FLUID MECHANICS

Online Class-Orifices and Notches

by

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- Orifice
- Small and Large Orifice (H more than 5 diameter, H less than 5 diameter)
- Rectangular, Triangular, Square and Circular Orifice
- Free Discharging, Partial and fully submerged orifice

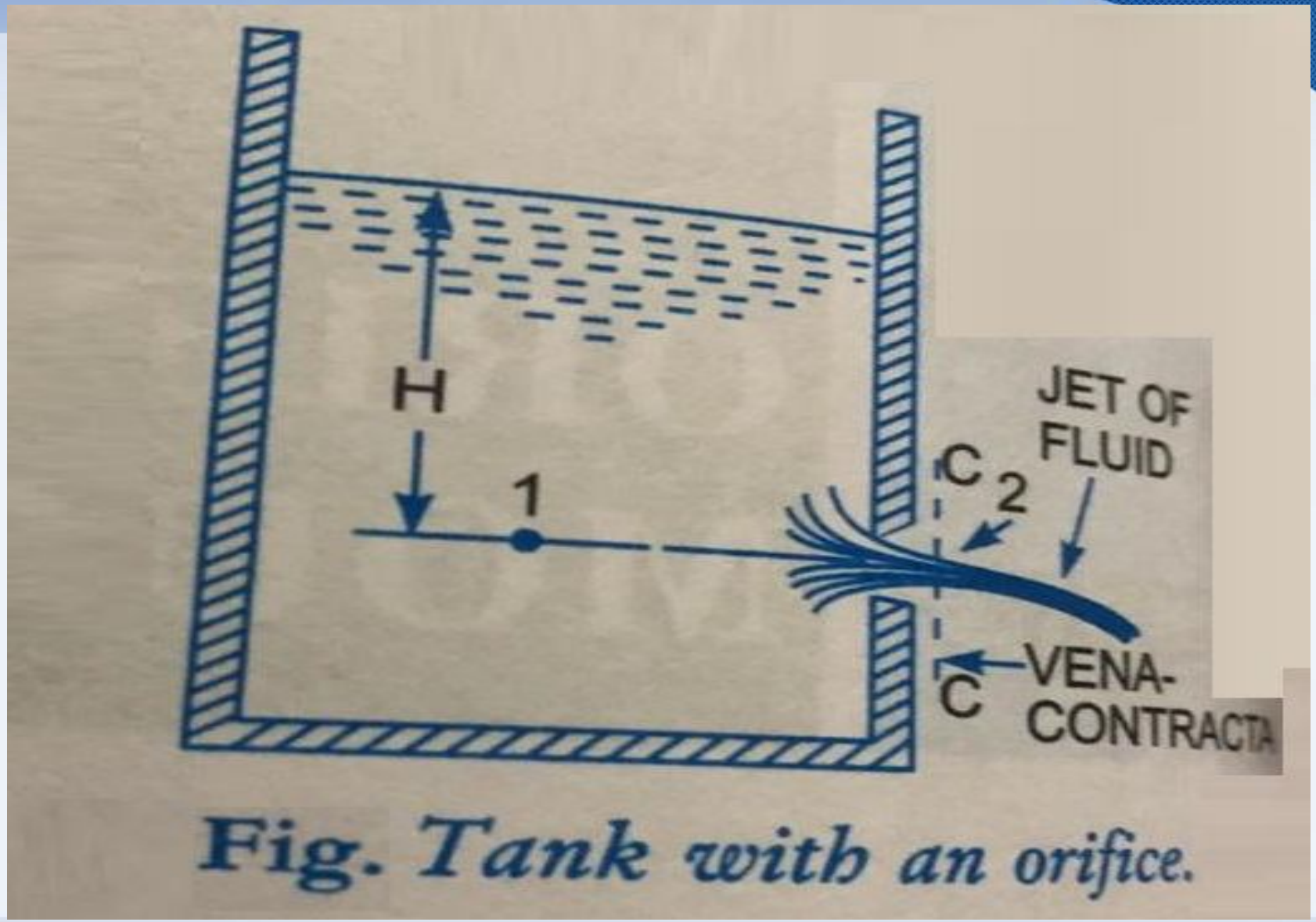


Fig. *Tank with an orifice.*

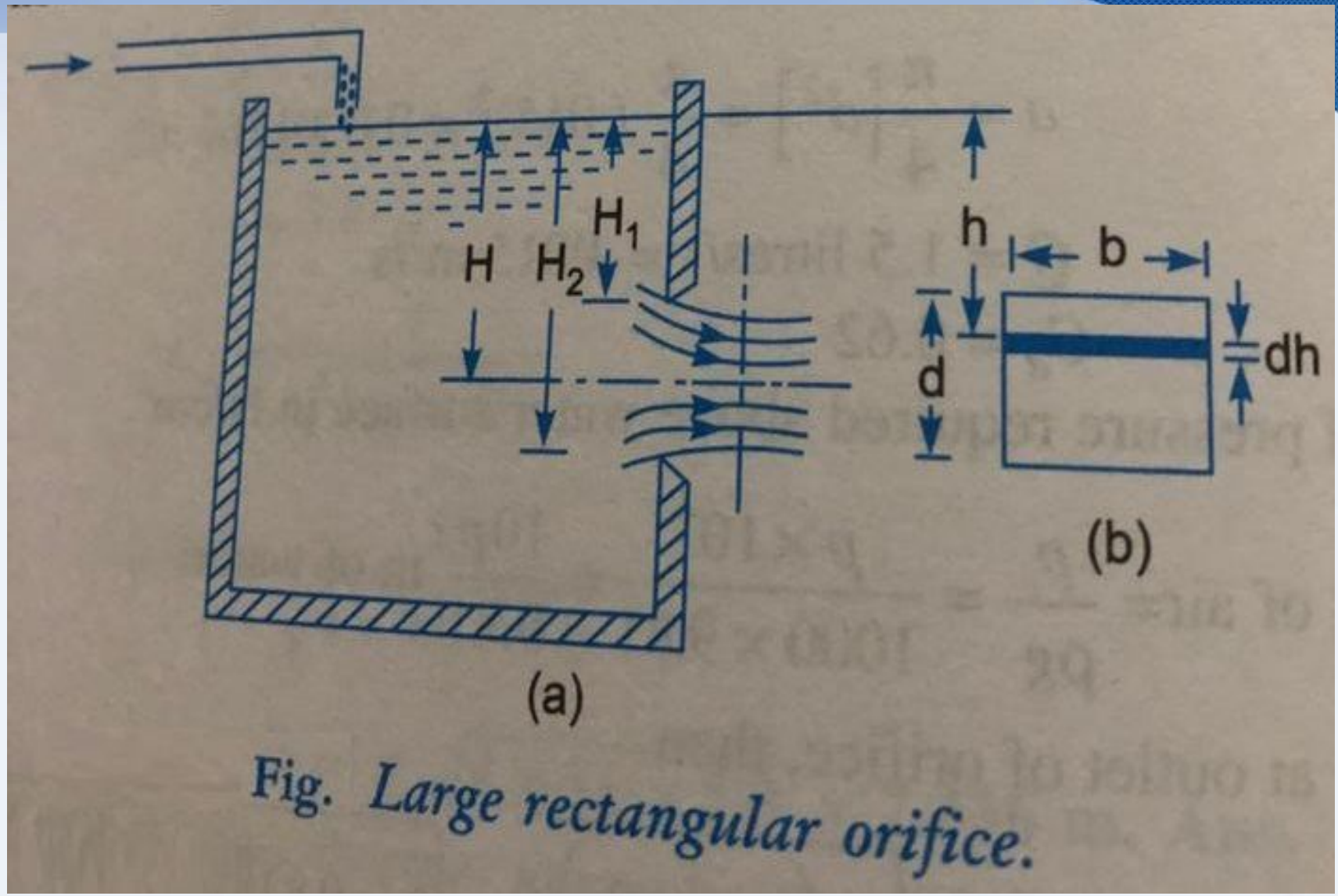
