

Moldex3D in Connector Industry Application

[v:1.0]



CoreTech System Co., Ltd.
www.moldex3d.com

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Moldex3D Content

- ❑ Introduction
- ❑ Challenges and common problems
- ❑ Case study
 - Problem diagnosis
 - Model and parameter
 - Simulation procedures
 - Result and Discussion
 - Effects of Moldex3D application

Moldex3D Connectors

□ Connectors contain

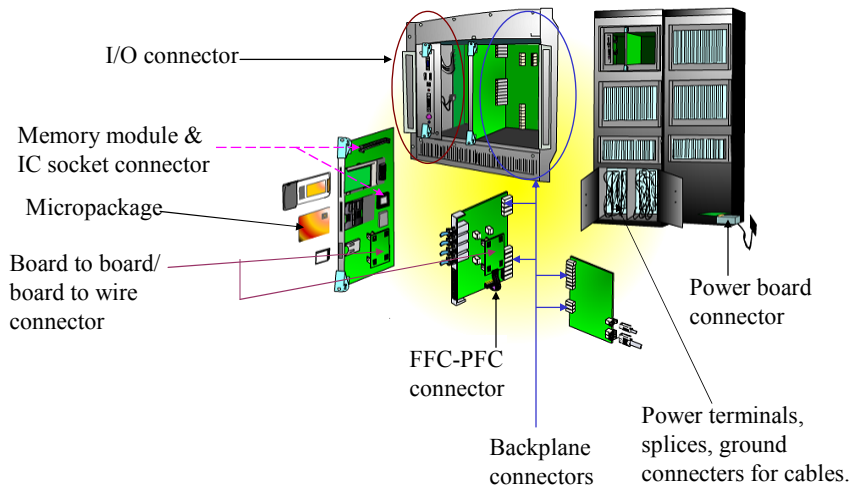
- Electrical contacts and a hosing to hold and align them.
- Many core competencies
 - Contacts,
 - Injection molding,
 - Material technology,
 - Mechanical and electrical design,
 - High-volume production.

Ref: John MacWilliams, Connector Specifier June, 2005

Moldex3D Application Fields of Connector

- Computer
- Telecommunication
- Digital Transfer
- Communication
- Automobile
- Consumer Electronics
- Industrial Electronics
- Military electronics
- Measuring Instruments
- Medical Equipment
- Others

Application Fields: For example Computer

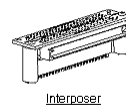
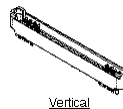
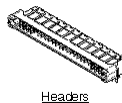
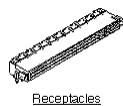


Ref: <https://portal.fciconnect.com>

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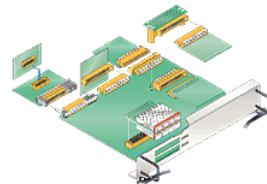
True 3D CAE for Injection Molding

Connector in Board-to-Board



Applications

- **Telecommunication**
 - Hubs, Routers, and Switches
 - Add-in Cards To Mid-Plane Or Host PCB
- **Computer Servers**
 - Enterprise and Blade Servers



Ref: <http://www.molex.com>

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True 3D CAE for Injection Molding

Moldex3D Challenges for Connector development

□ Challenges

- Miniaturization
 - Mobile application and various portable products application cause components to shrink in size and weight.
- Higher speed and performance
 - It might exceed the limits of copper, requiring alternative technology such as fiber optics.
 - High-speed signal attenuation.
 - Transitioning from parallel to serial buses.
- Lead-free issue

Ref: John MacWilliams, Connector Specifier June, 2005

Moldex3D Connectors

□ Major factors get involved

- Contacts,
- Injection molding,
- Material technology,
- Mechanical and electrical design,
- High-volume production.



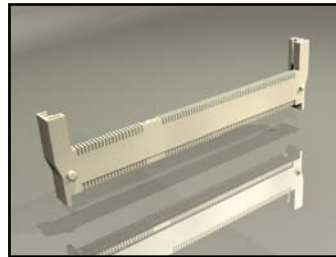
To more comprehensively realize and suitably control and manage, injection molding process is one of the most important factors to integrate all contents together.

Ref: John MacWilliams, Connector Specifier June, 2005

Moldex3D Origin of the Case Study

□ Problems and challenges the products encounter

- Flow imbalance and short shot
- Air trap and weld line
- Warpage or even distortion of products after ejection



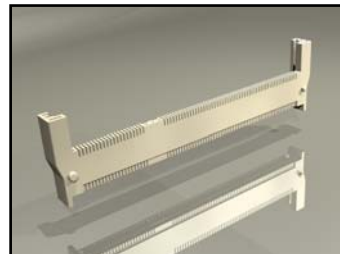
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True 3D CAE for Injection Molding

Moldex3D Origin of the Case Study (cont'd)

□ Methods once applied and their effects

- Adjustment of process conditions
 - Results are unimpressive and increase the cycle time
 - Packing time is increased from 0.8s to 5s
 - Cycle time is increased from 15s to 20s
 - Warpage is reduced by 2-3%
 - Flatness is reduced by 35%
- Modification of thickness of product geometry
 - Depth and location of the plastics to be cored out is unconfirmed.

