5. INTERNATIONAL BLACK SEA MODERN SCIENTIFIC RESEARCH CONGRESS
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INVESTIGATION OF THE EFFECT OF THE USE OF RISER IN CASTING MOLD DESIGN USING MODELING TECHNIQUES

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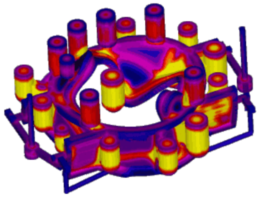


Riser Sleeves

- Riser sleeves are one of the most common casting auxiliary materials that increase mold efficiency by extending the solidification time of the feeder metal.

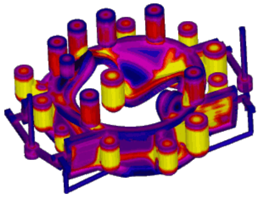
- Riser sleeves create a heating surface that delays the solidification of molten metal, thanks to the high energy generated as a result of the insulation-supported exothermic reaction.

- They are produced in various shapes and sizes, open and closed, for ease of molding. Thus, it can be placed at the most suitable point on the casting piece in different ways depending on the desired mold dimensions.

- A prominent characteristic feature of Riser sleeves is the effect they have on the module of the feeder. By reducing the cooling rate of the feeder, it remains liquid for longer periods of time, as if the feeder were larger or had a larger modulus.

Riser Sleeves

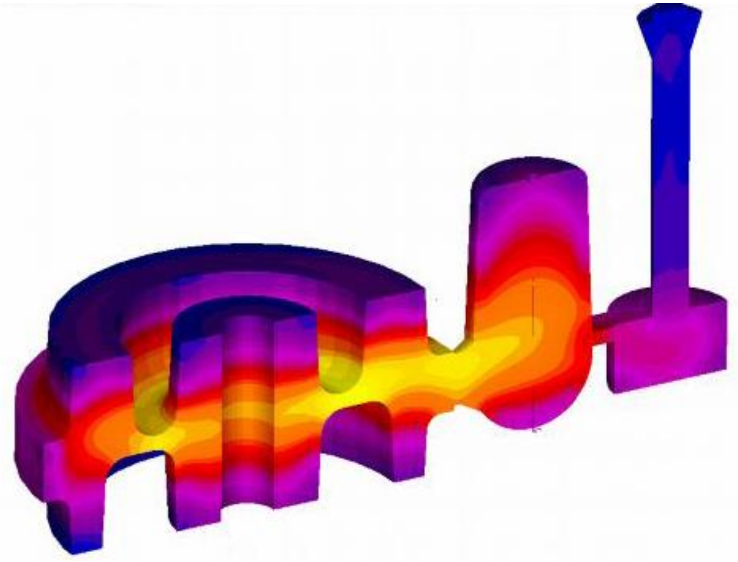
Casting Simulation



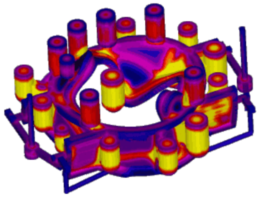
Casting Simulation is a method that mathematically expresses the physical events occurring under foundry conditions in a computer environment and can model casting processes in 3D.

Casting Simulation softwares are computer-based programs that virtually perform the casting of any alloy into sand molds, shell molds, precision or permanent molds, and subsequent solidification and cooling processes.

- Sand mold casting
- Shell mold casting
- Permanent mold casting
- Low pressure casting
- Investment casting

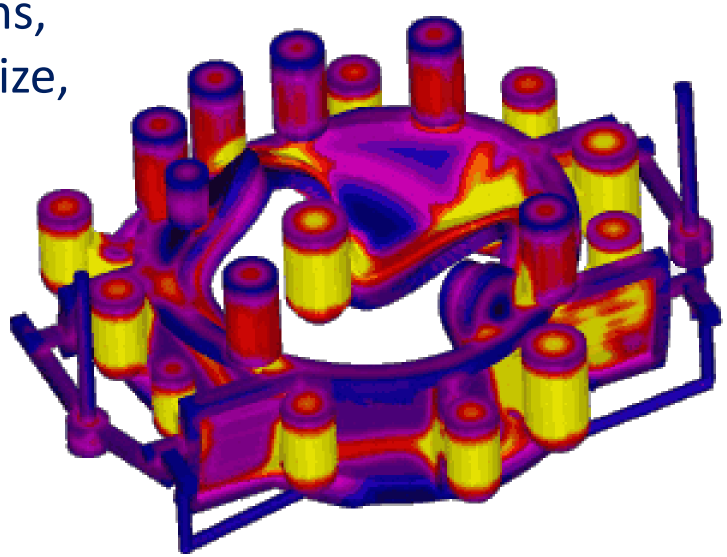


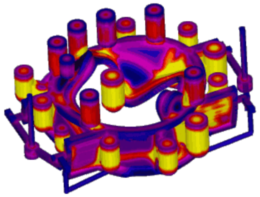
Casting Simulation



Casting process modeling is a mathematical method that allows the computer to make predictions about what happens inside the mold while it is being filled and after it is cast. With casting simulation programs;

- During mold filling, liquid metal's speed, pressure, direction, turbulence, cold junction areas,
- Time-dependent temperature distribution and solidification times in cast part cross-sections,
- Hot spots on the part, feeder location and size,
- Shrinkage and microporosity estimation,
- Casting microstructure,
- Stress analysis, risk of hot tearing,
- Casting part volumes and weights.





Aim of the study

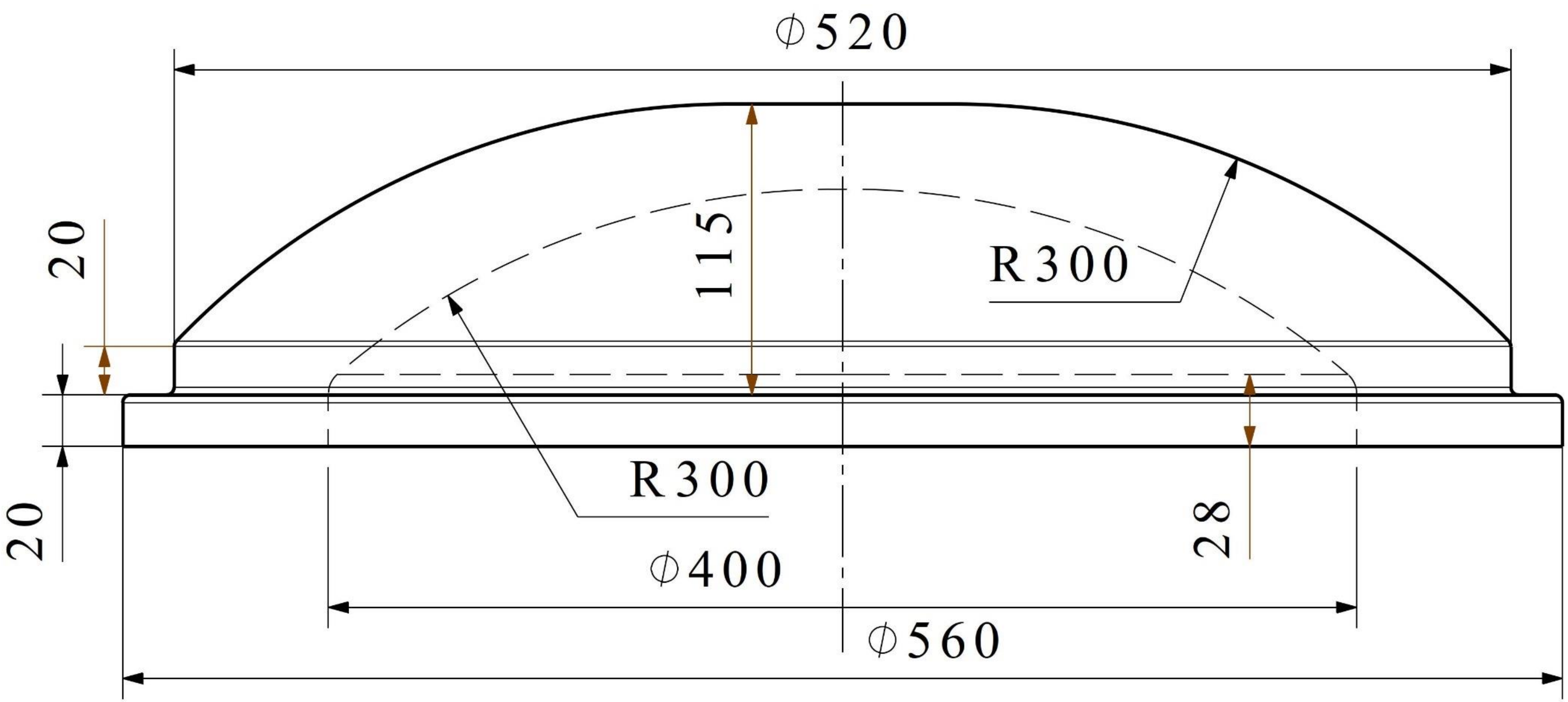
Within the scope of the study, riser design processes and calculations were carried out on a sample casting part using modeling techniques.

In accordance with the criteria for determining the location, quantity and dimensions of the riser in the molding design, design and modeling techniques were compared with alternative designs for the use of insulating sleeve, exothermic sleeve and no sleeve.

Design studies were carried out in SolidWorks, casting modeling studies were carried out in SolidCast software.

