Autodesk® Moldflow Insight 2024

Warpage Accuracy Improvements for Dual Domain Analyses

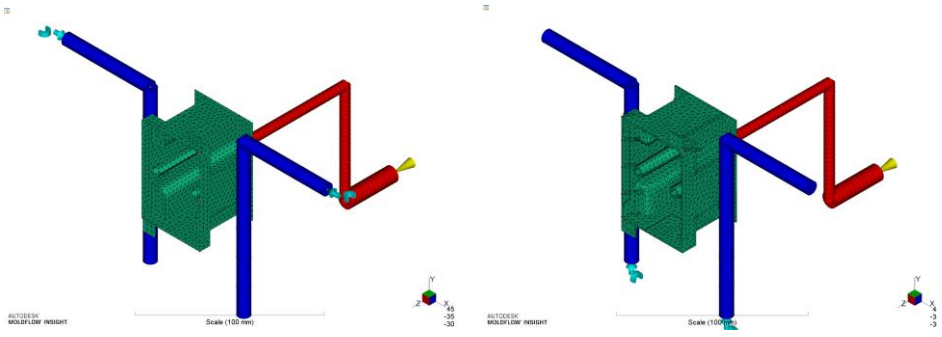
Background

The calculation of residual stress influences the accuracy of warpage predictions. The thickness of an element affects its residual stress prediction. In the Autodesk Moldflow 2024 release, the calculated thickness of Dual Domain edge elements is equal to that of the neighboring wall sections. Previously, their calculated thickness was less than that of the neighboring wall sections. This change improves the accuracy of Dual Domain warp predictions for some cases and minimizes the differences in warpage predictions between analyses using different mesh technologies. Typically, the warpage prediction of a slender long part with longitudinal ribs on one side will be affected by this improvement.

Example of minimizing the differences in warpage predictions between different mesh types

5-Sided Box with bosses

As depicted in Figure 1, a box model using either Midplane mesh or Dual Domain mesh types, supplied by Rhodia Engineering Plastics (now Domo Chemicals), is employed to validate the improvements in reducing the discrepancies in warpage predictions between Midplane and Dual Domain analyses. This model represents a typical thin-walled part with an average wall thickness of 1.5mm. The material and processing conditions for this model is given in Table 1. A complete analysis sequence, including cool, fill, pack, and warp, is run by both Autodesk Moldflow 2023 and 2024 releases.



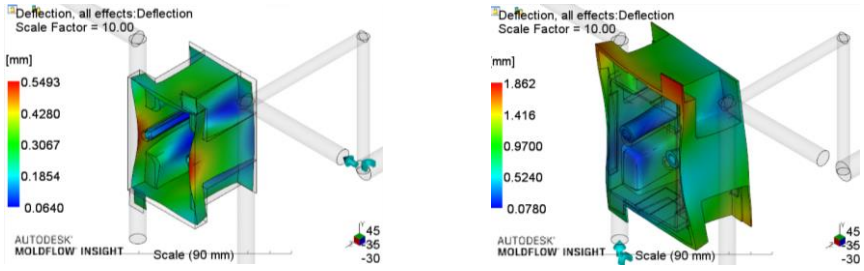
(a) Midplane (b) Dual Domain

Figure 1: 5-Sided Box Model: (a) Midplane; (b) Dual Domain.

Table 1: Material and processing conditions of 5-Sided Box Mode.

