AFDEX Newsletter Q3 / 2026

Adviser for metal Forming process Design EXpert

MFRC Metal Forming Research Corporation

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

Contents

1. Upcoming Release of AFDEX_V26R01

The AFDEX_V26R01 version is scheduled for release in September 2026. Preparations for release are currently underway, incorporating new features and improvements introduced in the Q1–Q2 newsletters as well as this issue.

2. AFDEX Application

2.1 Dynamic Recrystallization in Hot Extrusion

This study improved hot extrusion analysis accuracy by refining the finite element model to reflect how a real hydraulic press actually operates. Various friction models and hydraulic press operating conditions were evaluated to investigate their effects on forming load and grain size changes in P91 steel. In addition, dynamic recrystallization (DRX) behavior was analyzed based on representative specimen locations and their processing histories shown in Figures 2.1–2.2, providing a detailed examination of microstructure changes occurring during hot extrusion. The finite element analysis results agreed closely with experimental measurements, confirming that incorporating actual hydraulic press behavior into finite element analysis improves microstructure prediction accuracy and contributes to more reliable extrusion process design in industrial settings.

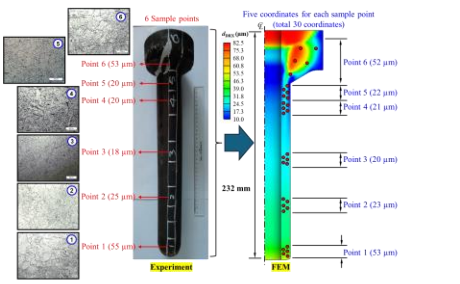


Figure 2.1 Analysis positions of dynamic recrystallization (DRX) behavior during hot extrusion

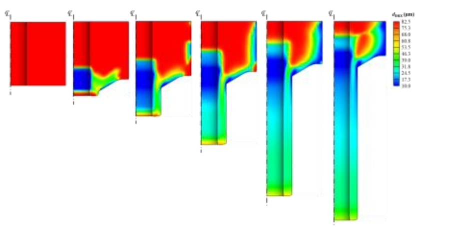


Figure 2.2 History of changes in dynamic recrystallization (DRX) behavior during hot extrusion

2.2 Automatic Multi-Stage Cold Forging Optimization for Hex Nuts

The automatic multi-stage cold forging process for an M8 hex nut was optimized, reducing the manufacturing process from five forging stages to three. Figure 2.3 illustrates the automatic multi-stage cold forging process and the corresponding die configuration. Figure 2.4 shows the metal flow lines (grain flow), confirming that the material flows smoothly throughout the entire forming process.

The optimized process produced no defects, such as underfill, while satisfying the required dimensional accuracy. From the analysis results, the optimized three-stage process demonstrated performance equivalent to that of the conventional five-stage process. This study shows that forging process optimization through simulation can significantly reduce the number of forming stages, leading to a more efficient and cost-effective manufacturing process.

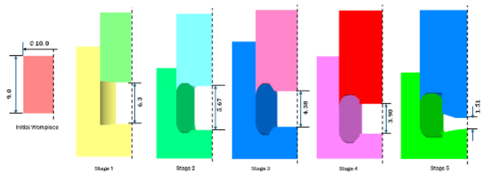


Figure 2.3 Process design

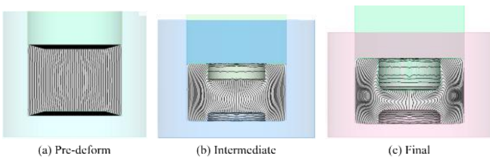


Figure 2.4 Change in grain flow lines

Furthermore, as seen in the analysis examples for the Front Hub (Figure 2.5) and Back Hub (Figure 2.6), simulation technology can be applied and processes improved for more complex forging components.

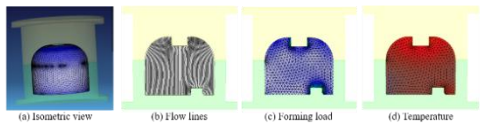


Figure 2.5 Front Hub analysis results

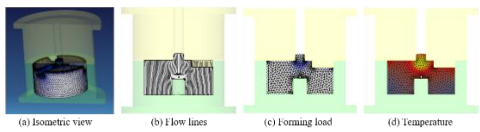


Figure 2.6 Back Hub analysis results

3. Key User Interface Improvements

3.1 3D Local Remeshing

The 3D Local Remeshing feature is officially available starting with AFDEX_V26R01. This feature selectively extracts only the regions undergoing severe local deformation, regenerates the mesh in those regions, and then reconnects them to the existing mesh. Compared with conventional global remeshing, which regenerates the entire mesh, local remeshing improves computational efficiency while maintaining the same number of degrees of freedom. It also enhances mesh quality in regions of large deformation without unnecessarily remeshing the entire model.