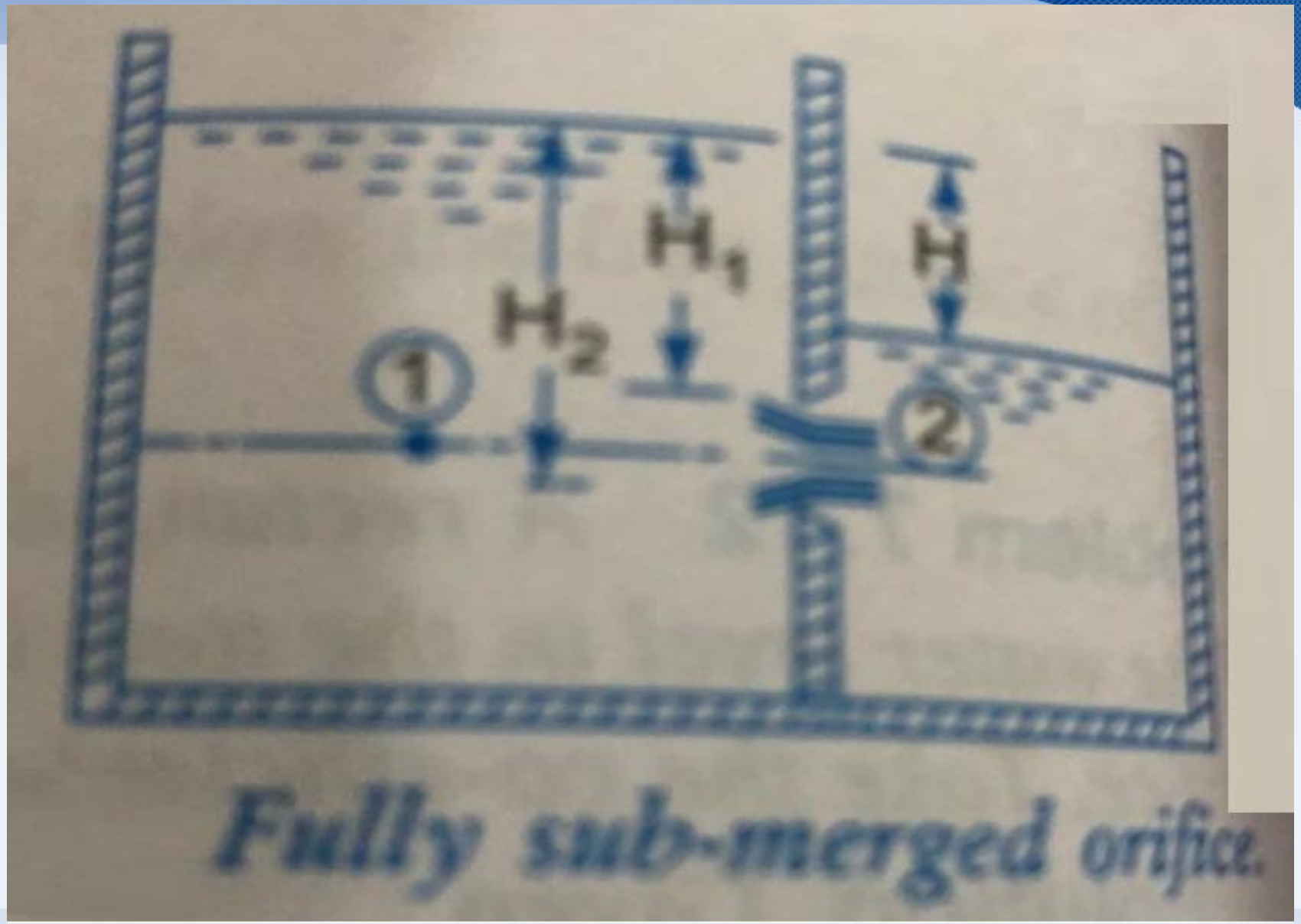


Fig. *Large rectangular orifice.*

- Flow through Small orifice
- Q act = Cd a $(2gH)^{1/2}$
- Cd = Cv x Cc
- Flow through Large Rectangular Orifice
- d Qact = Cd (b x dh) $(2gH)^{1/2}$
- Q act = 2/3 x Cd b $(2g)^{1/2}$ $(H_2^{3/2} – H_1^{3/2})$
- Flow through fully submerged orifice
- Q act = Cd b $(H_2\text{-}H_1)$ $(2gH)^{1/2}$



Fully sub-merged orifice.