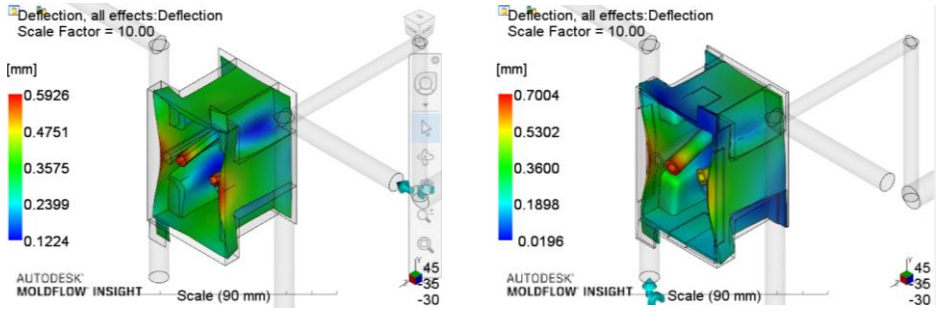
Material	TECHNYL A 218 V30 NC, DOMO Engineering Plastics Europe S.p.A. (PA66 with 30% by weight glass fiber)
Mold surface temperature	80 °C
Melt temperature	290 °C
Injection time	0.8 seconds
Velocity/pressure switch-over	By 98% volume filled
Pack/hold control	77.7 MPa for 5 seconds
Cooling time	4 seconds
Coolant inlet temperature	65 °C

The warpage predictions by the Moldflow 2023 Release and the Moldflow 2024 Release using both a Midplane mesh and Dual Domain mesh are depicted in *Figure 2* and *Figure 3*, respectively. The deflection in the x, y and z directions is scaled up by a factor of ten for all these result plots. In the 2023 release, there is a significant difference in both the magnitude and the deformation shape as predicted by the Midplane model and the Dual Domain model. The maximum magnitude of total deflection in the Midplane model is 0.5493mm, while it is 1.862mm in the Dual Domain model. This discrepancy is substantially reduced in the 2024 release, where the maximum magnitude of total deflection in the Midplane model is 0.5926mm, and it is 0.7004mm in the Dual Domain model. Furthermore, the deformed shapes predicted by the Midplane model and the Dual Domain model are more closely matched.



(a) Midplane (b) Dual Domain

Figure 2: Warpage predictions of 5-Sided Box Model by 2023 Release: (a) Midplane; (b) Dual Domain.

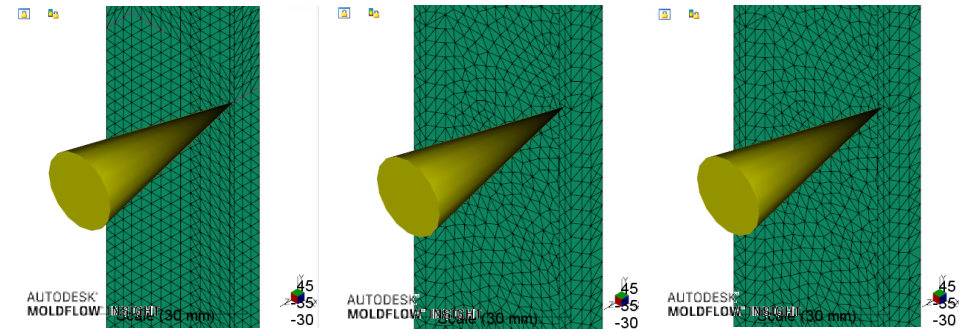


(a) Midplane (b) Dual Domain

Figure 3: Warpage predictions of 5-Sided Box Model by 2024 Release: (a) Midplane; (b) Dual Domain.

A long U-Beam

As depicted in *Figure 4*, a straight long U-Beam model is also employed to validate the enhancements in reducing the discrepancies in warpage predictions between Midplane, Dual Domain, and 3D analyses. This model represents a typical thin-walled component with an average wall thickness of 3mm and raised lips (or shallow ribs) at the edges of the part. The cross-section profile of this model is given in *Figure 5* and the material and processing conditions for this model is also listed in Table 2. An analysis sequence including fill, pack, and warp is run using both 2023 Release and 2024 Release.



(a) Midplane (b) Dual Domain (c) 3D

Figure 4: A model of long U-Beam: (a) Midplane; (b) Dual Domain; (c) 3D.

