Environment

Chapter 12

ct 4310 bed, bank and shoreline protection

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Faculty of Civil Engineering and Geosciences
Section Hydraulic Engineering

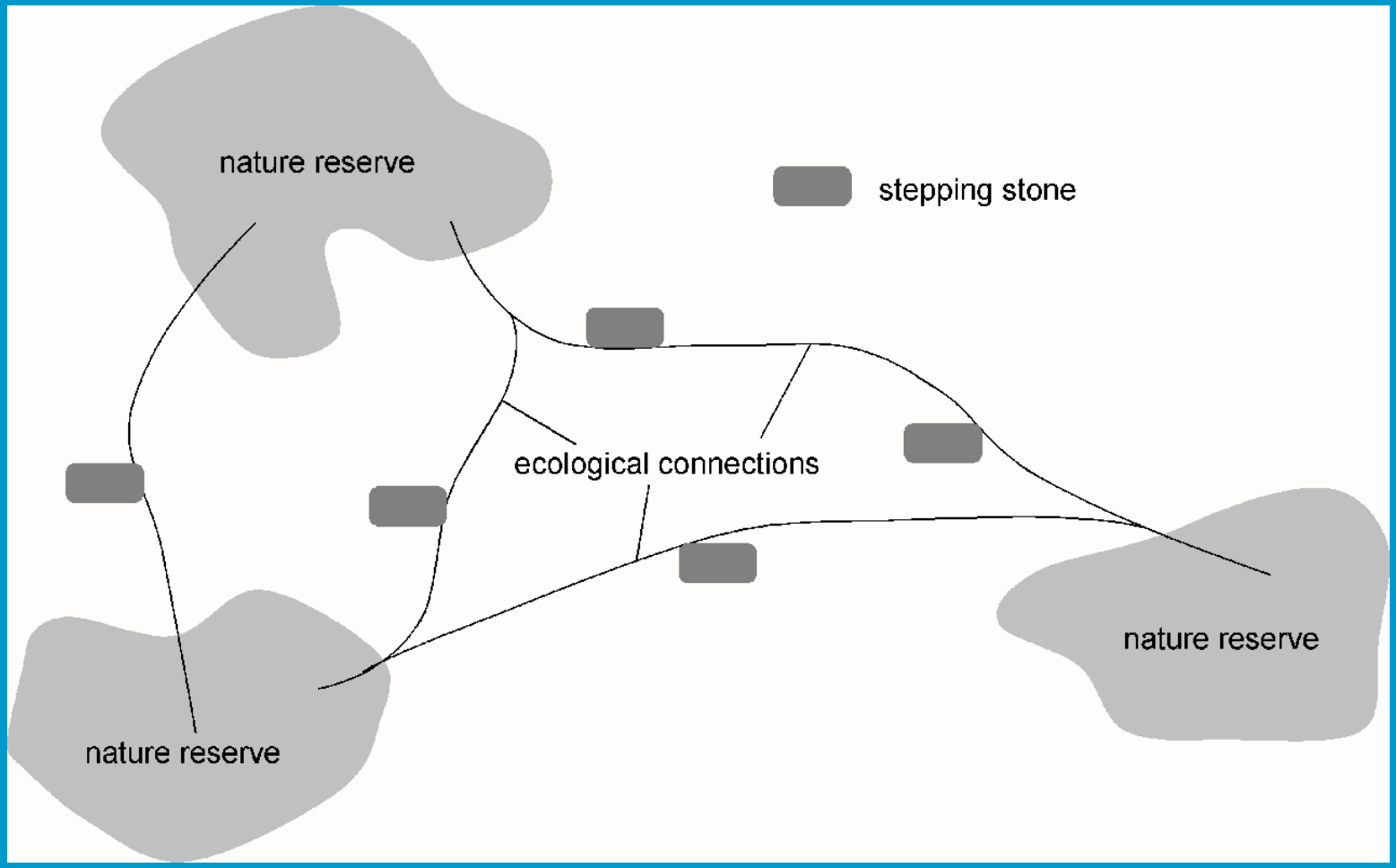
Introduction

- Ecologists stress that for a healthy environment there should be a good connection between land and water
- So shorelines are multifunctional elements in the landscape
- Main issues:
  - use of vegetation
  - allow animals to migrate from land to water and vice versa
  - use of sustainable materials
- So:
  - vertical walls are certainly not good

Other material

- Powerpoint presentation MilVriOev
- CUR manuals Natuurvriendelijke Oevers:
  - 200 Aaanpak en toepassingen
  - 201 Belasting en sterkte
  - 202 Oeverbeschermingsmaterialen
  - 203 Fauna
  - 204 Vegetatie langs grote wateren
  - 205 Water- en oeverplanten

ecological infrastructure

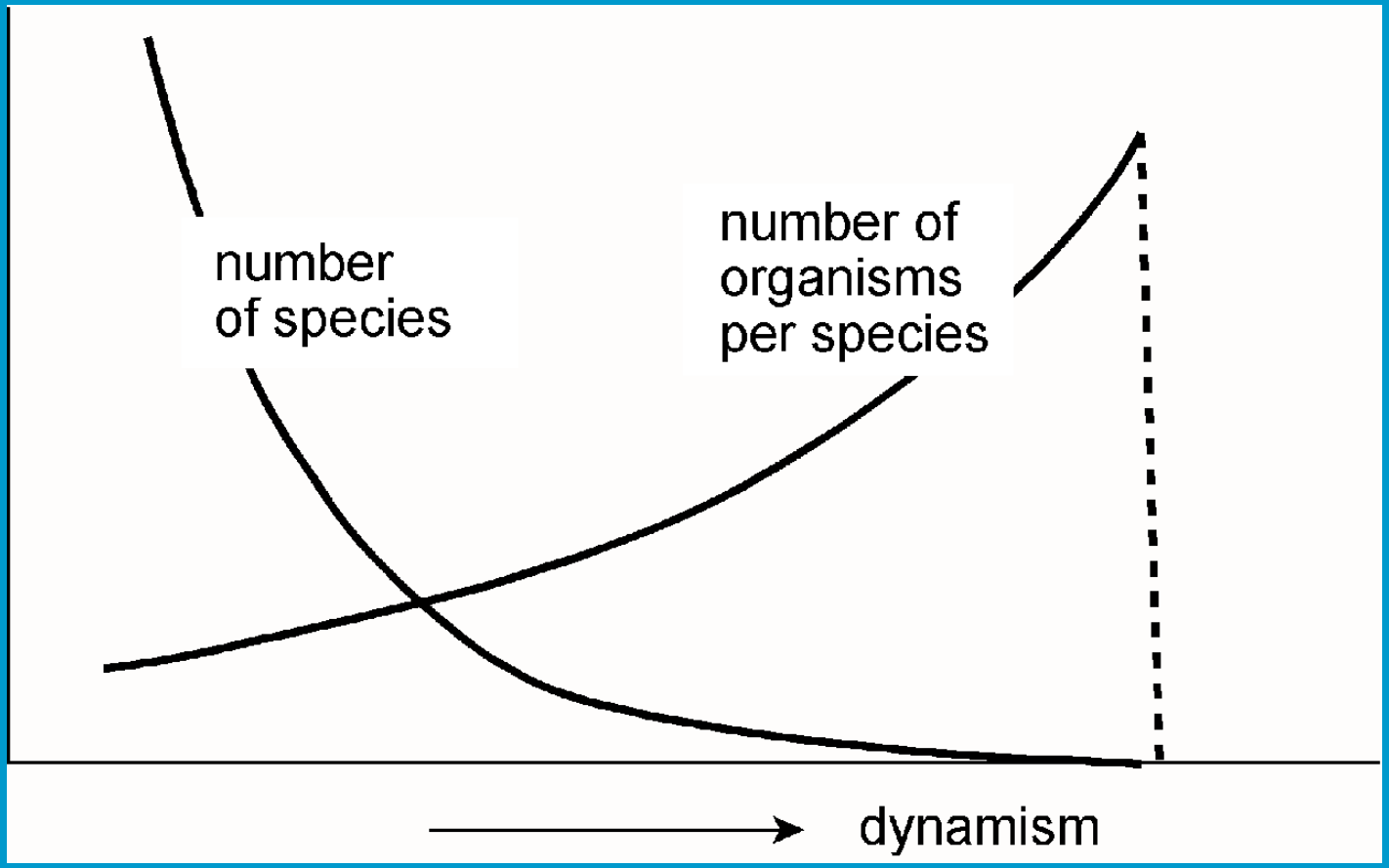


river as ecological connection with stepping stones

comparison

Space requirements versus
- discharge capacity,
- nautical possibilities, ect.

