AFDEX Newsletter
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MFRC
www.afdex.com, mfrc@afdex.com
Tel: +82-55-755-7529, Fax: +82-55-761-7529

Contents

1. AFDEX_V21

1.1 AFDEX_V21R02 Release

AFDEX_V21R02 will be released at the end of October, 2021 and offers a new set of improvements in solver and Pre/Post-processors.

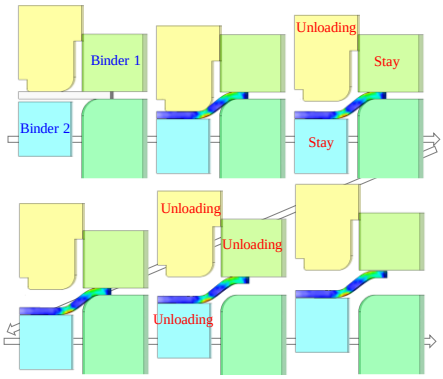
This new version includes improvements and bug fixes, notably the following features:

- Motion Analysis of Die Unloading
- Gap Flow Control
- Die Structural Analysis of Plane Strain
- Addition of CFRP Constitutive Model
- 2D Automated Process Setting for Workpieces/ Dies Model
- 3D Automated Process Setting for Workpieces/ Dies Model
- Initialization of Gravity Position
- Dimensioning
- Result Probe
- AFDEX_SP New Features and Improvement

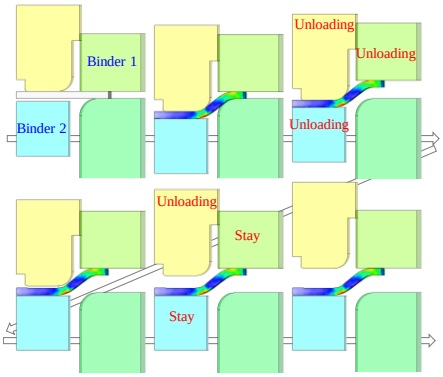
2. AFDEX_V21R02 Improvements

2.1 Motion Analysis of Die Unloading

Previously, for the case without binders or dependent (slave) dies, backward motion can be simulated with information of velocity profile of dies. AFDEX_V21R02 provides the forming analysis according to the backward motion of the dies regardless of the binders and slave dies. The motion of the dies will be differed according to the upper and lower binder force which is entered as an input. Using this feature, AFDEX can simulate the whole process of the dies' returning to the starting position during plate forging. Figure 2.1 shows the example of the motion analysis of die unloading.



(a) Case where binder force1 is greater than binder force2

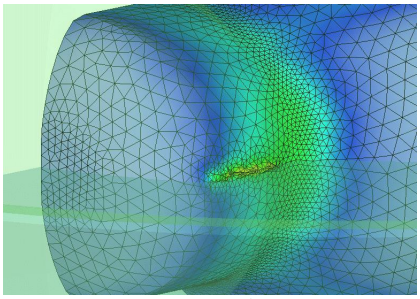


(b) Case where binder force1 is lower than binder force2

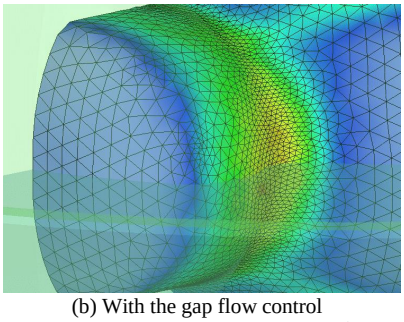
Figure 2.1 Unloading motion according to variation of the binder force

2.2 Gap Flow Control

Previous versions had a feature controlling gap flow occurring in the vertical direction but did not offer for the case of vertically-aligned dies, which the direction of the gap flow is horizontal. As shown in Figure 2.2(a), burr can be generated between the two actual dies, especially during enclosed-die forging. However, this can cause remeshing and increase in execution time, which is not proper in terms of obtaining a solution for the conceptual design. The new version allows to control all the gap flow according to what users enter for the input data.



(a)Without the gap flow control

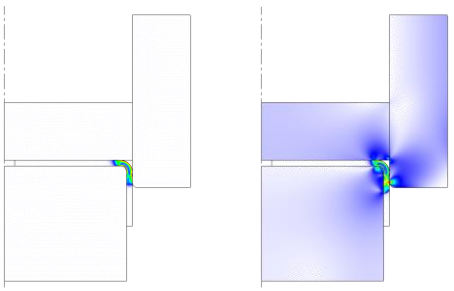


(b) With the gap flow control

Figure 2.2 Controlling burr in closed-die forging

2.3 Die Structural Analysis of Plane Strain

Die structural analysis (DSA) can be categorized into a single die DSA and assembled dies DSA, and DSA of 2D plain strain problem for the assembled dies was not provided in the previous version. Now, AFDEX_V21R02 adds a feature DSA of 2D plain strain. The analysis for the assembled dies is widely used for the analysis considering the elastic deformation of dies. Figure 2.3 compares the results of effective stress after performing DSA of plane strain in the prevision version and AFDEX_V21R02.



