

Research on the influence of moulding-casting technology on the quality of castings

A Josan, C Pinca Bretotean, S Rațiu, E Ardelean and M Ardelean

Politehnica University of Timisoara, Department of Engineering and Management, 5 Revolution Street, Hunedoara, 331128, Romania

E-mail: ana.josan@fih.upt.ro

Abstract. The quality of castings has a particularly role in the Romanian foundries. In this context, quality assurance is the overall objective of the foundries. The paper presents the critical analysis performed on moulding-casting technology of the type Lifting mechanism. This casting is a subset of the lifting and rotating mechanism of the furnace vault. The casting analysed is a medium size, with weight of 114 kg. The current moulding-casting technology involves moulding into three mould-parts leading to the occurrence of defects (decentering of the core, displacement of the lower mould and the middle mould and occurrence of burrs in area separated. Thus, to reduce the percentage of defects registered in industrial practice is necessary to change the moulding-casting technology. This requires the use of two mould-parts, re-dimensioning of the core and the core box and dimensioning of the runner network. The adoption of these changes in industrial practice has direct implications on the cost of casting and foundry costs default.

1. Introduction

In the modern technique, the technology is the predominant factor of progress, determining in most cases the qualitative leaps in manufacturing or basic condition of the technical performance [1]. Thus, the knowledge of technology is required both for manufacturing sector and research and development sector [1].

The casting technology of parts, respectively the technological process, has accurately scientific basis and should be projected, in all its stages, before the start of manufacture (from the achieving of moulds and cores, passing on to elaborating of the liquid alloy, the treating of alloys in the liquid phase, the pouring and solidification of the alloy into the mould and finishing with the cooling, cleaning and thermal treatment applied).

The technology must find always the best solutions of technically point of view (to fit the product in technical conditions imposed) but also the most economical. This is reflected in the correlation between product cost, which must be competitive or, in the absence of competition to be economical and profitable [1].

Steel castings represent 7-12% of the total quantity of castings [1]. They have applications across the economy and especially where high mechanical properties are required, at machines subjected to strong shocks and to wear stress, to high temperatures and of chemical substances attack. In this context, the analysis of fabrication technology of cast steel castings has an important role in ensuring the quality of castings.



Making of the moulds can be done by several methods related to the multitude of factors that influence the manufacturing of castings: moulding in two mould part, moulding in three mould part, moulding into the foundry ground, mechanized moulding etc.

The defects which appear to castings are the result of causes which act unilaterally and combined during the technological process of castings, starting the design stage and ending with their delivery [2].

Thus, a particularly important role it has the knowledge the formation mechanism of defects and the possible causes that they generate, respectively their measures for preventing.

2. The current moulding-casting technology for casting analyzed

The casting analysed is cast of steel 340-550 W (according to SR ISO EN 3755-95) and is part of the *Lifting mechanism* of an industrial furnace vault.

In according to the SR ISO 3755-95, for cast steel 340-550W, the chemical composition must be within the following limits (Table 1) [3]:

Table 1. The chemical composition for cast steel 340-550W

Chemical composition, %				
C	Mn	Si	S _{max}	P _{max}
0.40...0.50	0.40...0.80	0.25...0.50	0.040	0.040

The mechanical properties at ambient temperature, on samples of 28 mm thick, for cast steel 340-550W, according to SR ISO 3755-95, are presented in Table 2 [3].

Table 2. Mechanical characteristics for cast steel 340-550W

Grades	Yield point, R _{p0.2} min, MPa	Tensile strength, R _m , min, MPa	Breaking elongation, A min, %	Choosing, according to the order	
				Necking, Z min, %	Absorbed energy at breaking, KV min, J
340-550W	340	590	12	18	20

This steel has relatively good casting properties and favorable mechanical properties, especially after a thermal treatment performed correctly [3-7].

