

The recent developments of the metal forming modules in LS-PrePost[®] (2) - The Die System Module

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Abstract

New functions have been continuously implemented into LS-PrePost for users to set up the metal forming simulations with LS-DYNA[®]. In this paper, the newly added Die System Module will be briefly introduced. Given the designed part shape, the Die System Module can be used to create the forming tool for the subsequent simulation setup in the EZSetup module of LS-PrePost. The functions that would be needed in the tool creating process are, e.g. flange separation, part tipping, flange unfolding, binder and addendum generation, are provided by the Die System Module in a step-by-step manner. This new module will be under constant development to meet the requirements of our metal forming users.

Keyword: Metal Forming,; Tooling Creation; Addendum Generation; Binder Design

Introduction

For metal forming simulations, application modules have been continuously implemented into LS-PrePost. Some of them have already been used in practical production analysis, such as the EZSetup and Blank size/Trim Line Development. In this paper, the newly added Die System Module (DSM) will be briefly introduced. Given the final part shape, the Die System Module (DSM) can help metal forming users generate the tooling including the binder and addendums, which can be directly used in the EZSetup module for the forming simulation. As will be shown below, the DSM consists of workflow tabs that contain the operations in the tooling creation process.

Preparing the part

As shown in Fig. 1, the “Preping” Tab is the first tab of the DSM, allowing the user to prepare the given part for further processing. The part should be given as mesh by importing or meshing the IGES surface. With the part added to the DSM job, necessary operations such as filling the holes, defining the symmetry of the part and specifying the flanges of the part will be performed here.

