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Metal Casting. Instructor: Dr. D. B. Karunakar, Department of Mechanical and Industrial Engineering, IIT Roorkee. This course is an elective subject for manufacturing students. The subject comprises a little wider and deeper on the manufacturing techniques by casting process. It covers bigger spectrum for manufacture products by the casting techniques with required attributes specified for certain purpose such as intricacy, features detail, soundness and others. Among topics or issues include in this course are liquid metals, solidification, molding material, casting design, production techniques, Metal melting and treatment, and casting quality and evaluation. (from nptel.ac.in) Lecture 13 - Design Of Risering System: Caine's Method, Modulus Method, Chvorinov's Rule Go to the Course Home or watch other lectures: Introduction and Overview Lecture 01 - Introduction Lecture 02 - Overview of Different Casting Processes 1 Lecture 03 - Overview of Different Casting Processes 2 Lecture 04 - Overview of Different Casting Processes 3 Sand Casting Process Lecture 05 - Terminology and Tools of Sand Moulding Lecture 06 - Moulding Sands and Design Lecture 07 - Moulding Sands and Design (cont.) Lecture 08 - Moulding Sand Properties Lecture 09 - Moulding Sand Properties Testing Lecture 10 - Cores and Core Sands Lecture 11 - Patterns and Allowances Lecture 12 - Steps involved in Making a Sand Casting Lecture 13 - Design Of Risering System: Caine's Method, Modulus Method, Chvorinov's Rule Lecture 14 - Design Of Risering System: Naval Research Laboratory Method Lecture 15 - Design Of Risering System: NRL Method (cont.) Lecture 16 - Design Of Risering System: Feed Metal Volume, Riser Efficiency, Feeding Distance Lecture 17 - Design Of Risering System: Feeding Length, Bottle Risering, Safety Margin Lecture 18 - Design of Gating System Lecture 19 - Design of Gating System (cont.) Lecture 20 - Sand Casting Defects Lecture 21 - Sand Casting Defects (cont.) Melting, Fluidity and Solidification Lecture 22 - Melting Furnaces and Practice Lecture 23 - Treatment of Molten Metal Lecture 24 - Fluidity of Molten Metal Lecture 25 - Solidification Common Cast Alloys Lecture 26 - Cast Irons and Steels Lecture 27 - Aluminium and Magnesium Cast Alloys Lecture 28 - Copper, Zinc and Titanium Cast Alloys Permanent Mould and Special Casting Processes Lecture 29 - Die Casting Process Lecture 30 - Die Casting Process (cont.) Lecture 31 - Investment Casting Process Lecture 32 - Investment Casting Process (cont.) Lecture 33 - Continuous Casting Process Lecture 34 - Centrifugal Casting Process Lecture 35 - Evaporative Pattern Casting and Plaster Moulding Lecture 36 - Vacuum Sealed Moulding and Squeeze Casting Finishing Design and Environment Lecture 37 - Shakeout, Fettling and Finishing Lecture 38 - Inspection, Testing and Quality Control Lecture 39 - Design Considerations and Economics Lecture 40 - Environment, Health and Safety Aspects 0 ratings0% found this document useful (0 votes)619 viewsThis document presents an overview of riser design for casting. Risers are added to compensate for solidification shrinkage as the metal cools and solidifies. They must be designed to solidi...AI-enhanced title and descriptionSaveSave riser design ppt For Later0%0% found this document useful, undefined Unacademy is India’s largest online learning platform. Download our apps to start learningCall us and we will answer all your questions about learning on Unacademy Riser Design • Caine's method • Freezing Ratio (X) : SA /V (CASTING) SA/V (Riser) • Y = Riser Volume/ Casting volume • a,b & c are constants Calculate the size of a cylindrical riser necessary to feed a steel slab casting 25 cm X25 cm X5 cm (Assume a side riser , having diameter equal to its height) a = 0.1 b = 0.03 C = 1.0 • casting Volume: 25X25X5 = 3125 cm3 Surface area of the casting:2X25X25 + 4X25X5 1750 cm 2 Riser DIAMETER D=H Volume: πD3/4 Surface Area = π D2 + πD2/4 Modulus method (M) • Modulus is inverse of cooling characteristic • Surface area to volume ratio is cooling characteristic • Volume of riser = πD3/4 Surface Area = π D2 + πD2/4 MRISER = 1.2 M CASTING Naval research laboratory method • Shape factor: (Length +Width)/ Thickness • Shape factor = 25+25/5 = 10 1. Riser Design Methods Dr. P.M.Bhagwat Mechanical Engineering Department Sharad Institute of Technology College of Engineering 2. What is a riser? • A riser is a reservoir of molten metal that is connected to the casting during the solidification process. Risers are used to compensate for shrinkage that occurs as the molten metal cools and solidifies. This helps to prevent shrinkage defects, such as porosity and voids, in the casting. 