Autodesk® Moldflow Insight 2027

Improved Warp Prediction Accuracy for Midplane and Dual Domain

Executive Summary

This report validates the improvements made in Autodesk® Moldflow 2027 to reduce discrepancies in warp predictions between Dual Domain (DD), Midplane (MP), and 3D mesh technologies. In Moldflow Insight 2027, the Uncorrected residual stress model used for Midplane and Dual Domain analyses has been improved to better align residual stress behavior with measured molding data and 3D predictions. The improved formulation continues to be named "Uncorrected residual stress", while the prior-release (Moldflow Insight 2026) formulation is available as "Legacy uncorrected residual stress" in Moldflow Insight 2027.

Validation is performed using a suite of real-world warp validation molding studies, measured shrinkage data from the Autodesk Polymer Laboratory and selected (anonymized) customer support cases. The results demonstrate improved agreement between MP/DD and 3D warp predictions, while preserving backward compatibility through the legacy option.

Contents

Residual stress modeling in warp analysis

Role of residual stress in warp prediction

In injection molding, the part is constrained while it is inside the mold, and shrinkage of the solidified layers is prevented during solidification. Stresses therefore build up in the cavity during cooling and solidification, and these stresses are released after ejection in the form of shrinkage deformation. Moldflow's warp analysis is based on this physical picture: the predicted post-ejection deformation is driven by the non-uniform stress (or equivalent initial strain) state produced during Fill+Pack history.

Several mechanisms contribute to restraining in-mold shrinkage, including adhesion of the solid skin to the mold walls, stretching forces associated with melt pressure, and geometric constraints that restrict contraction while the part remains in the cavity. In simulation, this behavior is represented by assuming the part is fully constrained in the mold, with no part–mold detachment and no in-mold shrinkage, so that in-cavity stresses accumulate as the frozen layer grows and pressure evolves.

Residual stress models prior to Autodesk Moldflow 2027

Prior to Autodesk Moldflow 2027, MP/DD analyses relied on the existing MP/DD residual stress framework (Uncorrected residual stress and CRIMS). The "Uncorrected" nomenclature refers to a predictive model based solely on laboratory benchtop property measurements (modulus, Poisson's ratio and coefficient of thermal expansion), without the use of molded shrinkage-based calibration or correction. In 3D analyses, Uncorrected residual stress and STAMP represent the residual-stress-based approaches for materials without and with measured shrinkage data respectively, while the Generic shrinkage model is a legacy method that does not compute molded-in residual stresses in the same manner.

This report validates the improvement of the MP/DD Uncorrected residual stress behavior to better align MP/DD predictions with 3D predictions and measured molding data, while retaining a legacy option for backward compatibility (discussed in later sections).

Residual stress model improvements in Moldflow 2027

Motivation for the improvements

The focus of this work is to reduce the differences between MP/DD versus 3D warp predictions by improving the accuracy of Uncorrected residual stress behavior used by MP/DD analyses.

Using internal validation, we observed that the 3D residual-stress-based behavior was generally more physically consistent for tested materials. As a result, the changes in the Moldflow 2027 version improve the MP/DD implementation so that its residual stress behavior is more closely aligned with the 3D approach, thereby reducing MP/DD versus 3D differences while retaining MP/DD as an efficient workflow for production use.

What changes in Moldflow 2027

The Moldflow 2027 improvement updates the MP/DD Uncorrected residual stress formulation to better reflect the polymer stress behavior seen in 3D analyses, with the goal of improving consistency between different mesh technologies.

User options

To support both improved accuracy and backward compatibility, Moldflow Insight 2027 provides four shrinkage model options for Midplane (MP) and Dual Domain (DD) warp analyses: Uncorrected residual stress, Legacy uncorrected residual stress, Corrected residual in-mold stress (CRIMS), and Residual strain.

(1) **Uncorrected residual stress** (improved in Moldflow 2027)
The improved formulation remains named “Uncorrected residual stress” in Moldflow 2027.
For MP/DD, Uncorrected residual stress is used when it is selected or the selected material does not have measured shrinkage data, in which case the Fill+Pack analysis predicts residual stress values based on the flow and thermal history during the molding cycle.

