

Cast-Designer Performance

L'impiego di software dedicato all'analisi e alla convalida dei requisiti prestazionali del getto in funzione dei difetti di colata

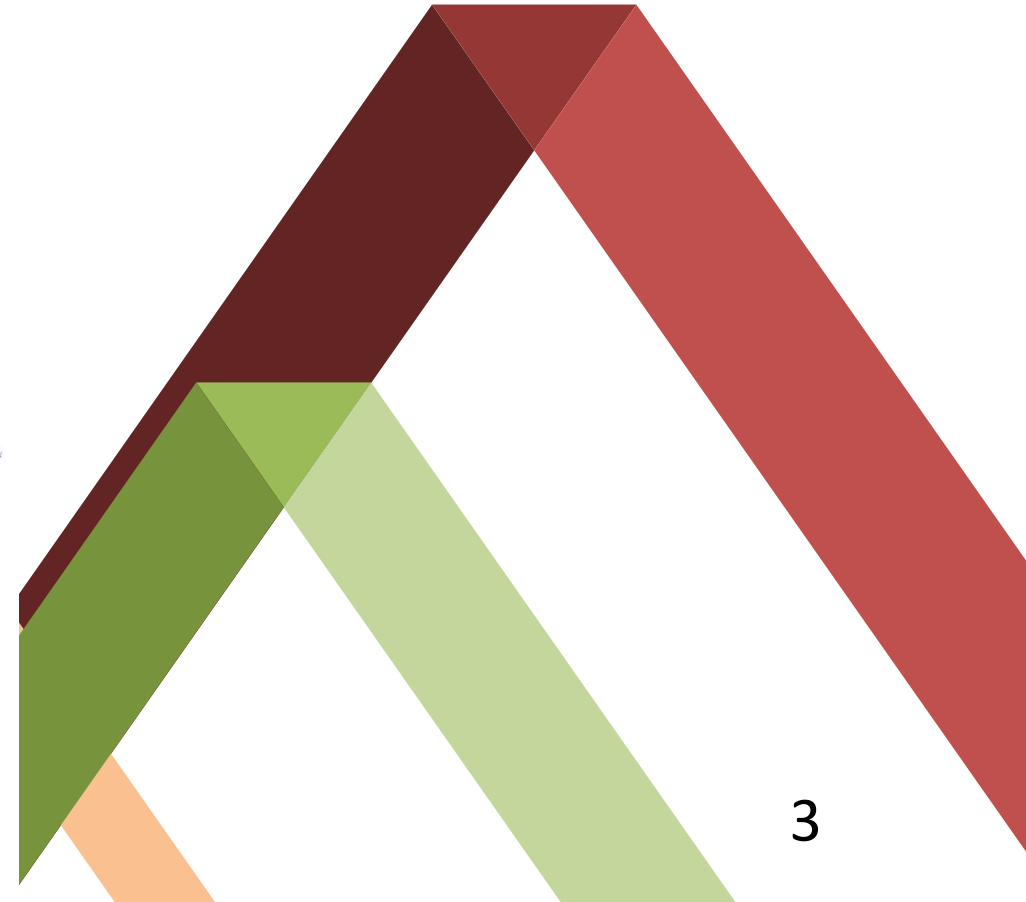
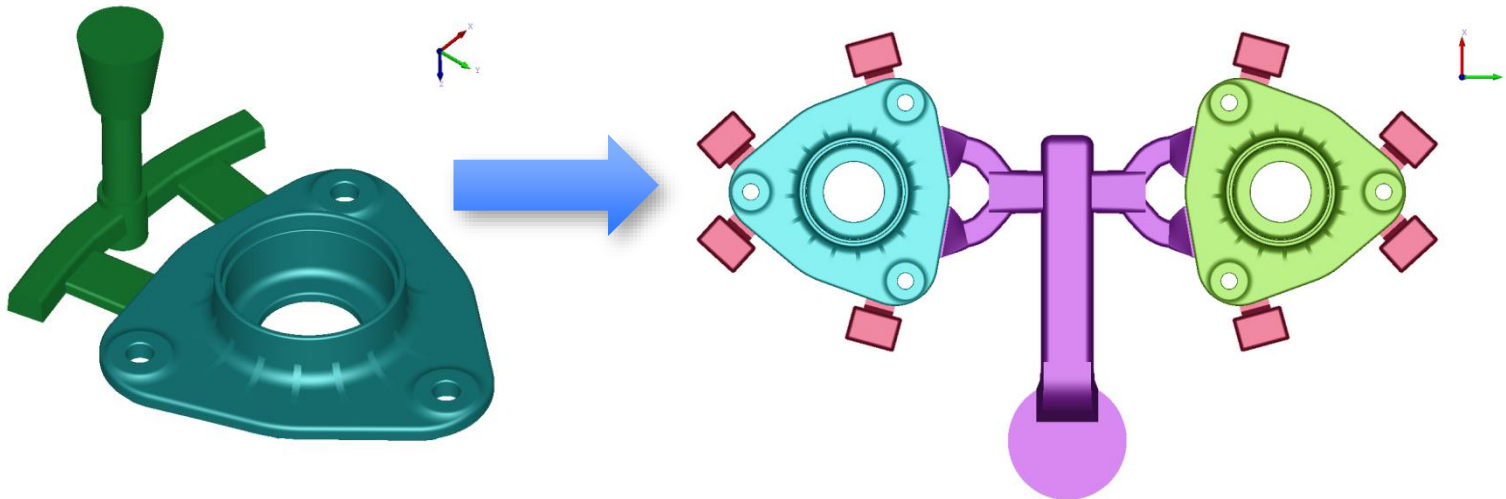


- Crea strumenti digitali di simulazione dei processi di manifattura per aiutare l'industria a raggiungere il **Time to Market** e la **Quality to Market** richieste da un mercato sempre più competitive.
 - **Cast Designer** è la soluzione dedicata ai vari processi di fonderia
- Dal 1958 produttore di ausiliari chimici per la fusione dei metalli **ferrosi** e **non ferrosi**. Le attività di ricerca della Jodovit sono orientate al continuo sviluppo di prodotti e servizi per incrementare la qualità e l'efficienza dei processi produttivi per la fusione di metalli.
 - Jodovit è rivenditore per l'Europa di **Cast Designer**, ed ha reso disponibili nel software le geometrie e le caratteristiche dei materiali dei suoi manicotti.



Caso di Studio

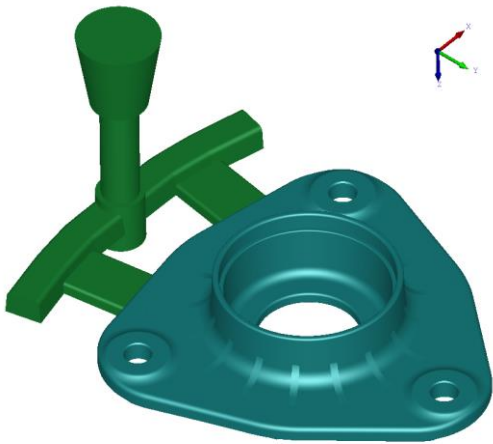
- Passaggio ad un nuovo tipo di materiale, da Ghisa a Lega di Alluminio
- Nuovo tipo di Processo Produttivo, da Gravità a Colata ad Alta Pressione
- Maggiori volumi produttivi
- Riduzione delle Masse Sospese
- Maggiore Resistenza alla Corrosione



Cast-Designer

Fusione per Gravità

- Progettazione del Sistema di Colata
- Simulazione di Riempimento e Solidificazione





Progettazione del Sistema di Colata

Gating system for gravity

Gravity casting Investment casting Centrifugal casting

Casting alloy: ☐ Steel ☒ Iron ☐ Al ☐ Mg ☐ Cu ☐ Ni ☐ Ti

Information of casting

Volume of casting mm³

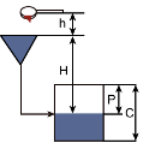
Ratio of riser to casting %

Ratio of gating to casting % ☐ By user

Avg. casting thickness mm

Nb. of cavities Total weight (kg) Total Volume (mm³)

Gating system design



H: mm

C: mm

P: mm

Height from ladle top to mould (h): mm

Friction loss factor: ☐ By user

Effective sprue height (Hst): cm

Gate location: ☐ Top ☒ Side ☐ Bottom

☐ Slow filling

Pouring temperature: °C

☒ Automatic pouring time

☒ By mass and thickness ☐ By flow rate ☐ Vertical pouring

☐ Kotschi method ☐ By iron composition

Pouring time s

Chock area mm² ☐ By user

Velocity of the choke m/s

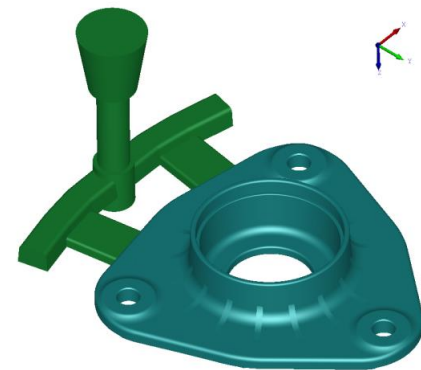
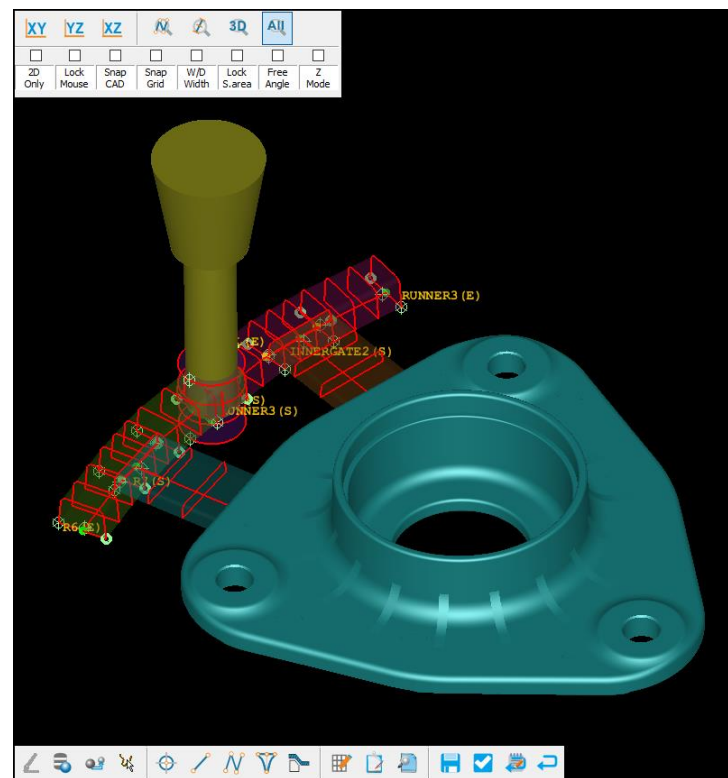
Maximum velocity (reference) m/s

Choke flow rate kg/s

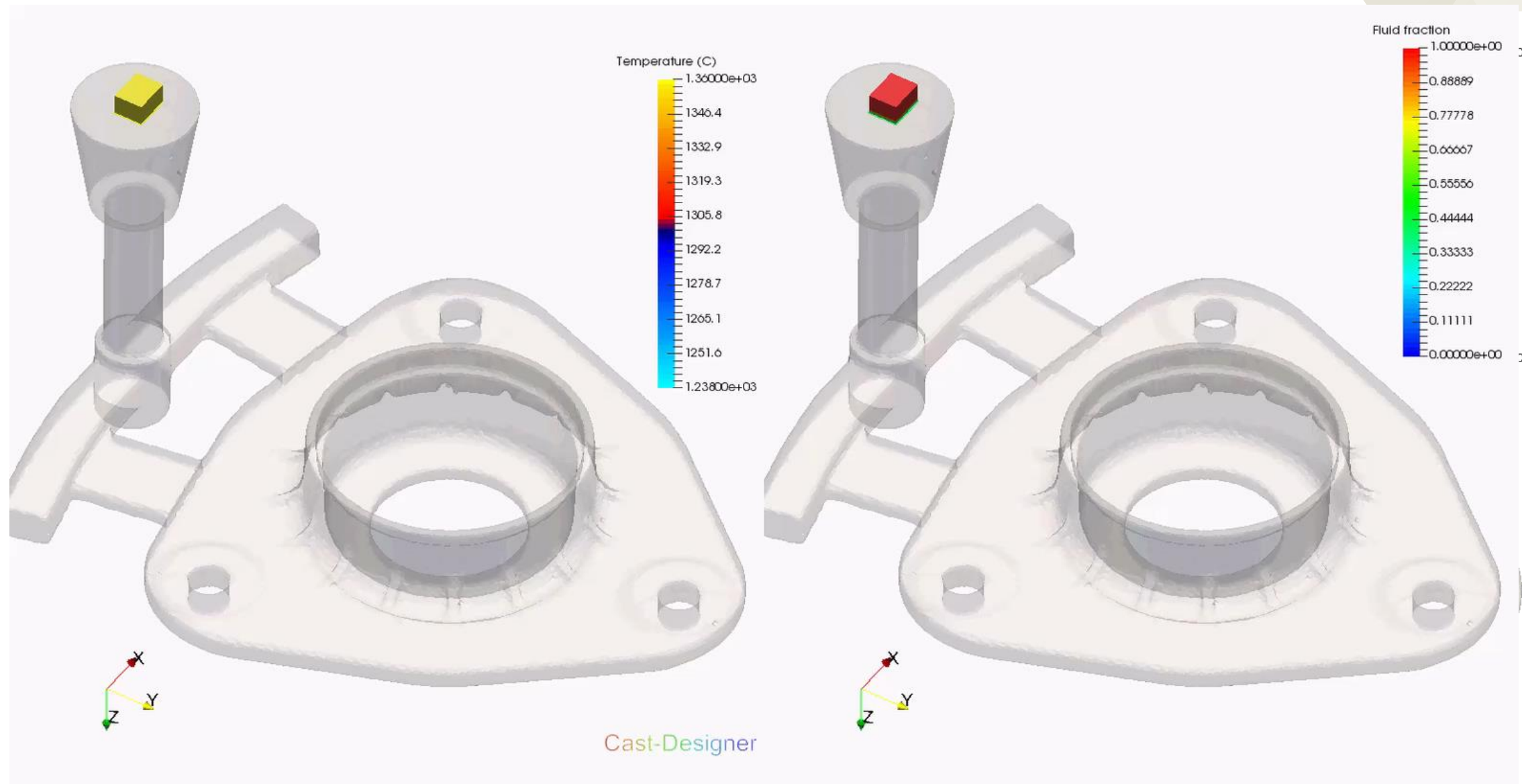
Pre-defined (Global ratio) Auto design (Dimension H/W)