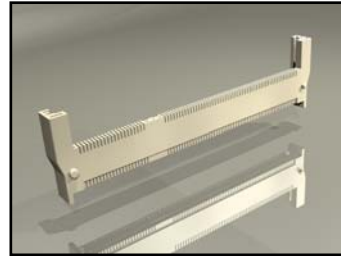


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True 3D CAE for Injection Molding

Moldex3D Origin of the Case Study (cont'd)

- ❑ Why CAE is needed to conduct an injection molding analysis
 - To find out potential problems using CAE
- ❑ Expected results and goals
 - To assure the areas to be cored out with correct parameters
 - Reduce cycle time
 - Reduce warpage

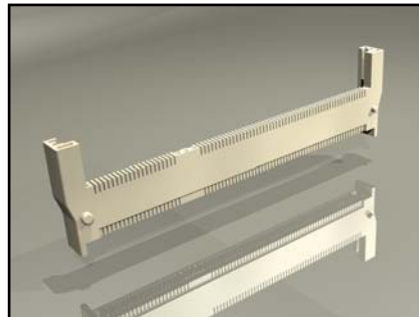


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True 3D CAE for Injection Molding


Moldex3D Information about the Case

- | | |
|---|---|
| <ul style="list-style-type: none">❑ Background information<ul style="list-style-type: none">■ Thickness of product: 0.7~1.0 mm■ Length: 55 mm■ Width: 5 mm■ Height: 15 mm■ Thickness of Frame: 0.35 mm❑ Materials<ul style="list-style-type: none">■ LCP \ Vectra E130i \ Ticona❑ Process Conditions<ul style="list-style-type: none">■ Filling time: 0.05 Sec■ Melt temperature: 340 °C■ Mold temperature: 120°C | <ul style="list-style-type: none">❑ Result data<ul style="list-style-type: none">■ Melt front distribution■ Volume shrinkage■ XYZ displacement■ Flatness |
|---|---|

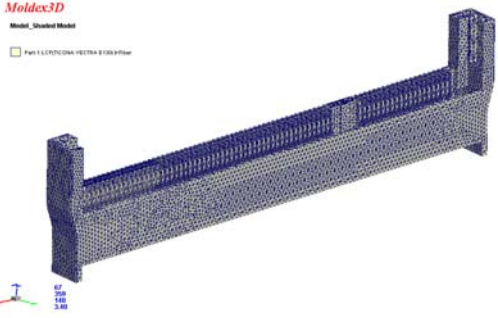


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True 3D CAE for Injection Molding



Original Design Mesh Model




Mesh type: Solid Mesh \ eDesign
 Mesh count =313,790
 Memory required = 475 MB

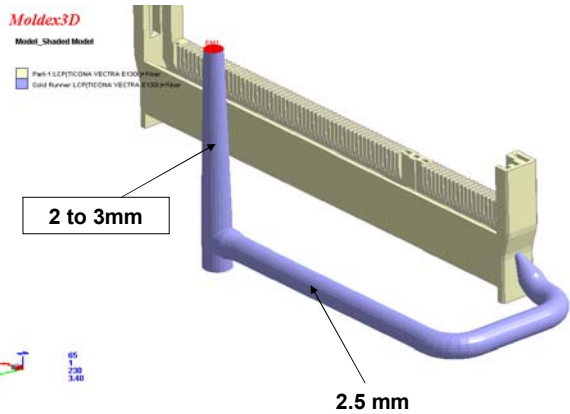
CPU time
 Filling = 1 hr
 Packing= 0.5 hr
 Cooling= 5 min
 Warpge= 0.7 hr

CPU : Intel P 3.2 GHz
 RAM : 4 GB Memory

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True 3D CAE for Injection Molding



Original Design Runner Layout



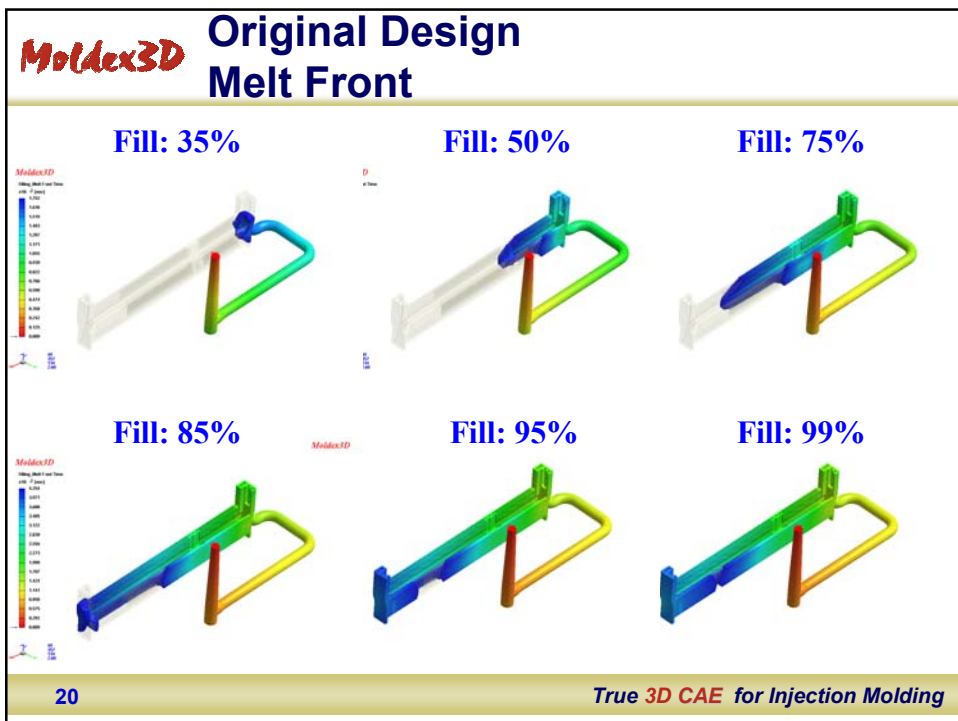
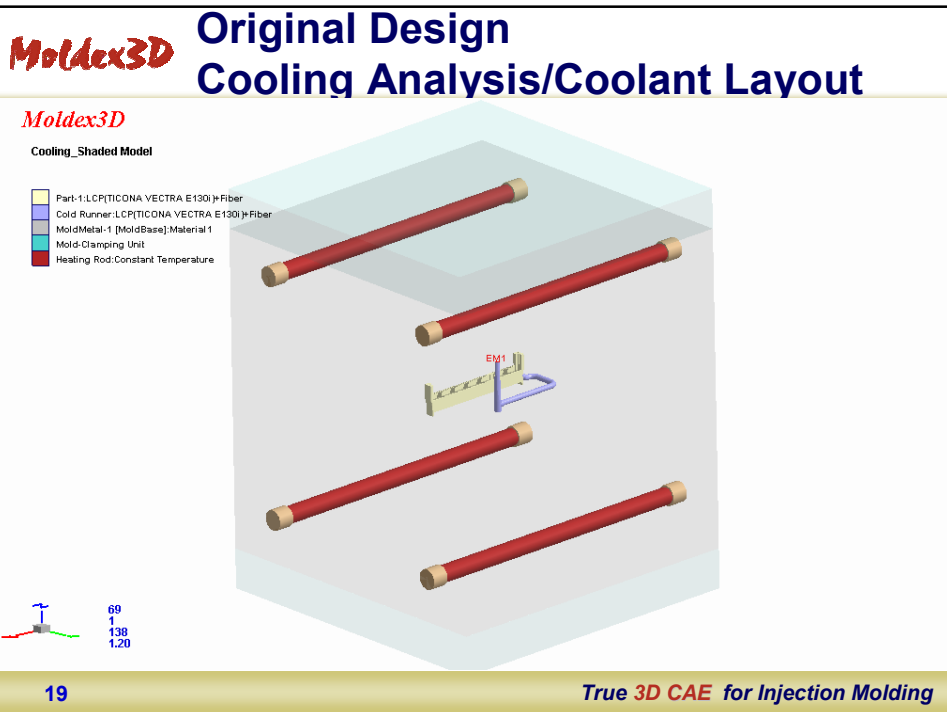
Runner type: cold runner

