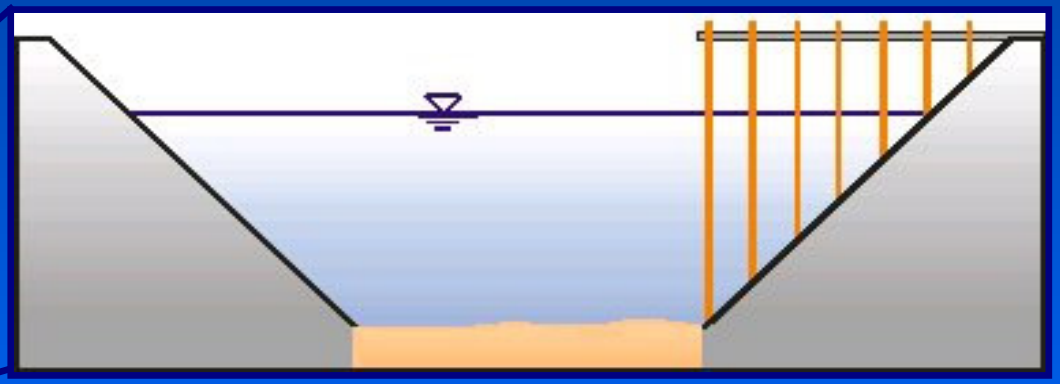
Consideration of Bank Vegetation on Bed-Load Transport



Dr.-Ing. Franz-Josef Specht
Dr.-Ing. Katinka Koll

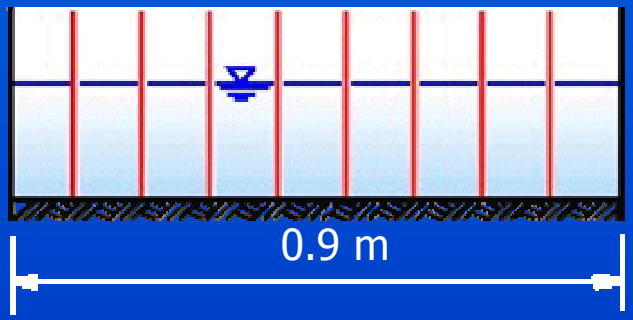
Outlook

- Review of Research at LWI
- Experimental Method
- Results
- Conclusion

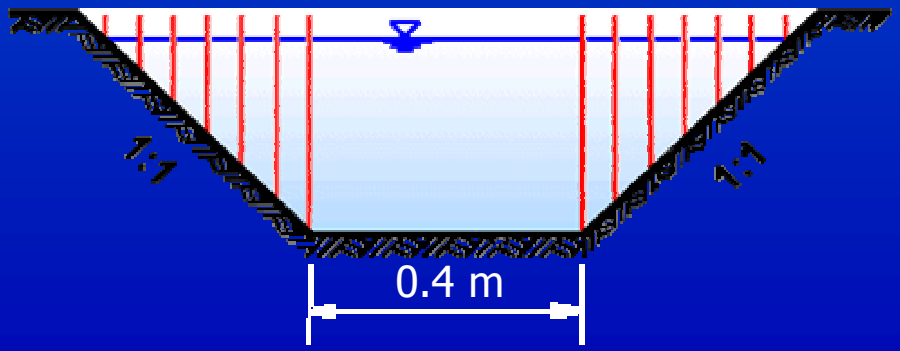
Vegetation and Bed-Load Transport at LWI

Hydraulics
(flow resistance)

Lindner (1982)

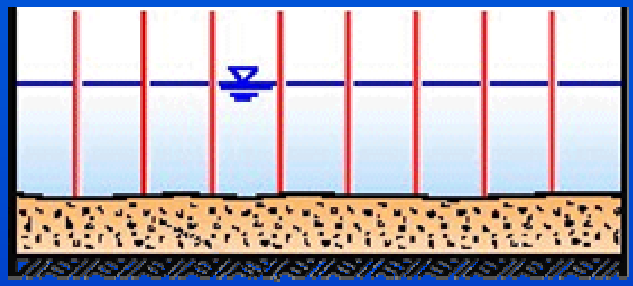


Bertram (1985)

