Definitions and Basic Principles

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Videos of Open Channel Flows

- **Explosive Breach of Condit Dam:**

https://www.youtube.com/watch?v=4LxMHmw3Z-U

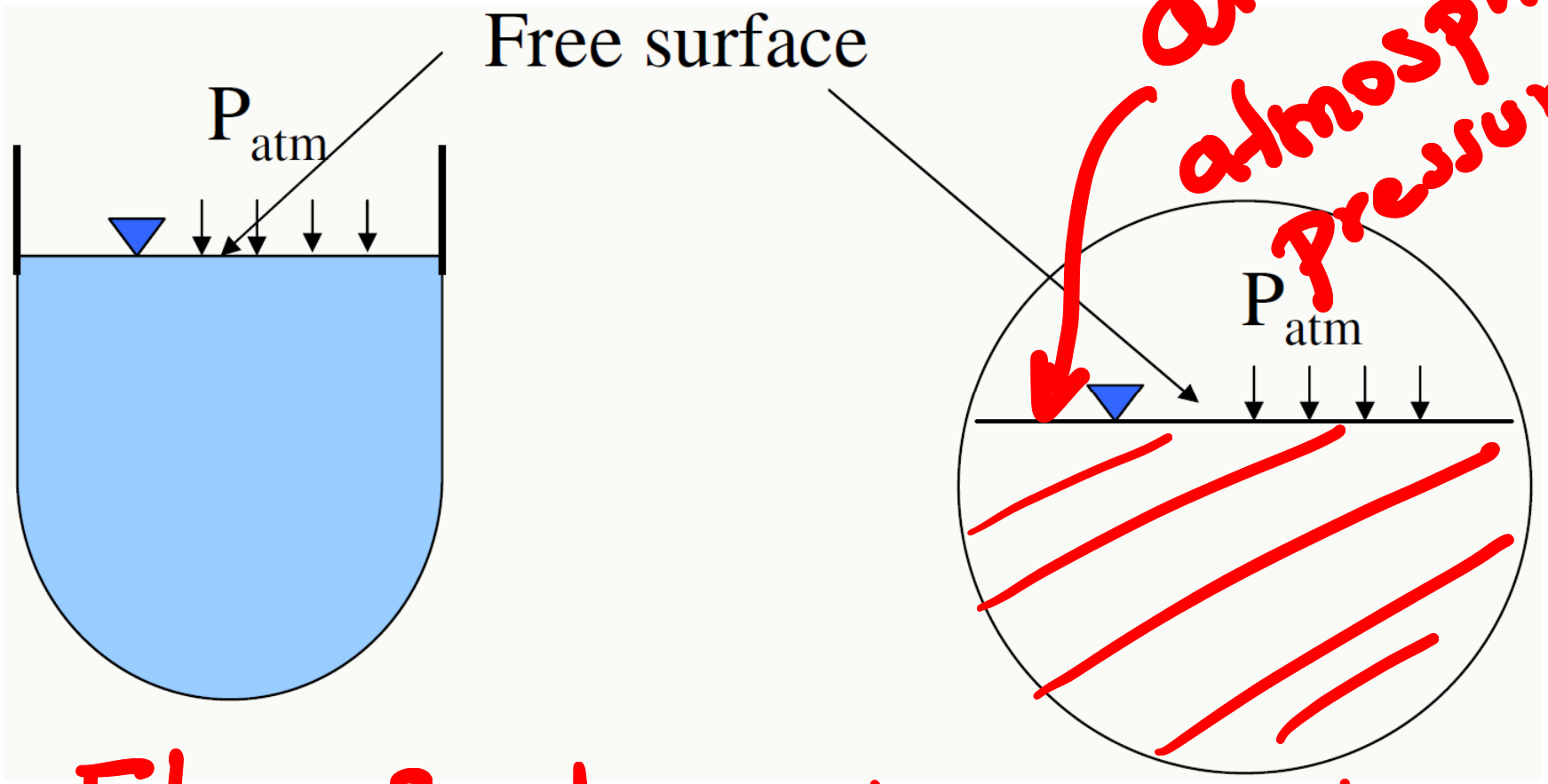
- **Road Collapse - Maine 2008**

https://www.youtube.com/watch?v=NTbhyHNA1Vc

- **Deep tunnel Geyser (Minnesota) (Mixed flow: open channel – pressurized flow):**

http://www.youtube.com/watch?v=NDy3fBLfhYQ

What is Open-channel Flow?