Gate size : 1*0.8 mm

2 to 3mm

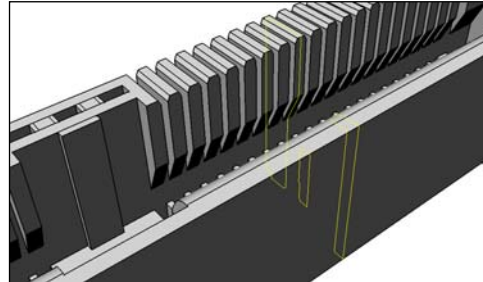
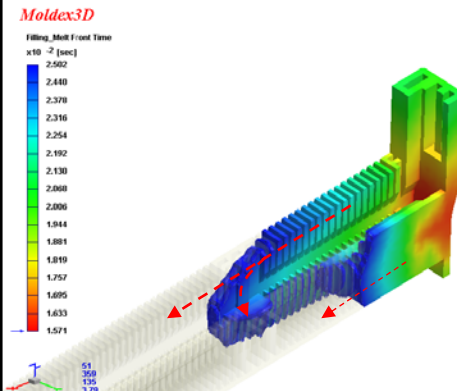
2.5 mm

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True 3D CAE for Injection Molding



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Original Design In-depth diagnosis(1) Fill: 50%



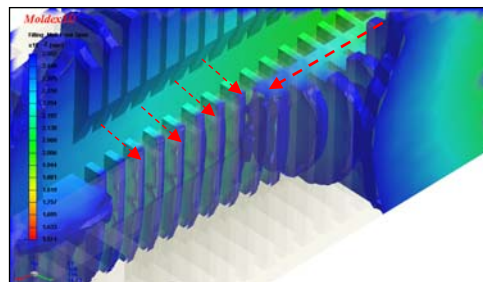
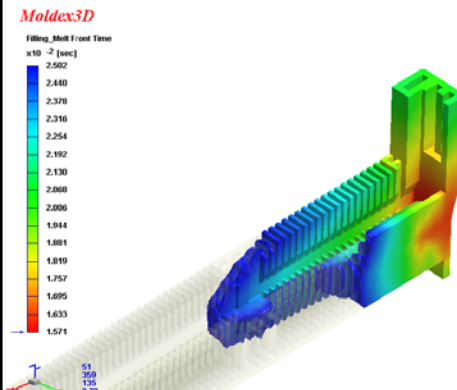
Due to the serious thickness variation in the product, race-tracking occurs during mold filling and thus leads to flow imbalance.

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True 3D CAE for Injection Molding

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Original Design In-depth diagnosis(2) Fill: 50%



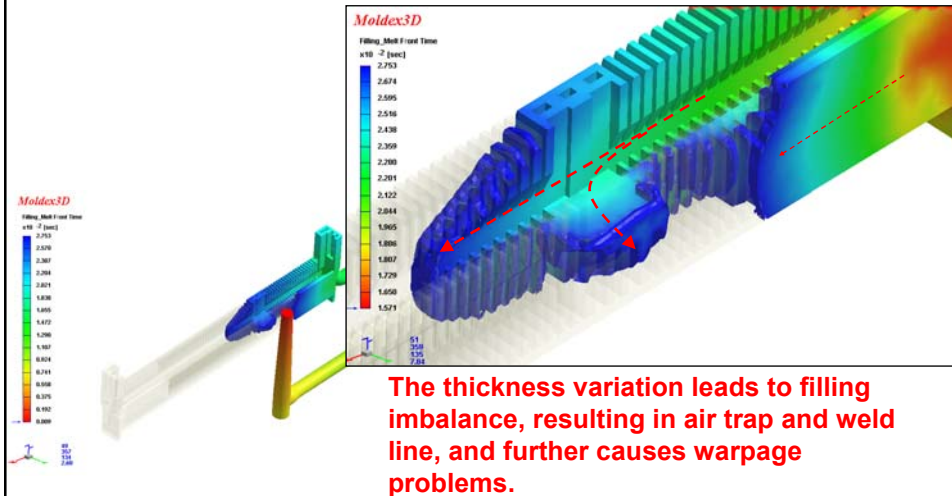
Hesitation occurs in thin areas in the middle of the part, leading to short shot, air trap and other problems.

