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Quality improvement in cover support casting using Auto-CAST software

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Abstract : The soundness of casting depends upon how the metal enters a mold and solidifies. Actually, many factors must be controlled if good castings are to be obtained. The gating and Risering Committee of American Foundrymens Society has done much towards standardizing the nomenclature in connection with feeding of castings. In mass production, it is almost impossible to inspect each and every product that is produced and hence we are forced to adapt to production techniques that need minimum or no quality inspection involved. In the sand casting process that we adopt, the casting component is modeled first, using NX10 modeling software. Once the component is modeled, it is simulated using unique casting software known as AUTOCAST. As the result of simulation, a proper gating system is designed. A perfect gating system for the casting ensures defect free components and shuns quality inspection. The design of gating system consists of various elements like pouring basin, sprue, sprue well, runner and in-gates. They act as the way for the flow of molten metal from pouring basin to various parts of the mold cavity and with influencing the casting quality and economy. Number of casting defects are happens due to the faulty design of the gating system and poor pouring. Proper design of feeder helps in avoiding the solidification related defects (hot spot). Also helps in improving the yield of the casting.

Keywards: NX10, AUTOCAST, gating system, casting defects, casting inspection.

1. Introduction:

Many researchers reported that about 90% of the defects in castings are due to improper design of gating and rising system and only 10% due to manufacturing problems due handling and storage of molds, improper pouring temperature and time etc[1]. Casting simulation process can able to overcome these problems by detecting location of Hot spot. It has observed that various type of simulation software has used in foundry [5], out of which AutoCAST based casting simulation software is used in organization. To detect these defects we have gone through the casting simulation. Computer simulation provides a clear insight regarding the location and extent of internal defects, ensuring castings are right first time and every time. It however, requires a 3D CATIA model of the method layout (with mold cavities, cores, feeders, and gating channels), proper setting of boundary conditions for each virtual trial, and correct interpretation of results. AutoCAST software integrates and automates the above tasks, and provides an extremely easy to use graphical user interface suitable for even first time computer users[7]. The mold cavities, feeders and gating system are automatically optimized, driven by the criteria and constraints specified by user. This reduces the total time for methods design and simulation of a typical casting to less than one hour.

3. Steps involved in Auto-CAST simulation:[5]

1. Solid model a cast part and save it as a .igs file.
2. Browse and upload the casting model file here.
3. Wait till the simulation results are displayed.
4. Identify hot spots. Decide feeder size and location.
5. Model the part with feeder and save as a .igs file.
6. Simulate again and check the location of hot spots.
7. If hot spots are not shifted inside feeders, repeat 4-6.

4. Problem Identification:

Cover Support is a Product of Zeal Engineers. In This case study Mainly Three Defects Shrinkage, Cracks, Moisture was observed. Shrinking defect occurs due to lack of design and insufficient feed metal. A crack occurs due to number of reasons. Some cracks visible by naked eye and too small cracks need to magnify for observation. Moisture defect occurring due to temperature changes in climates or environment. That means moisture contents present in the atmospheric air.

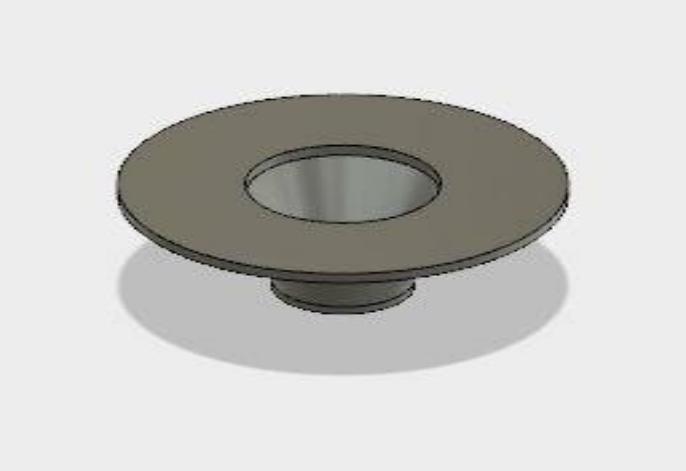


Fig.1 Part Model Design

5. Gating system

A proper method of gating system is that it leads the pure molten metal to flow through a ladle to the casting cavity, which ensures proper and smooth filling of the cavity. This depends on the layout of the gating channels too, such as the direction and the position of the runner, sprue and in-gates. In this product pressurized gating system is used, and molten metal enters from bottom side. The sprue, runnerand in-gate size decide from company standards, and tabulated as below.