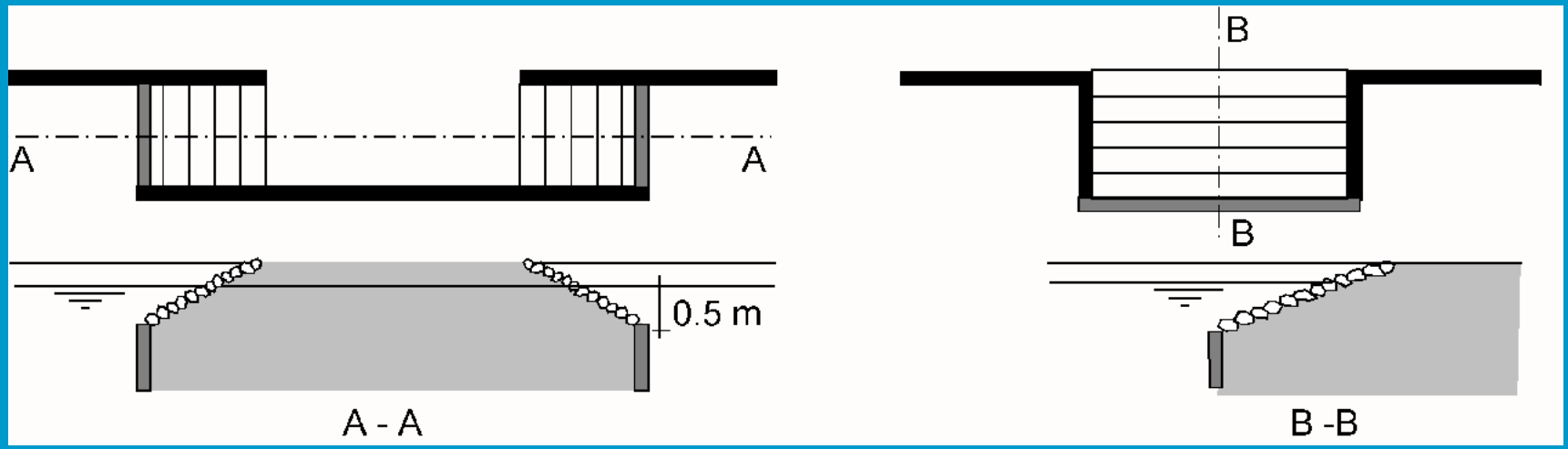
species and dynamics



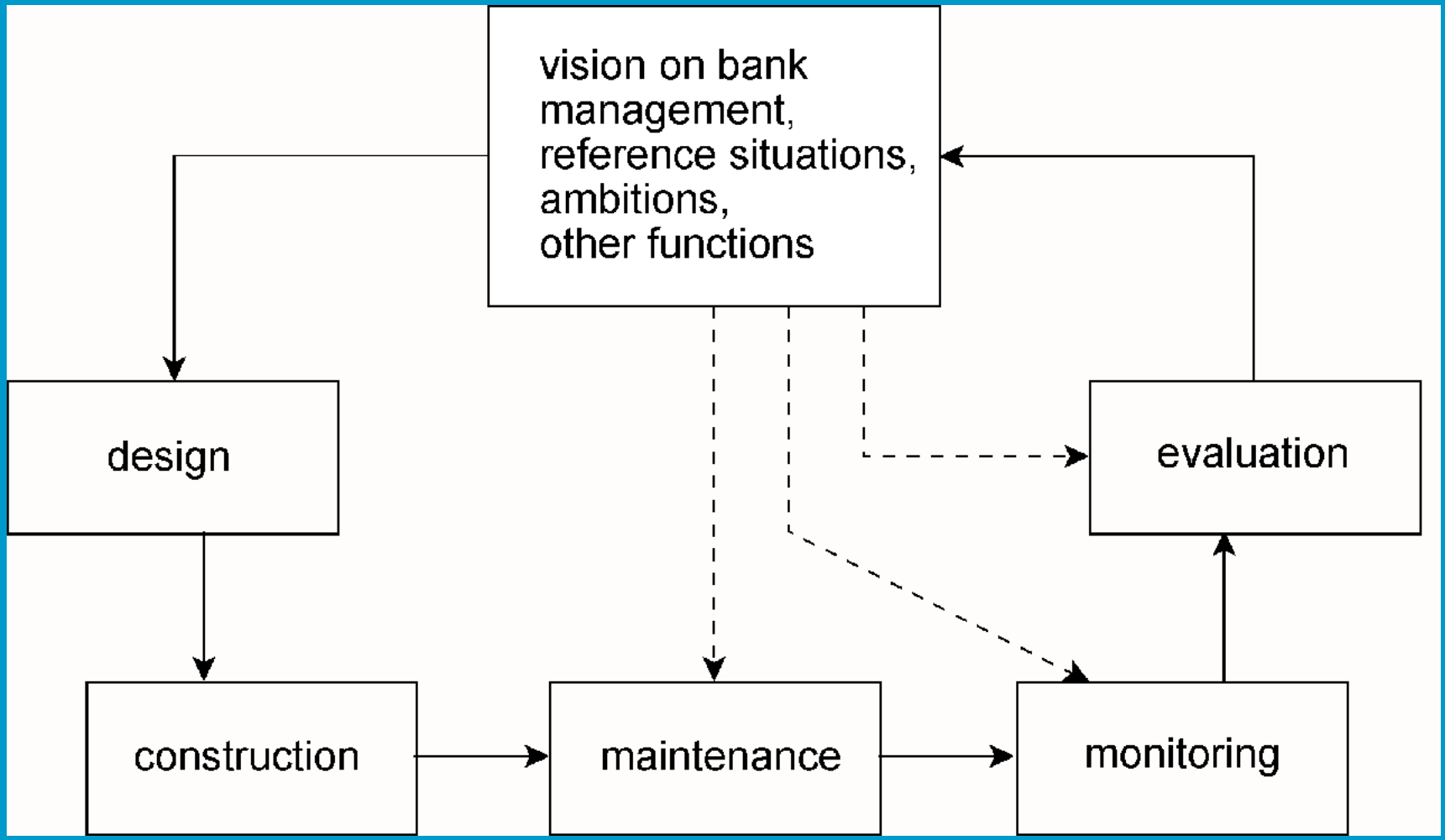
food chain relations in a bank

hardly any exchange of life is possible between land and water

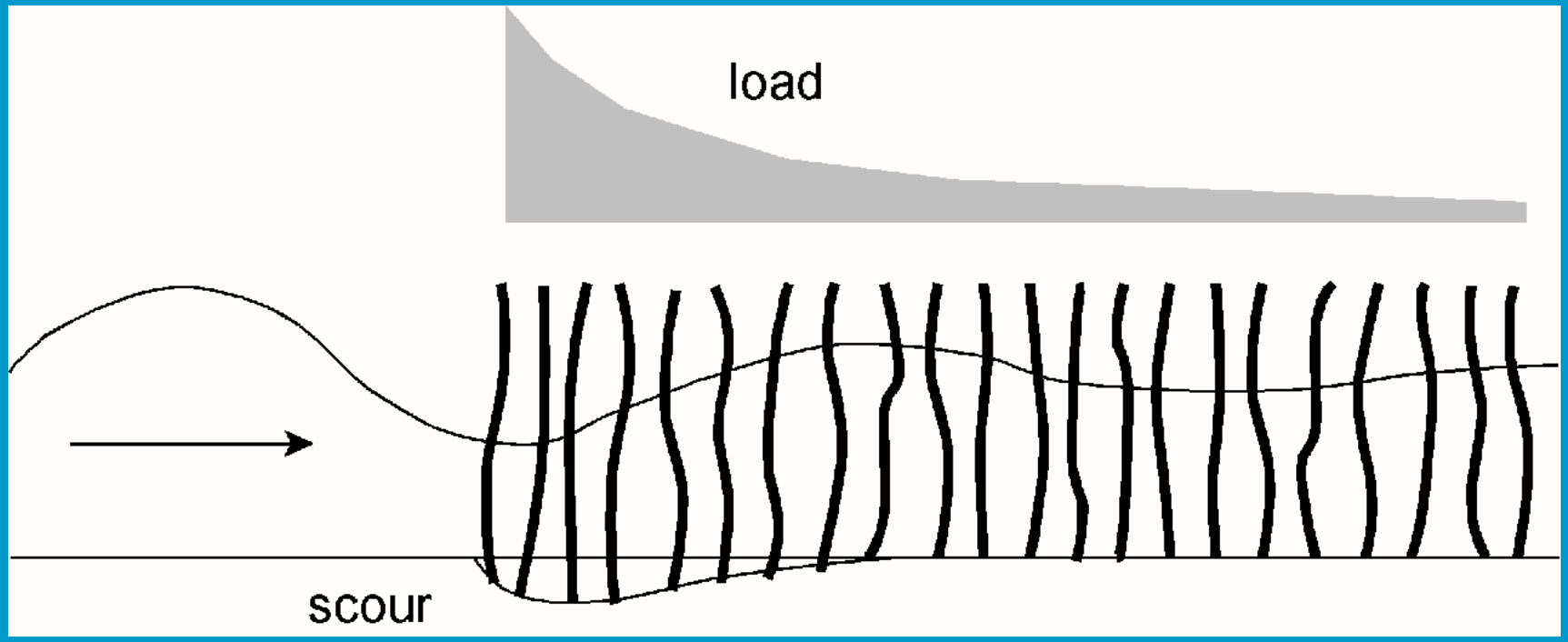
crossing location for mammals



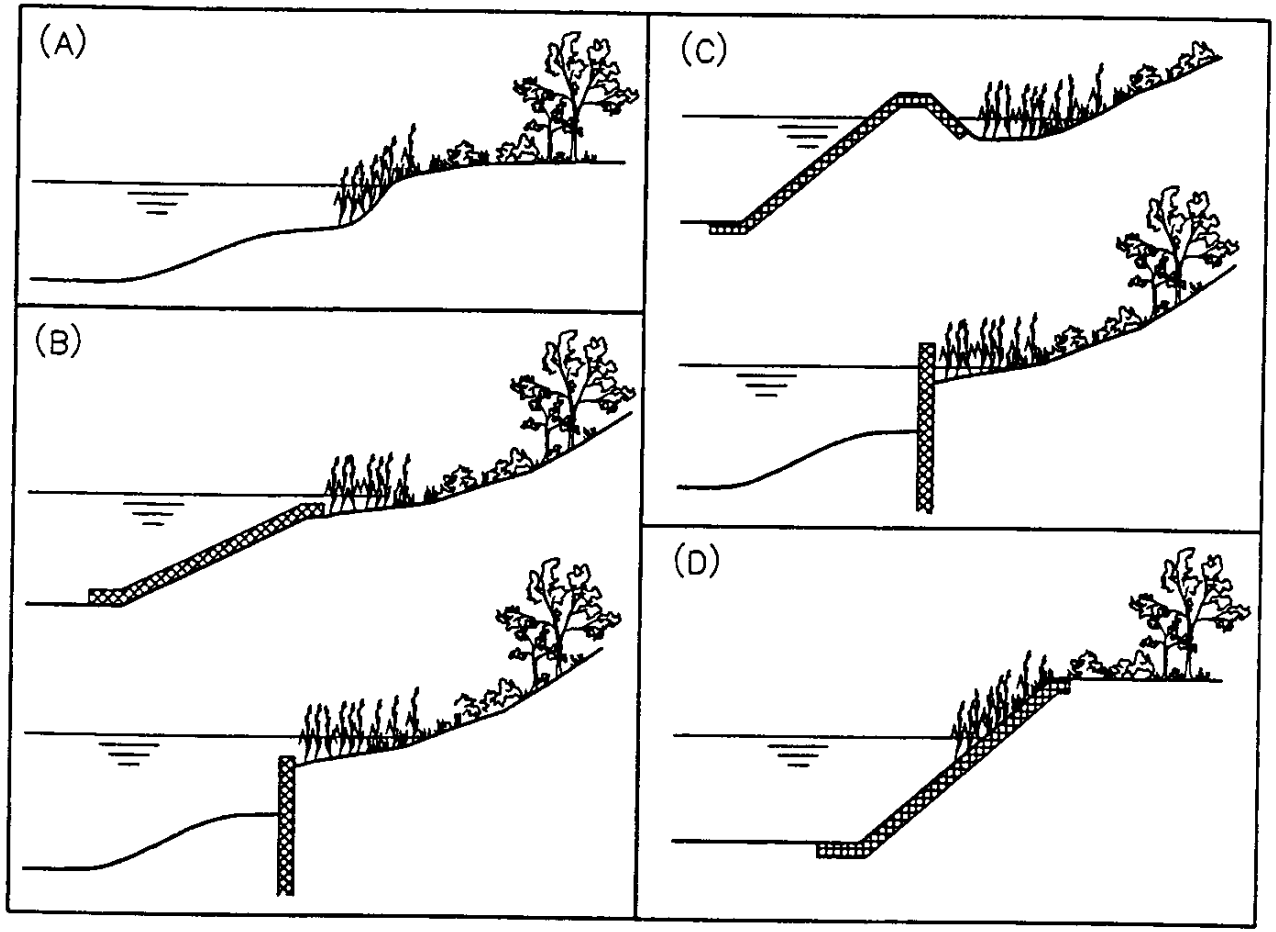
planning and execution of steps



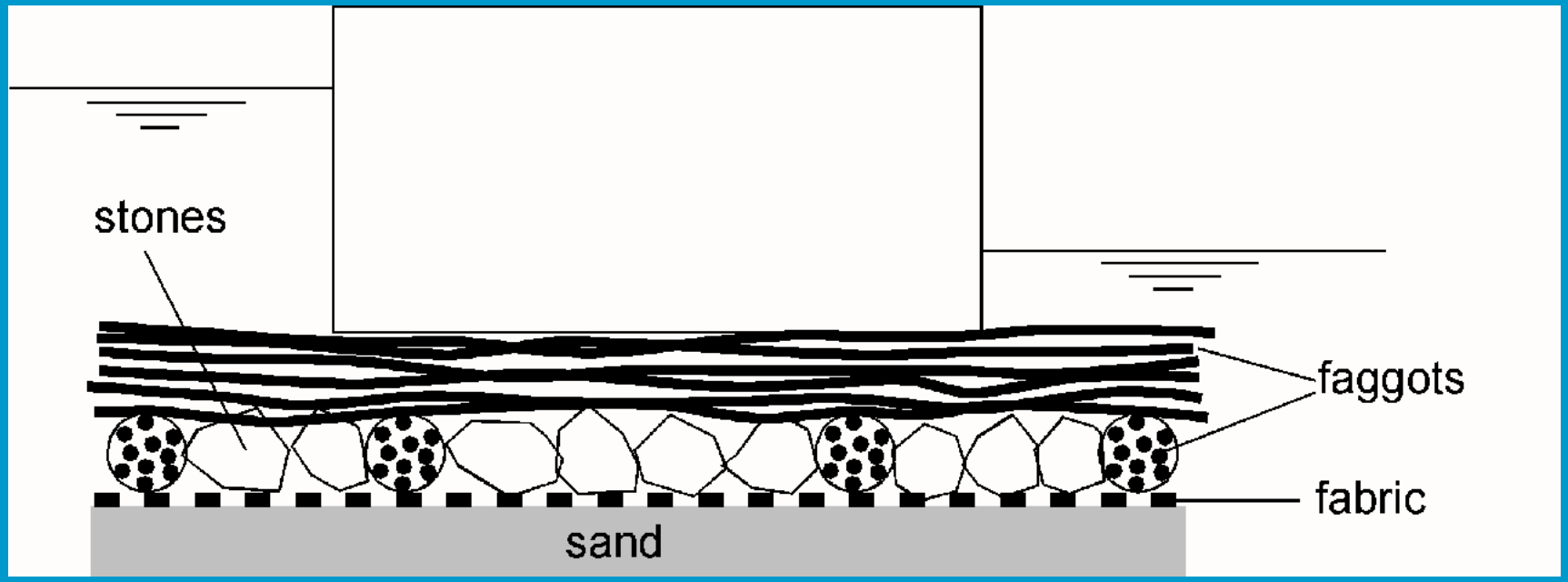
load and strength



Basic types of shoreline protection



filter tests for nature friendly fascine mattress



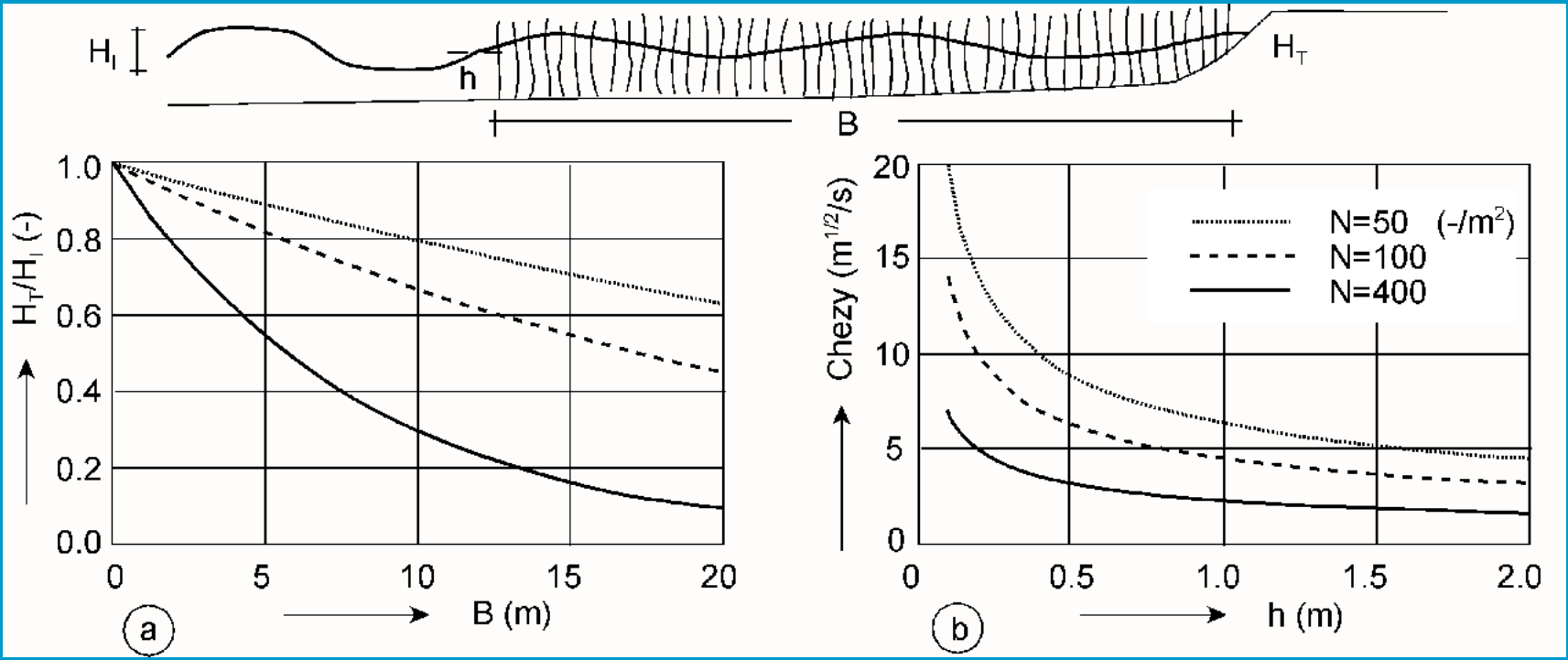
Reed and waves

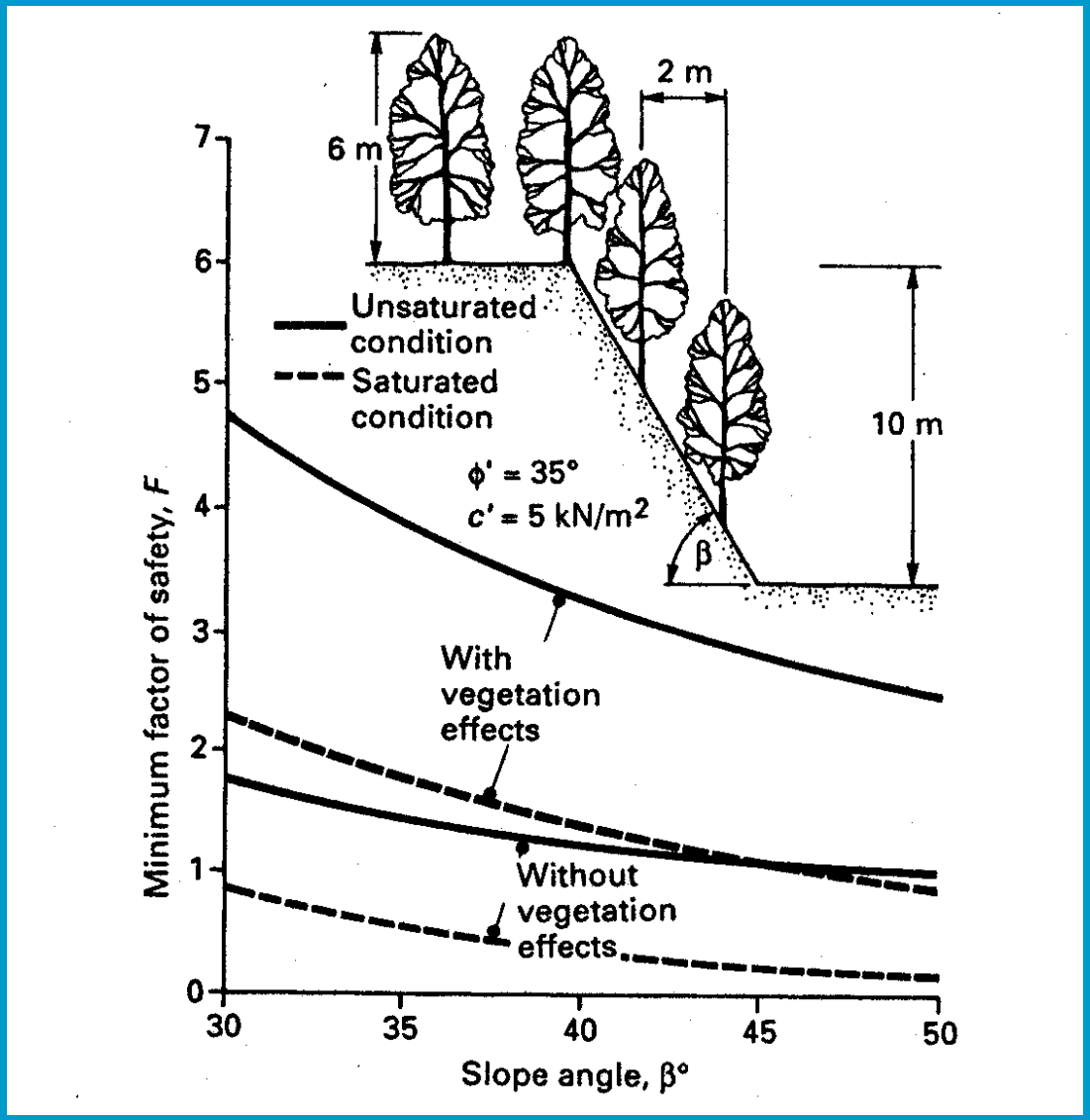
Damping of wave loads

$$K_T = \frac{H_T}{H_I} = 1 - \left[1 - \exp\left(-0.001 N^{0.8} \frac{B}{\cos \beta} \right) \right]$$

N = number of stalks per m^2
B = width of vegetation
β = angle of incidence
0° for windwaves
55° for ship waves