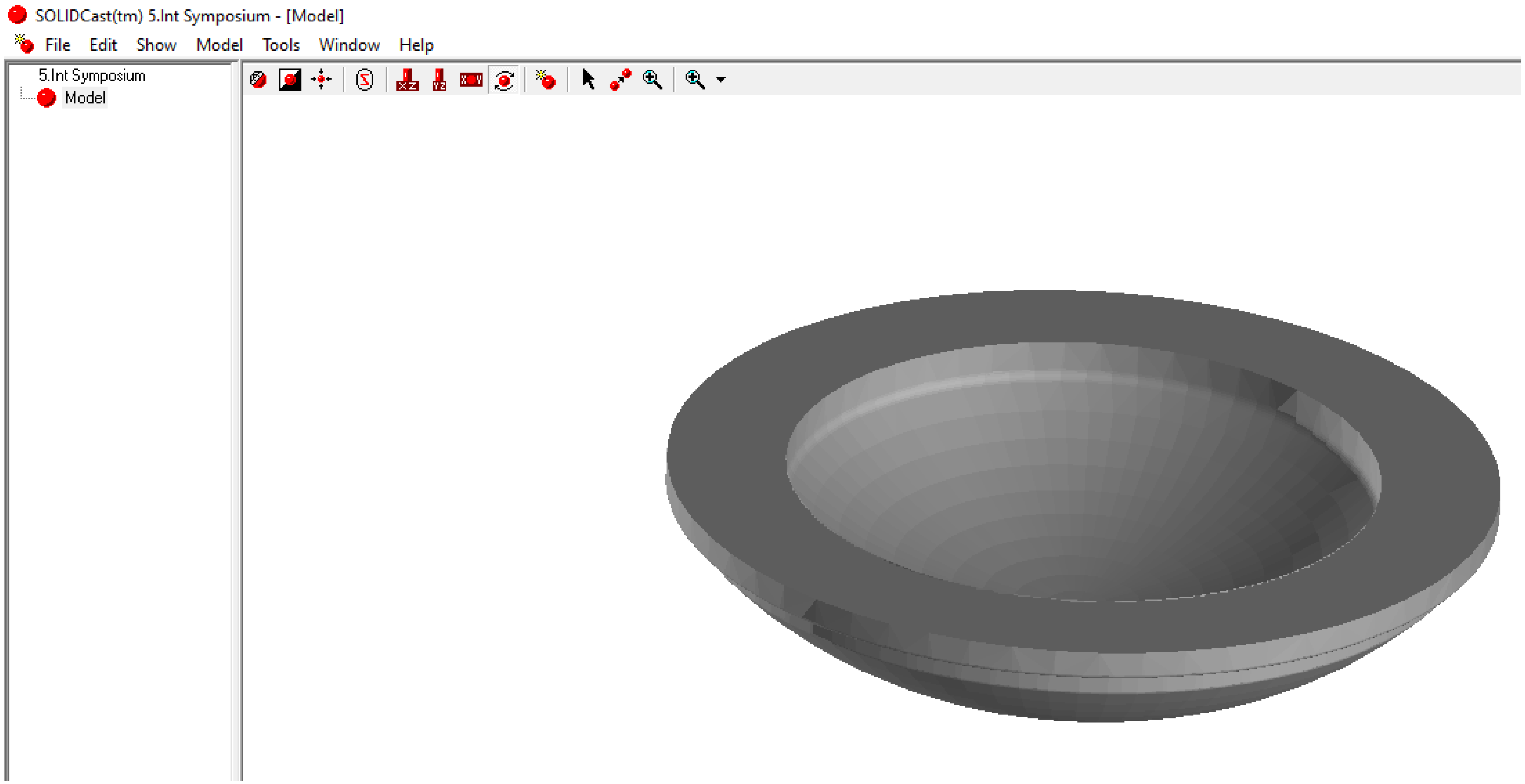
In the study, modeling was made with St1020 standart steel material.

Casting Model



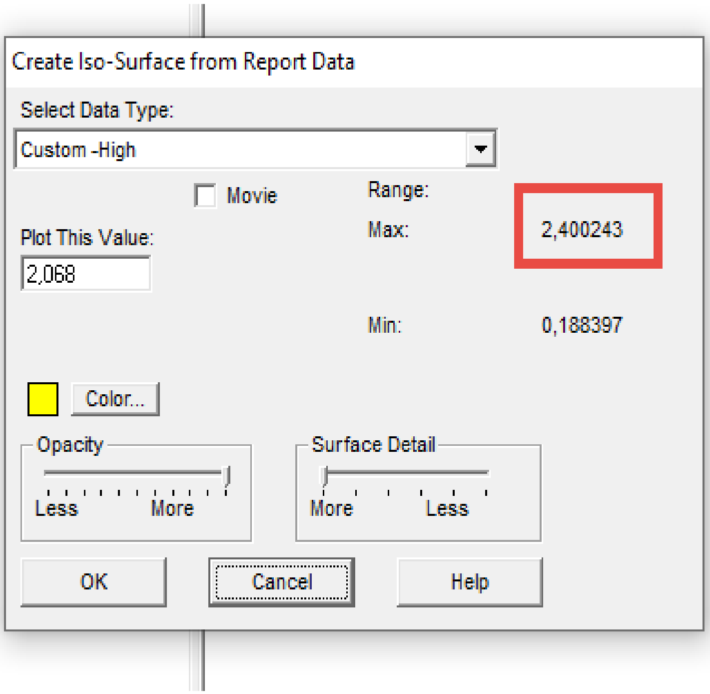
Casting Part Module Calculation

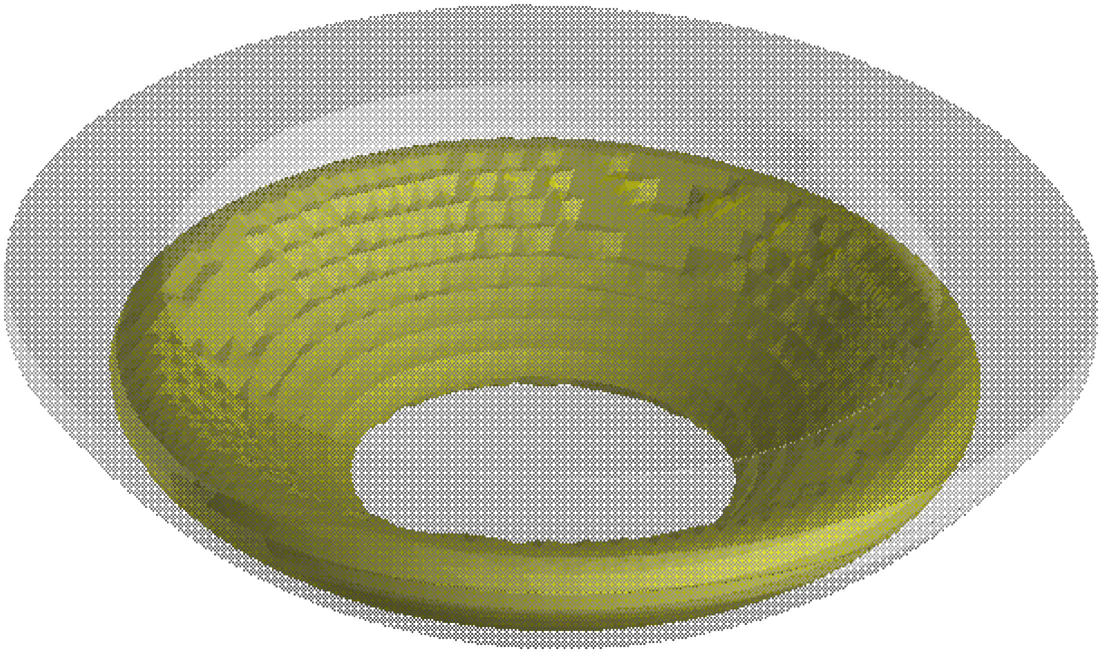
In order to determine the required riser sizes and number of risers in the simulation of cast parts, modeling was first done with and without risers to examine the natural solidification of the part.



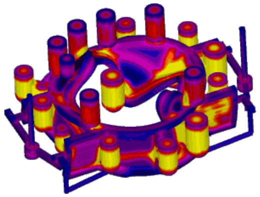
Casting Part Riser Module Calculation

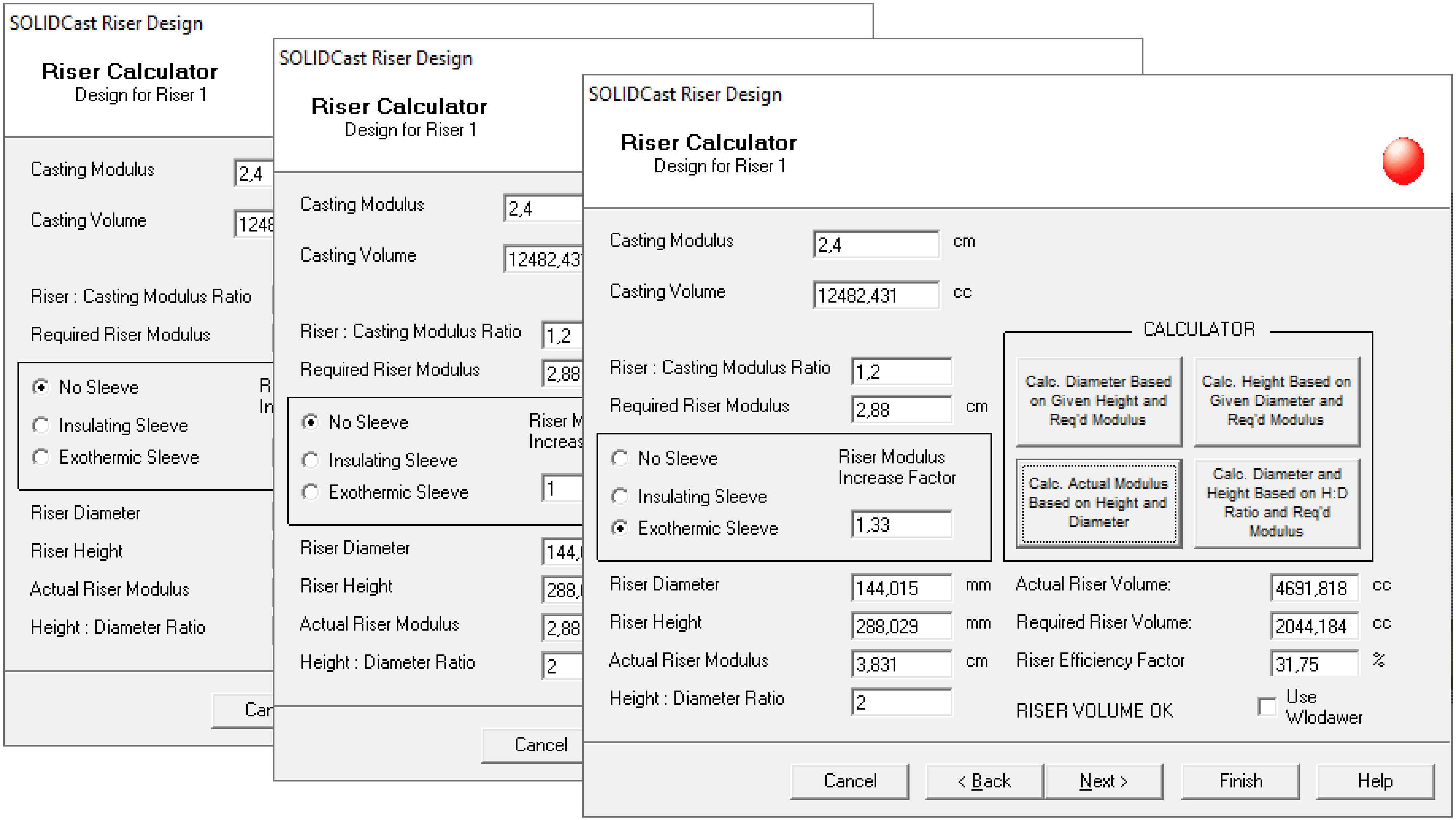
After the trial casting modeling for the casting part, it was determined that the highest casting modulus of the relevant part was 2.4 cm. The last solidified areas on the part are marked in red.