(a) Original (b) Improvement

Figure 2.3 Results of DSA of plane strain (Effective stress)

2.4 Addition of CFRP Constitutive Model

The constitutive model of CFRP proposed by Wang et al. (Polym. Compos., 2002, Vol. 23, pp. 858-871) is added for analysis of CFRP. The input variables for the CFRP analysis are max/min flow stress, max/min effective strain, max/min temperature, Young's modulus and stress coefficient as a function of temperature.

This model will be added in the constitutive library provided in AFDEX_SP of the new release version, AFDEX_V21R02.

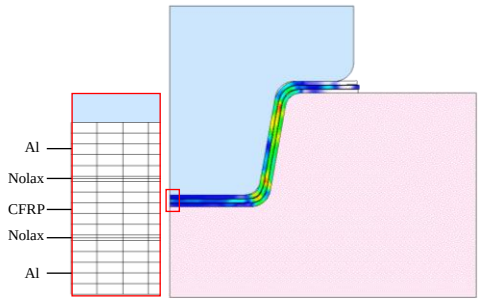


Figure 2.4 Application of CFRP constitutive model

3. AFDEX_V21R02 GUI Improvements

3.1 2D Automated Process Setting for Workpieces / Dies model

In cases of AFDEX 2D module, automated process setting is applied for each stage after importing DXF file which includes geometries information of material and dies. AFDEX_V21R02 can modify information of geometries of dies of an arbitrary stage, which previously was impossible.

3.2 3D Automated Process Setting for Workpieces / Dies Model

Previously, only AFDEX 2D has supported the feature of making overall processes automatically when importing DXF file. However, the new release supports the feature for both 2D and 3D, which STL file can also be utilized. For this feature in 3D, the automation of the process will be determined by filenames.

- Workpiece: SiiWjj, ii and jj stand for the stage ID number and the ID number of a workpiece, respectively.
  Ex) Stage: 1, workpiece ID number: 1, then S01W01

- Upper die: SiiUjj, ii and jj stand for the stage ID number and the ID number of an upper die, respectively.
  Ex) Stage: 1, upper die ID number: 1, then S01U01

- Lower die: SiiUjj, ii and jj stand for the stage ID number and the ID number of a lower die, respectively.
  Ex) Stage: 1, lower die ID number: 1, then S01L01

Note) If the filename includes any keywords described above, this feature will be applied.

3.3 Initialization of Gravity Position

Previously, the initialization of the gravity position has been operated by the solver. However, it needs to be implemented inside the pre-processor to check on input data while setting the conditions for analysis. As shown in the figure 3.3, AFDEX_V21R02 provides the feature of initializing position considering gravity as an initialization option in pre-processing.

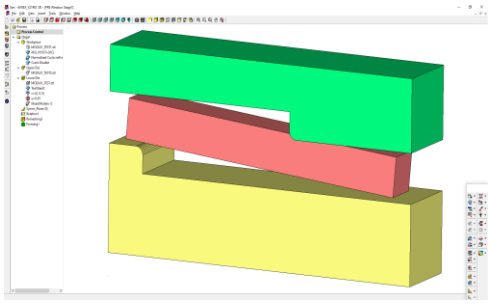


Figure 3.3 Gravity adjustment

3.4 Dimensioning

The dimensioning was used for measuring only the distance between two points such as any node of a model or vertex of a die. However, AFDEX_V21R02 adds the feature to measure the distance using points on an edge of elements or inside the elements. Figure 3.4 shows the case of dimension of user selected points.

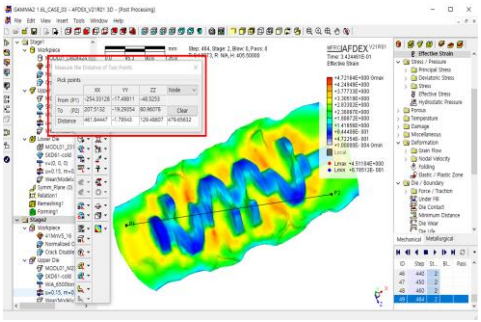


Figure 3.4 Dimensioning

3.5 Result Probe

Previously, analysis results and its coordinates were displayed on the status bar which is on the bottom of the post-processor. This can be distracting for users while checking the values.

