# DEVELOPMENT OF A NEW METHOD FOR PREDICTING BREAK OUT IN CONTINUOUS CASTING

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**2022/11/16**

WALSIN 華新麗華



C級：一般資料

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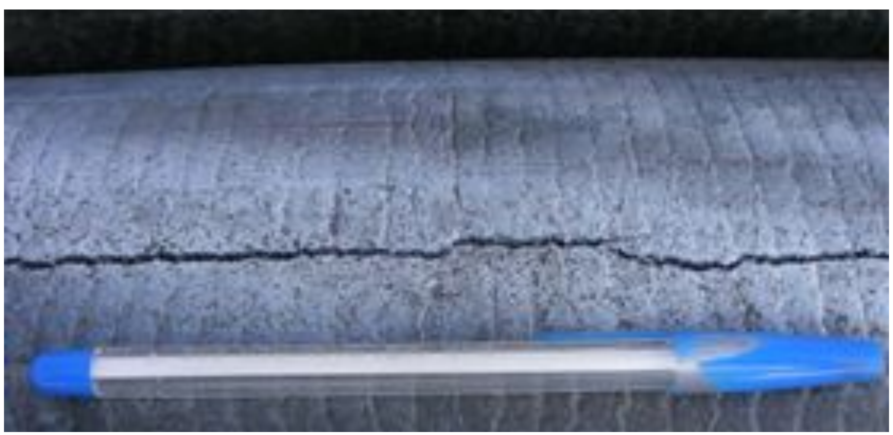
# Introduction

- The solidification behavior and material characteristic of stainless steel in high temperature are quite different from carbon steel because there are amounts of el

| Type | Steel Grade | Chromium(%) | Nickel(%) | Carbon(%) |
|---|---|---|---|---|
| AUSTENITIC | SUS304 | 18~20 | 8~12 | 0.08 |
| FERRITIC | SUS430 | 14~18 | 0 | 0.12 |
| MARTENSITIC | SUS416 | 12~14 | 0 | 0.15 |

- The cracking of the martensitic stainless steel is more severe, and it is difficult to



Cracking in billet

Break Out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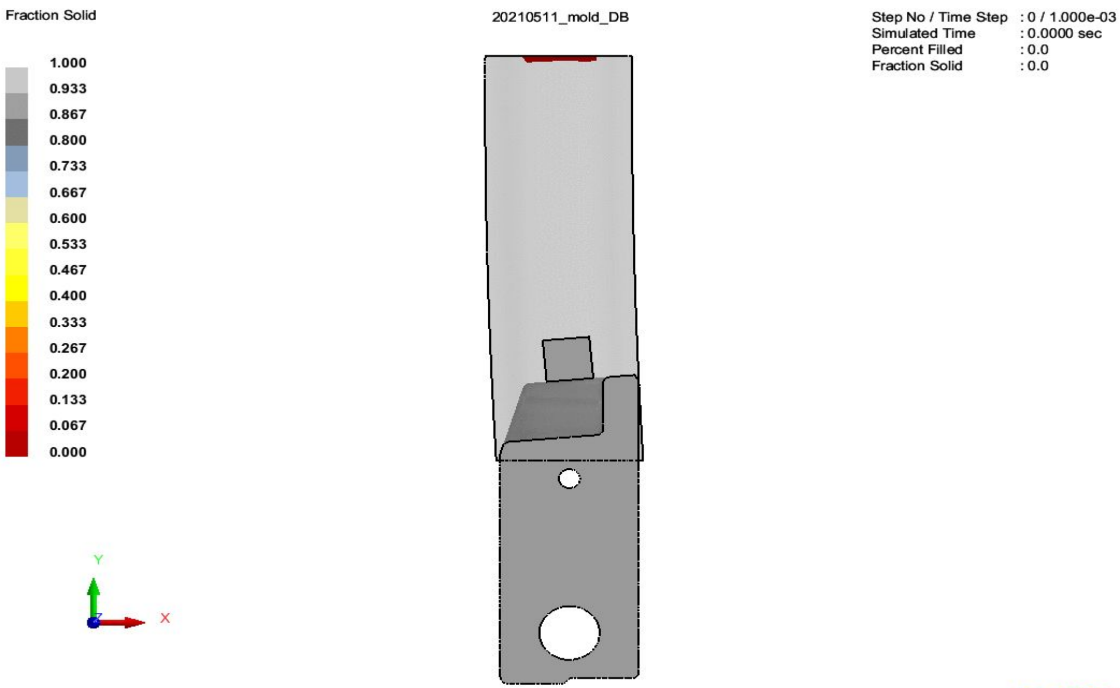
# Introduction

- **Computer Aided Engineering (CAE) and Computational Fluid Dynamics (CFD) were used to simulate and visualize the solidification behavior in the mold.**




**Solidification in mold**

# Experimental

**First step**

- CAD software was used to build 3D model geometric.

