Minimizing Sediment Transport at Lateral Intakes to Irrigation Canals

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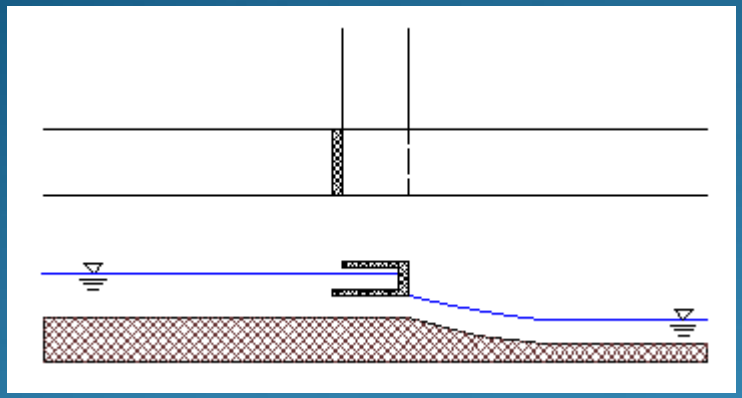
Sediment Deposition in Front of the Gate with Coarse Sediments

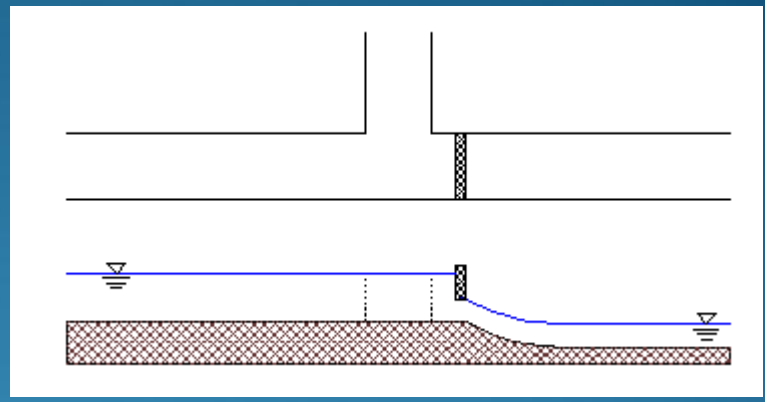
Functions of Intake

- Smooth water delivery
- Prevent or minimize trash and sediment transport to diversion canal
- Control the amount of diverted water

