→ In a given channel if Q, n and S_0 are fixed then y_0 and y_c are fixed depths.

y_0 = normal depth, can be achieved by
- Manning's equation $Q = \frac{A}{n} \cdot R^{2/3} S_0^{1/2}$
- Chezy's equation $Q = AC\sqrt{RS_0}$

y_c = critical depth, can be achived by

$$\frac{Q^2}{g} = \frac{A_c^3}{T_c}$$

→ y = Depth of flow at any instant of flow.

→ $\frac{dy}{dx}$ is +ve if (i) $[K > K_0$ and $Z > Z_c]$ i.e. $[y > y_0$ and $y > y_c]$

or

(ii) $[K < K_0$ and $Z < Z_c]$ i.e. $[y < y_0$ and $y < y_c]$

→ All the curves in region 1 have positive slopes. These are commonly known as backwater curves.

→ All the curves in region 2 have negative slopes, and are referred to as drawdown curves.

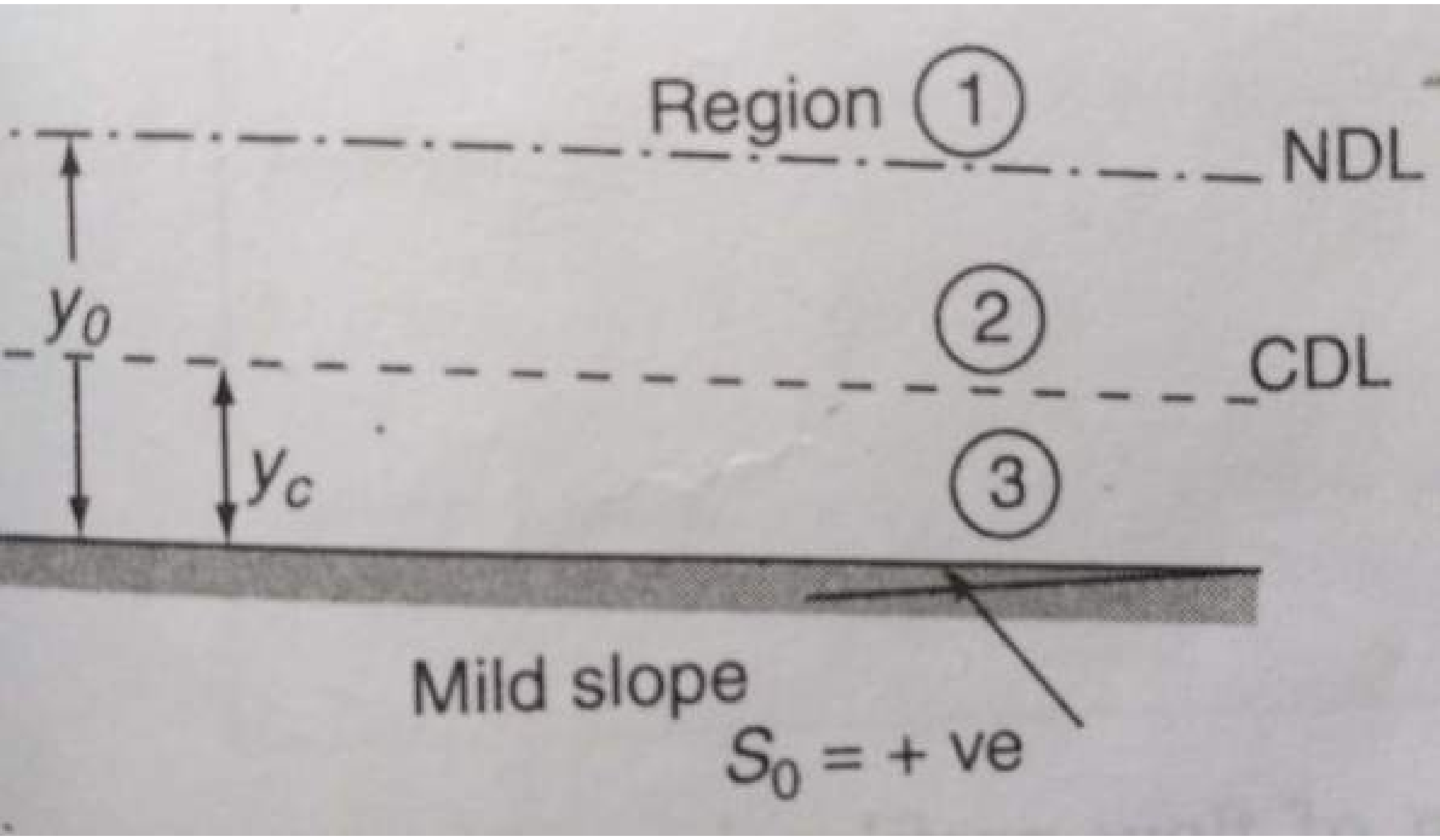
→ $y \to y_0$, $\frac{dy}{dx} \Rightarrow 0$, water surface approaches the normal depth line [NDL] asymptotically.