	Sprue	Runner	Ingate	Choke
Global ratio	1.1	1.3	1	1
Total section area	257.488	304.304	234.08	234.08
Nbs. of	1	2	2	2
Each section area	257.488	152.152	117.04	117.04
Type	Circular	Quadrate	Quadrate	Quadrate
Dimension: H/W	1	1	1	1
Dimension: height	9.053	12.335	10.819	10.819
Dimension: width	9.053	12.335	10.819	10.819
Flow velocity (m/s)	0.255	0.216	0.281	0.281
Reynold's number	8094.41	5264.96	6002.98	6002.98

Filling temperature of iron °C

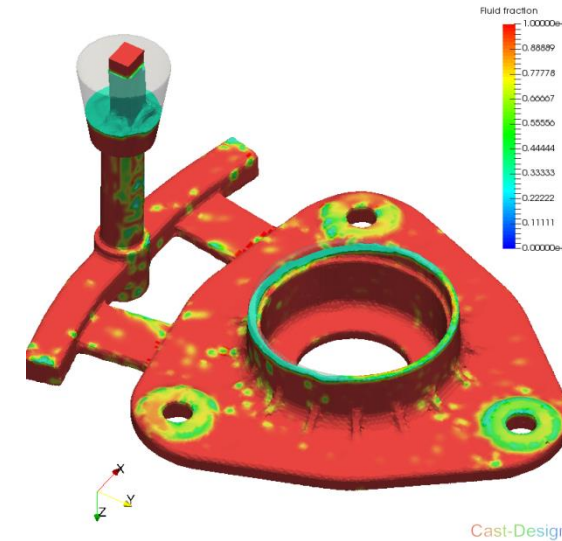
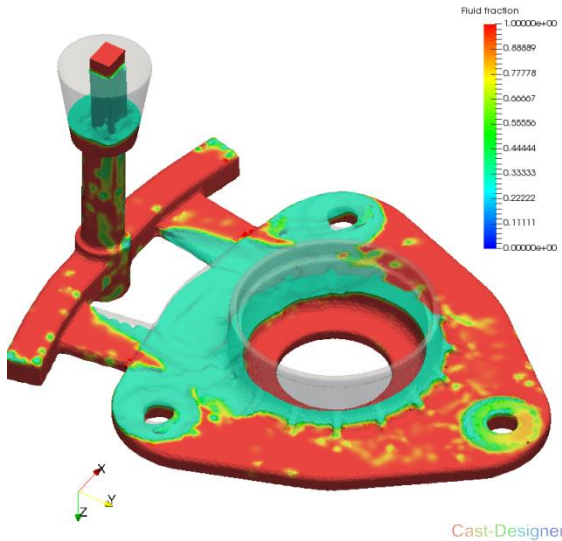
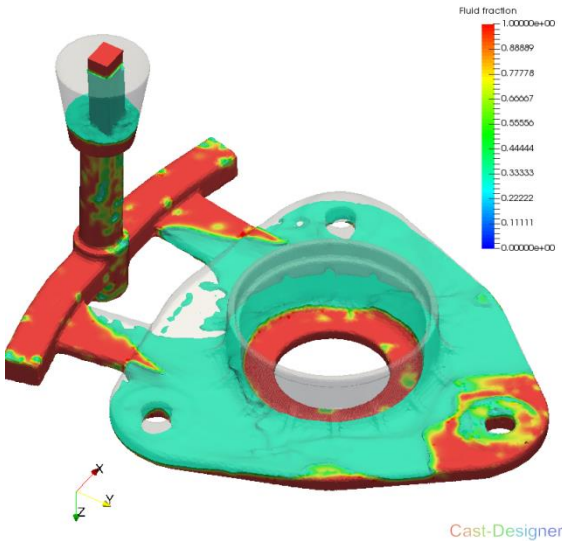
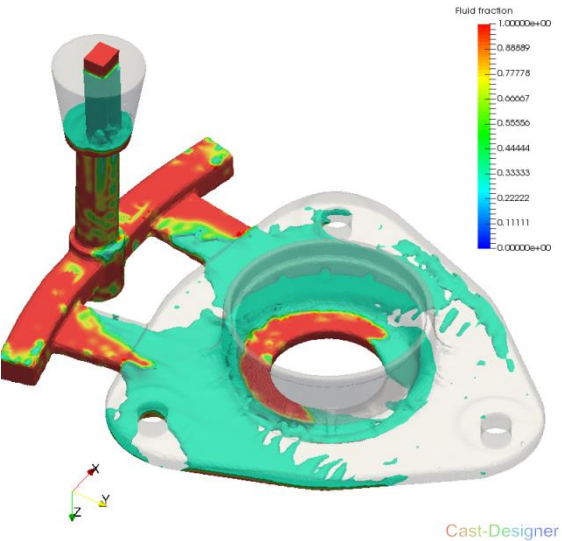
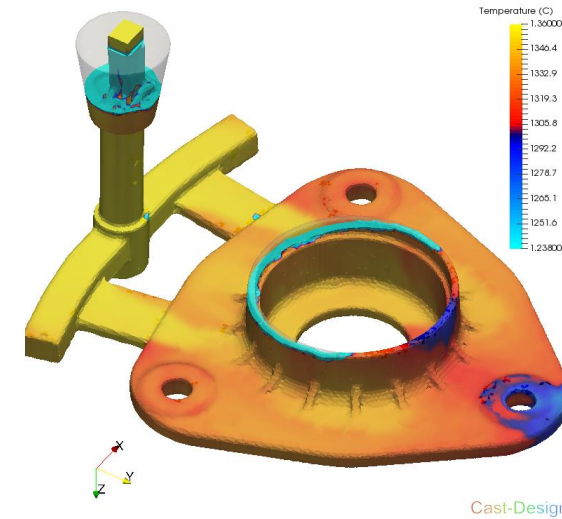
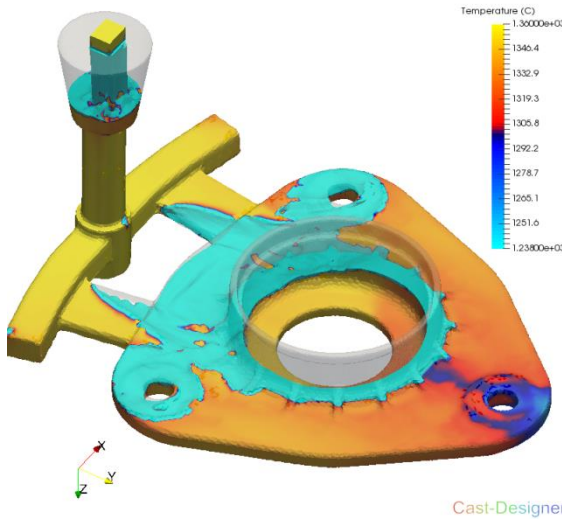
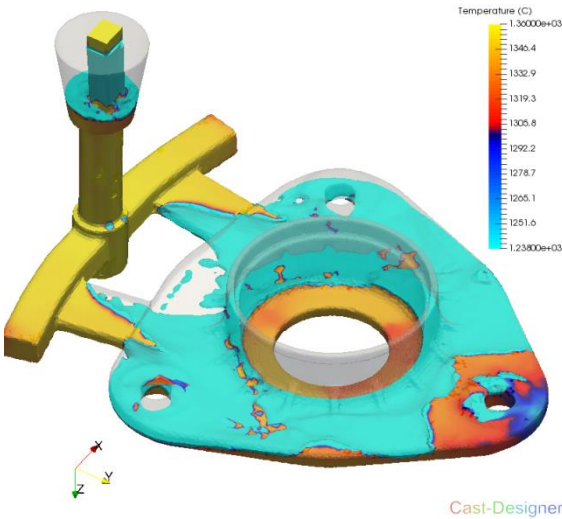
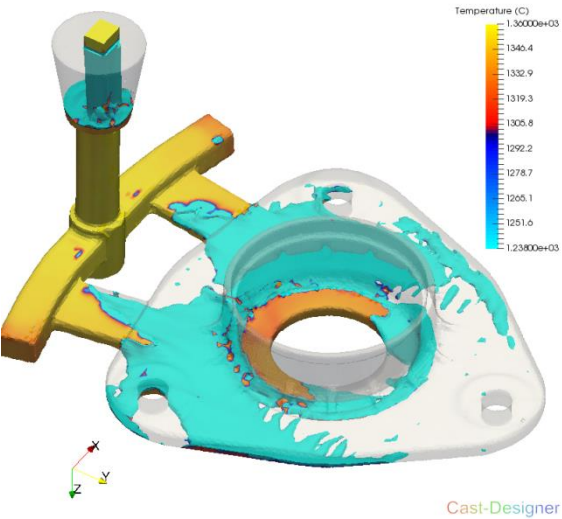