- Flow through Partially submerged orifice

- $Q_{act} = \frac{2}{3} \times Cd\ b\ (2g)^{1/2}\ (H^{3/2} - H_1^{3/2}) + Cd\ b\ (H_2 - H)\ (2gH)^{1/2}$

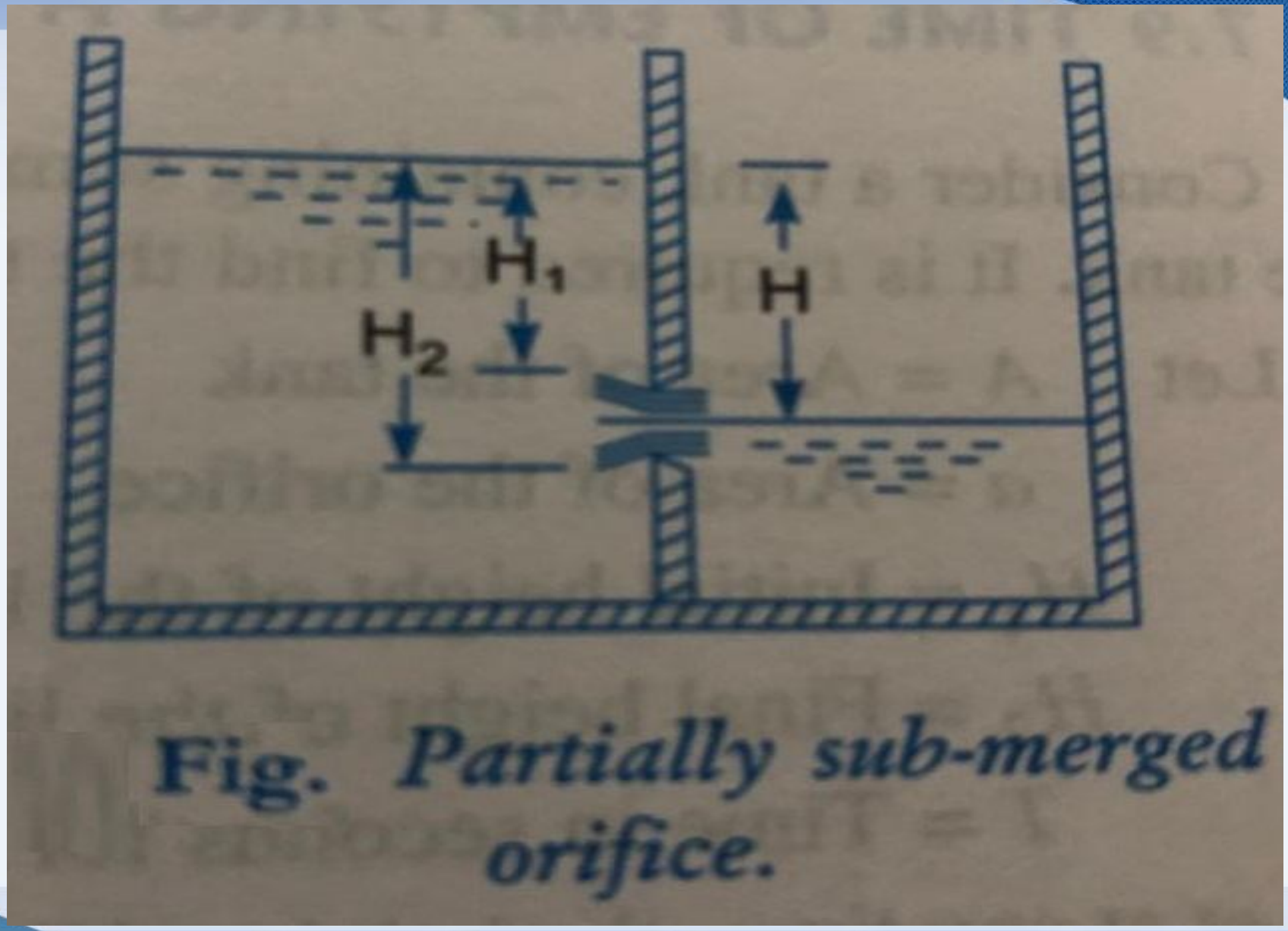


Fig. *Partially sub-merged orifice.*

- Problem: Find the discharge through a rectangular orifice 3.0 m wide and 2.0 m deep fitted to a water tank. The water level in the tank is 4 m above the top edge of orifice. Take Cd=0.6.
- Q act = 2/3 x Cd b $(2g)^{1/2}$ $(H_2^{3/2} – H_1^{3/2})$
- Problem: Find the discharge through a fully submerged orifice of width 2 m, if the difference of water levels on both sides of the orifice is 80 cm. The height of water from top and bottom of the orifice are 2.5 m and 3.0 m respectively. Take Cd = 0.6.
- Q act = Cd b $(H_2\text{-}H_1)$ $(2gH)^{1/2}$

- Notches
- Nappe
- Crest
- Crest height
- Rectangular, Triangular, Trapezoidal and Stepped
- Notch with and without end contraction

