Core:

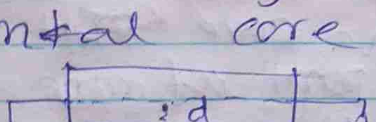
A core is device use in casting and moulding process to produce internal cavity.

core is norally disposible item, and that is destroided to get it at of the piece. they are most commonly used in sand casting but are also used in injection moulding.

Core print: core print is an added proj on the pattern and it forms a sheet in the mould on which the sand core base during puring of the mould. core print must be adequate size & shape that it can support the weight of the core during the casting operation.

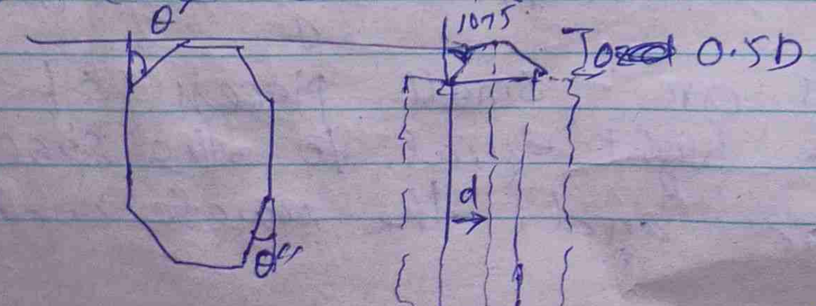
Differnt types of core prints.

(1) Horizontal core print.



core is layed Horizontally in the mould.

2. Varticale core print.

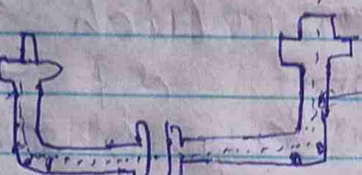


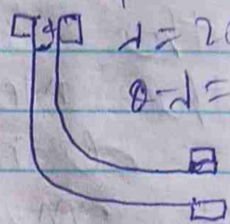
$\theta' = 10-5^\circ$

$\theta'' = 1-3^\circ$

That will stand vertically in the mould this also called cope & drag print it tapped should be given on the core print specially on cope site 10-15° to facilitate the pattern withdrawn and the replacement of the cope & drag and the the tapper on the drag print is only 1-3°.

Balanced core print:-





When the shape of the casting is such that its not possible to support the core from both side a balance print is required. and the core & the core print are than so desine that the part of core in the mould-cavity balances the part that rest in the core sheet. The shape at the print may not necessary with a same as that of the core in the mould cavity to add in the support of the core in the cavity there chaplet may be used

Chaplets are :- small pieces of metal having a hight equal to the spaces b/w the core and the mould wall.

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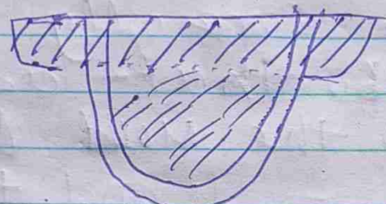
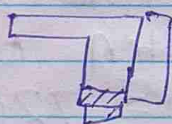
The metal of the chaplet & the casting should be identikal.

Cover core print or Hanging:-



This type of core print is called a hanging core print is favored when the intern pattern is rammed in the drag part and the core is to be suspended in the cope ~~core~~ side.

wing core print



A wing type of core print is used when a hole or races is requred in above or below the parting line. ~~...~~ owing to the large size of particale is required in this case, drop provided on the verticale wales of the core. wing print is also caled Drop chain, and Tail core print.

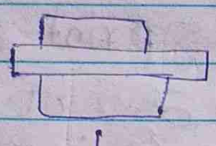
depending on the position of core and mould - shaped,

Core location; adqute location of core is very important to avoid the ~~tend~~ tedency to shift there position or turn about when the core must sit in

only one
~~only~~ particular position. The ~~nit~~ nit for proper setting become essential.

core print support:

The size of the core print shoued be correctly workout or estimated so that adqute grip is obtained b/w the Mould & the Core.



and the core has no tendency to shift or rise when molten metal which has bouyancy effect is pared.

bouncy of the molten metal is the weight of the liq metal being displaced by core. If the molten metal is Iron and it weight in $kg/m^3 = 7200$ and weight of the core/$m^3 = 1600$ than byoncy for

Buoyancy force $= 7200 - 1600$

$= 5600\ kg/m^3$

Then ratio bouncy force to weight of the core $: \frac{5600}{1600} = 3.5$ for cast iron.

Steel :- 3.9
Cu = 4.5
Brass = 4.25
Al = 0.66

greater the ratio of buoyancy force the weight of core more the tendency ~~to~~ for core to float. & more secure the

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the Method of holding required. Core print to heavy metal such as Iron, Steel & brass at therefore larger than lime metal & Al. once the core buoyncy is known the selection of core print size can be verified for its ______. Unsupported load = core buoyncy - core print holding load.

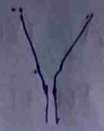
core print holding force = core print surface are × compressible strength of molding sand

If sand strength is taken,

$0.5 \ kg/cm^3$. So core print holding

= force = 0.5 × core print surface area.

unsupported holding face 0 or negative to ensure the ability of the core in the mould not with stand vaint effect of moulden metal. If the result is +ve value, the proportion of core print should be alter and the unsupported load again to attain -ve or zero. In order to get better support to core & prevent there deflation chaplet is used.



(i) To fill the mould metal completely.

(ii) To remove inclusion.

(ii) To minimize the Turbulance.

