Improvement of Corner Cracks in Slab Continuous Casting for Peritectic Steel by Chamfered Mold Technology

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OUTLINE

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3. Chamfered Mold
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Sliver Defect on Hot Coil

- appearance : tadpole-like, near coil edge 0~20mm.
- Decarbonization & internal oxidation exists at above area of defect.
- Found at Peritectic steel, Nb steel…etc.
- Causing coil quality failure and rejected.

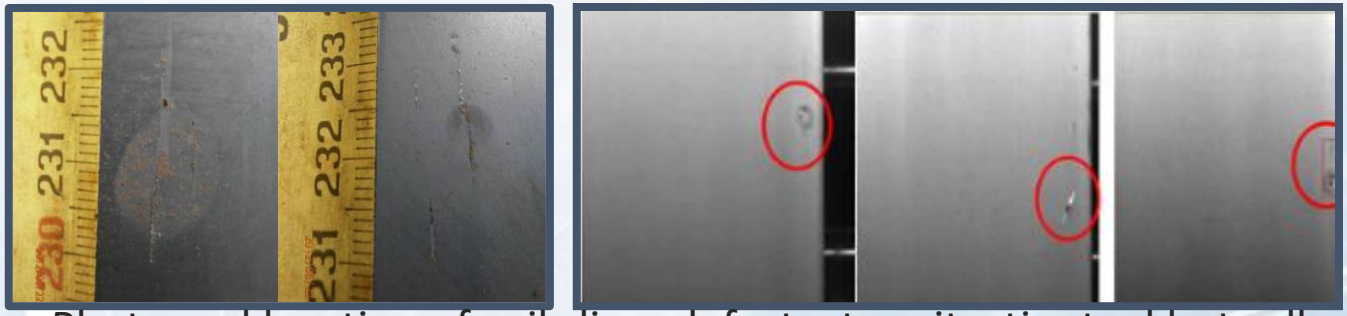
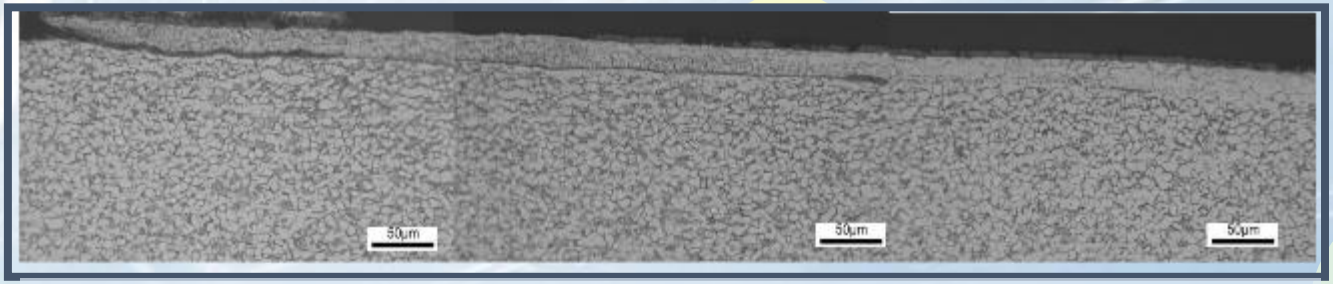


Photo and location of coil sliver defect at peritectic steel hot roll



Sliver defect revealed by OM

Transversal Crack on Slab

- From the features of defect, and observation of runback slabs, the tadpole-like sliver is highly related with transversal crack of slab.
- Causing the slab quality assurance cost become high.

