Introduction

Chapter 1

ct4310 Bed, Bank and Shoreline protection

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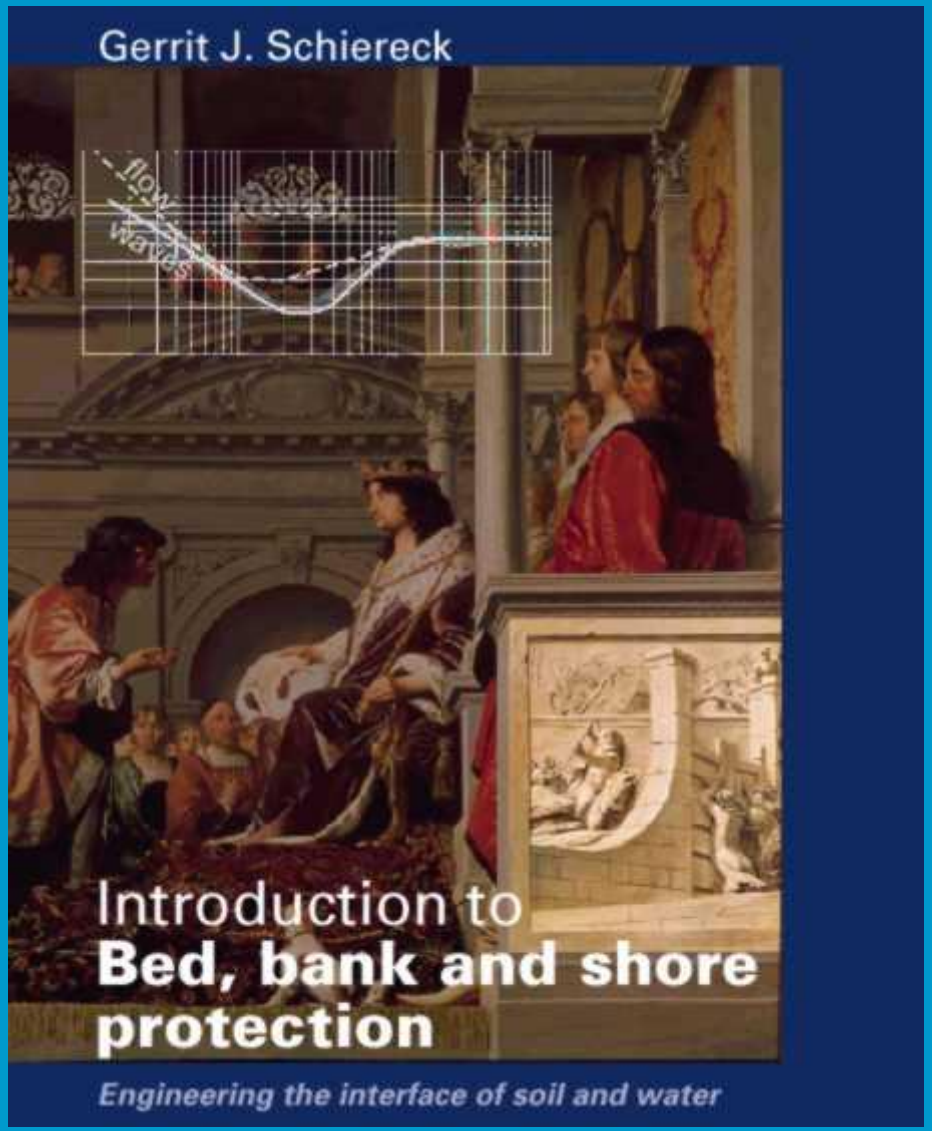
November 5, 2009

Faculty of Civil Engineering and Geosciences
Section Hydraulic Engineering

Material used:

Book:
Book is available from VSSD

ISBN 90-407-1683-8
400 pages,



Material used (2)

- Study guide
- reminders
- examination
- acsido
- Cress - www.cress.nl
- Quizz

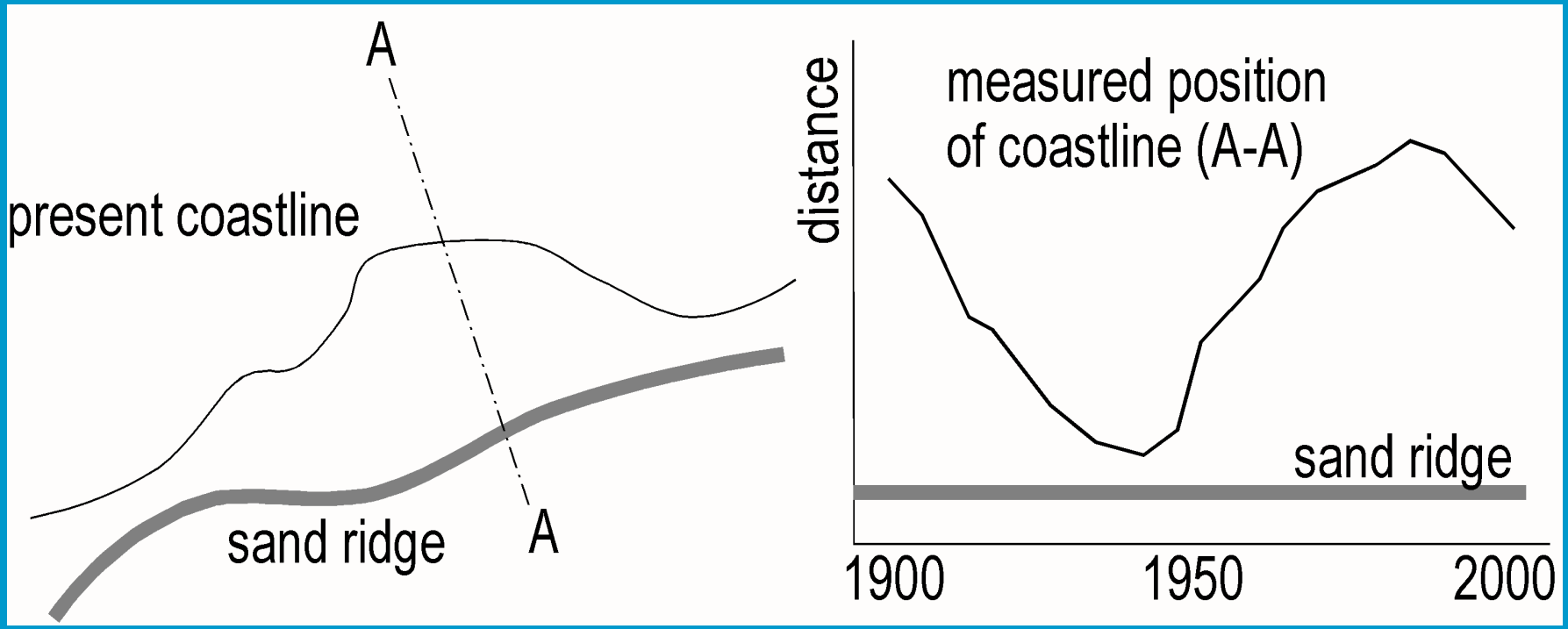
  (http://www.kennisbank-waterbouw.nl/oefening/index.htm)

