REDUCTION OF DEFECTS IN LARGE STEEL CASTINGS ON THE EXAMPLE OF "SIDE FRAME"

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Abstract. *Using a computer program, the process of forming shrinkage defects is simulated, in parallel with the use of exothermic inserts, in order to increase the efficiency of feeding the casting and reduce metal consumption on profits. At the same time, a reasonable choice of the design of profits is of great importance, as well as the calculation of their minimum permissible sizes used at the current production in the manufacture of the "Side Frame" casting of railway cars.*

Keywords: *Side frame, profit, defects, exothermic insert, modeling.*

Improving the operational and technological properties of industrial products, improving the technical level and quality of products is one of the main tasks of science and technology. The continuous tightening of requirements for the reliability of structural elements makes it possible to analyze in more detail the specific conditions of their work. Most machines, machines and parts are subjected to cyclic loads during operation. Therefore, the problem is endurance of materials is relevant for railway, automobile, aviation, ship construction, machine-tool, energy and other industries.

The main parts of freight cars produced by steel casting methods are the side frame and the superstructure beam of the trolley, as well as elements of the traction device. The side frame of the trolley is subjected to the greatest loads during operation. During operation, the side frames perceive static and dynamic vertical loads from the weight of the car, impacts when the car passes the irregularities of the track. In addition, longitudinal loads are tested-they depend on the traction force during uneven movement of the train, the forces when the cars collide, and also experience the effect of torque when the cars fit into curves. At the same time, the main part of dynamic vertical loads is cyclical in nature, and fatigue strength side frames (the ability to withstand the effects of cyclic loads for a long time) is the main characteristic of their operational reliability, i.e. it directly affects the safety of movement.

One of the problems of the side frames is a fracture. During operation, the fracture of the side frame leads to economic losses and human casualties.

During the operation of products, including frames, there are mainly two types of fracture: brittle and fatigue. The main factors contributing to these fractures are: reduced mechanical properties of steel; disadvantages of steel smelting and de oxidation technology; imperfection of casting technology and casting of steel, leading to the formation of volumetric structural defects and an increased number of non-metallic inclusions in steel. The reasons for the fracture of the side frames may be different. For example, due to the formation and development of fatigue cracks, internal casting defects (shrinkage shells, hot cracks), thermal stresses, underflows, undulation.

The main prevention of fracture is the reduction of hot cracks in steel castings, regulation of the content of harmful impurities in the metal and compliance with the casting temperature range.

A hot crack is a defect in the form of a rupture or tear of the casting body of shrinkage origin that occurs in the solidification interval. It has a strong oxidized surface (dark).

The causes of hot cracks in castings occur:

- due to incorrect design of castings;
- uneven cooling of individual parts of the casting;
- wrong choice of metal supply;
- insufficient nutrition of places of transition from one section to another (massive nodes);
- insufficient malleability of forms and rods;
- increased temperature of the poured metal;
- increased content of sulfur, phosphorus, hydrogen and impurities that contribute to the appearance of fusible compounds.

Analysis of the factors of defect formation showed that hot cracks are formed due to insufficient strengthening effect of shrinkage ribs on internal angular sections in the zone R55, and defects in the form of underflow, non-spillage and junction are formed due to the unsuccessful design of the gate system with a large length of channels and non-optimal supply of liquid metal to the casting.

In this paper, a new concept is proposed to reduce the defectiveness of frames by cracks due to the implementation of powerful reinforcing ribs. Thickened angular reinforcing ribs have been raised on the inner wall of the casting. For this purpose, the recesses with a thickness of 4 mm were increased to 8-9 mm on the central rod in the R55 zone. The results show that after using the thickened rib, hot cracks in the R55 zone were eliminated. In this regard , the following were proposed

innovative technological solutions for additional rib hardening in corner zones (R55) of the axle box opening and changes in the design of the gate system with the installation of filters on all feeders.

Proposal 1. Increase the number of thickened ribs on the first and fourth R55 from 3 to 4 pieces, and on the second and third R55 – from 4 to 5 pieces with an increase in the thickness of the mentioned ribs to 8 mm (Figure 1).

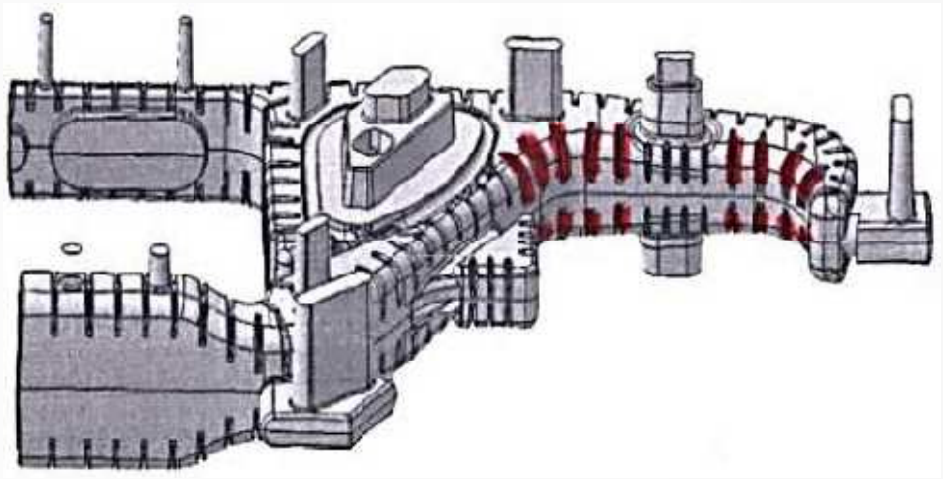

Figure 1 - Scheme of reinforcement of rib hardening by increasing the number of angular ribs