→ $y \to y_c$, $\frac{dy}{dx} \to \infty$, Water surface meets the critical depth line [CDL] vertically.

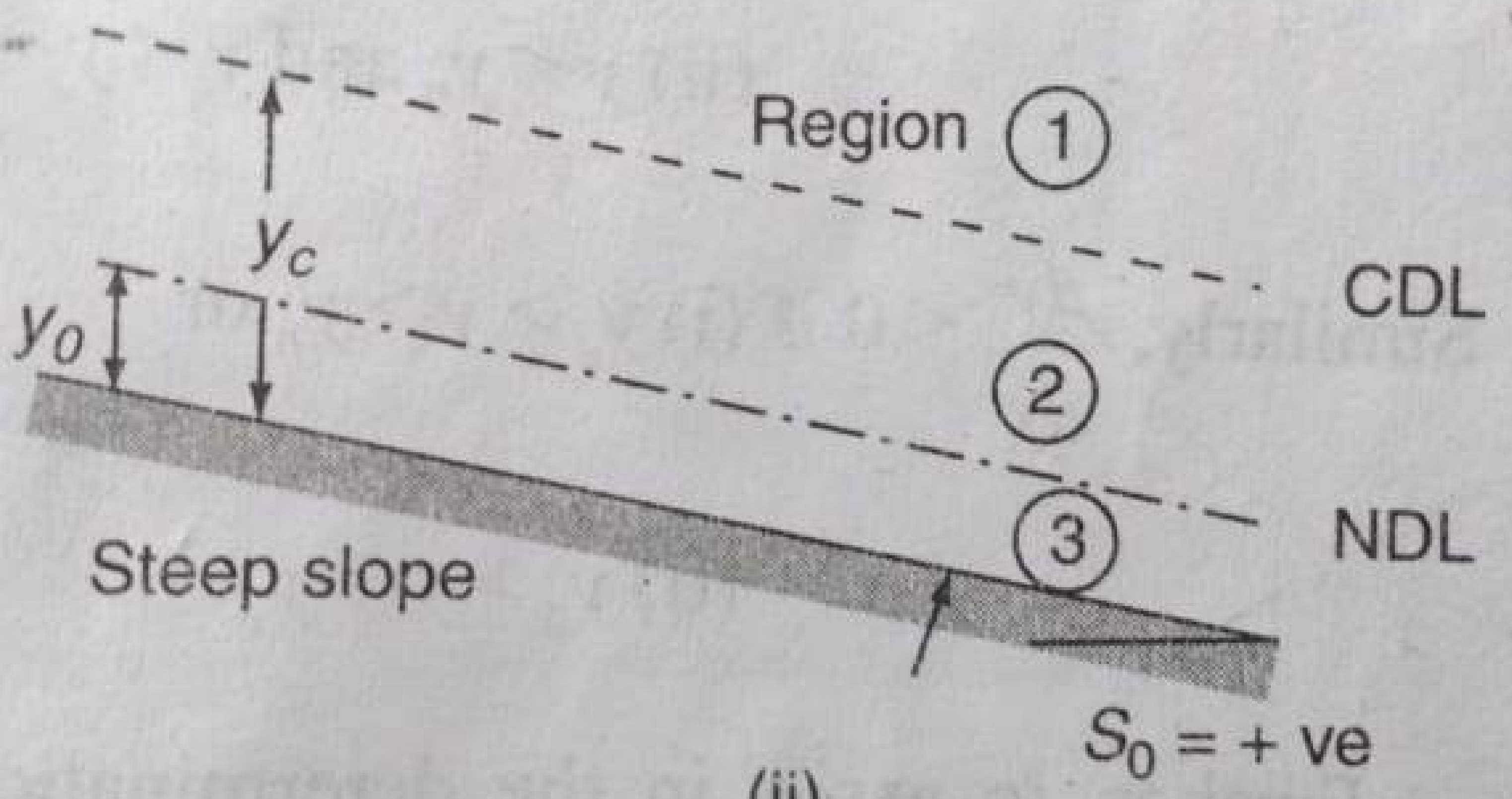
→ $y \to \infty$, $\frac{dy}{dx} \to S_0$, water surface meets a very large depth as a horizontal asymptote.