Processo di Riempimento – Temperatura & Frazione Fluida

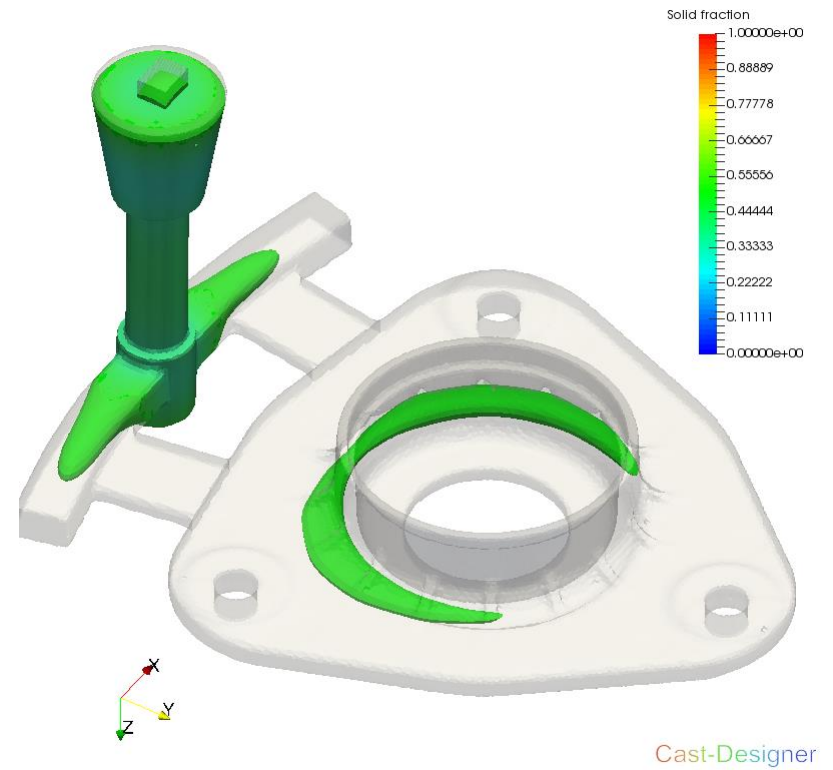
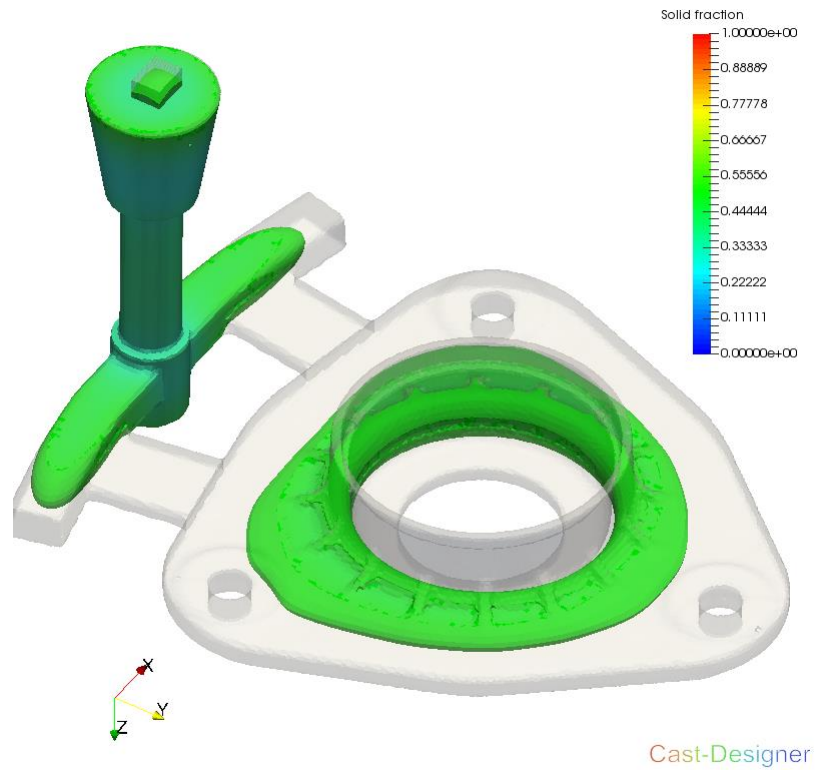
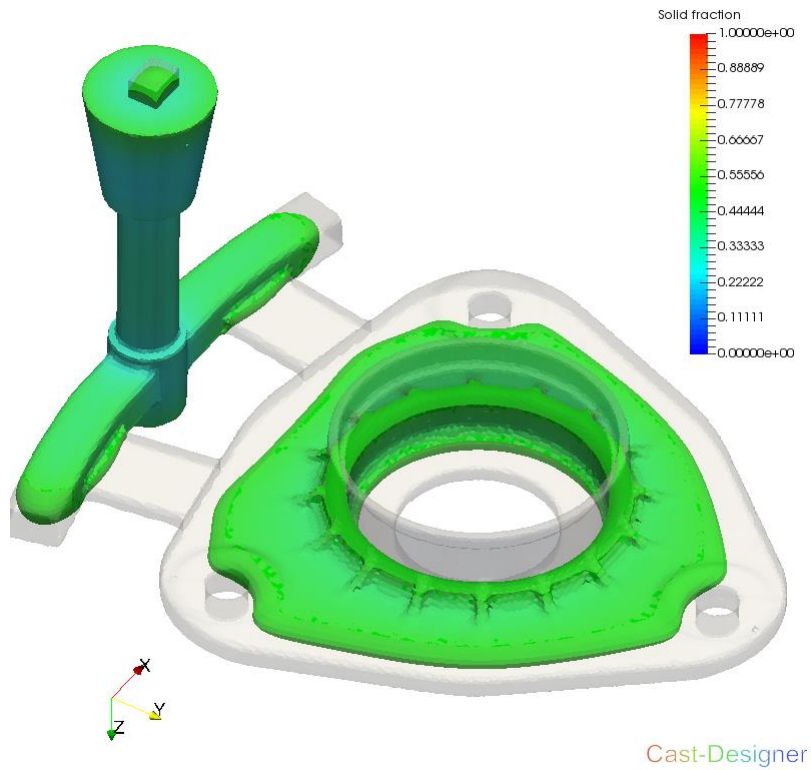




Processo di Riempimento – Temperatura & Frazione Fluida



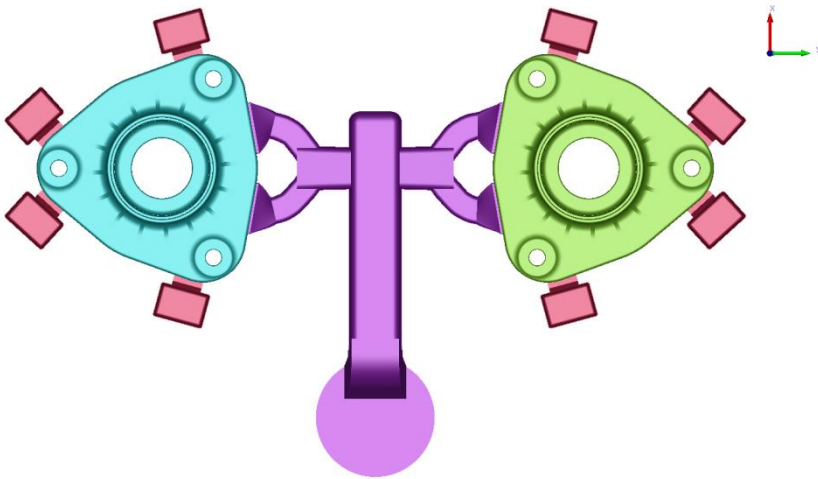
Processo di Solidificazione – Punti Caldi



Cast-Designer

Fusione per Colata ad Alta Pressione

- Progettazione del Sistema di Colata
- Simulazione di Riempimento e Solidificazione





Progettazione del Sistema di Colata

Gating system for HPDC

Design

Information of casting

Casting material type: Al

Volume of casting (mm³): 154606

Ratio of overflow & gas system to casting (%): 10

Ratio of gating to casting (%): 100

Number of cavities: 2

Automatic filling time design: ☒

Average wall thickness: 2.5 mm

Percent solid when the die is filled: 0 %

Reference filling time: 29.45 ms

Min. filling time: 20.62 ms

Max. filling time: 38.29 ms

Metal flow: 11.55 L/s

Pressure min: 2.08 MPa

Pressure max: 12.90 MPa

Gate area: 288.738 mm²

Gate depth: 1.5 mm

Gate width: 192.49 mm

Velocity at gate: 40.00 m/s

Velocity at gate min: 25 m/s

Velocity at gate max: 60 m/s

Total weight: 1.55843 kg

Total volume: 649345 mm³

Part + overflow weight: 0.81632 kg

Percentage yield of casting: 47.62 %

Projected area: 552 cm²

Information of die casting

Casting machine type: Cold chamber

Select shot machine: Buhler_H4008

Shot machine: ☒

Automatic process design: ☒

Casting pressure (MPa): 36.00

Clamping force margin (%): 56.90

Plunger diameter (mm): 80

Max. casting force (kN): 181

Shot sleeve length (mm): 480

Plunger speed (m/s): 4

Max. lockup force (tonnes): 470

Accum. pressure (MPa): 16

Shot cylinder diameter (mm): 120

Intensification ratio: 1

Speed up ratio: 17.41

LS(phase I) (m/s): 0.78

Speed-up time (s): 0.01

3rd FL time (s): 0.01

Filling ratio (%): 26.91

LS time (ms): 483.31

Speed-up stroke (mm): 15.35

3rd phase start (mm): 448.55

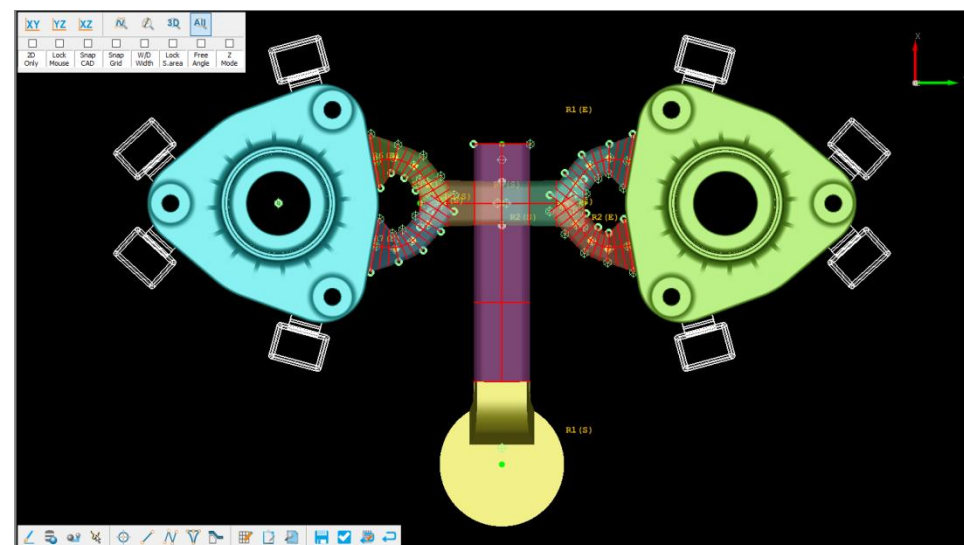
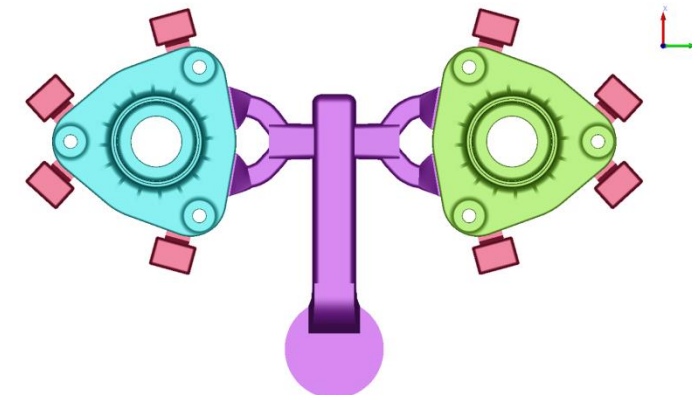
Biscuit height (mm): 20