Introduction

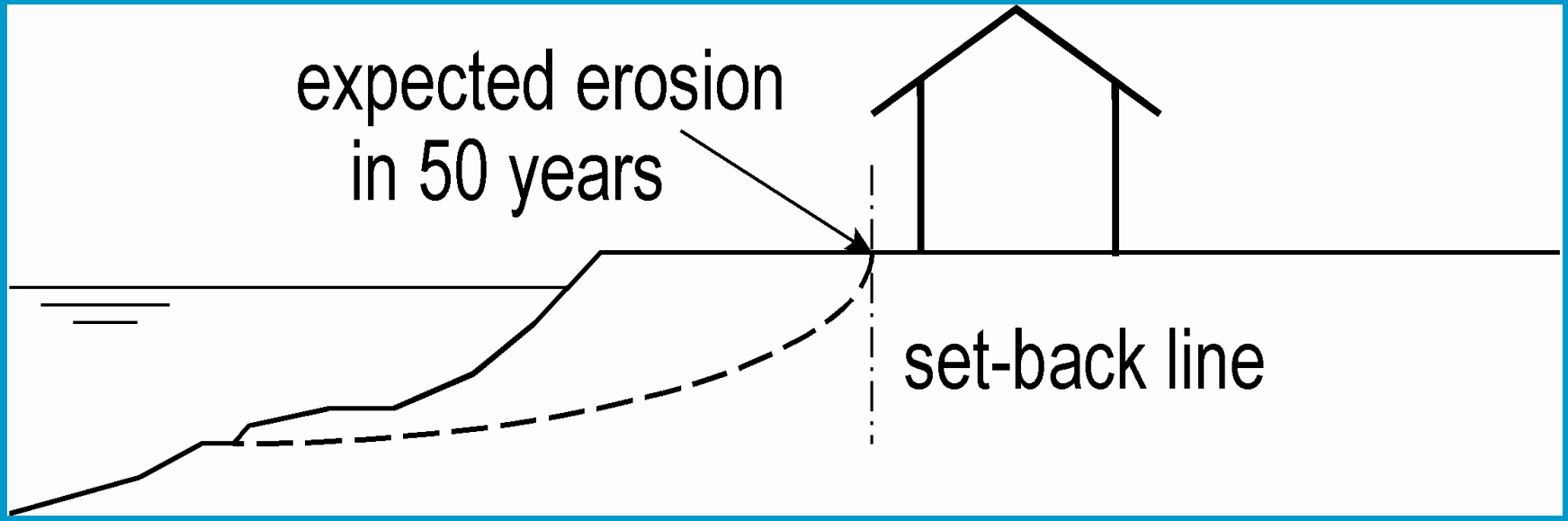
- protection of the boundary between land and water
- objective:
  - learn to design a structure for the protection against undesired erosion;
  - design structures based on understanding of processes

- knowledge needed:
  - fluid mechanics
  - soil mechanics
  - hydraulic engineering