Table 4. 1 *Classification of Channels*

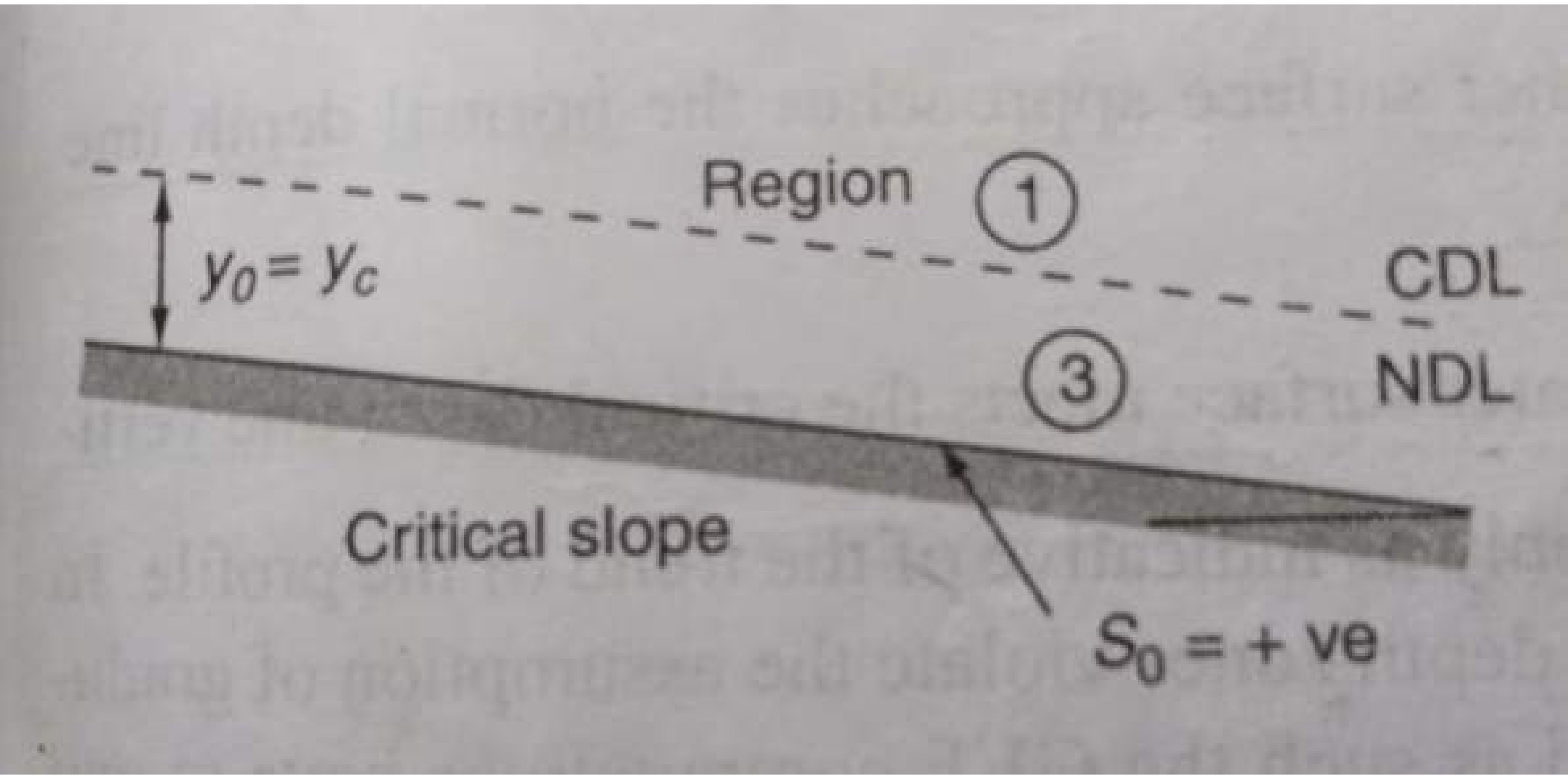
Sl. No	Channel category	Symbol	Characteristic condition	Remark
1	Mild slope	M	$y_0 > y_c$	Subcritical flow at normal depth
2	Steep slope	S	$y_c > y_0$	Supercritical flow at normal depth
3	Critical slope	C	$y_c = y_0$	Critical flow at normal depth
4	Horizontal bed	H	$S_0 = 0$	Cannot sustain uniform flow
5	Adverse slope	A	$S_0 < 0$	Cannot sustain uniform flow