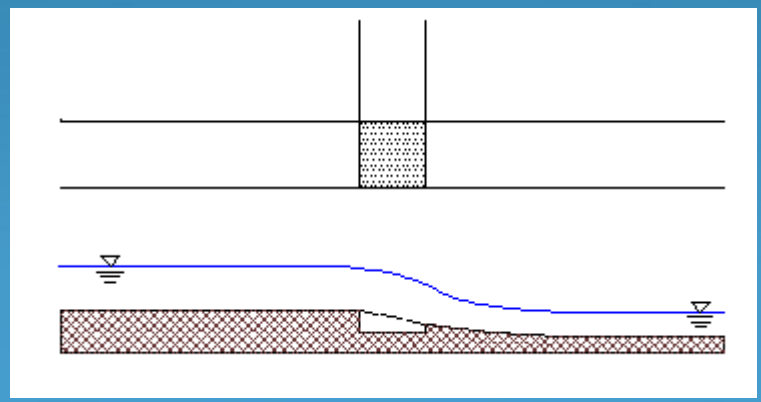
Different Types of River Intake



Frontal Intake

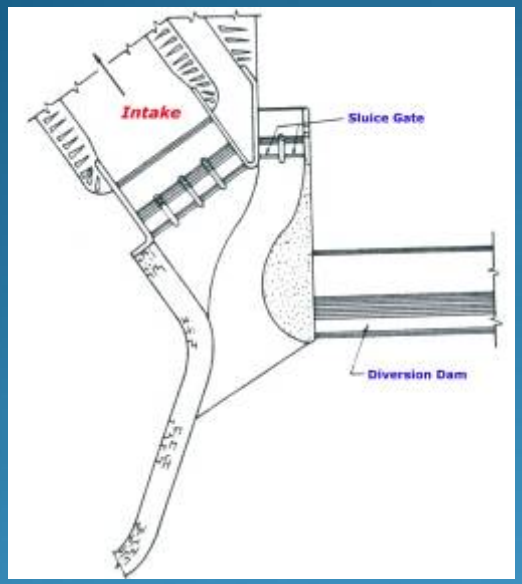


Lateral Intake

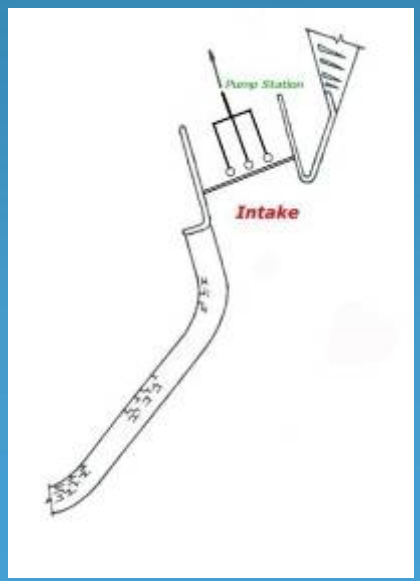


Bottom Intake

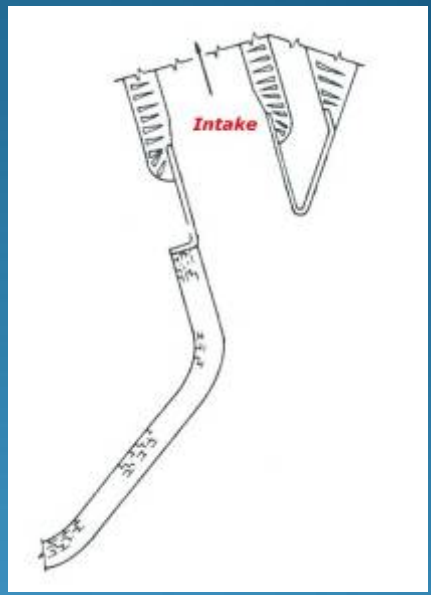
Different Types of Lateral Intakes



Intake with diversion dam



Intake with pumping station

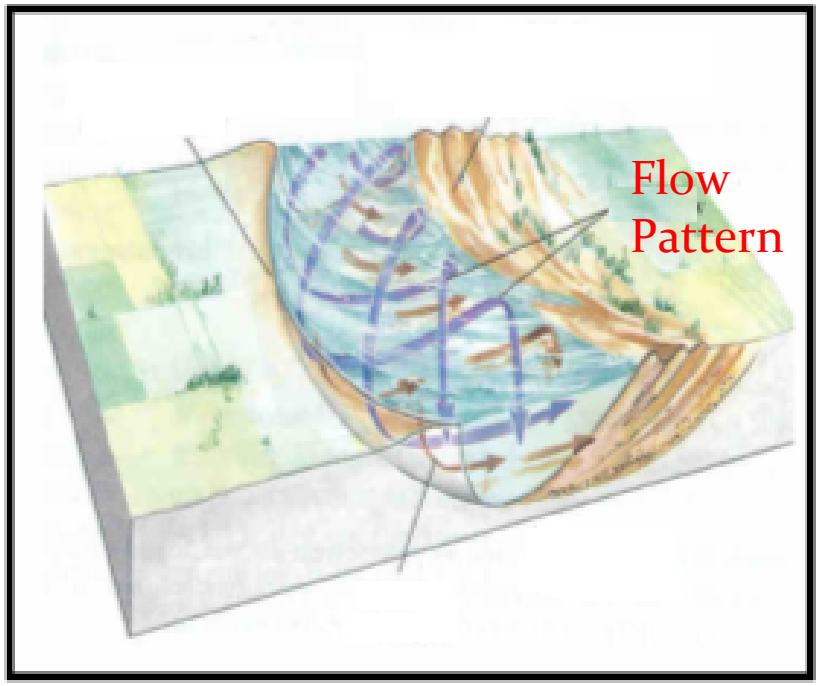


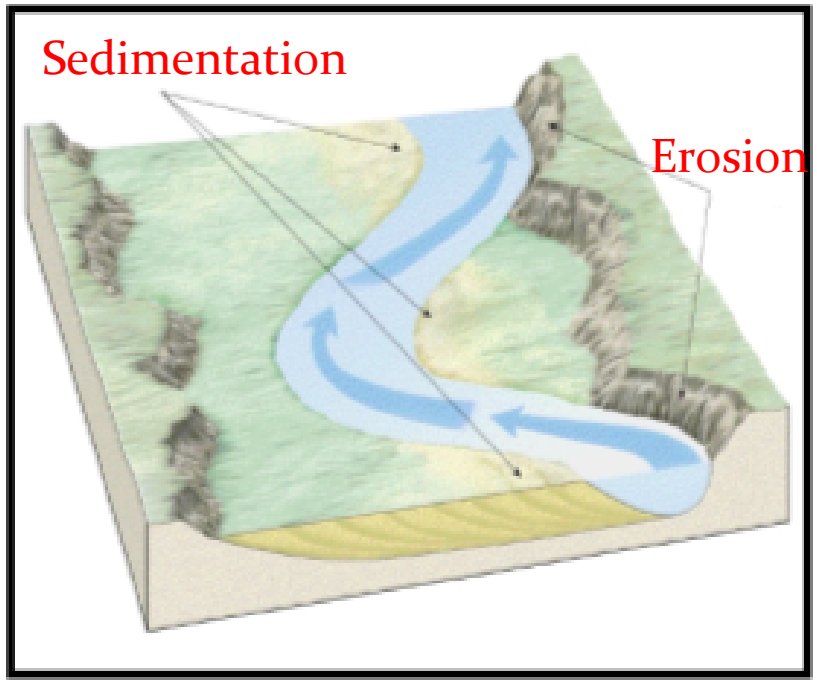
Simple intake

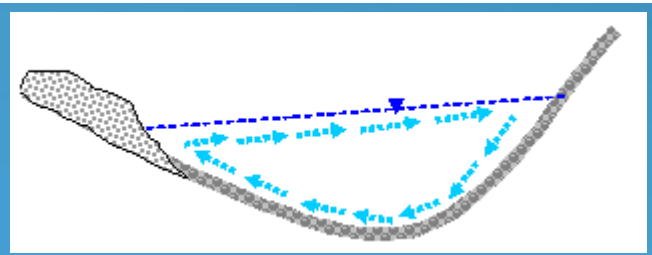
Effective Parameters on Sediment Diversion