**Second step**

- Built the continuous casting model by using CFD software.

**Third step**

- Verified the correlation between the simulation and the speculation at cracking in continuous casting.

# Experimental-3D geometry model in the continuous casting

- Build the independent parts in the continuous casting by using SOLIDWORKS.

Mold

Dummy Bar

Assembly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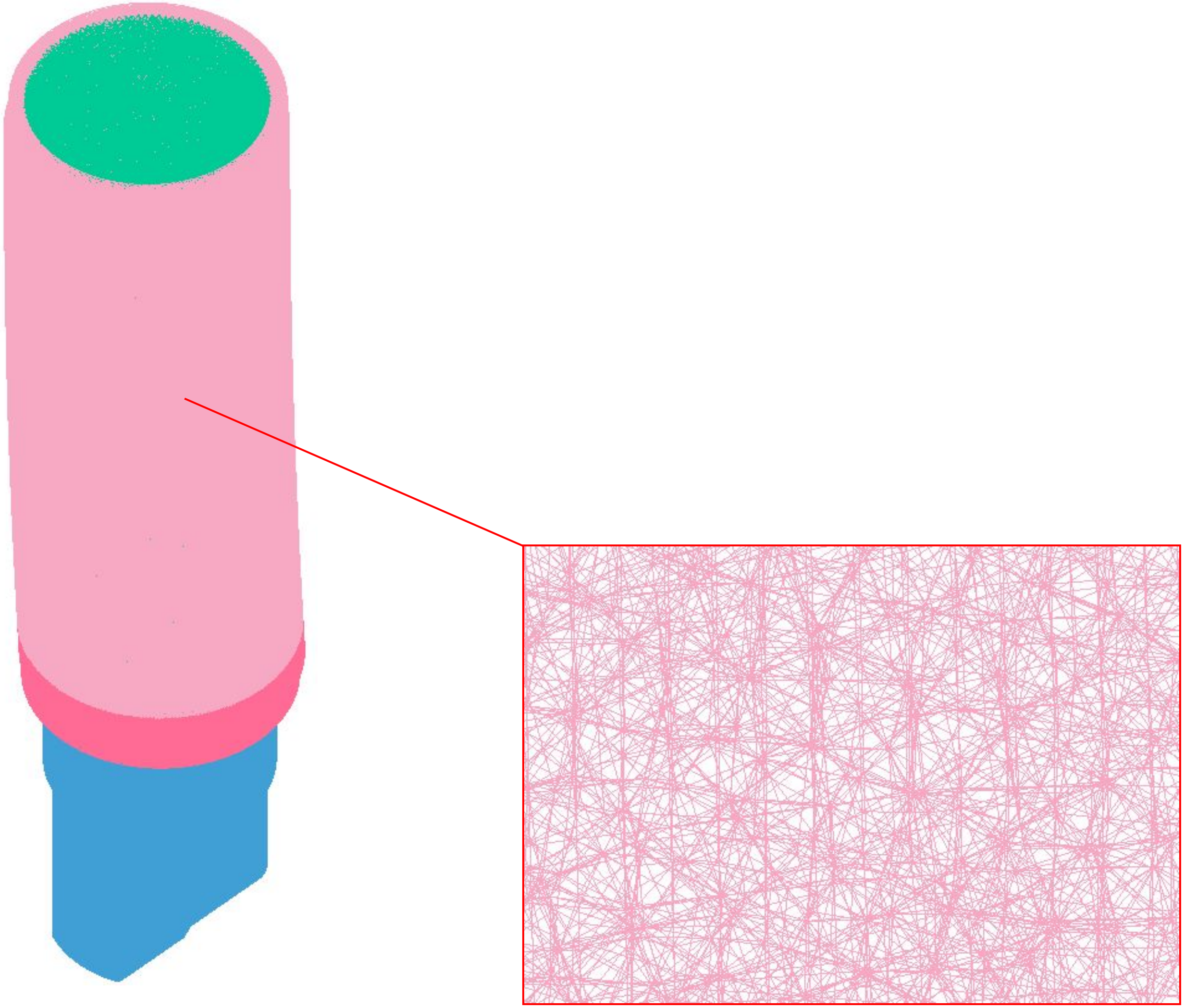
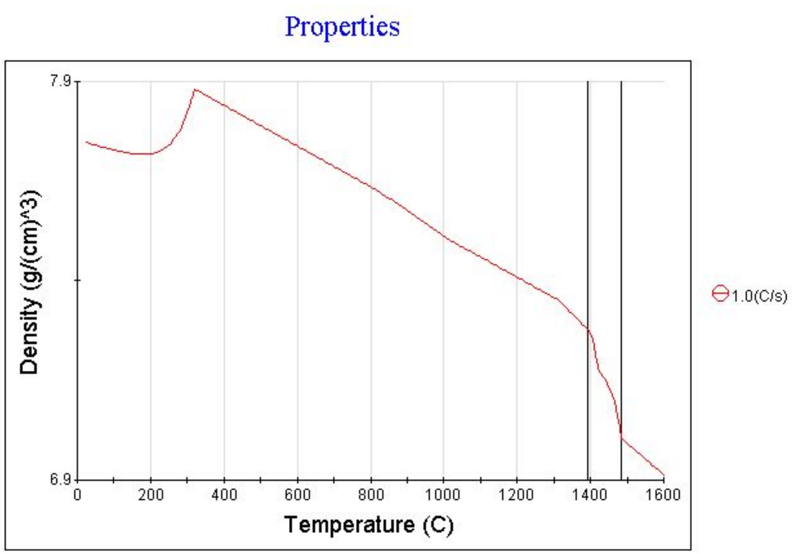
# CFD- First. geometry meshing