(iii) To avoiding ~~erosioning~~.

(iv) To regulate the flow of molten metal.

(v) To consume ~~least~~ less metal & less scrap.

(vi) To establish directional solidification.

Pouring cup:-

Generarally typical dimension of pouring cup

round inlet & outlet

Inlet dia	outlet dia	Hight
51	25	38
127	64	133
203	76	140
254	102	203

Square intlet & round outlet

78×90	33	117
105×134	~~134~~ 37	127
140×159	51	152

Sprue is a verticle ?

How to minimize the Turbulence in pouring basin or pouring cup?

Anti swirl bar

Sprue is the vertical passage inside the mould through which molten metal reaches the runner and eventually mould cavity.

Rules for design of a sprue

(i) The size of sprue should be optimized to limit the flowrate of molten metal.

(ii) vortex formation tendency in a sprue with circular cross-section is higher hence ractangular cross section sprue are better than the circular one with same cross sectional area. However for casting round sprues is more economical.

(iii) Hight of the sprue is determined by the casting & the Top Riser hight.

(iv) Sprue should be tappered by approximately 5% to avoid the aspiration of the air.

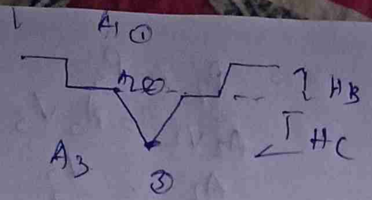
(v) Standered filter should be placed at the outlet of the sprue as the metal flows into the runner. Sprue should be placed centrally into the runner.

(vi) The rate of flow of mass of the fluid is constant at any cross section.

$$m = \rho A_1 V_1 = \rho A_2 V_2 = \rho A_3 V_3$$

m = rate of flow of mass.

ρ = density liq metal.



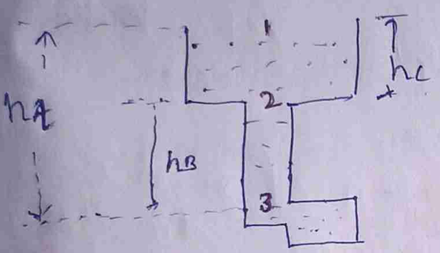
$A_{1,2,3}$ Area of cross section (1, 2, 3)

$V_{1,2,3}$: velocity of liq metal at 1, 2, 3

$$\frac{m}{\rho} = Q = A_1 V_1 = A_2 V_2 = A_3 V_3$$

$$V_2 = \sqrt{2g H_B} \qquad V_3 = \sqrt{2g H_c}$$

① & ③ use bernoulis eqn.



$$h_t + \frac{V_1^2}{2g} + \frac{\text{Pressure}}{dg} = h_3 + \frac{V_3^2}{2g} + \frac{P_{atm}}{dg}$$

$$h_t + 0 + \frac{P_{atm}}{dg} = 0 + \frac{V_3^2}{2g} + \frac{P_{atm}}{dg}$$

$$\boxed{h_t = \frac{V_3^2}{2g}}$$

$$\boxed{V_3 = \sqrt{2g h_t}}$$

② & ③

$$h_2 + \frac{V_2^2}{2g} + \frac{P_2}{dg} = h_3 + \frac{V_3^2}{2g} + \frac{P_{atm}}{dg}$$

$$V_2 = V_3$$

$$h_2 + \frac{P_2}{dg} = h_3 + \frac{P_{atm}}{dg}$$ air entrapped. that's why ↓

aspiration generate

or $P_2 = P_{atm} - h_2 dg$

↓ Avoid Aspiration ?

② & ③

$$\frac{P_2}{dg} + \frac{V_2^2}{2g} + h_2 = \frac{P_3}{dg} + \frac{V_3^2}{2g} + h_3$$

$$P_2 = P_3$$

$$\frac{V_2^2}{2g} + h_2 = \frac{V_3^2}{2g}, \qquad h_2 = \frac{V_3^2}{2g} - \frac{V_2^2}{2g}$$

$$= \frac{1}{2g}\left(V_3^2 - V_2^2\right)$$

$$h_2 2g = v_3^2 - v_2^2$$

$$= \cancel{R}^2 v_3^2 - R^2 v_3^2$$

$$= v_3^2 (1 - R^2)$$

$P_2 = P_3$

$A_2 V_2 = A_3 V_3$

$\frac{A_2}{A_3} = \frac{V_3}{V_2}$

$V_2 = R V_3$

$R = A_3 / A_2$

$$\frac{h_2 2g}{V_3^2} = (1 - R^2)$$

$$R = \sqrt{1 - \frac{2gh_2}{V_3^2}}$$

$$R = \sqrt{1 - \frac{2gh_2}{2gh_t}}$$

$$\boxed{R = \sqrt{1 - \frac{h_2}{h_t}}}$$

$$R = \sqrt{\frac{h_t - h_2}{h_t}}$$

$$R = \sqrt{\frac{h_t - h_2}{h_t}}$$

$h_t - h_2 = h_c$

$$\frac{A_3}{A_2} = \sqrt{\frac{h_c}{h_t}}$$

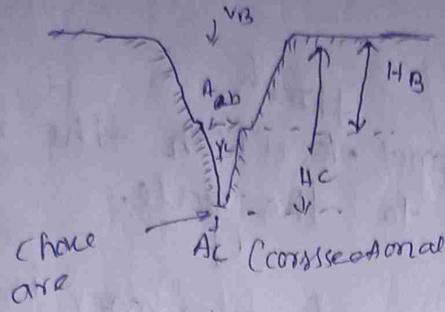
$$\frac{A_3}{A_2} = \sqrt{\frac{20}{80}}$$

~~Ayssu~~ Assume.