Riser Design Wizard



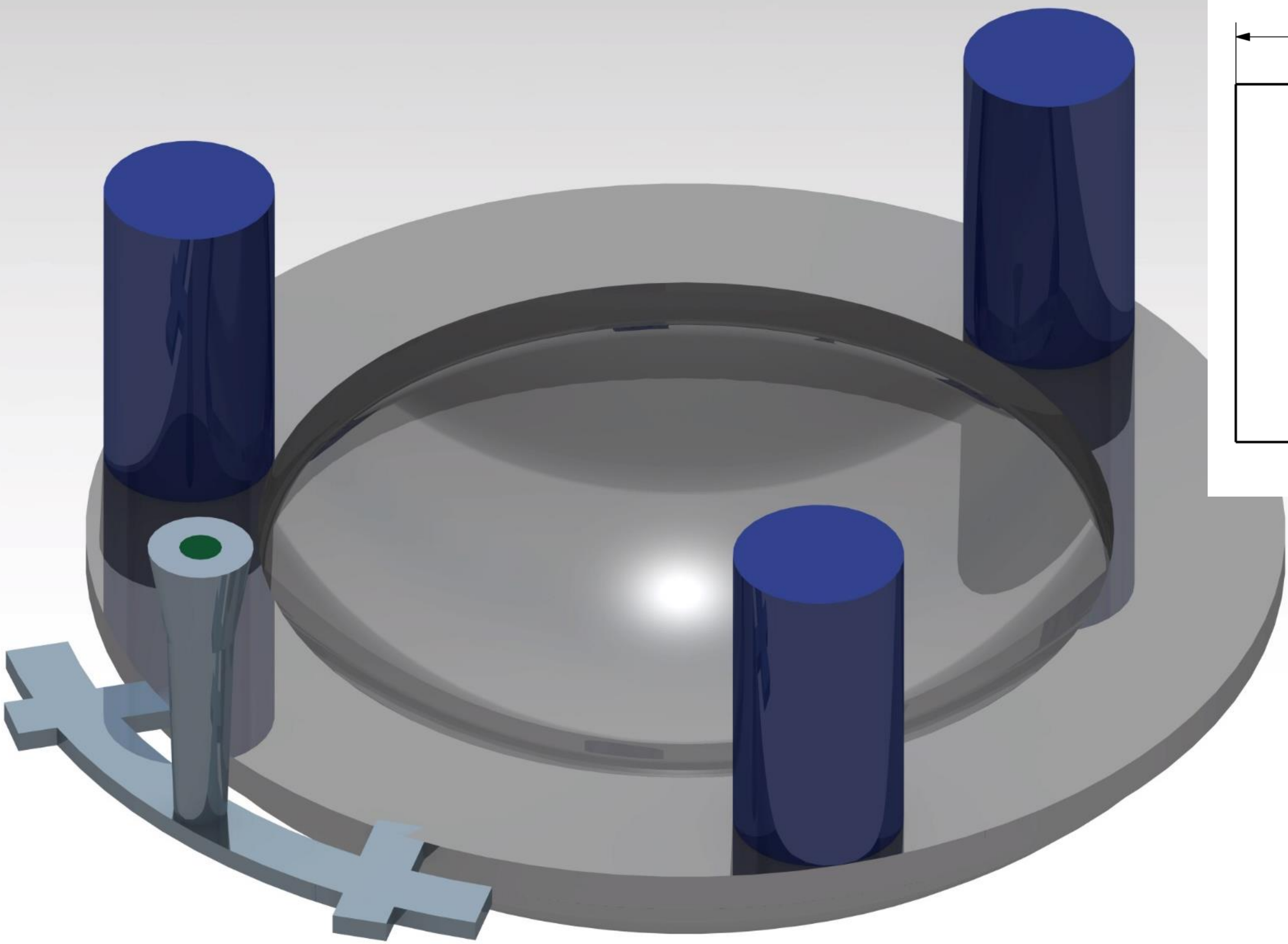


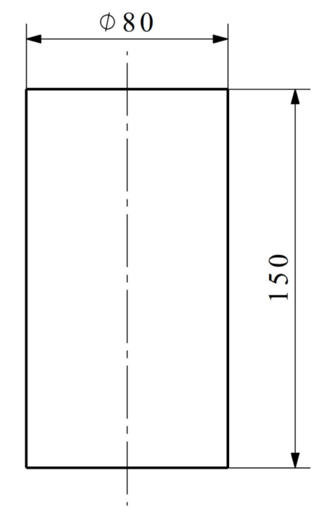
Design-1 Molding Picture

Casting Weight: 100 kg

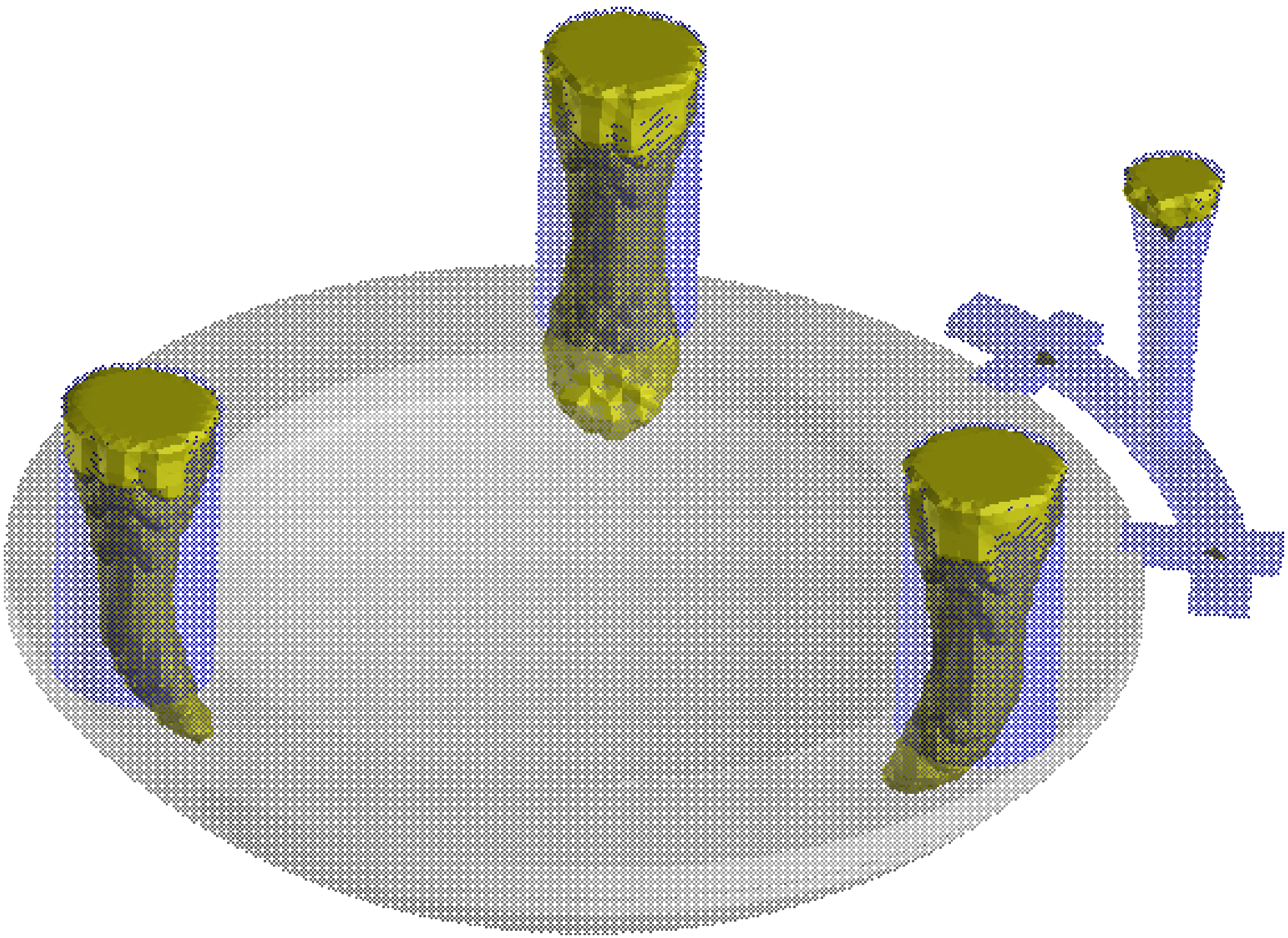
Gross weight: 123 kg

Molding Efficiency: 81.3%



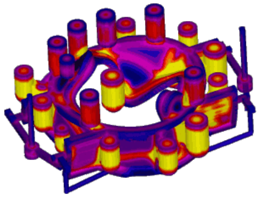


Design-1 Macro porosity Shrinkage Analysis



Images are the results of analysis performed at 99.8% density.