Now, the new version provides pop-up window of the analysis results with using Probe-at icon for user convenience. (Figure 3.5)

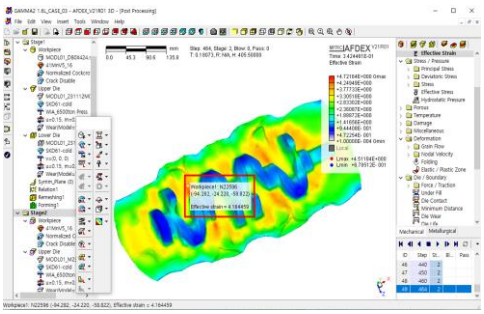


Figure 3.5 Result probe using Probe-at icon

3.6 AFDEX_SP New Features and Improvement

3.6.1 Point Tracking

AFDEX_V21R02 adds an improved option in AFDEX_SP to view the point tracking history. One can plot a state variable such as the effective strain at a point tracked by entering a node No. or selecting an arbitrary point. Figure 3.6.2 shows a part of point tracking history.

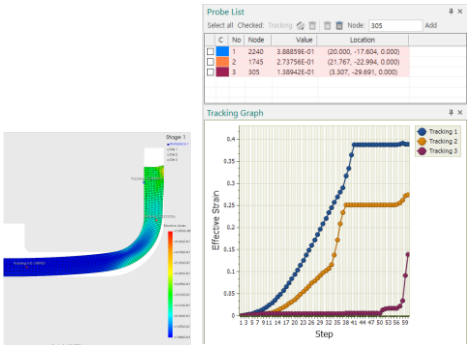


Figure 3.6.1 Point tracking history

3.6.2 Importing Mesh from NASTRAN format

AFDEX_V21R02 can import a geometry file which is in NASTRAN format (bdf file), and it is able to generate CTETRA elements for an analysis. Figure 3.6.2 shows the meshed model with bdf data.

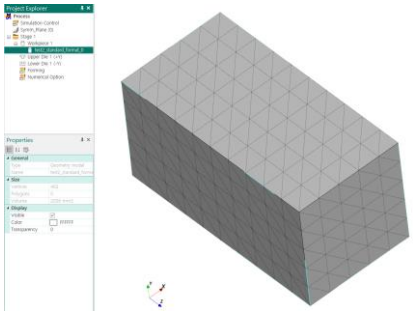


Figure 3.6.2 Meshed sample model with bdf data

3.6.3 FLC Input Data / FLD Output Data

AFDEX_SP provides a tool for entering input data of FLC (Forming Limit Curve) which Keeler's equation is used. Major strains and minor strains are plotted on a forming limit diagram (FLD), and contour values are described on the surface of the model.

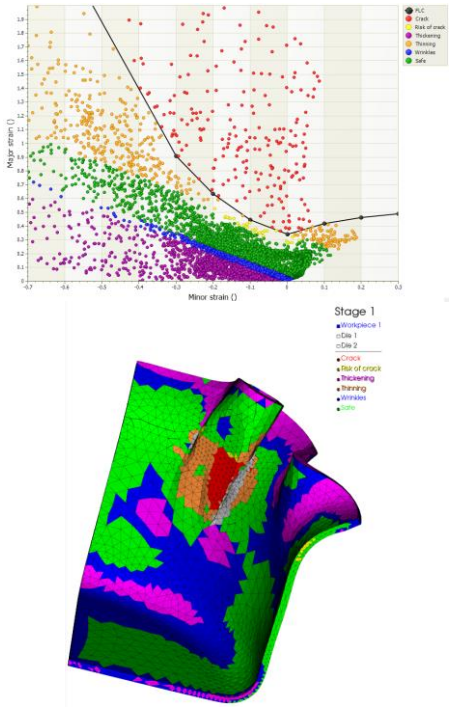


Figure 3.6.3 Formability with FLD (Forming Limit Diagram)

4. Notice

4.1 AFDEX Online/Offline Training

MFRC provides online and offline training programs that are designed to equip users with essential knowledge and skill to use AFDEX. If you are interested in AFDEX training program, please contact us.

4.2 SIAT 2021 EXPO in India

MFRC attended a biannual event in India, SIAT 2021 (Symposium on International Automotive Technology) and exhibition held by Automotive Research Association of India (ARAI) from September 29th to October 1st. In light of the ongoing global COVID-19 pandemic situation, SIAT 2021 was held as an online event.

Figure 4.1 SIAT 2021, MFRC booth

4.3 IS-KSTP30

International Symposium on Technology of Plasticity (IS-KSTP30) for Celebrating KSTP's 30 Years Anniversary will be held in Park Hyatt, Busan from November 24th to 26th. IS-KSTP30 serves as a forum for exchange of ideas and brainstorming for the metal forming industry with participation of experts in various metal forming areas. MFRC will present the applications using CAE technique and have a Q&A session to interact with AFDEX users at MFRC's booth.

4.4 JSOL CAE Forum 2021 Online

JSOL CAE Forum 2021 will be held online for 4 days from November 30th to December 3rd. This event introduces the latest technologies of various CAE packages provided by JSOL's engineering technology division. MFRC will be presenting a webinar entitled, "Metal forming simulation using AFDEX."

Figure 4.2 JSOL CAE Forum 2021 Online