To protect or Not to protect

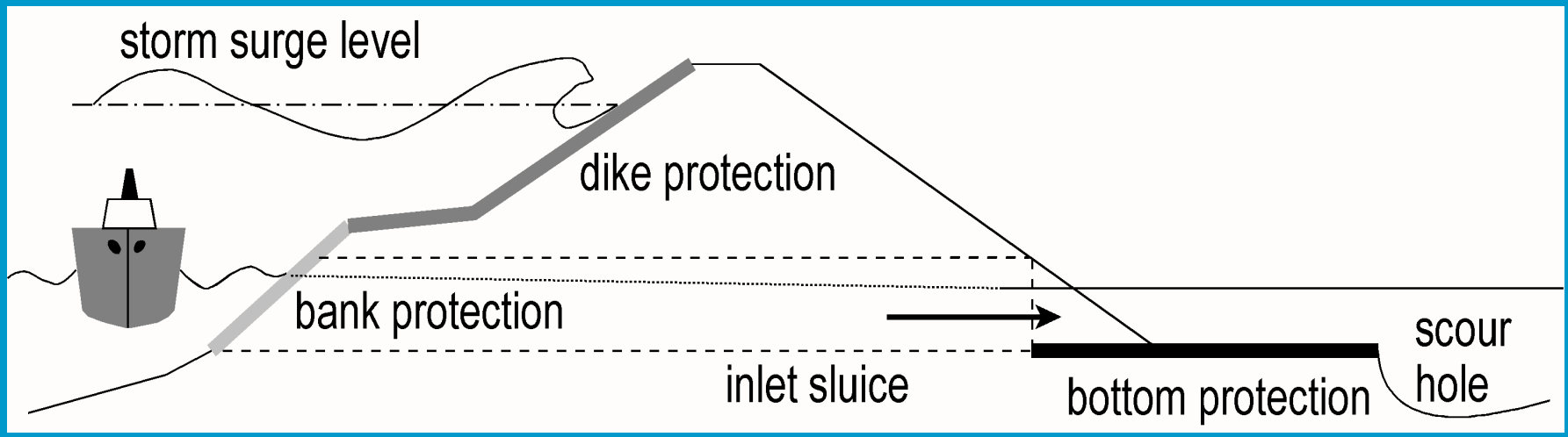


Building codes in eroding areas

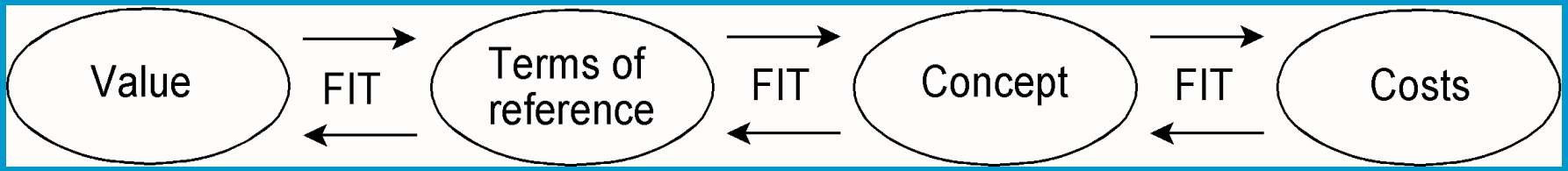


see also lecture ct5307
Coastal Zone Management

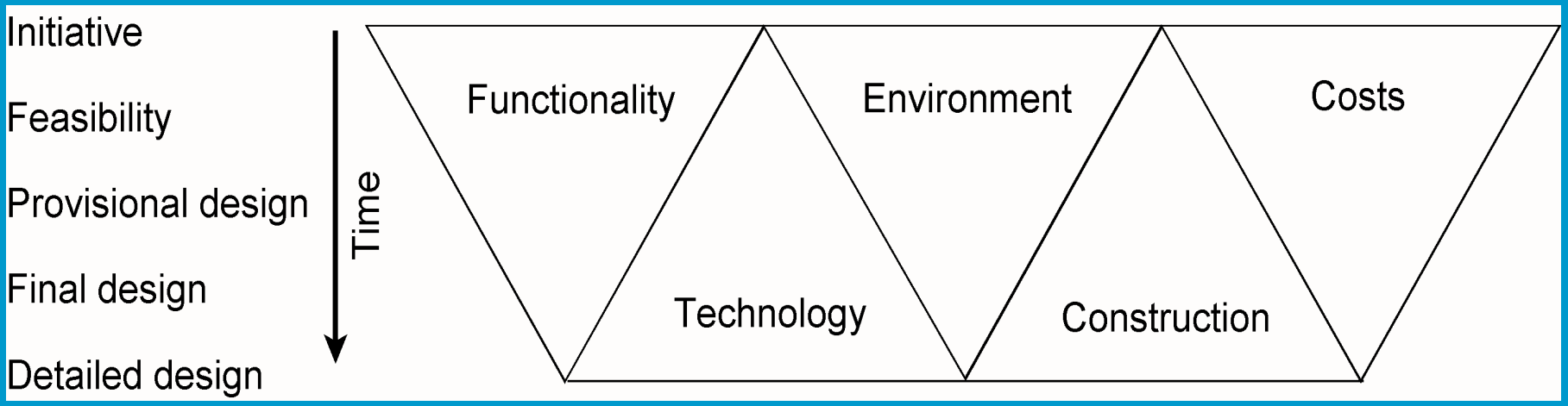
Examples of protection



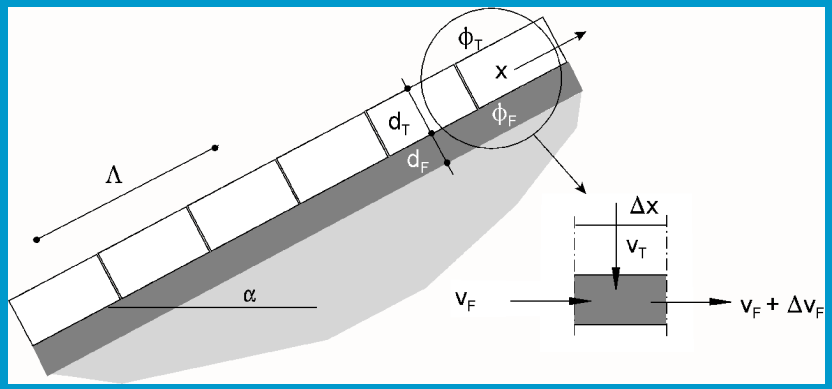
Value for money



Focus during design process



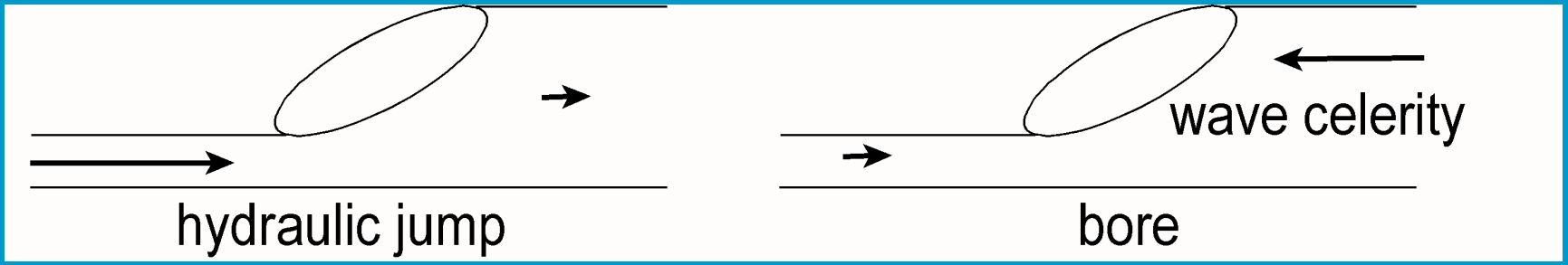
science or craftmanship ?