2nd phase start (mm): 376.98

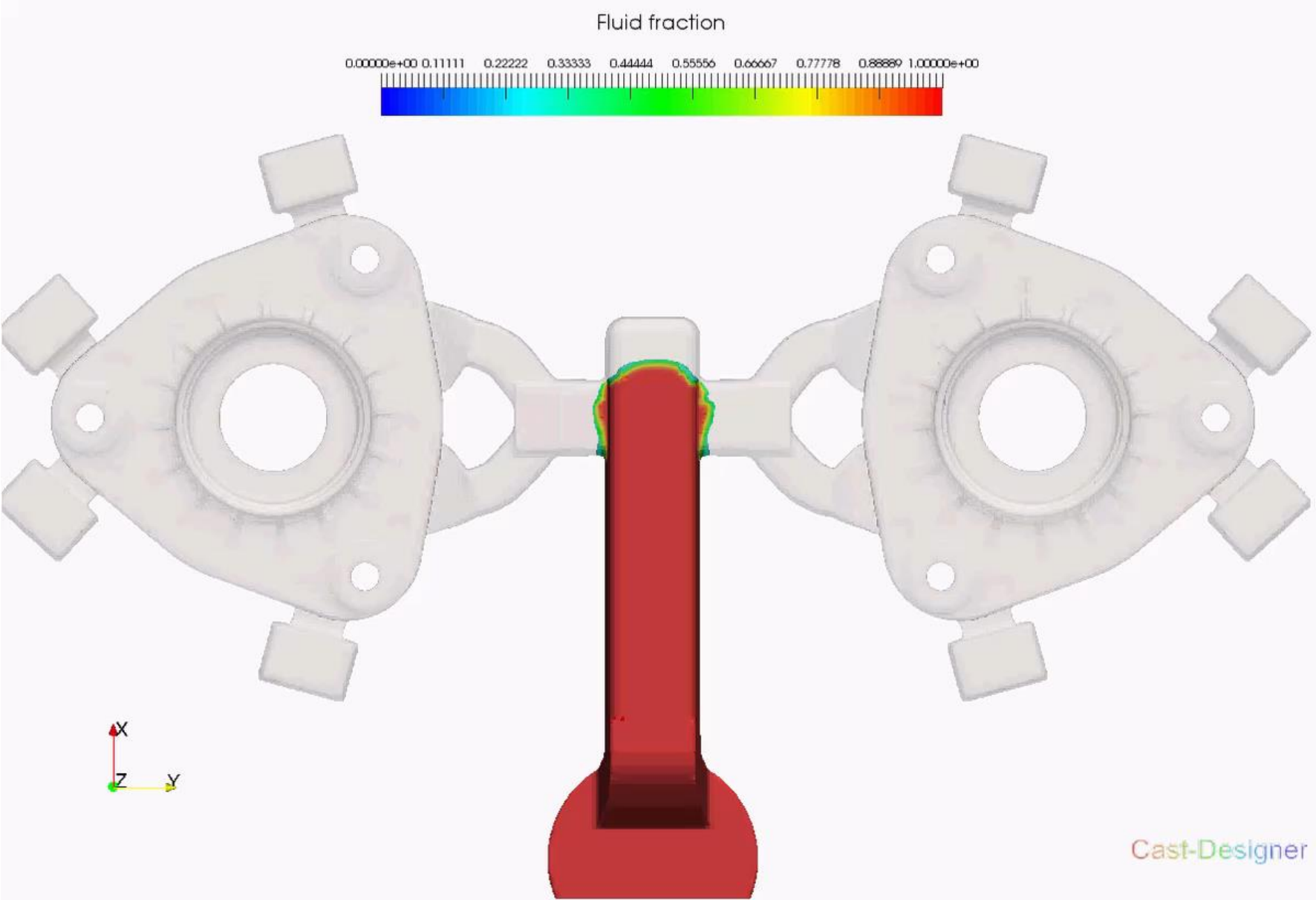
HS time (ms): 24.55

3rd phase stroke (mm): 11.45

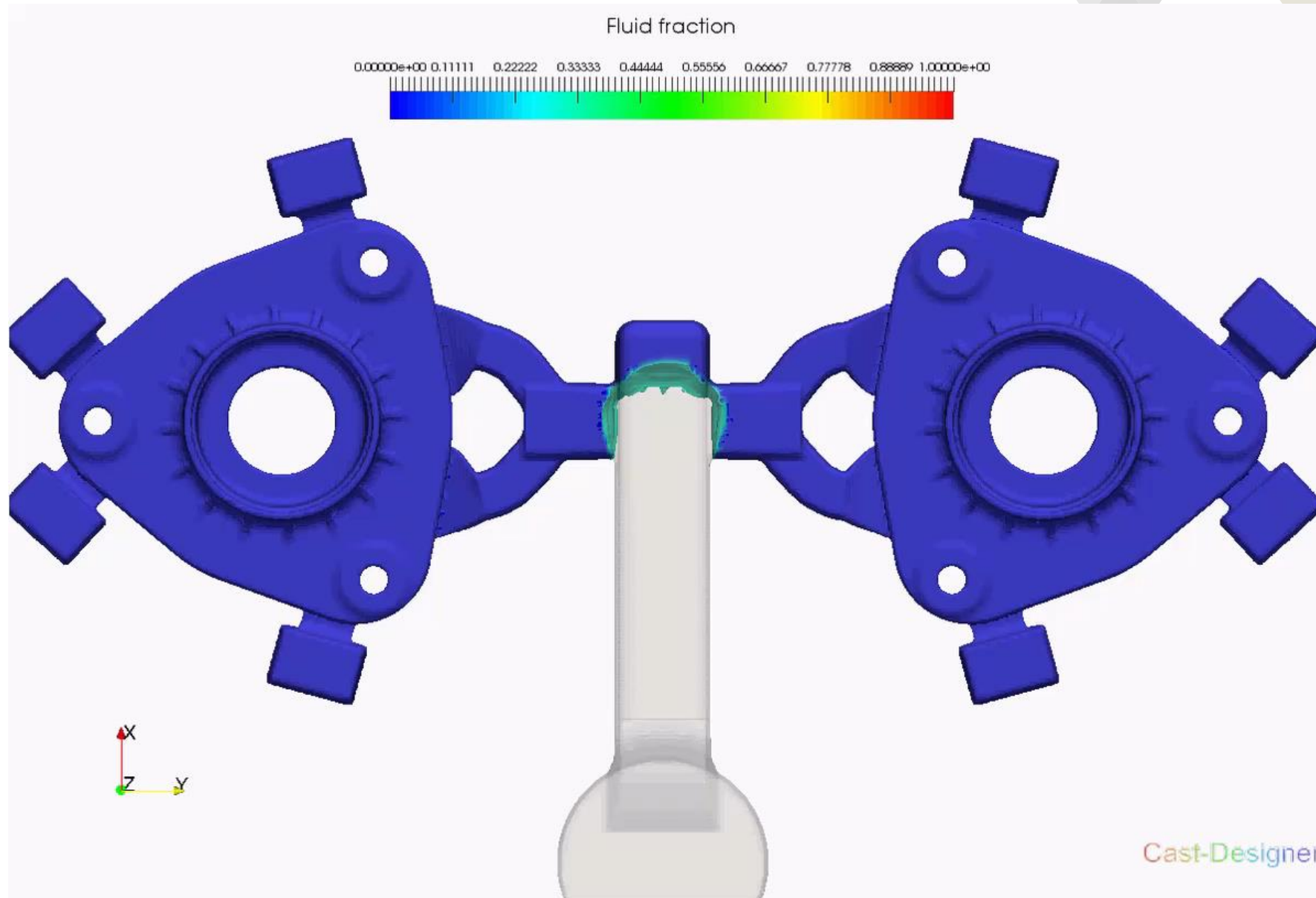
Close



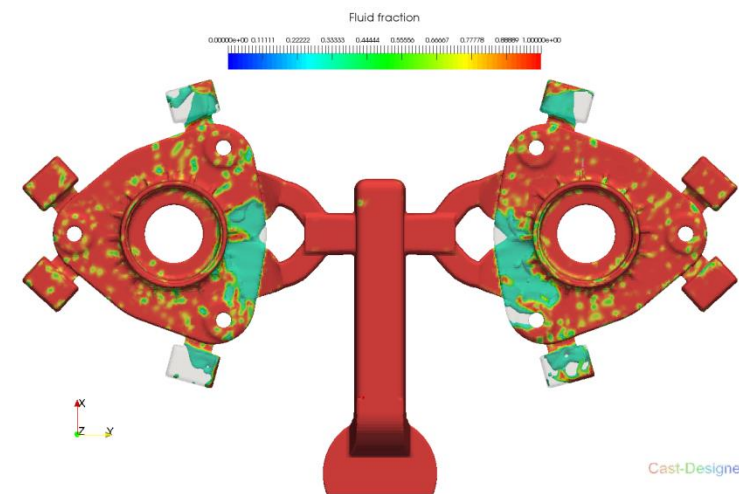
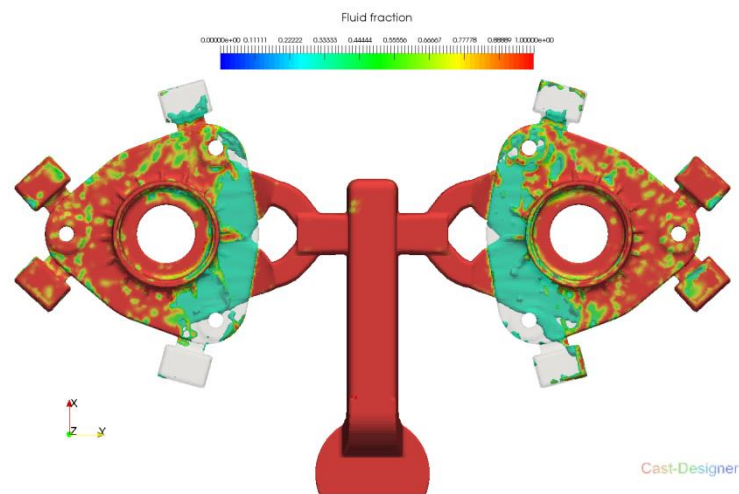
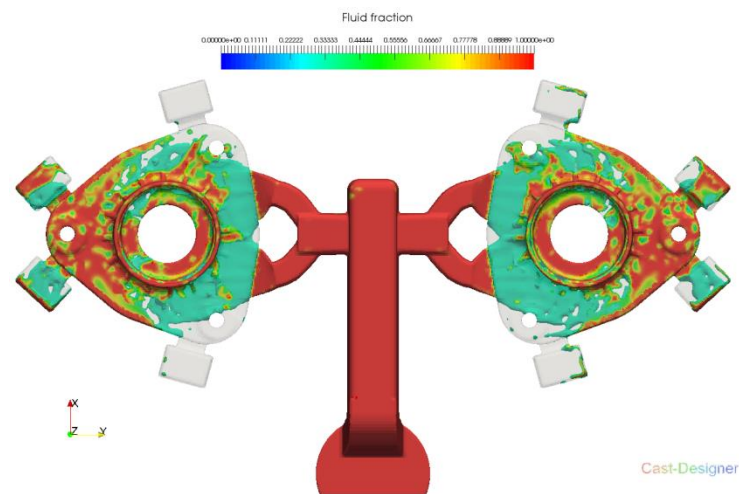
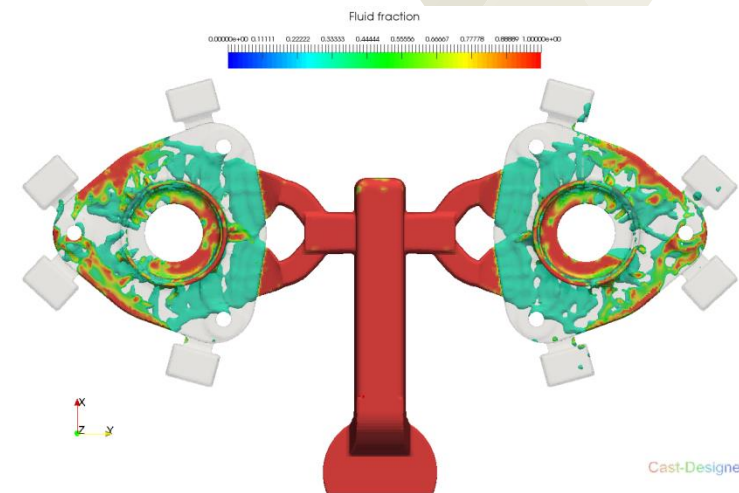
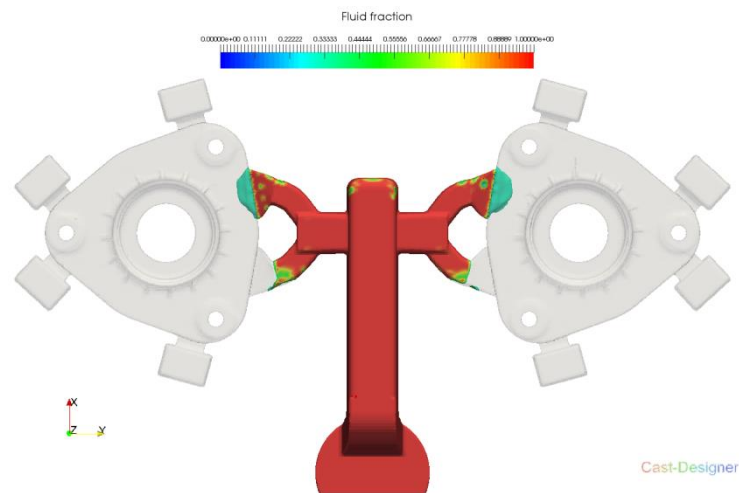
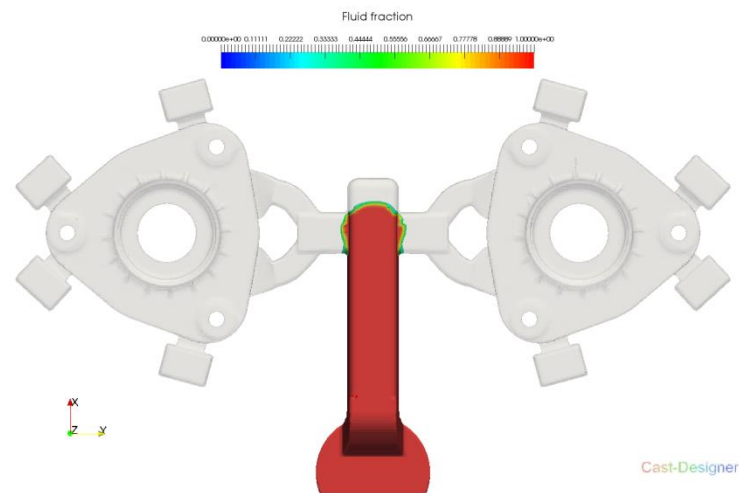
Processo di Riempimento – Frazione Fluida



