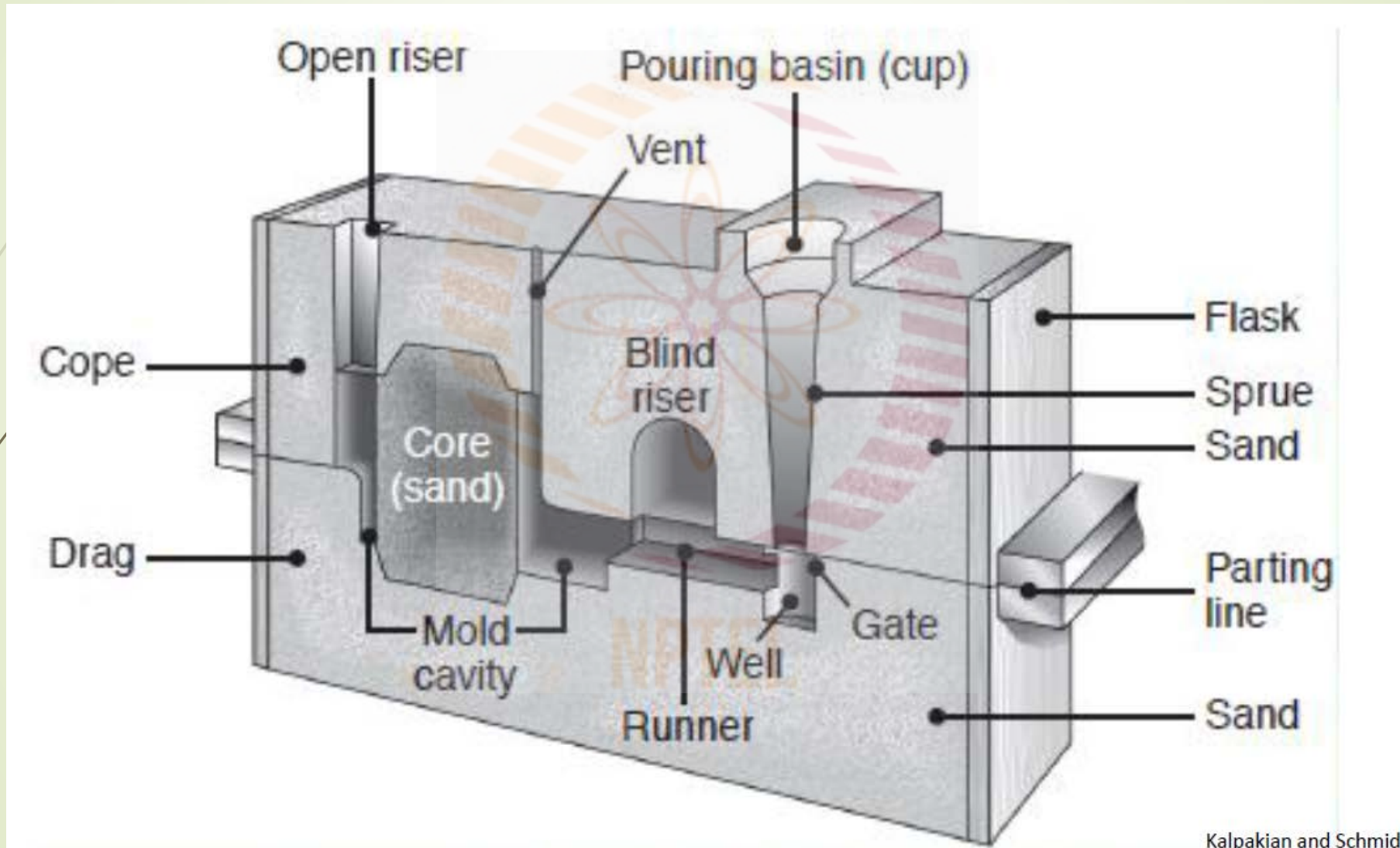


Schematic of a typical sand mold

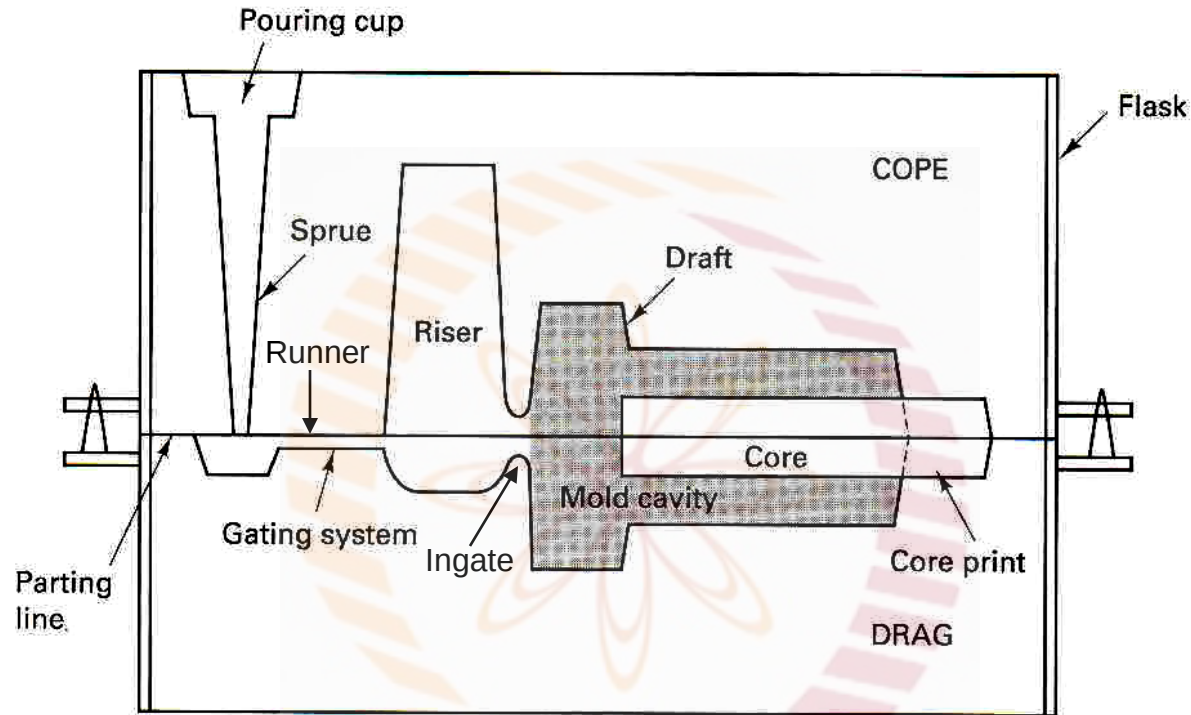