Proposal 2. Extend the mentioned edges according to option 1 until the upper and lower edges merge and form bracket-shaped edges (Figure 2).

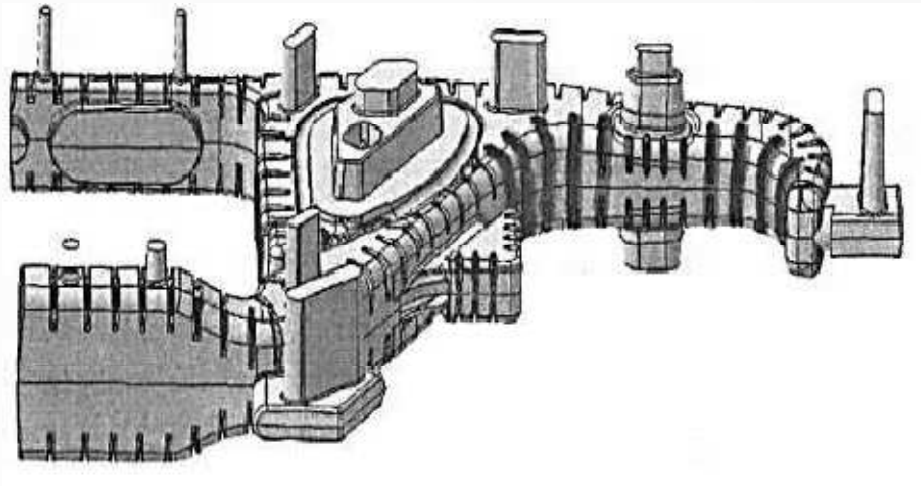

Figure 2 - Scheme of reinforcement of rib hardening due to the implementation of bracket-shaped angular ribs

Proposal 3. Change the design of the gate system and install filters on all switches (Figure 3).

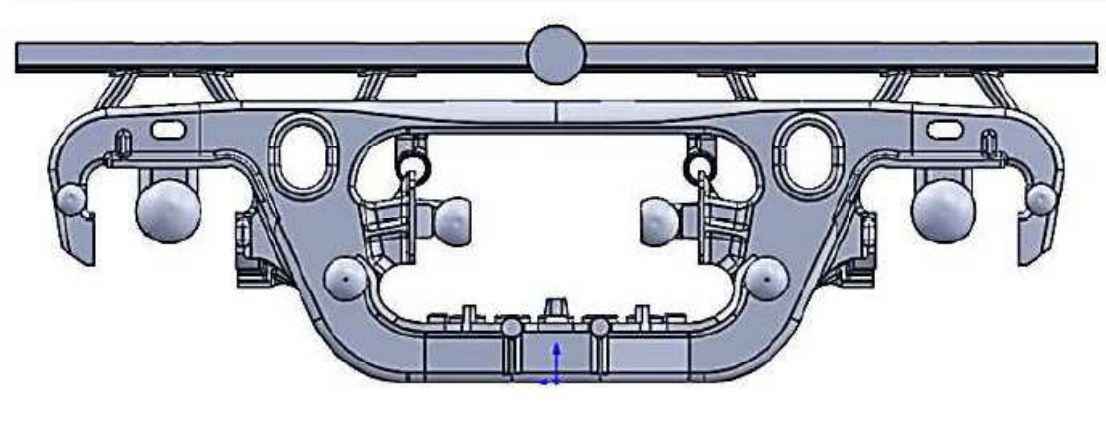

Figure 3 - Modified design of the gate system with the installation of filters on all feeders

Specialists of the BELGUT Housing and Communal Services Center on the basis of the Foundry and Mechanical Plant (Tashkent, Republic Uzbekistan) the determination of the bearing capacity (durability) of the side frames manufactured using the new technology was made. Tests were carried out on 3 side frames selected by the "blindly" selection method according to GOST 18321 (sub-section 3.4) from the products accepted by the technical control service. In each case, the number of loading cycles before the loss of load-bearing capacity exceeded the normalized value. For two frames, a 2-3-fold excess of the normalized durability was found.

Thus, we can state that the proposed and implemented innovative technology Gia reduction of the fracture large steel castings especially for critical applications, use-required for cast parts of rolling stock of railway transport, manufacture - Cach fit foundry products due to additional hardening rib corner areas (R55) axle openings and changes in the design of Gating system side frame with the established oriented filters on all the feeders, which leads to uniform cooling of individual parts, and it also reduces internal defects and hot cracks.

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