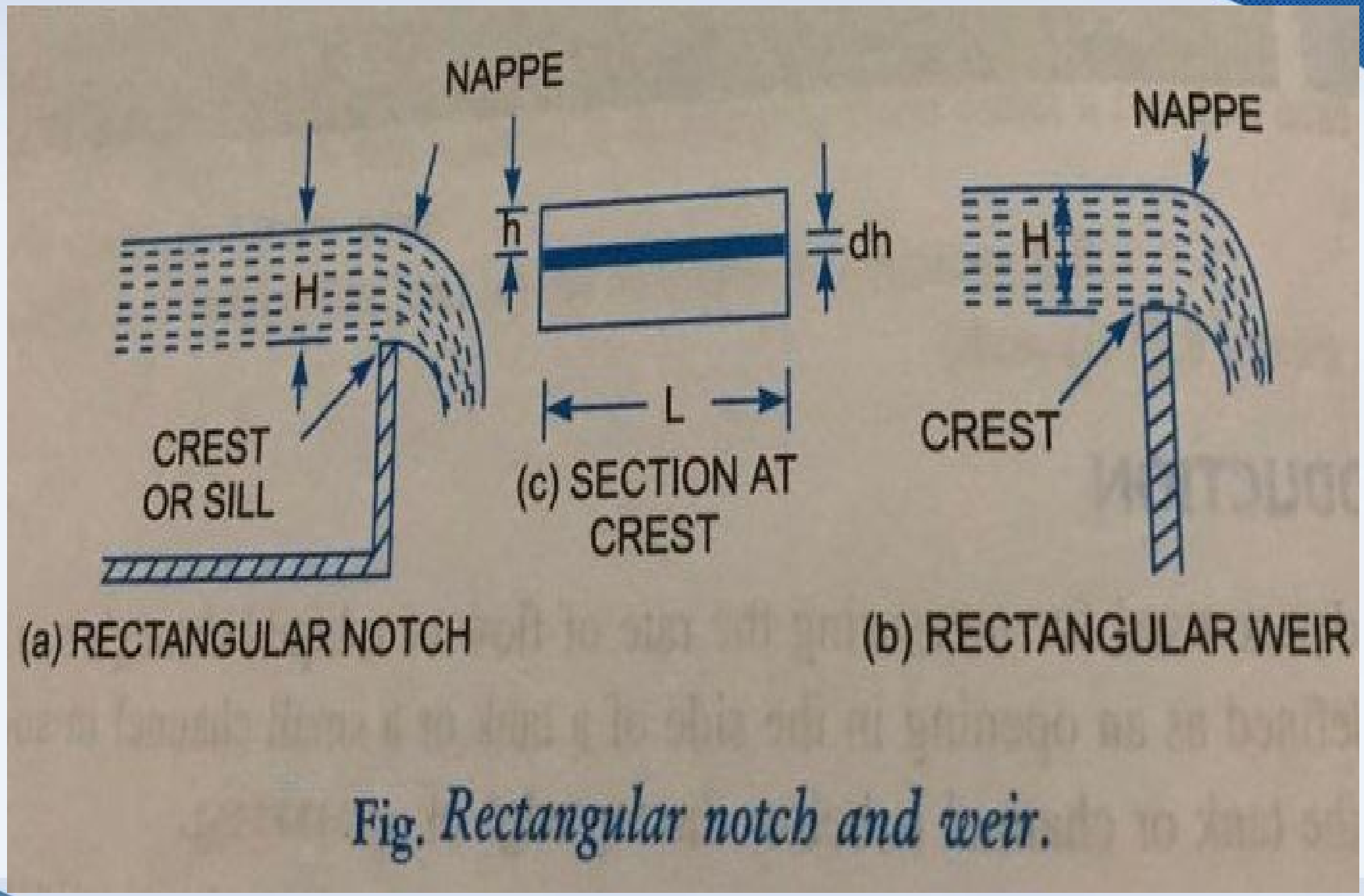


Fig. *Rectangular notch and weir.*

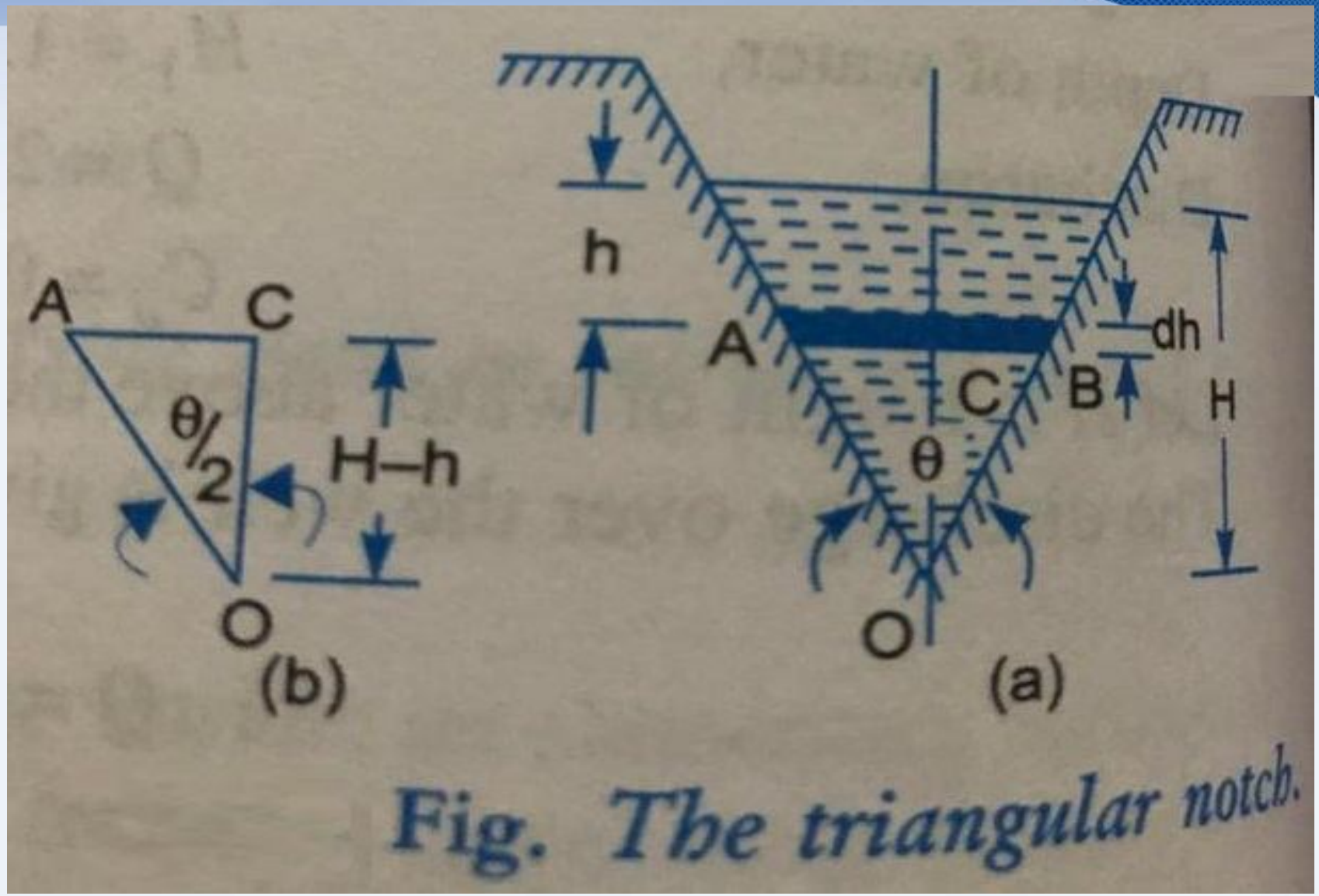


Fig. *The triangular notch.*

- Rectangular Notch or Weir
- $dQ = Cd\ L \times dh\ (2gh)^{1/2}$
- $Q = 2/3 \times Cd\ L\ (2g)^{1/2}\ H^{3/2}$
- Triangular Notch or weir
- $dQ = Cd\ 2\ (H-h)\ \tan 0/2\ dh\ (2gh)^{1/2}$
- $Q = 8/15 \times Cd\ (2g)^{1/2}\ \tan o/2\ H^{5/2}$
- Discharge over a Trapezoidal Notch
- $Q = 2/3 \times Cd\ L\ (2g)^{1/2}\ H^{3/2}$