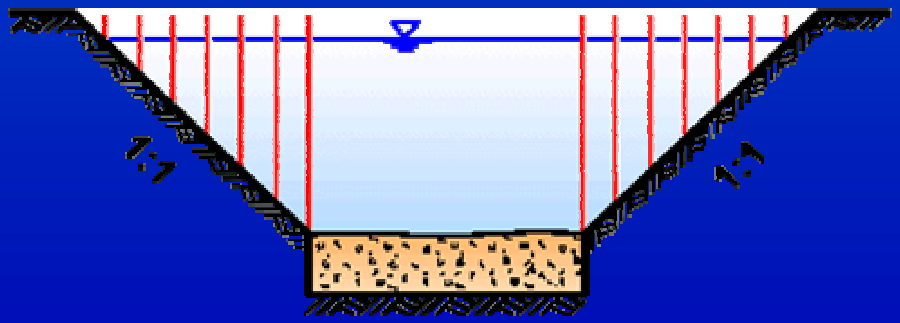


Sedimentology
(bed-load, bed forms)

Negraßus (1995)

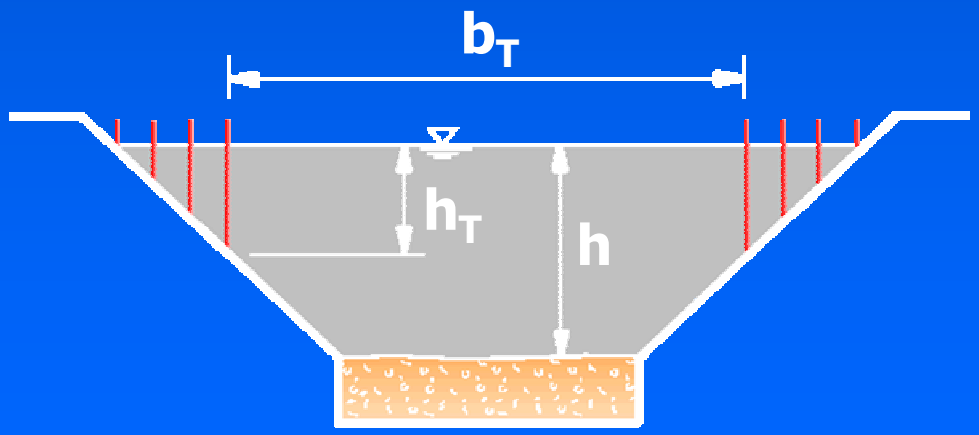


Eilers (1990)