3. Types of risers • Top risers: These risers are located on top of the casting. They are the most common type of riser and are used to feed metal to the casting as it solidifies from the top down. • Side risers: These risers are located on the side of the casting. They are used to feed metal to areas of the casting that are thicker or that solidify more slowly. 4. Types of risers • Blind risers: These risers are not connected to the casting. They are used to feed metal to the casting and to act as a heat sink to help control the solidification process. 5. Riser design considerations • When designing a riser, several factors must be considered, including: • The size and shape of the casting: The size and shape of the riser should be proportional to the size and shape of the casting. • The type of metal being cast: Different metals have different solidification characteristics, so the riser design must be tailored to the specific metal being used. • The casting process: The casting process will also affect the riser design. For example, sand castings require different risers than investment castings. 6. Riser design methods Caine's method • The Caine's method of riser design is a mathematical approach that helps determine the size and shape of a riser needed to prevent shrinkage defects in a casting. It is based on the concept of freezing ratio, which is the ratio of the surface area of the casting to the volume of the casting divided by the surface area of the riser to the volume of the riser. 7. Caine's method • The formula for the freezing ratio is: • Freezing Ratio = (SA/V)casting / (SA/V)riser • Where: • SA is the surface area • V is the volume • Caine conducted extensive experiments and found that the ideal freezing ratio for most castings is between 0.8 and 1.2. If the freezing ratio is too low, the riser will solidify before the casting, and the casting will not be able to draw liquid metal from the riser to compensate for shrinkage. If the freezing ratio is too high, the riser will solidify too slowly, and the casting will still have shrinkage defects. 8. To use the Caine's method, the following steps are involved: • Determine the surface area and volume of the casting. • Assume a freezing ratio. • Calculate the surface area and volume of the riser. • Check if the freezing ratio is between 0.8 and 1.2. • If the freezing ratio is not within the desired range, adjust the size of the riser and repeat steps 3 and 4 until the desired freezing ratio is achieved. 10. Modulus Method • The modulus method of riser design is a technique used to determine the size and shape of a riser needed to prevent shrinkage defects in a casting. • It is based on the concept of modulus, which is the ratio of the volume of a casting to its surface area. • The formula for modulus is: • Modulus = V/SA • Where: • V is the volume • SA is the surface area 11. Modulus Method • The modulus method assumes that the riser should have a higher modulus than the casting. This is because the riser should solidify later than the casting, so that it can continue to feed liquid metal to the casting as it solidifies. The ideal modulus ratio for a riser is between 1.2 and 1.5. This means that the riser should have a modulus that is 1.2 to 1.5 times the modulus of the casting. 12. Modulus Method • Determine the volume and surface area of the casting. • Calculate the modulus of the casting. • Multiply the modulus of the casting by 1.2 to 1.5 to get the desired modulus range for the riser. • Assume a shape for the riser (e.g., cylinder, sphere). • Calculate the volume and surface area of the riser using the assumed shape. • Calculate the modulus of the riser. • Check if the modulus of the riser is within the desired range. • If the modulus of the riser is not within the desired range, adjust the size of the riser and repeat steps 4 to 7 until the desired modulus is achieved. 