Table: 2

Sprue size	Runner size	In-gate size	Total weight
Φ50	Φ40	Φ30	36Kg.

6. Yield Calculation

Yield = casting weight / bunch weight × 100

Bunch weight = C. weight + R. weight + gating system weight.

Casting weight = 460kg.

Risers weight = 7 × 7 / 10× 8= 39kg × 4 = 156kg.

Gating system weight = 40kg.

Bunch weight = 460+ 156+ 40

Bunch weight =656

Y = 460 / 656 × 100=70.56%

7. Simulation Images

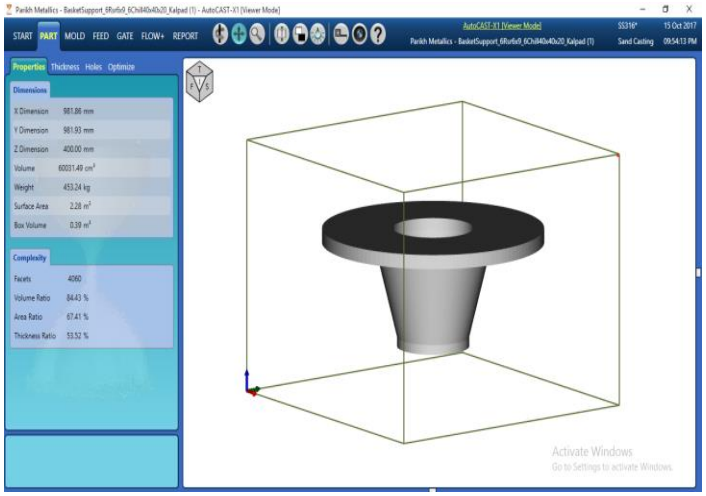


Fig:1,Three Dimensional model imported in auto-cast software

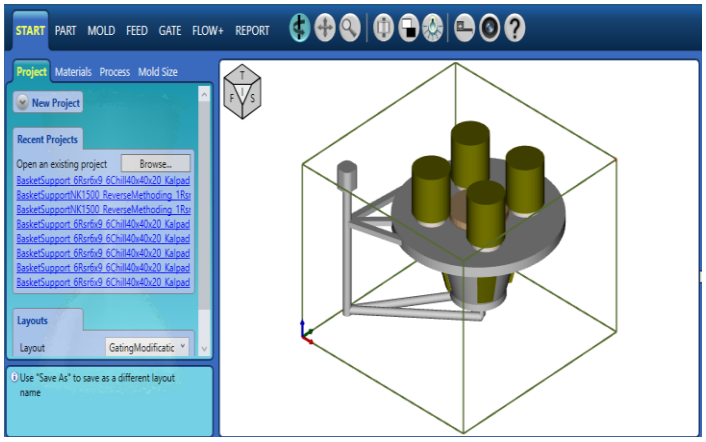


Fig:2,modified gating system in auto-cast software

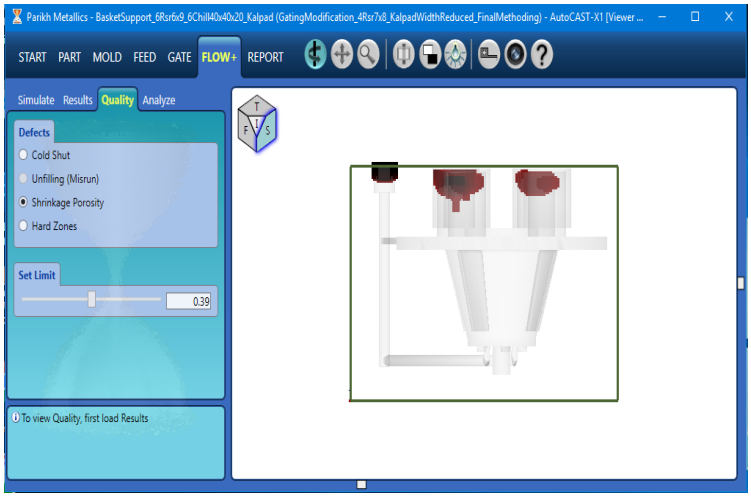
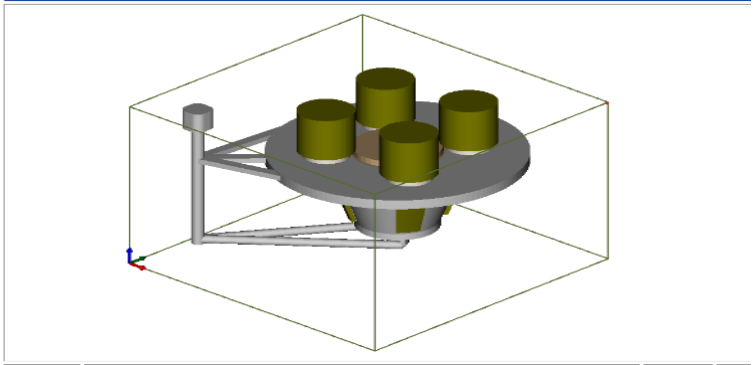


Fig: 3, Shrinkage defects in auto-cast software

Method Report - BasketSupport_6Rsr6x9_6Chill40x40x20_Kalpad			
			
Layout Name	GatingModification_4Rsr7x8_KalpadWidthReduced_FinalMethoding	Date and Time	01 A 18, 07:: AM
Cast Metal	Cast Steel - SS316	Casting Process	San Cas
Density	6949 kg/m³	Pouring Temp	149 °C
Order Quantity	1000	Yield	67.9 %

Sprue 1			
Pouring Basin			
Shape	Rectangular	Dimensions	100 mm X 100 mm X 100 mm
Sprue			
Shape	Cylindrical	Height	705.1 mm
Top Diameter	50 mm	Bottom Diameter	50 mm
Sprue Well			
Diameter	50 mm	Height	50 mm

Gates			
Number of Gates	5	Total Gate Area	44.14 cm²
Total Gating Weight	7.45 kg	Total Gating Volume	961.54 cm³
Gate 1			
Shape	Cylindrical	Length	50.07 mm