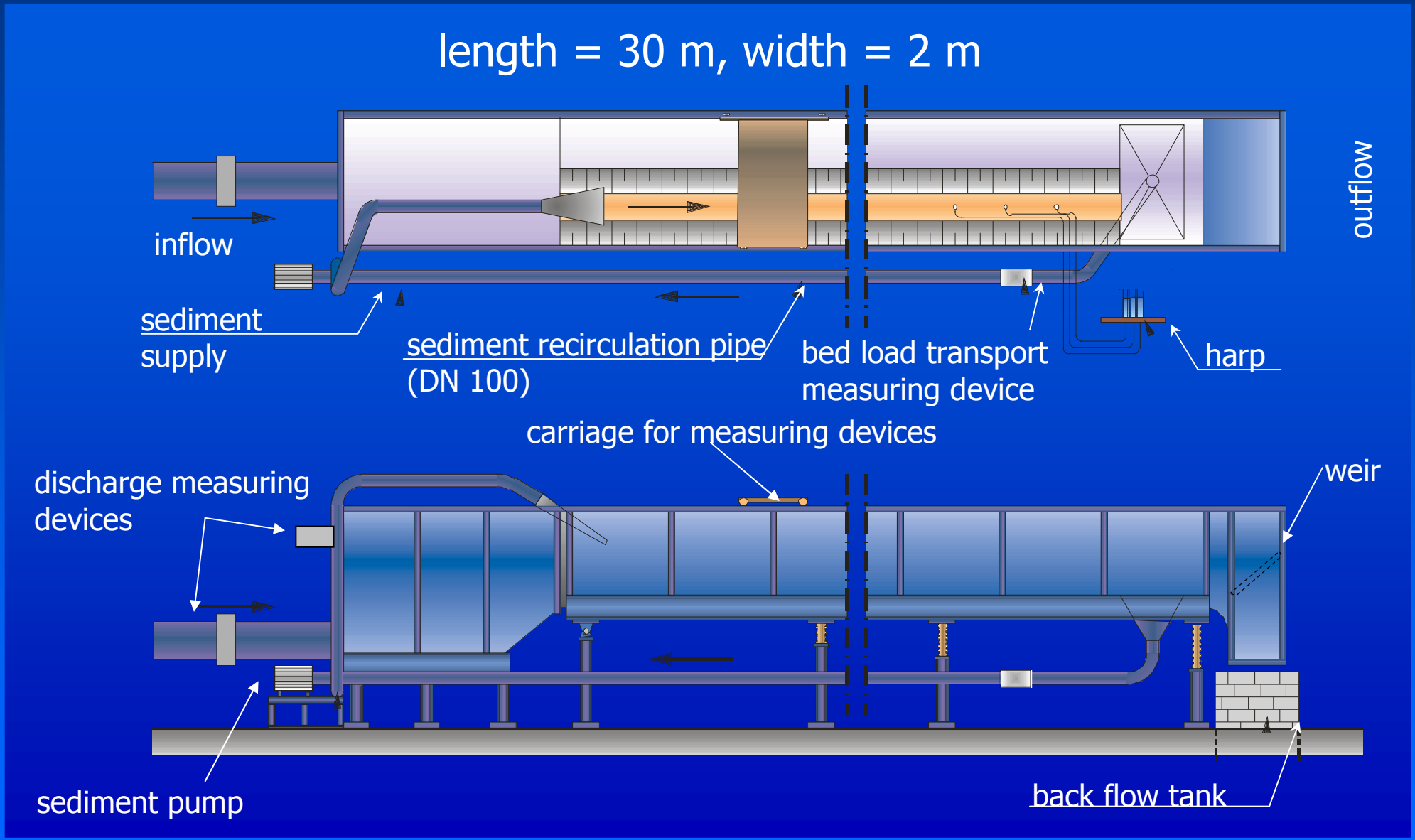


Specht (2002)