13. Shape factor method • The shape factor method, also known as the Naval Research Laboratory (NRL) method, is a technique used to determine the appropriate size and form of a riser to prevent shrinkage defects in a casting. It's based on the concept of shape factor, which is a dimensionless quantity that takes into account the geometry and dimensions of the casting section being fed by the riser. • The shape factor is calculated using the following formula: • Shape Factor = (L + W) / T • Where: • L: Length of the casting section • W: Width of the casting section • T: Thickness of the casting section 14. Shape factor method • The shape factor method assumes that the riser should have a freezing ratio between 0.8 and 1.2. • The freezing ratio is the ratio of the time it takes for the riser to solidify to the time it takes for the casting to solidify. A freezing ratio of 1.0 means that the riser and casting will solidify at the same time. A freezing ratio of less than 0.8 means that the riser will solidify before the casting, and the casting will not be able to draw liquid metal from the riser to compensate for shrinkage. • A freezing ratio of greater than 1.2 means that the riser will solidify too slowly, and the casting will still have shrinkage defects. 15. Shape factor method • To use the shape factor method, the following steps are involved: • Calculate the shape factor of the casting section. • Determine the desired freezing ratio (between 0.8 and 1.2). • Use a chart or formula to determine the required riser volume based on the shape factor and freezing ratio. • Select a riser shape (e.g., cylinder, sphere). • Calculate the dimensions of the riser based on the required riser volume and the selected riser shape. 16. Problems • A rectangular steel casting has dimensions of 100 mm x 150 mm x 20 mm. The solidification time for the casting is estimated to be 2 minutes. Determine the dimensions of a cylindrical riser that will have a solidification time of 2.5 minutes using Caine's method. Assume a freezing ratio of 1.0. 17. Solution • Calculate the surface area and volume of the casting: SA = 2(100 x 150 + 100 x 20 + 150 x 20) = 130000 mm² V = 100 x 150 x 20 = 300000 mm³ • Calculate the surface area and volume of the riser: SA = 2πrh + πr² V = πr²h • Substitute the freezing ratio equation: 1.0 = (SA/V)casting / (SA/V)riser • Substitute the surface area and volume equations for the casting and riser: 1.0 = (130000 / 300000) / [(2πrh + πr²) / (πr²h)] • Simplify and solve for r and h: 1.0 = (13 / 30) / [(2h + 1) / h] 13h = 30(2h + 1) h = 15.0 mm r = √(300000 / πh) = 62.5 mm • Therefore, the dimensions of the cylindrical riser are r = 62.5 mm and h = 15.0 mm. 18. Problems No 2 Shape Factor Freezing Ratio Riser Volume to Casting Volume Ratio 3 1 0.4 4 1 0.5 5 1 0.55 6 1 0.6 A rectangular steel casting has dimensions of 100 mm x 150 mm x 20 mm. The shape factor of the casting section is 4.5. The desired freezing ratio is 1.0. Determine the required volume of the riser using the shape factor method. Use the shape factor chart or formula to determine the required riser volume to casting volume ratio based on the shape factor and freezing ratio. 19. Solution • Since the shape factor of the casting section is 4.5, interpolate between the values for shape factors of 4.0 and 5.0: • Required riser volume to casting volume ratio = (0.55 - 0.50) / (5.0 - 4.0) * (4.5 - 4.0) + 0.50 = 0.525 • Calculate the required riser volume: • Required riser volume = Riser volume to casting volume ratio * Casting volume • Casting volume = 100 x 150 x 20 = 300000 mm³ • Required riser volume = 0.525 * 300000 mm³ = 157500 mm³ • Therefore, the required volume of the riser is 157500 mm³. 0 ratings0% found this document useful (0 votes)1K viewsThis document contains 3 examples of riser design calculations using different methods. Example 1 calculates riser diameter and height using Caine's and Modulus methods for a steel slab ca...SaveSave Riser Design Calculations (Report) For Later0%0% found this document useful, undefined0 ratings0% found this document useful (0 votes)1K viewsThis document contains 3 examples of riser design calculations using different methods. Example 1 calculates riser diameter and height using Caine's and Modulus methods for a steel slab ca... Elective Course: Foundry Engineering MDP457 Two Semester System Mechanical Design and Production Department (MDP) Assignment # 1 Riser Design Calculations Prepared by: Student Name (Arabic): لحا لاسأي لحا لوادلم Bn: 28 Presented to: Dr. Mohamed Gamal Mahmoud Nov 20, 2020 Using Caine’s and Modulus method, calculate the size of a cylindrical riser (height and diameter equal) necessary to feed a steel slab casting 25x 25 x 5 cm. Because the material is steel so the constants are X by trial and error D=H=11.48cm =12cm Design a riser for the casting shown in the following figure using NRL method. For casting L=35cm W=20cm t=10cm D=20cm or 22.5cm From graph for D=20cm H=15.9cm =16cm From graph for D=22.5cm H=12.2cm=12.5cm *the graph points in last two pages