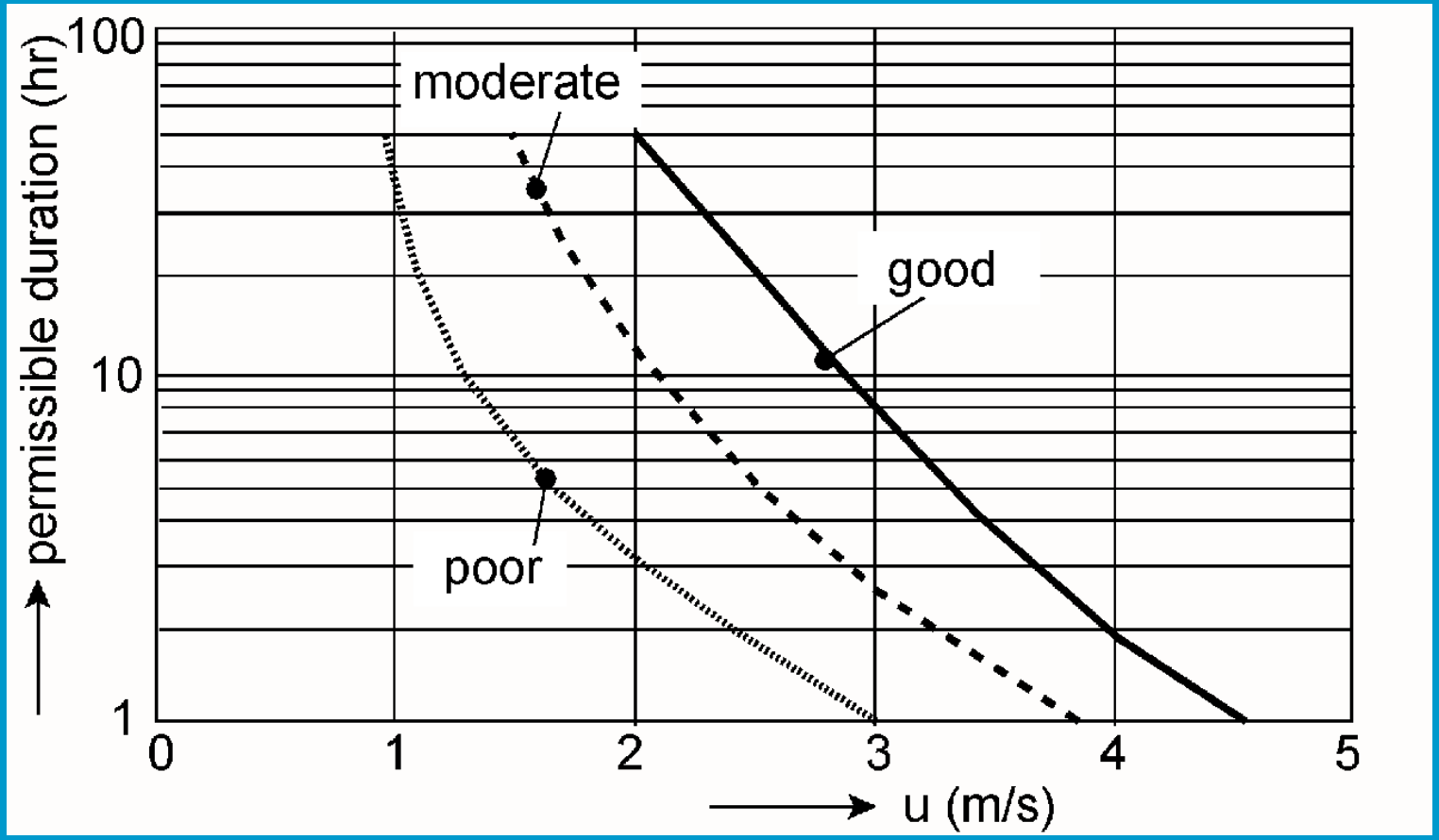
wave damping and roughness in reed



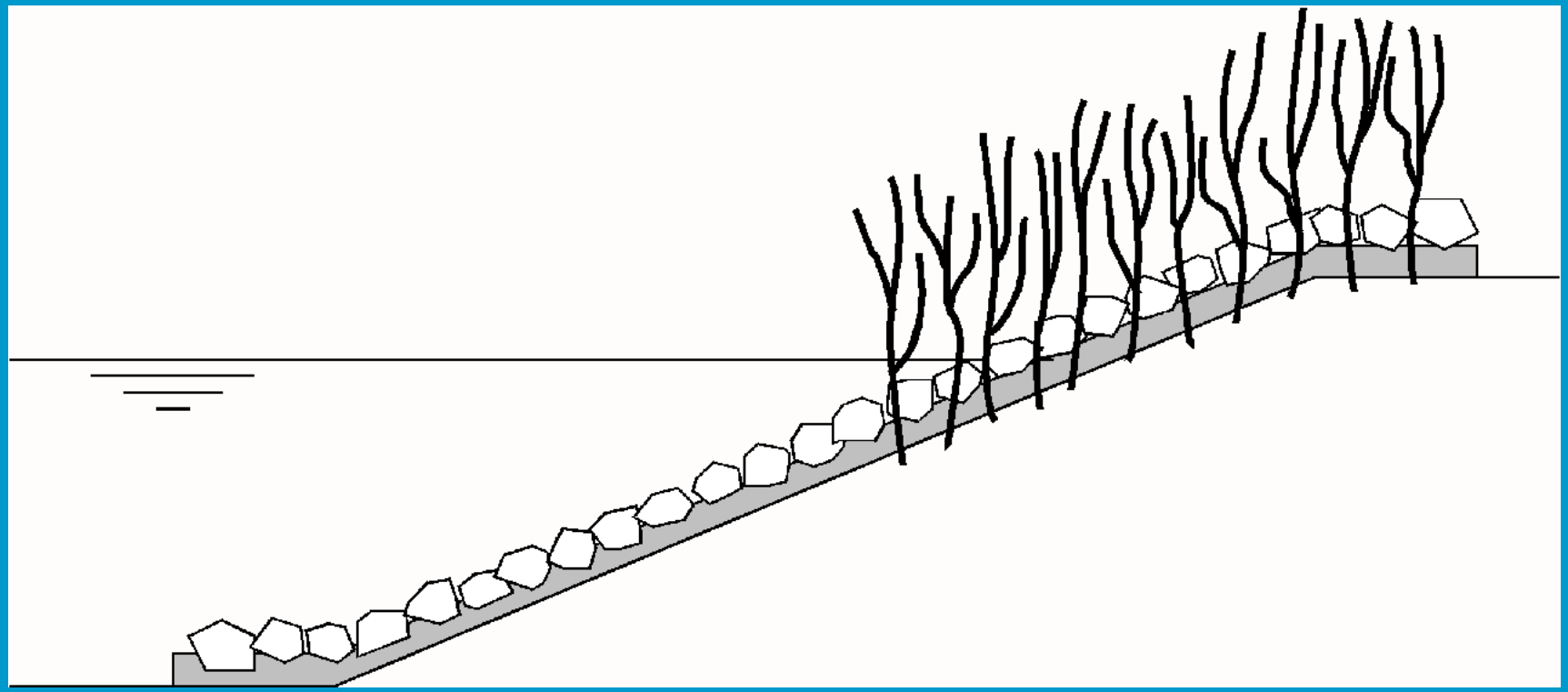


roots as an armour against sliding

permissible flow duration on grass cover

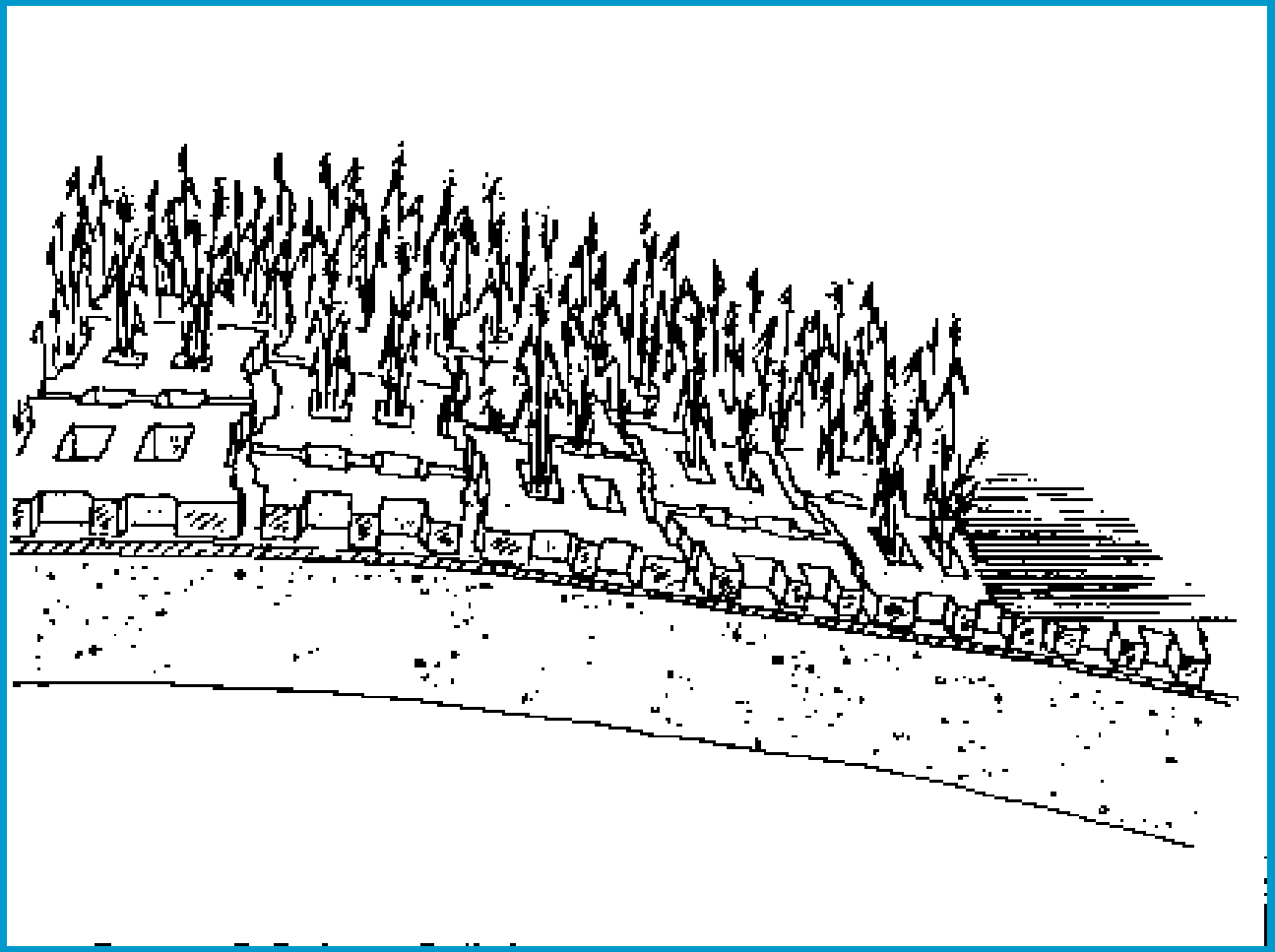


reinforced vegetation



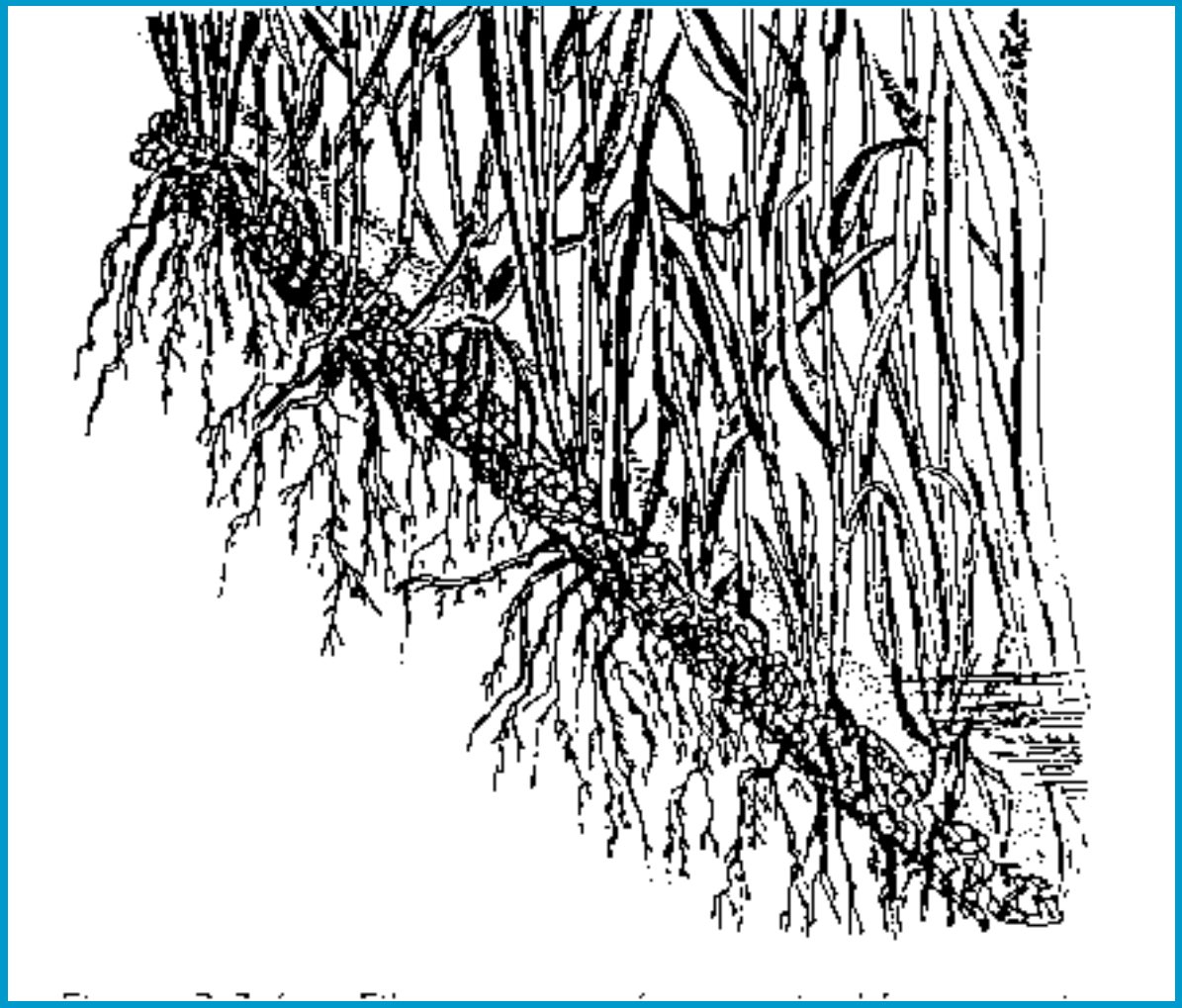