Users can control this feature by specifying the number of local remeshing operations, as shown in Figure 3.1. In addition, if the analysis conditions indicate that global remeshing is more appropriate, AFDEX automatically switches to global remeshing to ensure stable and reliable simulation.

Figure 3.2 compares the results obtained using conventional global remeshing and the new local remeshing technique. As shown in Figure 3.2(a), global remeshing regenerates the entire mesh during each remeshing operation. In contrast, the local remeshing method shown in Figure 3.2(b) remeshes only the regions where significant deformation occurs, while preserving the existing mesh in regions with little deformation. This approach minimizes unnecessary mesh regeneration, shortens computation time, and maintains simulation accuracy.

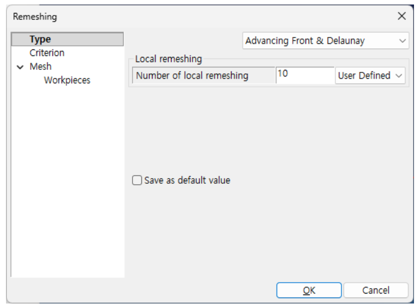
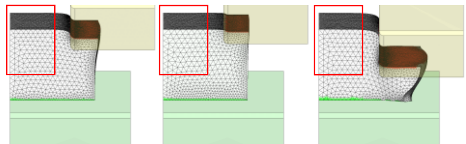


Figure 3.1 Local remeshing condition


(a) Global remeshing

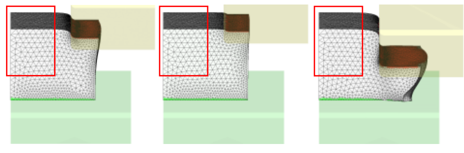

(b) Local remeshing

Figure 3.2 Application example of local remeshing

3.2 Sheet Thickness Display

The thickness display for sheet metal simulation results has been improved in AFDEX_V26R01. Previously, thickness and thickness variation rate were provided as two separate functions; in this version they are combined into a single Thickness Display tab, making them more convenient to use.

The thickness variation rate calculation has also been refined so that regions with large variation are highlighted in red, as shown in Figure 3.3. This makes it easier to identify briefly where thickness change is concentrated.

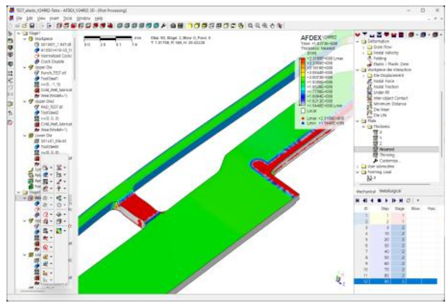
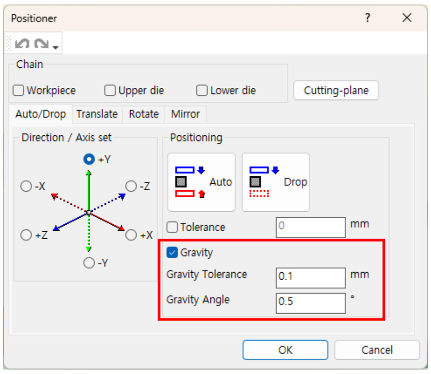


Figure 3.3 Sheet Thickness Display

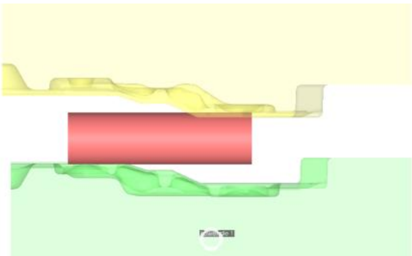
3.3 Initial Material Position – AFDEX SP

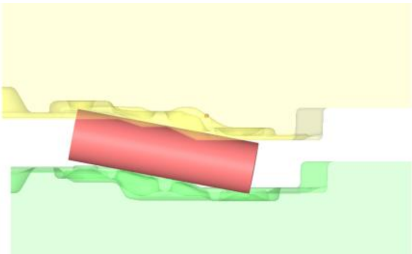
The gravity-based material position initialization function has been improved to enhance preprocessing convenience (Figure 3.4(a)). Previously, the initialization process ended as soon as the material came into contact with the die (Figure 3.4(b)). If the user wanted to consider tilting or sliding caused by gravity, additional manual adjustments were required.