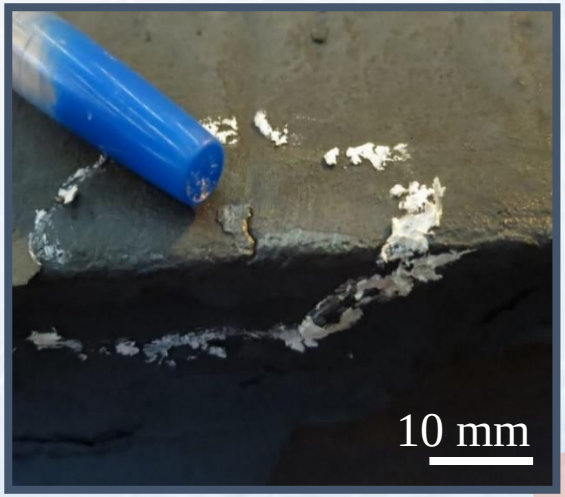
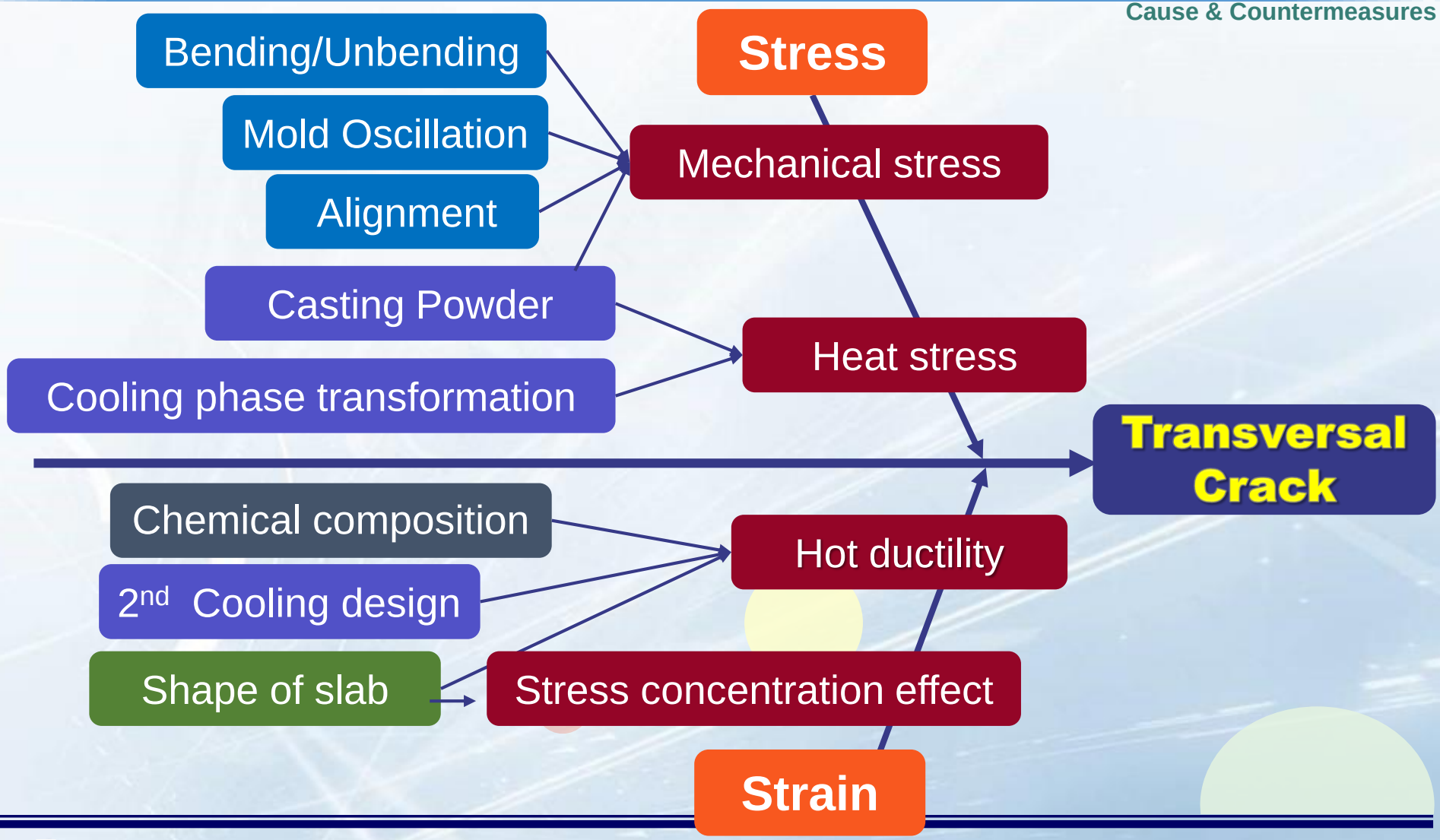