(2) **Legacy uncorrected residual stress** (Moldflow 2026 behavior preserved)
To preserve backward compatibility, the prior-release MP/DD formulation is retained in Moldflow 2027 as the “Legacy uncorrected residual stress” option. This option enables users to reproduce historical behavior when needed (for example, regression comparisons between software versions).

(3) **Corrected residual in-mold stress (CRIMS)** (default shrinkage model when shrinkage data is available)
When shrinkage testing has been performed and measured shrinkage data is available for the selected material, CRIMS is the default MP/DD shrinkage model. CRIMS improves prediction accuracy by correlating measured shrinkage values with Fill+Pack predictions. This correlation is built upon the improved uncorrected residual stress formulation; consequently, CRIMS model is indirectly influenced by the enhancements to the uncorrected residual stress model.

(4) **Residual strain** (an older shrinkage model based on measured shrinkage data)
Residual strain is available as an alternative MP/DD shrinkage model for shrinkage characterized materials.

Validation

To assess the effectiveness of the Moldflow 2027 improvements in reducing discrepancies in warp prediction across mesh technologies, validation was conducted using three complementary approaches:

(1) Shrinkage mold measured shrinkage correlation.
(2) A warp regression test suite on complex geometries with available measurements.
(3) Aggregated outcomes from selected anonymized customer support cases.

Measured shrinkage validation test

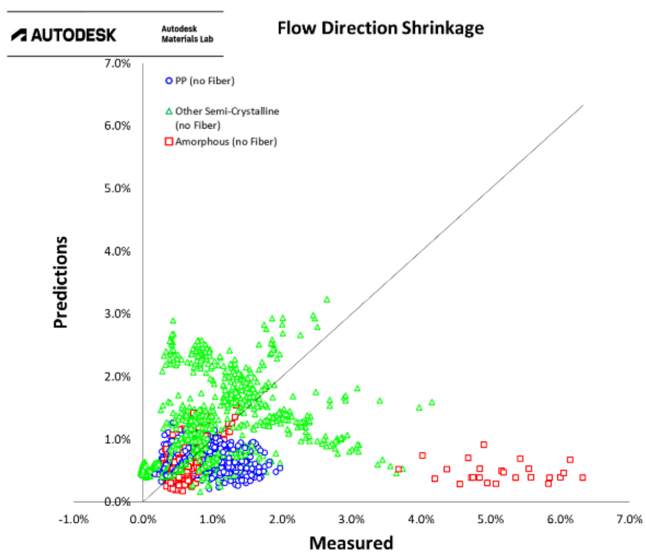
The measured shrinkage validation assesses whether the updated MP/DD Uncorrected Residual Stress (URS) formulation improves shrinkage prediction against physical measurements. The test suite simulates a plaque under 25 varied processing conditions, extracts shrinkage components parallel and perpendicular to the flow direction and compares them with measured data, which can be visualized in the charts in the following sections. A diagonal line is included in these charts to facilitate comparison between the predicted and measured shrinkage values. The closer the data point is to the diagonal line, the better the prediction agrees with the measured data.

Compared to the Moldflow 2026 predictions, the improved URS reduces prediction–measurement discrepancies in both directions for unfilled and fiber filled polymer materials and simultaneously improves consistency between MP/DD and 3D results. Overall, these shrinkage validation outcomes indicate that the Moldflow 2027 formulation moves predicted shrinkage trends closer to measured behavior while narrowing MP/DD–3D differences.