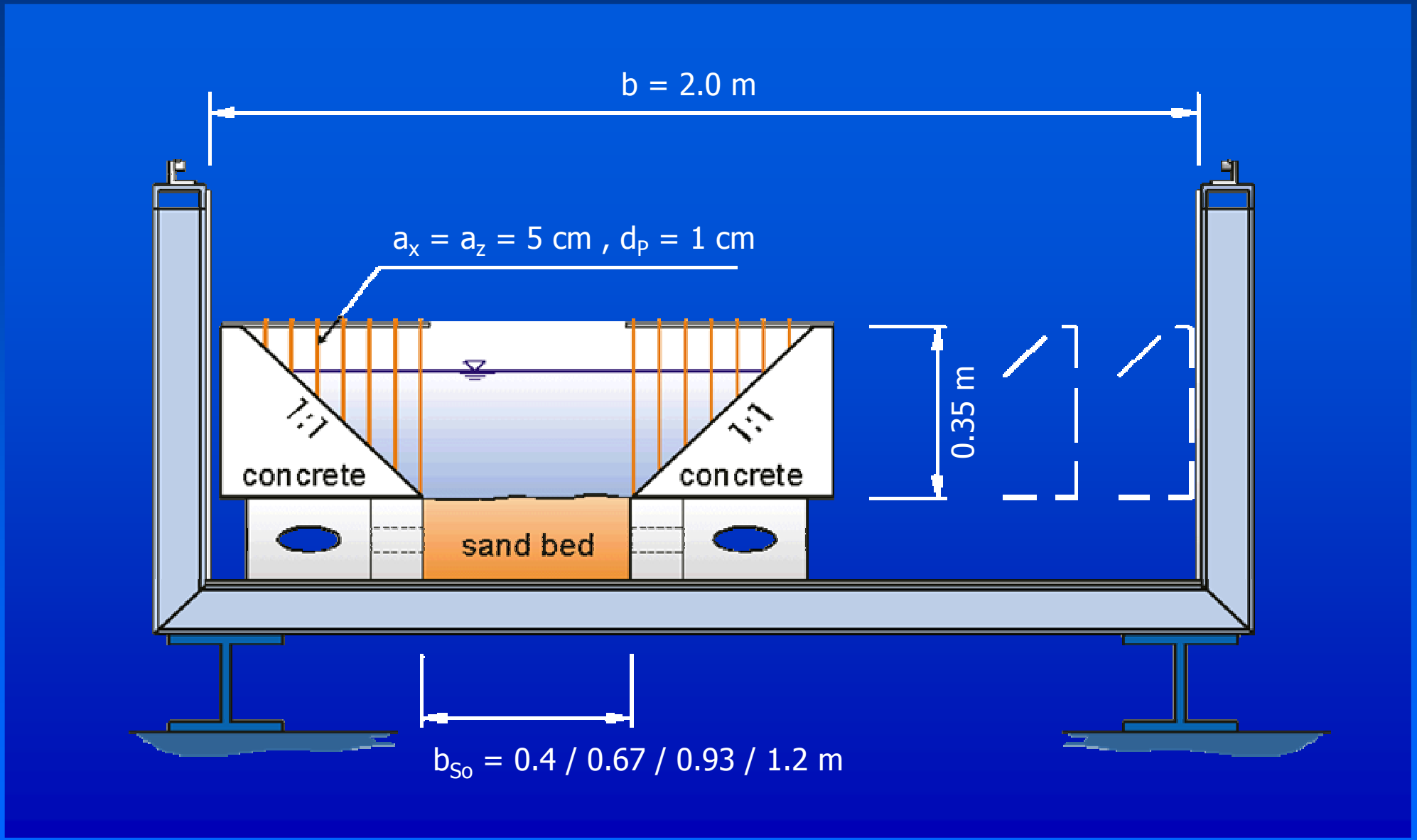
- Effect of distance between separation zones (b_T)
- Effect of channel width
- Effect of (a)symmetrically vegetated banks
- Adaptation of existing transport formulas



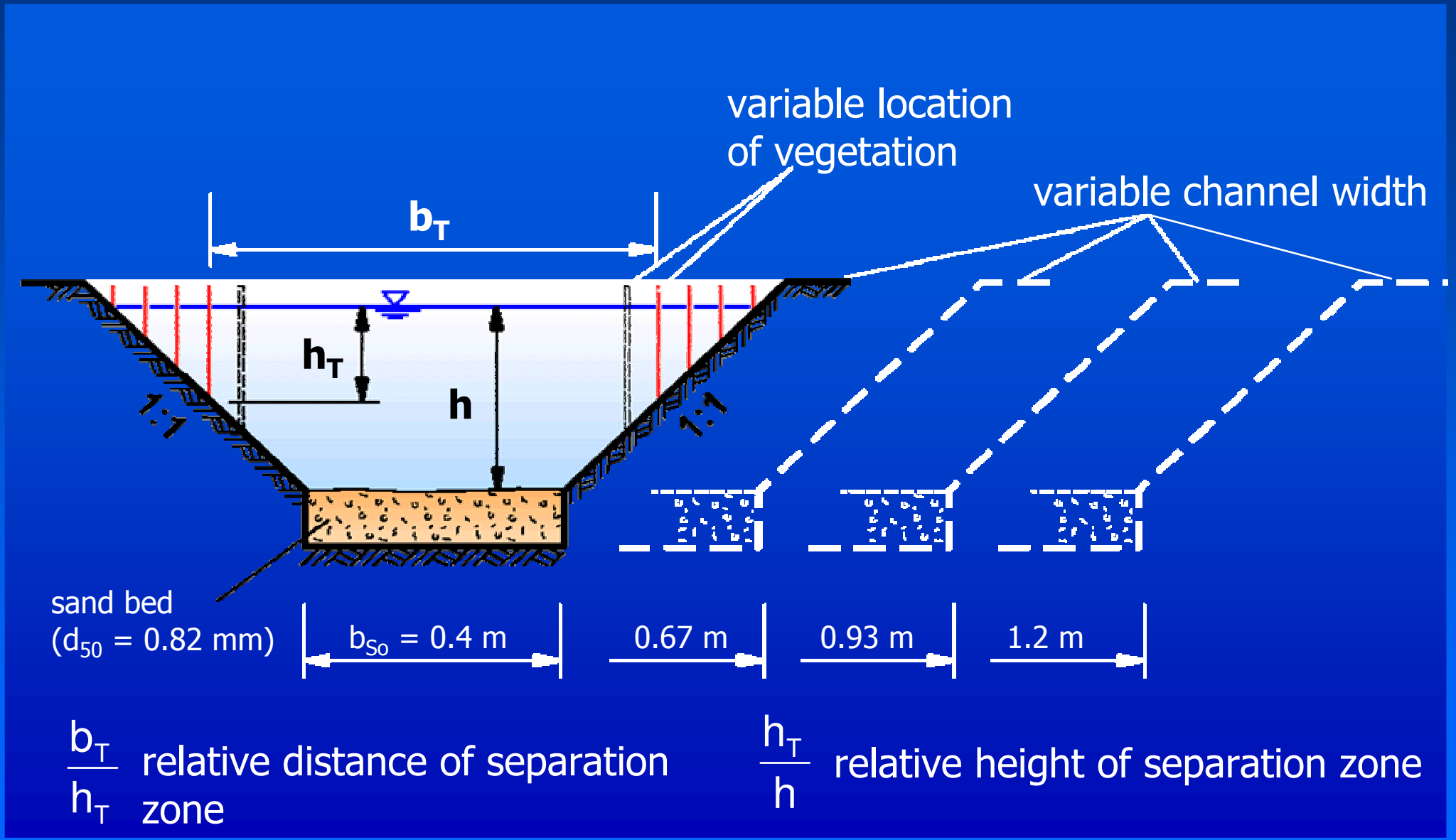
Tilting Flume with Sediment Recirculation