Vegetation growing through rock

Armorflex with vegetation

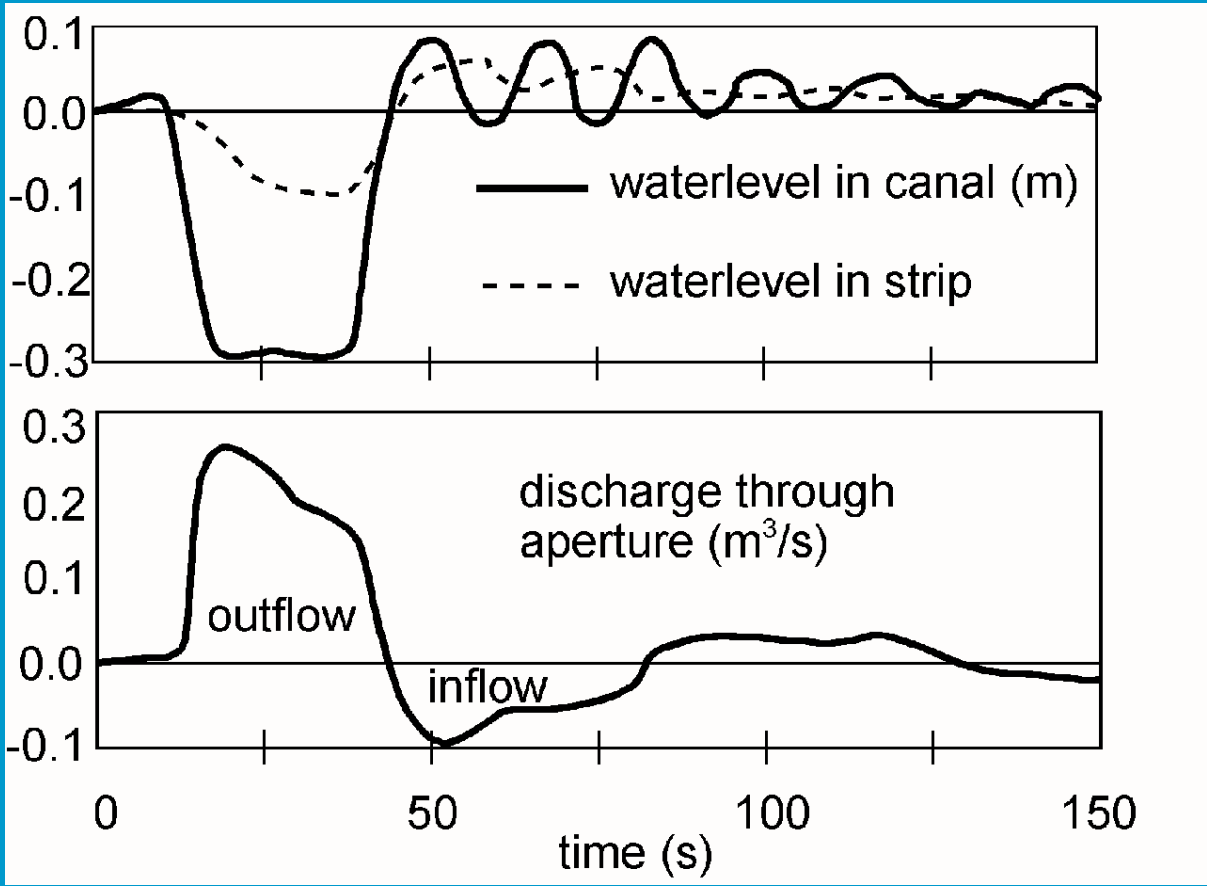


Roots in jute

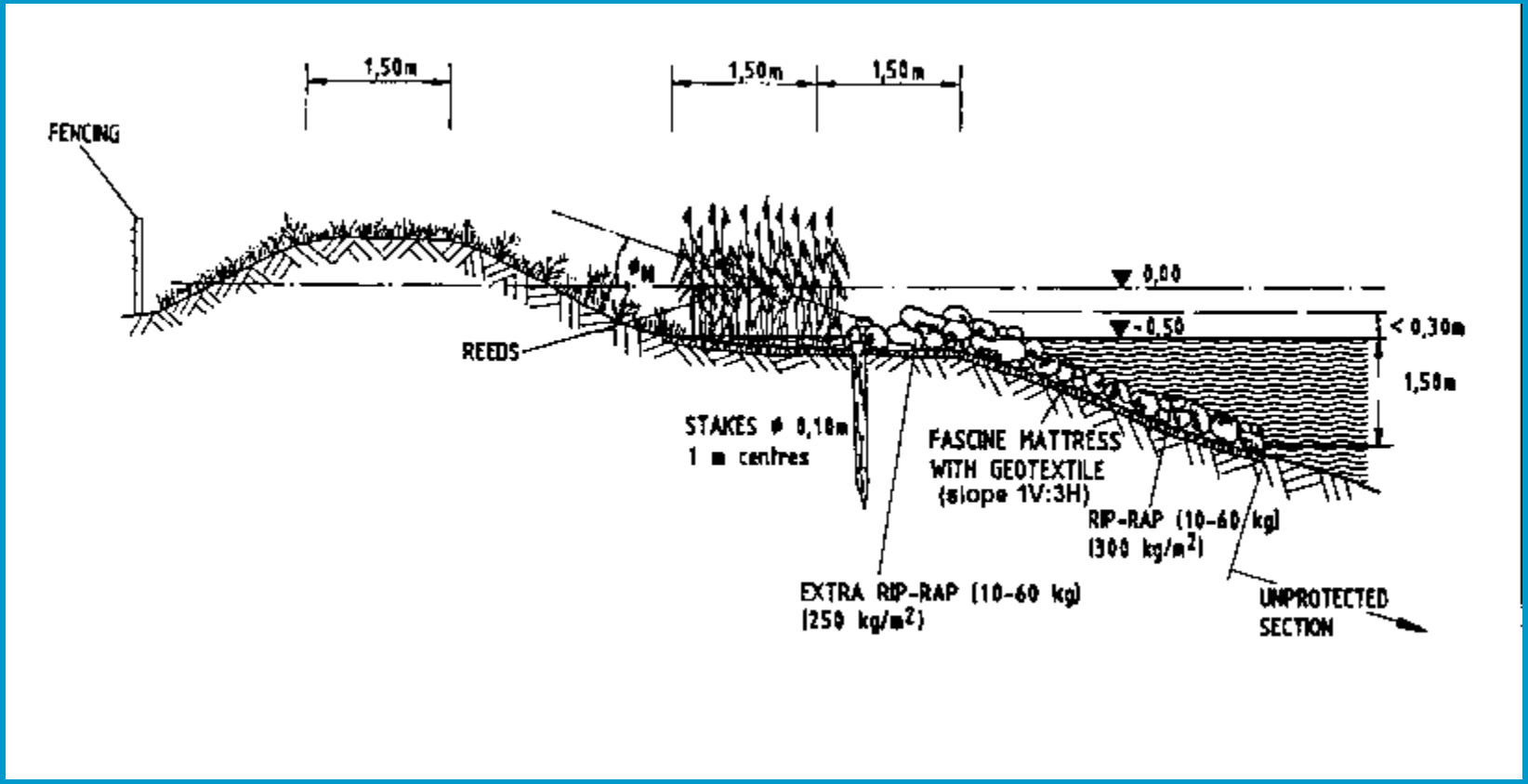
Roots and Enkamat



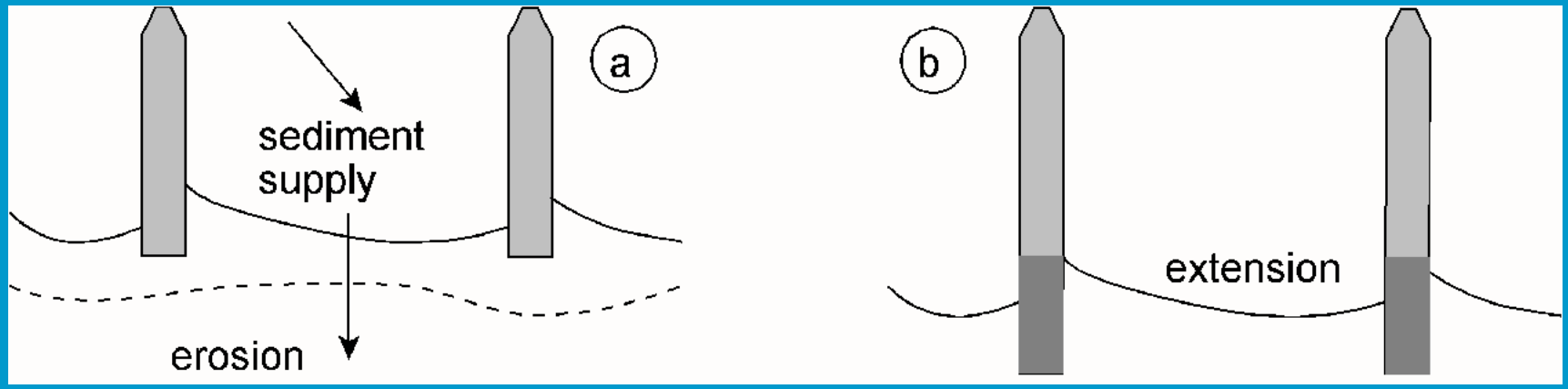
exchange of water in strip due to passage of a ship