- Channel type (Straight, Bend)
- Discharge ratio
- Flow conditions (Froud number)
- Sediment load (bed, suspended)
- Location of intake (Bend channel)
- Diversion angle
- Sill
- Submerged vane

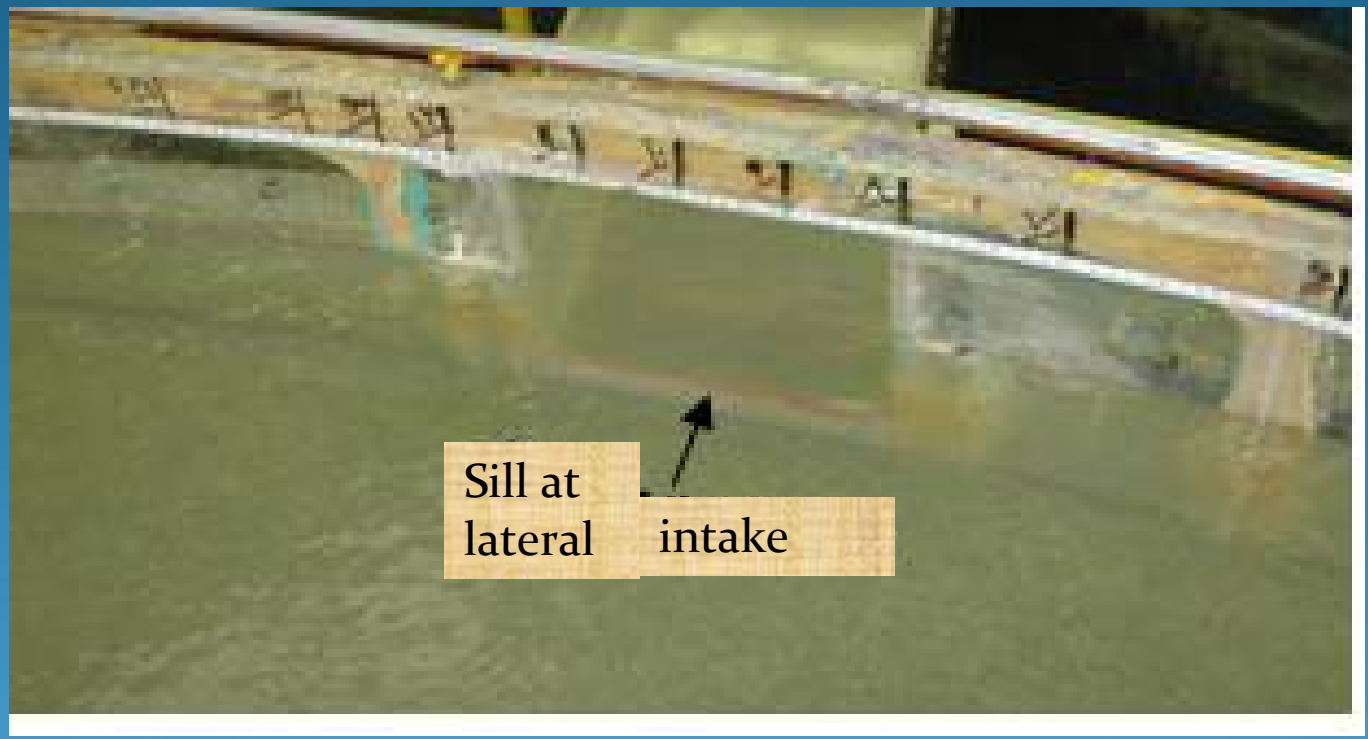
Spiral Flow at River Bend



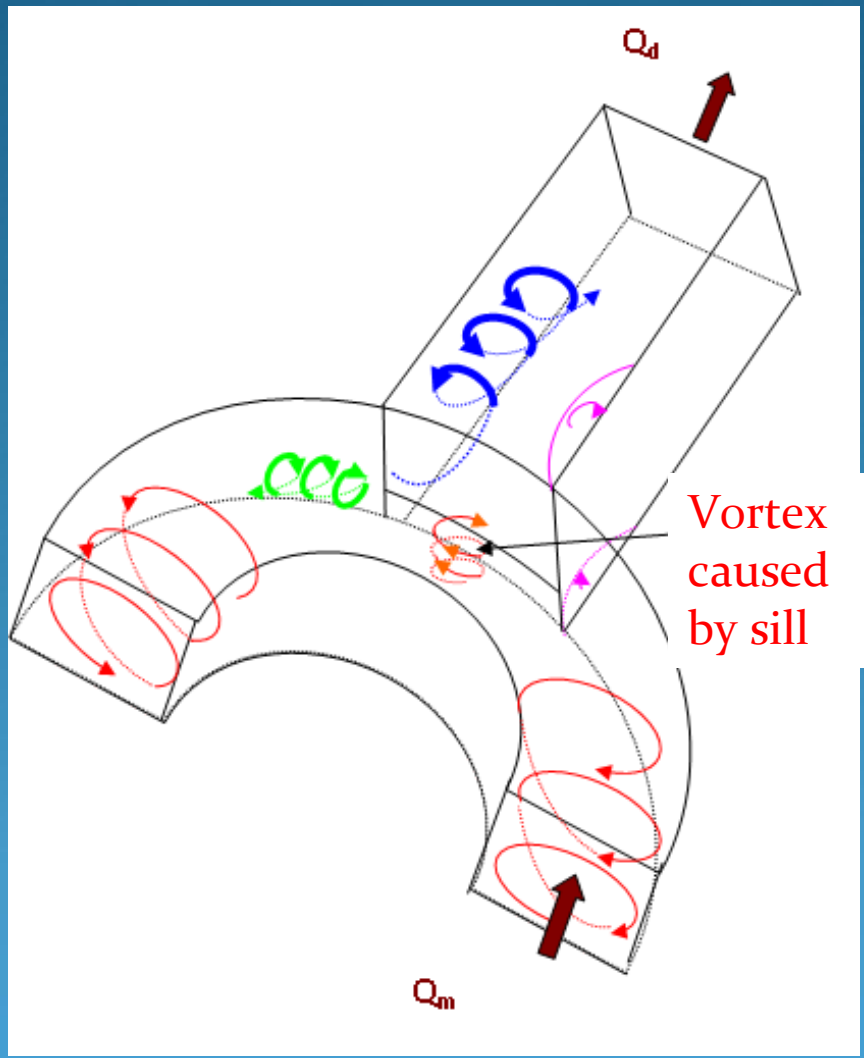




Sill at Intake

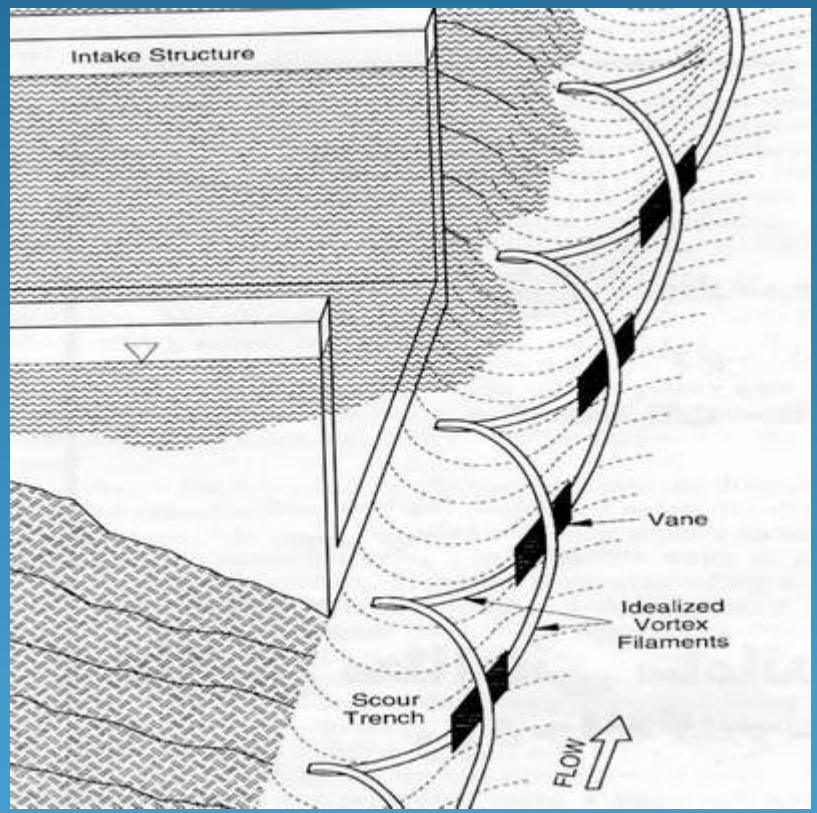


Flow Pattern Around Intake Using Sill



Submerged Vanes