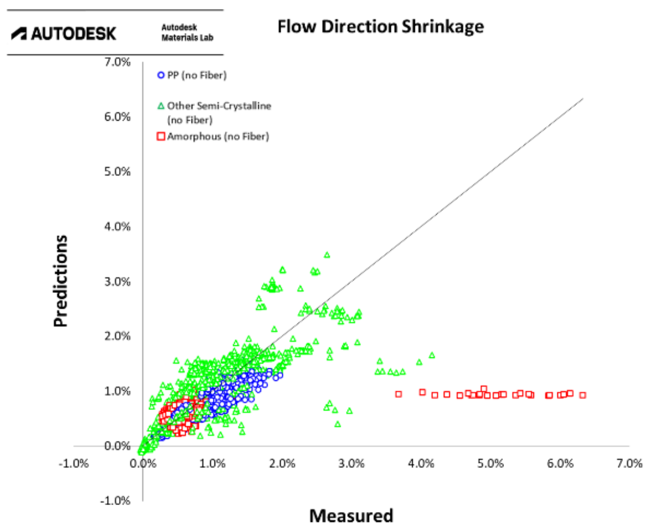
Unfilled polymer materials:

(1) Flow direction

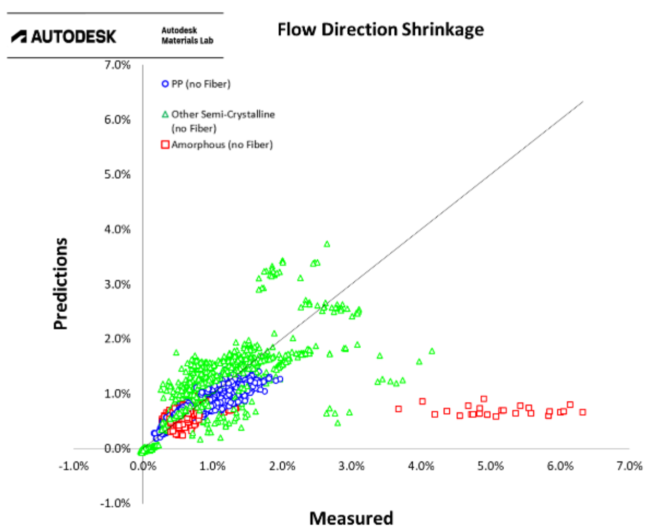
Figure 1 compares the flow direction shrinkage between prediction and measured data for 164 unfilled polymer materials. Comparing Figure 1 (a) and Figure 1 (c), it is demonstrated that the agreement between prediction and measurement is improved due to the updated URS formulation in MP/DD. Comparing Figure 1 (a) and Figure 1 (c) to Figure 1 (b), the consistency between 3D and MP is improved for unfilled polymer materials by the improvement in URS in MP/DD.