Cross-Section



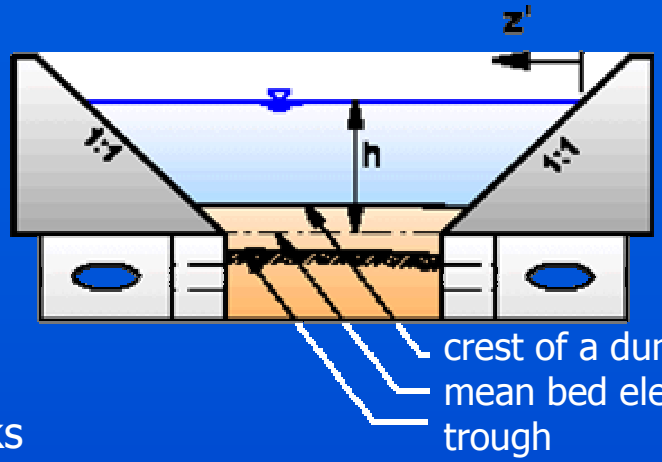
Experimental Programme



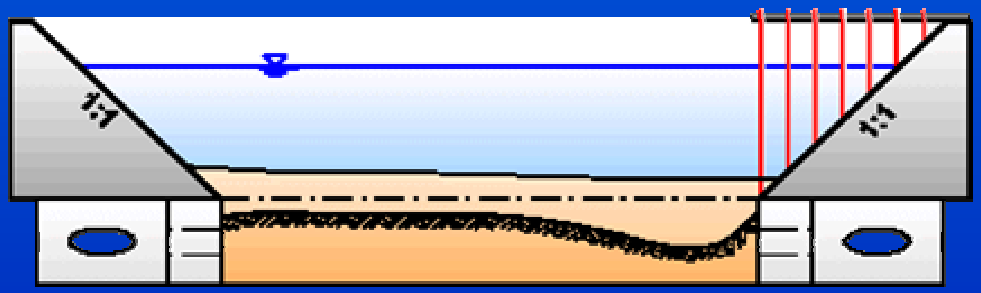
$\frac{b_T}{h_T}$ relative distance of separation zone