Flow Pattern Around Submerged Vanes

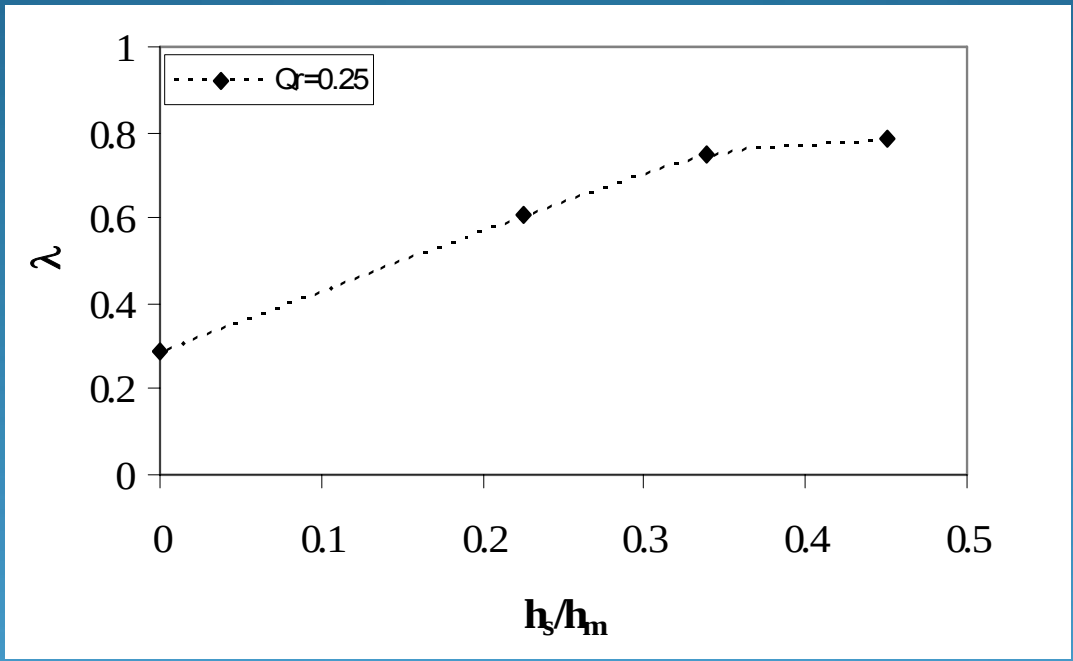


Submerged Vanes in Front of Lateral Intake

Straight Channel

- Experimental (1) and Numerical (2)
- Sediment diversion and flow pattern
- Discharge rate: 0.084-0.224
- Diversion angle (45°, **60°**, 75°, 90°)
- Submerged vane (q_r=0.2, no sediment diversion) (vane angle: 15°, **20°**, 25°)
- Sill (30% reduction of sediment diversion)