(a) Midplane in Moldflow 2026



(b) 3D in Moldflow 2026

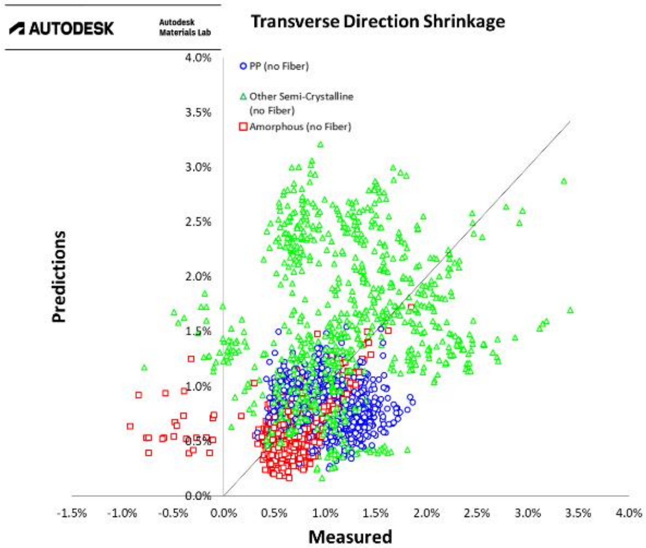


(c) Midplane in Moldflow 2027

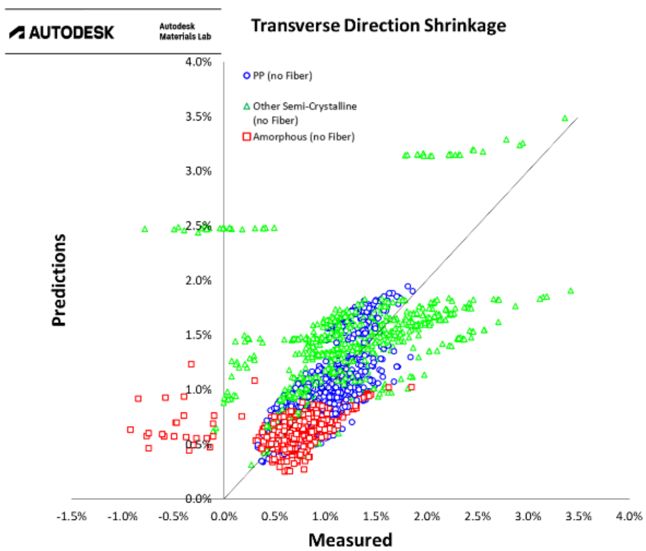
Figure 1 Comparison of flow direction shrinkage between prediction and measured data for 164 unfilled polymer materials.

(2) Perpendicular direction

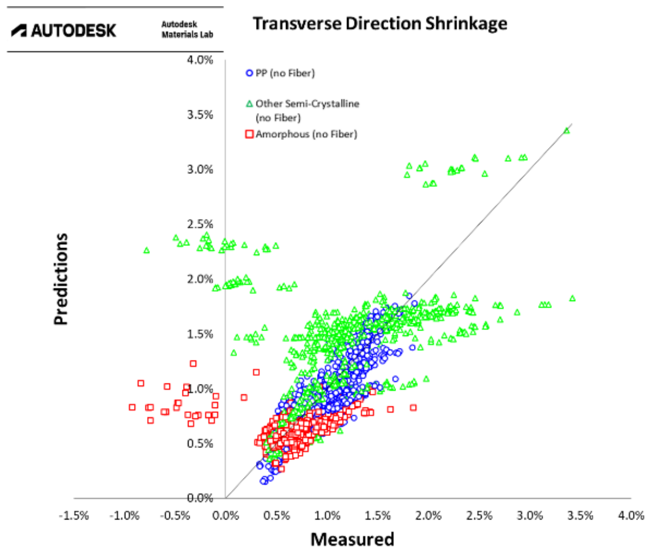
Figure 2 compares the perpendicular shrinkage between prediction and measured data for the 164 unfilled polymer materials. Comparing Figure 2 (a) and Figure 2 (c), it is demonstrated that the agreement between prediction and measurement is much improved after the improvement in URS. Comparing Figure 2 (a) and Figure 2 (c) to Figure 2 (b), the discrepancy between 3D and MP is significantly reduced following the URS update in MP/DD for unfilled polymer materials.



(a) Midplane in Moldflow 2026



(b) 3D in Moldflow 2026



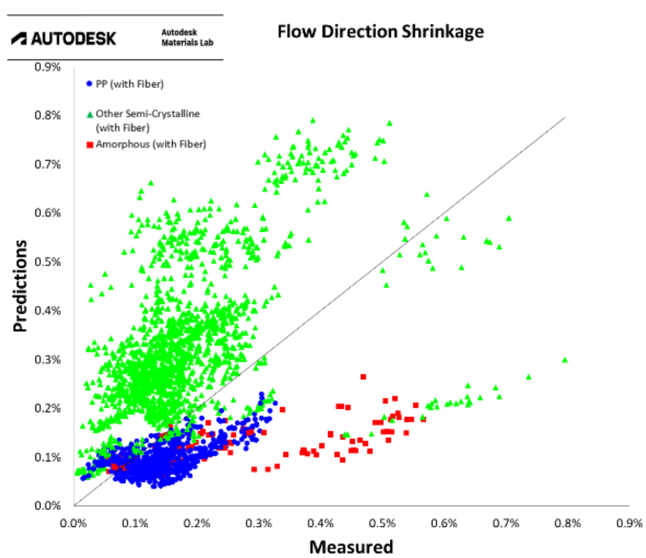
(c) Midplane in Moldflow 2027

Figure 2 Comparison of perpendicular shrinkage between prediction and measured data for 164 unfilled polymer materials.