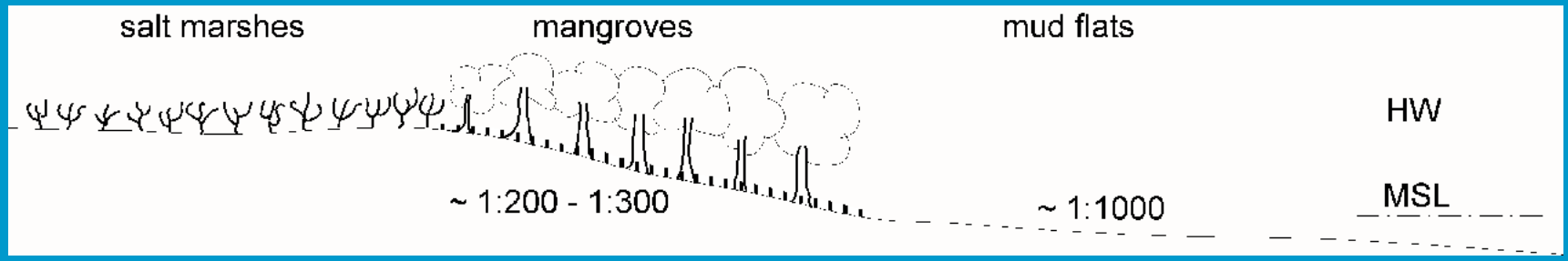
Berm along a shore

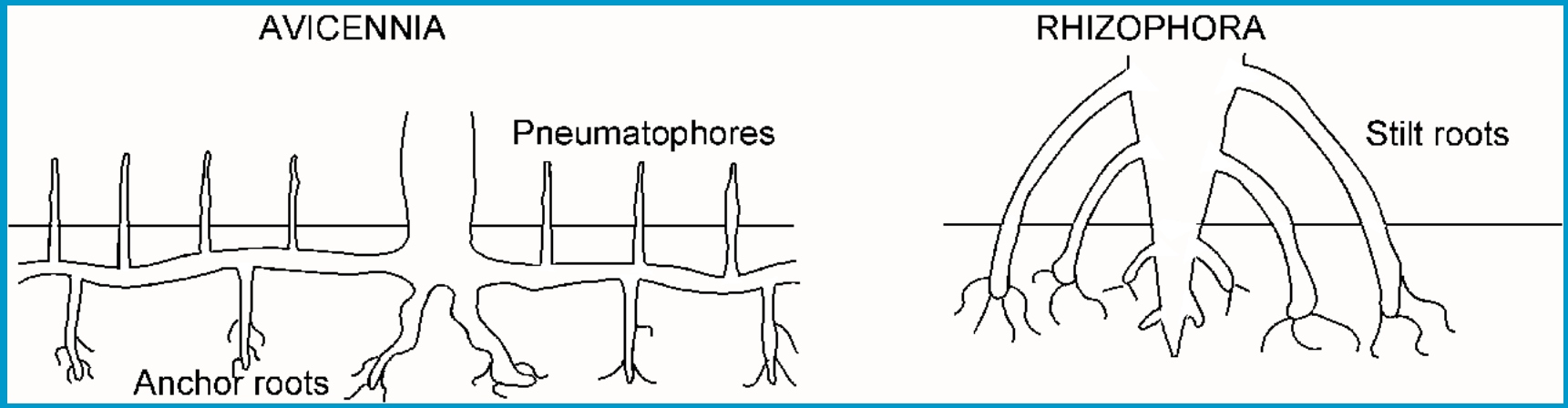


erosion between groynes

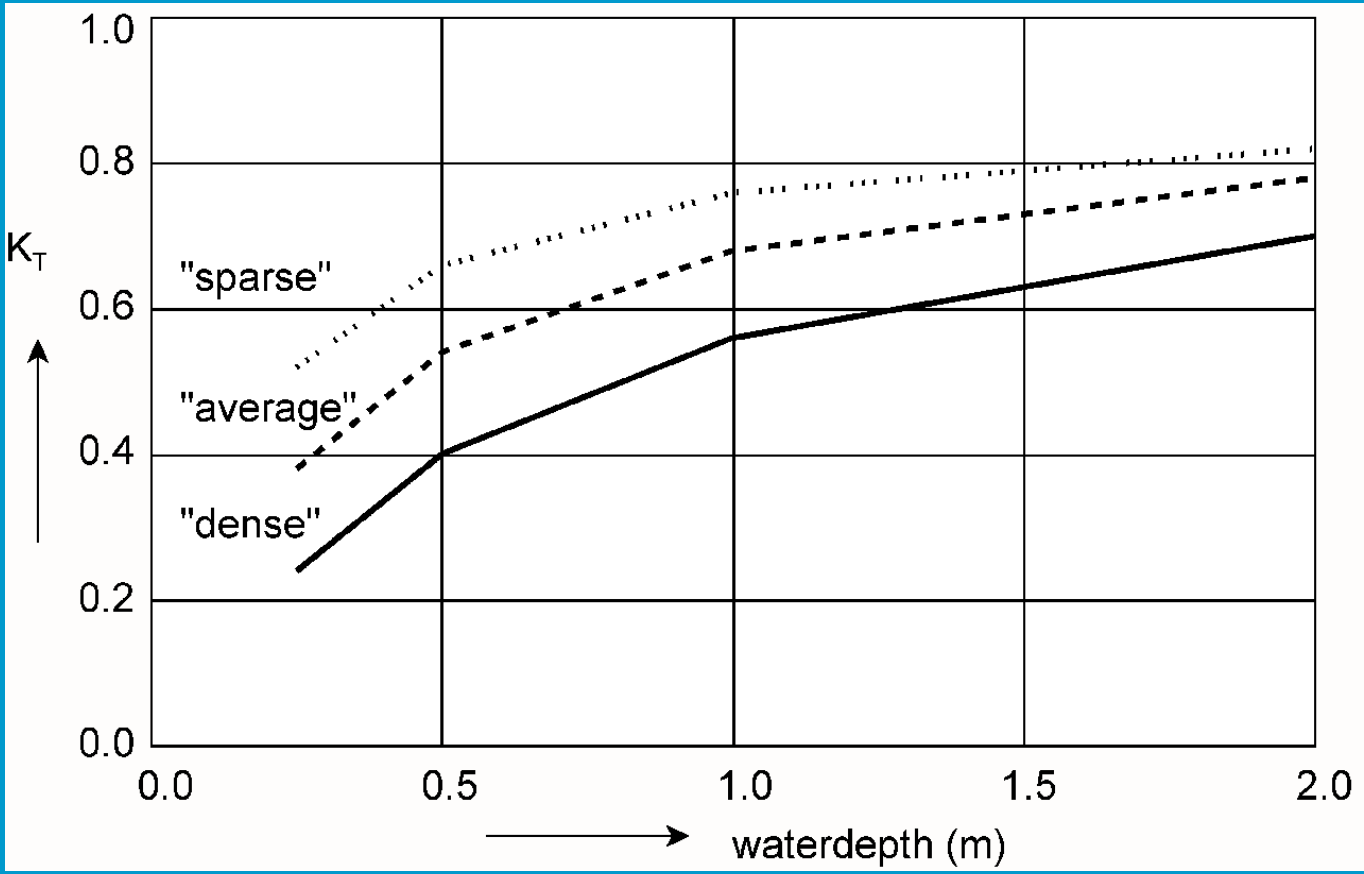


cross section of a coast with mangroves





wave transmission through mangroves (100 m)



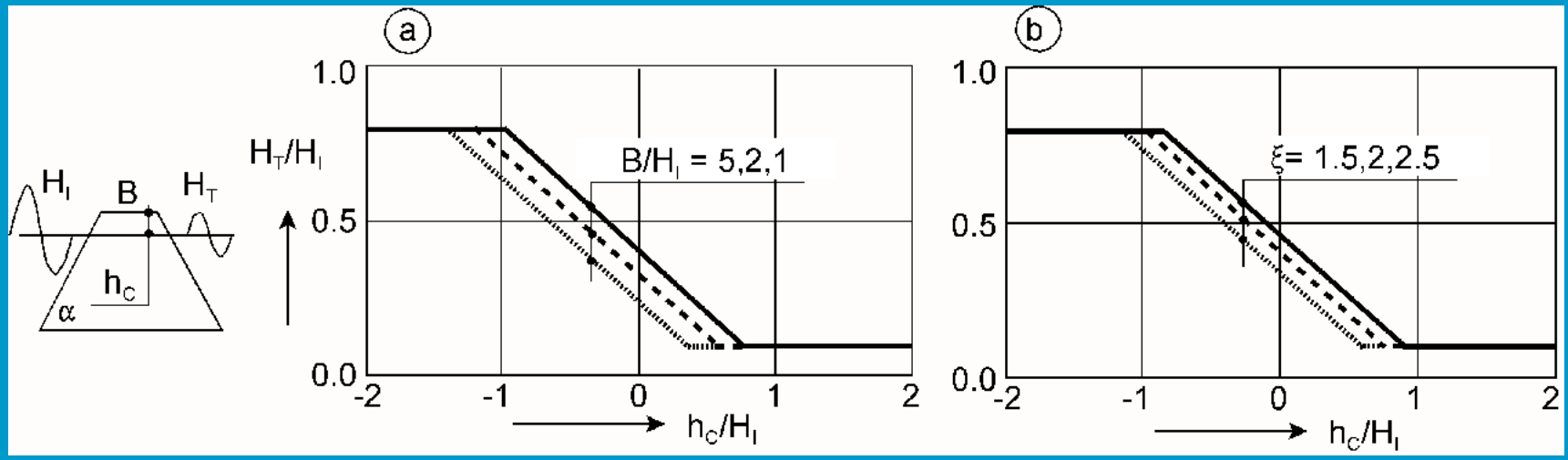
Load reduction over a dam

$$\frac{H_T}{H_I} = \left(\frac{B}{H_I} \right)^{-0.31} \left\{ 1 - \exp(-0.5\xi) \right\} F_{dam}$$