Effect of Sill Height on Sediment Diversion

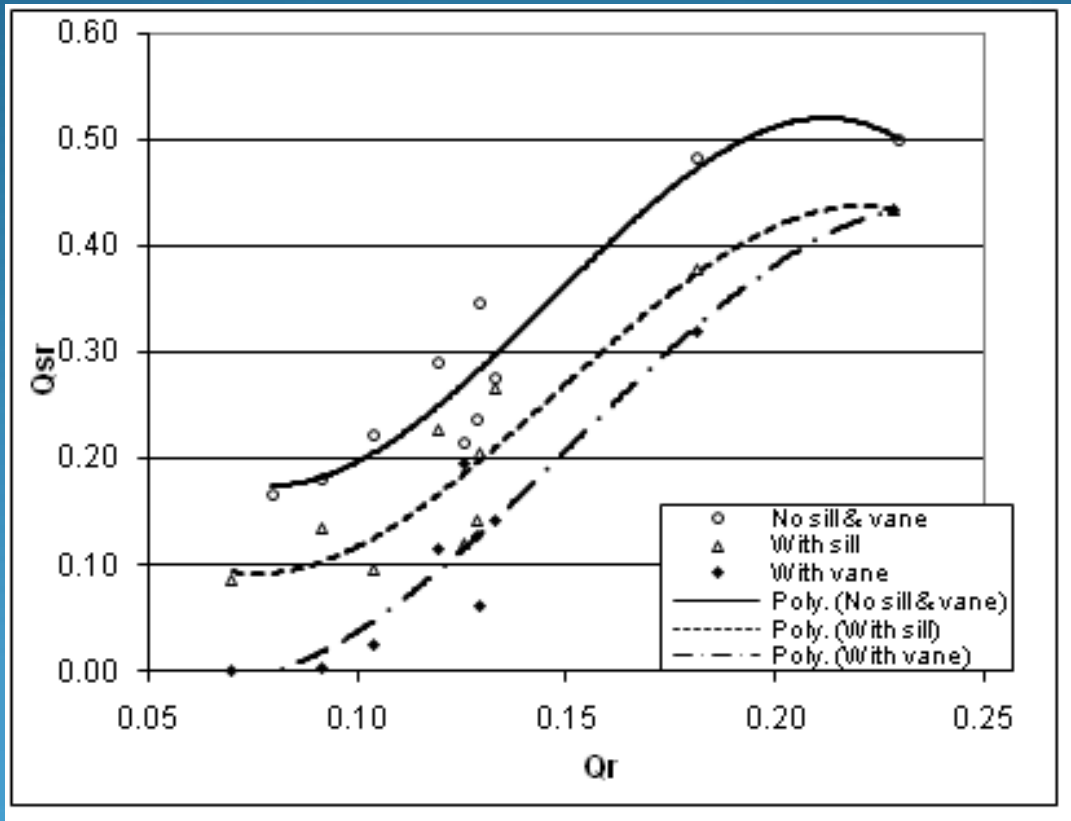


Intake efficiency $\lambda = 1 - \frac{G_r}{Q_r}$

$$G_r = Q_{Si} / Q_{Sm},$$

$$Q_r = Q_i / Q_m$$

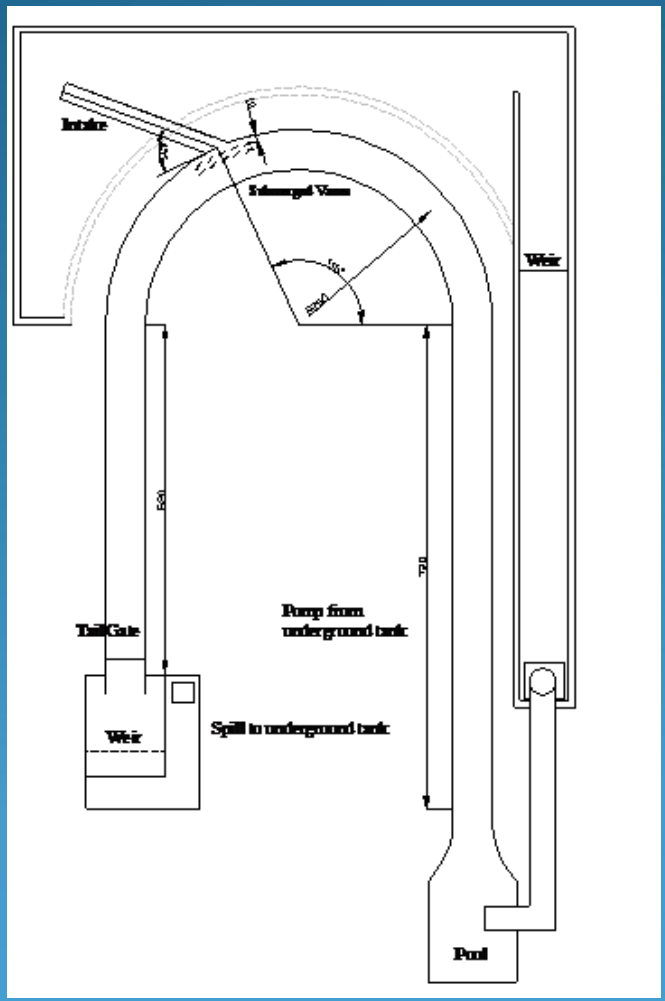
Effect of Sill and Vane



U-bend Channel

- Experimental (4) and Numerical (2)
- Sediment diversion and flow pattern
- Discharge rate