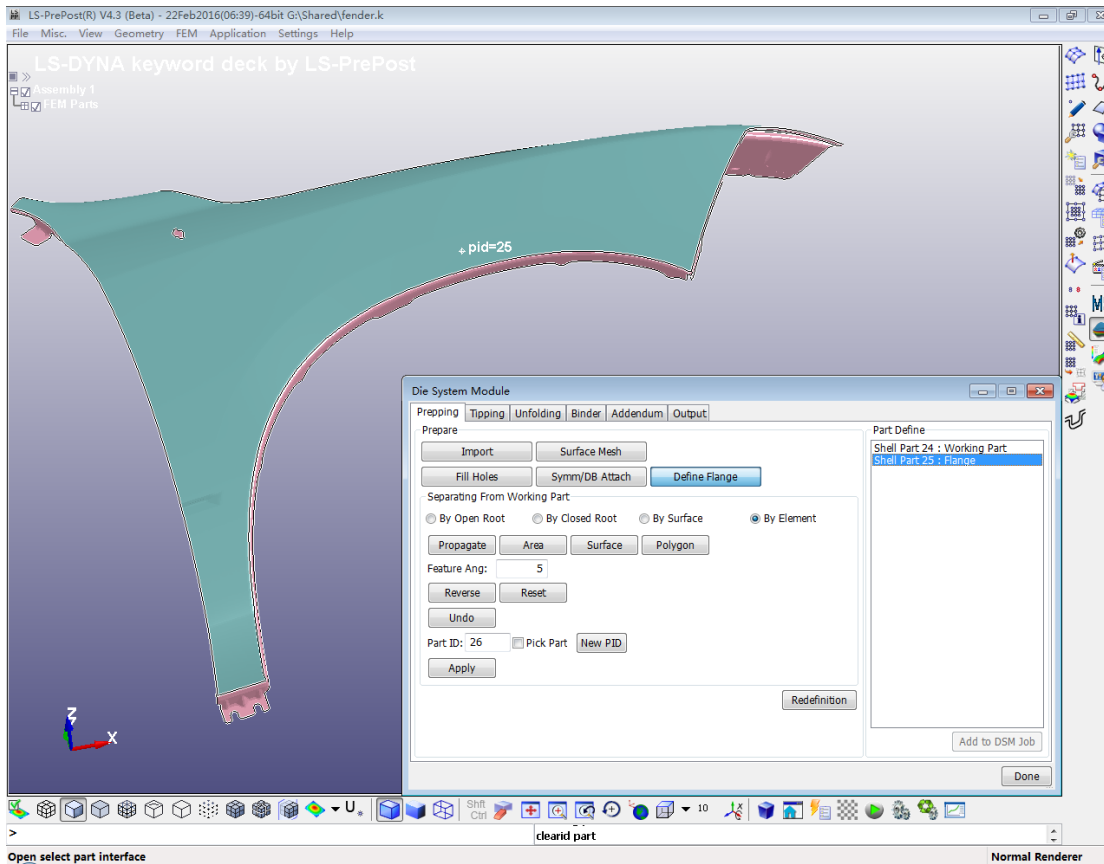


Fig.1 the Prepping tab of the DSM

New selecting methods (e.g. by root and by surface methods) are available to promptly define the flange elements. For symmetric parts, the symmetry definition is recommended although it is still possible to perform the later steps without doing so. And the trimming line of the filled holes can be saved and output later.

Tipping the part

The “Tipping” tab contains the tools to tip the part (with the exclusion of the flanges) to a proper draw position. Automatic tip center determination