The steels for castings were elaborated in an electric arc furnace type DSN-3, with basic lining and a nominal capacity of 3000 kg. Elaboration of batches was placed in 200...300min/batch [6],[7].

Critical analysis of moulding-casting technology of this type of castings lead to the idea that the rejected castings percentage registered in industrial practice (13%) is too high for the company costs. In this context was analyzed the current moulding-casting technology of this type of casting starting from the finished piece design (Figure 1) [6-10].

The moulding technology for this type of casting involves placing two separation plane (Figure 2). Thus, the casting is performed in three mould jacket [1],[6], [7], [11].

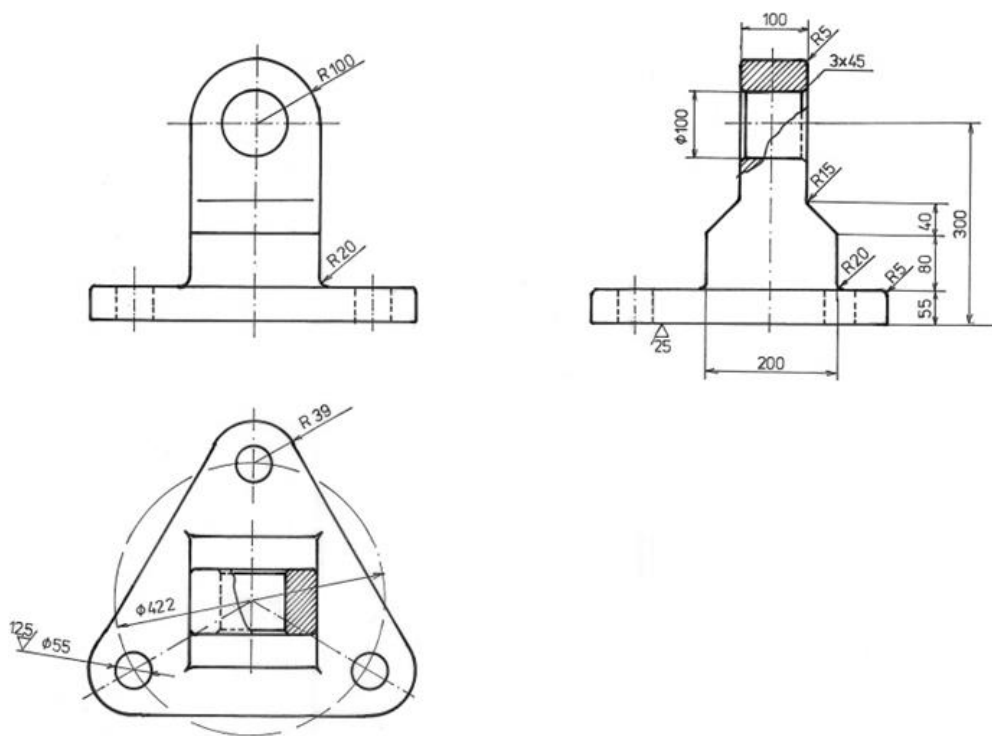


Figure 1. The finished piece design

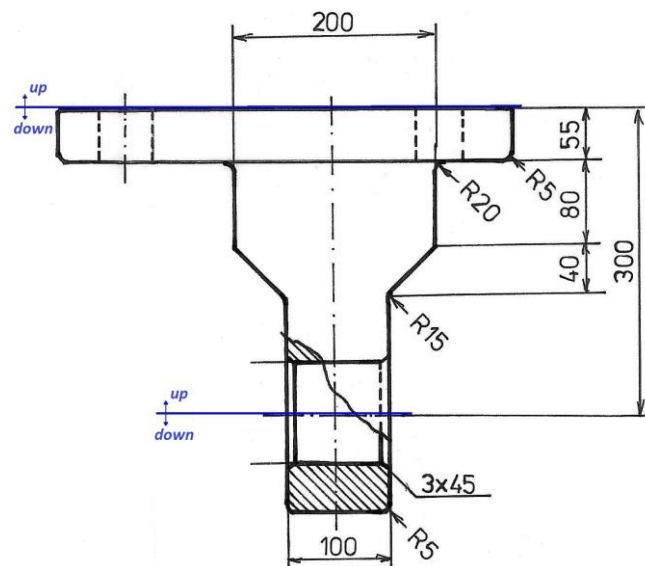


Figure 2. Presentation of separation planes

After establishing the separation planes the moulding-casting technology involves the following steps [1], [6-9]:

1. Establishing the processing allowance of casting and constructive inclinations in order to facilitate the demoulding of the pattern (Figure 3)
2. Establishing the configuration and size of the wooden pattern (Figure 4)
3. Placing the core in the lower mould part (Figure 5)
4. Dimensioning of center riser and realization the wooden pattern for this (Figure 6)

5. Realization of technological design (Figure 7)
6. Establishing the dimensions of mould jackets and casting of the liquid alloy (Figure 8).

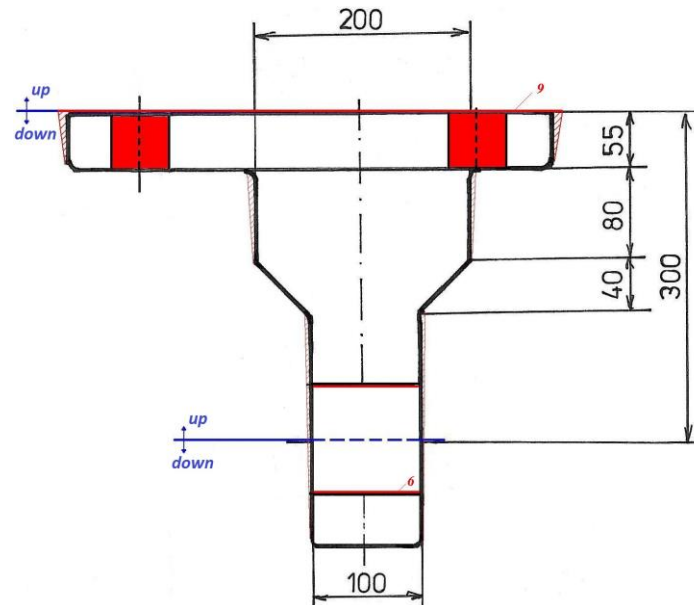


Figure 3. The processing allowance of casting

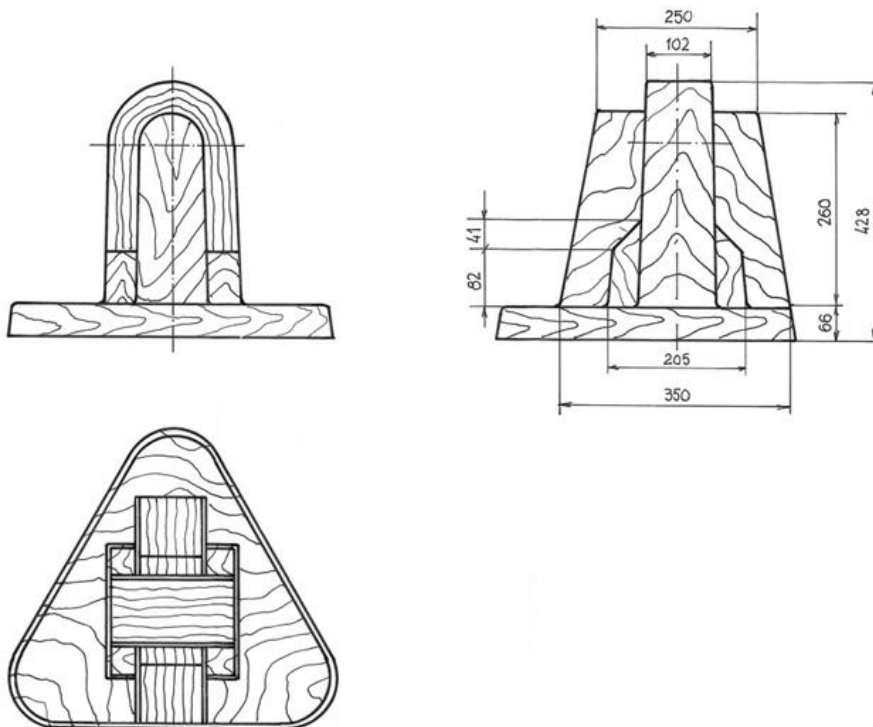


Figure 4. The wooden pattern of casting

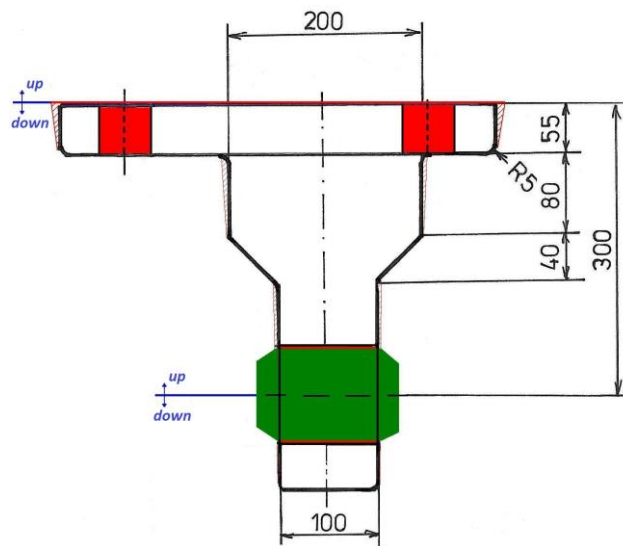


Figure 5. Placing the core on technological design

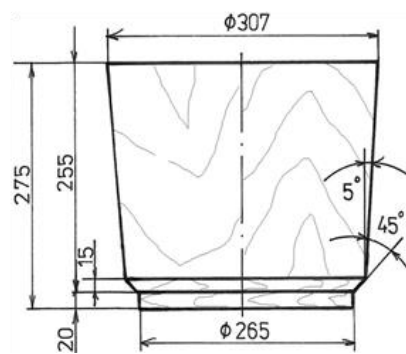


Figure 6. The center riser pattern (made of wood)