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True 3D CAE for Injection Molding

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Original Design In-depth diagnosis(3) Fill: 55%

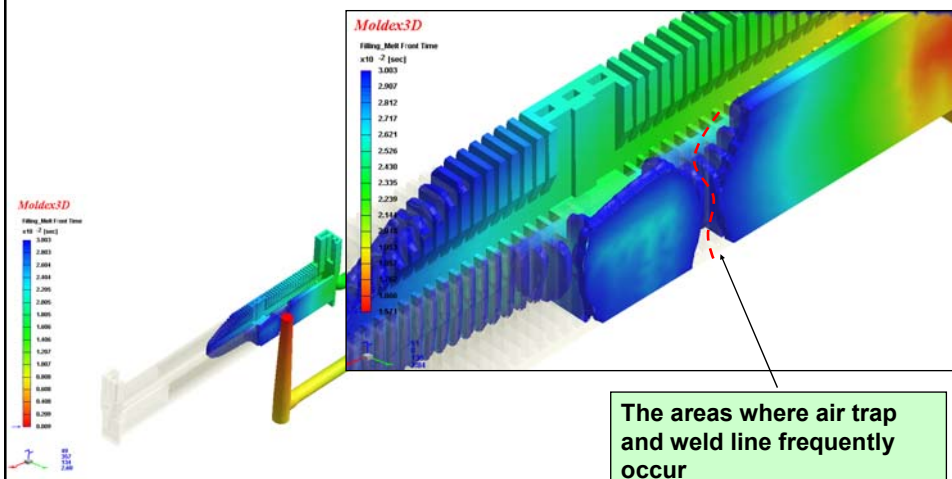


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True 3D CAE for Injection Molding

Moldex3D

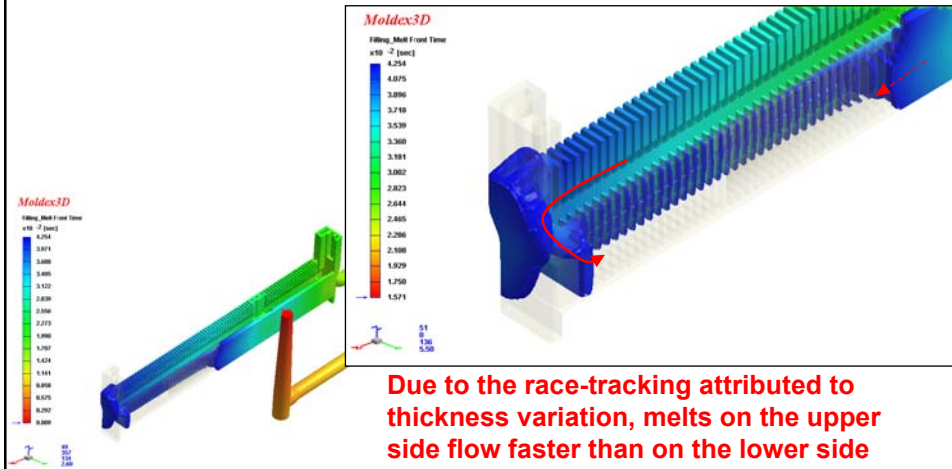
Original Design In-depth diagnosis(4) Fill: 60%



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True 3D CAE for Injection Molding

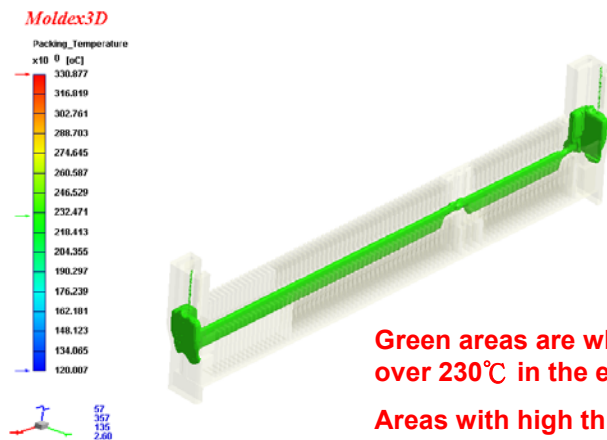
Original Design In-depth diagnosis(5) Fill: 85%



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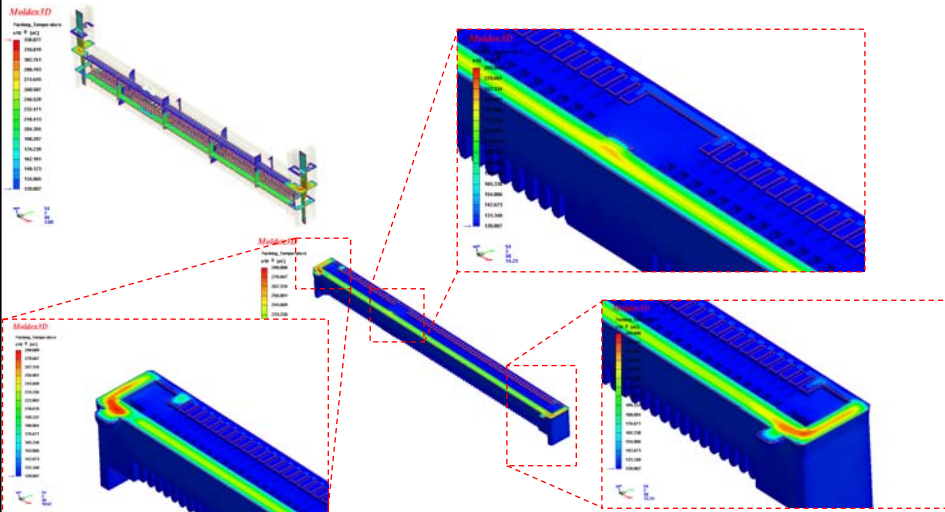
True 3D CAE for Injection Molding