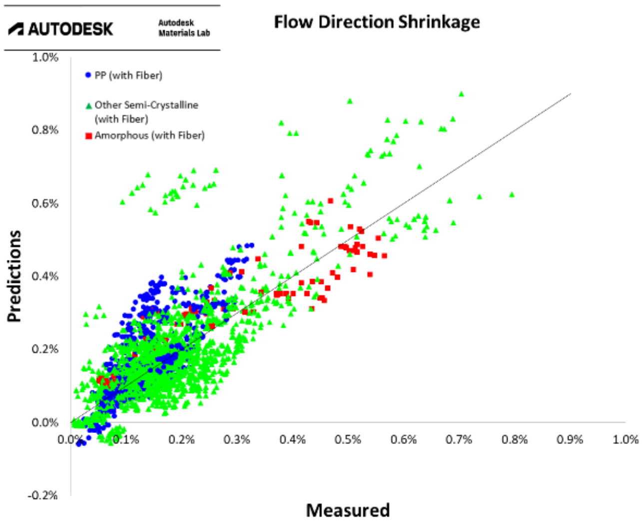
Fiber filled polymer materials:

(1) Flow direction

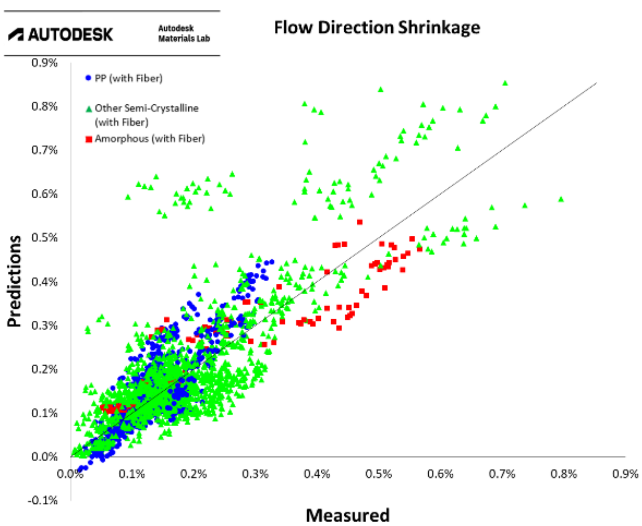
Figure 3 compares the flow direction shrinkage between prediction and measured data for 101 fiber filled polymer materials. The comparison between Figure 3 (a) and Figure 3 (c) reveals a remarkable improvement in the alignment between prediction and measurement by the improvement in URS in MP/DD. The comparison of Figure 3 (a) and Figure 3 (c) with Figure 3 (b) demonstrates effectiveness of the improvement of URS in MP/DD in reducing the discrepancy between 3D and MP for fiber filled polymer materials.