$A_3/A_2 = \frac{1}{2}$. $A_3 = \frac{1}{2} A_2$

Desine the choke area

H_B - hight of poring Basin
H_C = " " Total Metal head above the cho
V_B = velocity of liq Metal at the top of sprue.
V_C = velocity of liq Metal at the bottom of sprue or choke.



A_C (Crosssectional area at the choke

The smallest area that occur at the bottom of sprue.

According to the Bernoulis Theorem.
velocity of the liq Metal at the top of the sprue

$$V_B = \sqrt{2gH_B}$$

simmilarly verocity at the choke area.

$$V_C = \sqrt{2gH_C}$$

volume of flow at choke in a given time i.e

$$= A_C V_C \times t = \frac{W}{\rho}$$

where W = weight of pored Metal.
ρ = density of liq Metal.

thus, $A_C = \frac{W}{\rho V_C t \times C}$

C = co-efficiant of discharge (0.7 — 0.9)

$$V_C = \sqrt{2gH_C}$$

$$A_C = \frac{W}{\rho t C\sqrt{2gH_C}}$$

W = weight of pored Metal in kg

H_C = hight of the total Metal head above choke.

t = pouring time in sec.

g = acceleration due to gravity. 9.81 m/sec²

Sprue well: is used to catch & trap the fast Metal & to absorb errosion of sand. due to kinetic energy of Molten metal.

Rules for desine of sprue well.

(1) sprue oil area ~~$\frac{2}{3}$ times~~ 2-3 time area of choke area.

<u>Runner:</u>

is the Horizontal chanel ~~to~~ through which the molten flows from the sprue to the gate.

Typical cross section of a runner is squre.

The runner cross sectional area is genarall 2-4 time of the cross section ~~of~~ area of choke. Based on the gating ratio.

3. Abropt change ~~tho~~ In the direction of runner should be avoided if the changing direction is more that about 15° the joints needs to be fillated.

4. Runner should be maintain a minimum distance from the casting i,e 4-5 times the thickness of the Gate.

5. Runner extension is used to catch at trap the slag & impurities in the first metal that are likely to enter the mould cavity.

Runner extension diameter is 2-2.5 times width of Runner.

<u>Rules of Gate desiner</u>

(i) Multiple ingates often are preferrable for large part. a fillates should be used where an ingate nerked in casting produces less torbulance.

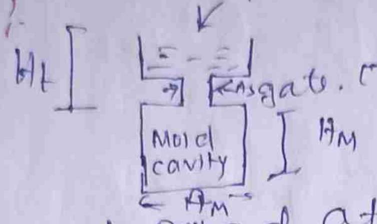
(ii) The Minimum ingate length should be 3-5 times the ingate width ~~dep~~ pending on the metal being cast.

(iii) curved ingate should be avoided as far as possible.

Type of Ingates:

(i) Top gate.
(ii) Parting line gate.
(iii) Bottom gate.
(iv) Side gate.

(i) Top gate:



Molten Metal is poured at the top of the Mould.

HM = hight of the mold.

Ht = pouring Hight

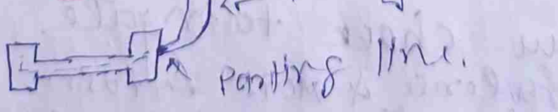
AM = cross sectional area of Mold.

$$\text{pouring time} = \frac{\text{volume of Mould.}}{\text{gate cross sectional area} \times \text{velocity of the metal at gate}}$$

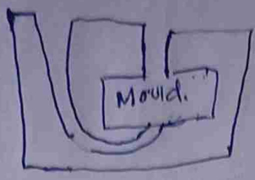
$$= \frac{A_m \times H_M}{A_S \times V_g}$$

Turbulence and errosion where moulds are errosion.

(ii) parting line gate:-



(III) Bottom gate (Horn gate)



Motten Metal flows into the Mould through the Bottom of mould cavity. Turbulence & errosion is minimum

Disadvantage: Metal at the top of the cavity

(IV) Side gate:-

Metal enters to mould cavity through the side of gate.

Types of Gating System:-

(I) pressurise gating system:-

(II) unpressurise gating system.

pressurise -

(1) Total cross sectional area gradually decreases from choke to ingate.

* More Turbulence & more errosion, casting yeild is more

complex shape & Thin shape easily casting.

(2) unpressurise gating sys. Total cross sectional area gradually increases from choke to ingate toward the mould cavity.

* less turbulence, casting yeild is less

Casting yeild = $\frac{\text{Finish casting weigh}}{\text{Use of casting metal}} \times 100$

complex & thin section may not cast in unpressurise.

Pressurised gating System   A = cross-sectional are. choke, Runner, Gate.

$A_C : A_R : A_G$

1 : 1.3 : 1.1 (For gray iron casting)

1 : 2 : 1 (Al.)

1 : 2 : 1.5 (For steel)

unpressurise gating System:-

$A_C : A_R : A_G$

1 : 4 : 4 (For G.I)

1 : 3 : 3 (Al)

1 : 3 : 3 [For steel)

Logical approch for a proper desine of gating system.

1. Estimation optimum pouring time.
(ii) calculation of ~~ser~~ sprue choke area.
(iii) selection of appropriate gating system.
(IV) ~~cal~~ selection of gating type & ingate location.
(V) calculation of Runner & Ingate size.