- Import the CAD model , fill the solid and liquid part and mesh the geometry.



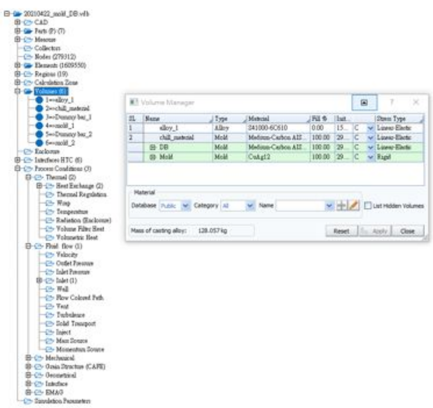
# CFD- Second. boundary condition setting

- Input the boundary condition setting
- Material property was built by JMatPro.



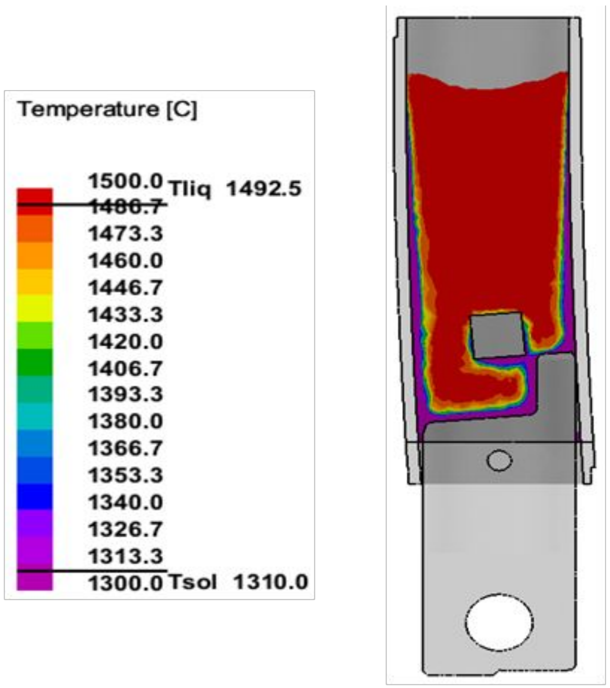

Grain size: 500.0 microns

COMPOSITION (Wt%)
Fe: 85.8447
C: 0.2741
Si: 0.4
Mn: 0.4
P: 0.0218
S: 0.0014
Ni: 0.34
Cr: 12.4
Mo: 0.09
Cu: 0.13
N: 0.013
Al: 0.0032
Nb: 0.02
Ti: 0.0018
V: 0.06