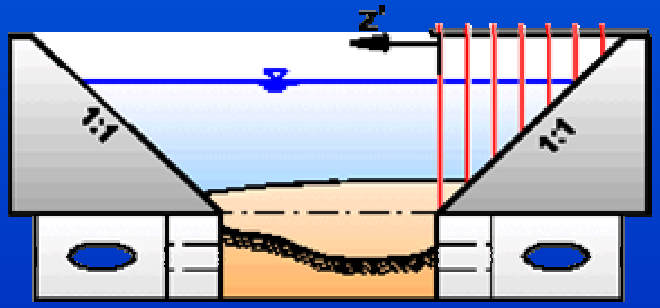
$\frac{h_T}{h}$ relative height of separation zone

Channel Width and Asymmetry of Vegetation

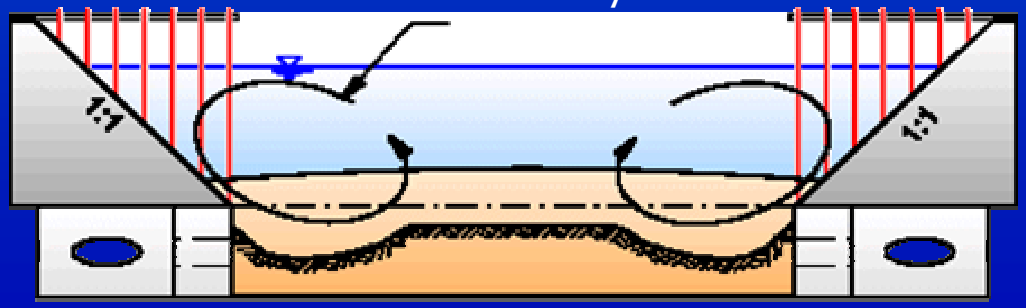


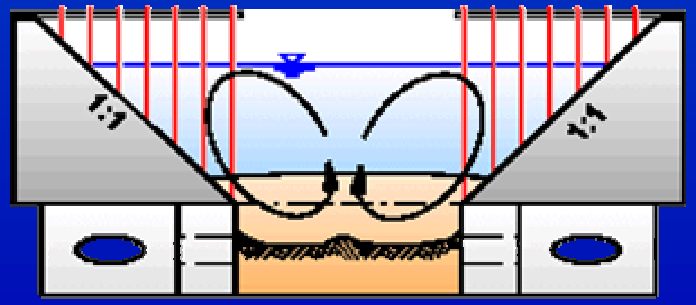
secondary currents lead to deep troughs on vegetated banks





secondary currents





if both banks are vegetated stripes in longitudinal direction develop due to secondary currents

Vegetation Coefficient σ_B

dimensionless transport rate

$$\Phi^* = \sigma_B \cdot \Phi_o^*$$

↑ original transport equation

vegetation coefficient

$$\sigma_B = \sigma_{B0} \cdot \sigma_{BB}$$

↑ spacing (density) of vegetation

vegetation coefficient for standardised spacing (density)