  $+\ 8/15 \times Cd\ (2g)^{1/2}\ \tan o/2\ H^{5/2}$

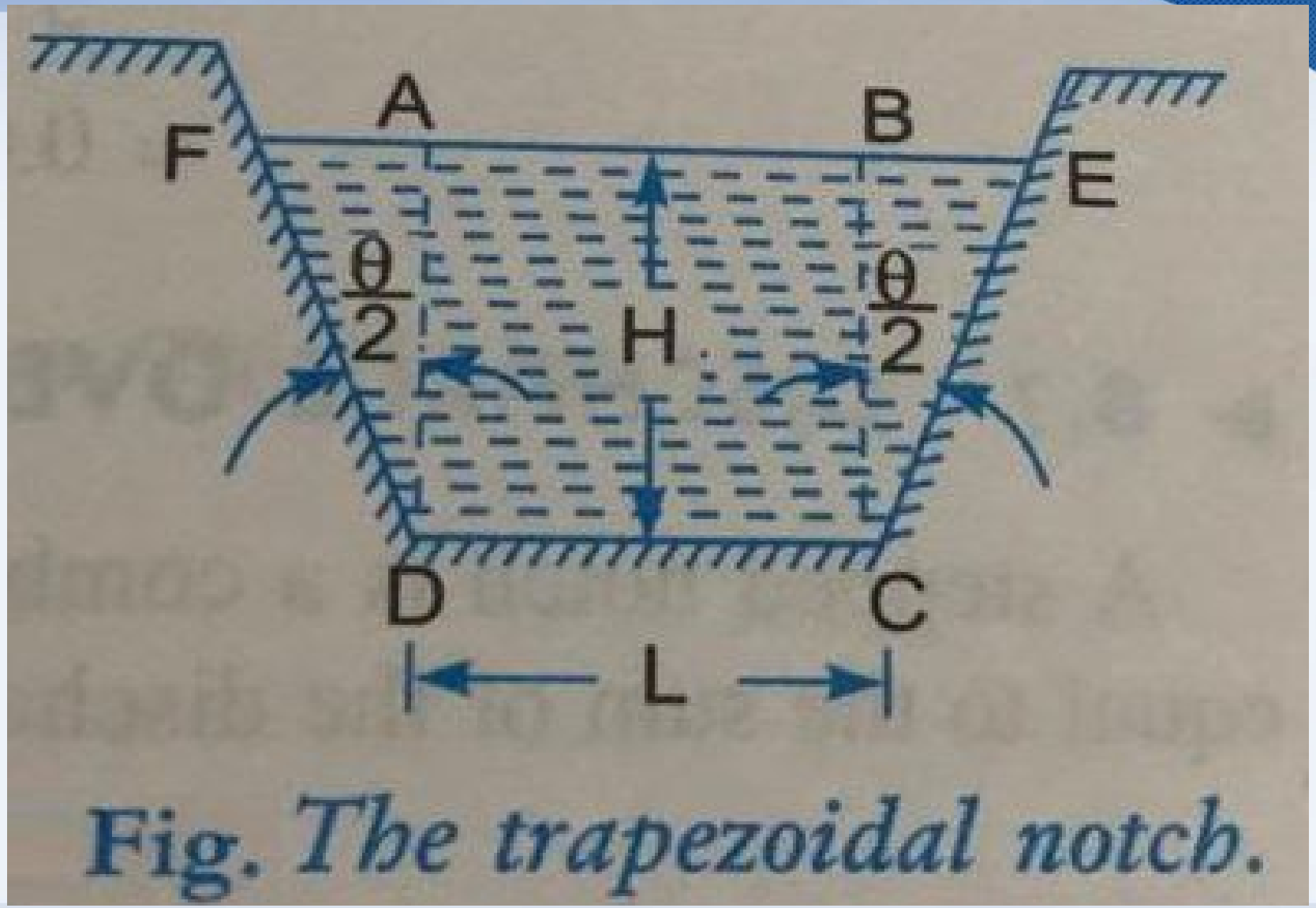


Fig. *The trapezoidal notch.*

- Problem: Determine the height of a rectangular weir of length 5 m to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1.5m and discharge is 1.5 m^3/sec. Cd= 0.6.
- (H= 0.309m), (H1-H = 1.5-0.309 = 1.191m
- $Q = 2/3 \times Cd\ L\ (2g)^{1/2}\ H^{3/2,}$

- Problem: Find the discharge over a triangular notch of angle 60^0, when the head over the triangle notch is 0.2m. Take Cd = 0.6.
- $(Q = 8/15 \times Cd\ (2g)^{1/2}\ tano/2\ H^{5/2}$

- Discharge over stepped Notch

$$Q = 2/3 \times Cd\ L_1\ (2g)^{1/2}\ (H_1^{3/2} - H_2^{3/2}$$