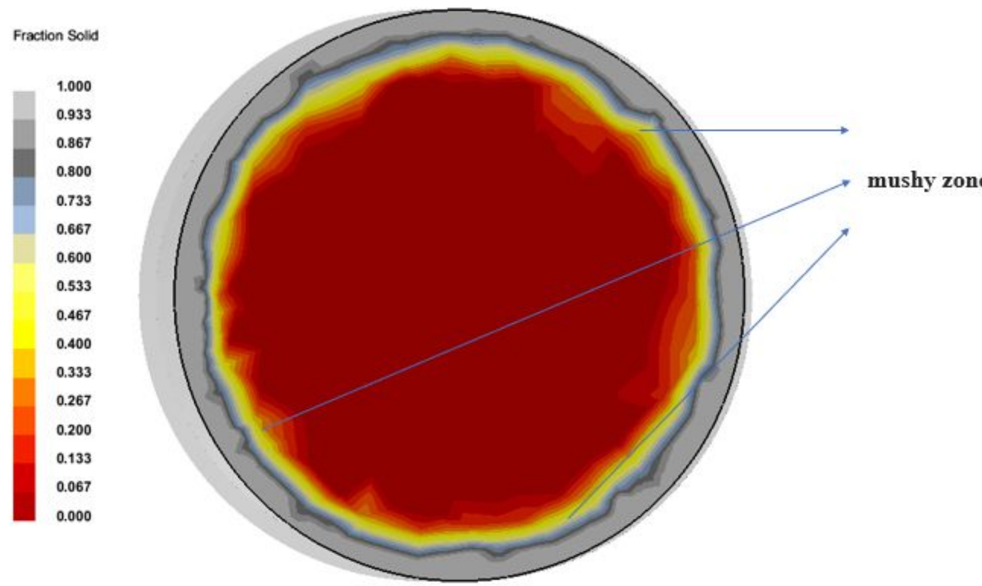


# CFD- Third. Posting

- Export the result from simulation such as temperature distribution and the thickness of solidification shell.