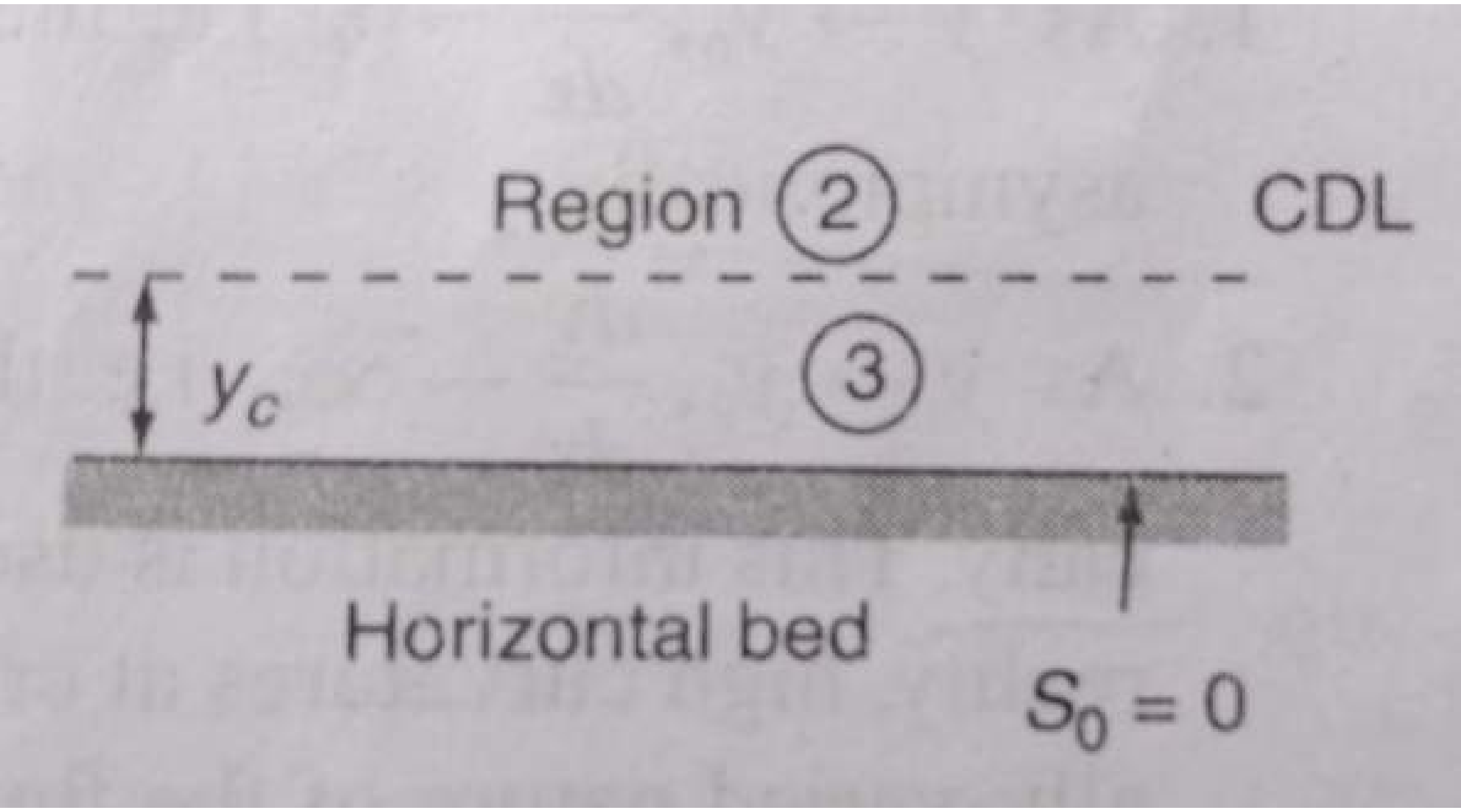


Region 1
NDL
y_0
2
CDL
y_c
3
Mild slope
$S_0 = +$ ve



(ii)