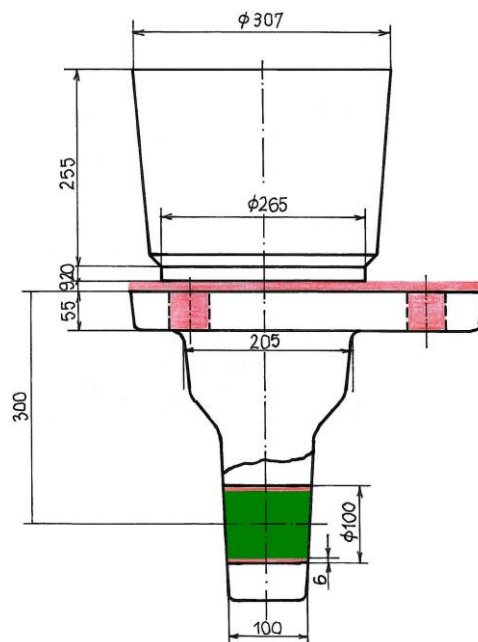


Figure 7. Placing the center riser on the technological design

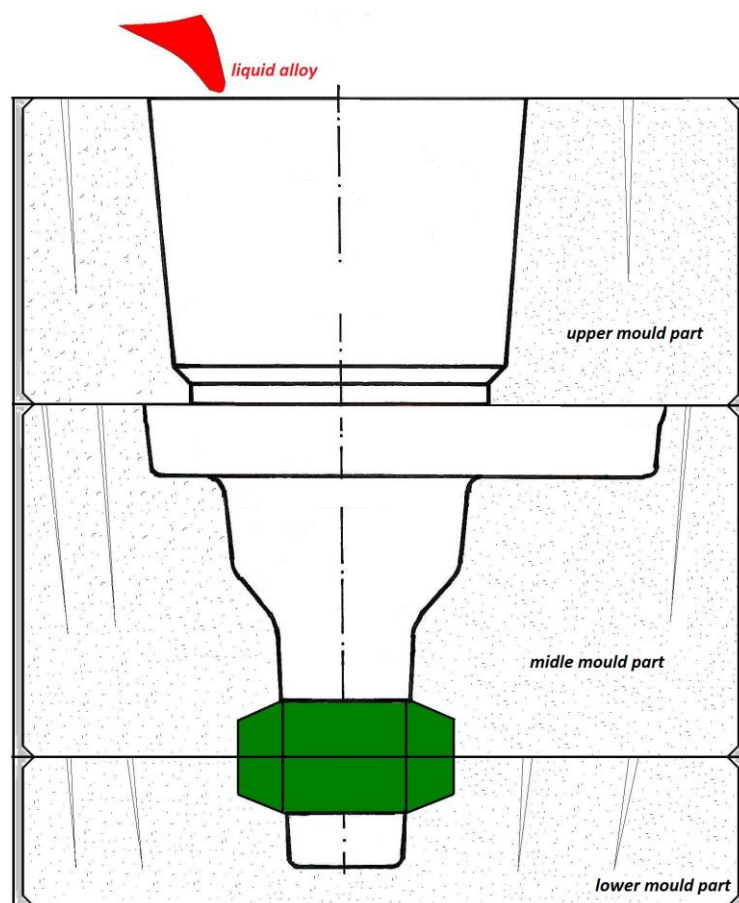


Figure 8. The assembled moulds for casting

3. The modified moulding-casting technology for casting analyzed

Performed the critical analysis of this approach of the possibility of casting the piece is found that the pouring in three mould jacket does not ensure high quality castings so that the percentage of defects (such as burrs and decentering) is high [8-10].

Another disadvantage of this moulding method is very high and unjustified consumption of moulding material.

For optimization of moulding-casting technology of casting studied takes a series of measures regarding [1], [2], [6], [7], [10], [11]:

- Changing current moulding technology (with the application of two plane separation of the pattern and the mould) and the use of moulding technology with a single plane of separation (Figure 9);
- Redimensioning the core and the core box (Figure 10)
- Dimensioning of the gating system (in case of current technology is provided a direct pouring through the open center riser) (Figure 11)
- Changing the casting technology in three moulds and using the casting technology in two moulds (Figure 12).

