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Short Communication

New vertical bloom caster

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Abstract – Driven by obvious advantages of the vertical casting process for very special steel grades there is a new trend to use vertical casting even for heavy bloom round sections. Compared with ingot casting routes, this technology reaches 12.5% more yield. Thus an additional share of the today's ingot casting route can be shifted to the more cost effective continuous casting line.

1 New concept for large round blooms

Siemens Metals Technologies got a contract from the Chinese company Zhongyuan Special Steel Co. Ltd. to build a new vertical continuous caster for production of heavy blooms in round cross-section. With the new two-strand caster, in future Zhongyuan will be able to produce blanks for high-quality steel grades, tool and bearing steels, as well as heat-resistant stainless steels. The new machine serves for a capacity of up to 370 000 metric tonnes per year.

The new 2 strand caster is designed with a metallurgical length of 23 m. It will produce heavy blooms with diameters of 400, 600 and 800 millimetres and lengths between 2.5 and 6 m. The caster is equipped with straight DiaMold tubular mold, DynaFlex hydraulic oscillator for flexible adjustment of oscillation parameters. Technology packages such as LevCon mold level control, Mold Expert with breakout prevention and assistance functions, Dynacs 3D metallurgical cooling model with DynaJet cooling nozzles as well as the complete process automation will ensure smooth casting.

1.1 New drive generation for vertical round caster

The core component of the plant is represented by the new multi-roller drive unit,

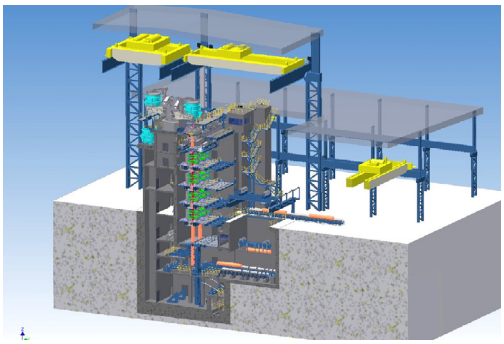

Fig. 1. Zhongyuan Special Steel Co. Ltd. China.

which compensates the high downward forces of the strand weight during casting and reduces the circumferential tensile stresses in the whole cross section of the solidifying bloom. By this advanced design, safe and optimum support of the 120 ton strand as well as homogeneous internal quality of the blanks is assured.

When casting heavy round sections, which operate with low casting speeds, the strand shell needs not to be supported against inner ferrostatic load by means of strand containment, since the circular strand shell provides sufficient stiffness. The driving rollers serve just for holding the strand. Vertical strands with bigger diameters become very heavy, and consequently the holding forces increase tremendously.

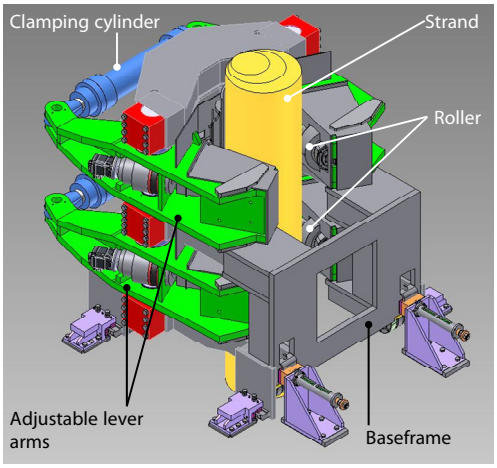

Fig. 2. New multi roller drive unit for round blooms.

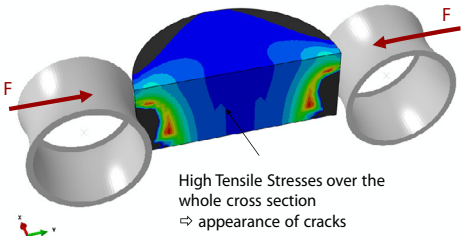

Fig. 3. Stress in the strand at a 2 roller drive unit.

With the current technology, the strand is held by applying pinching forces on the strand by two oppositely arranged rollers in pairs along the strand guide. Especially at round sections these pinching loads cause unfavourable deflection and stress in the solidifying strand. The forces generate tensile stresses in the shell and the mushy zone. Cracks appear at a certain pinching force level. See Figures 3 and 4.