and the various draw axis definitions are implemented. Four criteria are available to tip the part: average normal, min draw depth, max contact area, min under cut. The tipping information can be saved for later use. Also the undercut can be checked.

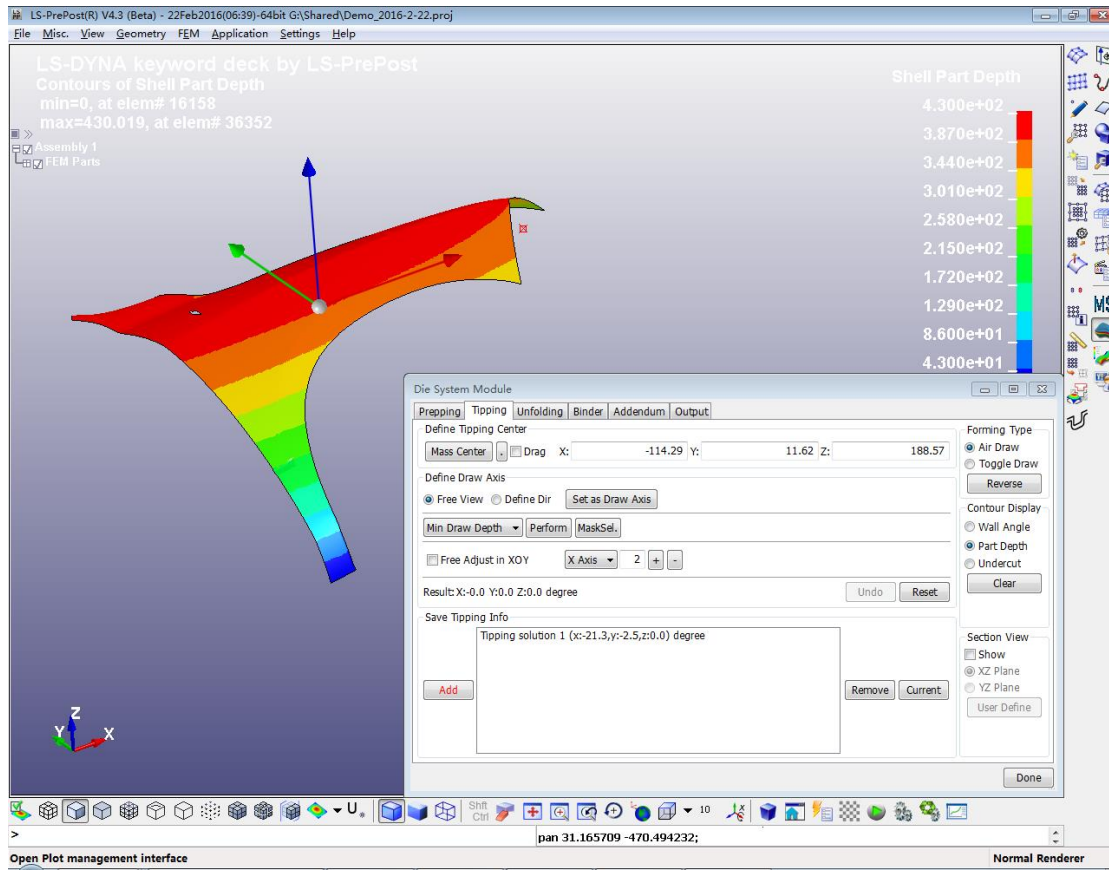


Fig.2 the Tipping tab of the DSM

Here the forming type, either the air draw or the toggle draw, will be specified. Also the wall angle, the path depth and the undercut can be checked and displayed as contours. To facilitate the inspection, the section view is available.