* Flow is driven by gravity

Types of Open-channel

- Canal
- Chute
- Drop
- Culvert
- Natural channel

Types of Open-channel (Cont.)

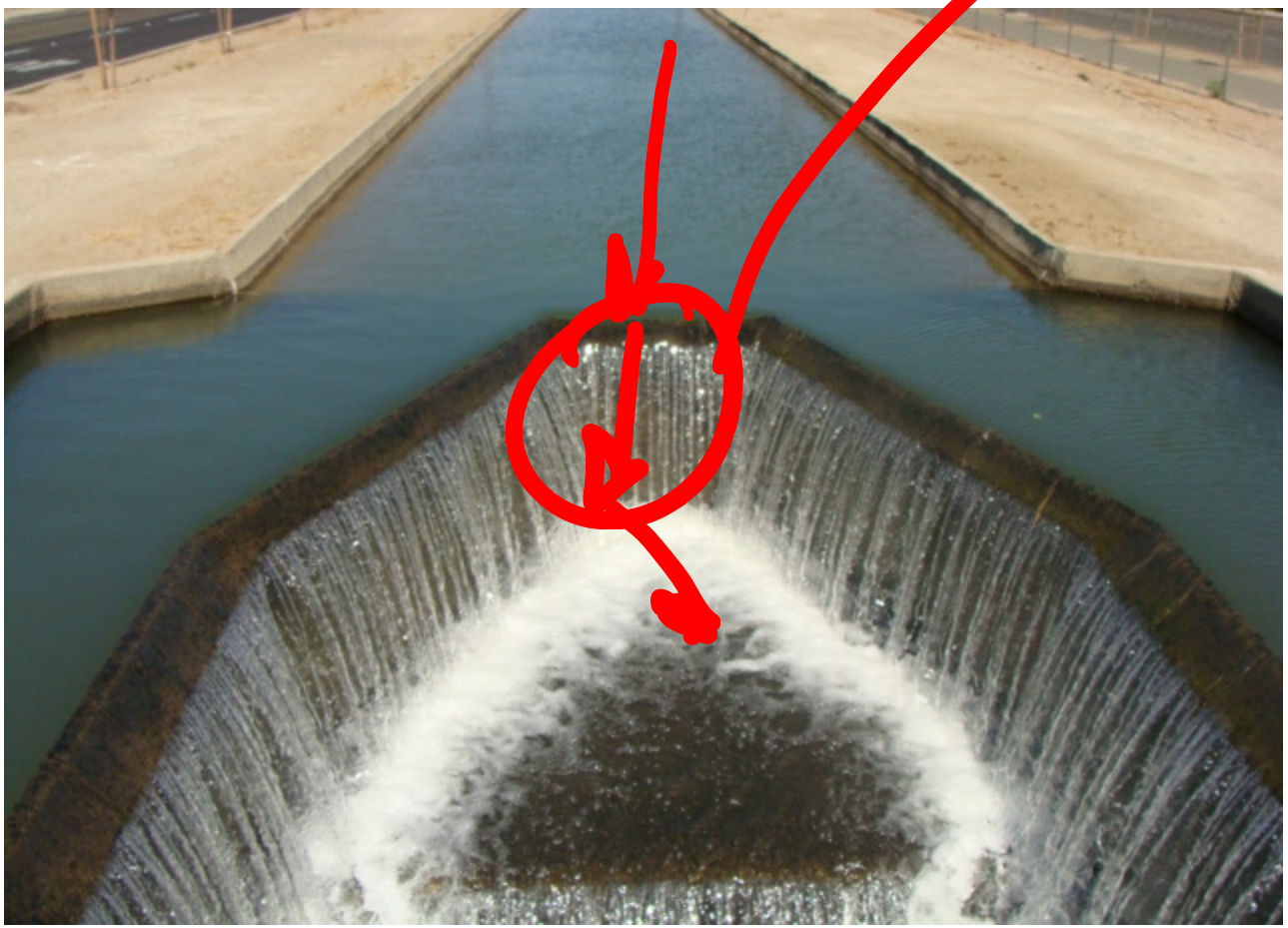
Canal: A canal is usually a long and mild-sloped channel built in the ground