$$\sigma_{B0} = f_T \cdot \left[a + b \cdot (b_T / h_T)^c \right]$$

↑ relative distance of separation zones

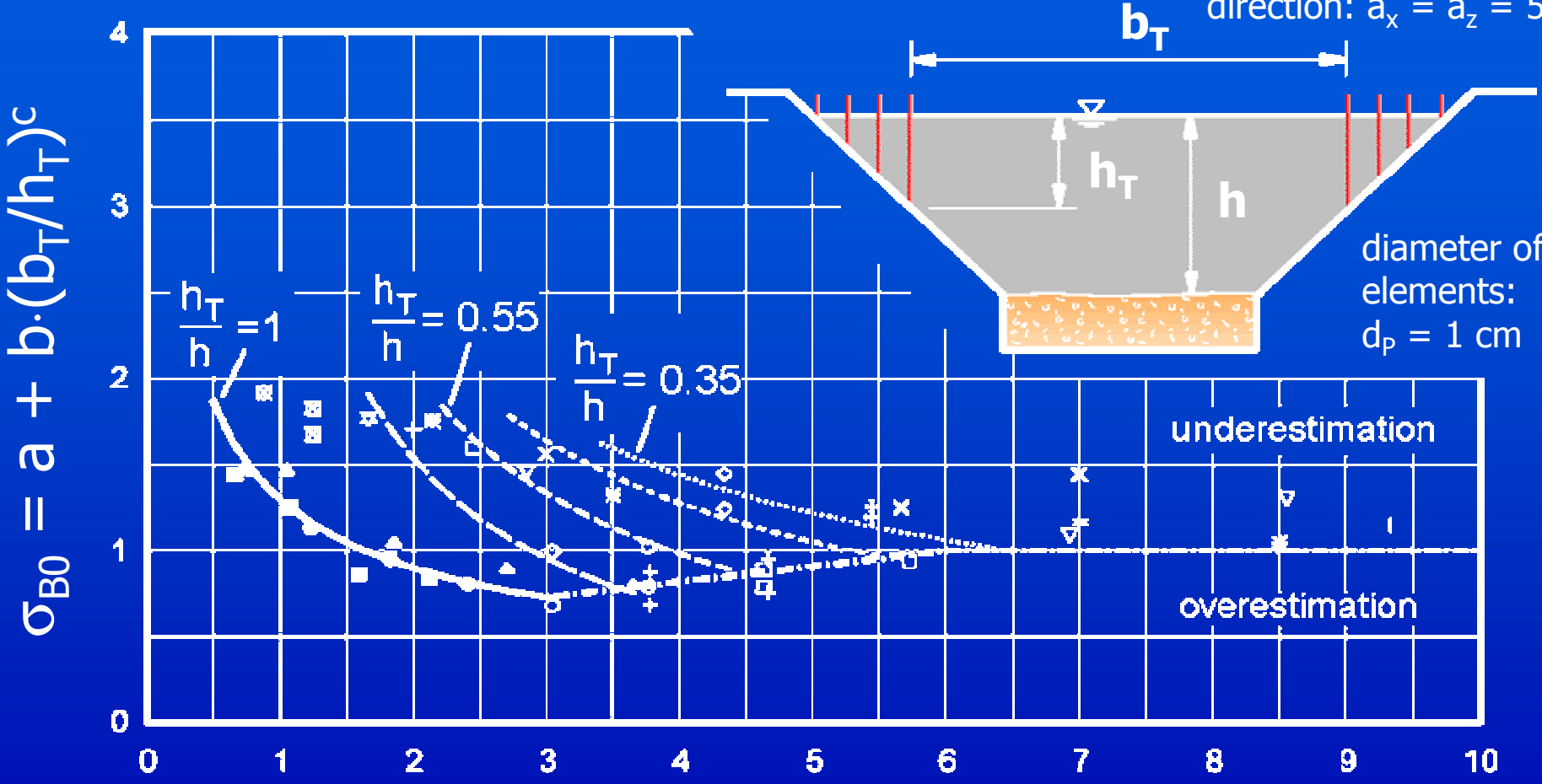
↑ (a)symmetry of vegetation and h_T/h

a, b, c = coefficients depending on transport equation

Correction Coefficient σ_{B0}

e.g. transport equation: van Rijn (1984)