photo of transversal crack

The quality assurance cost for potentially slab transversal crack

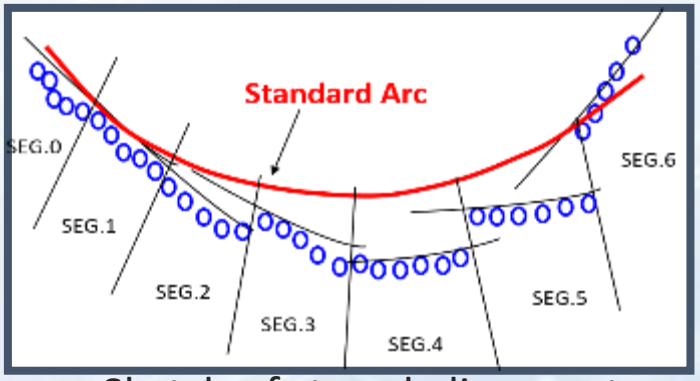
Cause and Effect Diagram of Transversal crack



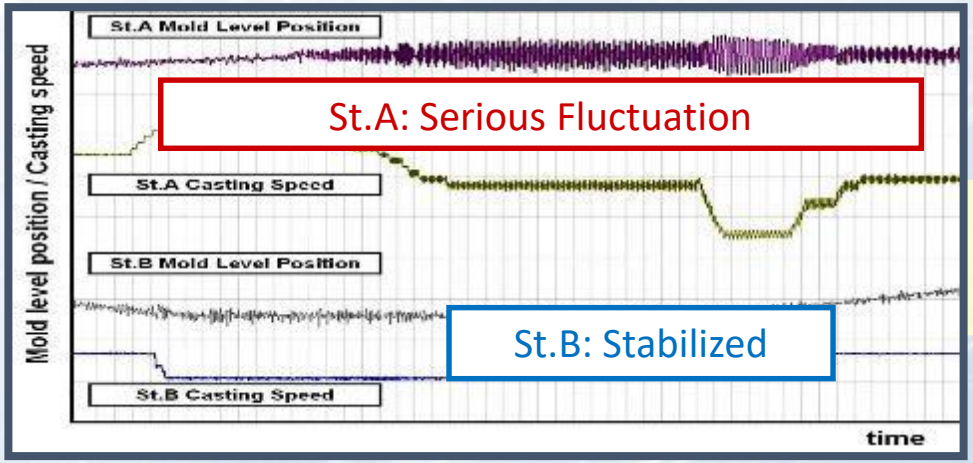
The Countermeasures Ever Done(1)

Elimination of abnormal mechanical stress

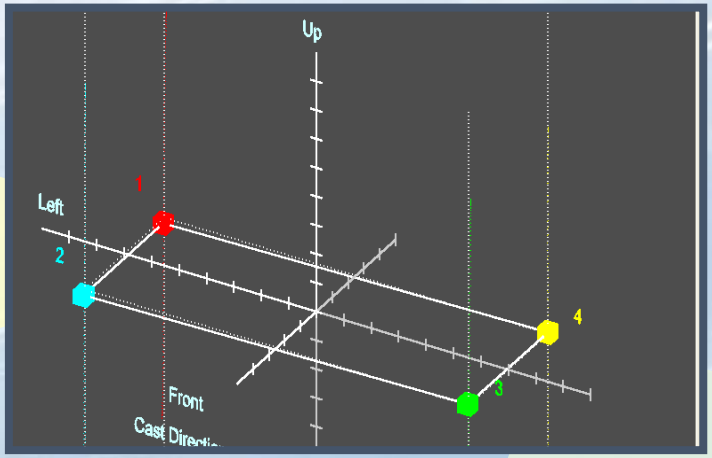
- Enhancement of alignment. esp. mold & 1st seg.
- optimization of mold oscillation. esp. oscillation pattern, hydraulic pressure…etc.