Types of Open-channel (Cont.)

Chute: A chute is a channel with a steep slope

Types of Open-channel (Cont.)

Drop: A drop is a channel with a sudden change in elevation



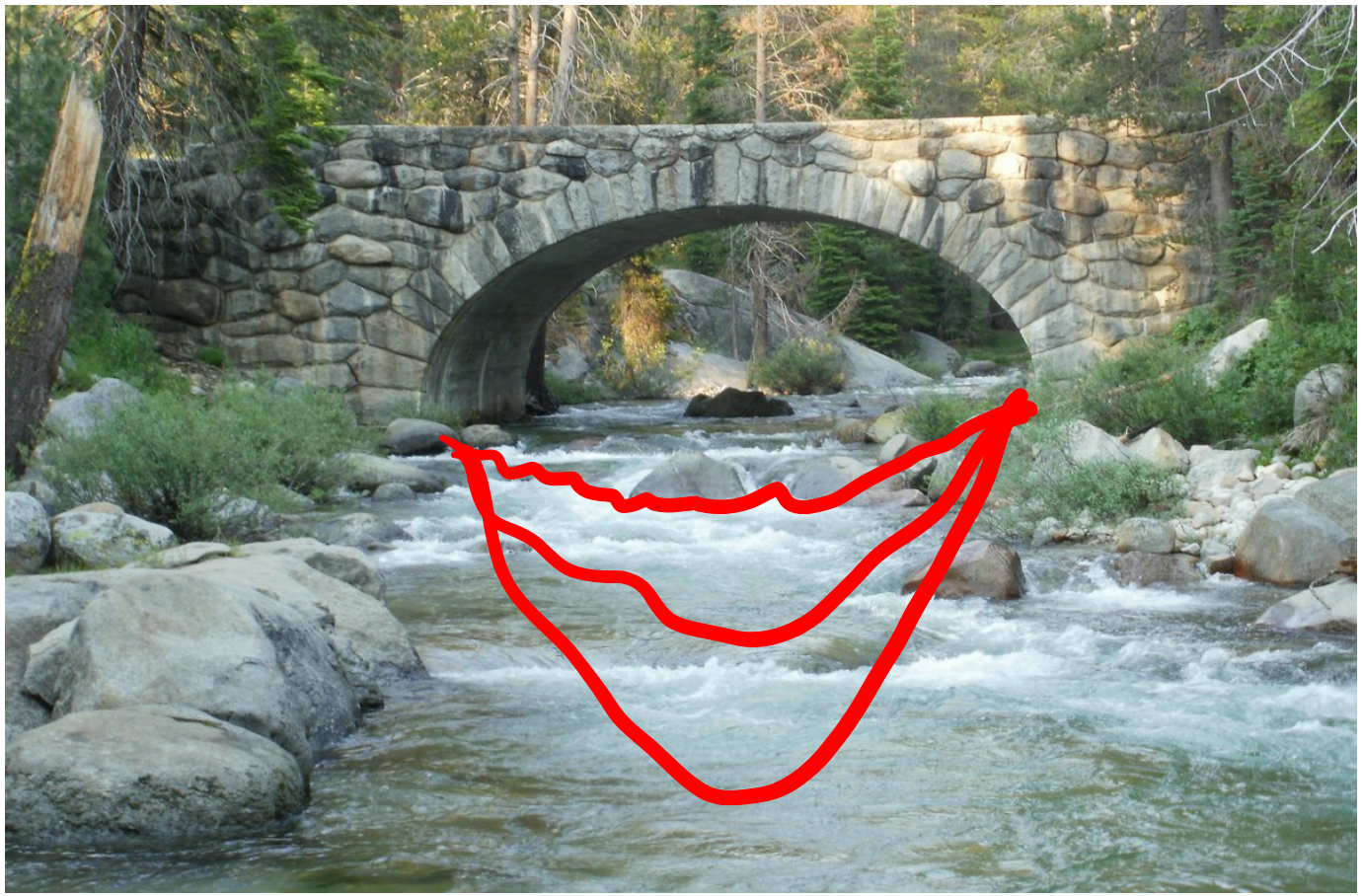
Types of Open-channel (Cont.)