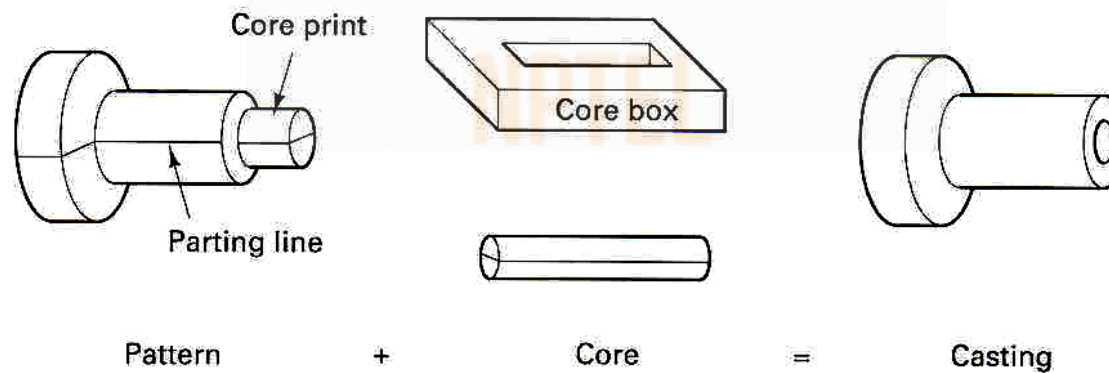
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Kalpakian and Schmid