Sketch of strand alignment



Mold level with different hydraulic pressure



Measuring of mold oscillation phase

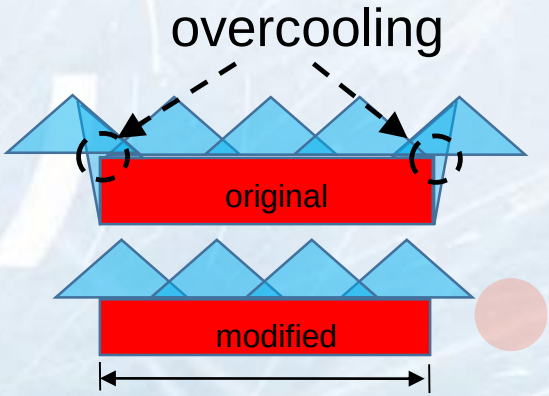
The Countermeasures Ever Done(2)

Lower the heat stress as possible

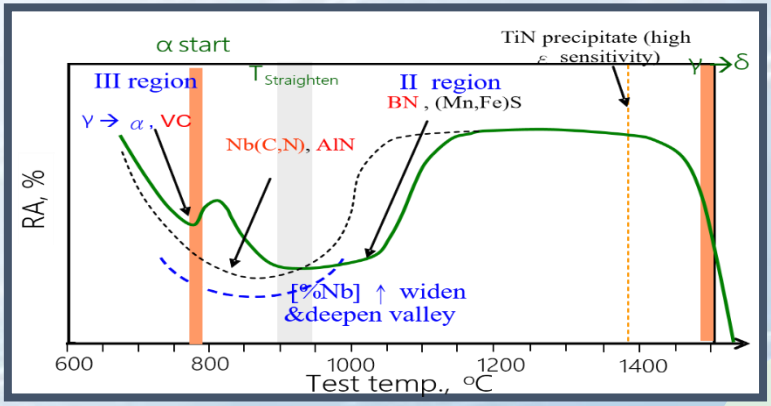
- Using soft cooling casting powder(high basicity).

Unbending at sufficient hot ductility temperature

- To increase the temperature when unbending.
- Modifying the 2nd cooling design, ex: spray pattern, specific water capacity…etc.



Sketch of different spray design

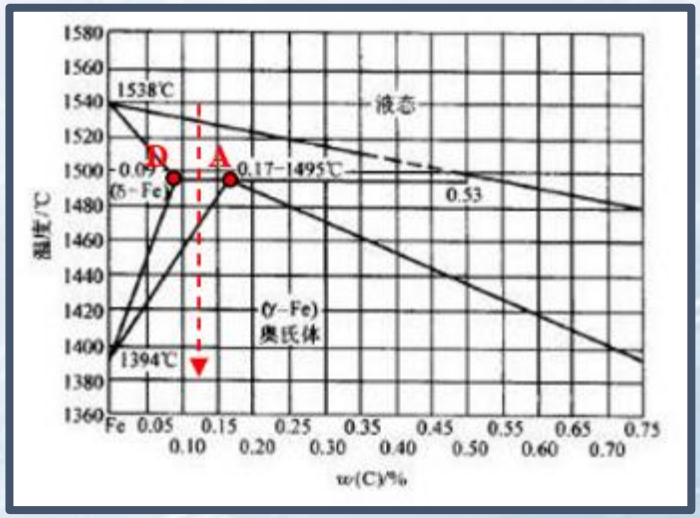


Sketch of hot ductility at different temperature

The Countermeasures Ever Done(3)