(a) Midplane in Moldflow 2026



(b) 3D in Moldflow 2026

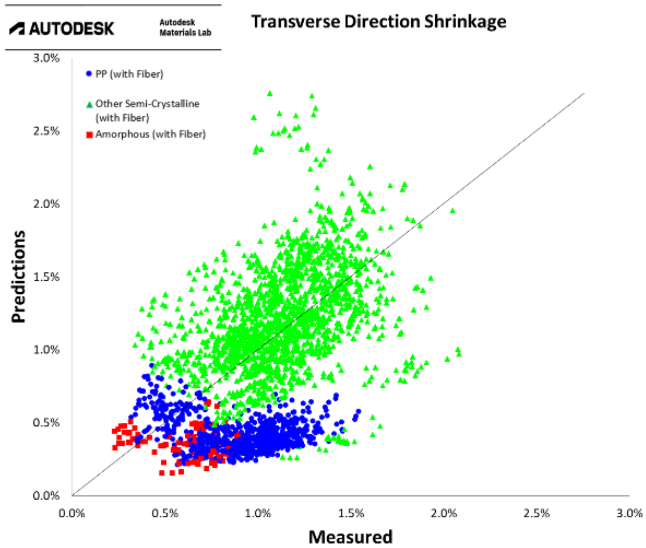


(c) Midplane in Moldflow 2027

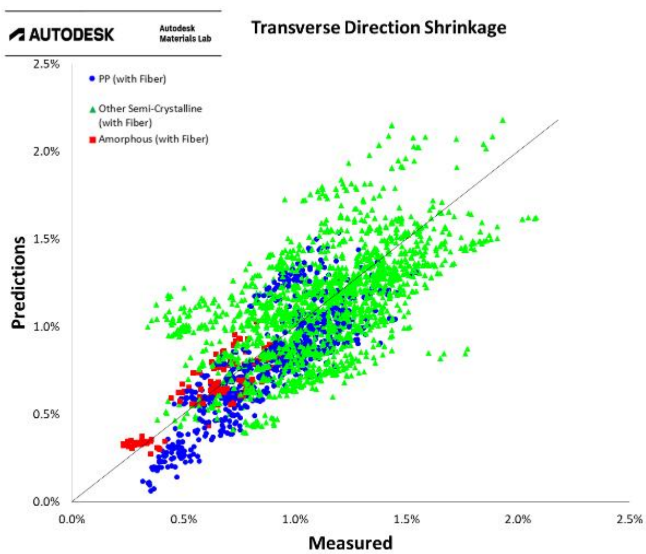
Figure 3 Comparison of flow direction shrinkage between prediction and measured data for 101 fiber filled polymer materials.

(2) Perpendicular direction

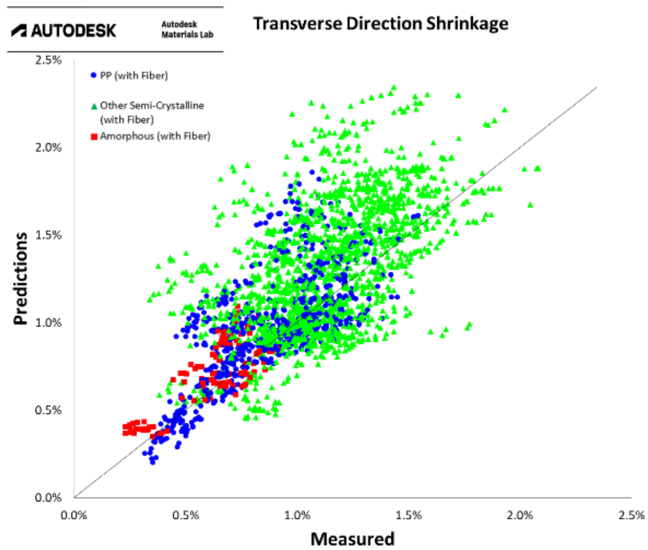
Figure 4 compares the perpendicular shrinkage between prediction and measured data for 101 fiber filled polymer materials. Comparing Figure 4 (a) and Figure 4 (c), the difference between prediction and measurement is reduced after the improvement in URS. Comparing Figure 4 (a) and Figure 4 (c) to Figure 4 (b), it is noted that the improvement in URS in MP/DD has improved the consistency between 3D and MP for fiber filled polymer materials.



(a) Midplane in Moldflow 2026



(b) 3D in Moldflow 2026



(c) Midplane in Moldflow 2027

Figure 4 Comparison of perpendicular shrinkage between prediction and measured data for 101 fiber filled polymer materials.

Warp regression test

A warp regression test suite was executed on a set of 17 real-world complex moldings to evaluate the impact of the updated MP/DD Uncorrected Residual Stress (URS) formulation on (i) consistency between mesh technologies (3D versus DD) and (ii) correlation to available measurement data. Performance was assessed by comparing solutions from Moldflow 2026 and Moldflow 2027 using deflection-based metrics (in-plane and out-of-plane components) and deformed-shape consistency, and by checking whether predictions trend closer to measurements where reliable data exist.