SAND MOLD CROSS-SECTION



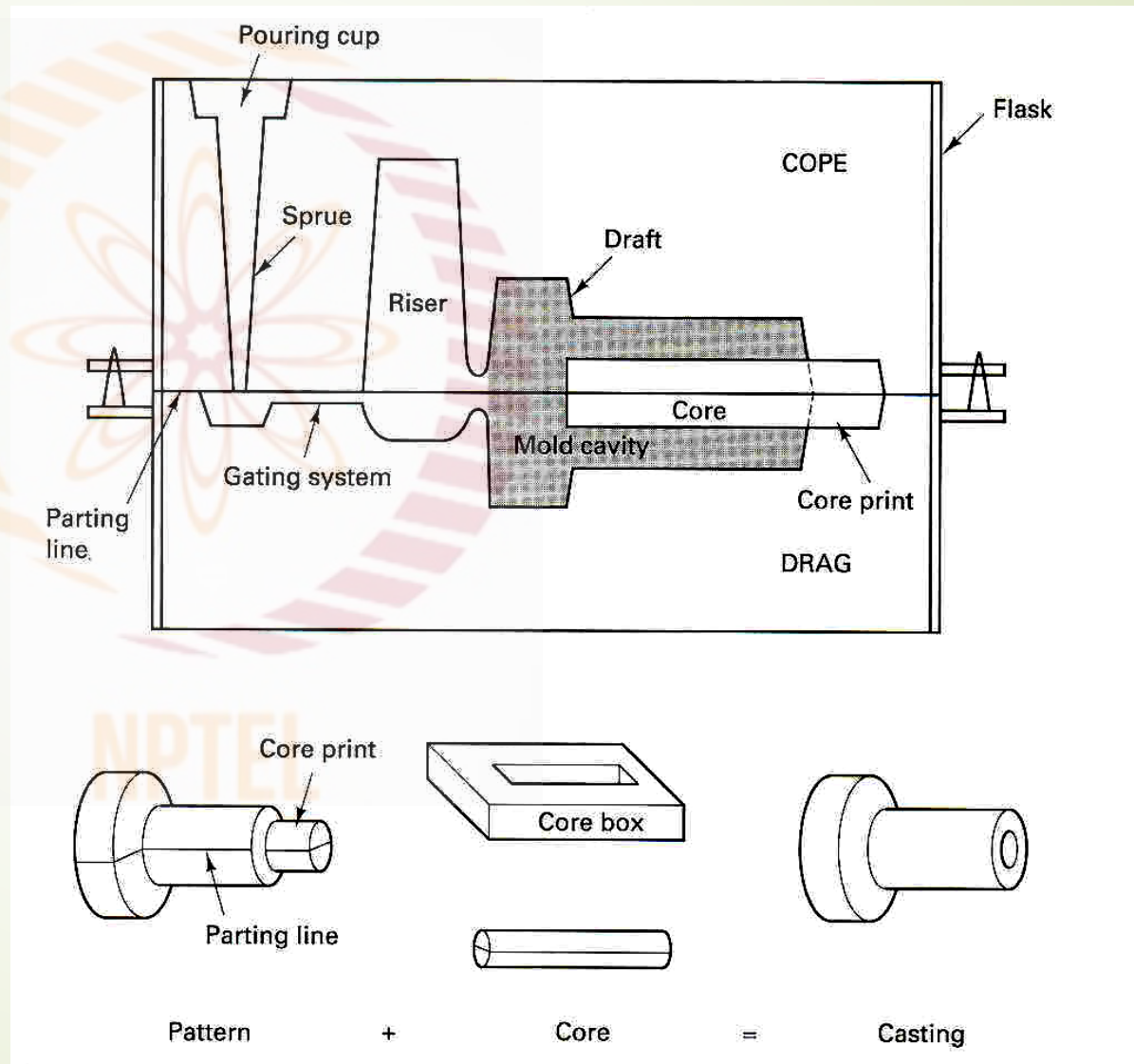
- **Flask:** Box that contains molding aggregate
- **Cope:** Top half of the flask
- **Drag:** Bottom half of the flask
- **Core:** Sand shape that is inserted to produce holes, hollows
- **Riser:** Extra void filled with metal. Supplies metal to mold cavity to compensate for shrinkage solidification