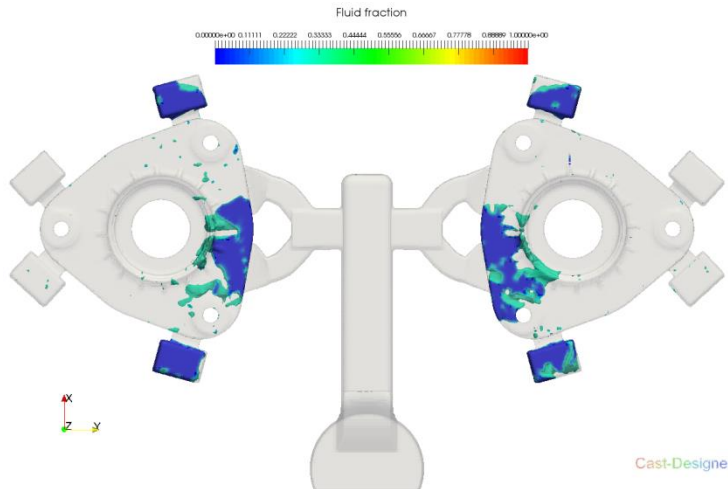
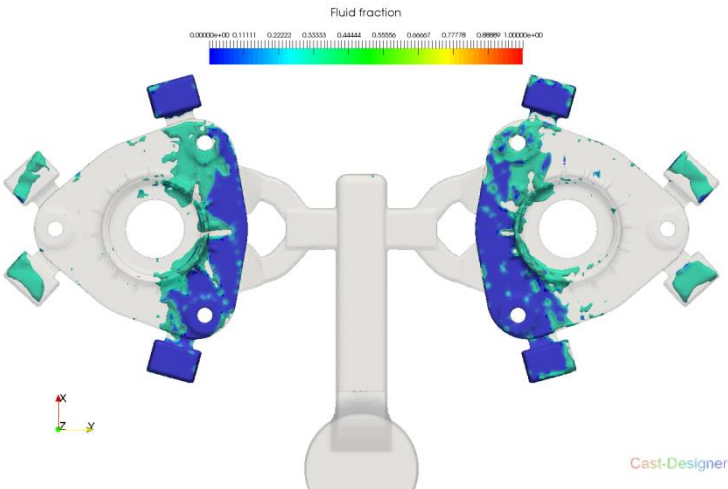
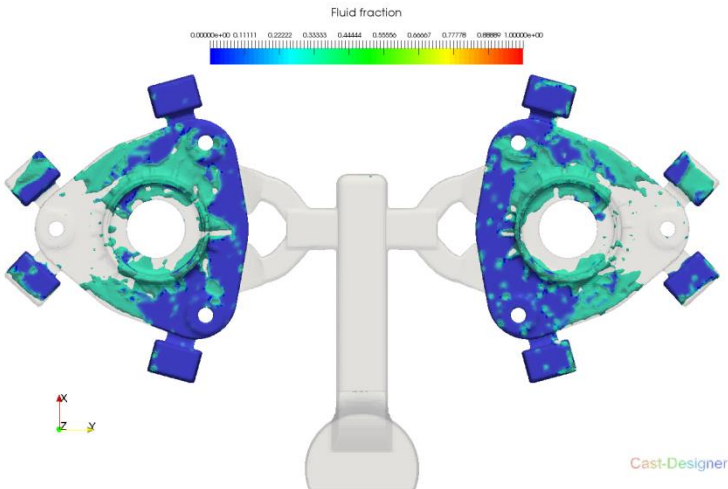
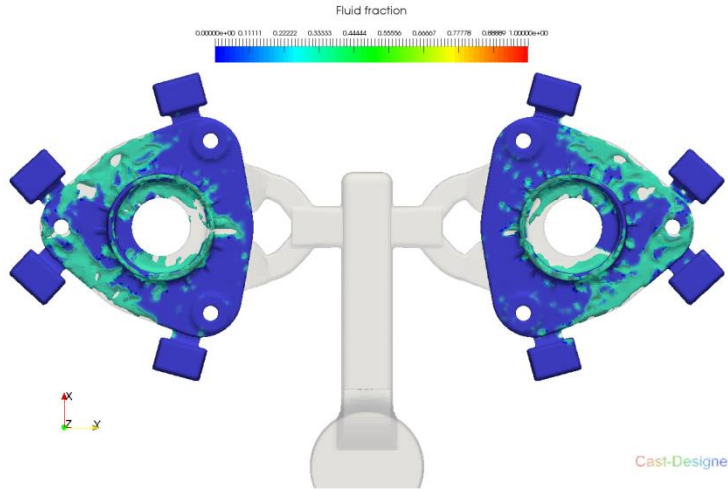
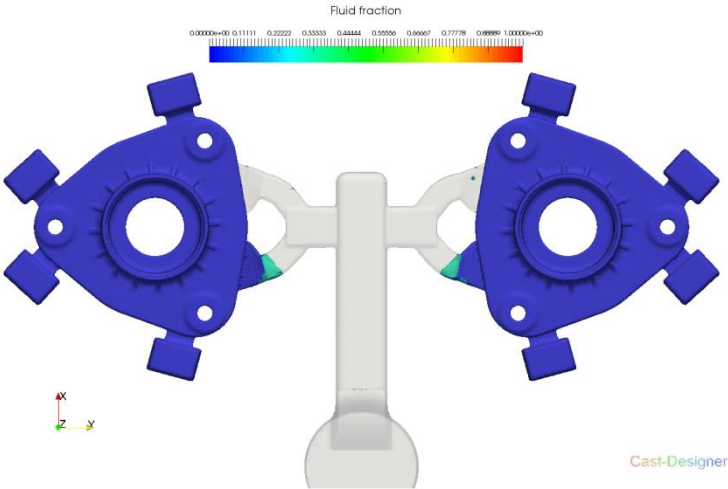
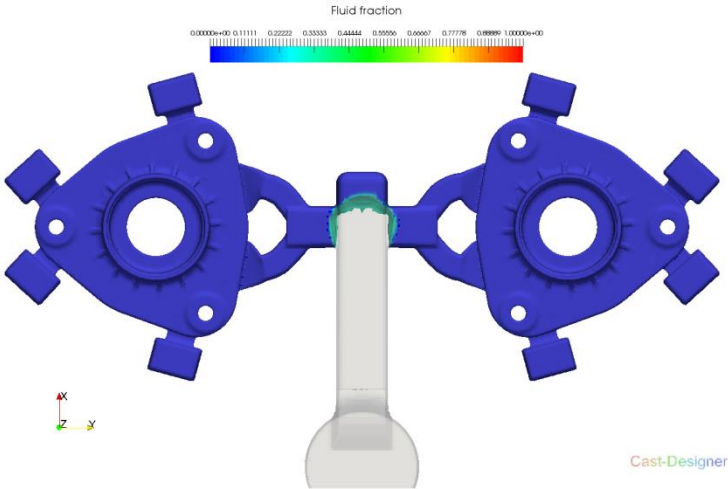
Processo di Riempimento – Aria



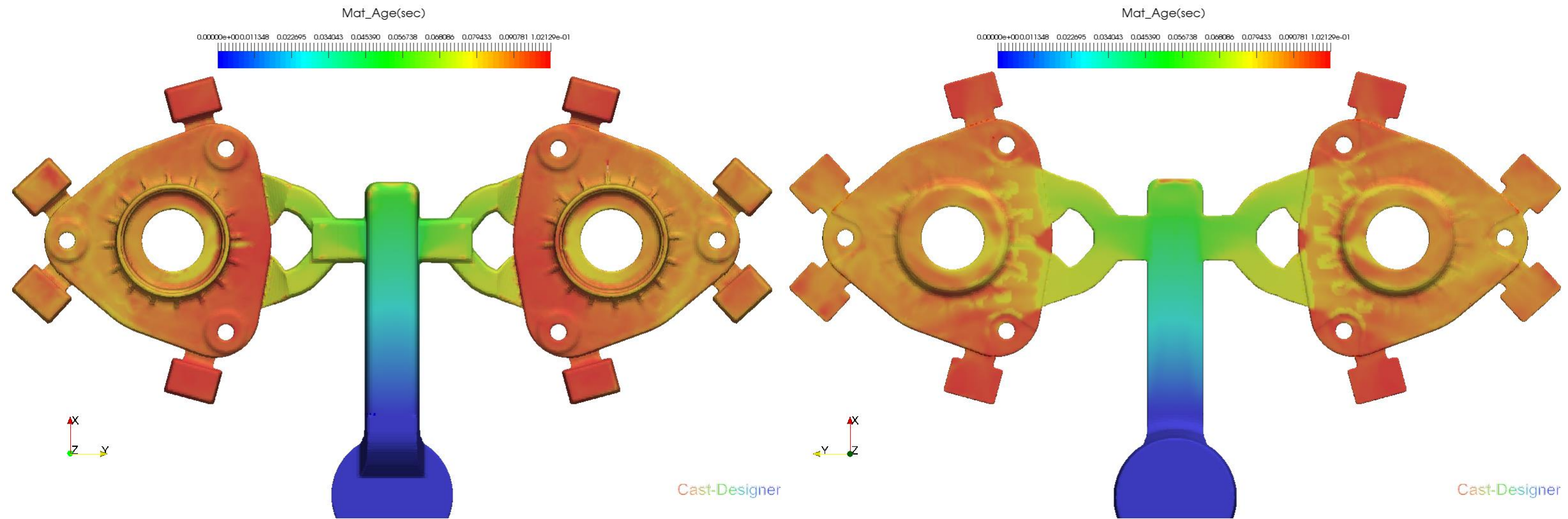
Processo di Riempimento – Frazione Fluida