Cross-mesh consistency (3D versus DD)

Across the 17 cases, the change is predominantly positive in reducing prediction differences between 3D and DD. As summarized in Table 1, in-plane deflection consistency improves in 6 cases, remains similar in 2 cases, worsens in 1 case, and 8 cases are classified as having geometries too complex for a clear in-plane component-wise interpretation. Out-of-plane deflection consistency improves in 7 cases and remains similar in 2 cases (with 8 cases with geometries too complex to define a clear out-of-plane direction). Overall, comparing predicted deflection with measurement in all 17 cases, 13 cases improve, 1 case remains similar, and 3 cases worsen in terms of 3D–DD consistency.

Table 1 Consistency between 3D and MP/DD

	Better	Similar	Worse
In-plane deflection	6	2	1
Out-of-plane deflection	7	2	0
Overall	13	1	3

Correlation to measured data

Against measurement data provided in the warp regression suite, 4 cases show improved agreement, 5 remain similar, 4 worsen, and 4 cases do not include measurement data of sufficient quality for a definitive assessment, as summarized in Table 2.

Table 2 Compared to measured data

	Better	Similar	Worse	No measured data
Overall	4	5	4	4

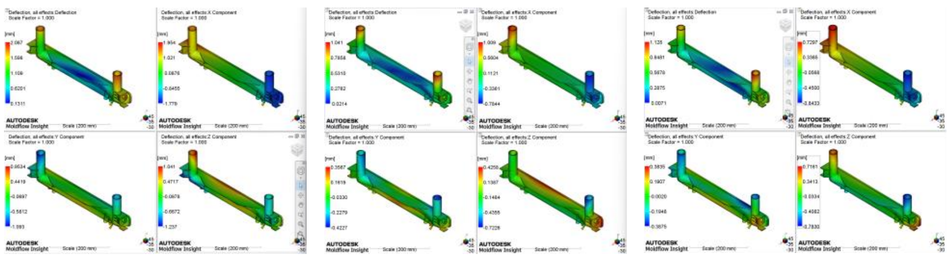
These results indicate that improvements in uncorrected residual stress formulation enhance consistency between 3D and MP/DD meshes without decreasing the warp prediction accuracy.

Representative improvement cases

The following representative cases are selected from the regression suite to illustrate typical improvement patterns observed after the URS update. Case identifiers are anonymized.

(1) Case A:

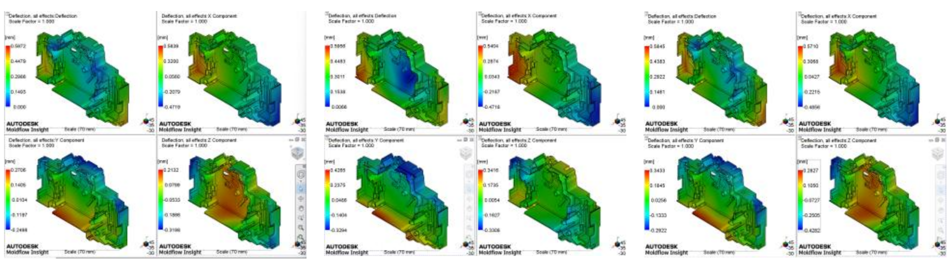
- Consistency between 3D and MP/DD: Better
- Compared to measured data: Better



(a) DD in Moldflow 2026 (b) 3D in Moldflow 2026 (c) DD in Moldflow 2027

(2) Case B:

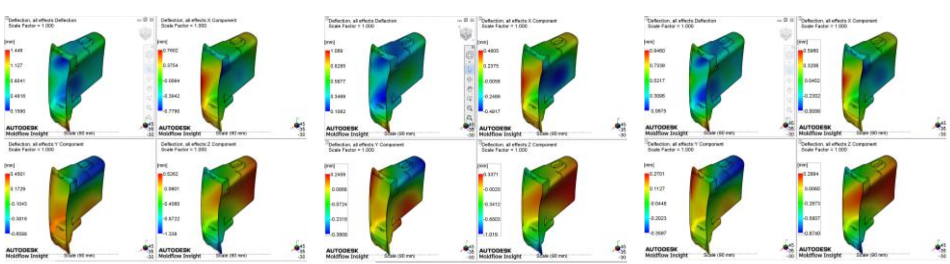
- Consistency between 3D and MP/DD: Better
- Compared to measured data: Better