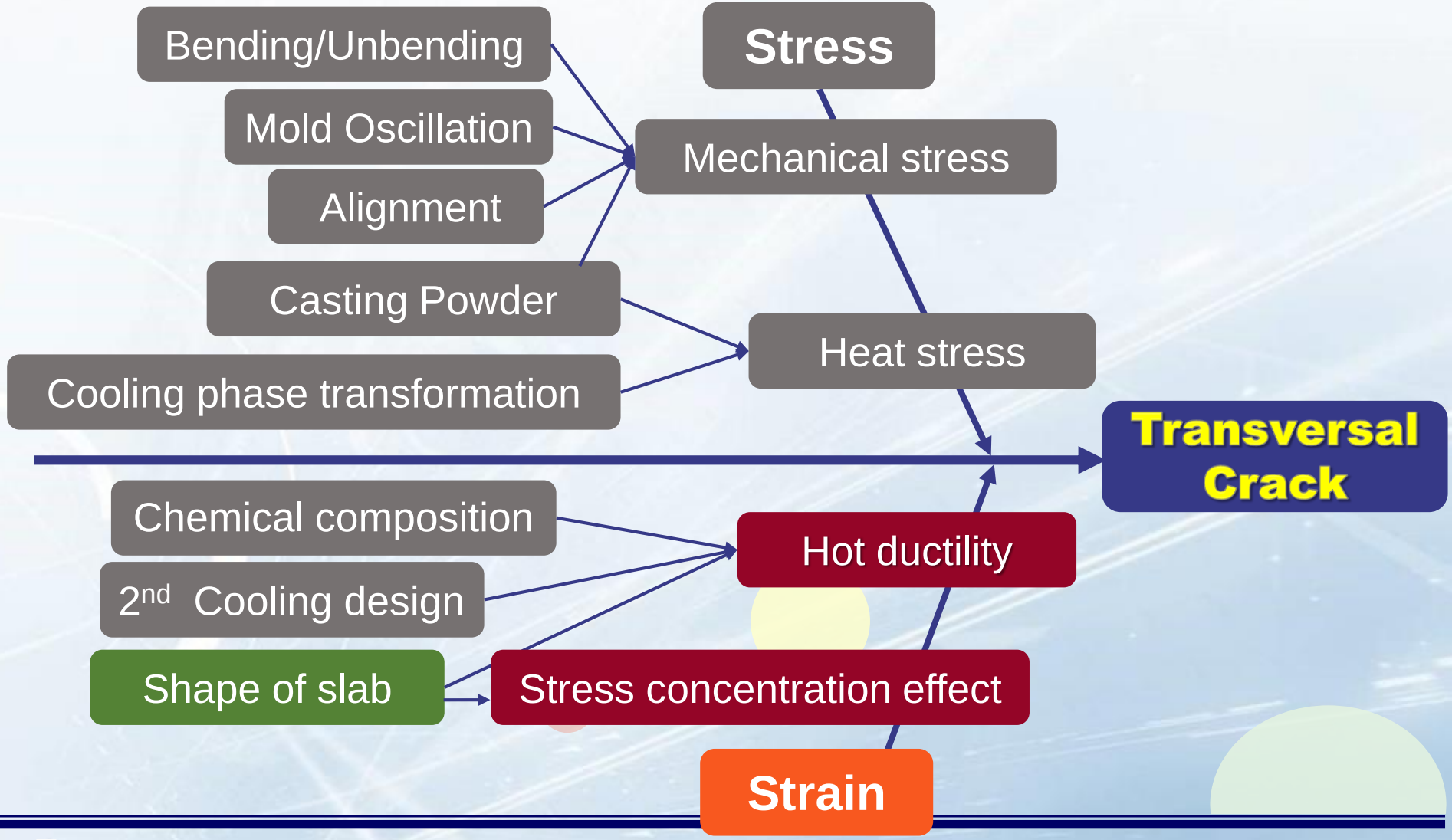
Switching the chemical composition design

- Choosing [C] not in 0.09%~0.17% when product design, to prevent peritectic effect, which slab volume shrinkage will be extremely when cooling.
- not easy to realization.