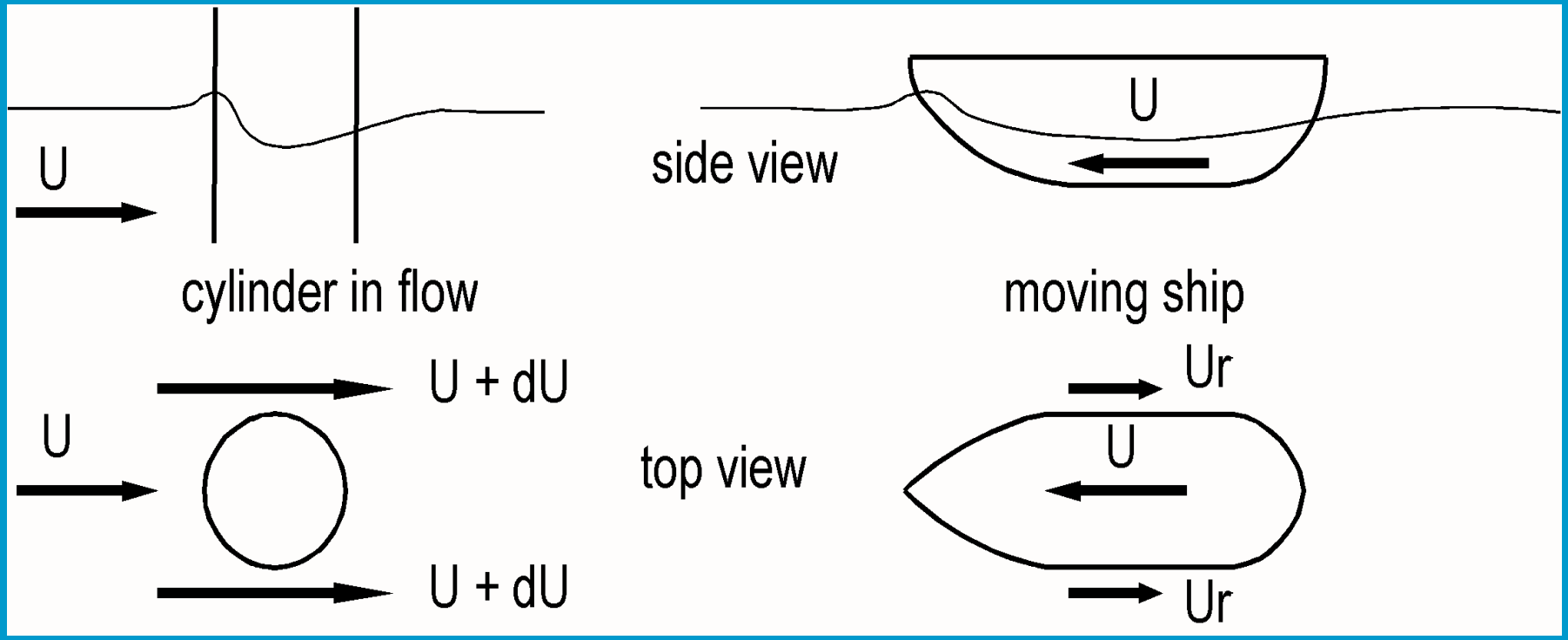
$$v_F = -k_F \frac{d\phi_F}{dx}$$

$$v_T = k_T \frac{(\phi_F - \phi_T)}{d_T}$$

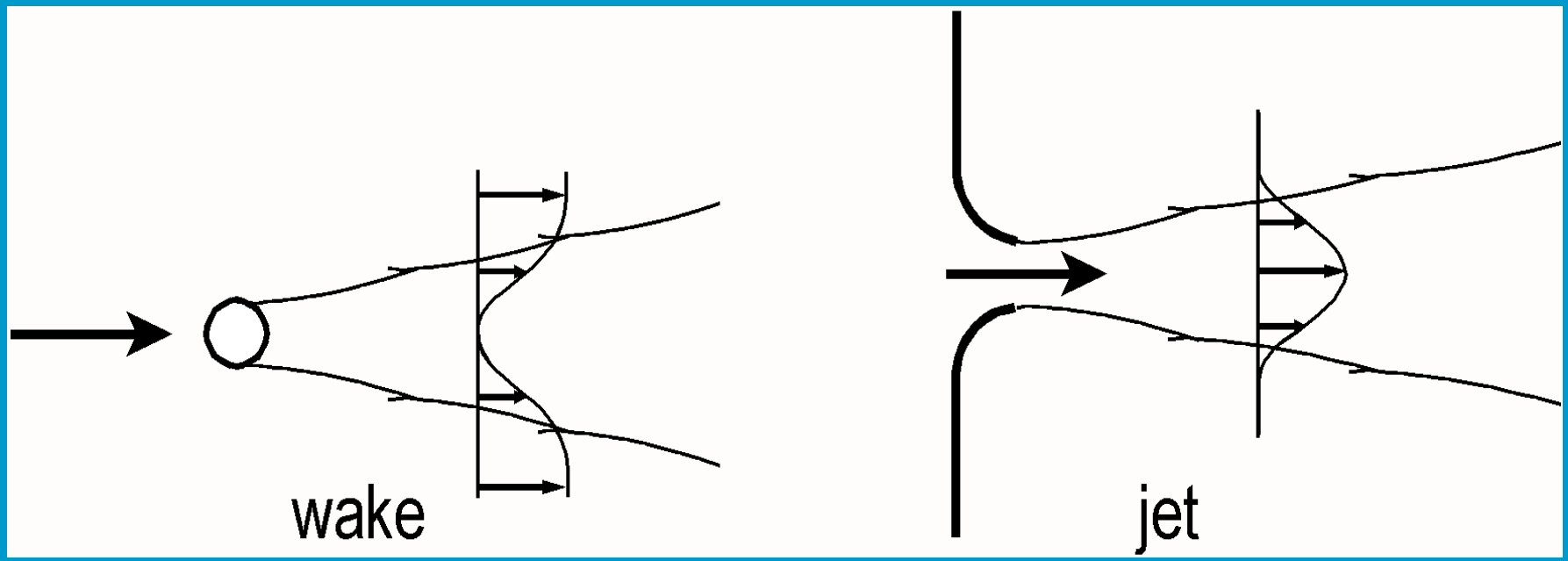
Jump and Bore



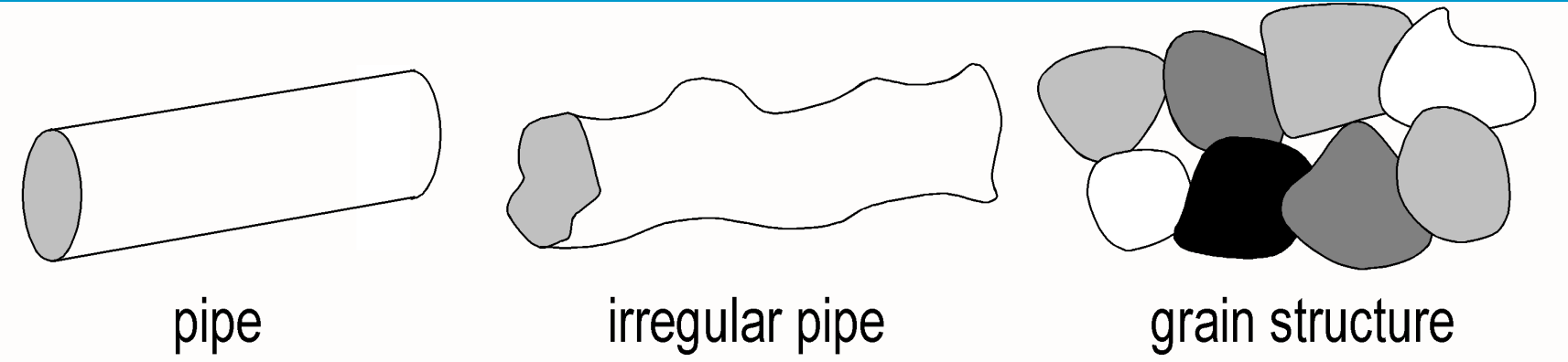
Flowing water vs. moving object



Mixing layers and Jet

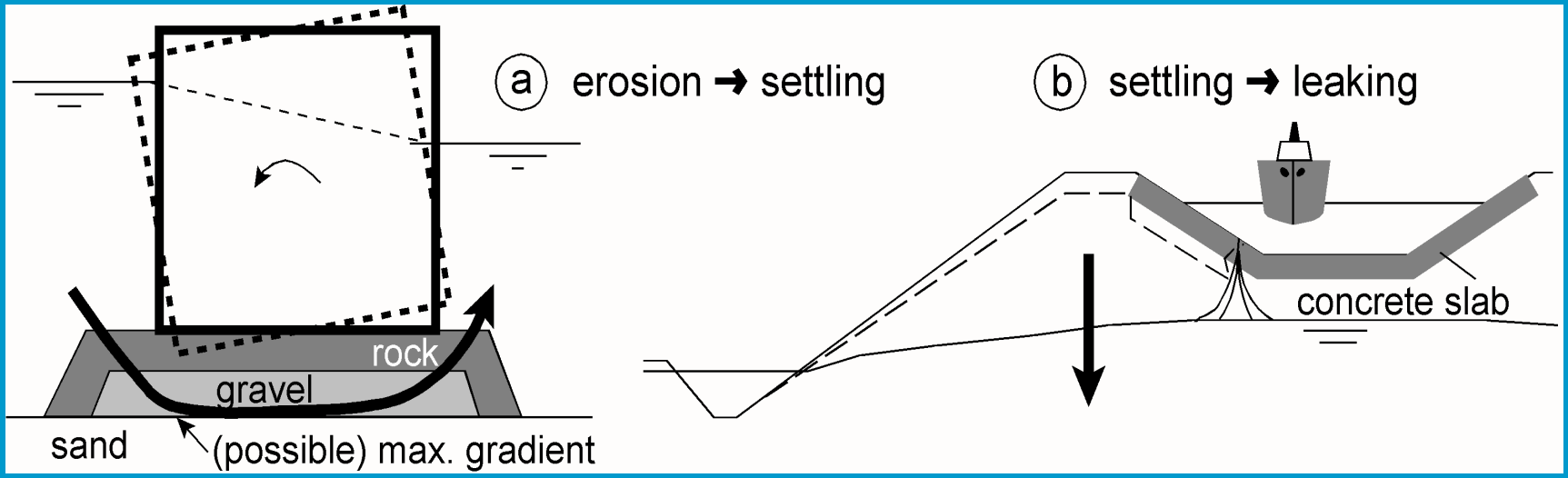


Pipe flow and Porous flow

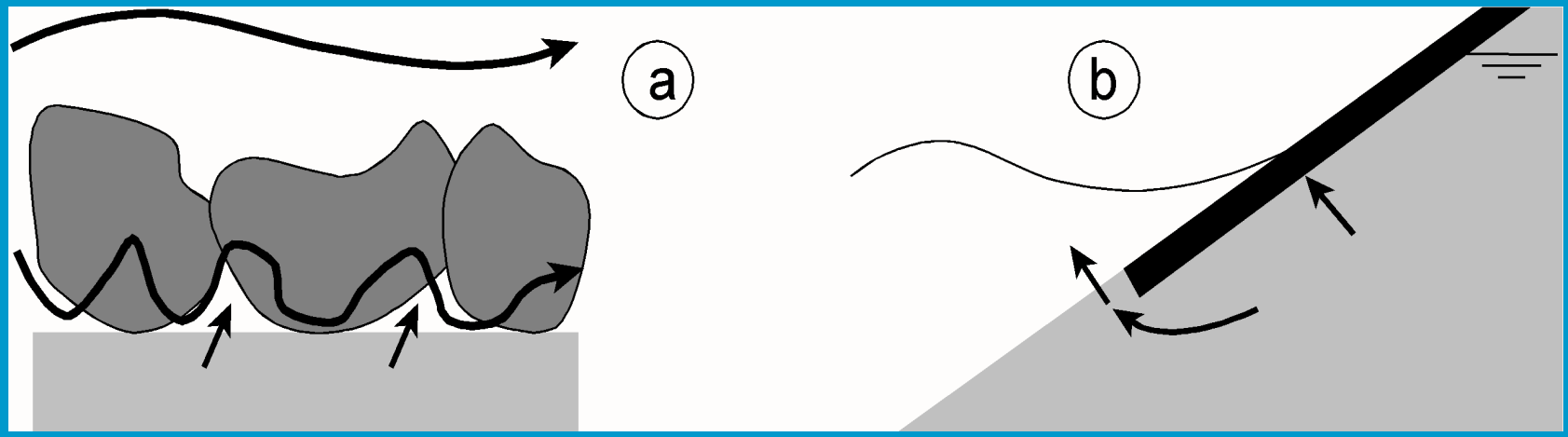


wall flow grenslaag
mixing layer menglaag
oscillating flow