(a) DD in Moldflow 2026 (b) 3D in Moldflow 2026 (c) DD in Moldflow 2027

(3) Case C:

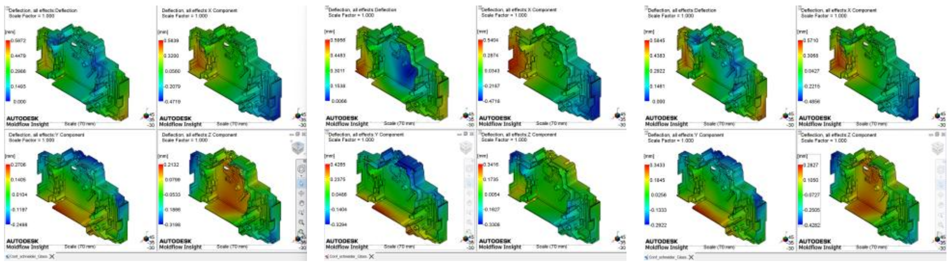
- Consistency between 3D and MP/DD: Better
- Compared to measured data: Similar



(a) DD in Moldflow 2026 (b) 3D in Moldflow 2026 (c) DD in Moldflow 2027

(4) Case D:

- Consistency between 3D and MP/DD: Better
- Compared to measured data: Similar



(a) DD in Moldflow 2026 (b) 3D in Moldflow 2026 (c) DD in Moldflow 2027

Customer case studies (anonymized)

In addition to internal test suites, the improvements were evaluated on selected customer support cases to reflect practical, real-world modeling conditions.

Across 17 customer case studies, the consistency between 3D and MP/DD is much improved. For in-plane deflection, 17 cases are improved. For out-of-plane deflection, 13 cases are improved, 3 cases show similar results and 1 case shows worse results. Overall, 15 cases are improved, and 2 cases are similar with the improvement in uncorrected residual stress formulation in MP/DD. All the results are summarized in Table 3. Overall, this change is positive in reducing numerical differences between 3D and DD mesh technologies.

Table 3 Consistency between 3D and MP/DD

	Better	Similar	Worse
In-plane deflection	17	0	0
Out-of-plane deflection	13	3	1
Overall	15	2	0

Compared to the measured data provided in these case studies, the Moldflow 2027 prediction by Dual Domain is improved compared to prior software versions, as summarized in Table 4. Overall, this change is positive in producing closer prediction to reality.

Table 4 Compared to measured data

	Better	Similar	Worse	No measurement provided
Overall	6	4	3	4

This confirms that improvements in uncorrected residual stress formulation positively impact prediction accuracy and mesh consistency.

Conclusions

Autodesk Moldflow 2027 introduces an improved Midplane/Dual Domain (MP/DD) uncorrected residual stress model aimed at reducing long-standing discrepancies in warpage prediction between MP/DD and 3D mesh technologies. The improvement is motivated by historically different residual stress formulation across solvers and aligns MP/DD residual-stress behavior more closely with the 3D approach.

Validation across internal test suites and selected real-world cases demonstrates that the improvement generally improves cross-mesh consistency and, in many scenarios, strengthens correlation to physical behavior.

To preserve backward compatibility and enable regression comparisons, Moldflow Insight 2027 retains the prior-release MP/DD uncorrected residual stress model as the “Legacy uncorrected residual stress” model, while continuing to provide other shrinkage model options (including CRIMS when measured shrinkage data is available).

Overall, the Moldflow 2027 improvement in uncorrected residual stress formulation supports more consistent warpage prediction across mesh technologies, improving confidence in MP/DD workflows as efficient alternatives to 3D for production use, while maintaining the ability to reproduce historical results via the legacy option.