(i) calculation of pouring time:-

G.I casting < 450 kg

Pouring Time 't' = $K\left(1.41 + \frac{T}{14.59}\right)\sqrt{W}$ sec.

K = Fluidity factor, which depends upon Temperature & composition of Molten Metal.

$$\text{fluidity factor} = \frac{\text{~~fluidity~~ fluidity of iron in inch}}{40}$$

~~TCA~~ T = Average thicnkness of the casting (mm)

W = Mass of the casting in kg

2. GI casting > 450 kg

Pouring time 't' = $K\left(1.206 + \frac{T}{16.65}\right)\sqrt[3]{W}$ sec

3. Steel casting

Pouring time 't' = $\left(2.4335 - 0.3953 \log W\right)\sqrt{W}$ sec.

4. S.G iron (Spheroidal graphite Iron)

Pouring time

$t = K_1\sqrt{W}$ sec.

K_1 = 2.08 for casting of thiner section <10 mm.

= 2.67 for Medium section 10-25 mm

= 2.97 for thick section or havier section >25 mm

W = Mass of casting in kg

5. Copper Alloy casting:

Pouring time 't' = $K\sqrt[3]{W}$

K = 1.3 for Top gating

2.18 for Bottom gating.

prob.

calc

cu

(T)

TC

& Sc

(6) Al Alloy :-

$t = A \sqrt[3]{TW}$

T = predominance section Thickness.

A = ~~1~~ 17.3

W = Mass of ~~gating~~ casting in kg.

problem : 1

calculate the optimum pouring time for a casting whose Mass 20 kg and Average section thickness is GI (T) 15 mm, the material of the casting is 28 inch Take fluidity of Material is 28 inch

$t = K\left(1.41 + \frac{T}{14.59}\right)\sqrt{W}$

$K = \frac{28}{40} = 0.7$

$t = 0.7\left(1.41 + \frac{15}{14.59}\right)\sqrt{20}$

$= 7.63$ second.

* Solve the problem if the material is steel.

$t = (2.4335 - 0.3953 \log 20)\sqrt{20}$

$= 8.58$ sec

1. Design the gating system for a casting made up of cast iron whose dimension are 500 × 250 × 50 mm density of solid cast iron 7.86 gm/cc. density of liq CI = 6.9 g/cm fluidity length = 22 inch hight of core 100 mm, calculate volume of casting = $500 \times 250 \times 50 = 6.25 \times 10^6\ mm^3$

$= 6.25 \times 10^3\ cm^3$

Mass of casting (Net weight) $= \rho \times vol$

$= volume \times density$

$= 6.25 \times 10^3 \times 7.86$

$= 49125\ gr$

$= 49.125\ kg$

Assume casting yeild is 70%

$\frac{\text{Mass of casting}}{\text{weight of pored metal}} = \text{yeild coff} = \frac{70}{100}$

weight of pored metal

$= \frac{\text{Mass of casting} \times 100}{70}$

$= \frac{49.125 \times 100}{70}$

$= 70.18\ kg$

pouring time (t) $= K\left[1.41 + \frac{T}{14.59}\right]\sqrt{W}$

$K = \frac{22}{40} = 0.55 = 0.55\left(1.41 + \frac{50}{14.59}\right)\sqrt{70.18}$

$= 22.28 = 23 = 23$ second

design of choke ar

$A_c = \frac{W}{\rho t c \sqrt{2gH}} = \frac{70}{10 \times 6.9 \times 23 \times 0.8\sqrt{2 \times 9.80 \times 1}}$

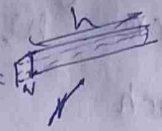
$\rho = 6.9 \times 10^{-6}$

39.38

$= 39.38 = 381\ mm^2$

Dia of choke = 22 mm

Design of runner.



$A_C : A_R : A_G$

$1 : 4 : 4$

$A_R = 4 \times 381$
$= 1524$

$381 : 4 \times 381 : 4 \times 381$

Design of ingates

$A_G = 4 \times 381 = 1524\ mm^2$

No of ingates taken = 2

cross section area of each ingate $= \frac{1524}{2}$
$= 762$

hight of ingate = a.

width of ingate = 2a

$2a \times a = 762$

$a^2 = 381$

$a = \sqrt{381} = 19.51 = 20mm$

hight of each ingate = 20mm

& width of each ingate = 40mm.

Design the gating system for a casting of size 400 × 200 × 40 mm made up of steel, ~~the casting has a two~~ density of solid steel 7.86 g/cm density of liq 6.9 g/cm hight of core box 150 mm, [illegible] length 24 inch

∴ volume $= 400 \times 200 \times 40$

$= 32000 \cdot 3.2 \times 10^6 \, mm^3$

$= 3.2 \times 10^3 \, cm^3$

Mass of casting = volume of casting × ρ_s

$= 3.2 \times 10^3 \times 7.86$

$= 25.152$ kg

Assume casting yeild is 70%

$$\frac{\text{Mass of casting}}{\text{weight of poured melt}} = \frac{70}{100}$$

$$\text{weight of poured melt} = \frac{25.152 \times 100}{70}$$

$= 35.93$ kg

paring time. $t = (2.4335 - 0.3953 \log 35.39)\sqrt{35.93}$

$= 10.9$ sec $= 11$ sec

design of core.

$$A_C = \frac{W}{\rho t c \sqrt{2gH}} = \frac{35.93}{6.9 \times 10^{-6} \times 11 \times 0.8 \sqrt{2 \times 9800 \times 150}}$$

$= \cancel{422.2} = \cancel{422.2 \, mm^2}$

$= 345.10$

Dia at choke

$\pi r^2 = \cancel{422.2}\ 345.105$

$r = \cancel{1[illegible]}\ 10.48$

so the dia of choke = $\cancel{2[illegible]}$ 20.96

Design of the Runner:-

$A_C : A_R : A_G$

1 : 3 : 3

$A_R = 3 \times \frac{\cancel{422.2}}{345.10} = \cancel{1266.6} = 1035.3$

Design of Ingates.