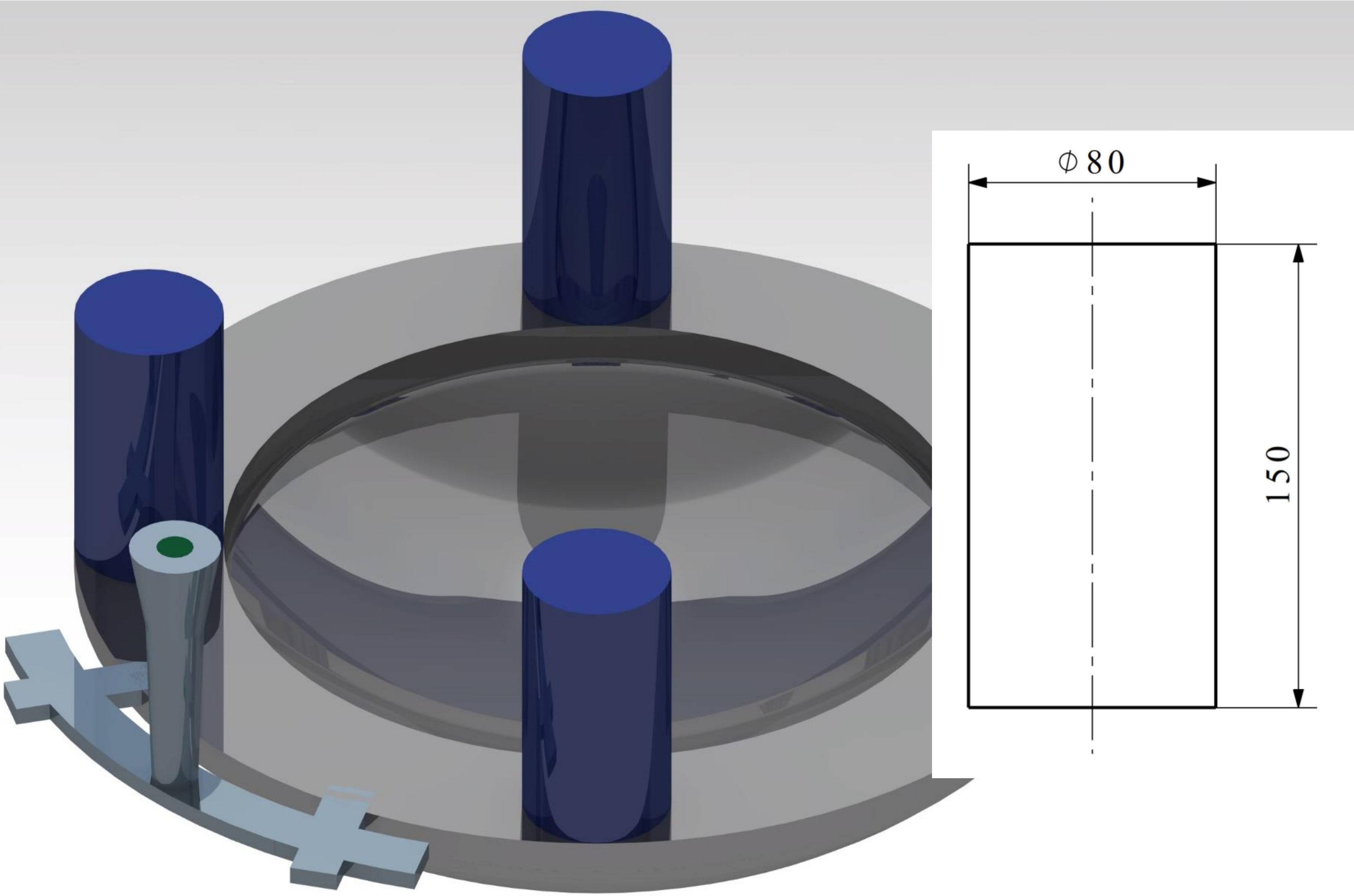
Design-2 Molding Picture



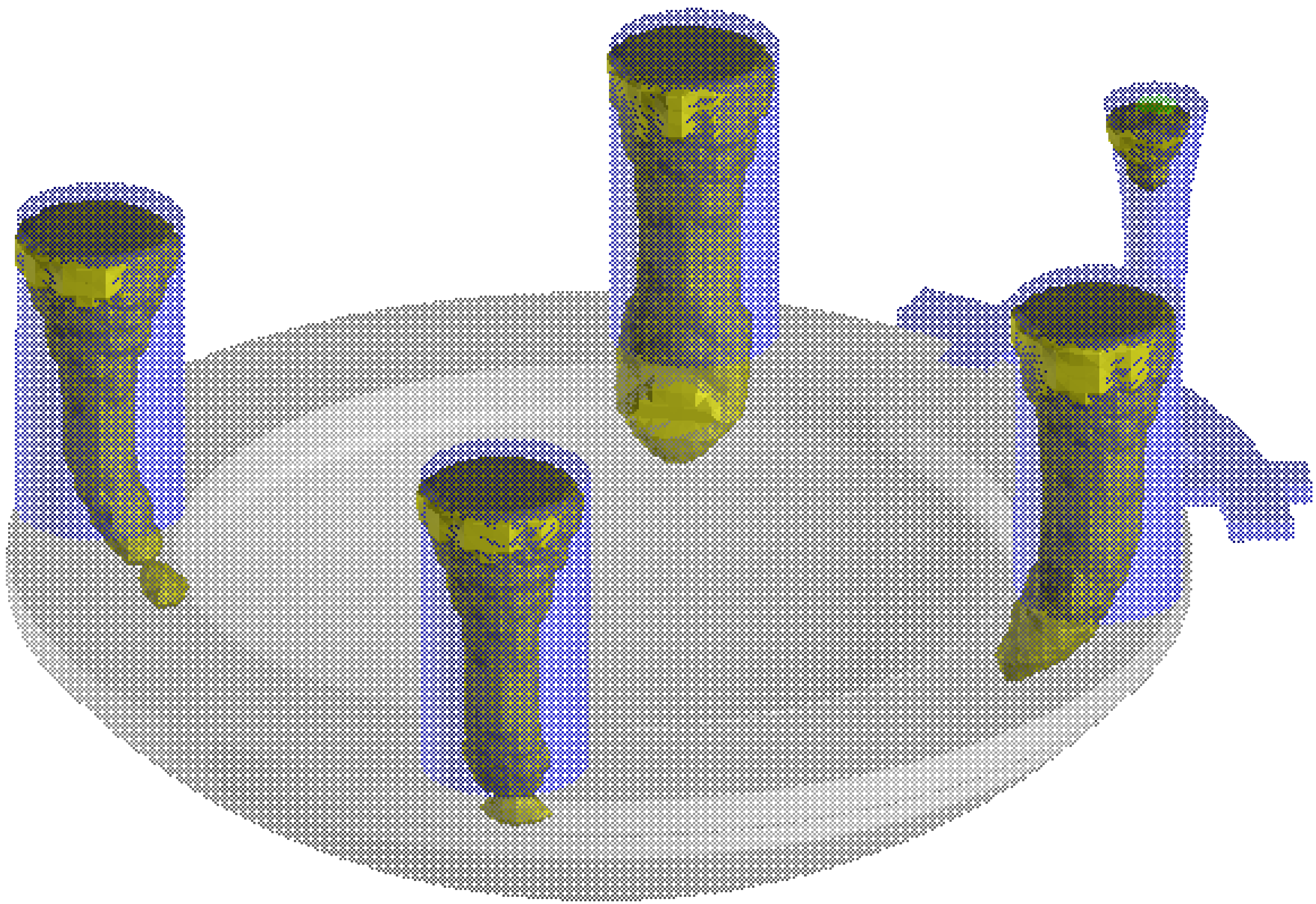
Casting Weight: 100 kg

Gross weight:128kg

Molding Efficiency: 78%

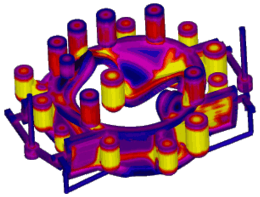


Design-2 Macro porosity Shrinkage Analysis



Images are the results of analysis performed at 99.8% density.