Original Design Packing Analysis/Temperature Distribution



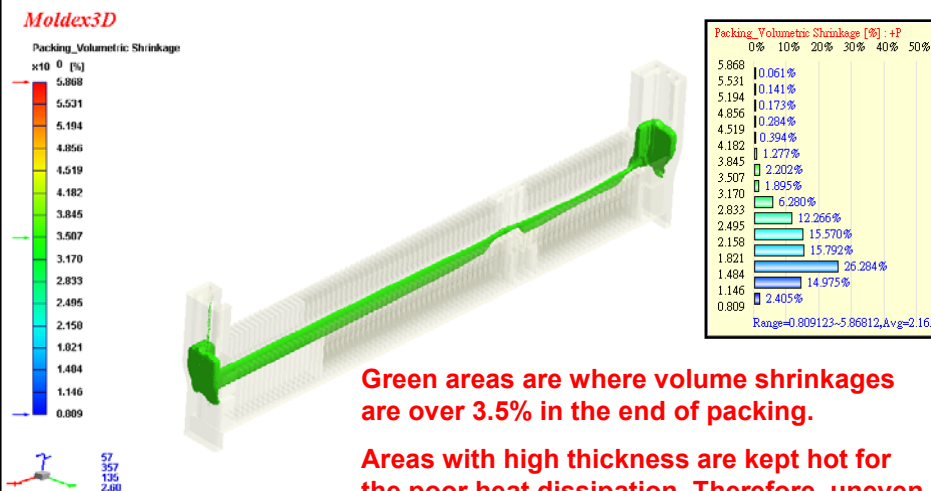
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True 3D CAE for Injection Molding



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True 3D CAE for Injection Molding



Green areas are where volume shrinkages are over 3.5% in the end of packing.

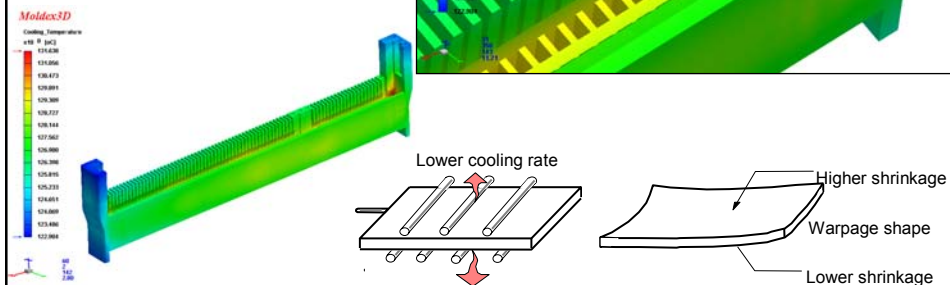
Areas with high thickness are kept hot for the poor heat dissipation. Therefore, uneven shrinkage of products might easily occur.

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True 3D CAE for Injection Molding

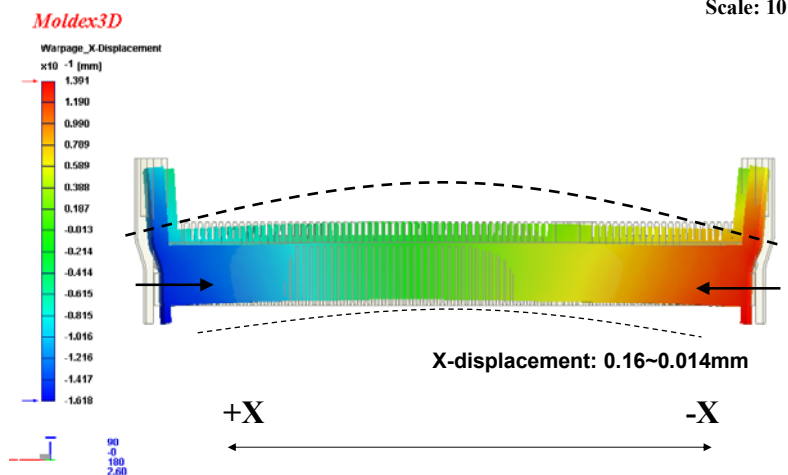
Red areas are where heat is not dissipated in the end of cooling.

High heat accumulation in some areas may cause warpage problems and increase the cycle time.



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True 3D CAE for Injection Molding

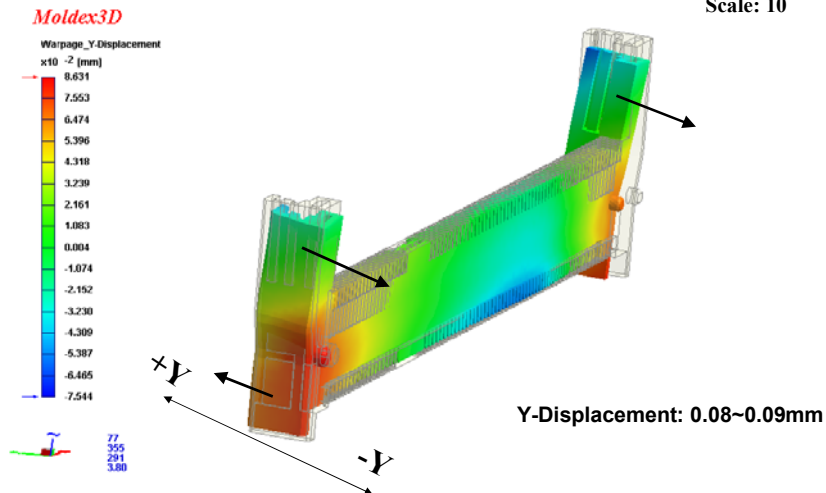


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True 3D CAE for Injection Molding