Consequently, the pinching forces have to be limited in order to prevent cracks in the shell and in the segregation sensitive centre area. Using the current 2 roller drive elements an uneconomic higher number of rollers would be necessary to achieve the required friction force for holding the strand.

The current 2 roller technology for strand holding at vertical round casters works favourable only up to a casting section of diameter 400 mm. For bigger blooms a different approach is recommended.

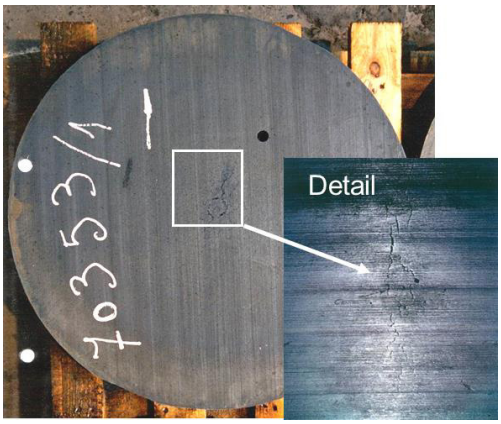

Fig. 4. Crack appearance at too high pinching loads at a 2 roller drive unit.

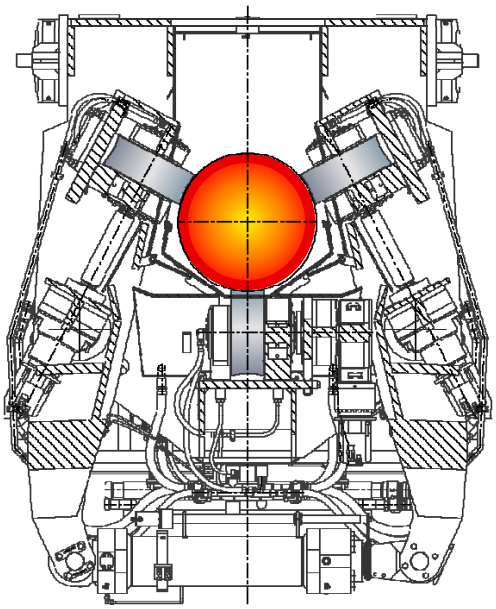

Fig. 5. New holding force technology – strand guide with multi roller drive elements.

1.2 Multi roller drive elements – new drive generation

Inspired by radial forging machines which are outstanding in forging technology, 3 rollers are combined in one plane to the new multi roller drive element. One roller serves as fixed side. The other rollers are 120° offset and mounted on swivelling levers. It needs just one hydraulic pinching cylinder to drive the levers and to generate identical forces to all 3 rollers. The system adjusts to different bloom diameters automatically.

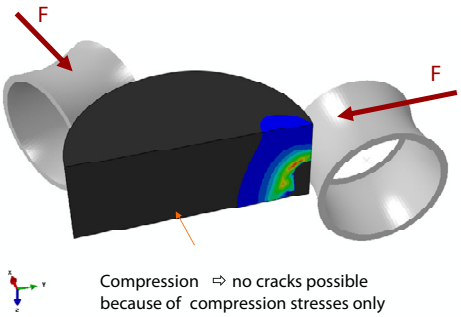

Fig. 6. FEM simulation of stress distribution in the strand at the new multi roller drive element.

Fig. 7. Optimum internal quality to be expected with multi roller drive element.

By placing the 3 rollers around the strand centre the pinching force distribution at the bloom is radial symmetric. In comparison to the conventional 2 roller system, shell deflection and the resulting stresses are considerably reduced. Therefore, the shell is able to withstand 3 times higher roller forces and increased holding forces are applicable.

The new multi roller technique is best applicable for vertical bloom caster especially for heavy round sections. The number of rollers and the cost for equipment remains at a reasonable level. High holding force safety and reliable strand quality is achieved.

2 Conclusion

The advanced vertical caster concept allows the casting of almost any steel grade particularly for those which can definitely not be cast on a bow type machine. Minimized crack occurrence due to the absence of any bending and straightening forces, highest cleanliness, symmetry and homogeneity of material properties of the produced blooms are the outstanding features.

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