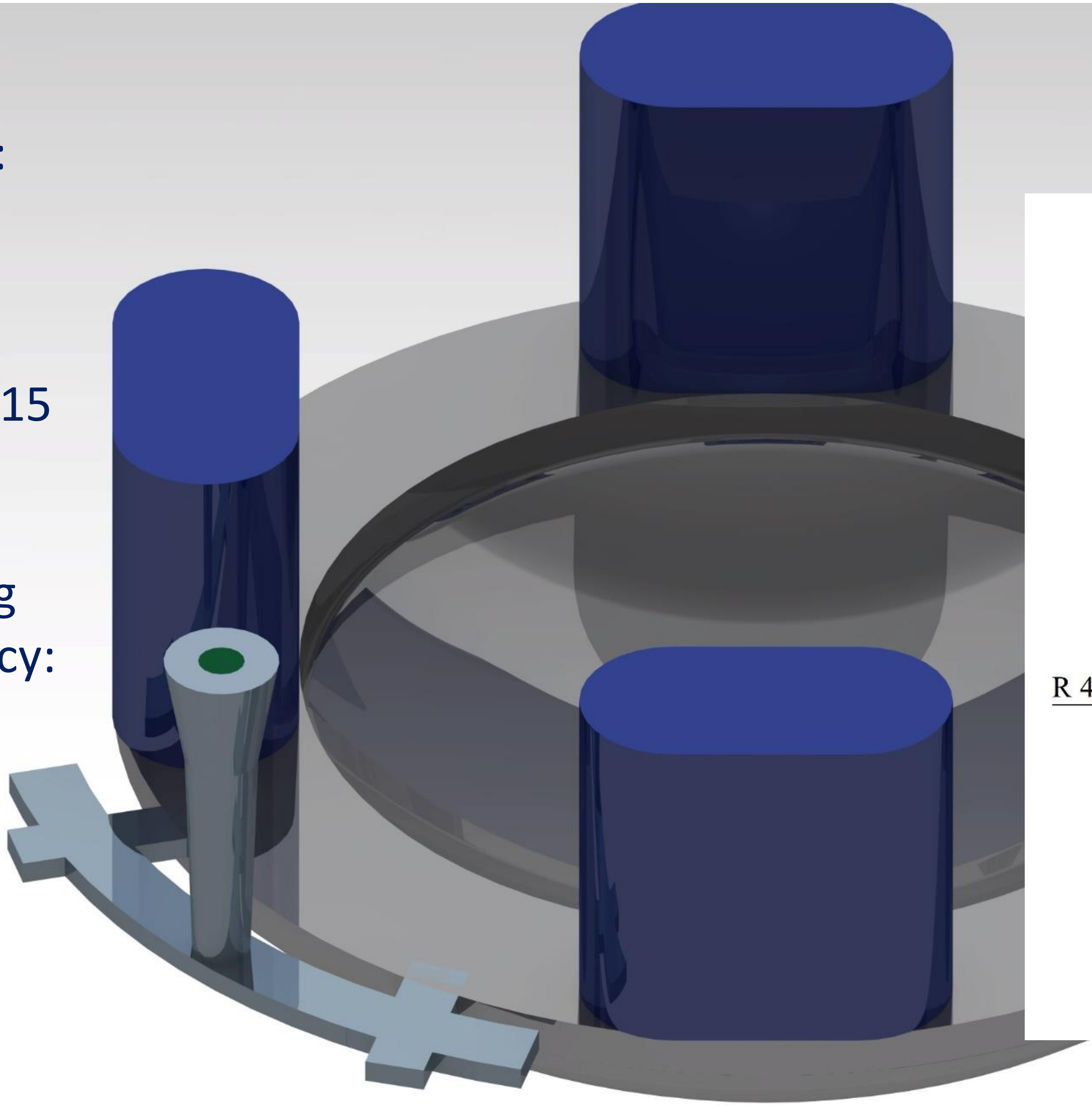
Design-3 Molding Picture

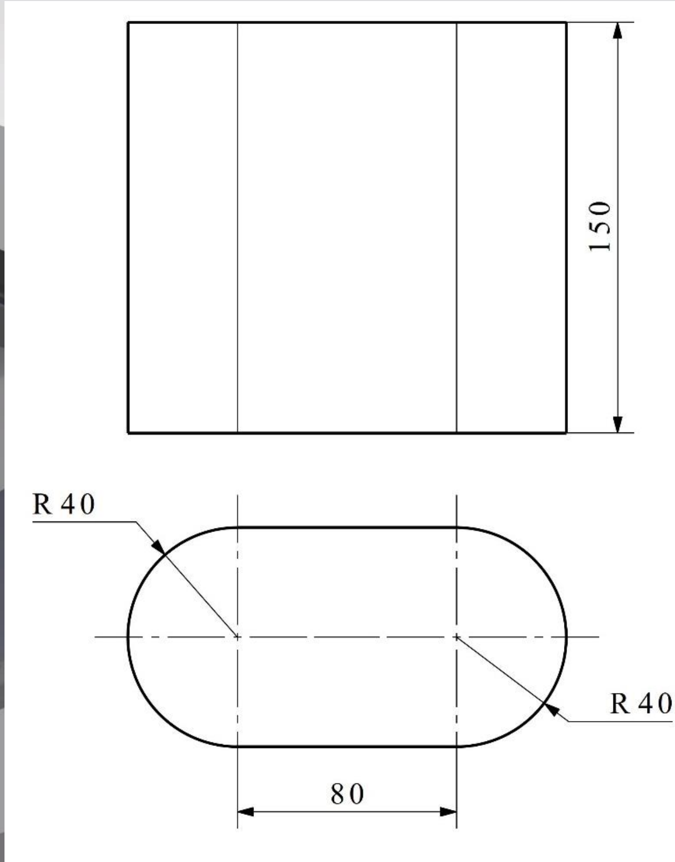


Casting Weight: 100 kg

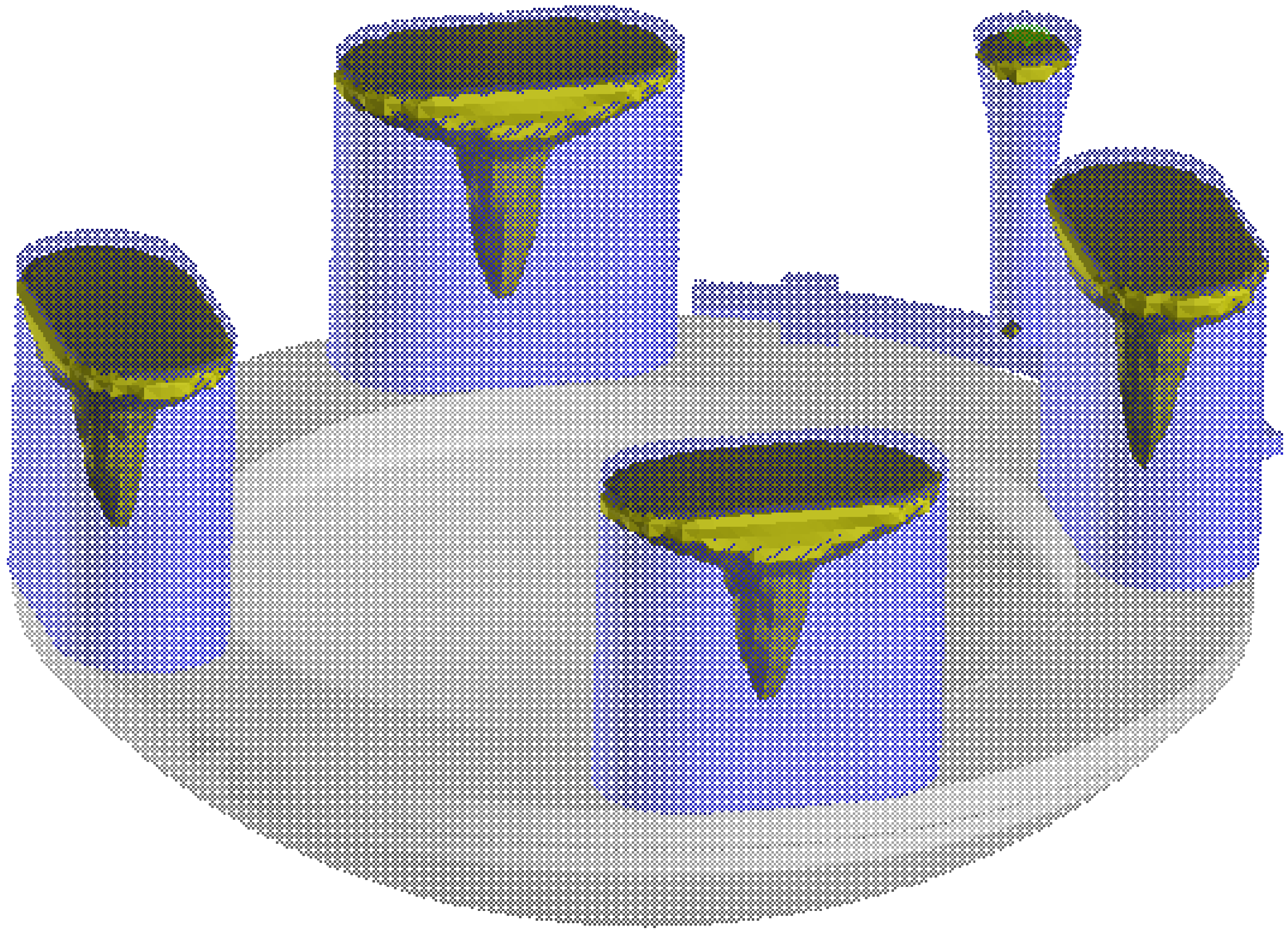
Gross weight:156kg

Molding Efficiency: 64.1%



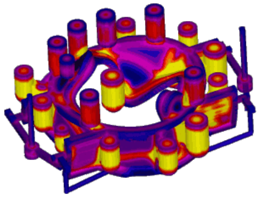


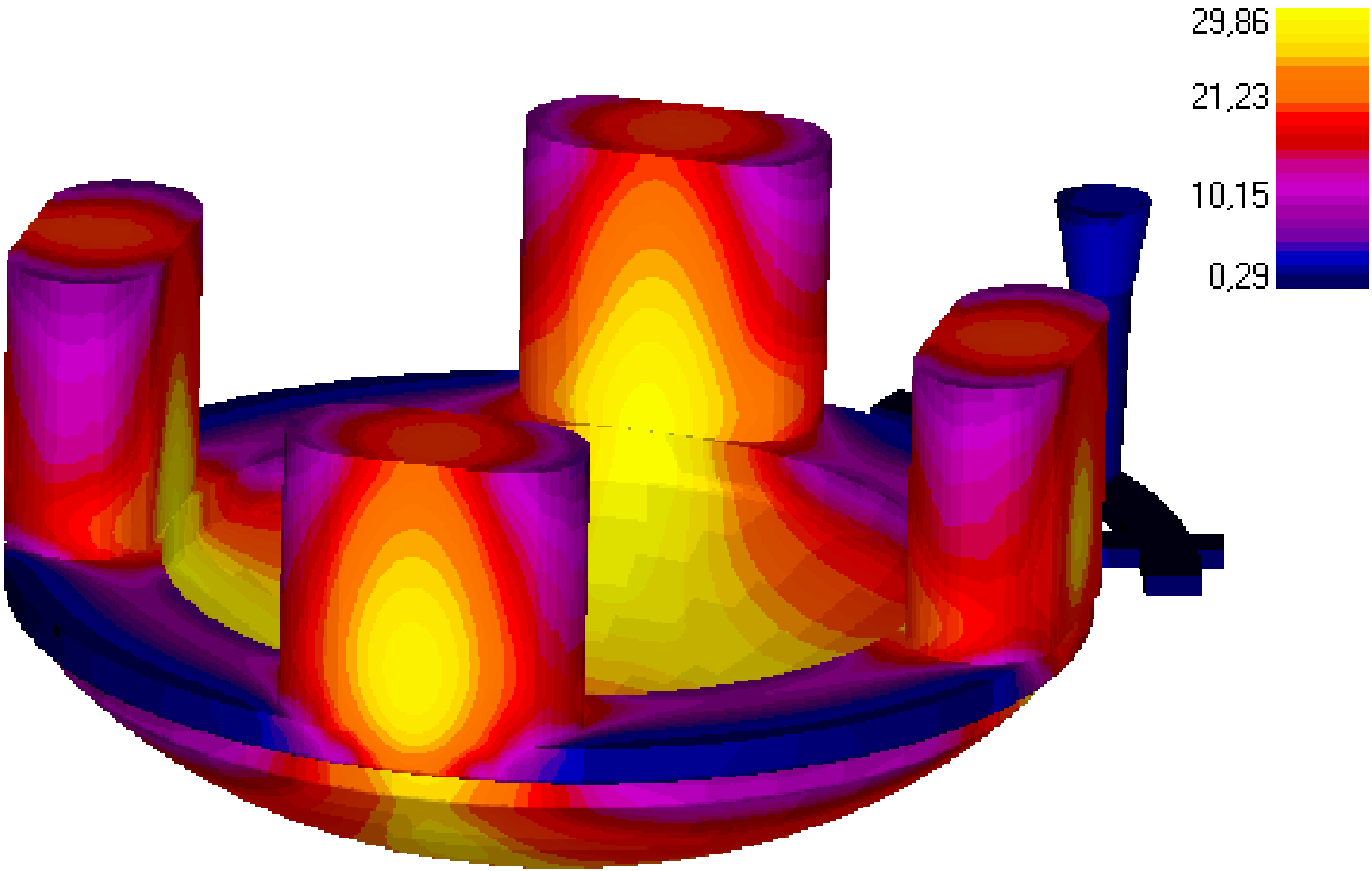
Design-3 Macroporosity Shrinkage Analysis



Images are the results of analysis performed at 99.8% density. The risk of shrinkage only occurred in the risers and there is no risk in the part.

