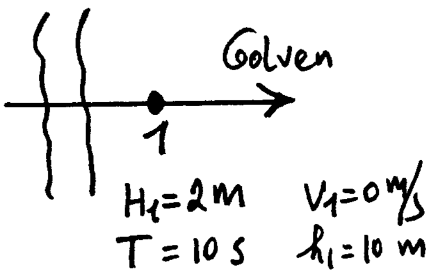
TENTAMEN KIVL 6 februari 1998, 9-12 uur

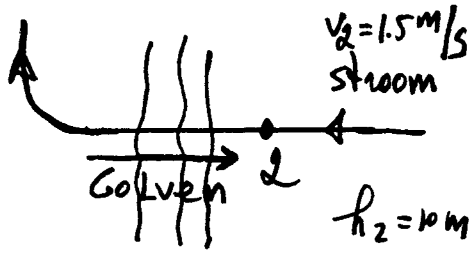
- General data:

water density	1000 kg/m^3
sediment density	2650 kg/m^3
gravity acc.	9.81 m/s^2
temperature	18 Celsius
kinematic viscosity	1. 10^{-6} m^2/s
Von Karman constant	0.4
shape factor sand	0.7
porosity factor	0.4

1.

Regelmatige golven (H= 2 m, T= 10 s) komen vanuit gebied 1 met waterdiepte h1= 10 m en stroomsnelheid v1= 0 m/s in gebied 2 met waterdiepte h2= 10 m en stroomsnelheid v2= 1.5 m/s (tegenstroom met φ= 180°).





a. bereken de golflengte en voortplantingssnelheid in punt 1.

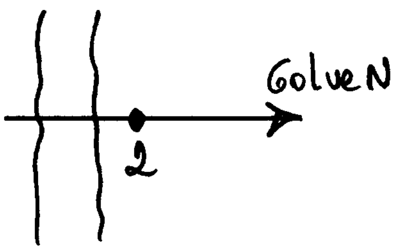
b. bereken de golflengte en voortplantingssnelheid in punt 2.

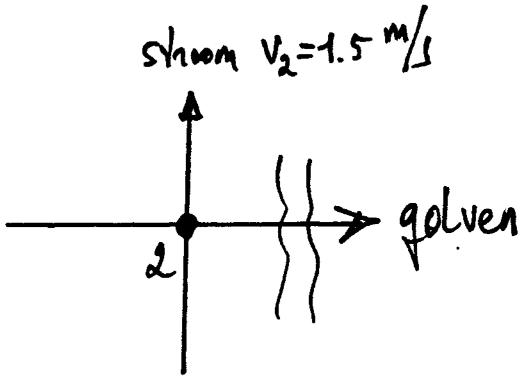
c. bereken de relatieve golfperiode in punt 2.

d. bereken de shoaling factor k_s en golfhoogte in punt 2.

e. toon aan dat de golf niet breekt op steilheid in punt 2.

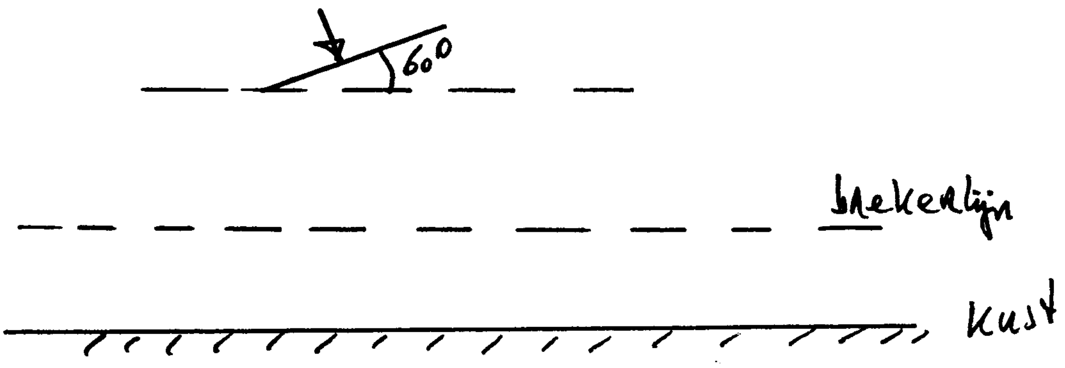
f. wat is de golfhoogte in punt 2 indien er een dwarstroom met v2=1.5 m/s (φ= 90°) is in punt 2?





2.