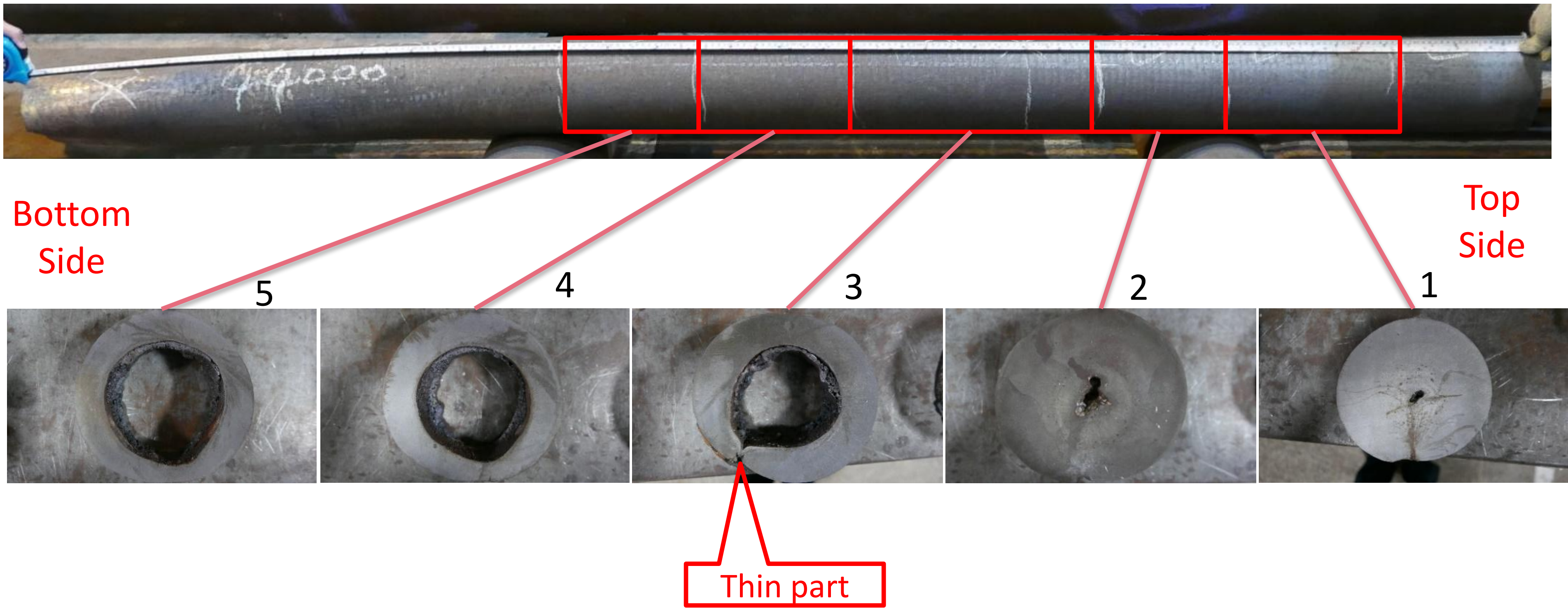

temperature distribution




thickness of solidification shell

# Experimental-The Break Out steel billet analysis

- **Compared the different parameters between the Break Out was occurred or not and compared the difference between the simulation results and the Break Out cracking**




- **We can know that the Break Out was occurred at the thin part of solidification shell.**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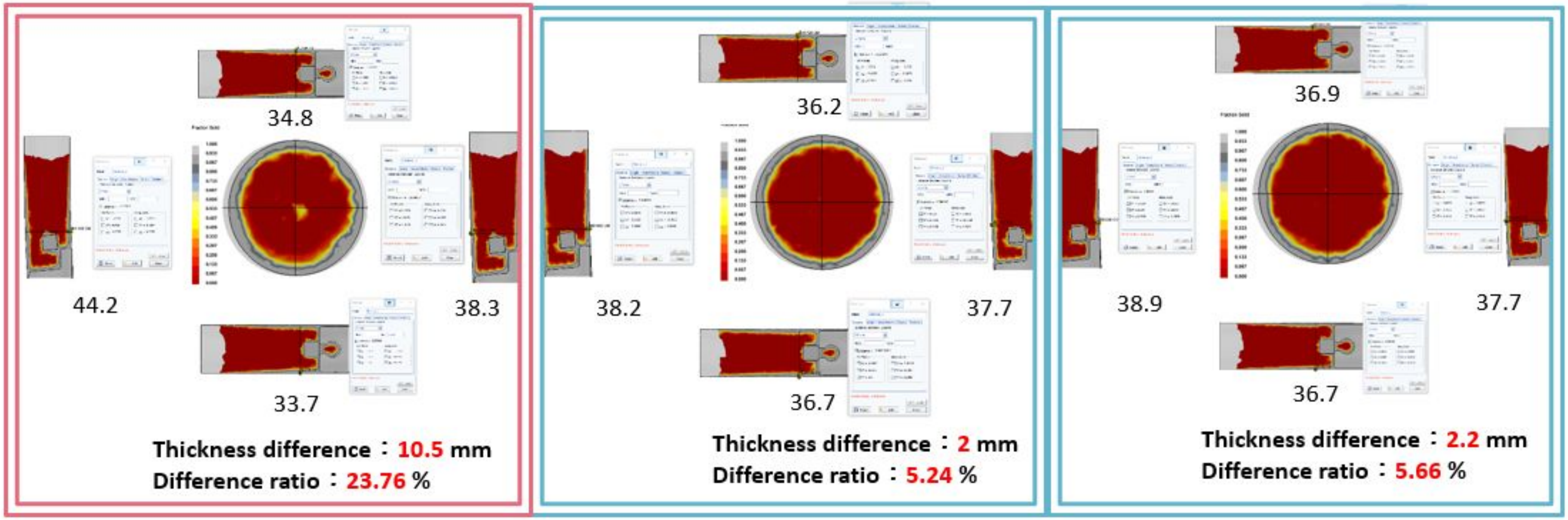
# Result and Discussion

- **From the result in simulation, we can know that, if the Break Out was occurred, the heat extraction rate was faster and uneven of solidification shell was more severe, and the vital of the solidification shell thickness was the cooling rate in the mold.**




Break Out | No Break Out | No Break Out

# Result and Discussion

- The vitals of cooling rate were relative heat input and relative heat extraction.
- Relative heat input was defined as the temperature difference between first measurement temperature in Tundish and the solidification temperature of steel fluid.
- Relative heat extraction was defined as the time difference between the beginning of continuous casting and the extraction starting.