$A_G = 3 \times \frac{345.10}{\cancel{422.2}} = \cancel{1266.6}\ 1035.3$

No of Ingate taken, 2.

cross-sectional area of each ingate. $= \frac{\cancel{1266.6}\ 1035.3}{2}$

$= \cancel{633.3}$

$= 517.65$

hight of Ingate = a.

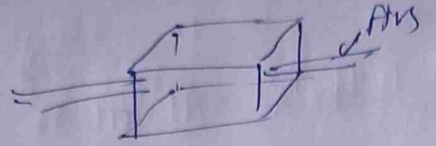
width of Ingate = 2a

area of Ingate $2a \times a = \cancel{633.3}\ 517.65$

$a = \cancel{17.[illegible]}\ 16.08$

hight of each ingate = $\cancel{17.[illegible]}$ 16.08 mm

and width of each ingate = $\cancel{3[illegible]}$ 32.17 mm design the gating system for a casting of size 600 × 300 × 100 mm madeup of steel the casting of two thin fins on the two side 250 × 50 × 3 mm density of solid 7.86 g/cm density of liquid steel 6.9 g/cm. hight of core 150 mm, fluidity len = 24 inch



volume of casting $= 600 \times 300 \times 100$

$= 18 \times 10^6 \ mm^3$

$= 18 \times 10^3 \ cm^3$

volume of fins $= 2 \times 250 \times 50 \times 3$

$= 75 \times 10^3 \ mm^3$

$= 75 \ cm^3$

Total volume of casting

$= 18 \times 10^3 + 75$

$= 18.075 \times 10^3$

Mass of casting $= 18.075 \times 10^3 \times 7.86$

$= 142.07 \times 10^3 = 142.07$ kg

Assume casting yeild 70%.

$$\frac{\text{Mass of casting}}{\text{weight of poured metal}} = \frac{70}{100}$$

$$\text{weight of poured metal} = \frac{142.07 \times 10^3}{0.7}$$

$= 202.95$ kg

paring time,

$$t = \left(2.4335 - 0.3953 \log 202.95\right)\sqrt{w}$$

$= 21.6$

$$A_C = \frac{W}{\rho t C\sqrt{2gH}}$$

$$= \frac{202.95}{6.9\times10^{-6} \times 21.6 \times 0.8 \sqrt{2\times9800\times150}}$$

$= ~~\ldots~~ \; mm^2$

$= 992.7$

dia at chase,

$\pi r^2 = 992.7$

$r^2 = \frac{992.7}{\pi}$, $r = 17.7$

so the dia is $= 35.5$

design of Runner,

$A_C : A_R : A_g$

$1 : 2 : 1.5$

$A_R = 2\times992.7 = 1985.42$

$A_g = 1.5\times992.7 = 1489.05$

No of ingates taken, 2

cross section area of each ingate,

$= \frac{1489.05}{2}$

$= 744.525$

hight of the ingate $= a$

width $= 2a$

width $= 38.5$

$2a\times a = 744.25$

$a = 19.29$

Riser Design:-

Primary function of Riser:-

(i) It act as a resarvior of Molten Metal in the Mould. to compensate shrinkage during solidification.

(ii) It gives an indication that the cavity is full with the Molten Metal.

(iii) A oversize riser require excess Molten Metal result requires.

Types of Riser:-

- (i) Blind Riser
- (ii) open riser
  - Side riser
  - Top riser

In general for side riser $H = D$

Top riser:- $H = 0.5D$

$$H = \frac{D}{2}$$

Guideline for Riser design location:

1. The riser & the feeder must not solidify before casting.

(ii) The volume of the riser must be large enough to feed the entire shrinkage of the casting.

(iii) The pressure head from the riser should enable complete cavity free

(v) Riser must be placed so that it enable directional solidification.

$$x = \frac{a}{y-b} + c$$

x = freezing factor

$$y = \frac{\text{volume of riser}}{\text{volume of casting}}$$

	a	b	c
steel	0.1	0.03	1
Al	0.1	0.06	1.08
CI	0.04	0.017	1.0

* ~~necessary~~ calculate the size of a cylindrical riser necessary to feed a steel slag casting of size 25×25×5 ... height of the riser & diameter is equal

⇒

volume of casting $= 25 \times 25 \times 5$

$= 3125$

Surface area of casting $= 2 \times 25 \times 25 + 4 \times 25 \times 5$

$= 1750 \ cm^3$

Let Diameter of the riser $= D$

volume of the riser $= \frac{\pi D^3}{4}$

Surface area of the riser $=$

$\pi D D + \frac{\pi D^2}{4}$

$= 1.25 \pi D^2$

freezing ratio $= 0.112D$

$y = \frac{\pi D^2/4}{3125}$

Drawback -

(i) for each material the constant a, b, c changing

(ii) calculation of freezing ratio is difficult if the surface of the casting is complex.

hence solution of the

Modulus Method:

Solidification Modulus or Modulus $= \frac{V}{A}$

Chvorinov's Rule:-

$$TST = C_m\left(\frac{V}{A}\right)^n$$

↓

Total solidification time.