$$+\ 2/3 \times Cd\ L_2\ (2g)^{1/2}\ (H_2^{3/2} - H_3^{3/2}$$
$$+\ 2/3 \times Cd\ L_3\ (2g)^{1/2}\ H_3^{3/2}$$

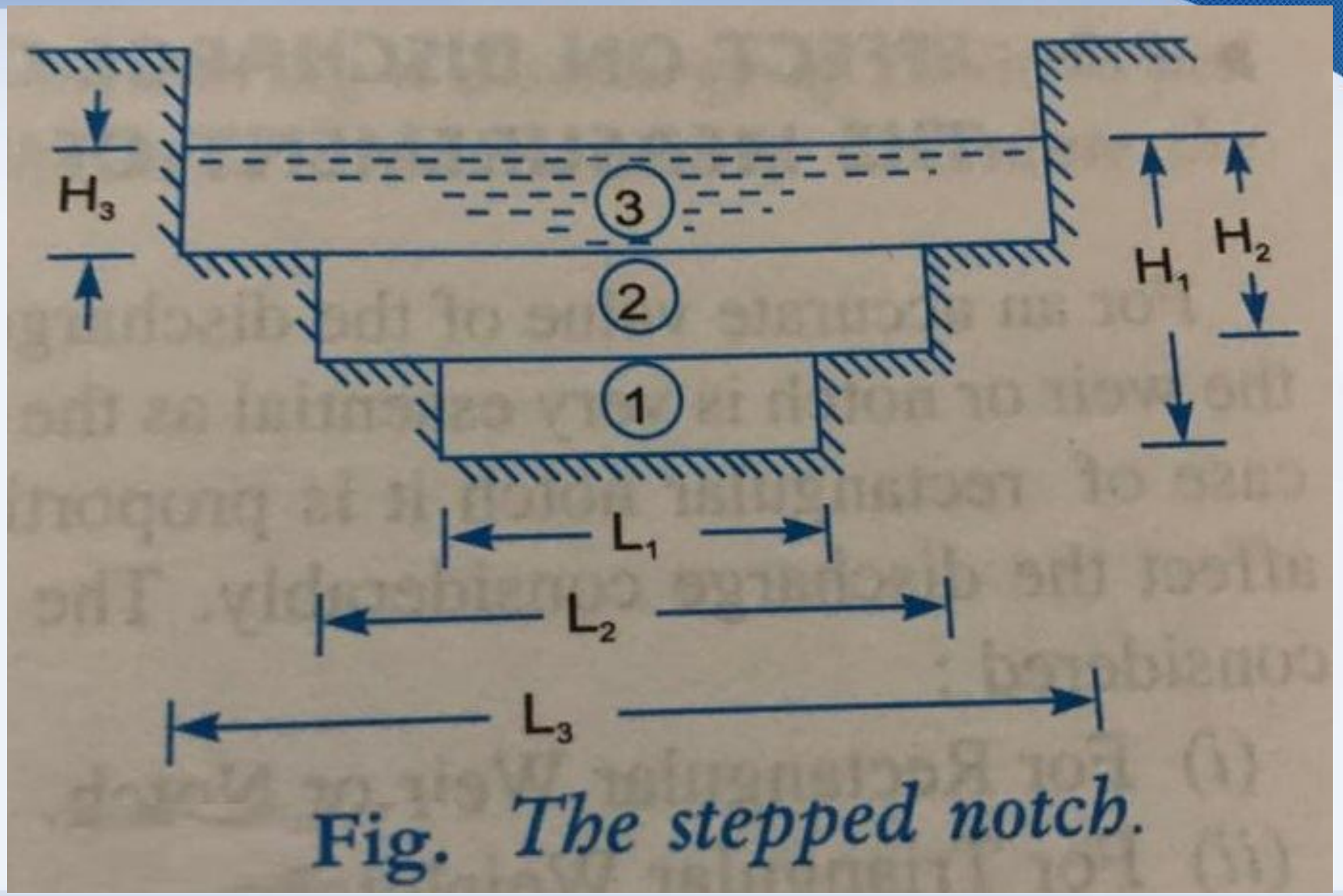


Fig. *The stepped notch.*

Objective Questions

IES-1. Match List-I (Measuring device) with List-II (Parameter measured) and select the correct answer using the codes given below the Lists: [IES-1997]

List-I	List-II
A. Anemometer	1. Flow rate
B. Piezometer	2. Velocity
C. Pitot tube	3. Static pressure
D. Orifice	4. Difference between static and stagnation pressure

Codes:	A	B	C	D		A	B	C	D
(a)	1	3	4	2	(b)	1	2	3	4
(c)	2	3	4	1	(d)	2	4	3	1

IES-1. Ans. (c) Anemometer is an instrument for measuring wind force and velocity.