Unfolding the flanges and smoothing the boundary

Before creating the binder, it is necessary to specify how the defined flanges will be processed. Four strategies are provided in the “Unfolding tab”: Tangent, Horizontal, Down and Die surface. Unlike the former three which are performed immediacy when applied; the Die Surface option allows the flanges to be unfolded to the addendums that will be determined later.

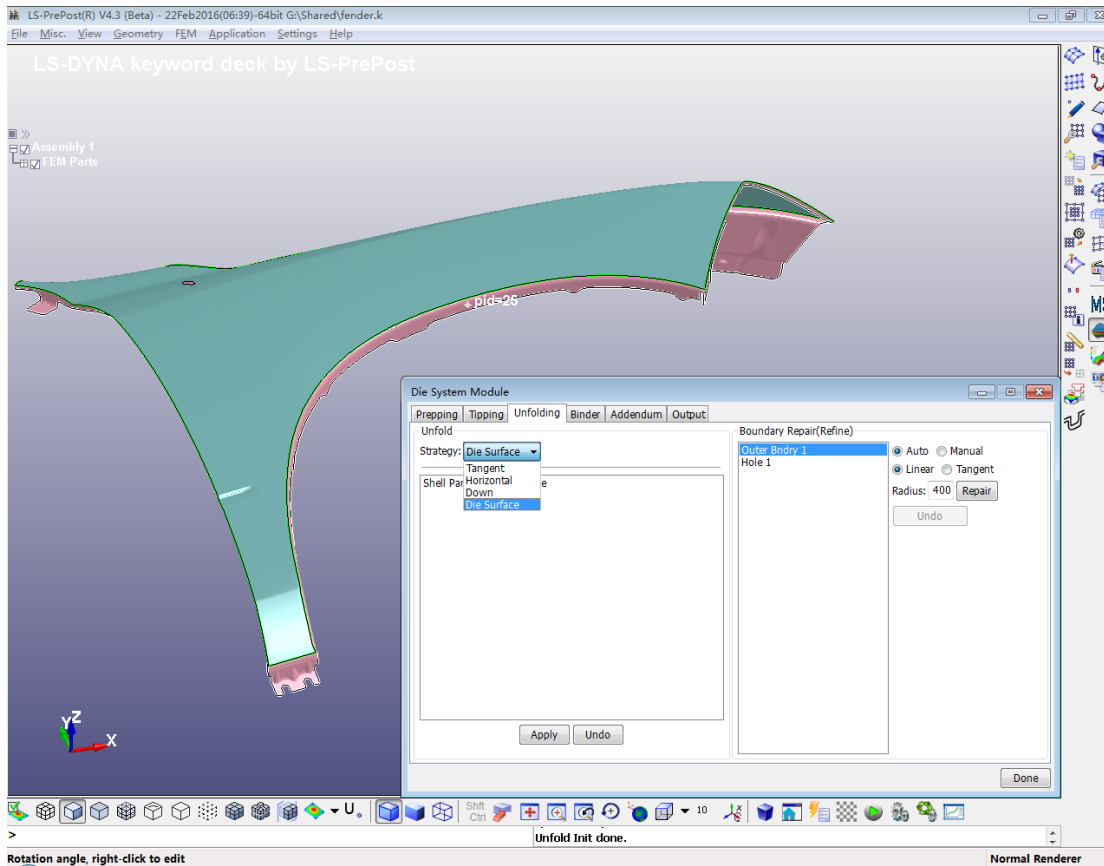


Fig.3 the Unfolding tab of the DSM

The boundary repair (refine) function is also included in this tab, with different means available.