In the new version, as shown in Figure 3.4(c), the initialization process continues even after the material first contacts the lower die, taking into account possible tilting or sliding under gravity. The program repeatedly checks whether the material can continue moving in the direction of gravity and automatically updates its position until it reaches a stable resting state. This feature simplifies the positioning of assembled or inserted components while reducing manual model preparation effort. It also provides more realistic initial positioning when the clearance between the die outer diameter and the material inner diameter is very small, where contact conditions are highly sensitive.



(a) Material position initialization dialog


(b) Initialization without gravity


(c) Gravity-based initialization
Figure 3.4 Gravity-based material position initialization

3.4 Tracking Point Markers and Labels – AFDEX SP

Marker and label display options have been added to the Point Tracking function. Point Tracking is used to monitor changes in analysis results at a specified location throughout the simulation, allowing users to track the evolution of selected variables over time or process steps.

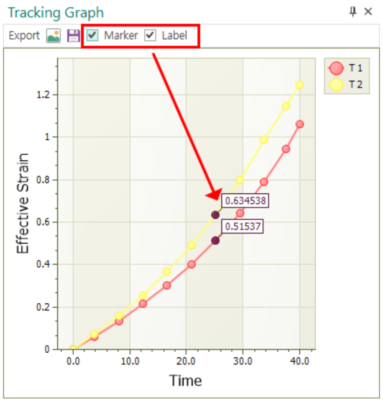


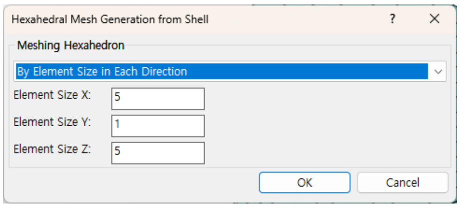
Figure 3.5 Point Tracking graph

As shown in Figure 3.5, the selected tracking point is displayed with a marker, while its corresponding information is shown as a label. This makes it easy to correlate graph data with the actual location on the model and makes result variations in regions of interest easier to interpret.

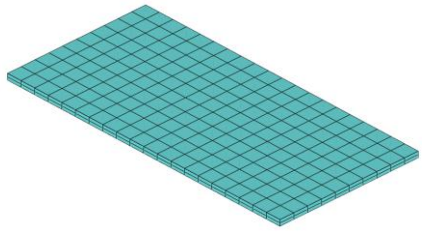
3.5 Hexahedral Mesh Generation – AFDEX SP

A hexahedral mesh generation function has been added to strengthen sheet metal forming simulation capabilities. Because hexahedral elements provide well-defined mesh structures in both the thickness and in-plane directions, they are particularly suitable for sheet metal forming simulations and enable more stable numerical analysis.

Using this feature, users can automatically generate hexahedral meshes for rectangular and circular sheet blanks, as shown in Figure 3.6(b). After creating a primitive geometry (Box or Cylinder) in the workspace, users can right-click the geometry and select Meshing → Hexahedral Meshing, as illustrated in Figure 3.6(a). The mesh can be generated based on element size, number of elements, or directional element size, allowing users to easily create meshes suitable for different geometries and analysis requirements.



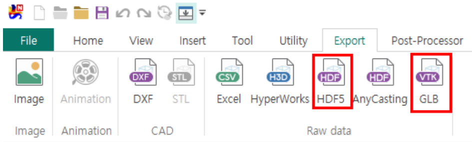
(a) Hexahedral mesh generation dialog


(b) Generated hexahedral mesh
Figure 3.6 Hexahedral mesh generation

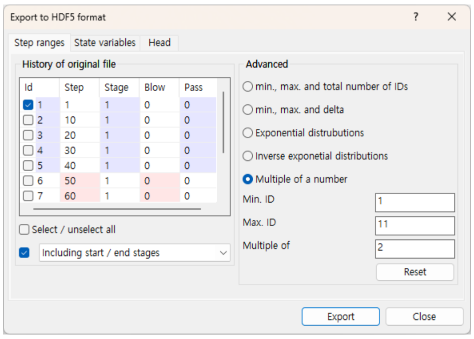
3.6 Simulation Result Export – AFDEX SP

The export functionality has been expanded to improve the usability of analysis results.

A newly added GLB export function (Figure 3.7(a)) allows the currently displayed simulation results to be saved as a 3D model that can be directly used in Microsoft PowerPoint.



(a) Export tab in the ribbon menu



(b) HDF5 export dialog
Figure 3.7 Analysis result export

In addition, an HDF5 export function (Figure 3.7(b)) has been added. Users can selectively export analysis steps and state variables, making it easier to exchange data with external software while efficiently managing large-scale analysis results.