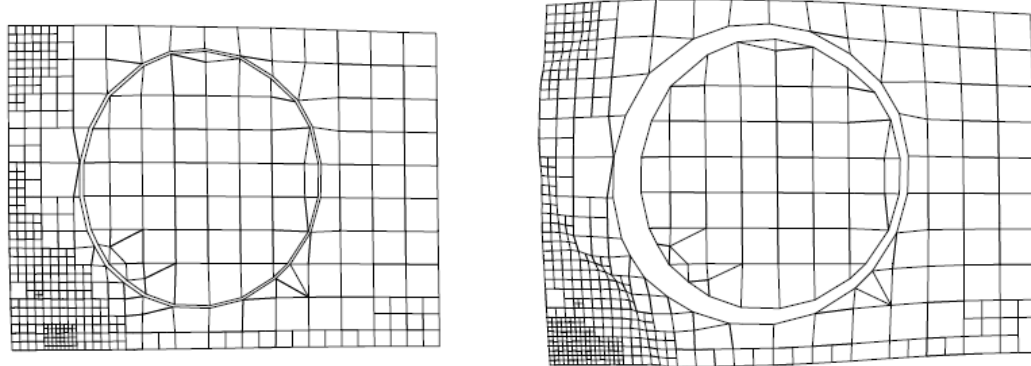


Fig. 7. the result of an instant lancing simulation

Multi-Stage Setup

With the multiple stage function added in the EZSetup as shown in Fig. 8, there are no limits on repeating the same process. For example, the gravity and springback simulation can be accounted for before and after each forming or flanging process; and the forming type can be different from stage to stage. It would be convenient to set up the whole process and run the jobs continuously, e.g. the progressive die simulations.