Generating the binder

In the “Binder” Tab, one can generate the binder as the flat or non-flat types. To define the flat type, only the shift in z-direction and the size of the binder are needed. With the free hand drawing, the non-flat binder can be created with the sketched profile (by Extruding, Sweep or 2-Side Surface). As shown in Fig.5, the sketch of the binder profile can be accomplished with the abundant functions.

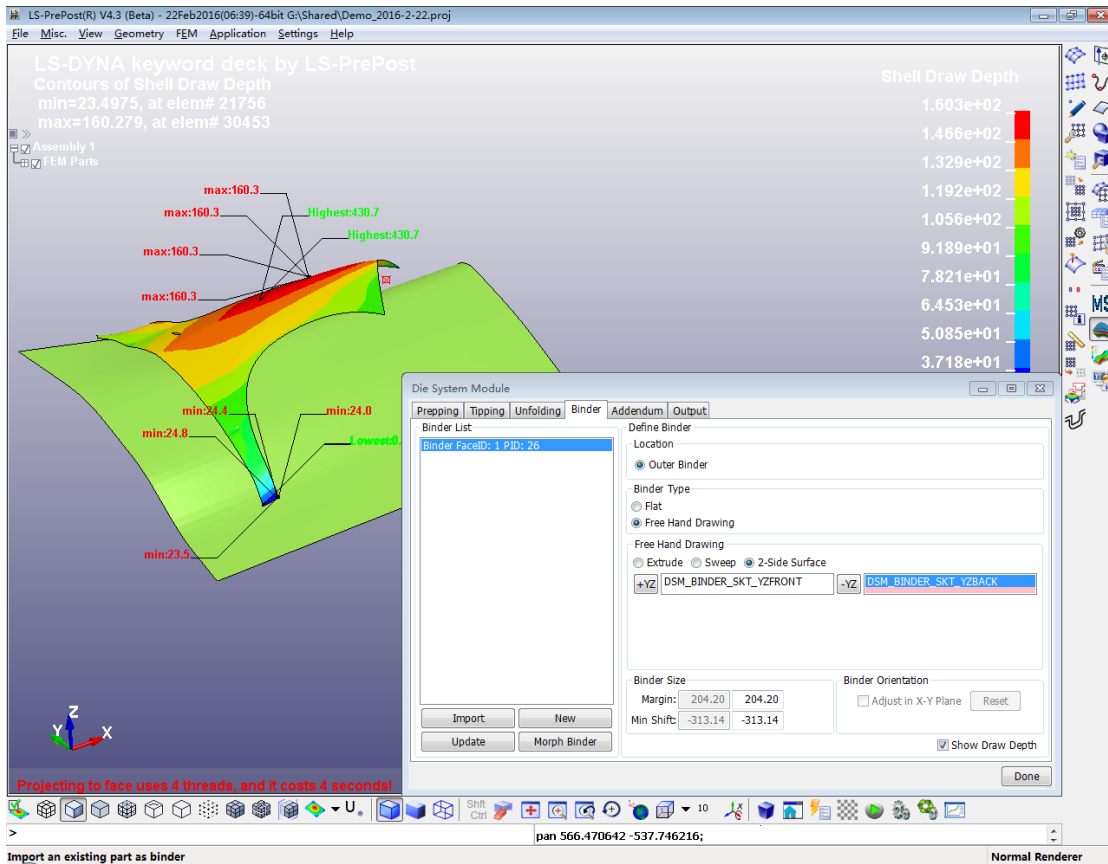


Fig.4 the Binder tab of the DSM

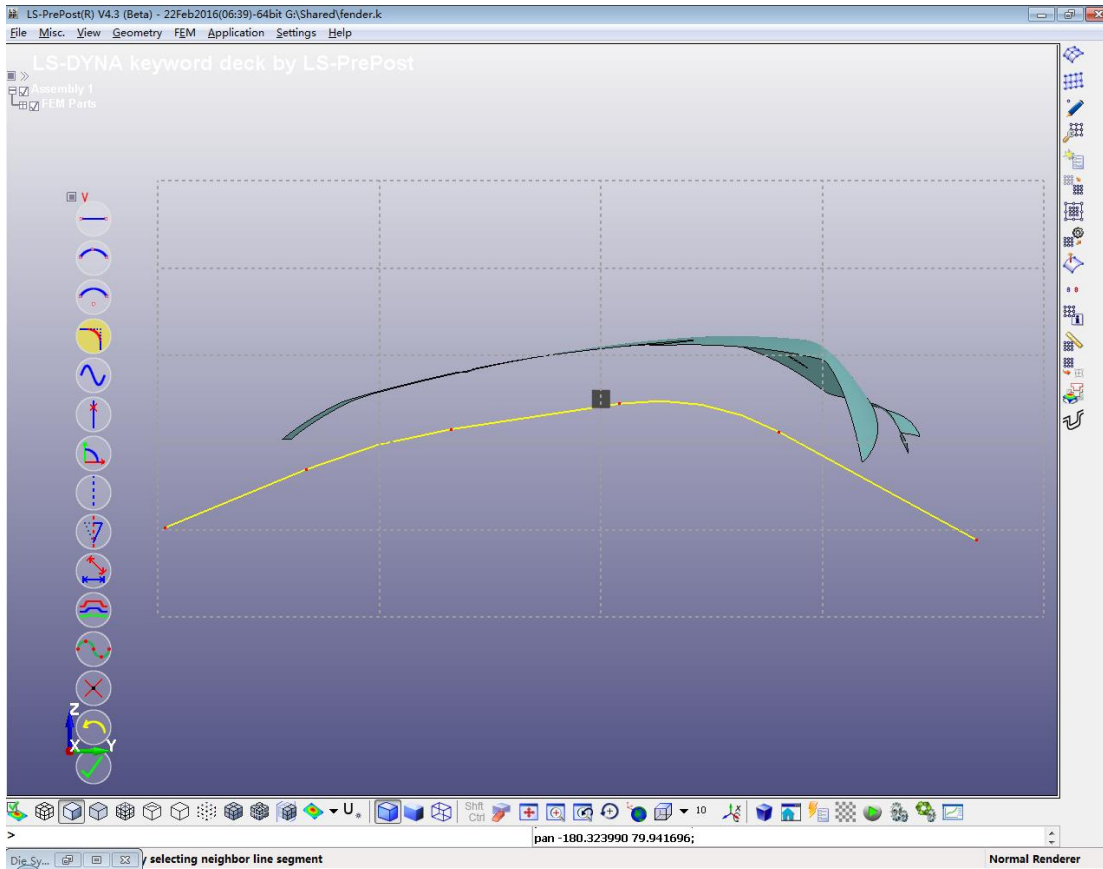


Fig.5 creating the binder profile by sketching

It can be noted that the DSM allows the user to create and save more than one set of binder for later use. In the current version the outer binder type is supported and the inner type is being developed and will be added soon.

Generating the addendums

The addendum design is critical in the tool creation. In the “Addendum” tab, several preset templates are provided to cover the common addendum profiles. With the specified geometric parameters, the selected profile can be easily created along the edge of the part by picking the location.