Region
1
$y_0 = y_c$
CDL
3
NDL
Critical slope
$S_0 = + ve$


Region 2
CDL
3
y_c
Horizontal bed
$S_0 = 0$

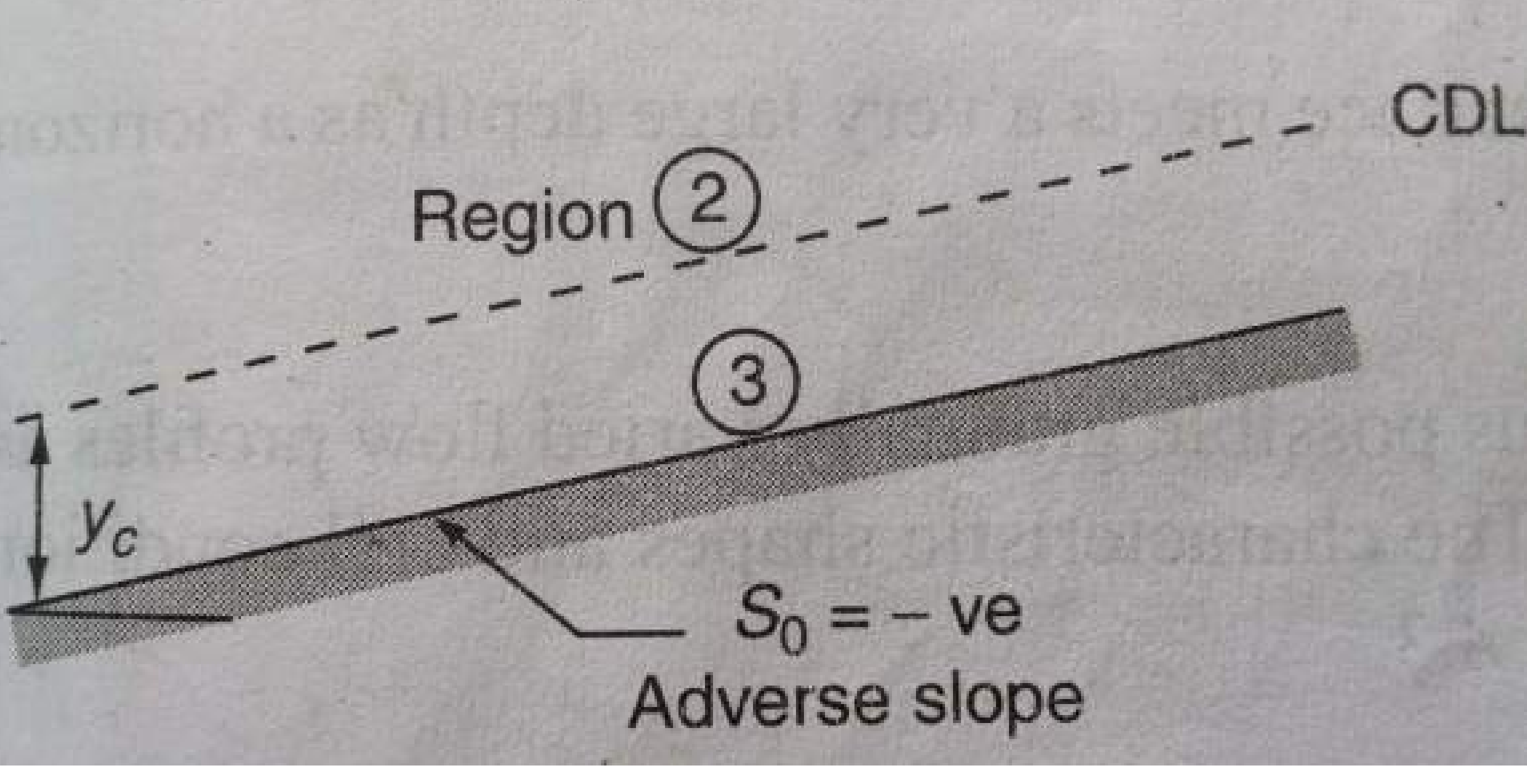
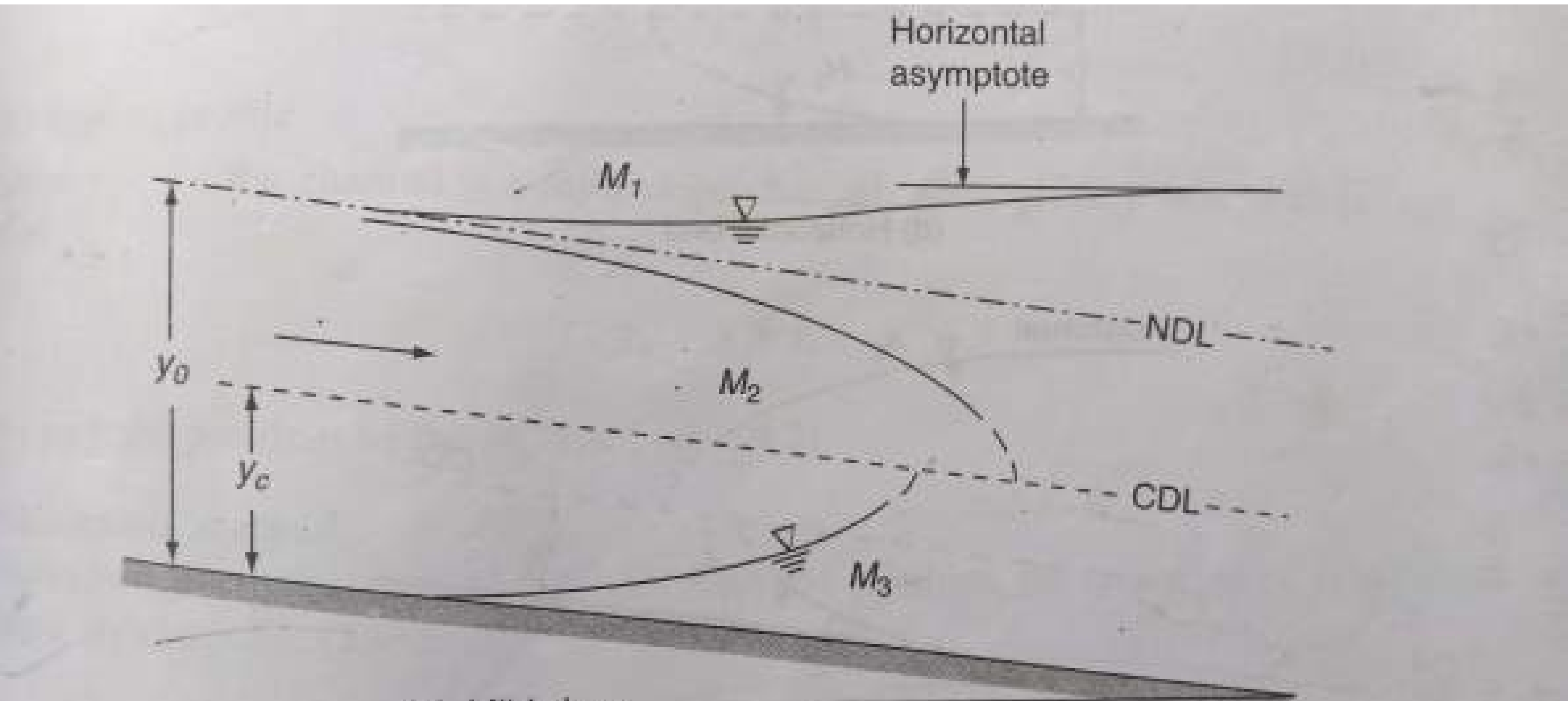
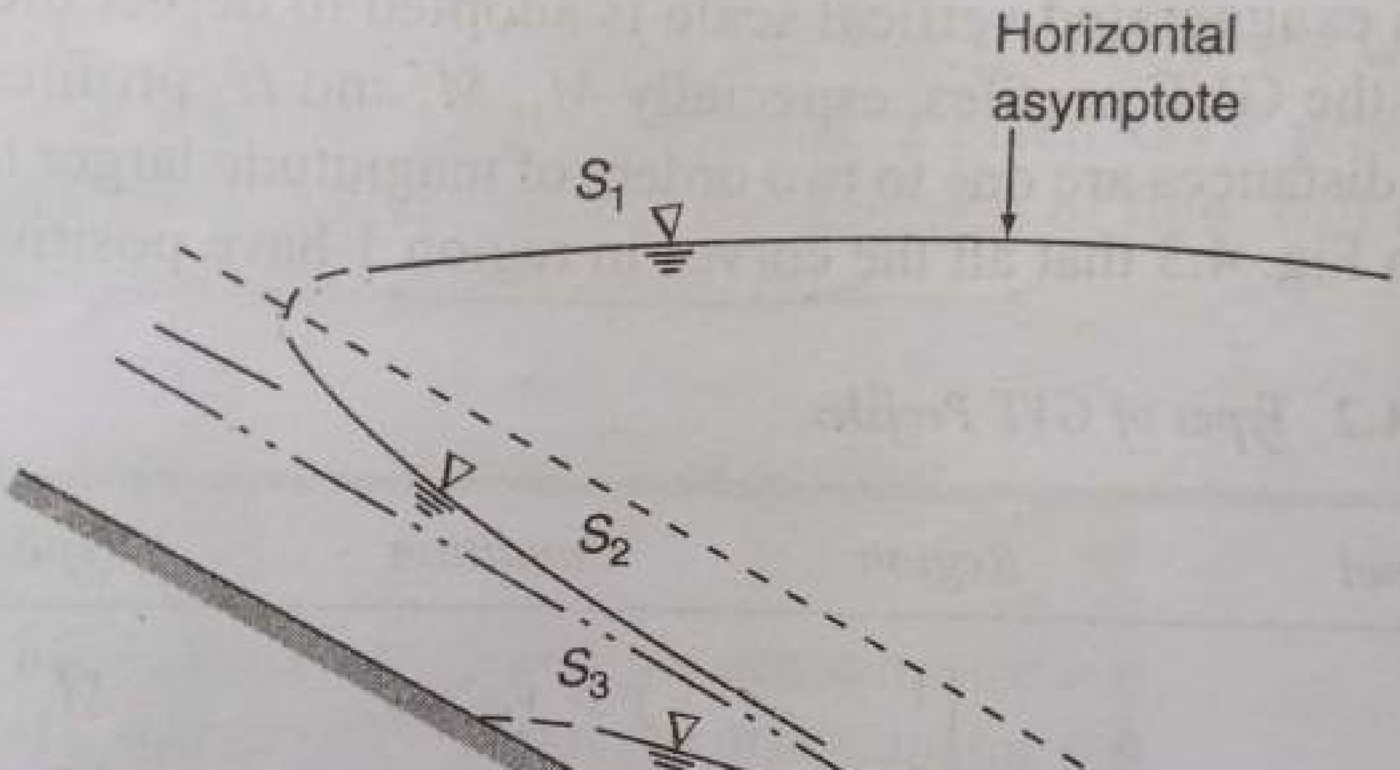