Peritectic [C] region

The Next Countermeasure



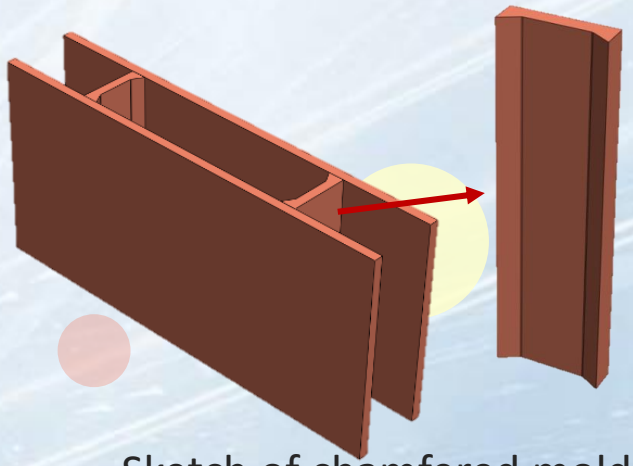
The Aim of Chamfered Mold

Dispersion stress

- To Reducing the stress concentration effect via chamfering slab.

Unbending at sufficient hot ductility temperature

- To increase the temperature when unbending.



Sketch of chamfered mold

Comparison of Countermeasures

- long-term effect, worthy to take effort for.

	Chamfered mold	Alignment	2nd cooling	Casting powder	Chemical composition	Mold control
Effect	★★★★	★★★★	★★★	★	★★★★	★★
Effective period	★★★★	★	★★	★★★★	★★★★	★★★
Controll-ability	★★	★	★★	★★★	△	★★
Effort to control	●●●●	●●●	●●	●	△	●●●