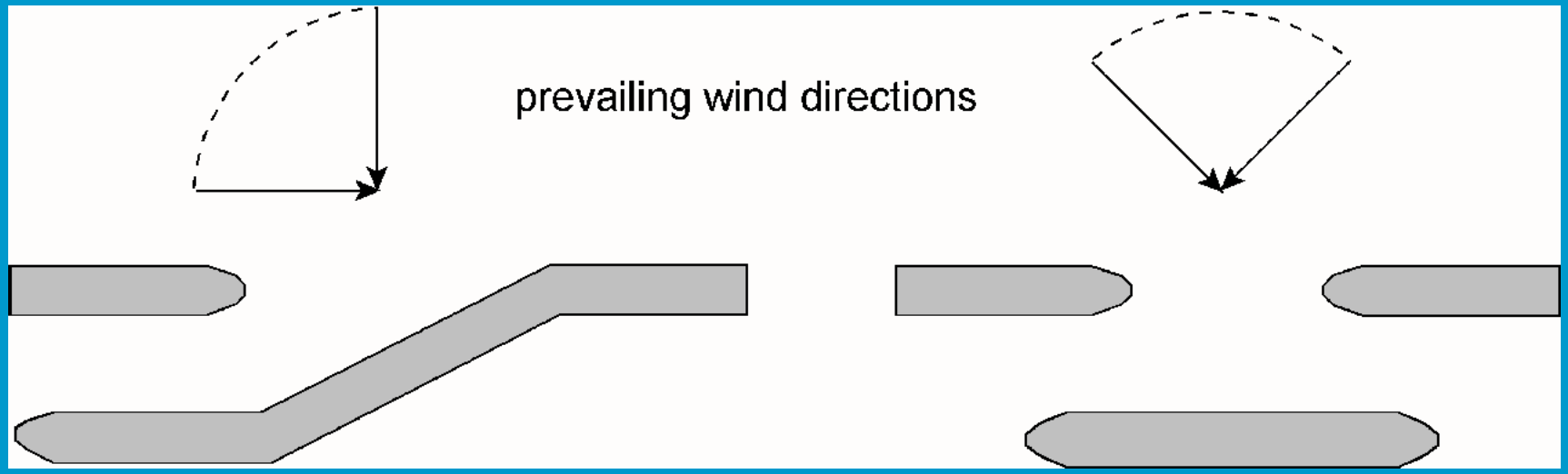
B = crest width of the dam

F_{dam}: 0.64 rock
0.70 gabions
0.80 closed (asphalt, blocks)

wave transmission dams



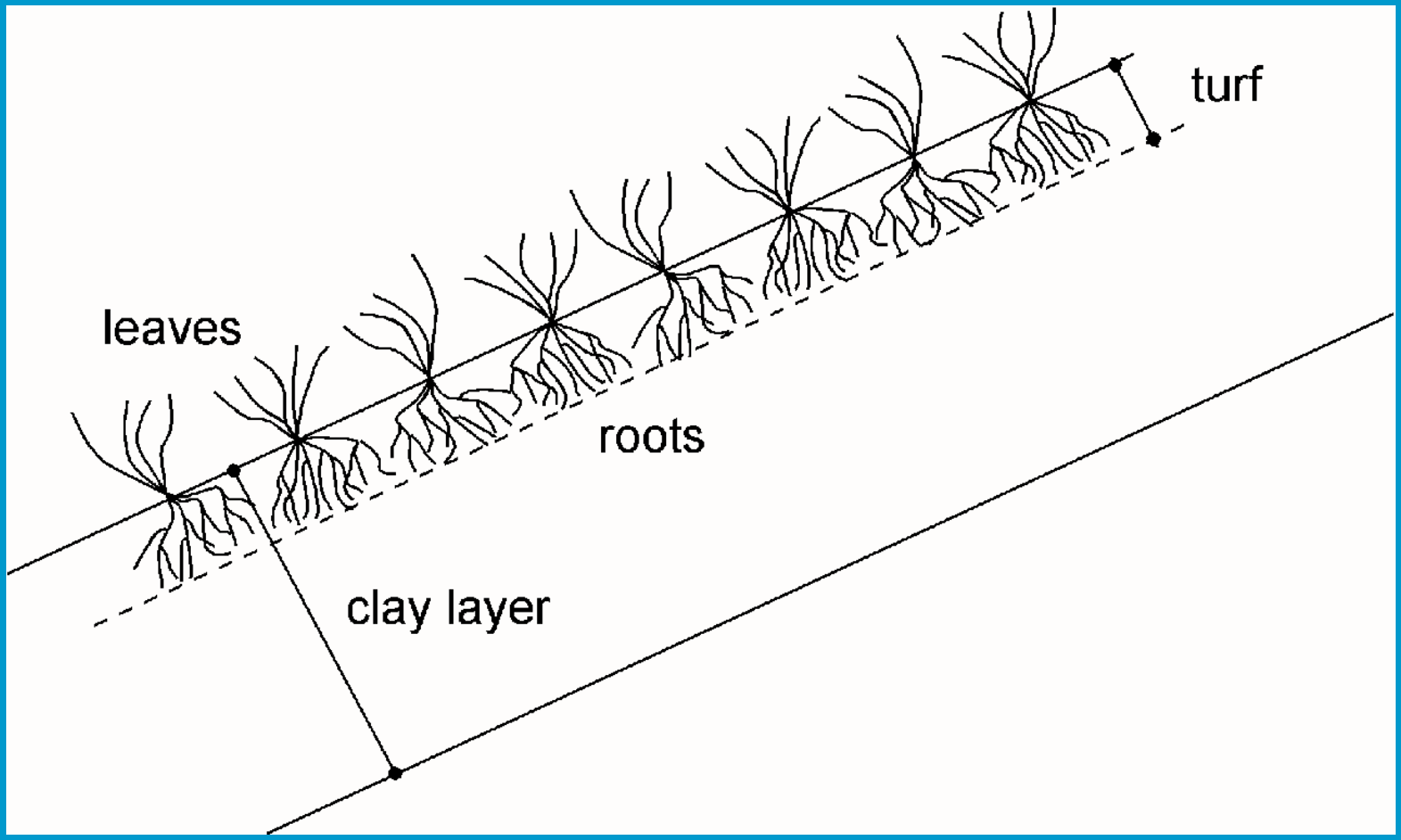
water exchange possibilities

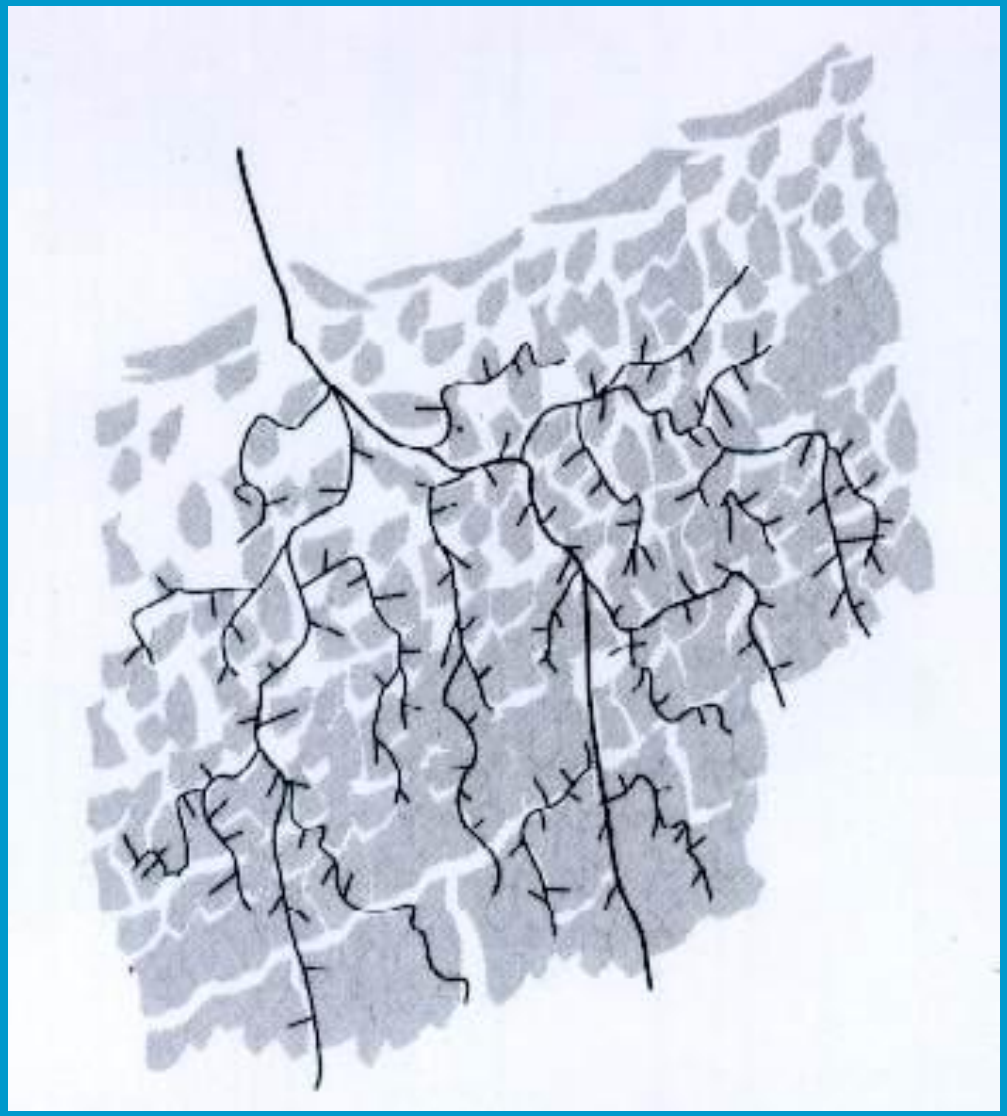


grass

- Grass is a flexible, renewable slope protection
- Grass can withstand quite some load
- Environmentalists do not like “monocultures”
- Fortunately from an engineering point of view, variation is also better
- Hydraulic engineers like roots, farmers like leaves

grass and clay layer

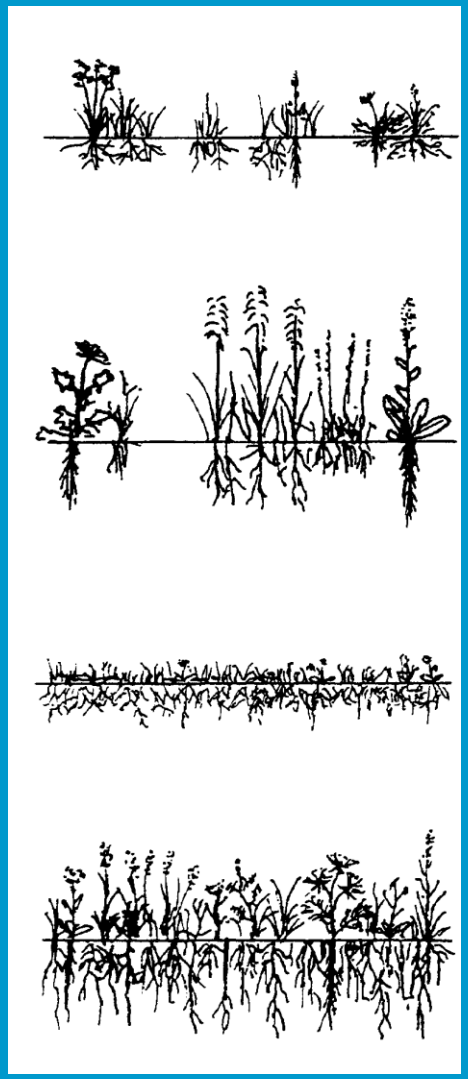




Texture formation in the clay body

Texture formation = structuurvorming
Textured = gestructureerd

“Maintenance”