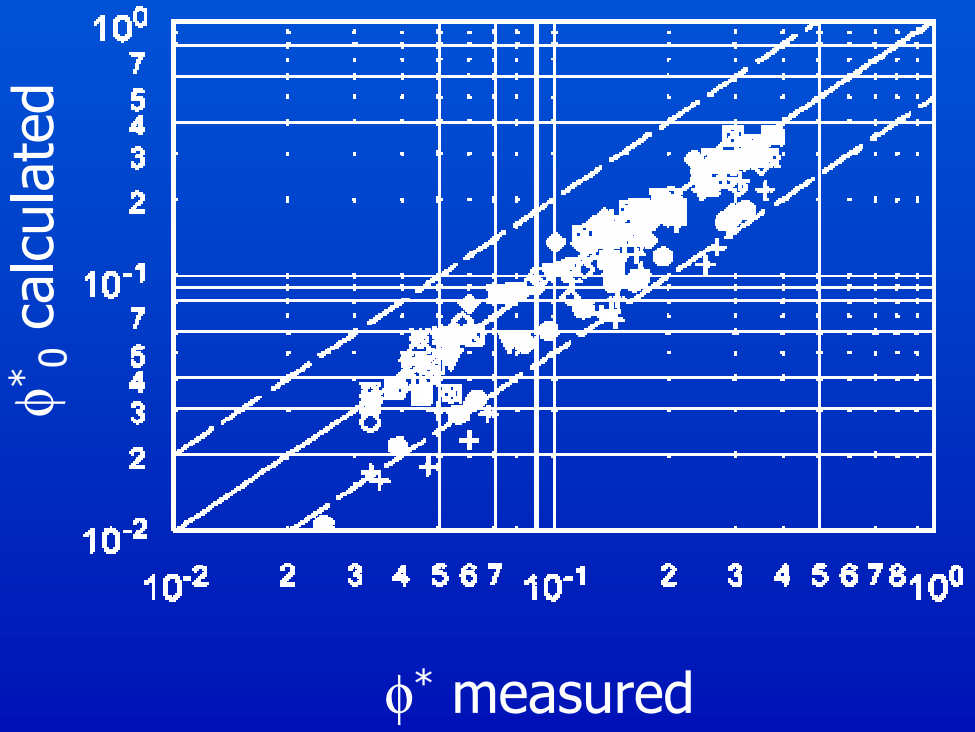
distance of elements in lateral and longitudinal direction: $a_x = a_z = 5$ cm



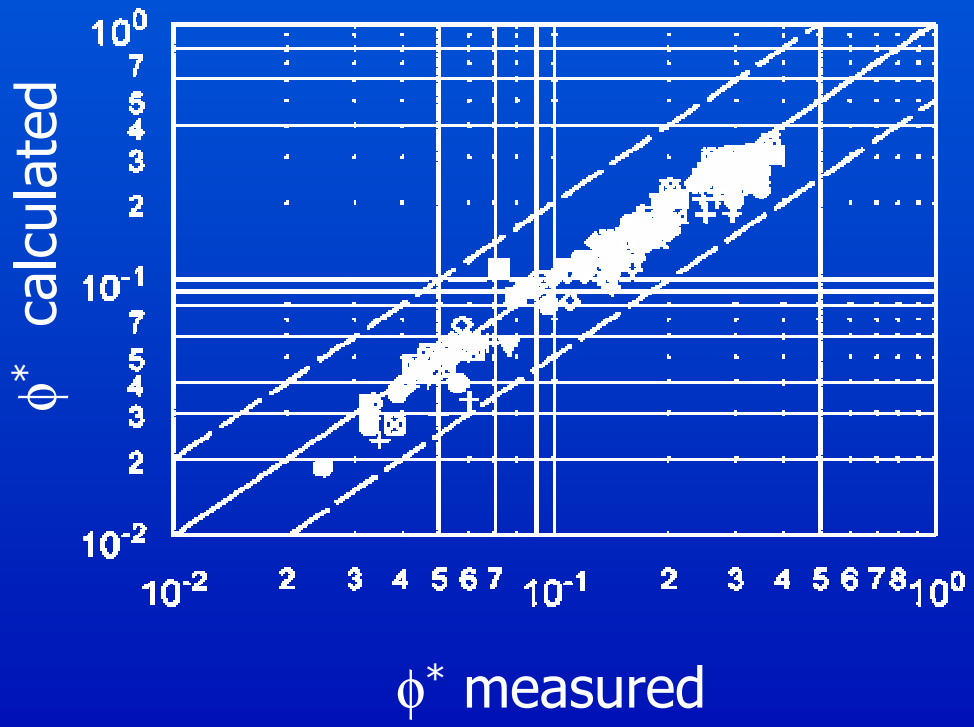
Bed-Load Transport Calculation

transport equation: van Rijn (1984)

without correction coefficient σ_B



with correction coefficient σ_B



Conclusion

- neglecting bank vegetation can cause deviatons in transport rates up to 350 % especially in narrow channels
- influence of vegetation depends on relative distance b_T/h_T and relative height h_T/h of seperation zones, (a)symmetry, and density
- vegetation coefficient σ_B considers the influences in trapezoidal channels with rigid elements
- σ_B was developed to adapt existing transport formulas and thus slightly depends on the chosen formula (16 formulas were used)
- highly resoluted measurements of the flow field are required to describe the processes in detail