IES-2. Given, H = height of liquid, b = width of notch, a = cross-sectional area, a_1 = area at inlet, A_2 = area at the throat and C_d = coefficient of drag. Match List-I with List-II and select the correct answer using the codes given below the Lists: [IES-1997]

List-I	List-II
A. Discharge through Venturimeter	1. $\frac{2}{3}C_d b\sqrt{2g}\,H^{3/2}$
B. Discharge through an external mouthpiece	2. $\frac{8}{15}C_d b\sqrt{2g}\,H^{5/2}$
C. Discharge over a rectangular notch	3. $\frac{C_d a_1 a_2}{\sqrt{a_1^2 - a_2^2}}\sqrt{2gH}$
D. Discharge over right angled notch	4. $0.855\,a\sqrt{2gH}$

Code:	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	3	4	1	2
(c)	2	1	3	4	(d)	2	3	1	4

IES-2. Ans. (b)

IES-3. In a submerged orifice flow, the discharge is proportional to which one of the following parameters? [IES-2009]

(a) Square root of the downstream head

(b) Square root of the upstream head

(c) Square of the upstream head

(d) Square root of the difference between upstream and downstream heads

IES-3. Ans. (d) A drowned or submerged orifice is one which does not discharge into open atmosphere, but discharge into liquid of the same kind.

$$Q = C_d \frac{A_1 A_2}{\sqrt{A_1^2 A_2^2}} \sqrt{2g(h - h_L)}$$

∴ In submerged orifice flow discharge is proportional to square root of the difference b/w upstream and downstream heads.

IAS-1. A fluid jet is discharging from a 100 mm nozzle and the vena contracta formed has a diameter of 90 mm. If the coefficient of velocity is 0.95, then the coefficient discharge for the nozzle is: [IAS-1994]

(a) 0.855 (b) 0.81 (c) 0.9025 (d) 0.7695

IAS-1. Ans. (d) $C_c = \frac{A_v}{A} = \frac{\frac{\pi}{4}(90)^2}{\frac{\pi}{4}(100)^2} = 0.81$, $C_v = 0.95$ $\therefore C_d = C_c \times C_d = 0.81 \times 0.95 = 0.7695$

IES-1. Which of the following is/are related to measure the discharge by a rectangular notch? **[IES-2002]**

1. $2/3\ C_d\ b\ \sqrt{2g}\ H^2$
2. $2/3\ C_d.\ b\ \sqrt{2g}\ H^{3/2}$
3. $2/3\ C_d.\ b\ \sqrt{2g}\ H^{5/2}$
4. $2/3\ C_d.\ b\ \sqrt{2g}\ H^{1/2}$

Select the correct answer using the codes given below:

(a) 1 and 3 (b) 2 and 3 (c) 2 alone (d) 4 alone

IES-1. Ans. (c)

IES-2. Match List-I (Measuring Instrument) with List-II (Variable to be measured) and select the correct answer using the code given below the lists: **[IES-2007]**

List-I	List-II
A. Hot-wire anemometer	1. Discharge
B. Pitot-tube	2. Rotational speed
C. V-notch weir	3. Velocity fluctuations
D. Tachometer	4. Stagnation pressure

Code:	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	3	4	2	1
(c)	4	3	1	2	(d)	3	4	1	2

IES-2. Ans. (d)

IES-3. A standard 90° V-notch weir is used to measure discharge. The discharge is Q_1 for heights H_1 above the sill and Q_2 is the discharge for a height H_2. If H_2 / H_1 is 4, then Q_2 / Q_1 is: [IES-2001]

(a) 32 (b) $16\sqrt{2}$ (c) 16 (d) 8

IES-3. Ans. (a) We know that for a V-notch, $Q = \frac{8}{15}\sqrt{2g}\tan\left(\frac{\theta}{2}\right)H^{\frac{5}{2}}$

$$i.e.\ Q \propto H^{\frac{5}{2}} \therefore \frac{Q_2}{Q_1} = \left(\frac{H_2}{H_1}\right)^{5/2} = 4^{5/2} = 32$$

IAS-1. A triangular notch is more accurate measuring device than the rectangular notch for measuring which one of the following? [IAS-2007]

(a) Low flow rates
(b) Medium flow rate
(c) High flow rates
(d) All flow rates

IAS-1. Ans. (a)


THANK YOU
VERY MUCH

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Online Class Objective Questions Set - 1

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Objective Questions Set-1

01. The flow in a pipe or channel is said to be uniform when

(a) The liquid particles at all sections have the same velocities

(b) The liquid particles at different sections have different velocities

(c) The quantity of liquid flowing per second is constant

(d) Each Liquid particles has a definite stream line

02. The loss of head at entrance in a pipe is

(a) $V^2/2g$

(b) $0.5V^2/2g$

(c) $0.375V^2/2g$

(d) $V^2/2g$

03. The velocity corresponding to Reynolds number of 2000 is called

(a) Sub-sonic velocity

(b) Super-sonic velocity

(c) Critical Velocity

(d) Approach velocity

(e) Mean Velocity

04. A steady Uniform flow is through

(a) A long pipe at decreasing rate

(b) A long pipe at constant rate

(c) An expanding tube at constant rate

(d) An expanding tube at increasing rate

05. A non-uniform steady flow is through

(a) A long tube at a decreasing rate

(b) An expanding tube at constant rate

(c) An expanding tube at increasing rate

(d) A long pipe at increasing rate

06. A flow through an expanding tube at increasing rate is

(a) Unsteady Non-uniform flow

(b) Unsteady Uniform flow

(c) Steady Uniform Flow

(d) Steady Non Uniform Flow.