Design-3 Solidification Time



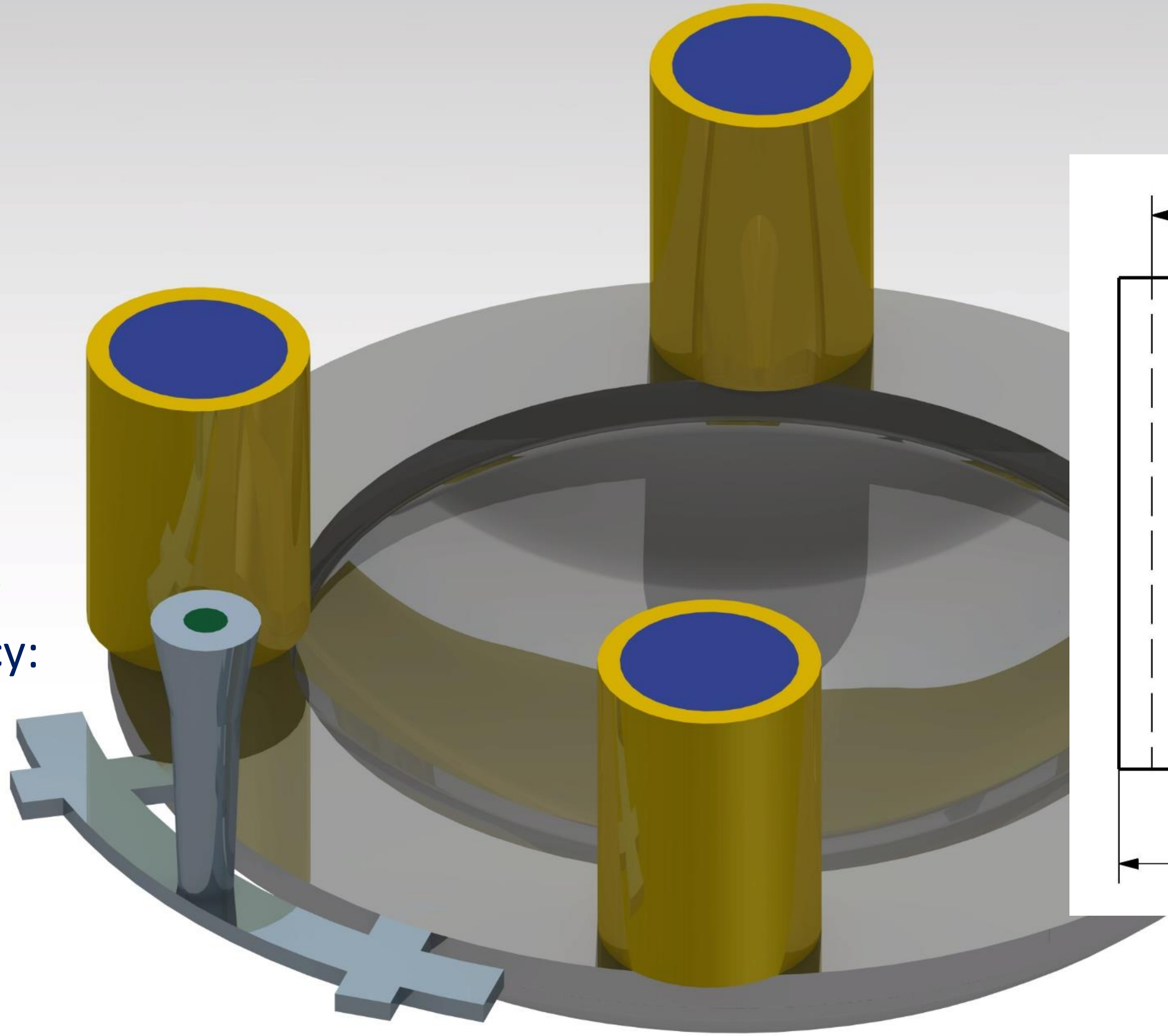


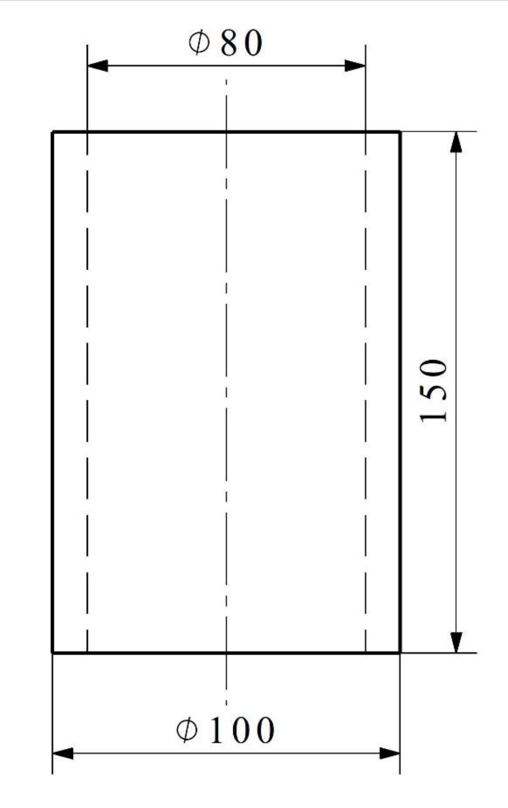
Design-4 Molding Picture (Insulating Sleeve)

Casting Weight: 100 kg

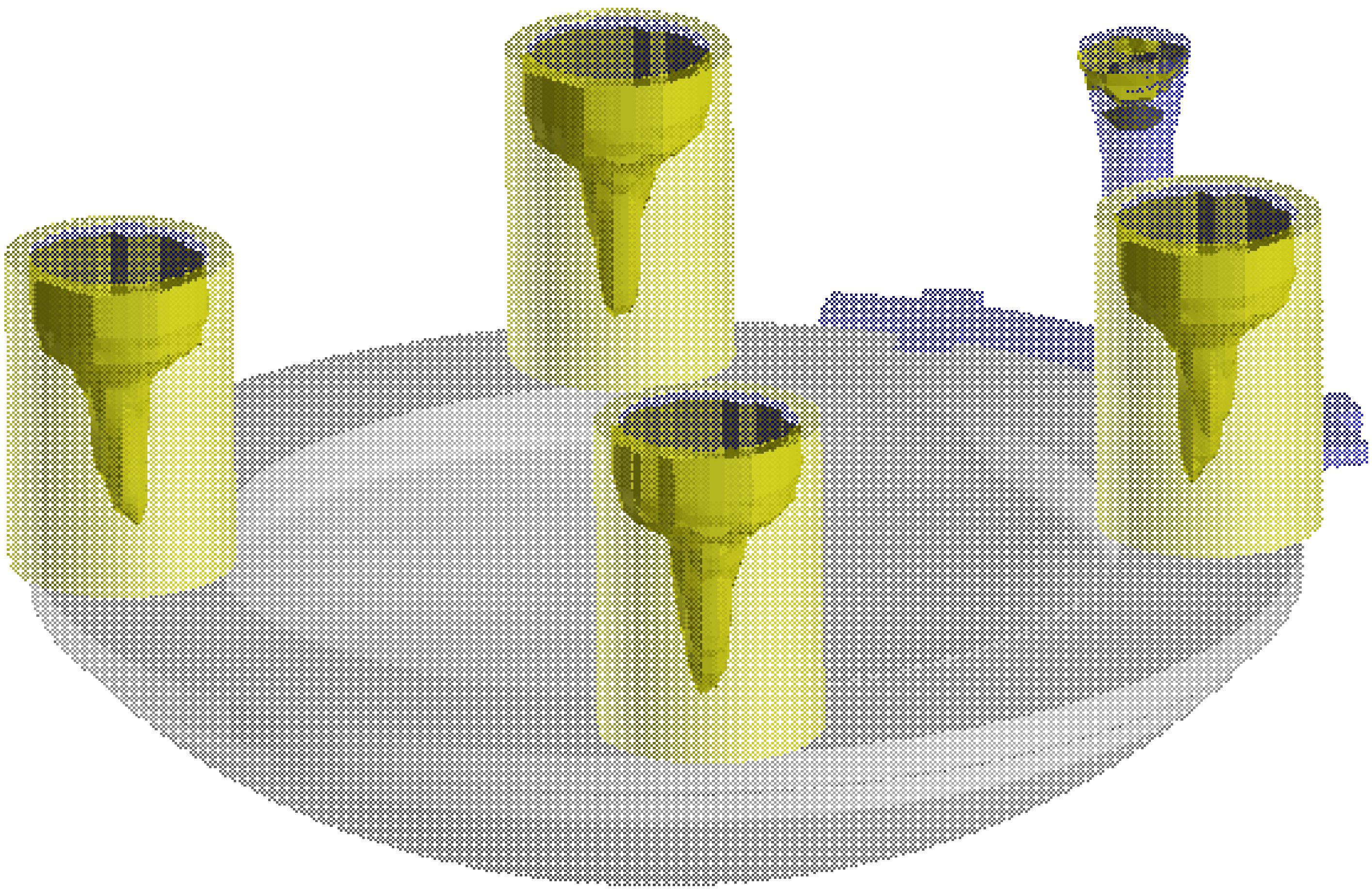
Gross weight: 128kg

Molding Efficiency: 78%





Design-4 Macro porosity Shrinkage Analysis



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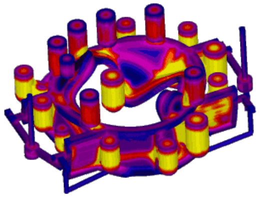
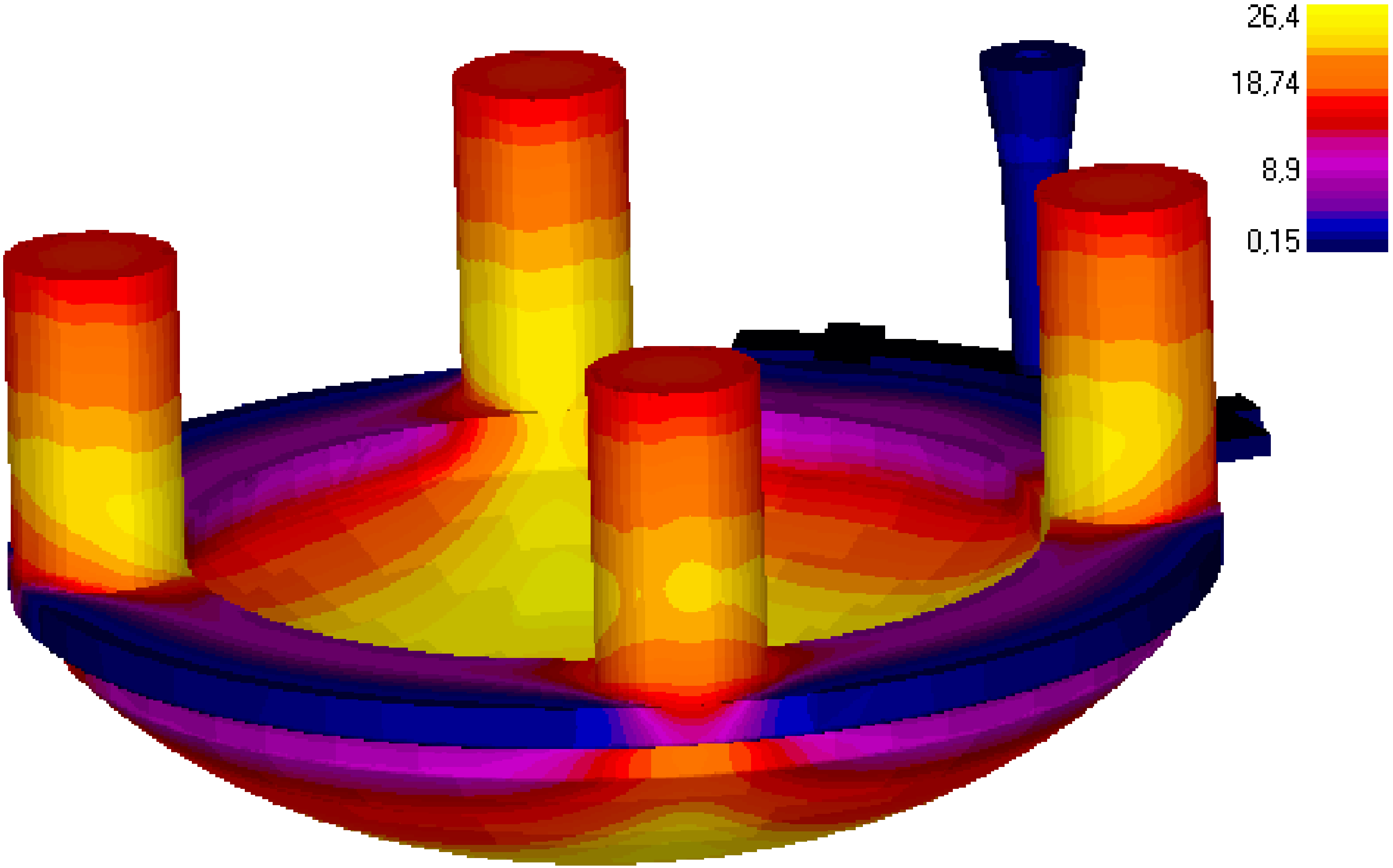
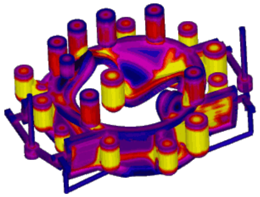
Design-4 Solidification Time