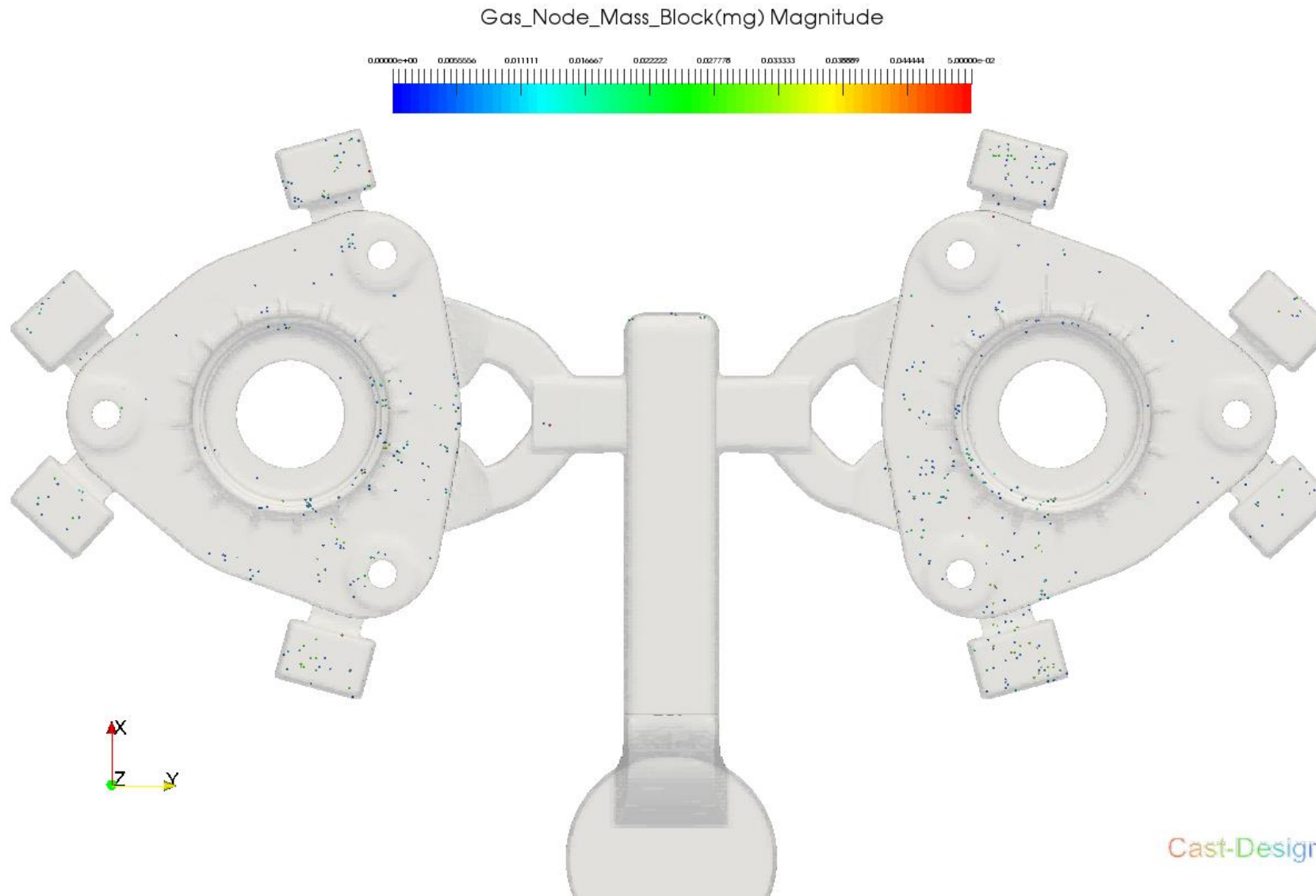
Processo di Riempimento – Aria



Processo di Riempimento – Material Age

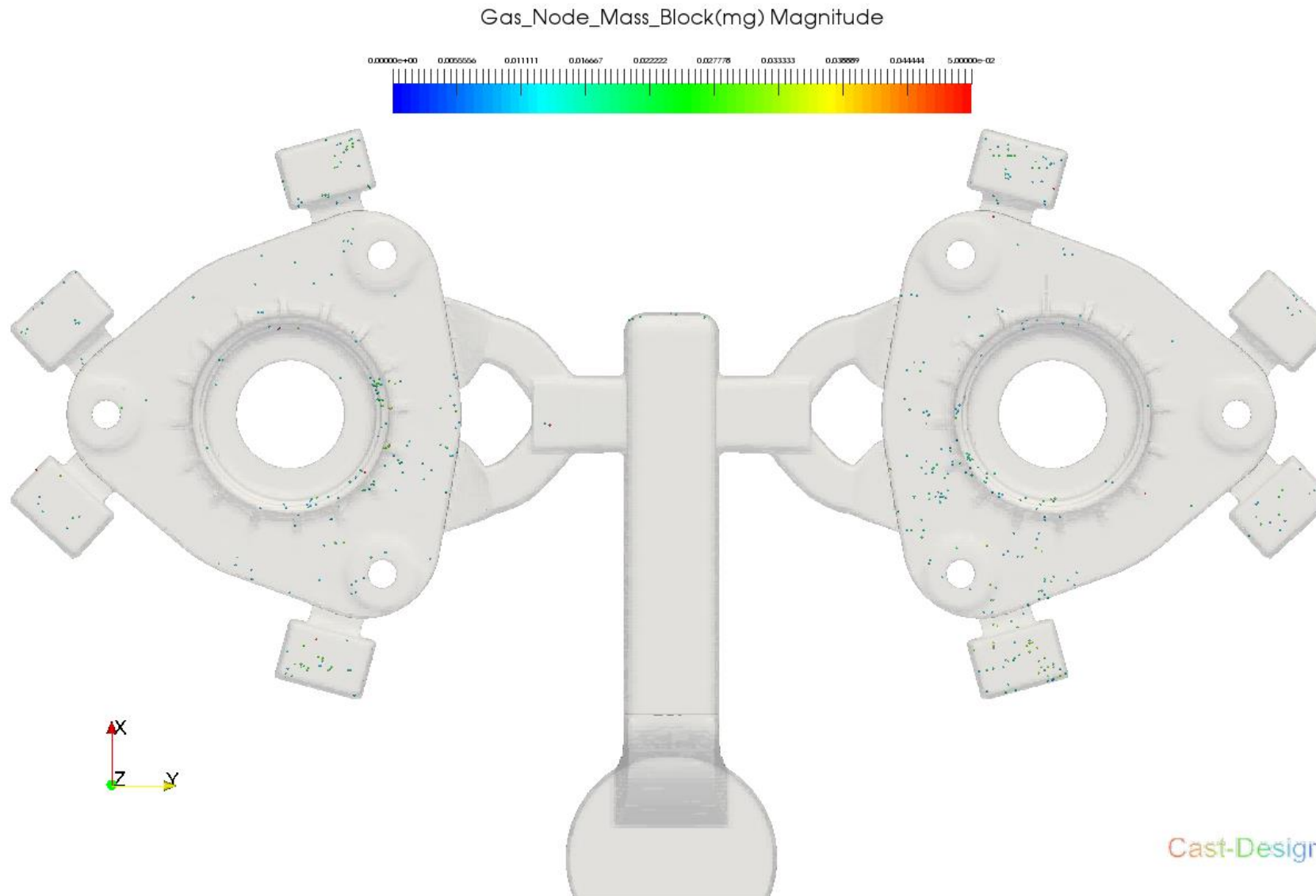


Processo di Riempimento – Gas node mass block (0.005mg)



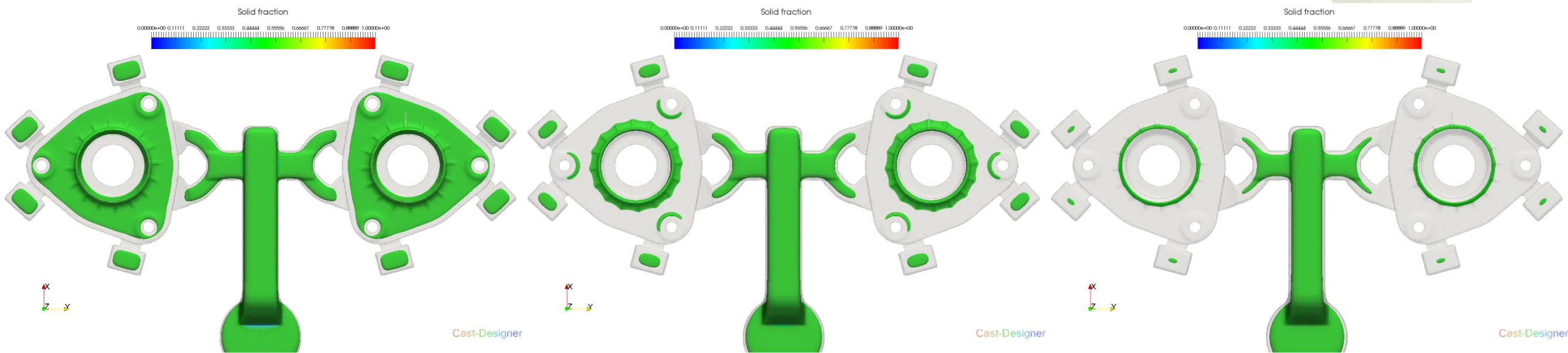
Gas Node Mass Block – Massa di Aria Statica intrappolata. Sono rappresentate le bolle d'aria fisiche (tramite sfere) comprese tra 0,1 e 0,005 milligrammi che si arrestano in una data posizione durante il riempimento. Le bolle si formano e appaiono, si muovono, si aggregano o si dividono e possono anche scomparire dissolvendosi nel metallo liquido per poi riapparire in un'altra posizione.

Processo di Riempimento– Gas node mass block (0.01mg)

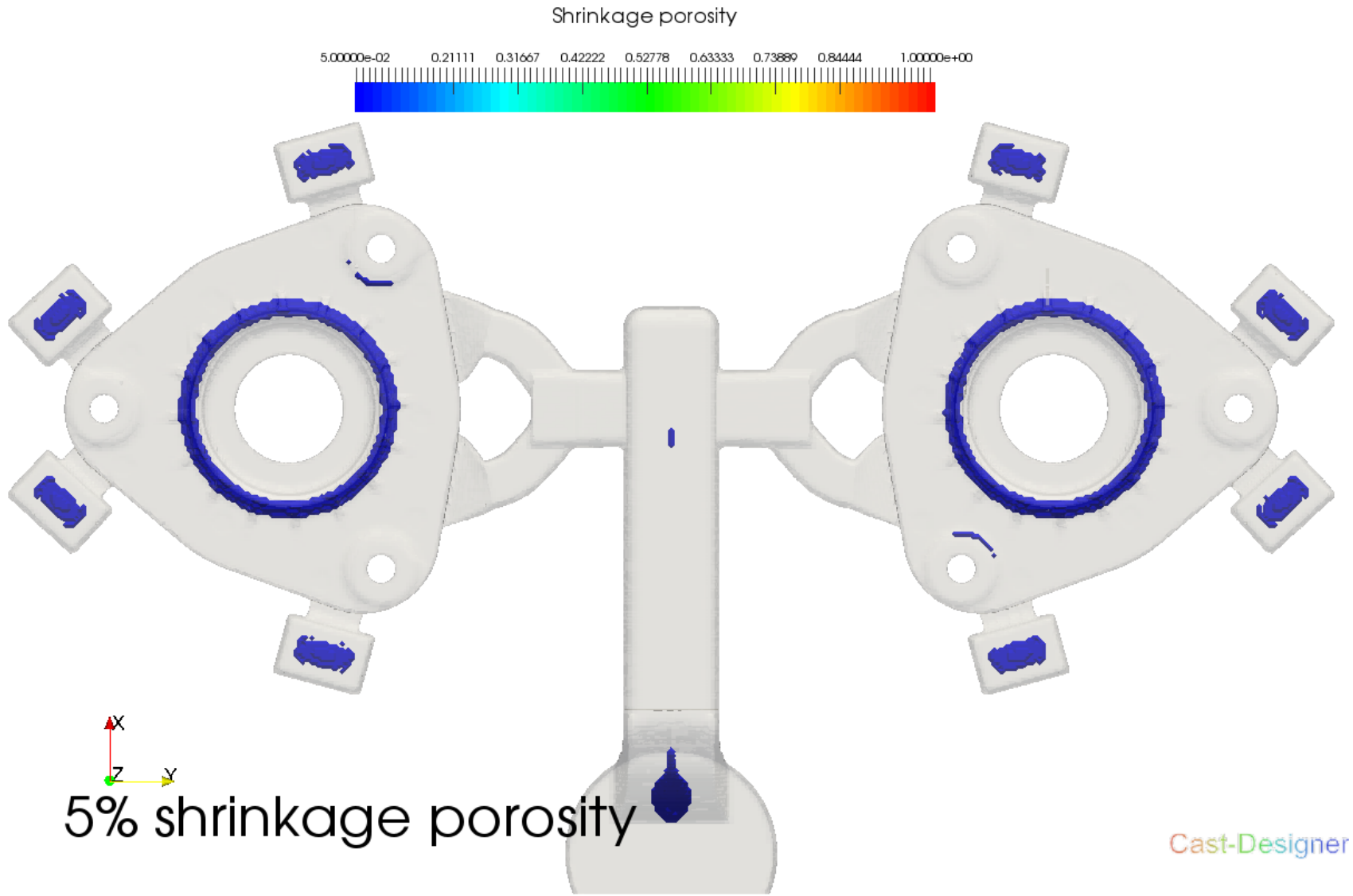


Gas Node Mass Block – Massa di Aria Statica intrappolata. Sono rappresentate le bolle d'aria fisiche (tramite sfere) comprese tra 0,1 e 0,01 milligrammi che si arrestano in una data posizione durante il riempimento. Le bolle si formano e appaiono, si muovono, si aggregano o si dividono e possono anche scomparire dissolvendosi nel metallo liquido per poi riapparire in un'altra posizione.

Processo di Solidificazione – Punti Caldi



Processo di Solidificazione – Porosità da Ritiro





Cast-Designer Performance (CDPE)

Validazione di Getti sottoposti a Carichi di Esercizio
includendo gli Effetti delle Difettosità derivanti dal
Processo Produttivo (Stress Residui, Porosità da
Ritiro, Aria Intrappolata)



Cast-Designer Performance Setup

Cast-Designer performance setup

Object assign

Mapping (Stress & temperature)

Mapping (Porosity)

Map Cast - Designer stress / porosity result to performance analysis

☒ Couple gas porosity and shrinkage porosity result

Shrinkage porosity result file name: D:\Users\yxj\3_Performance\2_Zinal\2_housing_couple\run\R_TF_New\R_1

Core3D_3
runner_2

PartMesh_1

Extract result in step: 97

Shrinkage porosity range: Minimum(%) Maximum(%)

1 35

Gas porosity result file name: D:\Users\yxj\3_Performance\2_Zinal\2_housing_couple\run\gas_porosity\g_1

runner

PartMesh

Extract result in step: 15

Gas porosity: Minimum(mg) Porosity(%) Maximum(mg) Porosity(%)

0.003 2 0.05 40

Material properties

Material Name	E(Mpa)	Nu	Nu Yield stress (Mpa)
Alumin	70000	0.3	150
n	Tan-E	Density(Ton/mm^3)	Alpha
4	150	2.7e-9	1.0e-6

Mapped material numbers: 10 E(phi)Min 0

Porosity to mechanical properties: $E(\phi) = E0 * (1 - \phi/\phi0)^n$

Parameters: $\phi0$ n

0.5 2.5

OK

Cancel

Cast Designer Performance permette di valutare la risposta di una parte sottoposta a carichi di esercizio tenendo in conto le difettosità derivanti dal processo produttivo. Per fare questo si estraggono dalle simulazioni precedentemente calcolate di riempimento e solidificazione le informazioni relative alla porosità da ritiro ed all'aria intrappolata. Possono essere anche inclusi i dati di stress residuo, che in questo caso sono stati trascurati. Le informazioni ottenute vengono poi utilizzate per creare 10 o 20 tipi di materiali con caratteristiche meccaniche diverse da applicare alla parte per poi calcolare lo stress una volta applicati i carichi d'esercizio.

Risultati del test sperimentale



(a)



(b)



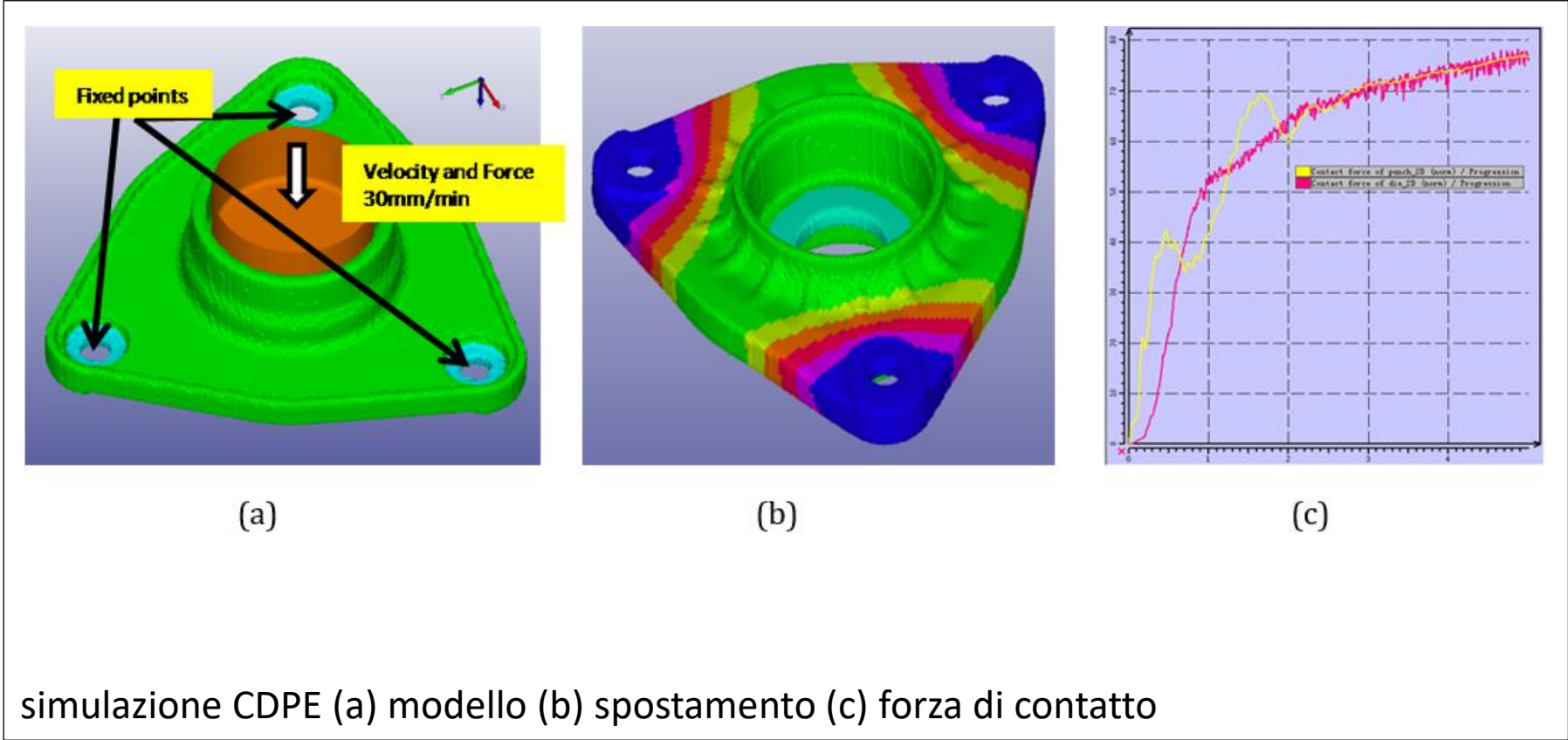
(c)