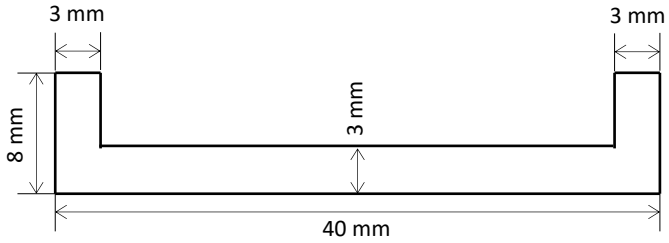
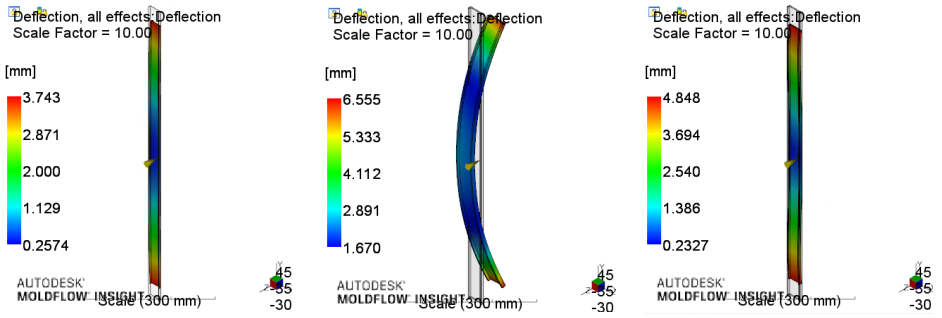


Figure 5: Cross section of long U-Beam model

Table 2: Material and processing conditions of long U-Beam.

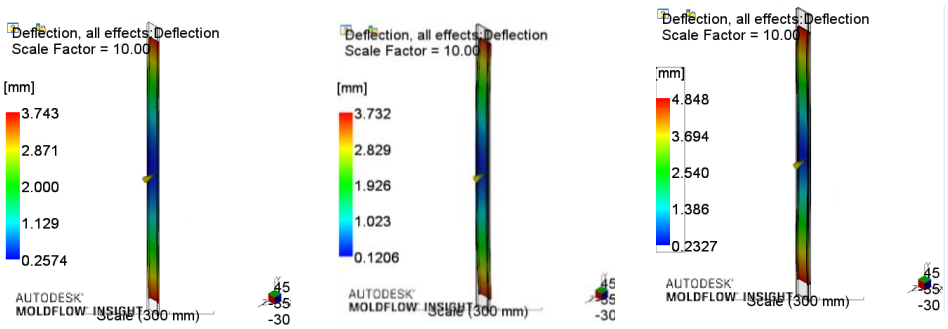
Material	AE-2030, Lotte Chemical Unfilled PC+PET
Mold surface temperature	70 °C
Melt temperature	260 °C
Injection time	4 seconds
Velocity/pressure switch-over	By 99% volume filled
Pack/hold control	60 MPa for 10 seconds

The warpage predictions by the 2023 Release and 2024 Release using a Midplane mesh, Dual Domain mesh, and 3D mesh are depicted in *Figure 6* and *Figure 7*, respectively. The deflection in the x, y, and z directions is scaled up by a factor of ten in all the result plots. In the 2023 release, there is a significant difference in both the magnitude and the deformed shape as predicted by the Dual Domain model compared to the Midplane model and the 3D model. The maximum magnitude of total deflection in the Dual Domain model is 6.555mm, which is notably different from 3.743mm in the Midplane model and 4.848mm in the 3D model. Most notably, the deformed shape in the Dual Domain model is significantly different from that in the Midplane model and the 3D model. This discrepancy is substantially reduced in the 2024 release. In the 2024 release, the maximum magnitude of total deflection in the Dual Domain model is 3.732mm, which is very close to the 3.743mm in the Midplane model. The deformed shapes predicted by the 2024 Release in these three models are also quite similar.



(a) Midplane (b) Dual Domain (c) 3D

Figure 6: Warpage predictions of a long U-Beam by 2023 Release: (a) Midplane; (b) Dual Domain; (c) 3D.



(a) Midplane (b) Dual Domain (c) 3D

Figure 7 Warpage predictions of a long U-Beam by 2024 Release: (a) Midplane; (b) Dual Domain; (c) 3D.