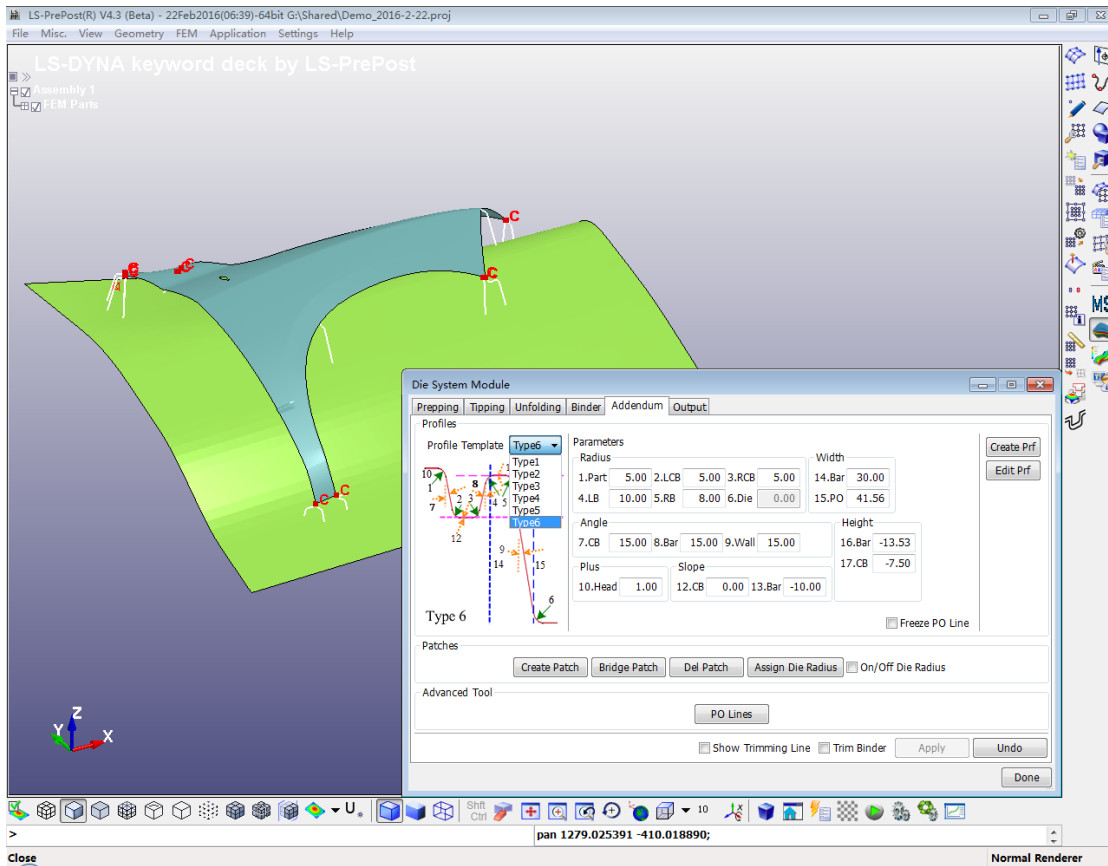


Fig.6 Creating the addendum profile in the “Addendum” tab

Editing the existing profiles, including modifying the geometric parameters, moving or copying the entire profile, can also be readily done with as shown in Fig. 7.