$$I = T_{in} \times T_{out}$$

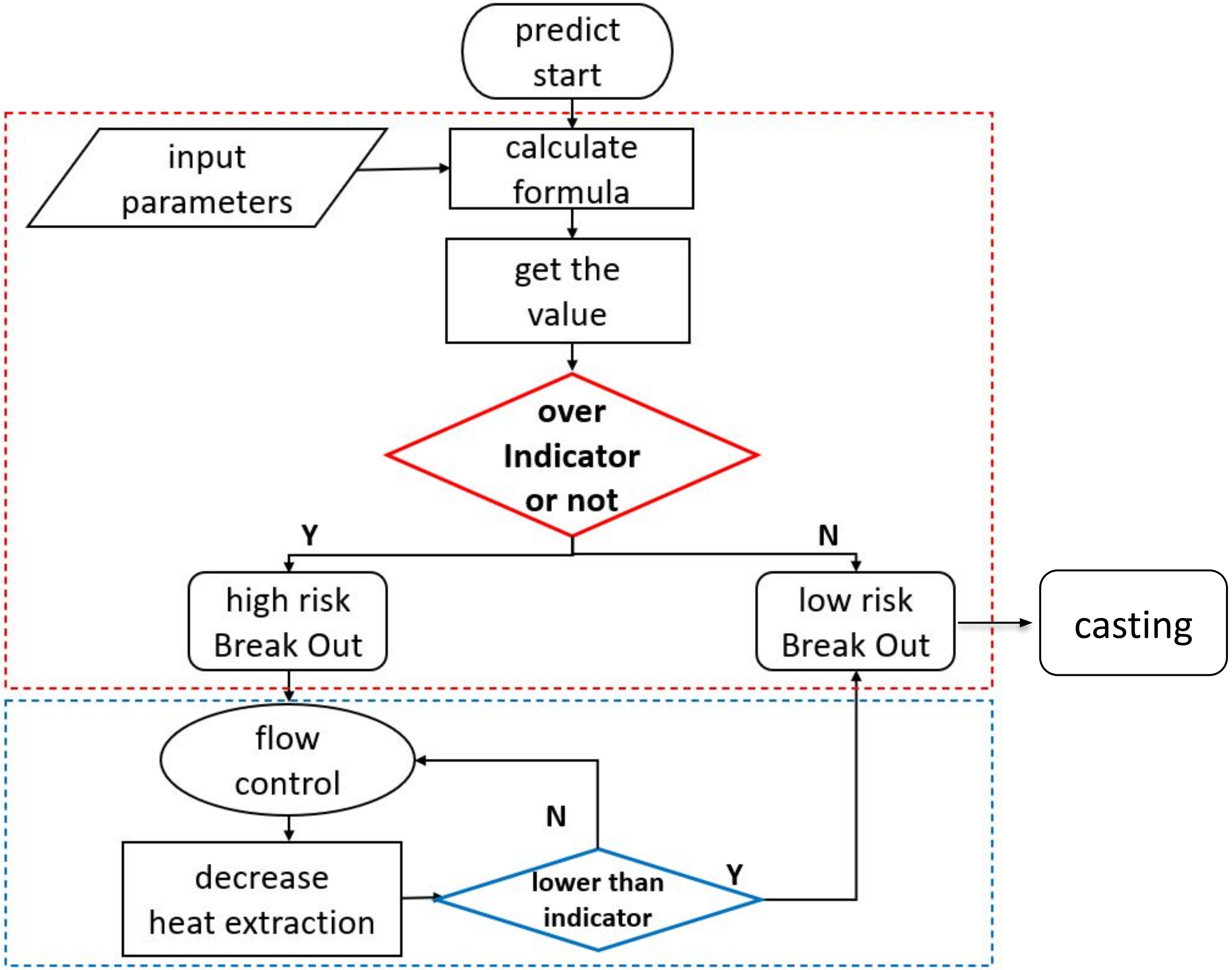
$I$ = indicator

$T_{in}$ = relative heat input

$T_{out}$ = relative heat output

# Result and Discussion

- Built the risk indicator bv the steel billet which were occurred the Break Out.



# Conclusion

- **By observing the results of simulation and the experimental, the cause of the Break Out was the uneven solidification shell which was affected by high cooling rate, especially in martensite stainless steel.**

- **The cooling rate was affected by two parameters: relative heat input and relative heat extraction. These parameters correspond the temperature difference and time difference in the continuous casting process.**

- **In this research, we built the indicator to prevent the Break Out risk in continuous casting process. And confirmed this theory in our manufactory to improve the produce technology and reduce the cost in steel billet follow-treatments.**

# Thanks for your listening

# 內容聲明 (Content Statement)

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