Regelmatige golven (H= 2.5 m, T= 10 s) maken in diep water een hoek θ_o= 60° met een rechte kust. De bodemhelling nabij de kust is 1 op 50.



a. bereken de golfhoogte op h= 5, 3 en 2 m; gebruik de formule van Weggel om de maximale lokale golfhoogte te bepalen.

b. bereken de golfhoogte en waterdiepte op de brekerlijn volgens Weggel.

c. bereken de golfsteilheid en maximale golfsteilheid op de brekerlijn; breken de golven op diepte of op steilheid?

d. bereken de 'wave set-down' ter plaatse van de brekerlijn (gamma=0.6) en bereken de 'wave set-up' ter plaatse van de kustlijn (gamma=0.6).

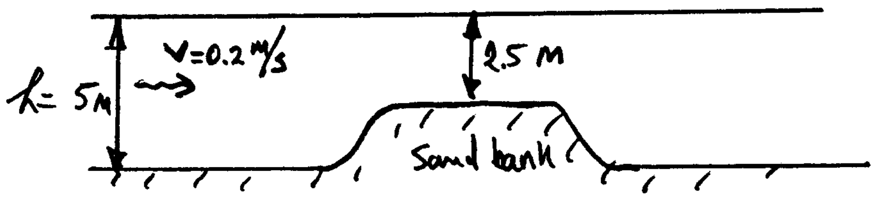
e. wat is de breedte van de brandingszone (afstand brekerlijn tot kust)?

f. wat is de grootte van de 'undertow' ter plaatse van de brekerlijn?

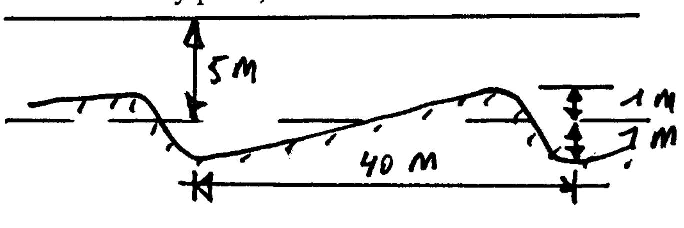
3.

a. A sand particle with diameter of d= 0.02 m is resting on a flat horizontal bed. What is the critical bed shear stress for initiation of motion?

b A sand bank (d_{50}=0.0005 m, d_{90}= 0.001 m) is present on the bed of a wide river. The depth above the bank is 2.5 m; the depth of the river is 5 m. The depth mean velocity in the river is 0.2 m/s. There are no bed forms. Is there movement of sand at the top of the sand bank?



c. Sand dunes are formed in the same river (see, 1b) with mean depth= 5 m, d_{50}= 0.0005 m, d_{90}= 0.001 m) with maximum dune height= 2 m and dune length=40 m. What is the critical discharge (no sand movement at any place)?



4.

Given is a wide river with the following data:
Slope $I = 1.9\ 10^{-4}$
Depth: $h = 2$ m
Bed material $d_{50} = 0.4$ mm, $d_{90} = 1.3$ mm

Questions

a. Compute the bed roughness k_s, if the depth-mean velocity is 0.95 m/s.
Do you expect the presence of bed forms and what type of bed forms (based on the computed k_s-value)?

b. Suppose the bed is plane. What is the depth-mean velocity? What is the flow velocity at the water surface?

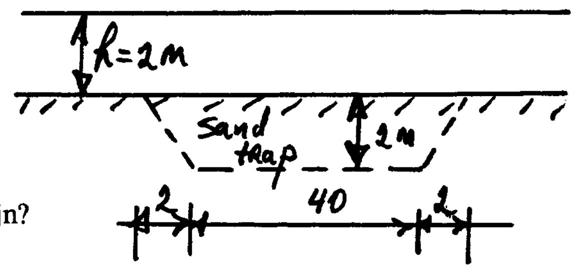
c. What bed forms are expected based on the graph of Simons and Richardson (1966)? Use mean velocity of 0.95 m/s.

d. What is the total sand transport according to the formula of Engelund-Hansen (mean velocity=0.95 m/s)?

e. Could you give an estimate of the percentage of suspended sand transport by only computing the ratio of the bed shear velocity u_* and the fall velocity w_s (use d_{50} to determine the fall velocity).

5.

Given is a wide river with the following data:
Slope $I = 2\ 10^{-4}$
Depth: $h = 2$ m
Discharge: $Q = 1000\ m^3/s$
Width: $b = 500$ m
Bed material $d_{50} = 0.3$ mm, $d_{90} = 1$ mm, $\sigma_s = 1.5$ (geometric standard deviation of bed material), 1 m^3 of sand = 1600 kg



Questions

a. Compute Chezy-coefficient C and k_s.

b. What type of bed forms are present according to Van Rijn?

c. Compute the bed form dimensions according to Van Rijn.

d. Compute k_s-value of bed forms.

e. Compute the bed load transport (in kg/s/m) according to Meyer-Peter and Mueller.

f. A sand trap is excavated (dimensions, see Figure). The trap is filled with sand due to bed load transport after 30 days. What is the bed load transport in kg/s/m based on this data? What is the best result (the value under e or f)?