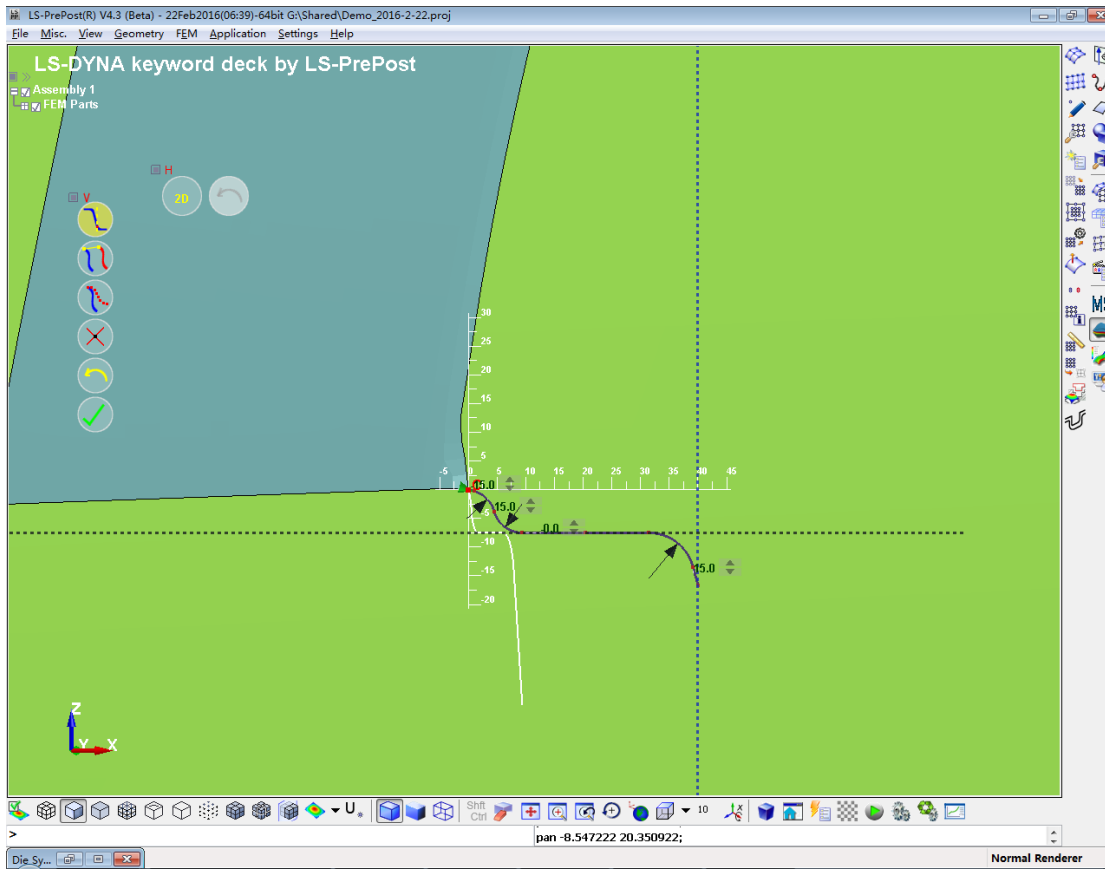


Fig. 7 editing the existing addendum profile

When two addendum profiles are established at the two selected locations, a patch can be created between the profiles with automatic transition. Meanwhile bridging function is also provided to create transition patch between two patches. The PO lines can be adjusted manually if necessary. When the addendums are generated, the die radius can be specified and created and the binder can be accordingly trimmed with the trimming lines saved.