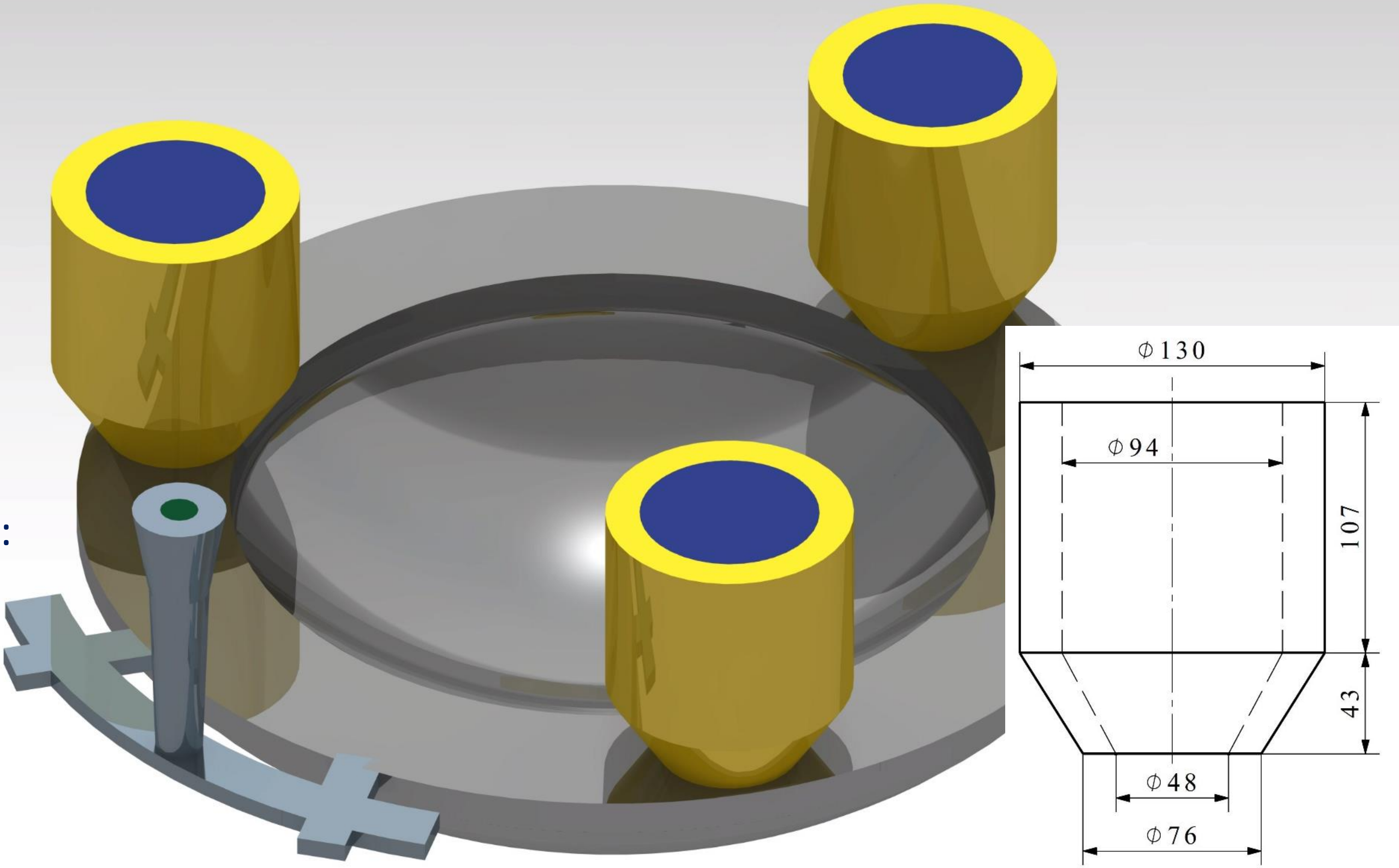
Design-5 Molding Picture (Exothermic Sleeve)