Moldex3D

Original Design Warpage Analysis / Y-Displacement

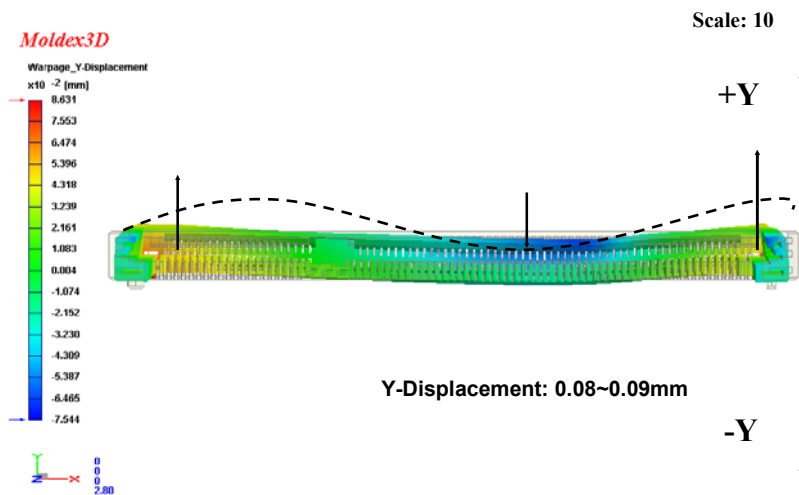


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True 3D CAE for Injection Molding

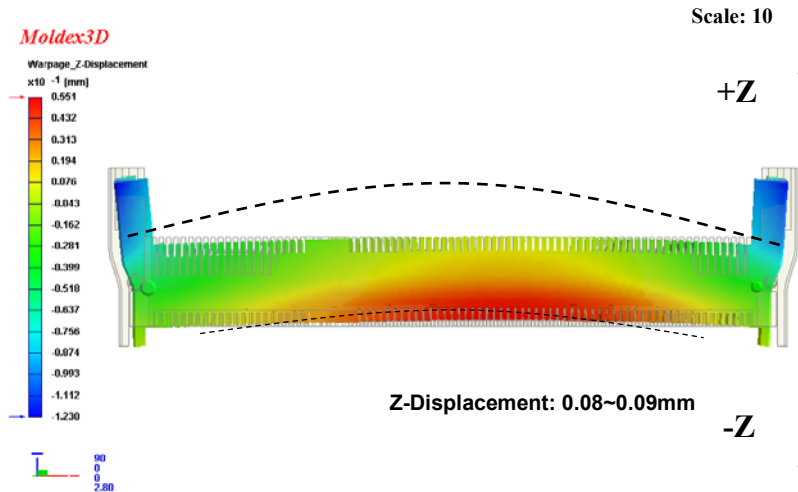
Moldex3D

Original Design Warpage Analysis / Y-Displacement



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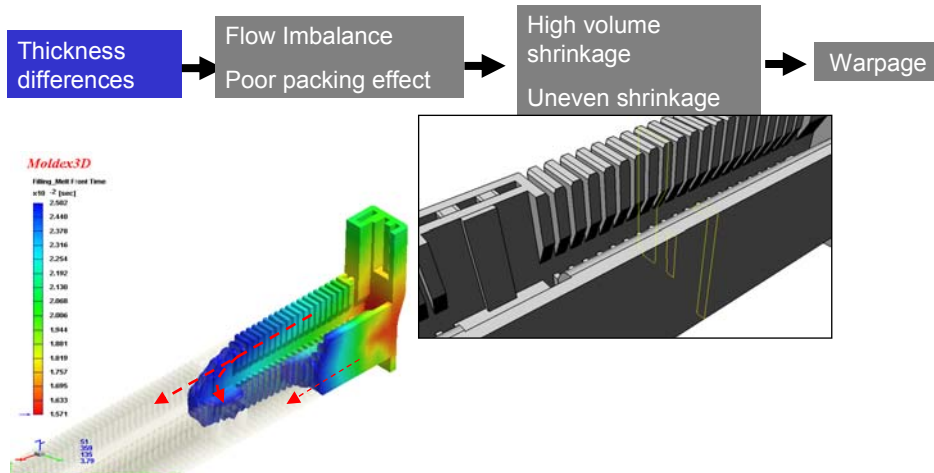
True 3D CAE for Injection Molding



- ❑ **Efficient diagnosis of the molding system**
 - Problems and risks that exist in product design and development
 - Flow imbalance and short shot
 - Air trap and weld line
 - The warpage or even distortion problems of products after ejection
 - To further analyze and find out the factors causing the problems.

Moldex3D Key Point of the Analysis

□ Moldex3D for Know-Why

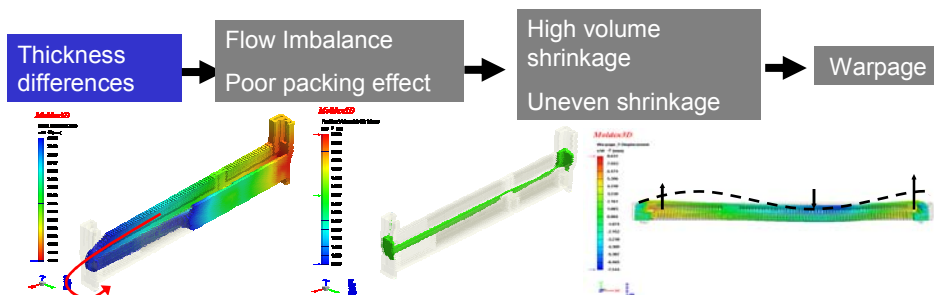


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True 3D CAE for Injection Molding

Moldex3D Key Point of the Analysis

□ Moldex3D for Know-Why (cont'd)



Moldex3D can help to find out both Know-Why & Know-How. This is very advantageous for users to effectively accumulate trouble-shooting capabilities and build up a technical team.