Culvert: A culvert is a covered channel flowing usually partly full.

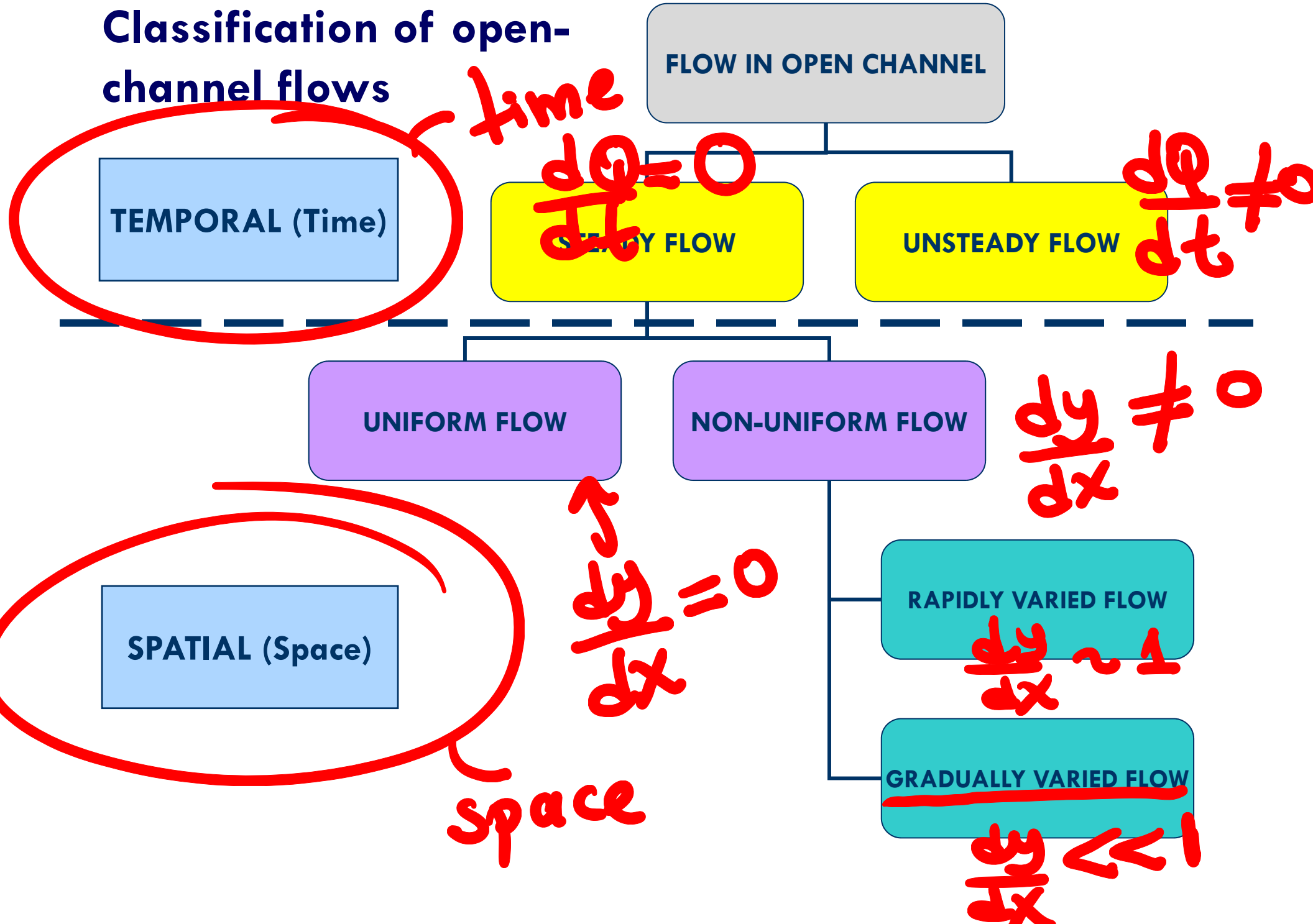
Culvert with “sediments”