CDL
Region 2
3
y_c
$S_0 = -$ ve
Adverse slope

Table 4.2 *Types of GVF Profiles*

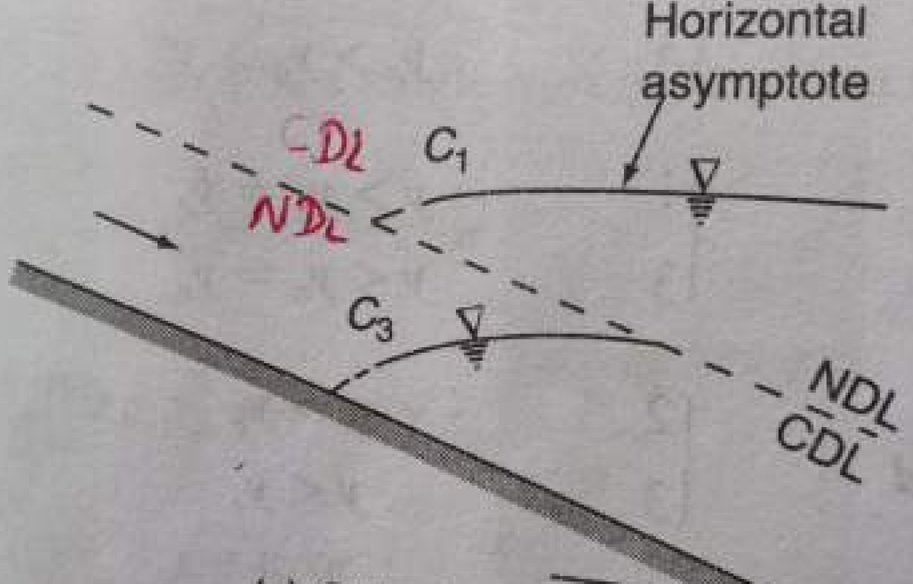
Channel	Region	Condition	Type
Mild slope	1	$y > y_0 > y_c$	M_1
	2	$y_0 > y > y_c$	M_2
	3	$y_0 > y_c > y$	M_3
Steep slope	1	$y > y_c > y_0$	S_1
	2	$y_c > y > y_0$	S_2
	3	$y_c > y_0 > y$	S_3
Critical slope	1	$y > y_0 = y_c$	C_1
	3	$y < y_0 = y_c$	C_3
Horizontal bed	2	$y > y_c$	H_2
	3	$y < y_c$	H_3
Adverse slope	2	$y > y_c$	A_2
	3	$y < y_c$	A_3