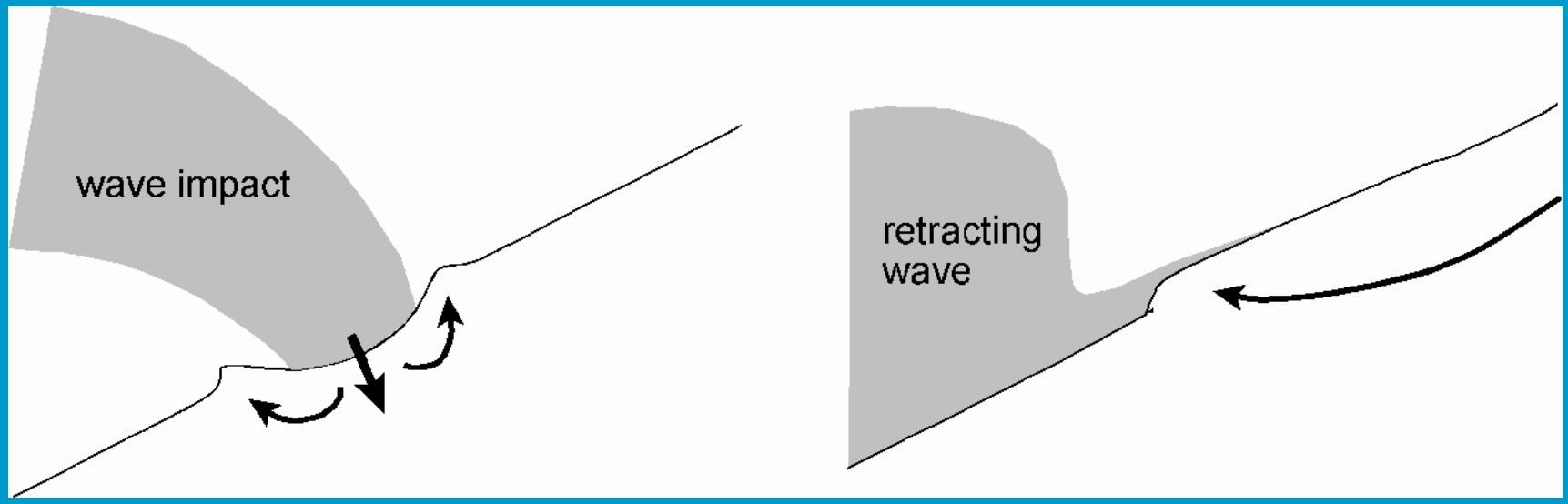
Cattle, fertilizer and herbicides

Fertilising, and no removal of grass

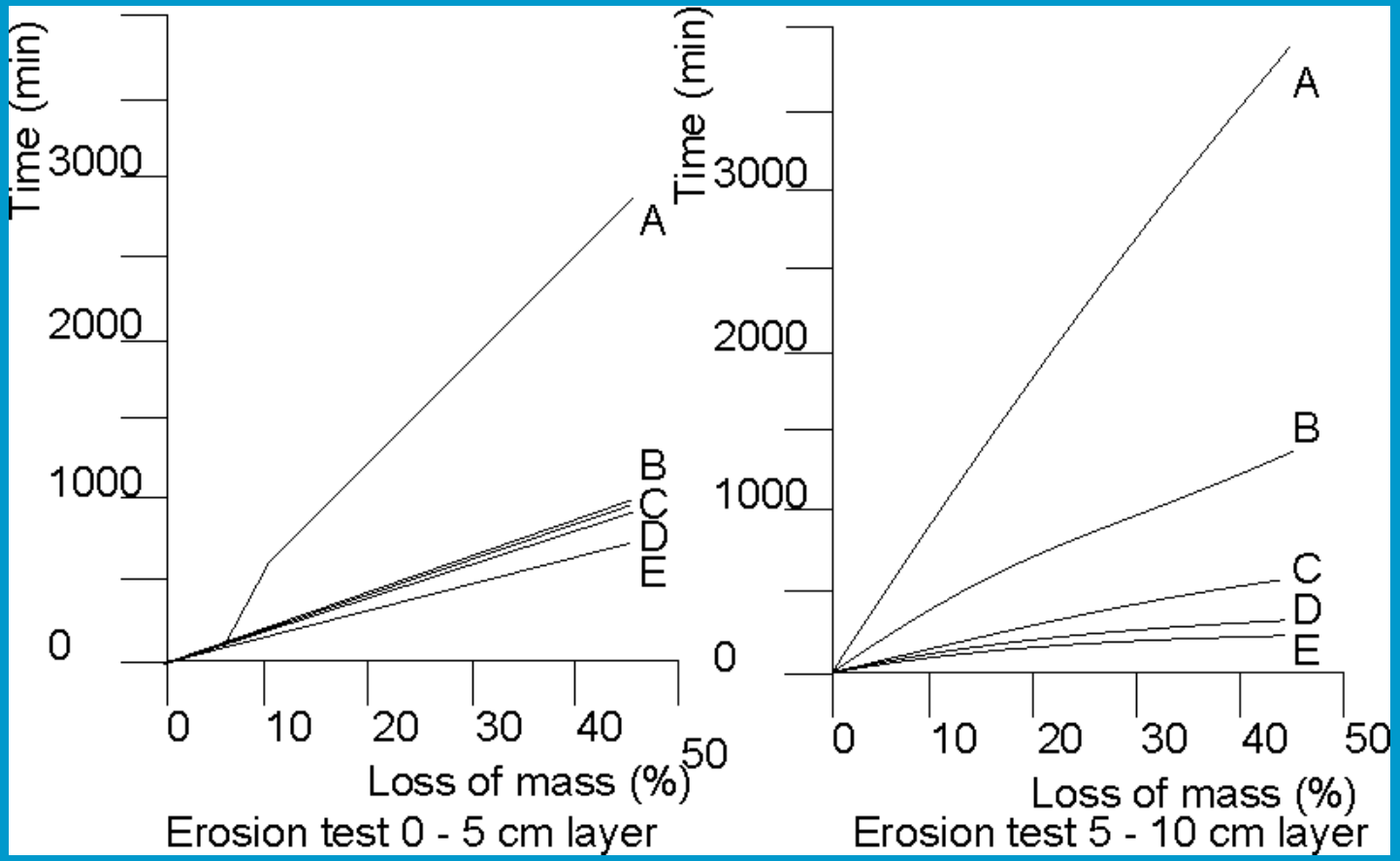
Cattle and light fertilising

No cattle, removal of grass

load and strength of grass under wave attack



results of erosion tests

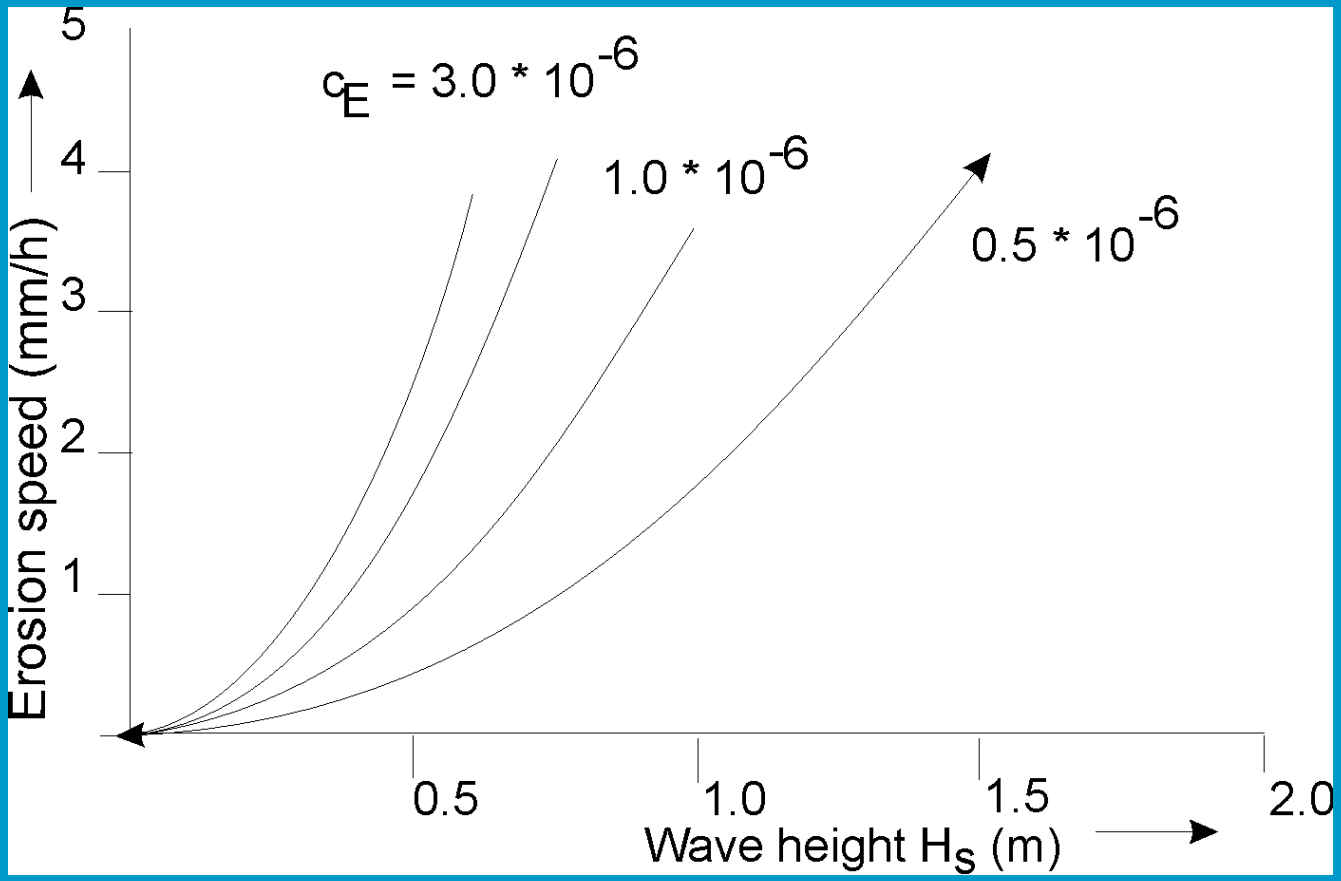


Non-fertilised after 25 yrs

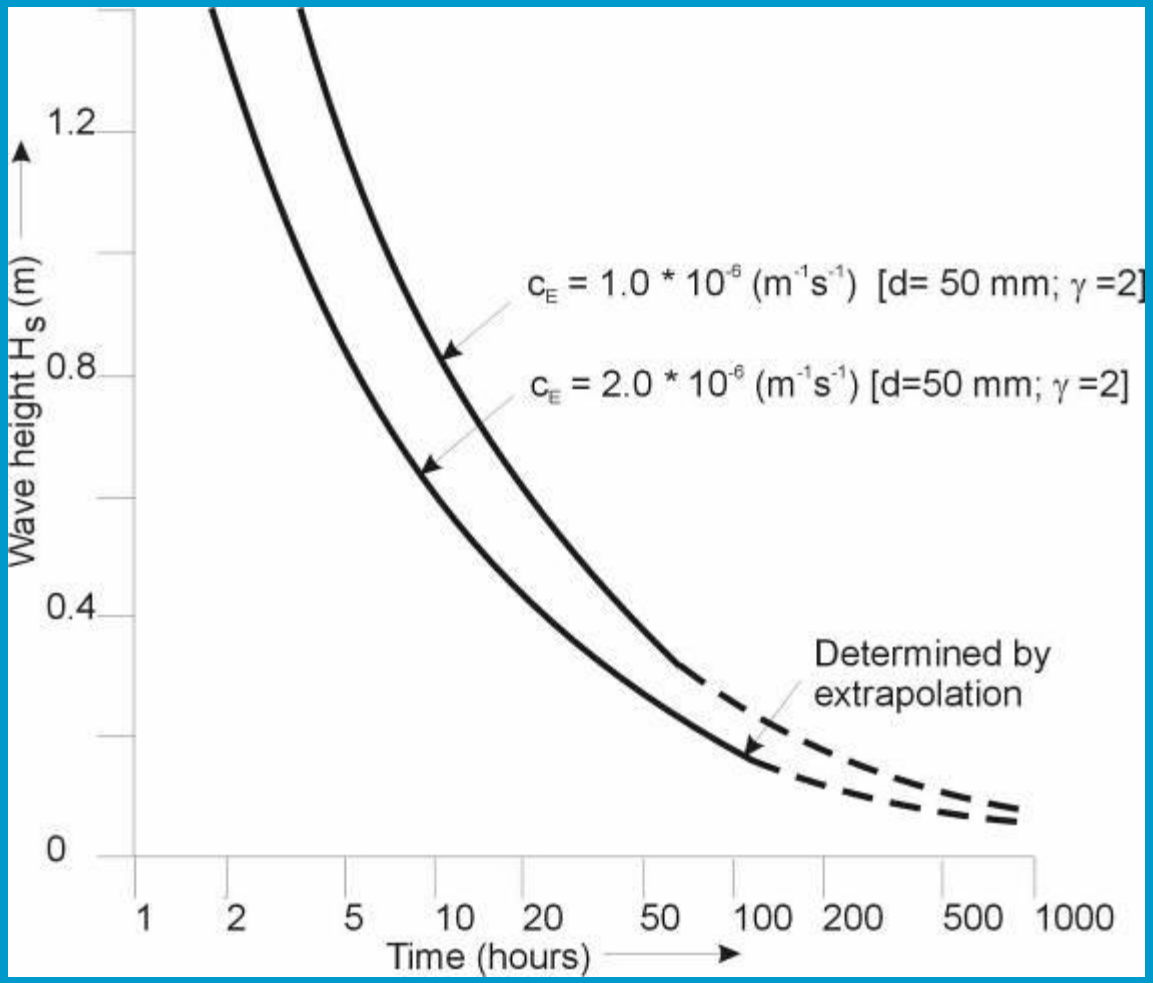
Non-fertilised

Fertilised + cattle

erosion speed as function of wave height



Erosion speed of a grass turf

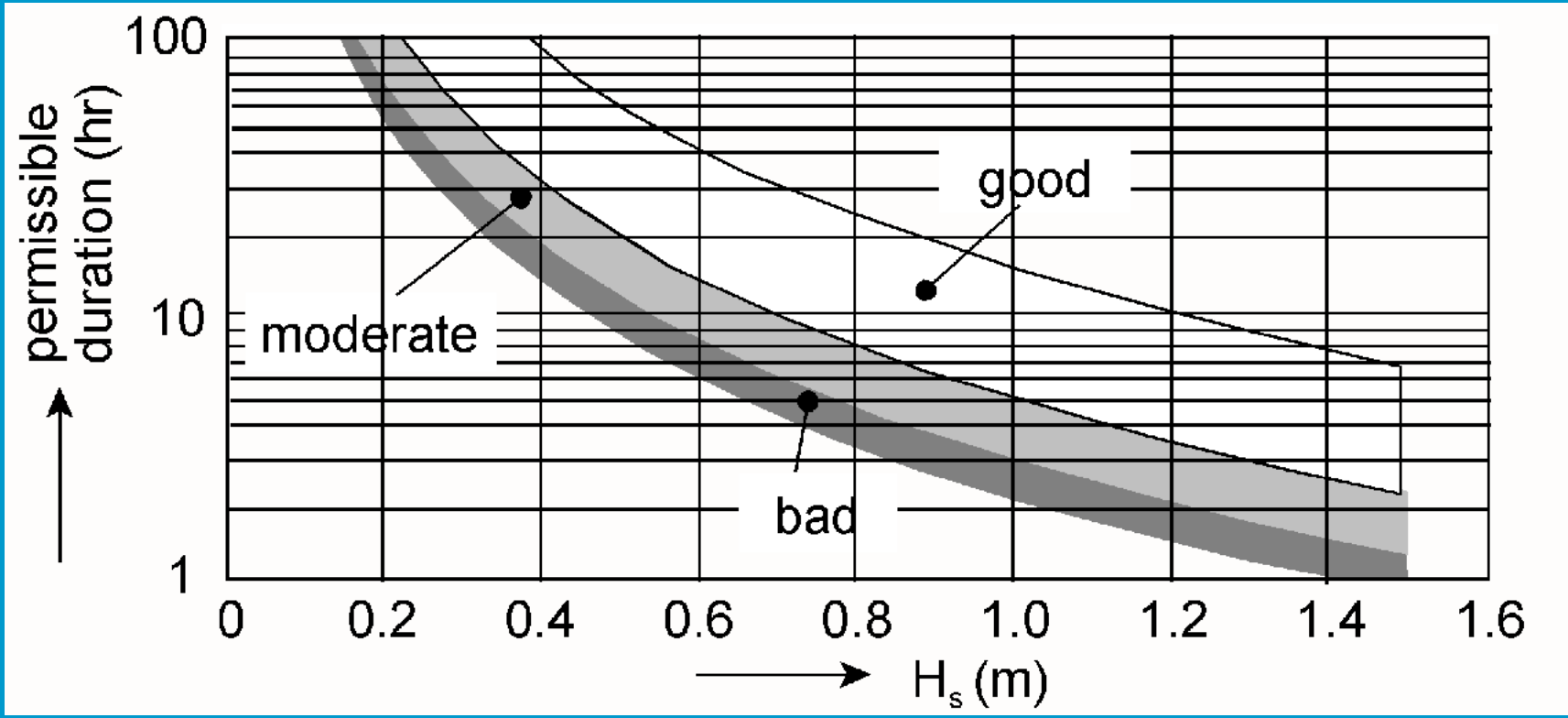


Quality	c_E
good	0.5 - 1.5
moderate	1.5 - 2.5
bad	2.5 - 3.5

$$t_{\max} = \frac{d}{\gamma E} = \frac{d}{\gamma c_E H_s^2}$$

γ safety coefficient
E erosion speed

permissible duration of wave load and grass quality



Inner slope problems