Types of Open-channel (Cont.)

Natural channel: A natural channel has irregular geometry. Examples include, rivers and creeks.



Classification of open-channel flows



Classification of open-channel flows (Spatial criteria)

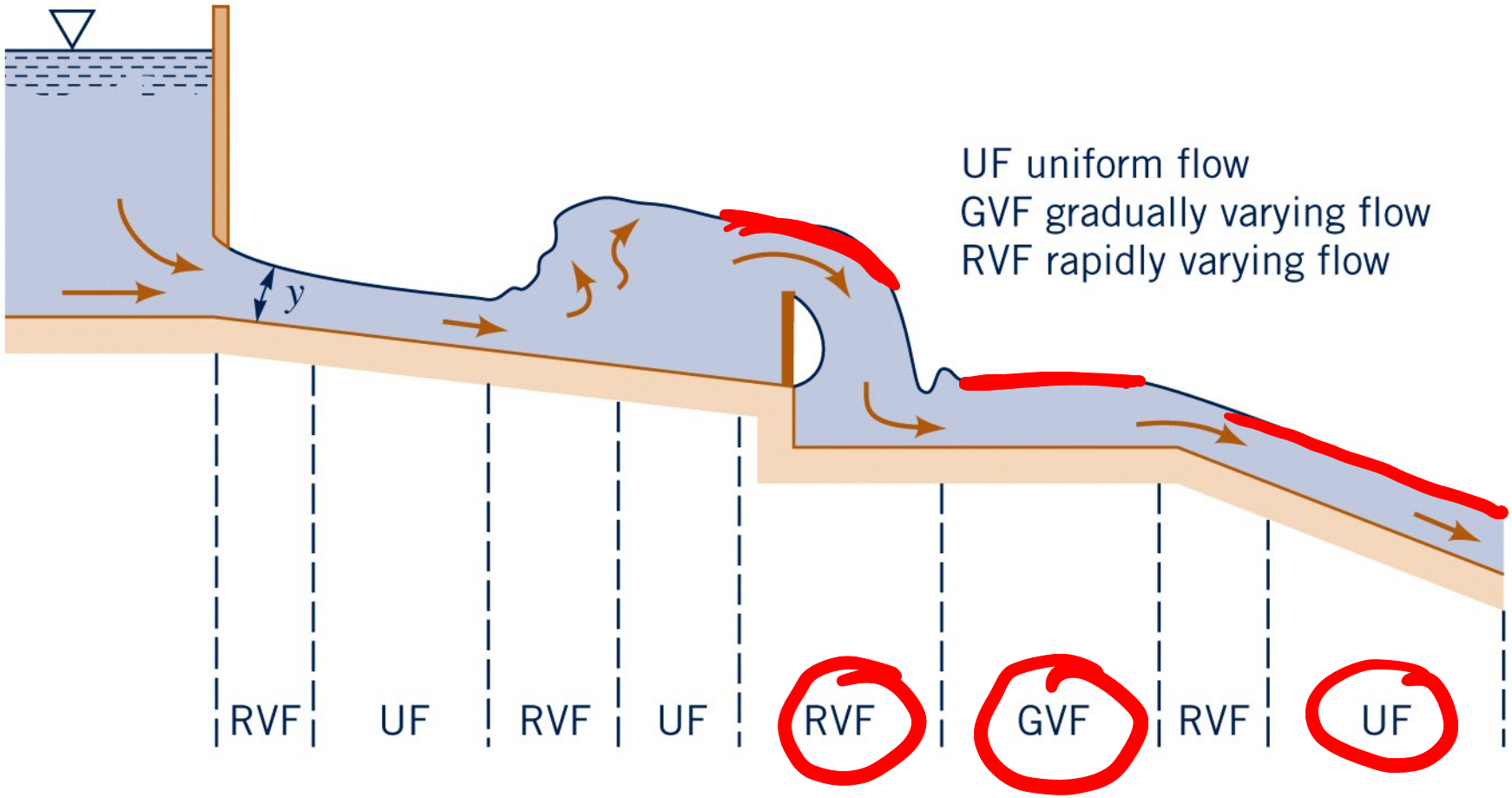