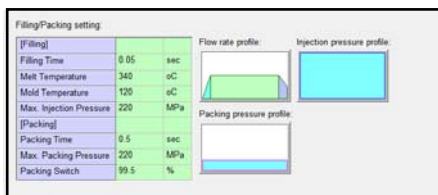
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True 3D CAE for Injection Molding

- ❑ To obtain a plan with **lowest cost**, **shortest cycle time** and **highest practicability**.
- ❑ **The order of design changing with the lowest cost**
 - First is the change of process condition.
 - Change the materials if allowed.
 - Modify the mold or/and part design

- ❑ **Process condition**
 - Increase packing time and packing pressure
 - Increase cooling time

Original design



Revised design I

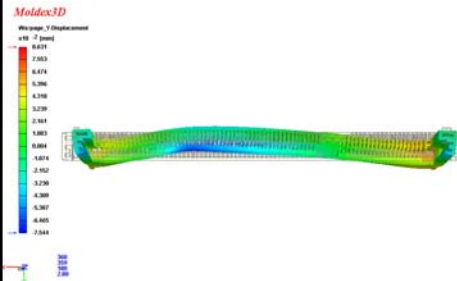


Packing time is changed from 0.5s to 5s

Moldex3D Revise Design I: Warpage Results

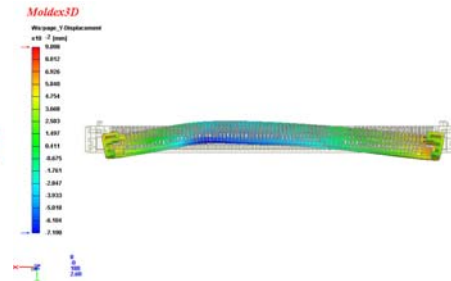
Scale: 20

Original design



In the original design, due to flow imbalance and thickness variation that result in uneven shrinkage, warpage or distortion occur.

Revised design 1



In revised design 1, flow imbalance and uneven shrinkage are reduced and thus warpage is also reduce.

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True 3D CAE for Injection Molding

Moldex3D Warpage Results (cont'd)

Unit: mm	X-displacement		Improvement
	Min	Max	
Original	-0.16	0.14	
Revised I	-0.16	0.13	
			3%
Unit: mm	X-displacement		Improvement
	Min	Max	
Original	-0.08	0.09	
Revised I	-0.09	0.09	
			-6%
Unit: mm	X-displacement		Improvement
	Min	Max	
Original	-0.13	0.06	
Revised I	-0.11	0.05	
			16%
Unit: mm	Flatness		Improvement
	Min	Max	
Original	-0.13	0.13	
Revised I	-0.12	0.23	
			-35%

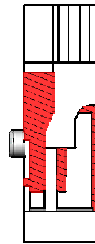
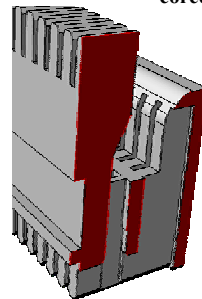
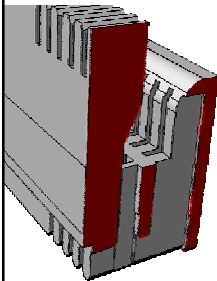
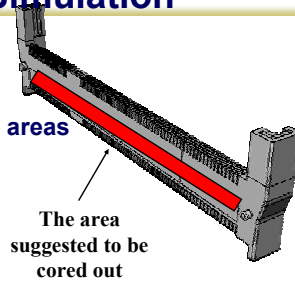
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True 3D CAE for Injection Molding

Original Design Molding Analysis by Simulation

Product design

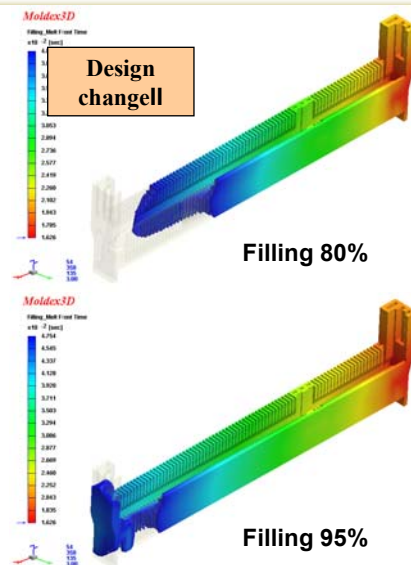
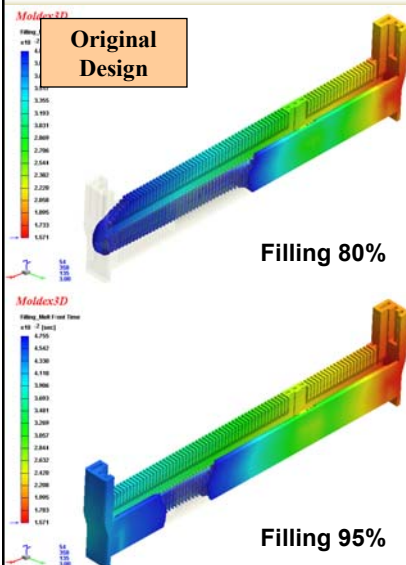
- Uneven volume shrinkage
- Flow imbalance and hesitation in some areas
- Weld lines and air traps
- Uneven packing pressure distribution
- Warpage



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True 3D CAE for Injection Molding

Flow Behavior



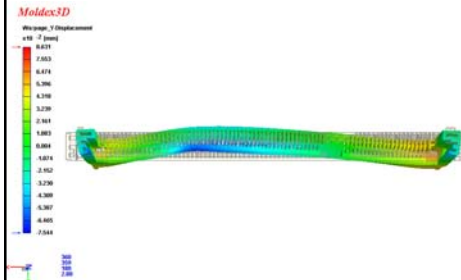
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True 3D CAE for Injection Molding

Moldex3D Revised Design II: Warpage Results

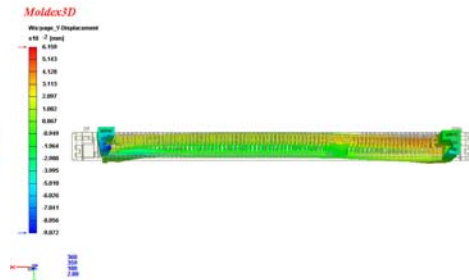
Scale up 20 times

Original Design



In the original design, due to flow imbalance and thickness variation that result in uneven shrinkage, warpage or distortion occur.