Bosman, 2007

Inner slope erosion without cover

ComCoast, 2007

Reinforced grass

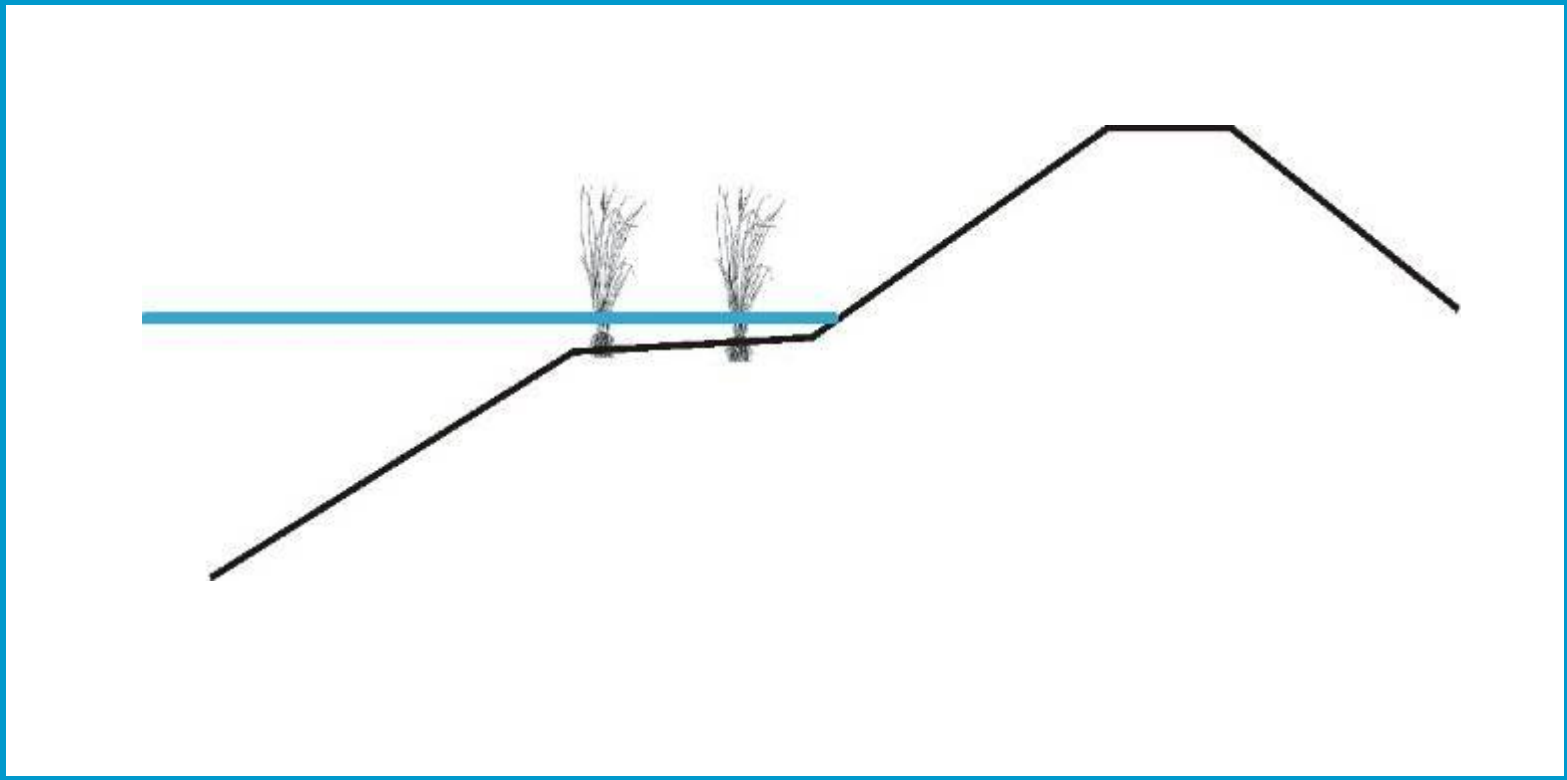
Conclusions

- Good grass cover does not show damage, even with very high overtopping discharges
- Grass with damages shows erosion with high overtopping rates
- Reinforced grass shows less damage in case of damage
- After removal of the grass cover, damage is considerable

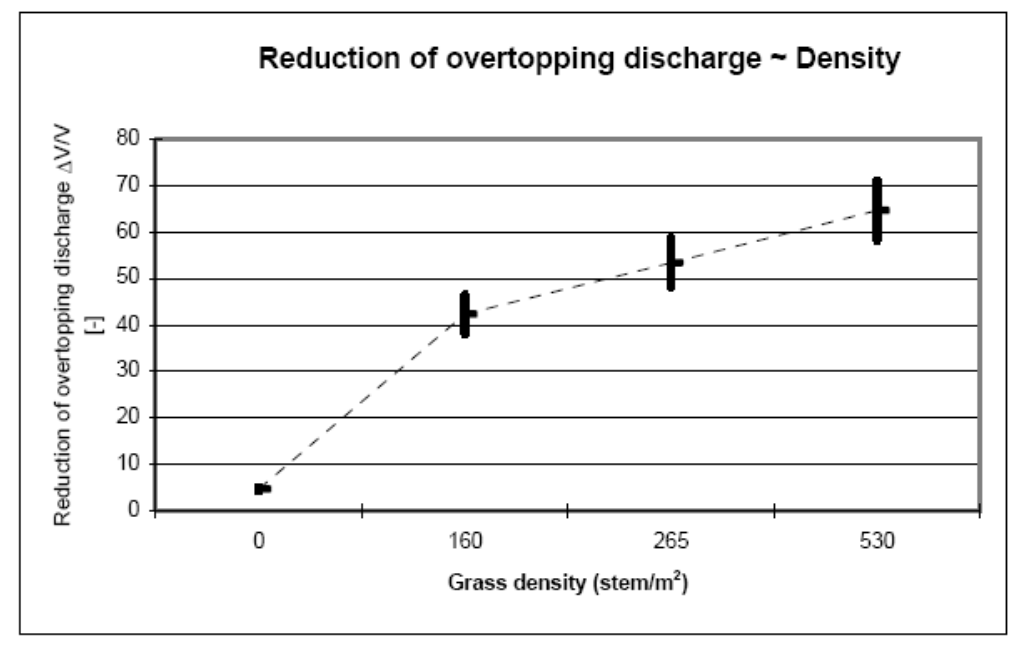
Vetiver nursery

Agricultural University,
Ho Chi Minh city, Vietnam

Vetiver as run-up reductor

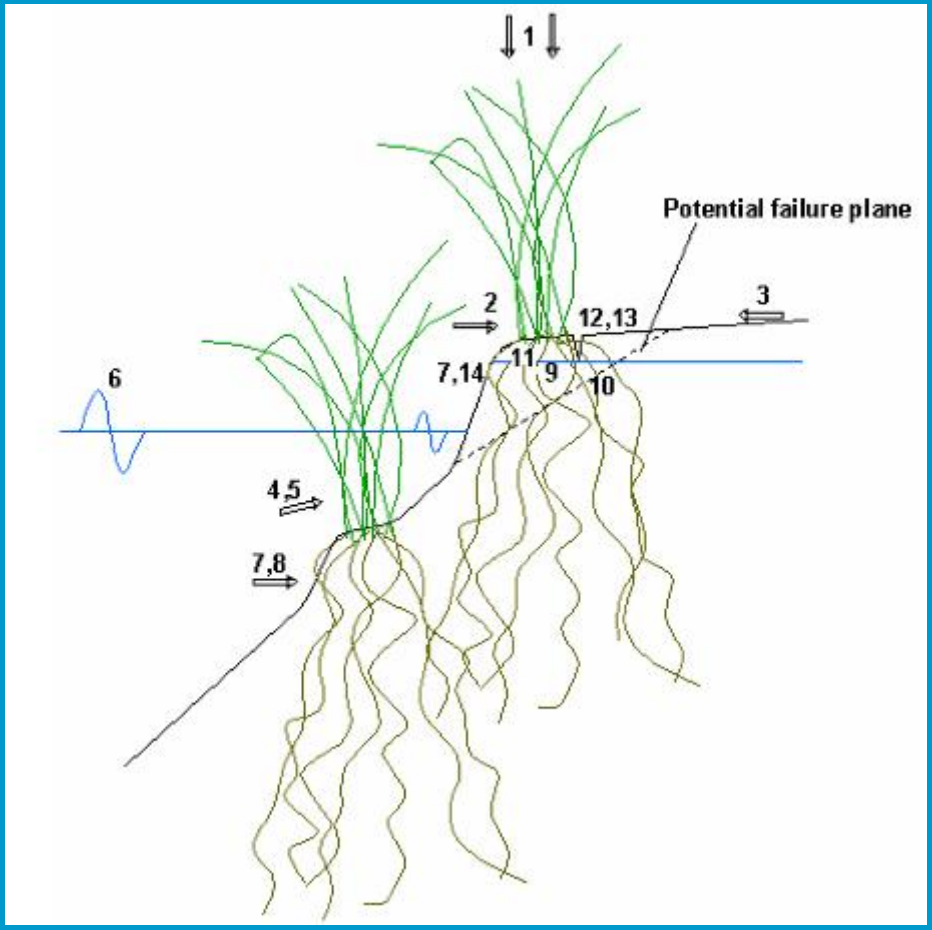


Results of the experimental work



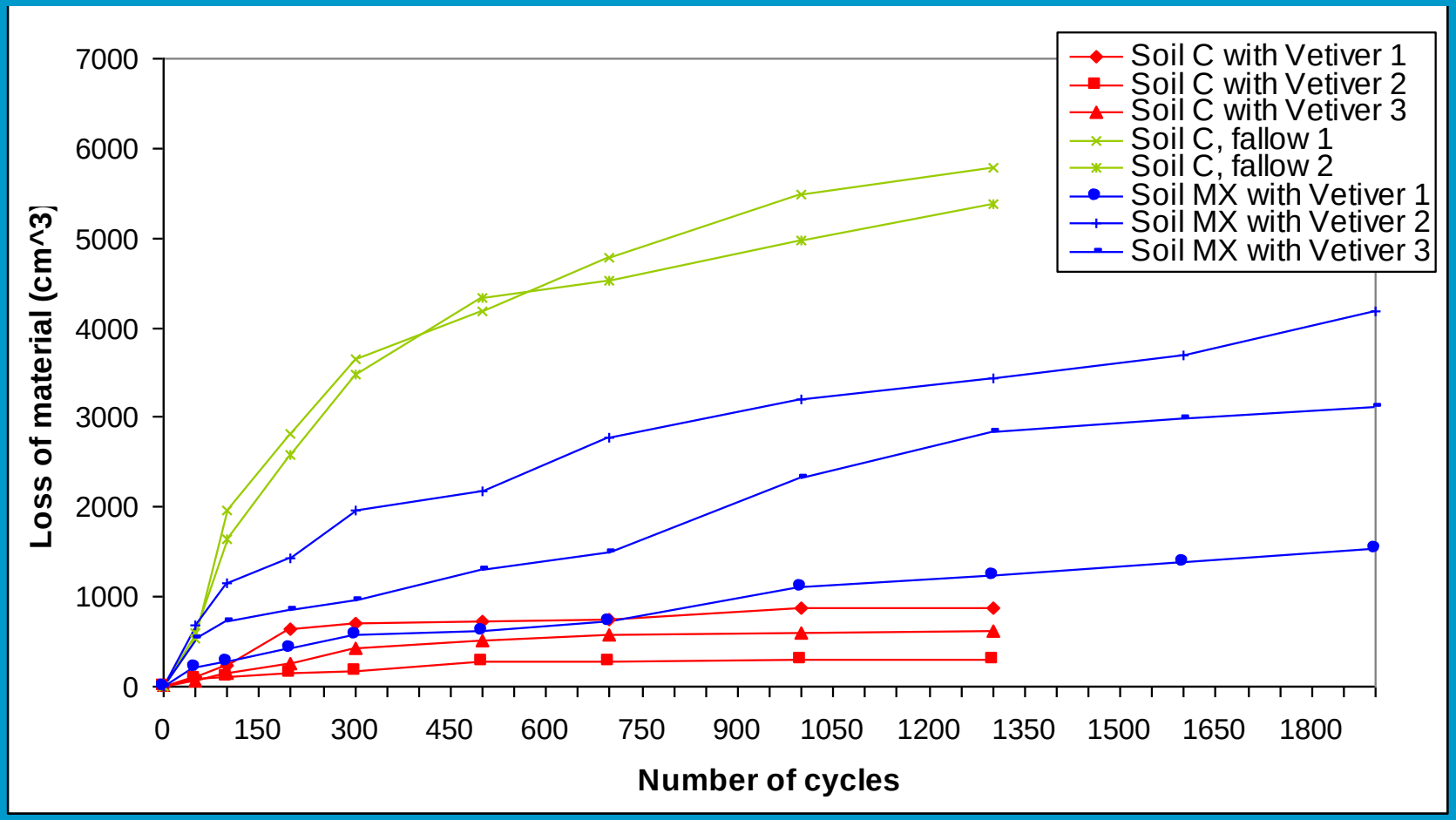
Algera, 2006
Vu, 2007

Bank protection with Vetiver



Jaspers Focks, 2006

Cumulative loss of bank materials



Jaspers Focks, 2006