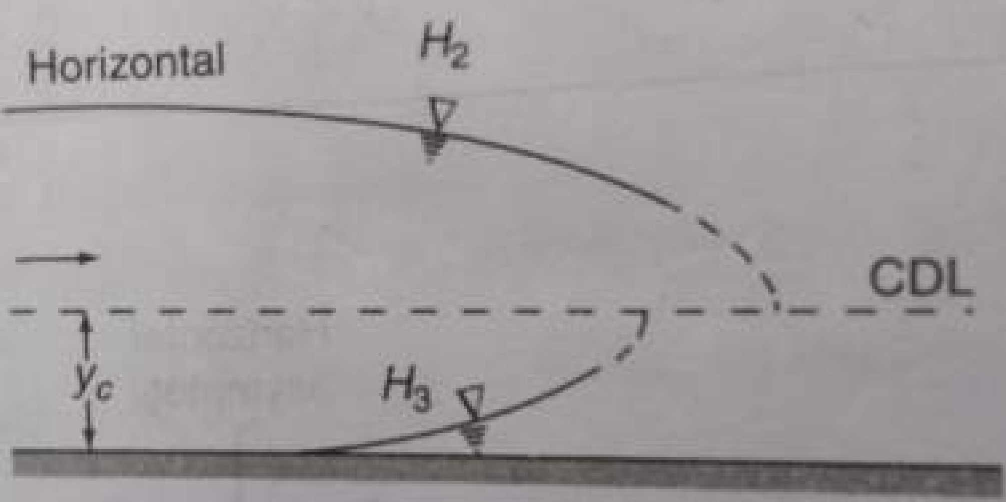
(a) Mild slope



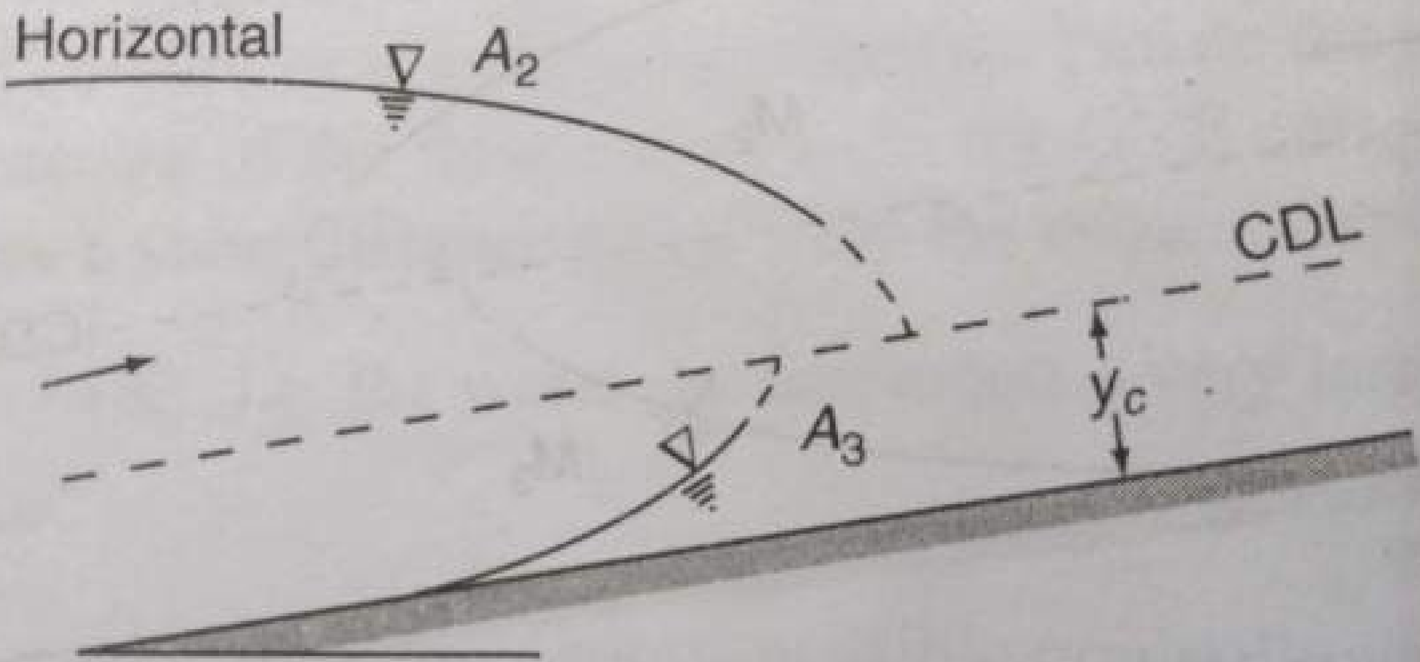
(b) Steep slope



(c) Critical slope



(d) Horizontal bed



(e) Adverse slope