V = volume of casting

A = Surface area of the casting

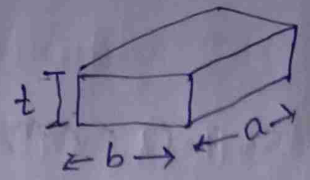
n = exponent usually taken as 2

C_m = a ~~coefficient~~ constant ~~which~~ which "depend upon Mould Material.

Ideal Shape of riser is Sphere.

Requirement of the riser to feed the

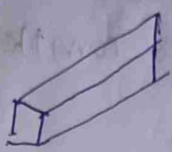
$$M_R = 1.2 M_C$$



$M = 0.5t$

$a < 5t$

Long bar:

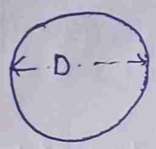


$M = \frac{a}{2}$

Cube: $M = D/6$

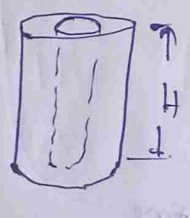
Cylinder: $M = \frac{D}{6}$

Sphare :-



$M = \frac{D}{6}$

Hollow cylinder:-



$M = \frac{rH}{2(r+H)}$

Determine the size of a side riser for a casting of dimension 25 × 25 × 5 cm using Modulus Method

⇒ volume of the casting. $V_C = 25 \times 25 \times 5$
$= 3125 \text{ cm}^3$

Surface area of the casting $= 2(25 \times 25) + 4(25 \times 25)$
$= 1750 \text{ cm}^2$

Modulus of casting,
$M_C = \frac{V_C}{M_C} = \frac{3125}{1750} = 1.7857$

Modulus of riser $= 1.2 \times M_C$
$= 1.2 \times 1.7857 = 2.1429$

$\frac{D}{6} = 2.1429$

$D = 12.6$ cm

and hight $h = 12.6$ cm $\quad$ [$h = D$] riser

During the casting of a certain alloy using a sand mold it took ___ inters 155 sec for a cube casting to solidify, The cube was 50 mm on each side (i) determine the value of mould constant

(ii) for the same alloy & mold determine the solidification time for a cylindrical casting whose diameter is 30 mm & length is ~~45~~ 50 mm

$$155 = C_m \left(\frac{50^3}{6 \times \cancel{50}^2} \right)^2$$

$$155 = C_m \times \left(\frac{\cancel{50}^{25}}{\cancel{6}\,3} \right)^2$$

$$C_m = 2.32$$

$$T_{ST} = 2.3 \times \left(\frac{V}{A} \right)^2$$

$V = \pi r^2 h$

$= 2\pi r h + 2\pi r^2$

$$= 2.32 \times \left(\frac{\pi \times 15^2 \times 50}{2 \times \pi \times 15 \times 50 + 2\pi \times 15^2} \right)^2$$

$= \frac{\pi \times 15^2 \times 50}{\pi \times h \left(2 + \frac{2r}{h}\right)}$

$$= 2.32 \left(\frac{15}{2 \times \cancel{15} + 2 \times \frac{15}{50}} \right)$$

$= \frac{r}{\left(2 + 2\frac{r}{h}\right)}$

$$= 13.38$$

Merits:-

The Method is independent of the material of castin

Demerit:

The Moduls of casting depands upon the surface area of in many cases the determination of surface are is very difficult for complex casting.

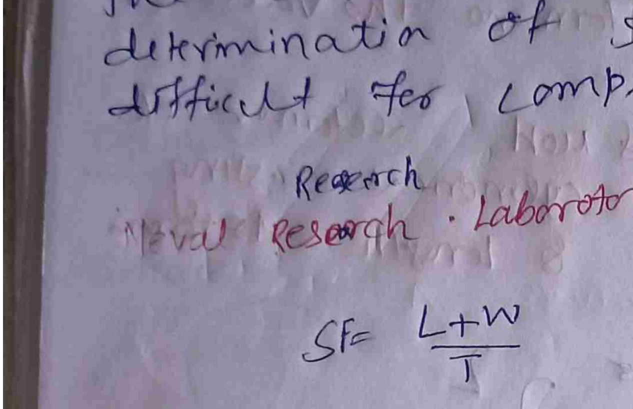
Research
~~Naval~~ Research Laboratory (NRL)

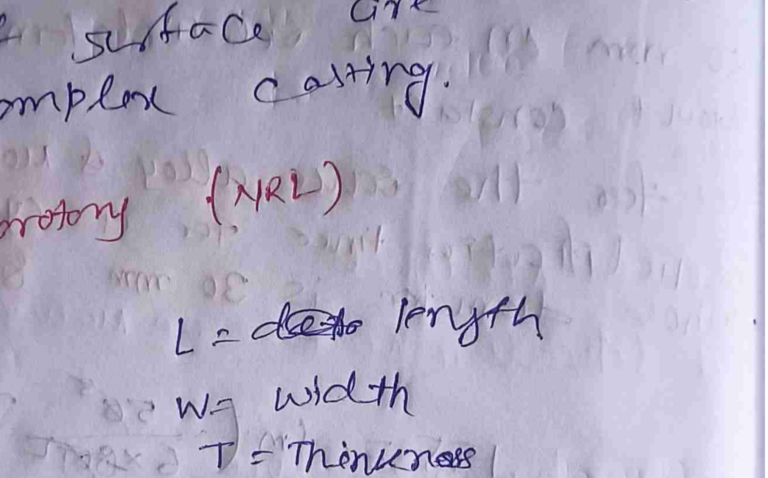
$SF = \frac{L+W}{T}$ L = ~~deto~~ length