★ more; better
● more; need more effort
△ not easy to realization

Introduction of Target Caster

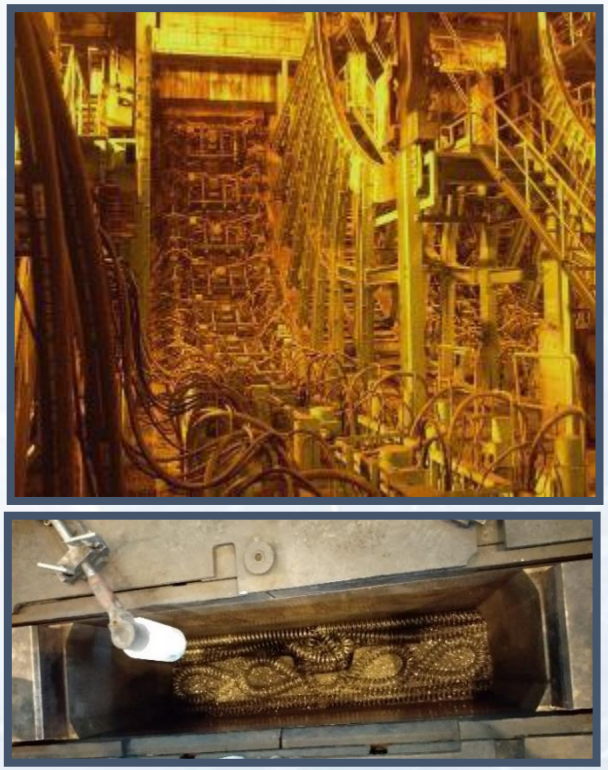


Photo of #5SCC caster and chamfered mold

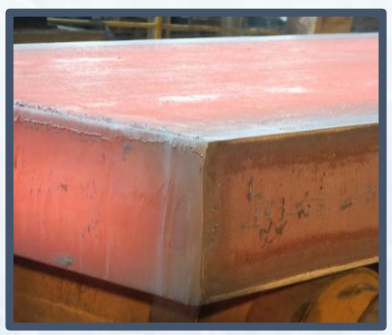
#5SCC Caster and chamfered mold

- Type: Vertical-Bending
- Dimension: 250 mm*(950~1575) mm
- Metallurgical Length: 37.2 m
- Casting Speed: 1.0~1.4m/min
- Products: low carbon & peritectic steel for hot rolling, tin plate…etc.
- Chamfered mold design target: transversal crack
- Mold figures: multi-phase, and modified foot-roller, large chamfered face

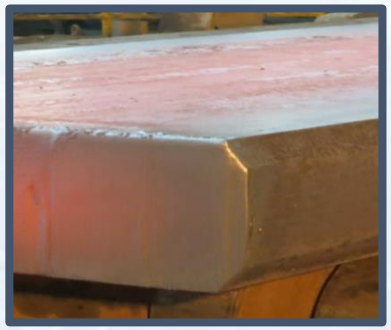
Result Discussion(1)

Slab corner temperature and transversal crack

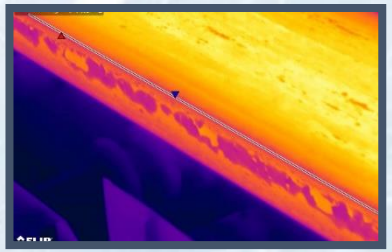
- Temperature increased ~60 ℃.
- Transversal crack rate was reduced by 33%.

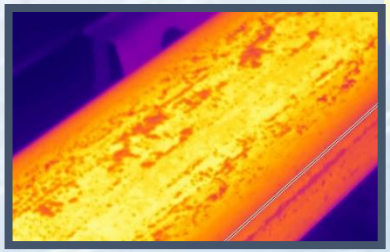


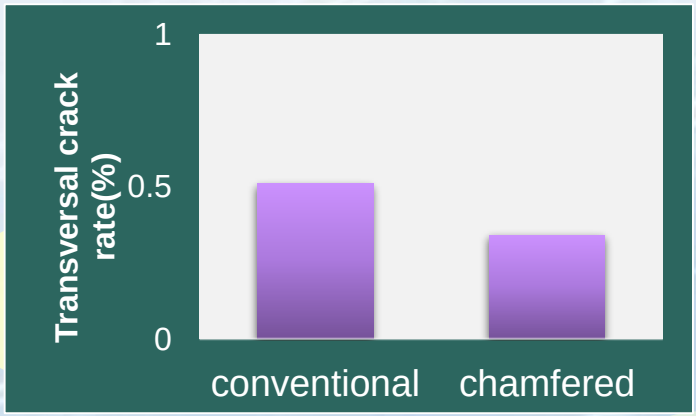
Conventional slab
~758℃(IR Sensor)



Chamfered slab
~818℃(IR Sensor)







Result Discussion(2)

Corner problem and improvement effort

Corner problem	Cause	Improvement
Slab corner squeezed	Misalignment of mold & foot-roller	① Enhancing Skill training ② modify alignment tool
Corner longitudinal crack and bleeding	① Mold angle deformed ② Mold coating peel off ③ Mold seam stock with slag	① Adjust producing plan to reducing mold-change ② Modifying coating material(Ni- to Ni-Co-) ③ Enhancing cleaning procedure and skill