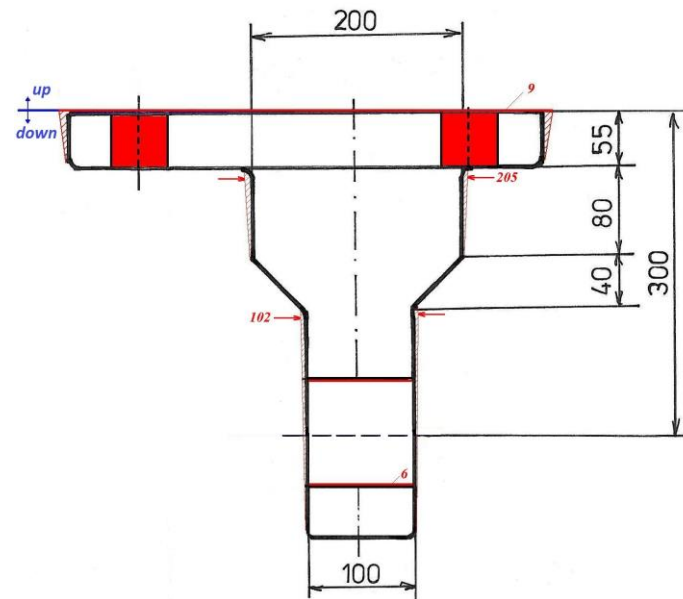


Figure 9. The separation plane

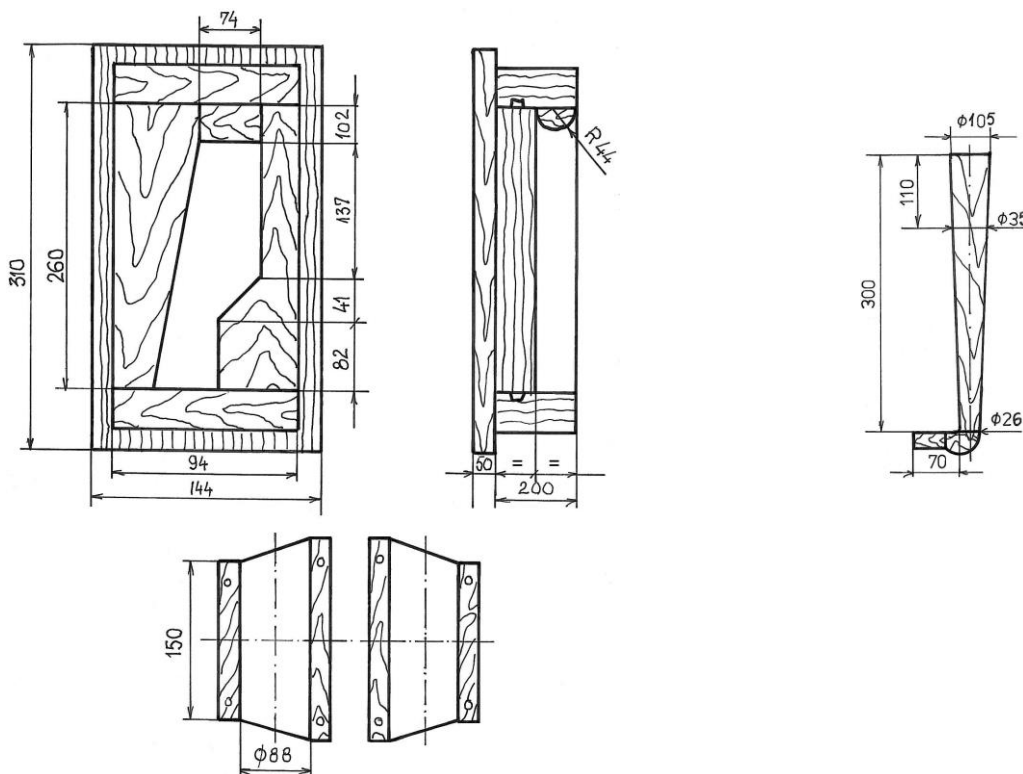


Figure 10. The core box – modified

Figure 11. The dimensions of the gating system

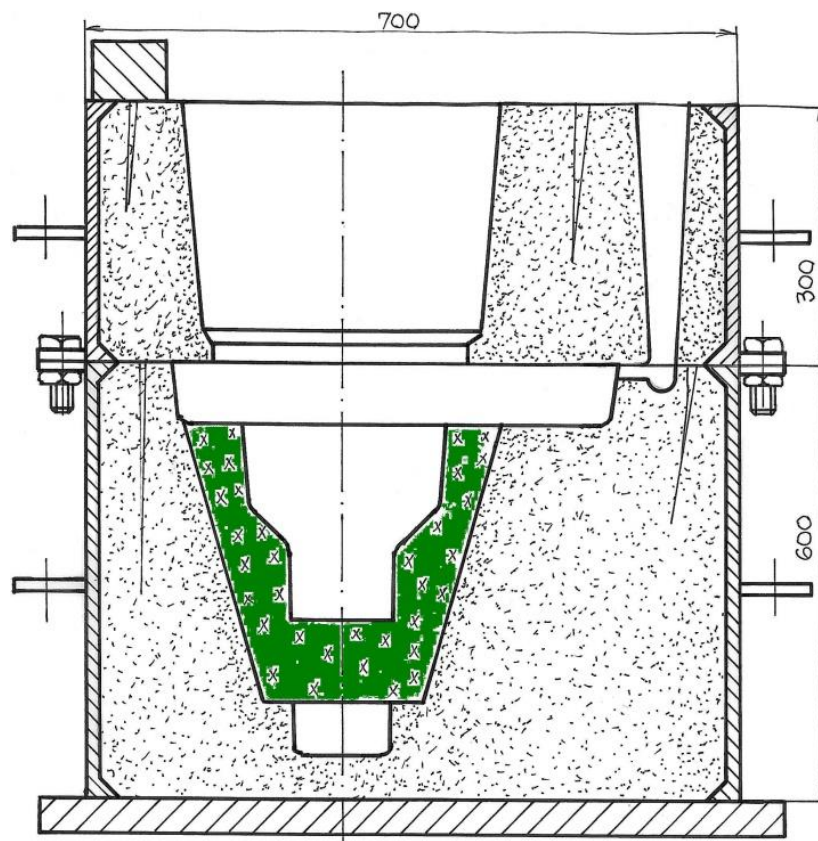


Figure 12. The assembled mould for casting

4. Conclusions

The multitude of problems, large and difficult, facing the manufacturers of castings can not be adequately resolved without a continued increase of the level of theoretical and practical training. The rejects of castings caused by unremedied defects are too high in many foundries, leading to significant material losses caused by inadequate production. The activity of prevention of castings defects and rejects registered must be intensified with the ultimate aim to increase the castings production effectiveness [2], [8], [9].

Application in industrial practice of all the technological method mentioned lead to the decrease the percentage of rejects registered from 13% to about 4%. This aspect has a positive influence in castings costs respectively in the company costs.

References

- [1] Stefanescu C and Cazacu I 1980 *Technologies of realization of the parts by casting*, Technical Publishing, Bucharest
- [2] Istrate Gh and Toboc P 1981 *Controlul de calitate și remanierea defectelor pieselor turnate*, Publishing House Didactic and Pedagogical, Bucharest