(d)

Modello CAD 3D (a) telaio di montaggio superiore, (b) processo di test delle prestazioni (c) e (d) frattura della parte in alluminio dopo il test delle prestazioni

Modello Cast-Designer Performance



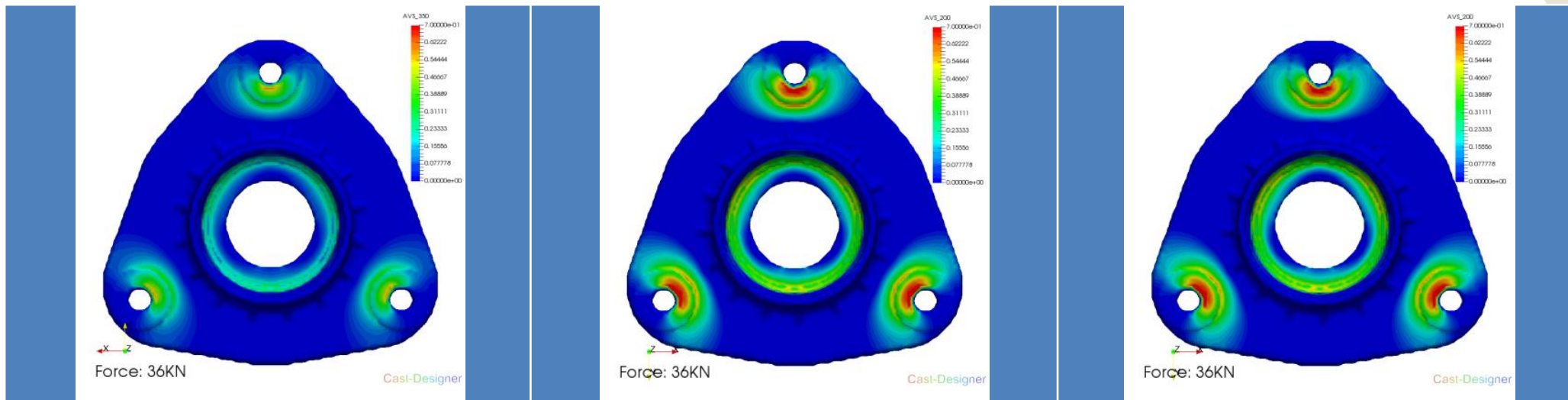
Forza:

- 36KN
- 45KN
- 70KN

CDPE Model setting	
Analysis type	Strength
Solver	Cast-Designer Performance (CDPE)
Solver type	Implicit
Element type	Hexahedron
Material	Iron or Aluminum

Material	Young Modulus (MPa)	Poisson ratio	Yield stress(MPa)	Density(ton/mm ³)
Fe	210000	0.3	350	7.8e-9
Al	73500	0.33	200	2.7e-9