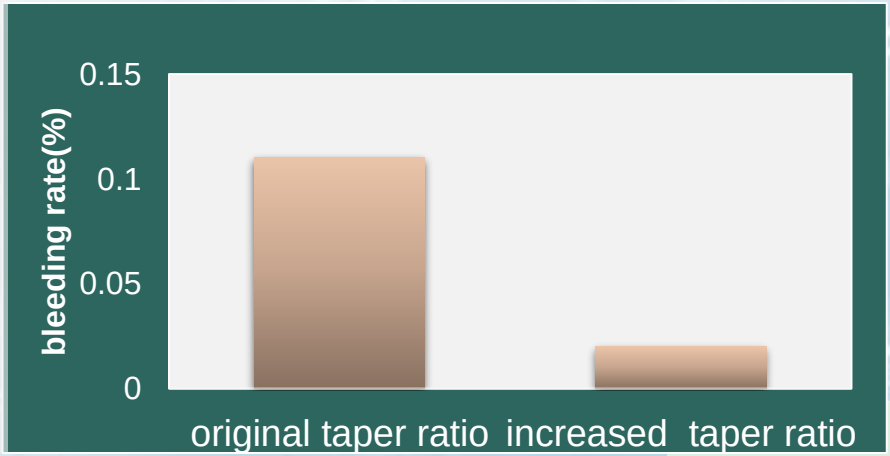
Photo of slab corner defect and associated mold problem

Result and Discussion(3)

Bleeding on Narrow Face

- parallel to oscillation mark, leaking out and quick repaired.
- without breaking out, messy sticking casting powder, and sticking point.
- Considering the support would be insufficient at upper mold area.
- Improved by increasing taper ratio~0.01%.

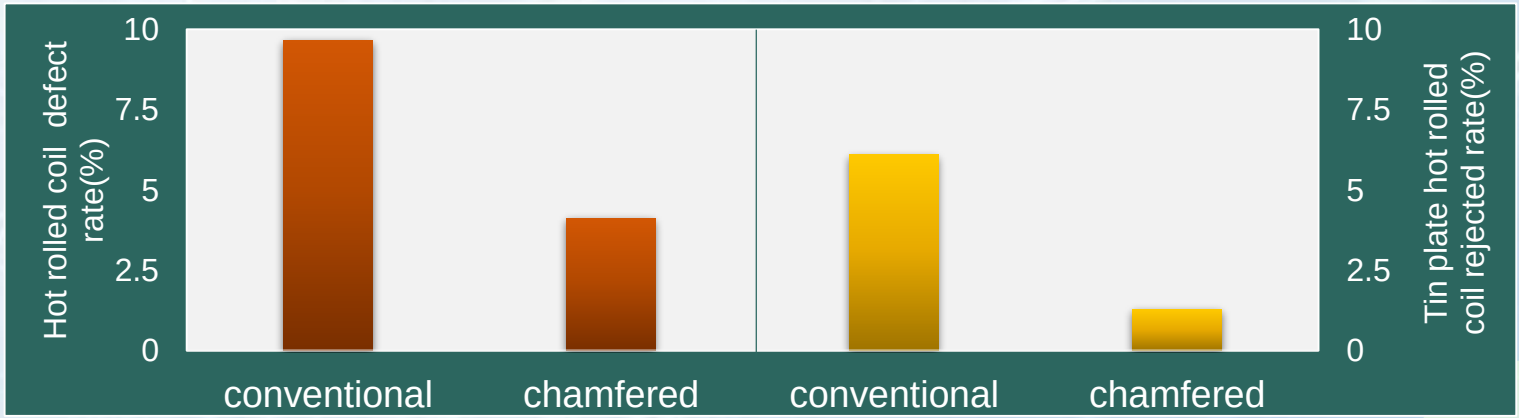
Photo of bleeding on chamfered slab



Result and Discussion (4)

Quality of Hot Coil

- Coil sliver rate was 57% lower.
- Tin plate coil rejected rate decreased 78%.
- Saving slab reconditioning cost, and going hot-charge.



Conclusion

- The application of chamfered mold lowered down slab transvercal crack rate by 33%, hot rolled coil defect rate by 57%. Which saved the cost of recondition of slab gratefully.
- Through adjusting producing plan, changing coating material, enhancing slag cleaning process, repairing and alignment art, slab corner problem was controlled.
- Via increasing taper ratio, bleeding on slab narrow side was solved.


THANKS!!

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