Gating system: Network of channels used to deliver molten metal to the mold cavity.

Comprises of

- Pouring cup
- Sprue
- Runners
- Ingates



Green Sand Mould

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Composition:

Sand (70-85%); Clay (10-20%); Water (3-6%); Additives (wood flour, dextrin, sea coal) (1-6%)

Shape and Size of Sand Grains:

- Vary widely
- The bulk density of a sand-mix is very low if the grains are of equal size with smooth round shape
- Result in increased voids and higher permeability
- ❑ Clay, together with water, acts as a bonding agent. Imparts tensile and shear strength to the moulding sand.
- ❑ The organic additives burn out at high temperatures making room for the moulding sand to expand and thus save the mould from crumbling.



Properties of Moulding Sand

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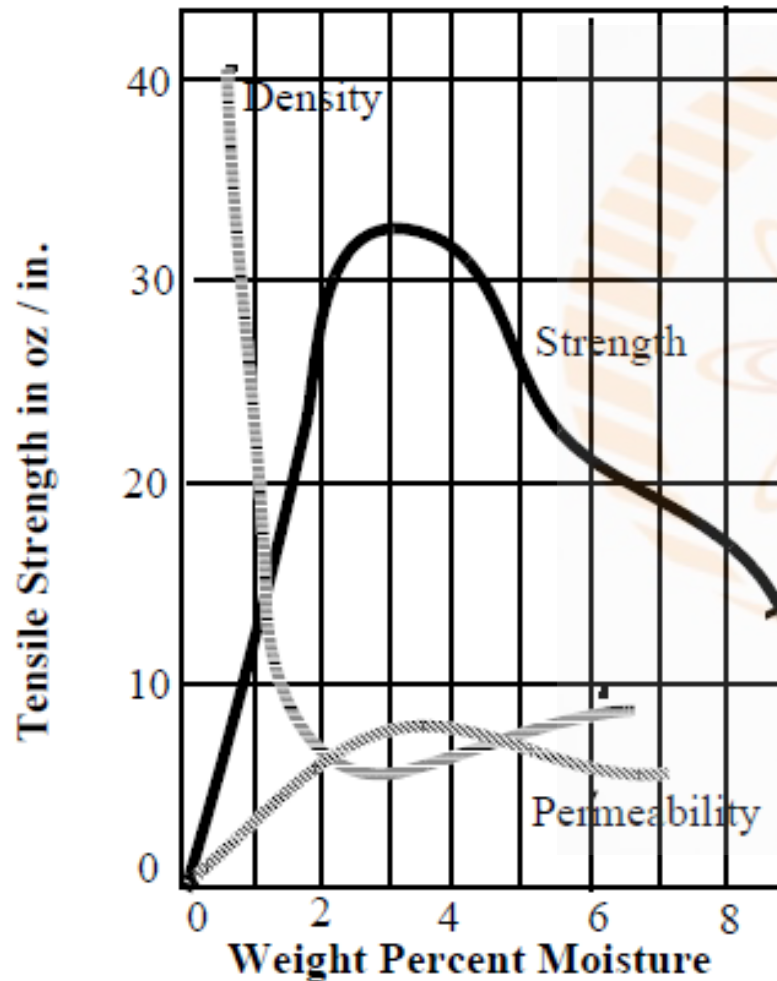
Properties of the Moulding Sand:

- **Strength** (Compressive Strength)
- **Permeability** (Gas flow rate through the specimen under a specified pressure difference across it)
- **Deformation** (Change in length of a standard specimen at the point of failure)
- **Flowability** (ability of the sand to flow around and over the pattern when the mould is rammed)
- **Refractoriness** (ability of the sand to remain solid as a function of temperature)



Effect of Water Content on moulding sand properties

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6% CLAY

It can be seen that the strength increases to a maximum at about 3 percent moisture for a 6 percent clay binder, then falls slowly out to 8 percent moisture. Increasing strength from 0 to 3 % reflects the taking on of water by the clay resulting in swelling of the clay particles, thereby pushing the sand particles apart, resulting in reduced density and increased permeability. At about 3% the clay becomes saturated with water; beyond this point the water merely fills space in the void volume, resulting in an increase in density and decrease in permeability and tensile strength..

Gating Design

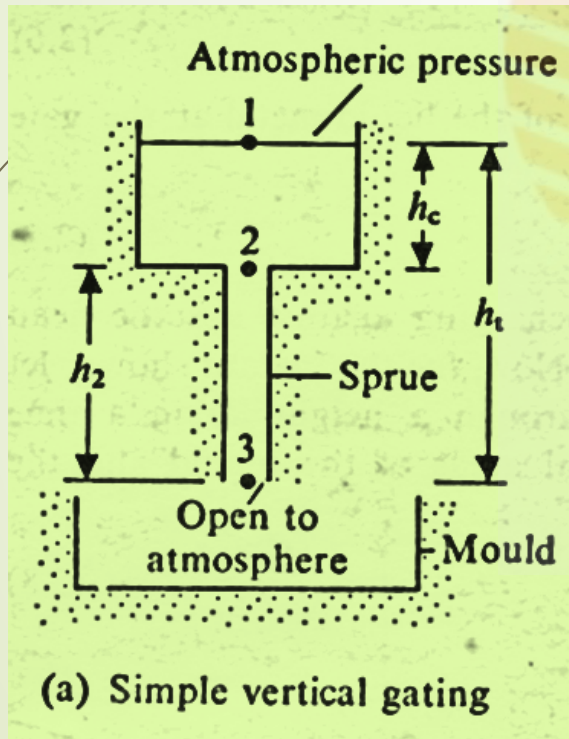
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- A good gating design ensures distribution of metal in the mould cavity at a proper rate without excessive temperature loss, turbulence and entrapping gases and slags.
- Bernoulli's theorem states that the sum of the energies (head, pressure, kinetic, and friction) at any two points in a flowing liquid are equal

Between points 1 and 3: (In a simple vertical gating)

$$h_1 + \frac{p_1}{\rho} + \frac{v_1^2}{2g} + F_1 = h_3 + \frac{p_3}{\rho} + \frac{v_3^2}{2g} + F_3$$

where, h is the head, cm, p is pressure on the liquid, N/cm²; ρ is the density, g/cm³; v is the flow velocity; cm/s; g is gravitational acceleration constant, 981 cm/s/s; and F is head losses due to friction, cm. Subscripts 1 and 2 indicate any two locations in the liquid flow.



Gating Design (Contn.)

- In the figure, pressure at points 1 and 3 is equal ($p_1 = p_3$)
- Level 1 is maintained constant. Thus the velocity, $v_1 = 0$
- Frictional losses are neglected

The energy balance equation between points 1 and 3 gives:

$$h_t = \frac{v_3^2}{2g}; \text{ or, } v_3 = \sqrt{2gh_t}$$

Where, g is the acceleration due to gravity and v_3 is the velocity of the liquid metal at the gate.

Time taken to fill up the mould is obtained as:

$$t_f = \frac{V}{A_g v_3}$$

Where, A_g and V are the cross-sectional area of the gate and the volume of the mould respectively.