- Diversion angle
- Submerged vane
- Sill

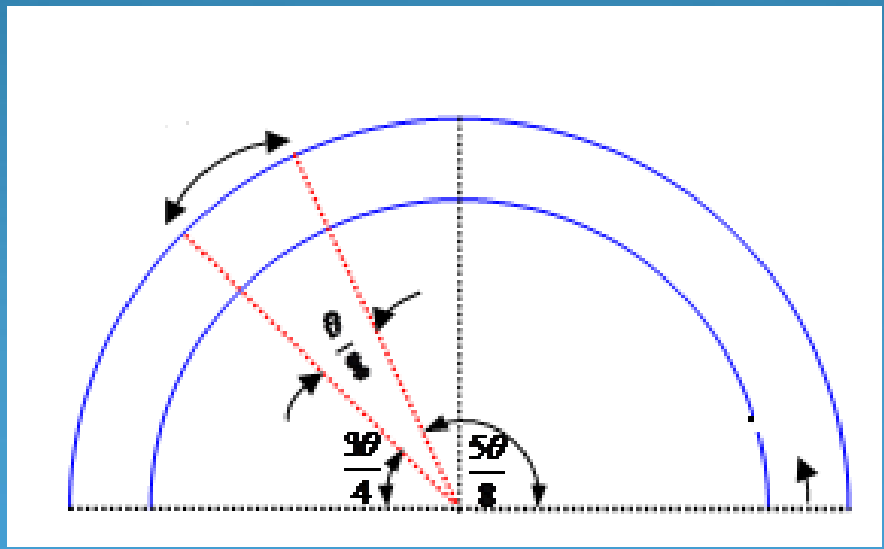
Plan of Experimental Setup



Experimental Setup

U-bend - Intake Location

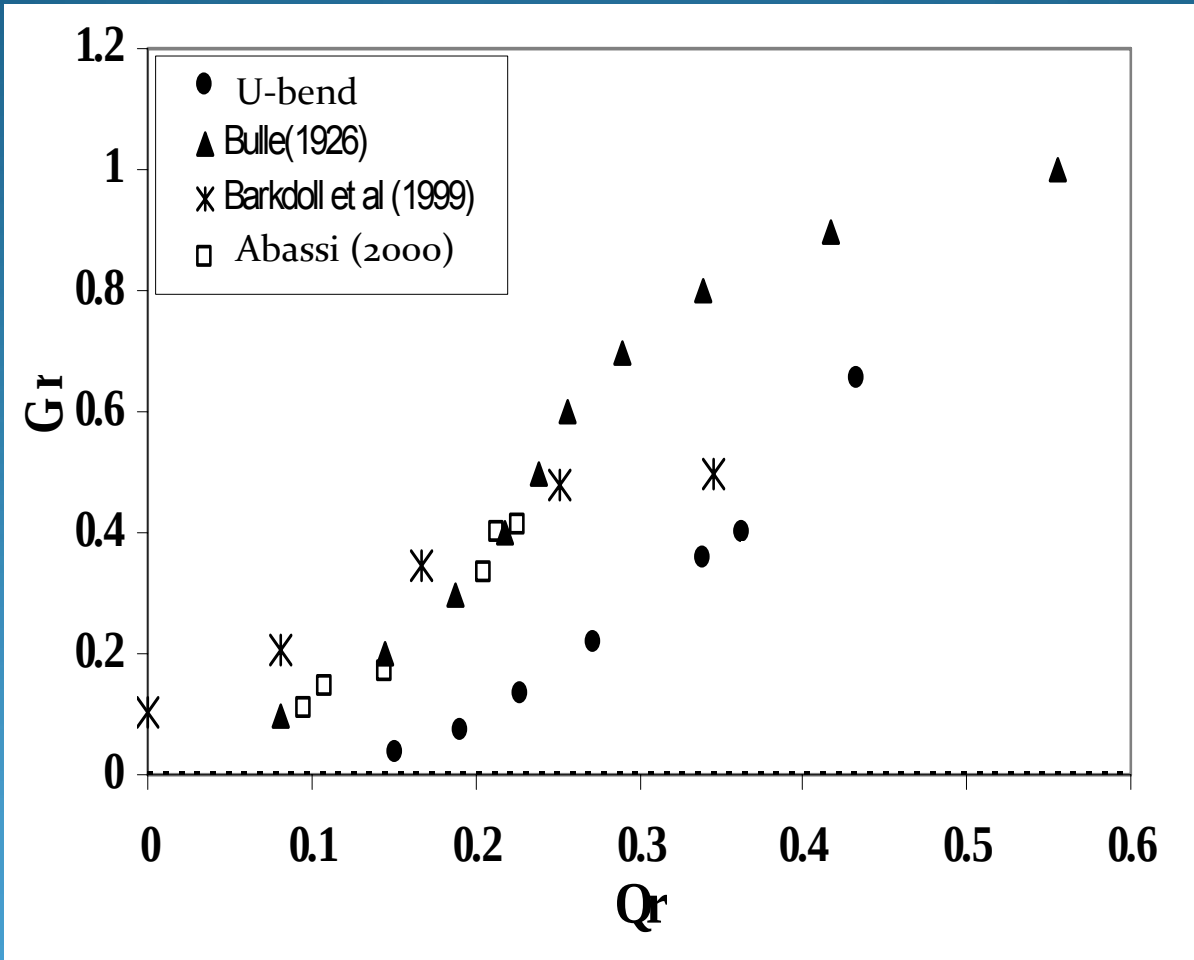
- Pirestani (2004): (Exp.) (40°, 75°, **115°**)
- Safarzadeh (2004): (Num.)(40°, **115°**)
- Dehghani (2006): (Exp.)(90°, 102°, **115°**, **135°**, 150°)