Figure 10.1

$$\frac{dy}{dx} = 0$$

$$\frac{dV}{dx} = 0$$

Uniform flow

$\frac{dy}{dx} \sim 1$

$\frac{dy}{dx} \sim 1$

Rapidly varied flow

$\frac{dy}{dx} \ll 1$ much smaller

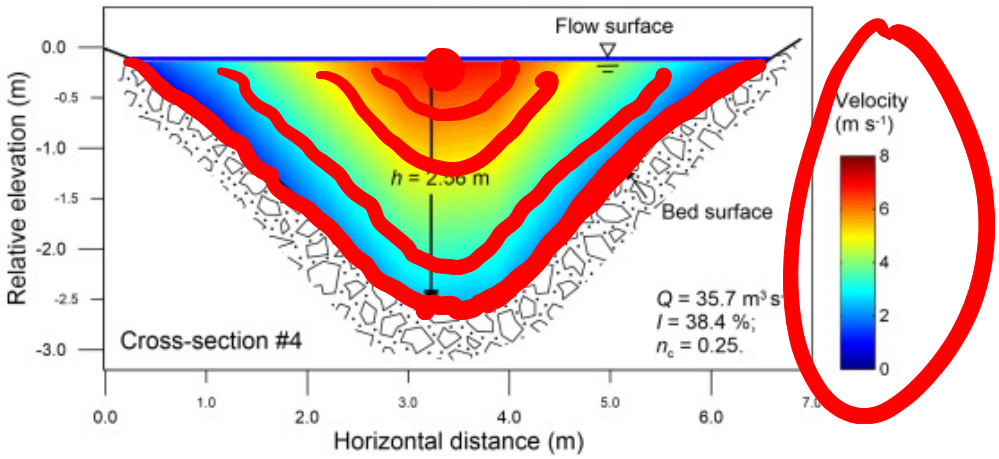
Gradually varied flow

Which flow type is this?