6.

Given is a wide river with the following data:

Slope	I= 0.0002
Depth:	h= 5 m
Dimensionless bed shear stress	T= 10
Bed material	d_{50}= 0.3 mm, d_{90}= 1 mm, σ_s= 1.5 (standard deviation of bed material)
Suspended sand	d_s=0.2 mm
Dune height	Δ=0.1 m

Question

Determine the sand concentration at 0.5, 1, 3 and 5 m above the bed.

7.

Gegeven een kustzee met zandbodem

d_{50}=	0.0002 m,
d_{90}=	0.0005 m,
D_*=	5,
ρ=	1025 kg/m^3 en
waterdiepte=	10 m.

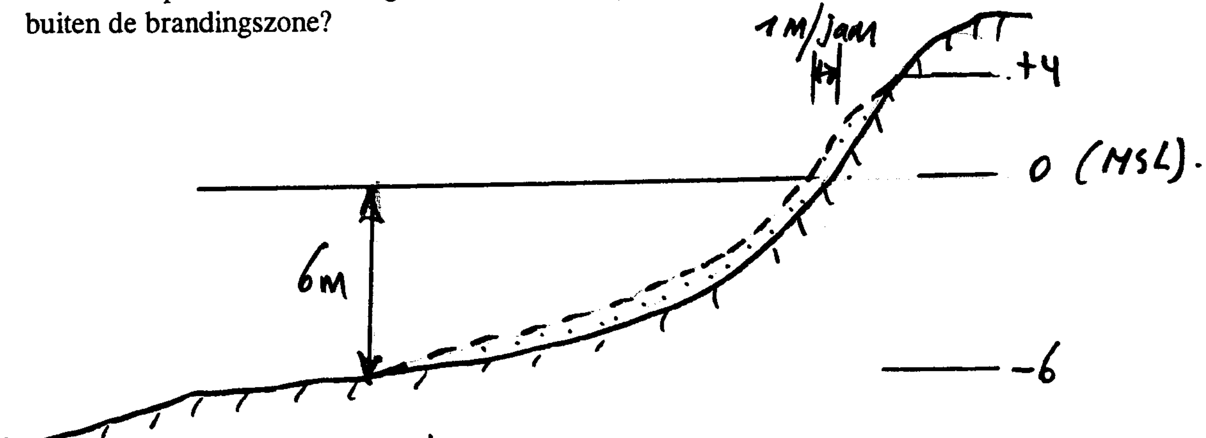
a. bepaal de piekorbitaalsnelheid bij de bodem waarbij nog net geen beweging optreedt (T=8 s).

b. bij welke piekorbitaalsnelheid treedt er 'sheet flow' op?

c. uit metingen van de positie van de hoogwaterlijn blijkt dat er kustaangroei is van ca 1 m per jaar; wat is bij benadering het netto transport (in m3/m/jaar) naar de kust over de -6 m lijn indien de aangroei overal plaats heeft tussen de -6 m en +4 m lijn; welk transportmechanisme veroorzaakt deze aangroei?

d. wat is de orde van grootte van het netto langstransport ter plaatse van Noordwijk? In welke richting (noord of zuid)?

e. welke transportmechanismen geven een naar zeegericht transport in de brandingszone? idem buiten de brandingszone?



Tekening bij vraag c

8.

Answer the following questions as short as possible!

a. Sand particles are driven by fluid forces. Is the velocity of the sand particles smaller, larger or equal to the velocity of the surrounding fluid?

b. The Shields curve does not really represent conditions of initiation of motion. What is the reason for this?

c. A channel with plane bed in the lower regime has a bed roughness of 1 mm; the same channel with plane bed in the upper regime has a bed roughness of 10 mm. What is the reason for this difference?

d. What is form roughness? What stresses are involved? Make a sketch of the distribution of these stresses along a sand dune.

e. Why is the form roughness of sand waves negligibly small?

f. What is the cause of the Stokes drift velocity?

g. Do shear stresses play a role in wave-induced orbital motion?

h. What mechanisms give dissipation of wave energy (decrease of wave height)?

i. Onshore propagating waves meet an ebb current in a tidal inlet; will the wave height become larger or smaller?

j. What is a bound-long wave and what is the propagation velocity of such a wave?