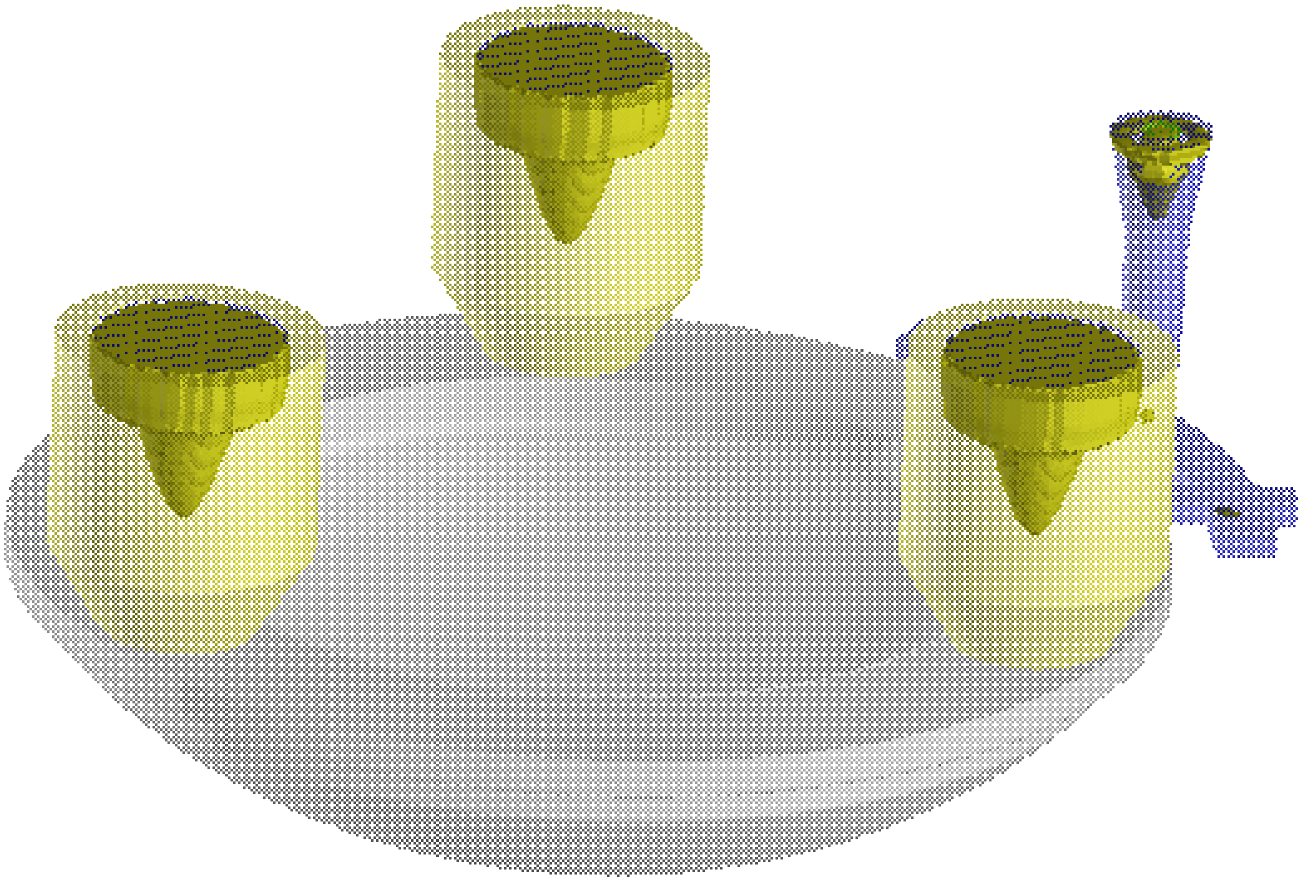
Casting Weight: 100 kg

Gross weight: 122kg

Molding Efficiency: 82%

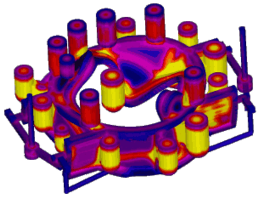


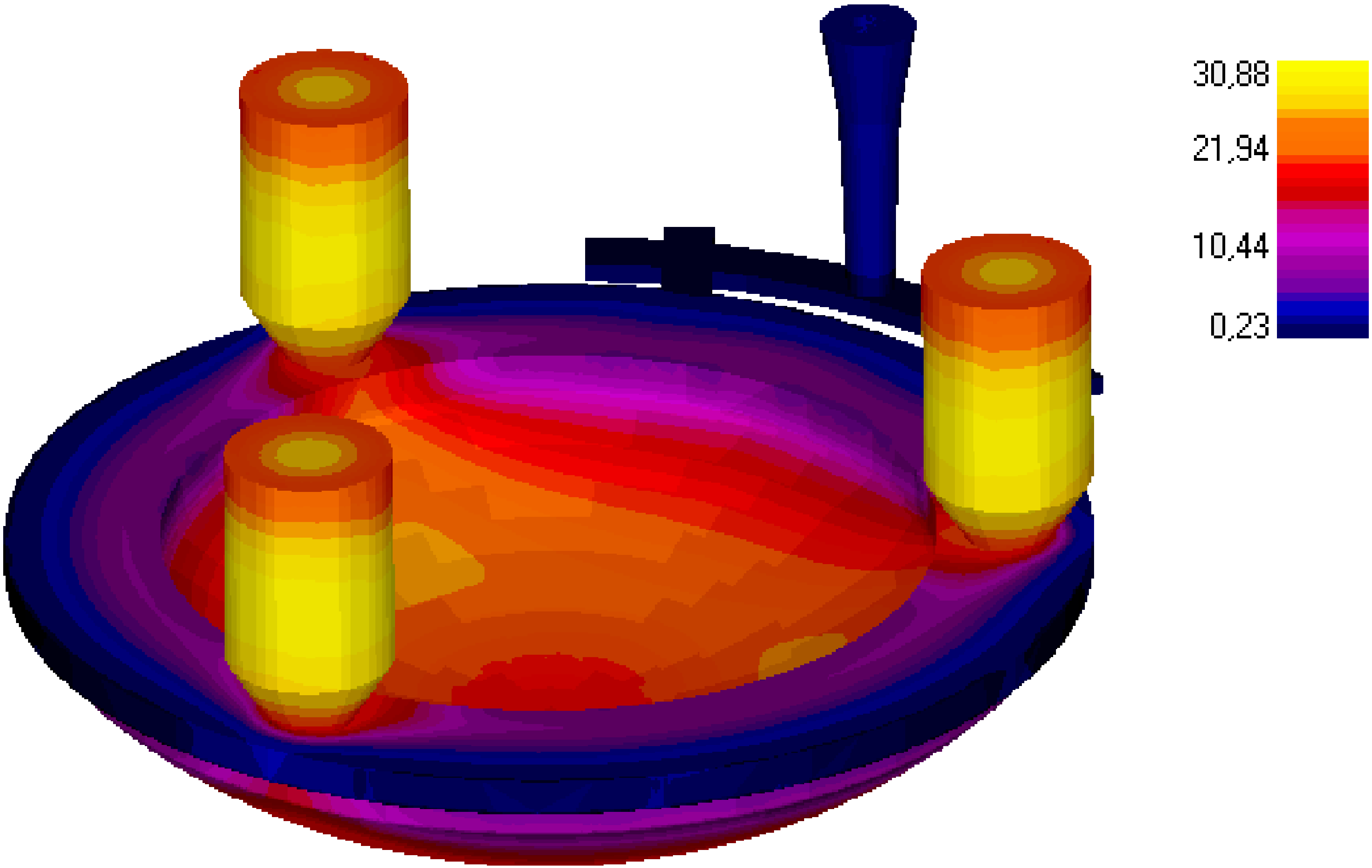
Design-5 Macroporosity Shrinkage Analysis



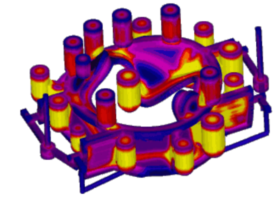
Images are the results of analysis performed at 99.8% density. The risk of shrinkage only occurred in the risers and there is no risk in the part.

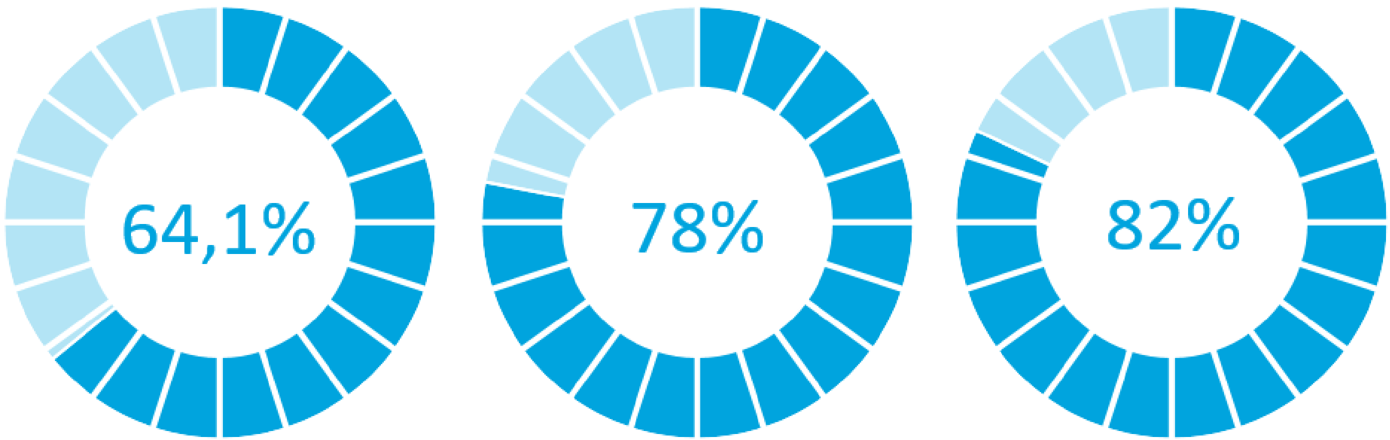
Design-5 Solidification Time



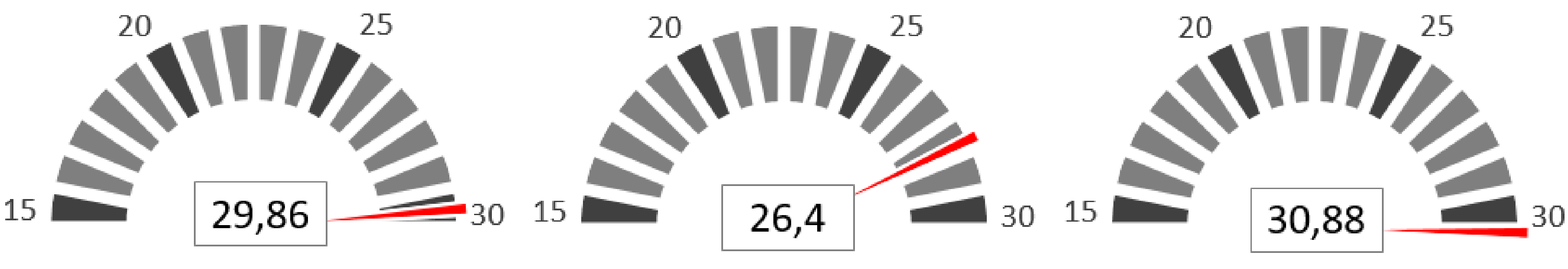


Molding Design Comparisons



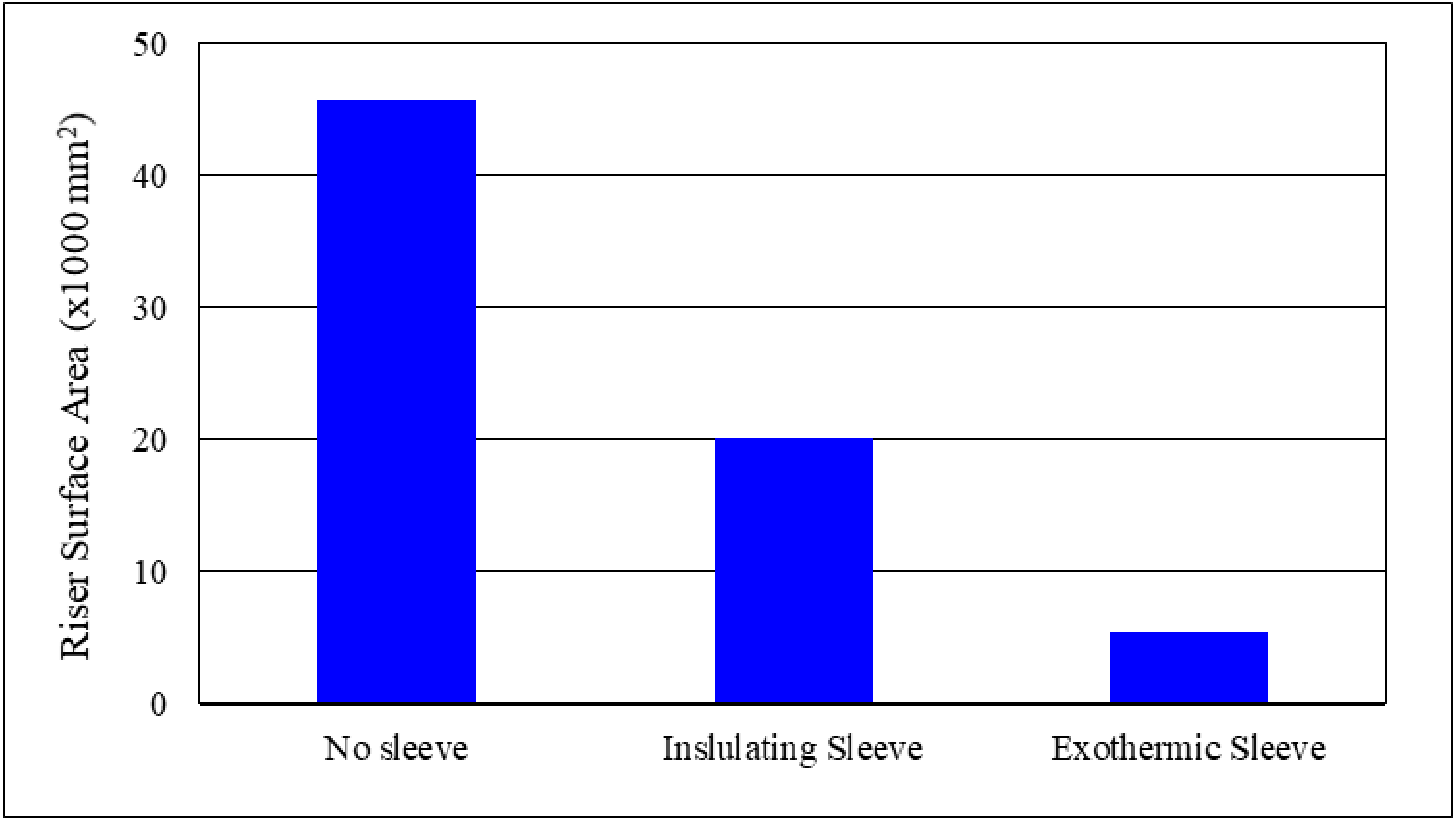


No sleeve Insulating Sleeve Exothermic Sleeve

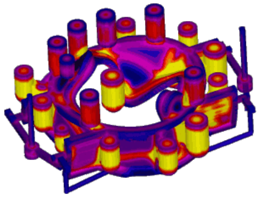


No sleeve Insulating Sleeve Exothermic Sleeve

Riser Cutting Surface Areas



Results



The results of the molding designs made with 100 kg St1020 carbon steel casting part are given below.

- In the design no sleeve, 4 oval risers were used, depending on the width of the area to which the riser will be connected.
- With the use of insulating and Exothermic sleeve, the required amount of riser decreased and molding efficiency increased.
- While an additional 56 kg of metal is required for a sound casting part in the no sleeve design, 28 kg of metal is sufficient when using an insulating sleeve, and 22 kg of metal is sufficient when using an exothermic sleeve. In this case, a 21% capacity increase is possible by using an exothermic sleeve in a foundry with the same furnace capacity for the sample part.
- Due to the expectation of an increase in the mechanical properties of the cast piece with the increase in solidification time, the use of casing contributes to the development of casting properties.
- When post-cast riser cutting labor is considered, there is a gain in labor and material depending on the riser casting part connection used.