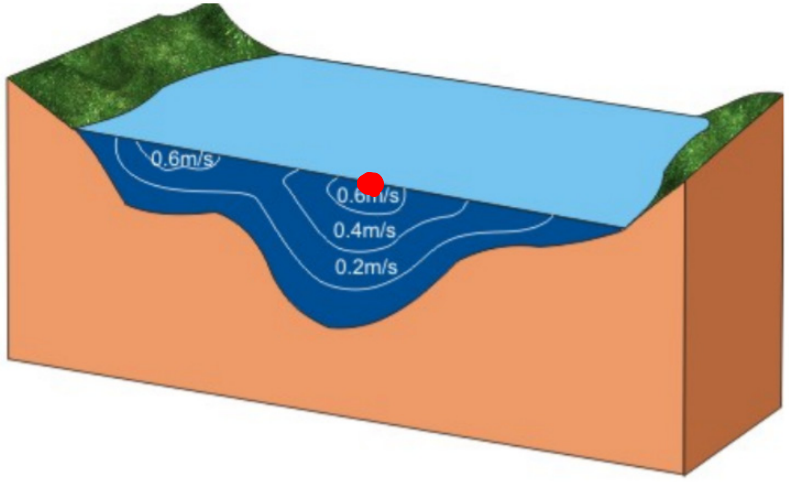
Dry Meadow Creek, Calif., USA.

Velocity Distribution

- In a macro-analysis, we are concerned with the major component velocity only, viz., the longitudinal component, v_x.
  - The other two components being small are ignored and v_x is designated as v.



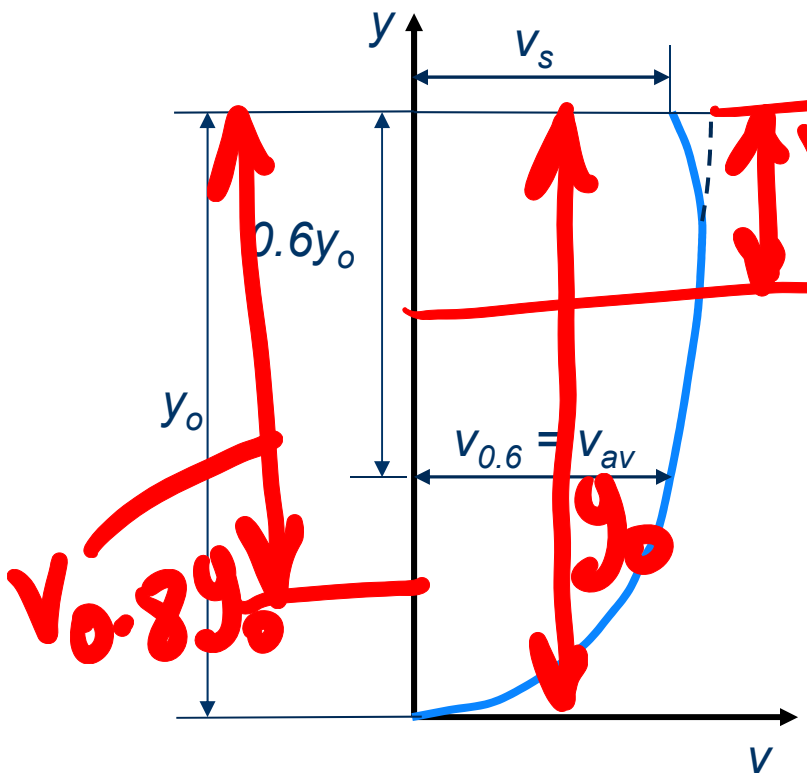
Source:
https://www.sciencedirect.com/science/article/pii/S0169555X15002159



Source:
https://nptel.ac.in/content/storage2/courses/105105110/pdf/m2l08.pdf

Velocity Distribution

- Observations in rivers and canals have shown that the average velocity at any vertical v_{av}, occurs at a level of $0.6y_0$ from the free surface, where y_0 = depth of flow.



- Further, it is found that

$$V_{av} = \frac{V_{0.2} + V_{0.8}}{2}$$

in which $v_{0.2}$ = velocity at a depth of $0.2y_0$ from the free surface, and $v_{0.8}$ = velocity at a depth of $0.8y_0$ from the free surface.

- Surface velocity v_s is related to the average velocity v_{av} as $V_{av} = kV_s$

where, k = a coefficient with a value between 0.8 and 0.95.