W = width

$L > W > T$ T = Thickness

SF = Shape factor





Designe the top riser for a plate like casting whose dimension are $\underset{L}{50} \times \underset{W}{50} \times \underset{T}{5}$ the material of the casting is low alloy steel

$$S = \frac{50 \times 50}{5} = 20.$$

casting volume V_C = $50 \times 50 \times 5$

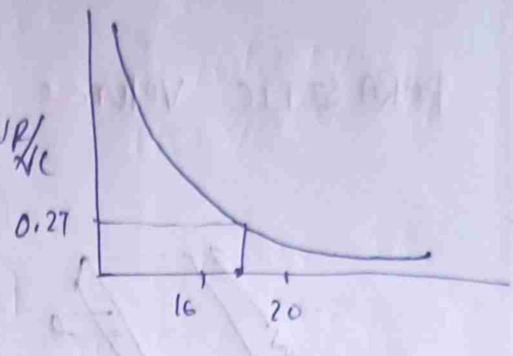
= 12500 cm^3

$\frac{V_R}{V_C}$

V_R = 5×12500

= 20×12500

= 250,000



$$\frac{V_R}{V_C} = \frac{V_R}{V_C} = 0.27$$

$$V_R = 0.27 \times 12500$$

$$= 3375\, cm^3$$

Advantage:-

Limitat:

only application

Low carbon

Steel

- Plain C steel
  - Low C (0.05–0.3%)
  - Medium (0.3 to 0.8)
  - High C steel (0.8–2.1%)
- Alloy steel
  - Low alloy steel (< 5% Alloying element)
  - Medium Alloy steel (5–8% total alloy element)
  - High Alloy steel (> 8% Alloy content)

Advantage:

The freezing ratio, as in the case of caine Method dosnot come.

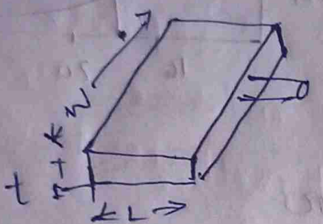
(i) Surface area of the casting dneednot be calculated as in the case of Modulus Method.

(ii) Most of the result can be obtained from the graph very less calculation.

(iv) Riser dimsion can be selected in different combination of the diameter & hight as per the conveniance.

Limitation: this method applicable only 'c' steel and low alloy steel.

PARASITIC volume of NRL Method:

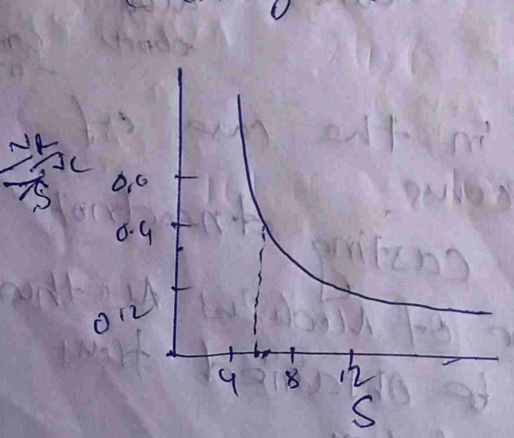


Final riser volume
= Riser volume (calcula.
+ 30% Parasatic valume

* Designe a riser for the casting shown in the following figure L = 35 cm, T = 10 cm, W = 20 and Parasatic volume L = 20, W × T 4 × 4

$$S = \frac{L+W}{T} = \frac{35+20}{10} = 5.5$$

Casting volume = 35 × 10 × 20 = 7000



$$\frac{V_R}{V_C} = 0.7$$

$$V_R = 0.7 \times 7000$$

$$= 4900$$

Final riser volume

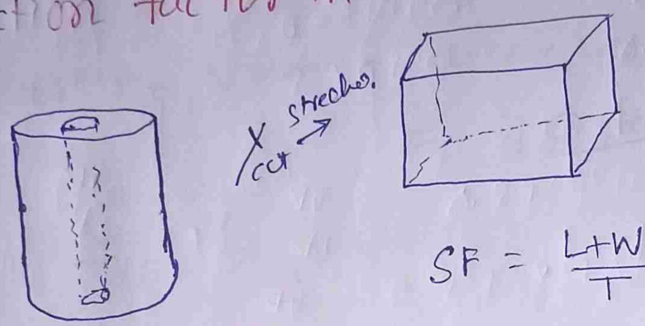
$= 4900 + (20 \times 424)\frac{30}{100}$

$= 4900 + 96$

$= 4996$

$D = 22.5$ $H = 10$

correction facter in NRL method:



$SF = \frac{L+W}{T}$

Inner serface take more time to solidification.

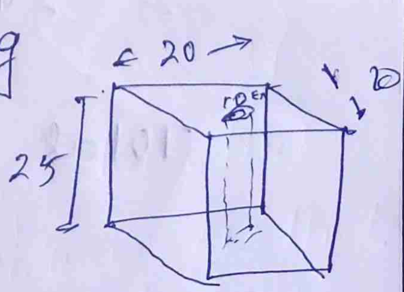
corrected safe factor $= \frac{L+W}{KT}$

K= correction factor.

correction factor in different cases, is different.

core diameter	0.5T	T	2T	4T
correction facter	1.17	1.4T	1.02	1.00

designe the riser for the casting the following figure, hole 10x10.