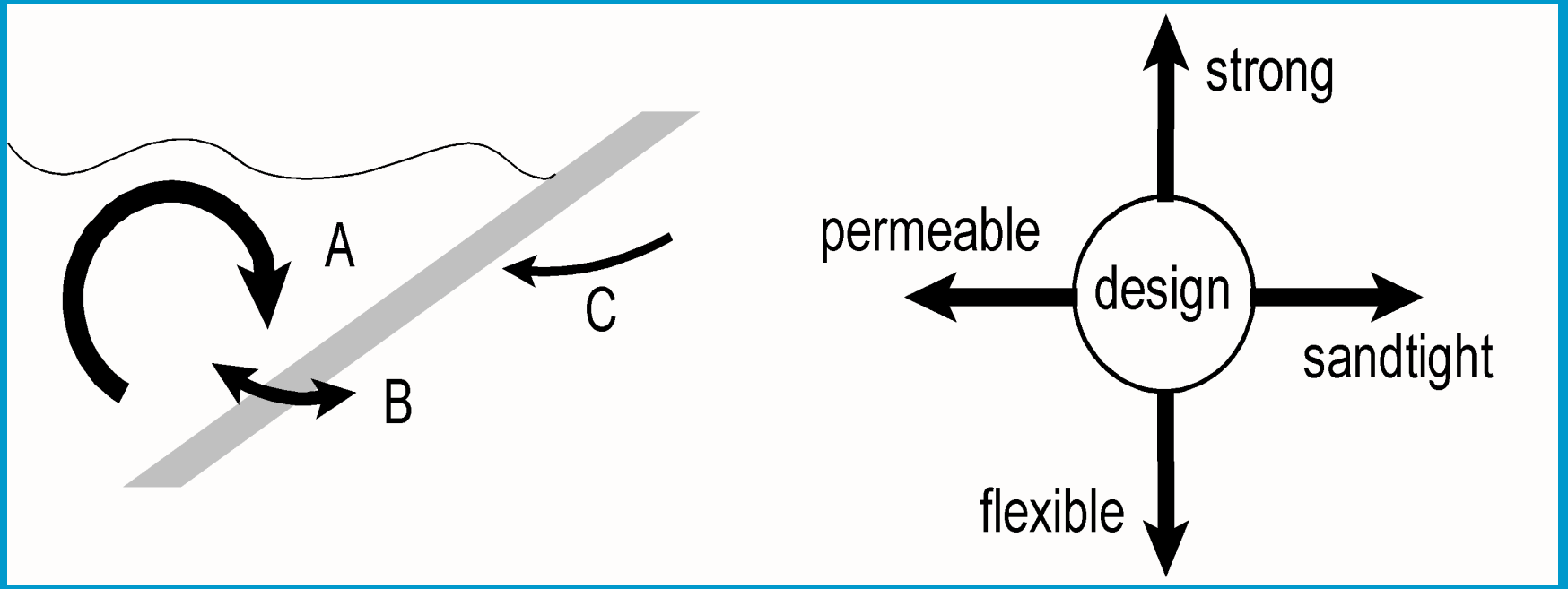
Cause and Effect



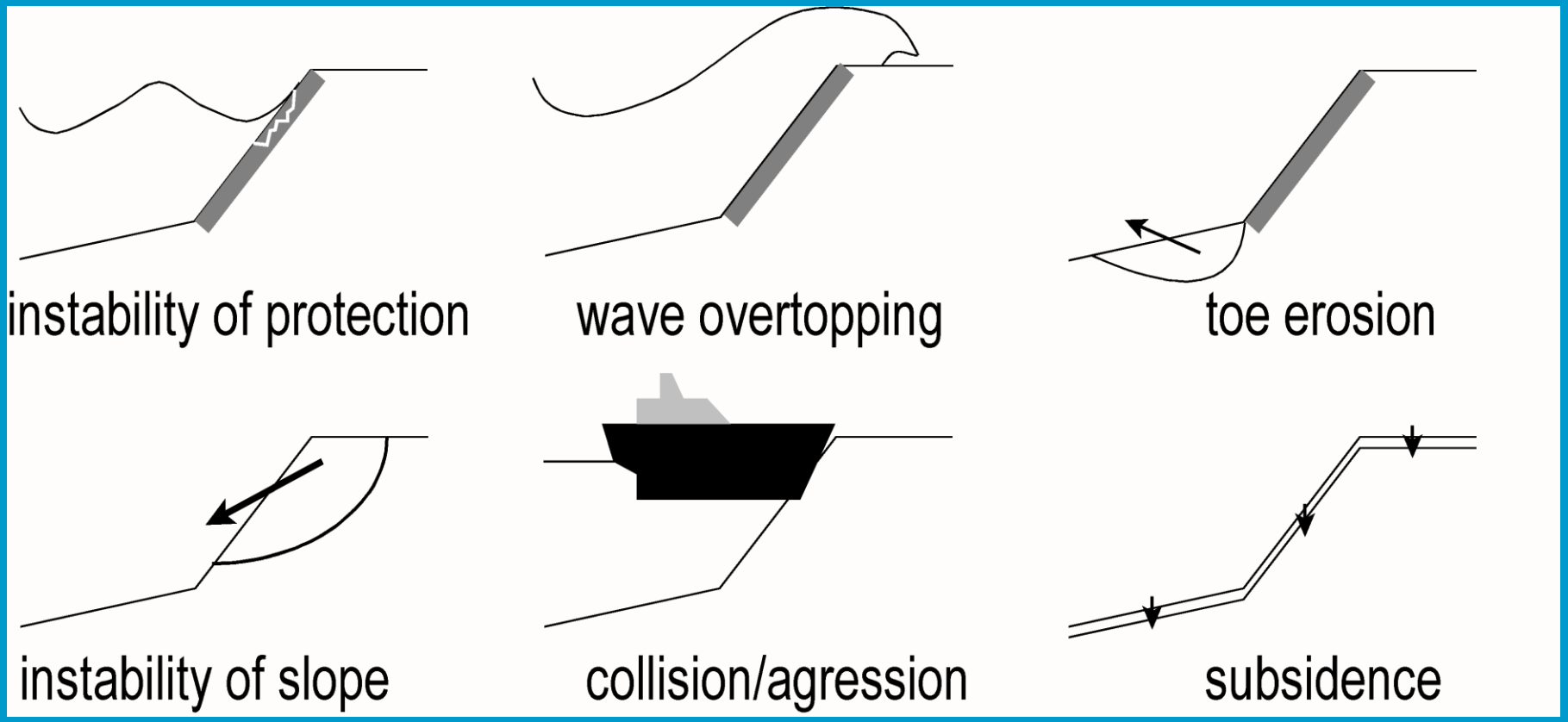
Ill-designed protections



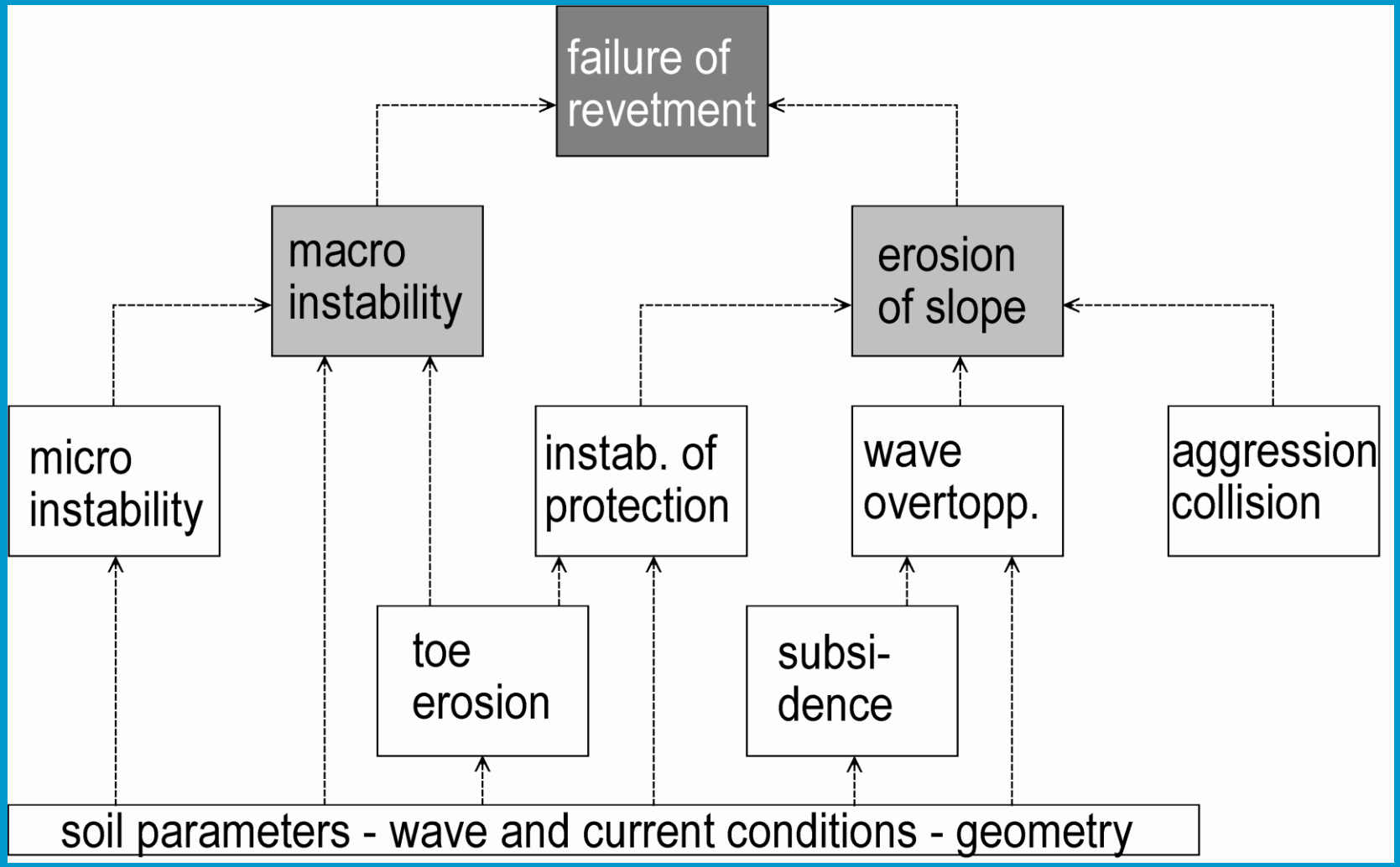
Contradicting demands



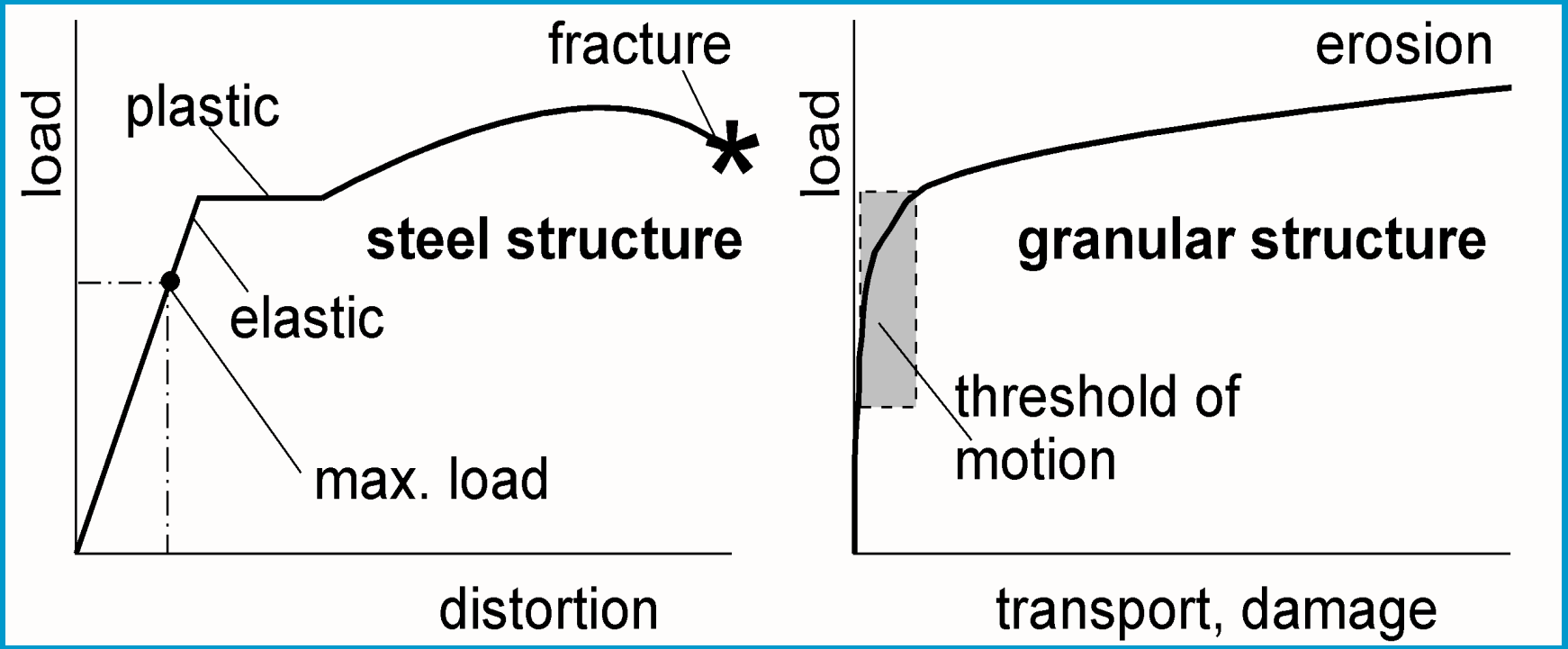
Failure Mechanisms



Fault tree



Steel and Granular Material

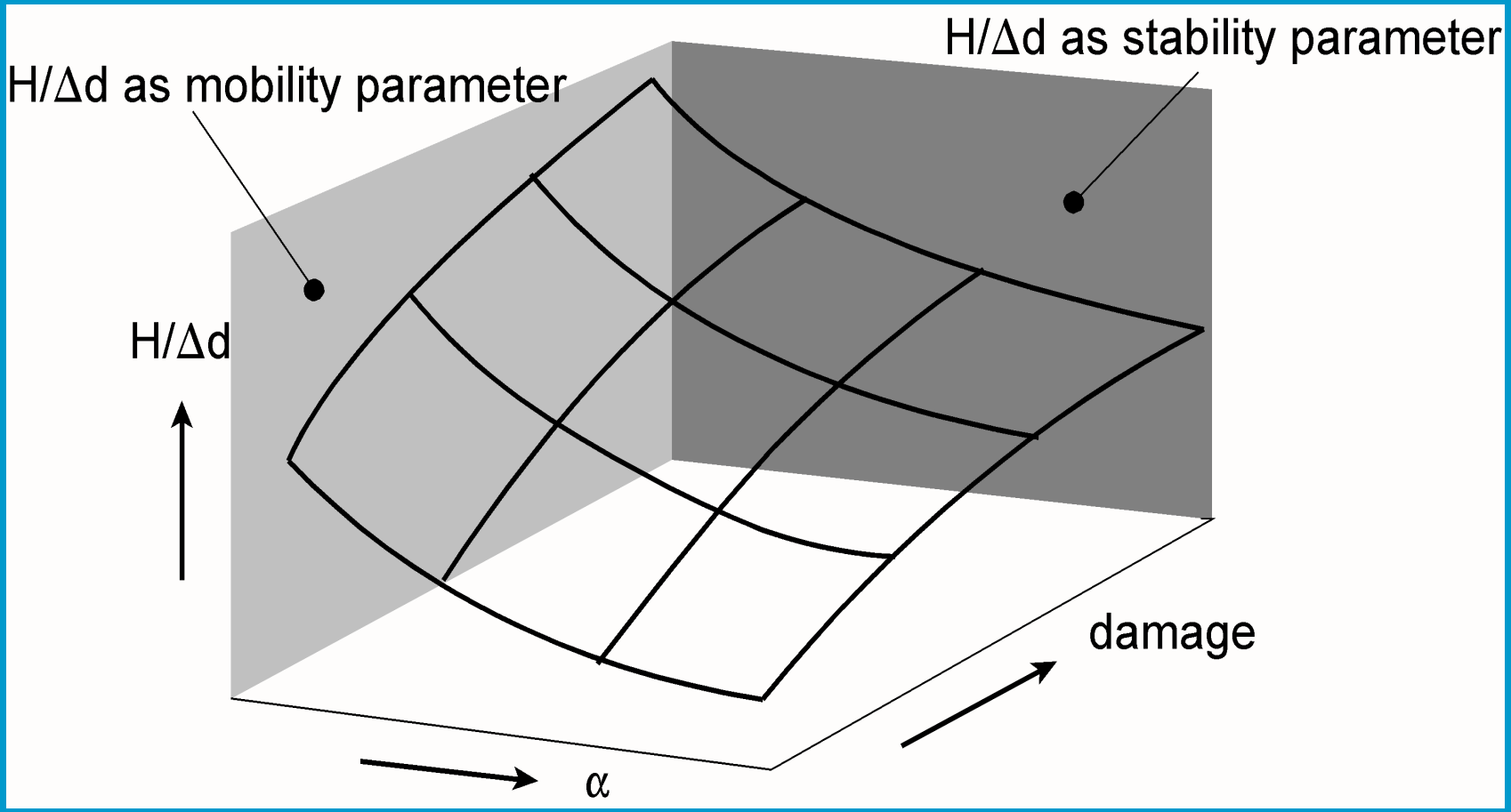


load and strength

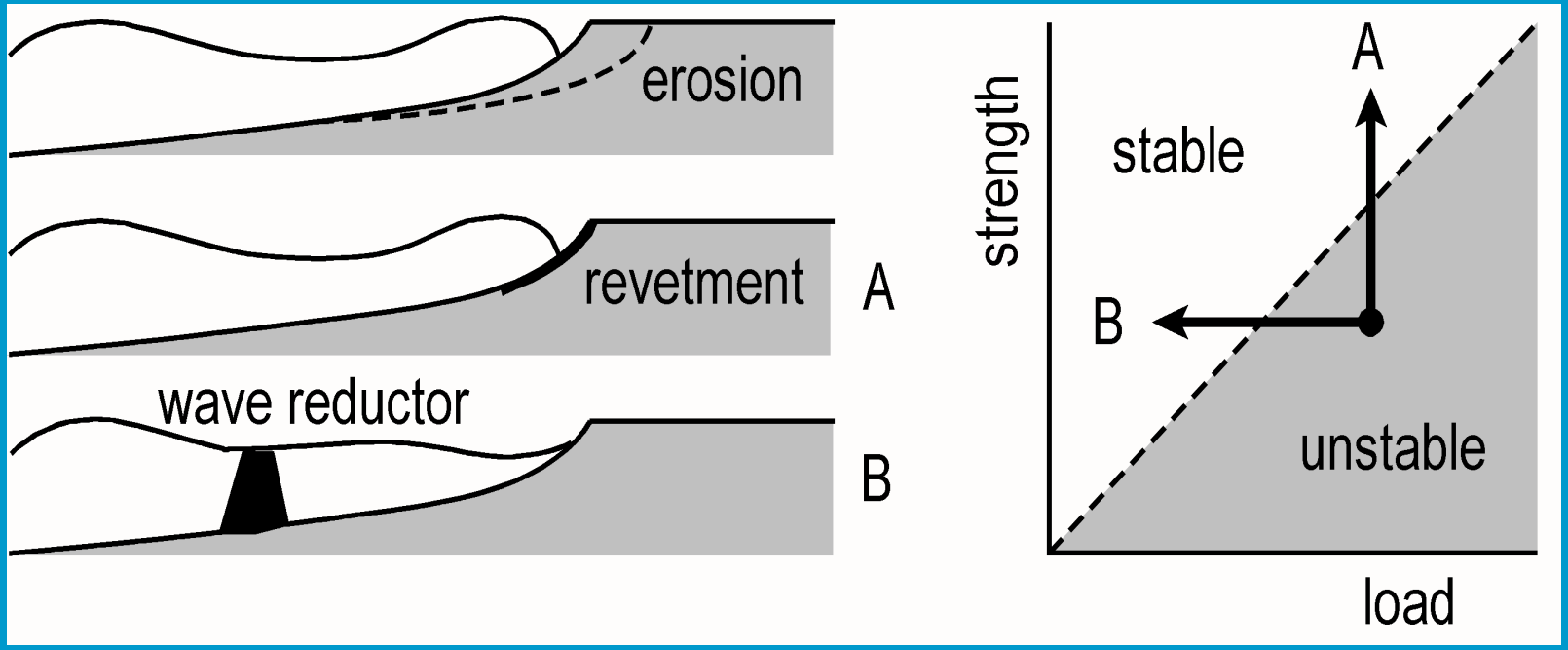
- transport, damage =
  f(mobility parameter, geometry, etc.)