U-bend - Diversion Angle

- Pirestani (2004): (Exp.) (45°, **60°**, 75°, 90°)
- Safarzadeh (2004): (Num.) (45°, 75°, 90°)
- Dehghani (2006): (Exp (**45°, 60°**, 75°)

Comparison Between Straight and Curved Channel Sediment Diversion at Intake



U-bend - Submerged Vanes

- Dehghani (2006): (40% reduction on sediment diversion)
- Montaseri (2008):

  H/h=0.23, 0.33, 0.5,

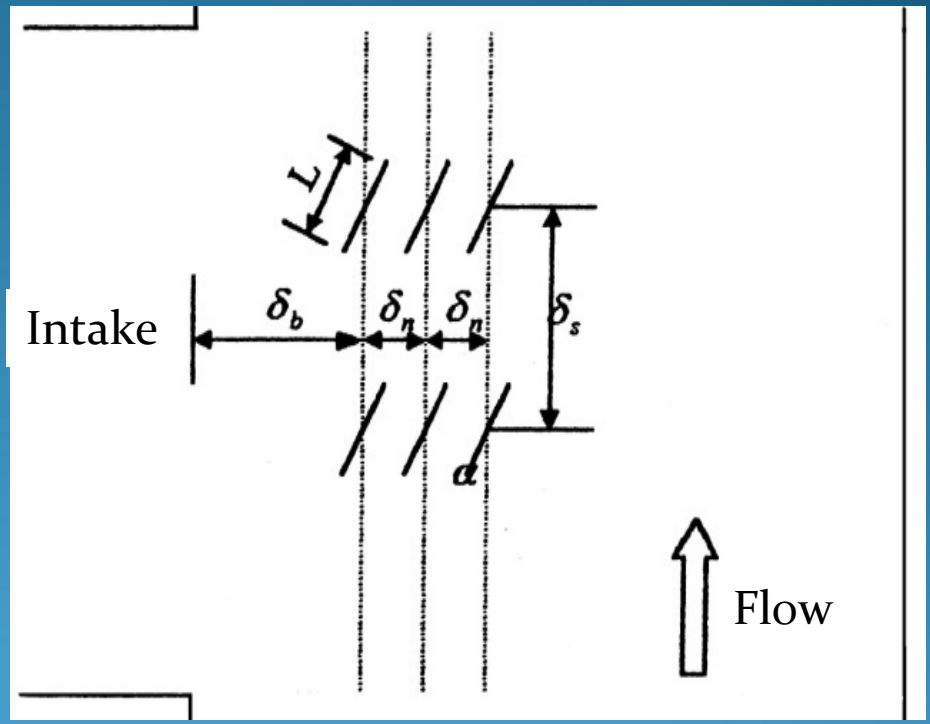
  α=10°,20°, 30°, 40°