07. Hydraulic Jump is an example of

(a) Unsteady non-uniform flow

(b) Unsteady Uniform flow

(c) Steady Uniform flow

(d) Steady Non-uniform flow

08. Flow through a Venturimeter is an example of

(a) Unsteady Non-uniform flow

(b) Unsteady Uniform flow

(c) Steady Uniform Flow

(d) Steady Non-uniform flow

09. The flow in GVF and RVF (Gradually and Rapidly Varied Flows) are ------- & ------

(a) Steady Uniform, Steady Non-Uniform

(b) Steady Non-Uniform and Steady Non-Uniform

(c) Unsteady Uniform Flow, Unsteady Non-Uniform

(d) Steady Non-Uniform, Unsteady Non-Uniform.

10. Bernoulli's equation is applicable between any two points

(a) In any rotational flow of an incompressible fluid

(b) In any type of irrotational, laminar and uniform flow of a fluid

(c) In steady rotational flow of an incompressible fluid

(d) In steady, irrotational flow of an incompressible fluid.

11. The difference between Total Head Line and the Hydraulic Grade Line represents

(a) The velocity head

(b) The Piezometric head

(c) The pressure head

(d) The elevation head

12. The lower limit of critical Re in pipe flow has a value approximately equal to

(a) 2000

(b) 600

(c) 4000

(d) upto 40000 also sometimes.

14 For rough pipes, the friction factor depends on

(a) Roughness parameter

(b) Reynolds No.

(c) Velocity and pressure

(d) Roughness parameter and Reynolds No.

16 The head loss in turbulent flow in a pipe varies

(a) Varies inversely as the square of the velocity

(b) Varies approximately as the square of the velocity

(c) Varies inversely as the square of the diameter

(d) Varies inversely as the diameter

17 Pressure drop per unit length in laminar flow between closely spaced parallel plates

(a) $64/e_v$

(b) $32vL/rd^2$

(c) $8\ VL/d^2$

(d) $64 / R_N$

19 The velocity distribution in turbulent flow follows a

(a) Logarithmic law

(b) Linear law

(c) Parabolic law

(d) None

20 The shear stress in laminar flow between two parallel plates is

(a) Constant over the cross section

(b) Varies parabolically across the section

(c) Zero at the mid plane and varies linearly with distance from the mid-plane

(d) Varies linearly across the cross section

21 In a Siphon, the maximum (vacuum)–ve pressure occurs at

(a) Summit

(b) Inlet

(c) Exit

(d) Inlet & exit

22 In an inclined pipe, the pressure difference at the two ends is due to

(a) Entrance loss

(b) Exit loss

(c) Frictional loss

(d) Difference of elevation

23. Loss of head due to sudden expansion when velocity changes from 5m/s to 4m/s is

(a) 0.05m

(b) 0.46m

(c) 0.23m

(d) 0.5m

24. To replace a single pipe of dia ‘D’ by ‘n’ parallel pipes of diameter ‘d’,

(a) d=D/n

(b) d=D/n

(c) $d=D/n^{3/2}$

(d) $d=D/n^{2/5}$

25. In a siphon, the Hydraulic Gradient Line lies

(a) Above the center line of the pipe

(b) Coincides with the center line

(c) Below the center line

(d) Partly above and partly below the center line

26. When the pressure drop in a 60 cm dia pipe line is 700 kPa. If the length of pipe is doubled, the new Pressure loss will be:

(a) 0

(b) 350

(c) 700

(d) 1400

28. If discharge in a pipe is doubled, the loss of head

(a) Is doubled

(b) Increases four times

(c) Remains same

(d) Reduces to half

29. The ratio of inertia and viscous forces acting in any flow, ignoring other forces, is

(a) Euler number

(b) Froude number

(c) Reynolds number

(d) Weber number

30. Ratio of inertia and gravitational forces acting in any flow, ignoring other forces is

(a) Euler number

(b) Froude number

(c) Reynolds number

(d) Weber number

32. A 10 cm dia 500m long C.I. pipe is equivalent to a 20cm dia …….m long pipe.

(a) 64

(b) 250

(c) 1000

(d) 16000

(e) 15.5

33. If coefficient of friction is 0.0008, Reynolds Number may be taken as:

(a) 2000

(b) 8000

(c) 0.032

(d) 800

36 If coefficient of friction is taken as 0.024, Chezy's constant is

(a) 55

(b) 45

(c) 50

(d) 40

37 In equivalent pipes, which tow parameters are the same?

(a) L/D

(b) Q

(c) hf,Q

(d) hf

38 Flow through which of the following is normally turbulent?

(a) River during summer

(b) Ground water flow

(c) Municipal water lines

(d) Flow of blood in veins

41 The slop of HGL in a turbulent flow is proportional to

(a) 1/d

(b) $1/d^2$

(c) $1/d^4$

(d) $1/d^5$

42 The most accurate expression for velocity of flow (V) through a siphon is : V =

(a) $\sqrt{2gH\left(1.5+\frac{4}{5}\right)}$

(b) $\sqrt{2gH\left(\frac{5m}{5}-1\right)}$

(c) $\sqrt{2gH/(1.5+6L/D)}$

(d) $\sqrt{2gDH/1L}$

Ans.: (c)

43. In a laminar flow of Kerosene, if discharge varies from 600 lpm to 1200 lpm, the corresponding head loss varies from 2.0m to ……

(a) 2.0m

(b) 8.0m

(c) 32m

(d) 16m

44. In a laminar flow of Kerosene, if diameter varies from 600mm to 300mm, the corresponding head loss varies from 5.0m to ….

(a) 80m

(b) 160m

(c) 0.32m

(d) 10m


THANK YOU
VERY MUCH