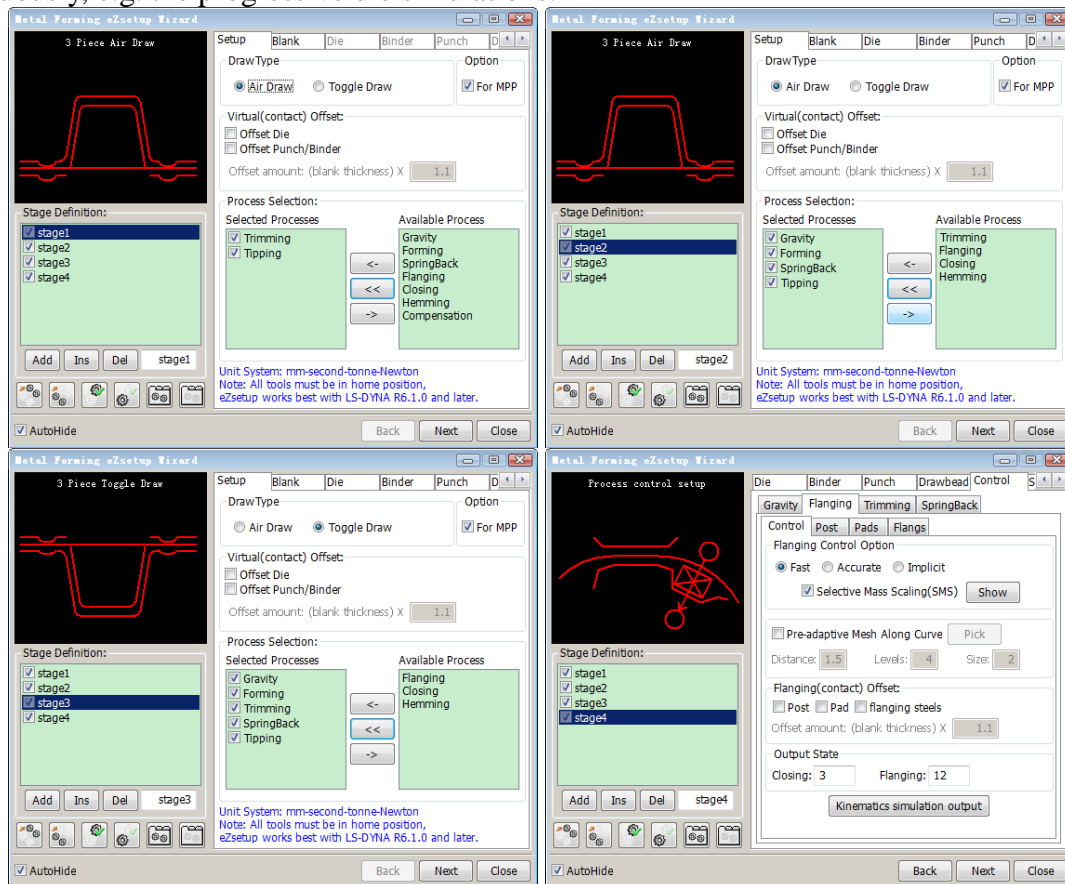


Fig. 8 the multi-stage setup

3D DrawBead Module

The 3D Drawbead Module is an independent application in LS-PrePost to generate the real bead mesh on the forming tools with the specified geometric parameters from the given center line of the line beads. With this module, the user can perform more accurate simulations (e.g. springback prediction) by replacing the line beads with the real beads. With the bead profile parameters specified in the 3D Drawbead Module and assigned to each line bead by clicking on it (Fig.8), the real bead mesh can be generated immediately.

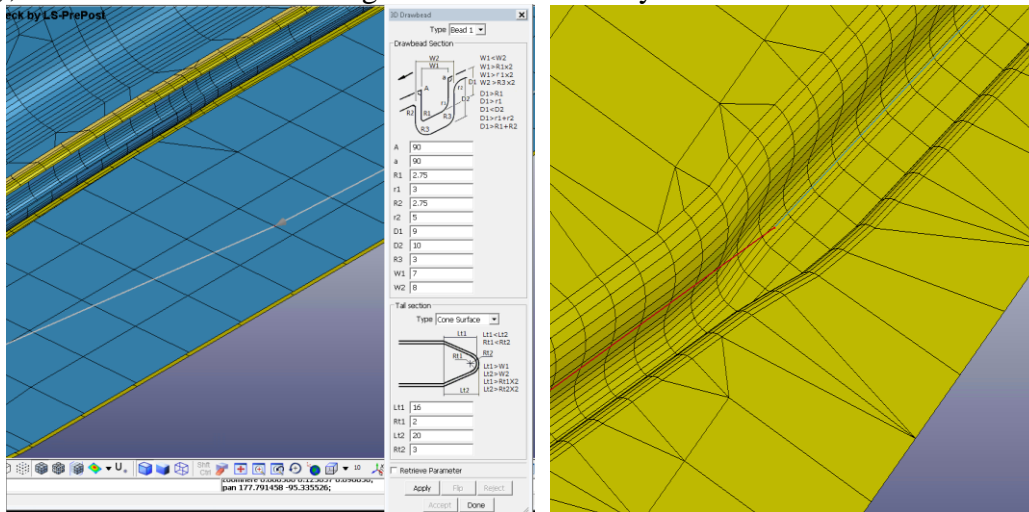


Fig 9. the 3D DrawBead Module

If two line beads representing different profiles (i.e. giving different forces) are used, automatic transition would be created for the generated real beads (Fig. 8). The mesh check and the parameter verifications are also provided to help the user to avoid possible issues when creating real beads (e.g. the geometric conflict between the male and female beads due to improper profile parameters).

Summary

In the paper the recent developments for the metal forming analysis were briefly introduced. In the EZSetup, more processes (e.g. springback compensation, lancing) were added to set up the metal forming simulations. The multi-stage setup was also enabled so that there would be no limit on the same process to be repeated in the progressive die simulations. As a newly added module, the 3D Drawbead module can help create the real bead mesh on the give tool mesh. These modules are under constant developments to assist the metal forming setup by LS-DYNA.

Reference

- [1] LS-DYNA Keyword User's Manual Volume I
- [2] Springback Prediction of A Cross Member. NUMISHEET 2005BENCHMARK 2