Revised Design II



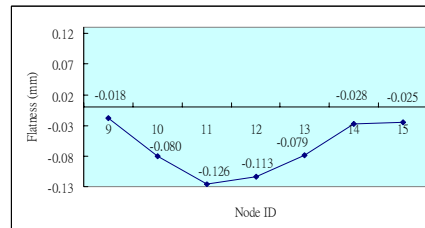
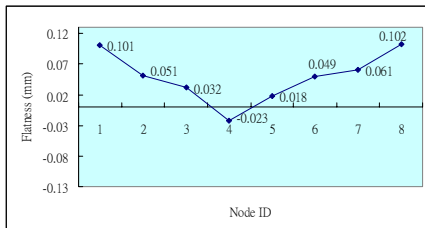
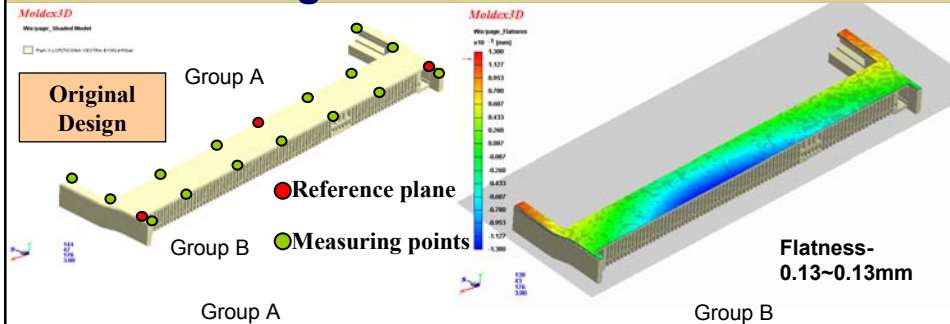
In design change II, flow imbalance and uneven shrinkage are reduced and thus warpage is also reduce.

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True 3D CAE for Injection Molding

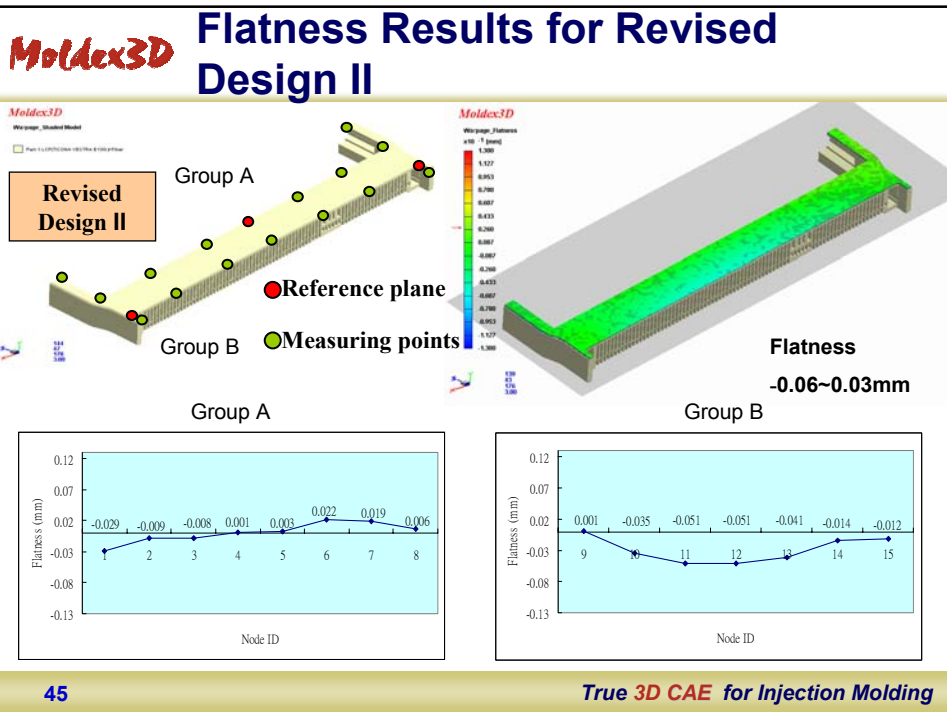
Moldex3D Flatness Results for Original Design

Original Design



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True 3D CAE for Injection Molding



Flatness and Warpage Results of Revised Design II

Unit:mm	X-displacement		Improvement
	Min	Max	
Original	-0.16	0.14	
Revised II	-0.19	0.14	-10%

Unit:mm	X-displacement		Improvement
	Min	Max	
Original	-0.08	0.09	
Revised II	-0.09	0.06	12%

Unit:mm	X-displacement		Improvement
	Min	Max	
Original	-0.13	0.06	
Revised II	-0.11	0.06	11%

Unit: mm	Flatness		Improvement
	Min	Max	
Original	-0.13	0.13	
Revised II	-0.03	-0.06	65%

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True 3D CAE for Injection Molding

Moldex3D Benefits of Moldex3D

□ Using Moldex3D software and technology

- A solution is proposed to the users who face the challenges and problems
- Practical effects

Product quality:

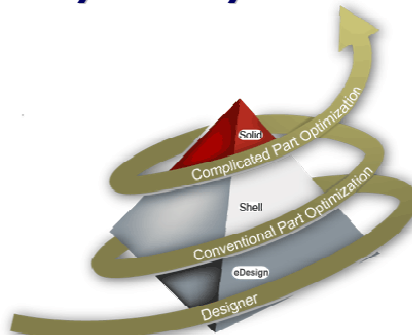
- Quality is enhanced by **25~50%**
- Problems are reduced
 - » Hesitation
 - » Flatness
 - » Roundness
 - » Warpage

Economic Improvement :

- Production enhancement: **20~45%**
(Flatness requirement < 0.12mm)
- Reduce cycle time
- Reduce the material waste

Moldex3D

Thank you for your attention!



CoreTech System Co., Ltd.

☎ :+886-3-5600199
☎ :+886-3-5600198
✉ :mail@moldex3d.com
🌐 :http://www.moldex3d.com