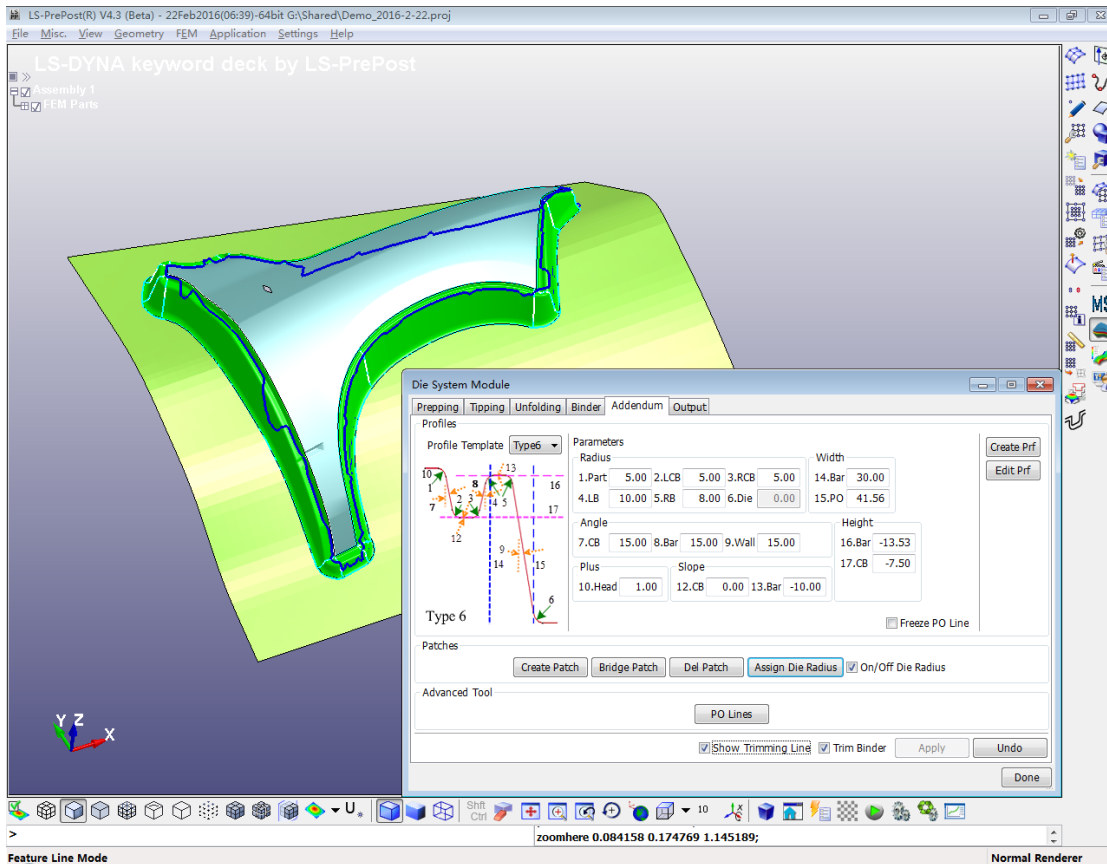


Fig.8 Created addendum in the “Addendum” tab

Output the tooling components

When all the tooling components are created, the mesh along with the trimming lines (including the boundary lines of the holes in the original part) can be output to the folder specified by the user in the “Output” tab.

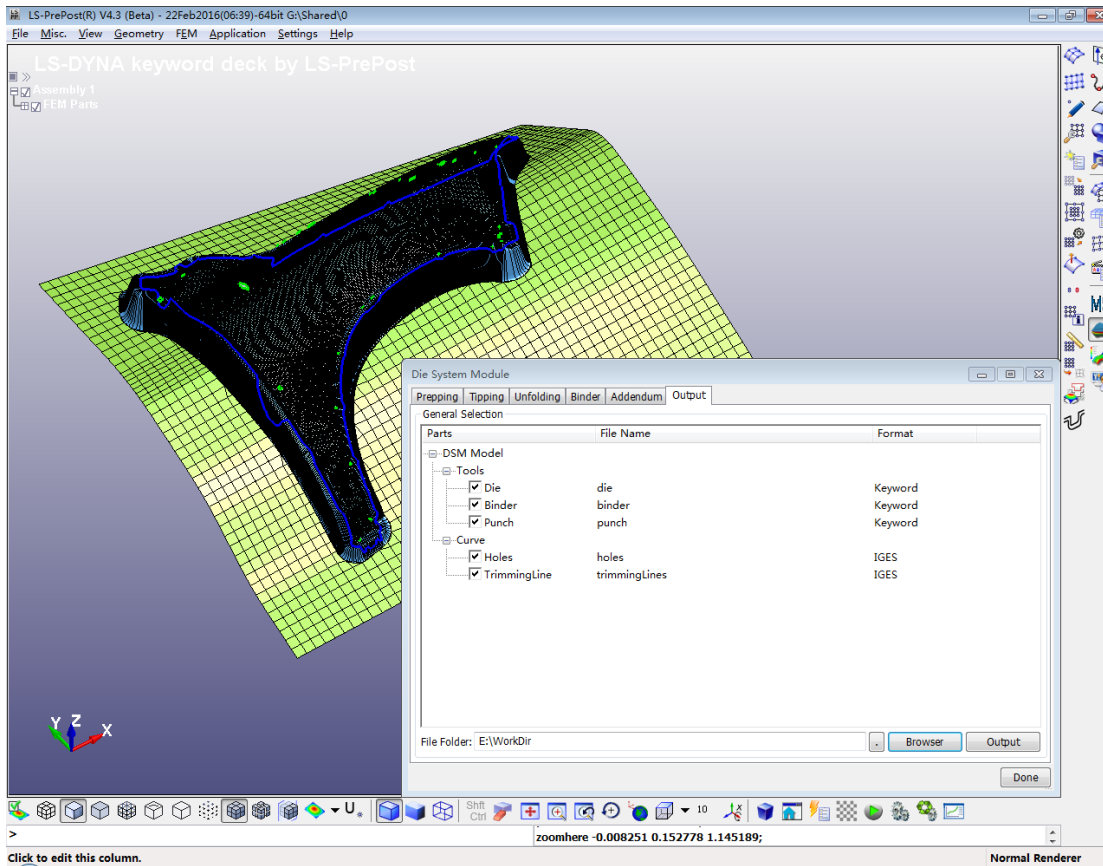


Fig.9 the Output tab of the DSM

Currently the mesh output is supported and the output in the IGES format will be implemented in the future.

Summary

In the paper the functions of the Die System Module (DSM) in LS-PrePost were briefly introduced. The newly added module allows the metal forming users to start the product stamping analysis with the final part instead of existing tool mesh. This module will be under constant development to meet the requirements of our metal forming users.