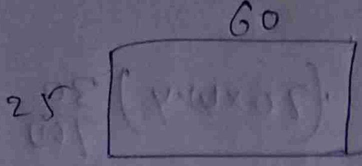
$\pi r^2 = 10 \times 10$

$r^2 = \frac{100}{\pi}$, $r = 5.64$

Dia = 11.2

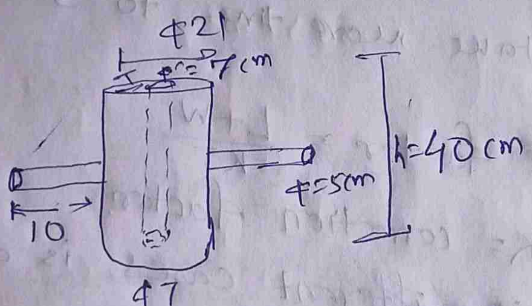
$L = 20$, $W = 20$, $T = 25$

$SF = \frac{L+W}{KT} = \frac{20+20}{25 \times 1.17} = 1.36$



$W = 5{\cdot}64$

$SF =$



Designe the riser shown in figure.

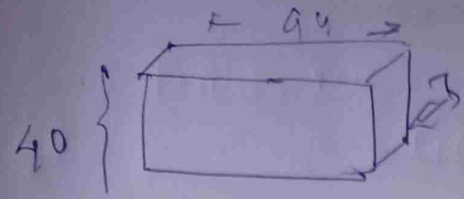
<u>Fin</u> $\pi r^2 \times h = \pi 5^2 \times 10$

$= 250\pi = 785.39\ cm^3$

Riser Volu $\pi (14)^2 \times 40$

$= 24.63 \times 10^3\ cm^3$

Total volume of riser $= 25.41 \times 10^3$



$L = \pi \times 14$

$= 44\ cm$

Width = ~~0~~40 cm

Thickness = 7 cm

$SF = \frac{L+W}{kT} = \frac{44+\cancel{0}40}{1.\cancel{04}\times 7}$

$= 10.52$

Casting volume $= 44 \times 40 \times 7 + \cancel{2}\,785.39 \times 2$

$= \cancel{13.89\ldots}\ 1.2320$

$\frac{V_R}{V_C} = 0.4$

$V_R = 0.4 \times 12320$

$= 4928$

Total Riser volume with parall

$= 4928 \cancel{\times} + \left(\frac{500\pi \times 30}{TW}\right)$

$= 5399.23$

Riser Efficiancy:- is the ratio of Total feed Metal available to the total volume of ~~the metal~~ riser.

	Efficiancy
Open cylindrical	$< 15\%$

exothermic Slits with exothermic powder efficiency increase upto 70%.

Maximum efficiancy of riser depands on its shabe & use of feed adds.

Riser efficiancy can be improved by achiving directional solidification ed & modified its designe.

* Designe & open side riser without any feeding add like insulating slits, exothermic cover etc using for a casting of dimension $25 \times 25 \times 5$ when (a) the modulus Method check its adequaty material of the casting is Plain carbon steel

(b) The material of casting is pure aluminium.

Ans.

volume of the casting $= 25 \times 25 \times 5$

$= 3125 \text{ cm}^3$

Surface area of casting $= 2(25 \times 25) + 4(25 \times 5)$

$= 1750 \text{ cm}^2$

Modulus of Casting $M_c = \frac{V_c}{M_c} = \frac{3125}{1750} = 1.787$

Modules of riser $= 1.2 \times 1.787$

$= 2.1429$

$\frac{D}{6} = 2.1429$

$D = 12.6$

hight $= 12.6$

volume of the riser = $2\pi rh + 2\pi r^2$

$= \frac{\pi D^3}{4}$

$= 1572$

$= 2\pi \times \frac{12.6}{2} \times 12.6 + 2\pi r + (6.3)^2$

$= 748.1388$

For plain carbon steel.

$\alpha (V_C + V_R) = \eta_f \times V_R$

$\eta_f = 15\% = 0.15$

$0.04 (3125 + 1572) = 188 cc$ 235.8 cc.

$\alpha = (2.5 - 4)\%$

For Al: $\frac{6.6}{100}(3125 + 1572) = 235.8$

$\eta_f = 15\% = 0.15$

$V_R = 1572$

$= 235.8$

310 cc

demand of feed Meta = 310 cc

supply = 235.8

supply < demand.

Size of the riser is not adequate.

Feed Metal volume:

Little volume of liq Metal from the riser soli-dify during process of feeding, hence entire volume of the riser will not be aviabable of the feeding. Thus Feeder must compensate for perpose of the following express solidification shrinkage by the

$\underbrace{\alpha (V_C + V_R)}_{demand} = \underbrace{\eta_f V_R}_{supply}$

η_f = riser efficiency.

V_C = volume of casting

V_R = " " Riser

α = % volumetric shrinkage, it values different with differ Meta.

Value-α	α
Pure Al	6.6
Al+Si	3.8

Al 4.5 Cu alloy	6.3
G I	0.7 to 1.8
W I	4 to 5.5
plain carbon steel	2.5 to 4
pure Cu	4.5
Sn-Bronze	5.5
Al - Br	4.0
Mg	4.2
Zn	6.5
Pb	3.2
Au	5.5