Diameter	30 mm		
Gate 2			
Shape	Cylindrical	Length	50.07 mm
Diameter	30 mm		
Gate 3			
Shape	Rectangular	Length	411.47 mm
Height	25 mm	Width	40 mm
Gate 4			
Shape	Rectangular	Length	249.8 mm
Height	25 mm	Width	40 mm
Gate 5			
Shape	Rectangular	Length	339.74 mm
Height	25 mm	Width	40 mm

Runners			
Number of Runners	2	Total Runner Area	55.13 cm²
Total Runner Weight	15.78 kg	Total Runner Volume	2035.71 cm³
Runner 1			
Shape	Cylindrical	Length	736.53 mm
Diameter	40 mm		
Runner 2			
Shape	Cylindrical	Length	757.9 mm
Diameter	40 mm		

Costing			
Tooling Cost	1931 Rs	Energy Cost	3357 Rs
Cast Metal Cost	73918 Rs	Labor Cost	264 Rs
Indirect Material Cost	7226 Rs	Total Process Cost	3620 Rs
Total Material Cost	81144 Rs	Total Cost	86695 Rs

Report Generated by AutoCAST

8. **Conclusion:** The gating design optimization improves the yield of the casting and it also helps in reducing the defects like shrinkage cold shunt and cracks. A good gating design provides smooth and uniform metal flow, with minimum turbulence to avoid entrapment of air, metal oxidation and mold erosion. Due to this gating system defects are minimized and yield also get improved. The bunch weight, Yield and annual costing are tabulated in below table. Using above methoding bunch weight of casting is 640Kg, while the yield is 71.0%.which is satisfactory.

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