- stability (parameter) =
  f (accepted damage, geometry, etc.)

The stability parameter is a critical value of the mobility parameter

Mobility vs. Stability



Strength increase or Load reduction



reminders (1)

$$H = z + \frac{p}{\rho g} + \frac{u^2}{2g} = h + \frac{u^2}{2g}$$

energy head
= location head
+ pressure head
+ velocity head

$$p = \rho g h$$

hydrostatic pressure

$$\Delta h = \frac{u^2}{2g} \rightarrow u = \sqrt{2g\Delta h}$$

(Torricelli)

$$\frac{p}{\rho g} = \frac{u^2}{2g} \rightarrow p = \frac{\rho u^2}{2}$$

transfer of velocity into pressure

reminders (2)

$$\bar{u} = C\sqrt{RI} \quad \left(C = 18 \log \frac{12R}{k_r} \right)$$

(Chezy)

$$u_f = kI$$

(Darcy)

$$\sigma' = \sigma - p$$

(effective stress = total stress - water pressure

$$\left.\begin{aligned} L &= cT \\ c_0 &= \frac{gT}{2\pi} \end{aligned}\right\} \rightarrow \quad L_0 = c_0 T = \frac{gT^2}{2\pi} \approx 1.56\,T^2$$

deep water wave length

$$c_s = \sqrt{gh} \quad \rightarrow \quad L_s = \sqrt{gh}\,T$$

shallow water wave length

reminders (3)

$$\mathrm{Re} = \frac{uL}{\nu}$$

Reynolds number, inertia vs. viscosity
for open channel flow, with L=h,
Re > 2000 to 3000

$$Fr = \frac{u}{\sqrt{gh}}$$

Froude number,
kinetic energy vs. potential energy

Fr < 1 sub-critical flow
Fr = 1 critical flow
(u = celerity of shallow water waves)
Fr > 1 super-critical flow