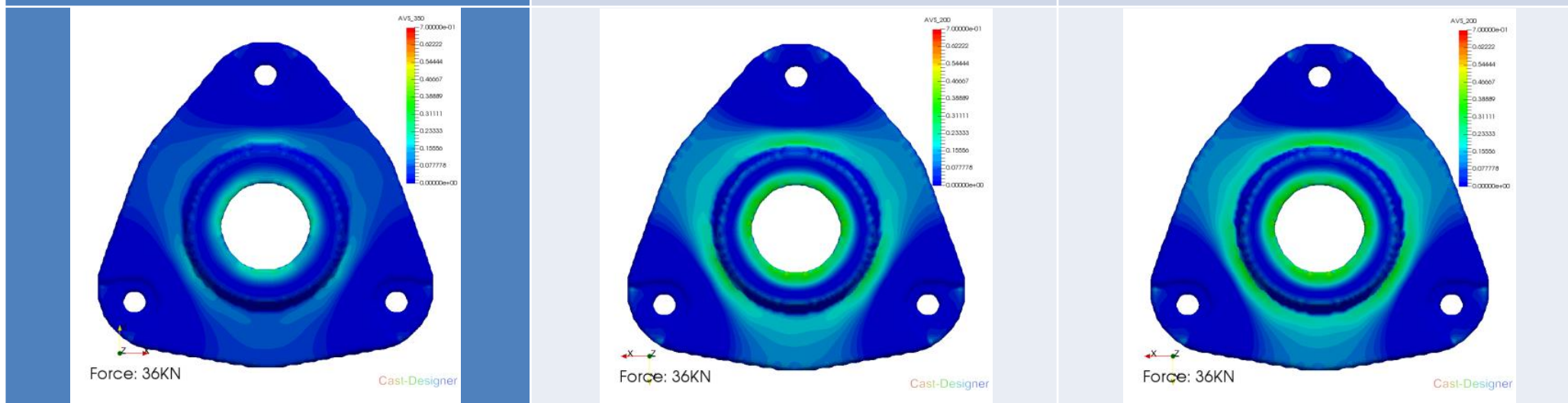
Risultati Cast-Designer Performance



(A) Ghisa con difetti

(B) AL senza difetti

(C) AL con difetti

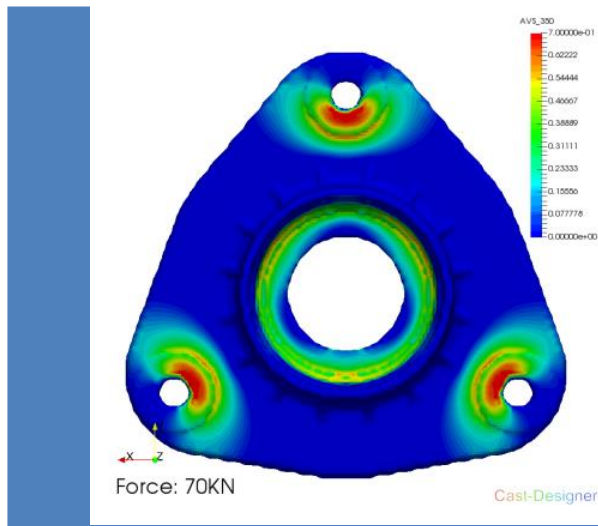


(A') Ghisa con difetti

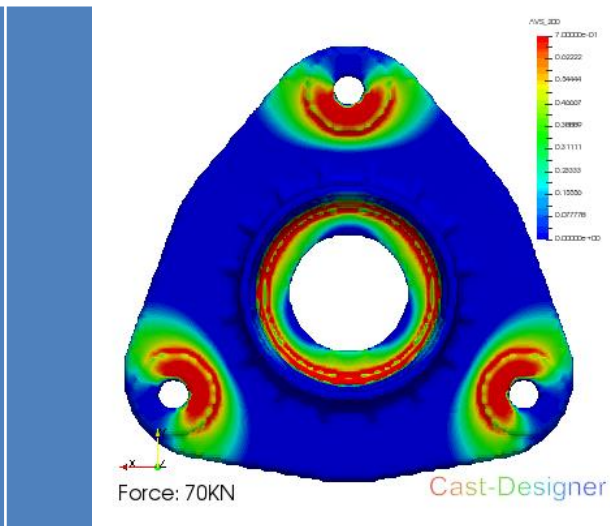
(B') AL senza difetti

(C') AL con difetti

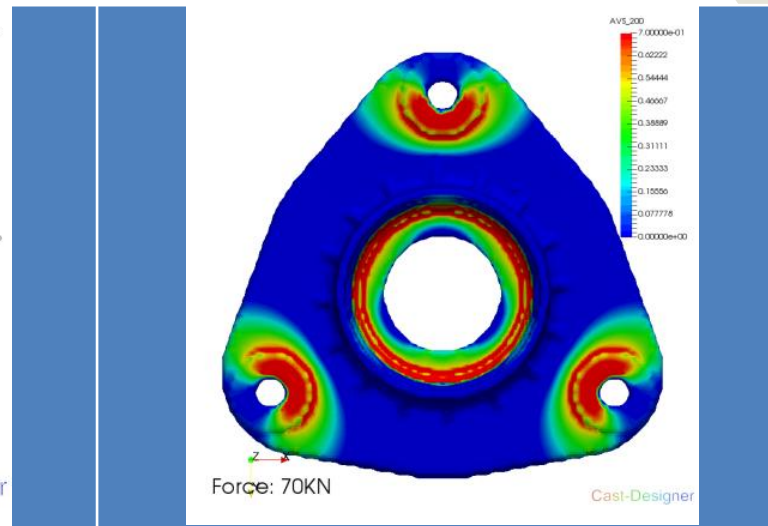
Risultati Cast-Designer Performance



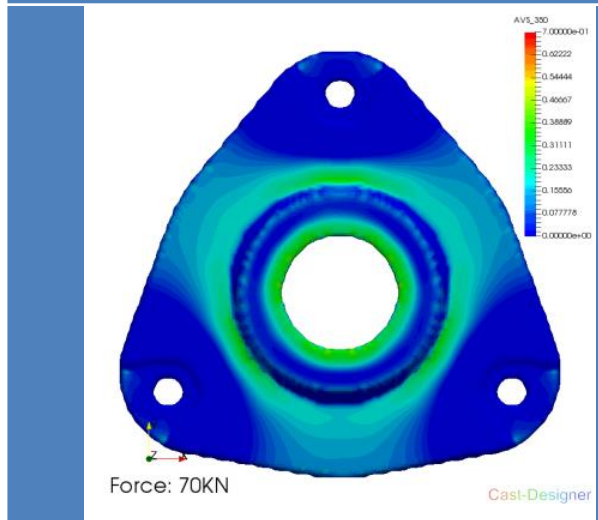
(A) Ghisa con difetti



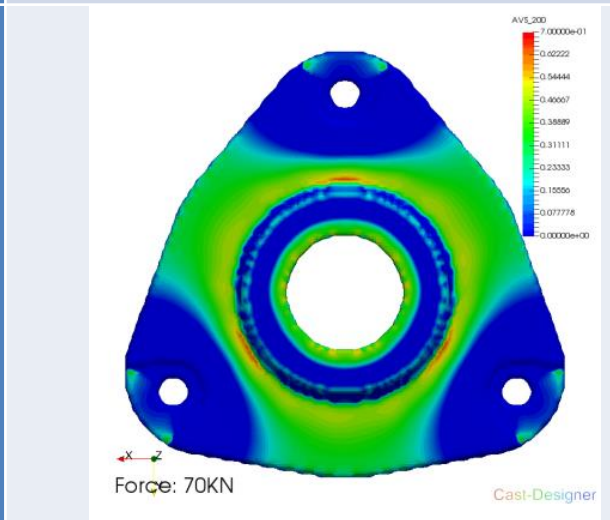
(B) AL senza difetti



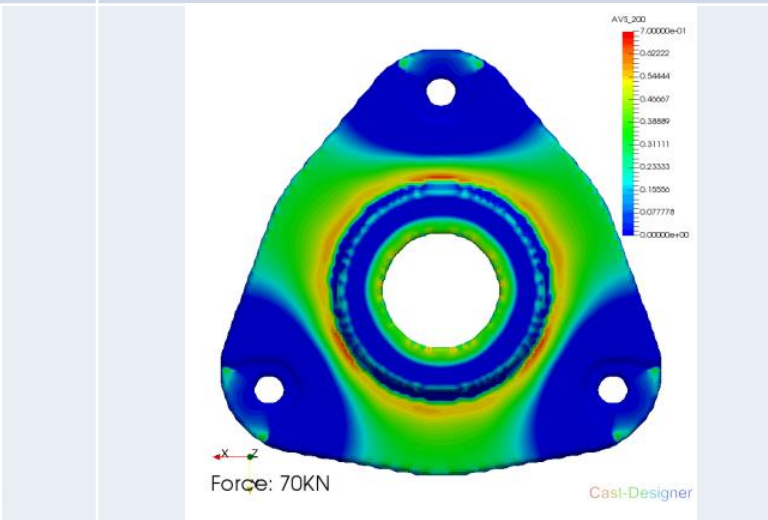
(C) AL con difetti



(A') Ghisa con difetti

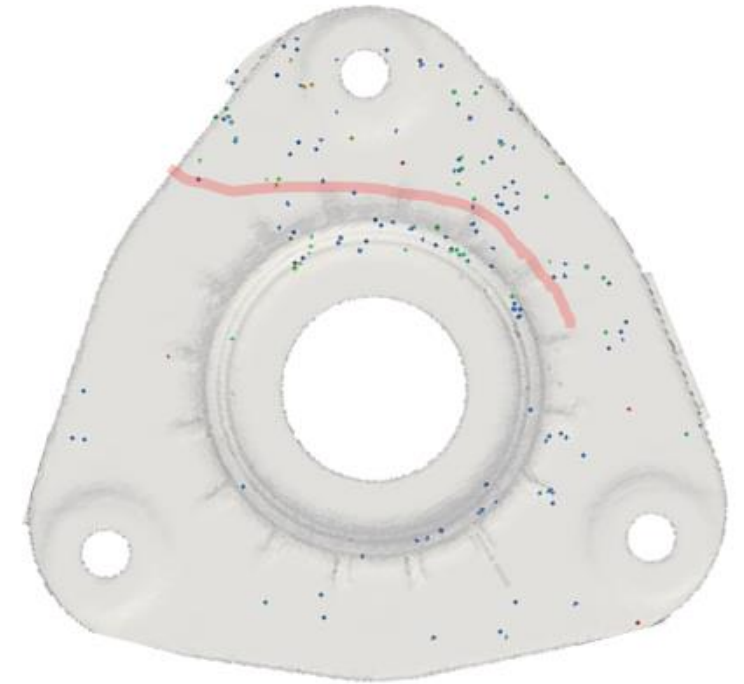
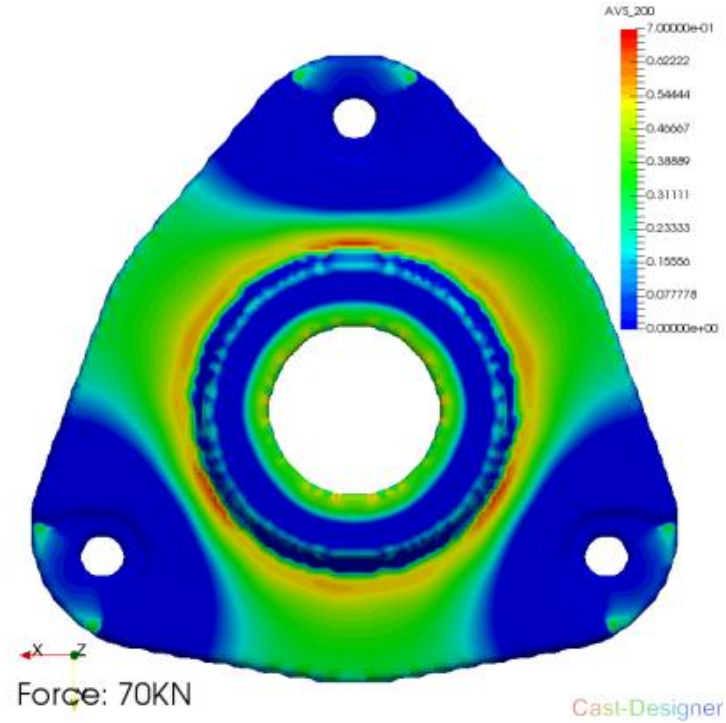


(B') AL senza difetti



(C') AL con difetti

Risultati Cast-Designer Performance

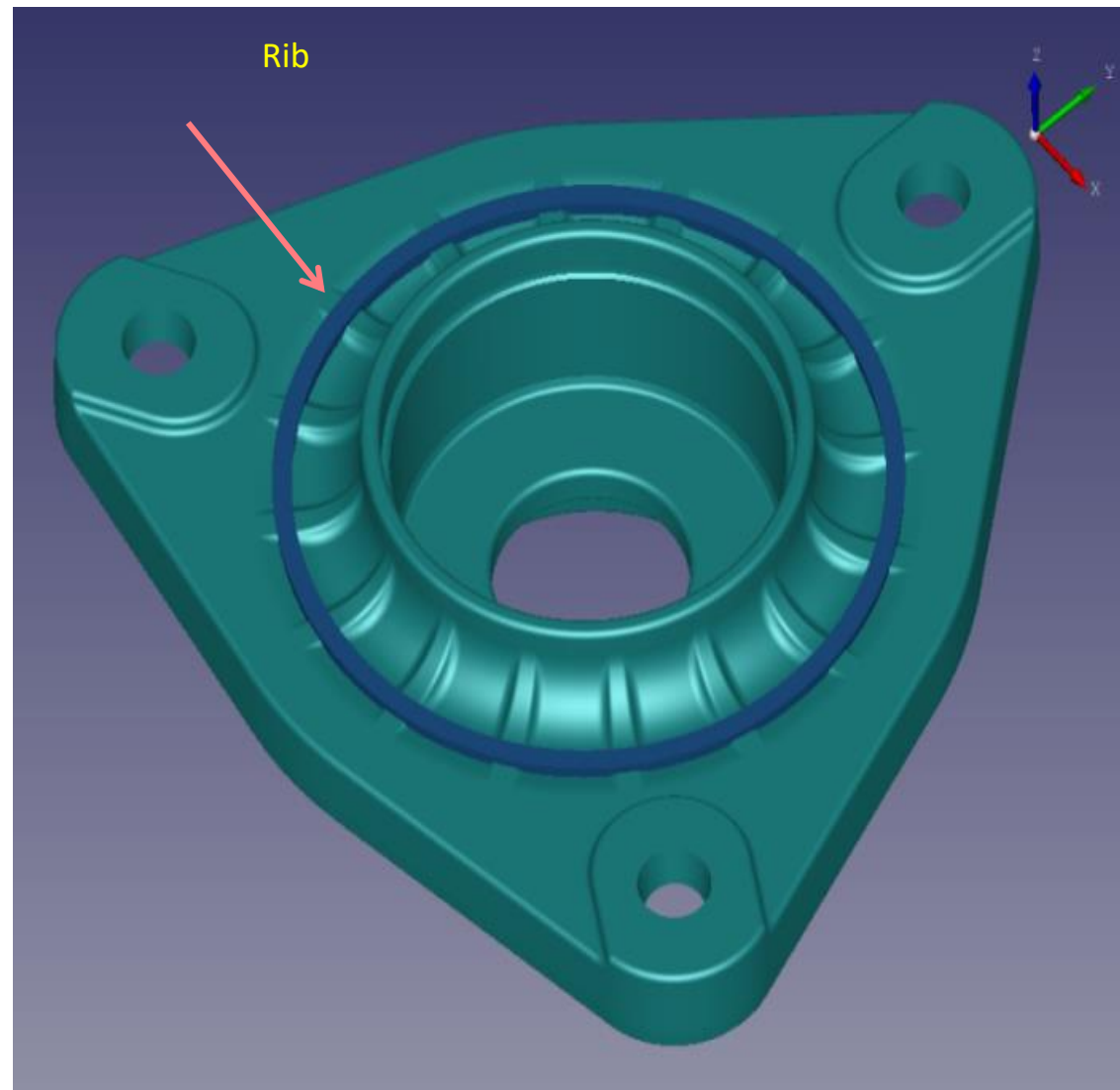


(a) Test

(b) Risultati CDPE

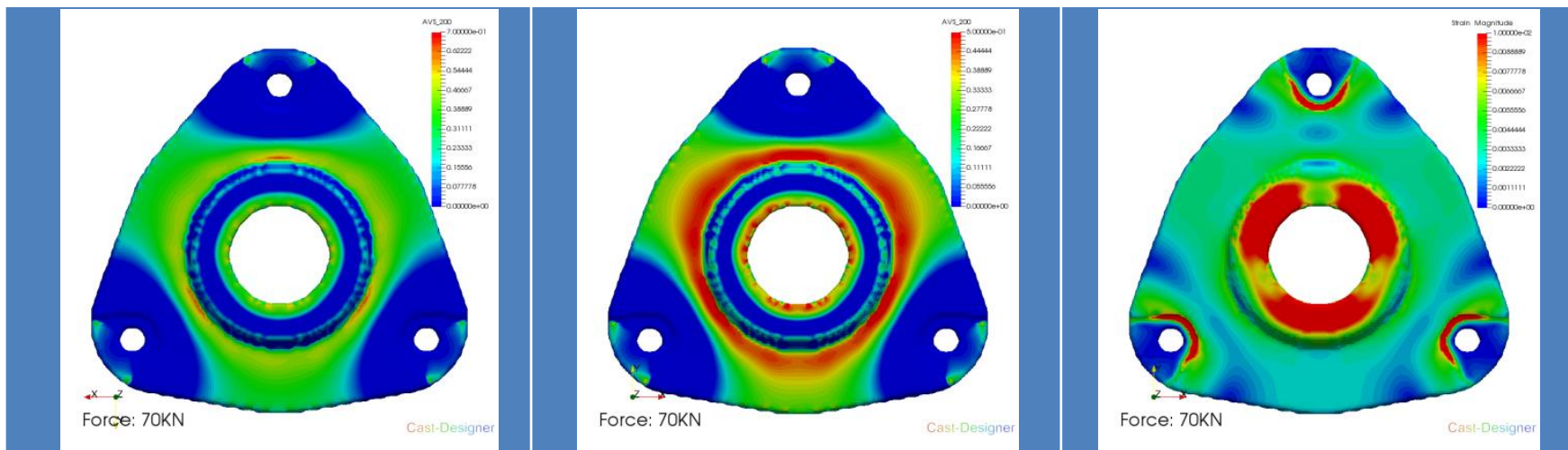
(c) Massa di Aria Statica

Parte modificata aggiungendo una nervatura





Risultati Cast-Designer Performance della parte modificata

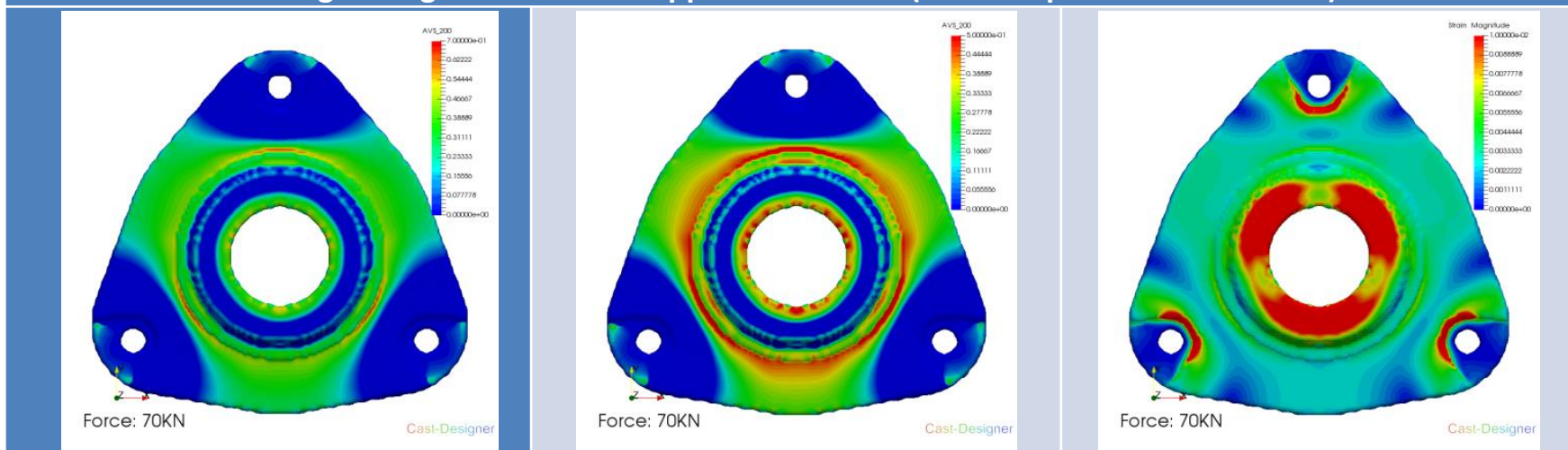


(A1) Fattore di Sicurezza 30%

(A2)) Fattore di Sicurezza 50%

(A3) Deformazione

Disegno Originale con Forza applicata di 70KN (difetti di processo non inclusi)



(B1) Fattore di Sicurezza 30%

(B2) Fattore di Sicurezza 50%

(B3) Deformazione

Disegno Modificato con Forza applicata di 70KN (difetti di processo non inclusi)



Grazie!

C3P Engineering Software International Co., LTD

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