- [3] ***1991 The Standard *SR ISO 3755 - Cast carbon steels for general engineering purposes*
- [4] Sofroni L 1975 *The elaboration and pouring of alloys*, Publishing House Didactic and Pedagogical, Bucharest
- [5] Socalici A, Ardelean E, Ardelean M, Heput T and Josan A 2007 *The casting and solidification of the steel*, Publishing CERMI, Iasi
- [6] Josan A 2012 *Casting and moulding technologies of metal parts – the project guide-book*, Publishing Polytechnic, Timișoara, Romania
- [7] Josan A 2002 *The technology of moulding and casting alloys*, Politehnica Publishing, Timisoara

- [8] Josan A 2016 Improving the quality of castings by optimization of the moulding-casting technology, *Acta Technica Corviniensis - Buletin of Engineering* **IX**(4) 75-78
- [9] Josan A 2010 *The analysis of casting defects recorded in the metallurgical enterprises*, International Symposium on Advanced Engineering & Applied Management - 40th Anniversary in Higher Education (1970-2010), Hunedoara, Romania, on CD
- [10] ***1977 *International Atlas of casting defects*, Technical Publishing, Bucharest
- [11] Josan A, Pinca Bretotean C, Ardelean E and Ardelean M 2015 Using lateral cores to casting of carbon steel parts of drive wheel type in a metallurgical enterprise, *IOP Conf. Ser.: Mater. Sci. Eng.* **85** 012016