  δ_s/H=7, 8, 9, 10, 12

  δ_n/H=1.0, 1.5, 2.0

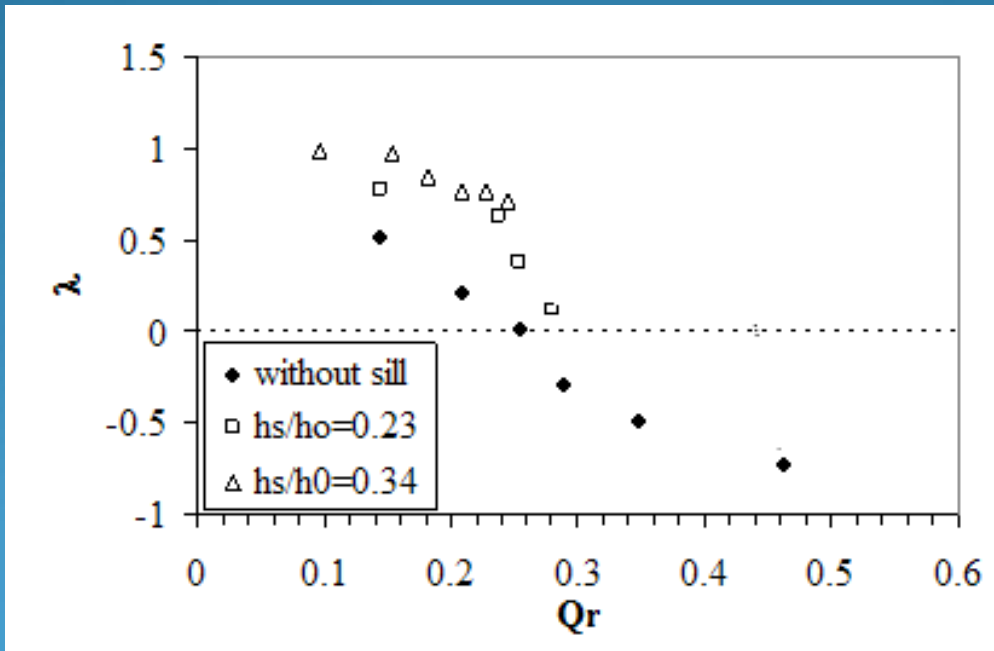
  δ_b/H=1.0, 2.0, 3.0

  Arrangement: 2rows, zigzag
- Rostamabadi (2007): (Agreement with Montaseri res.)



U-bend - Sill

Sill height/water depth: 0.23, 0.34, 0.45



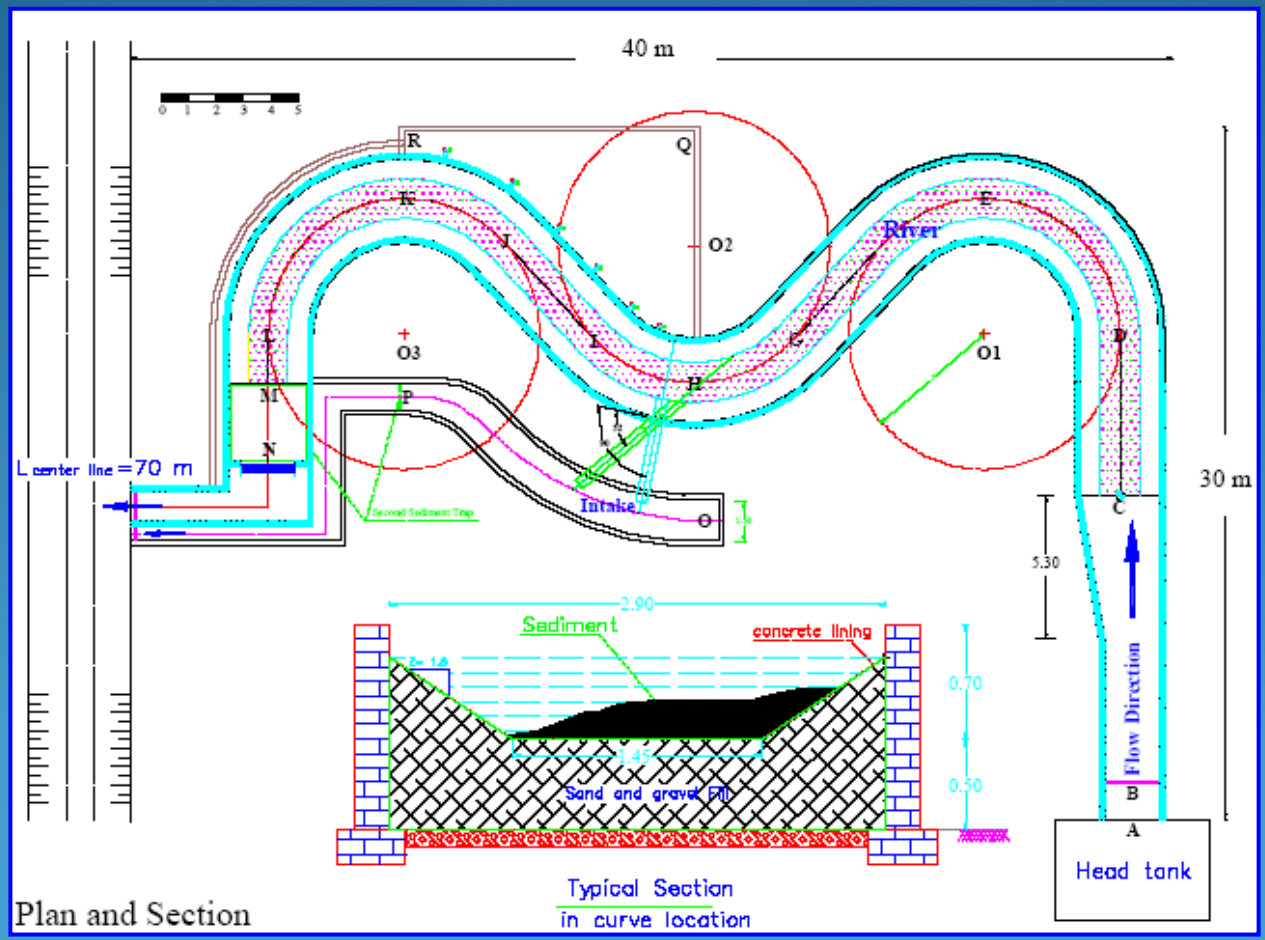
90° Bend Channel

- Experimental (1)
- Sediment diversion
- Intake location (65° , 70° , **75°**)
- Diversion angle (30°, 45°, **60°**, 70°)

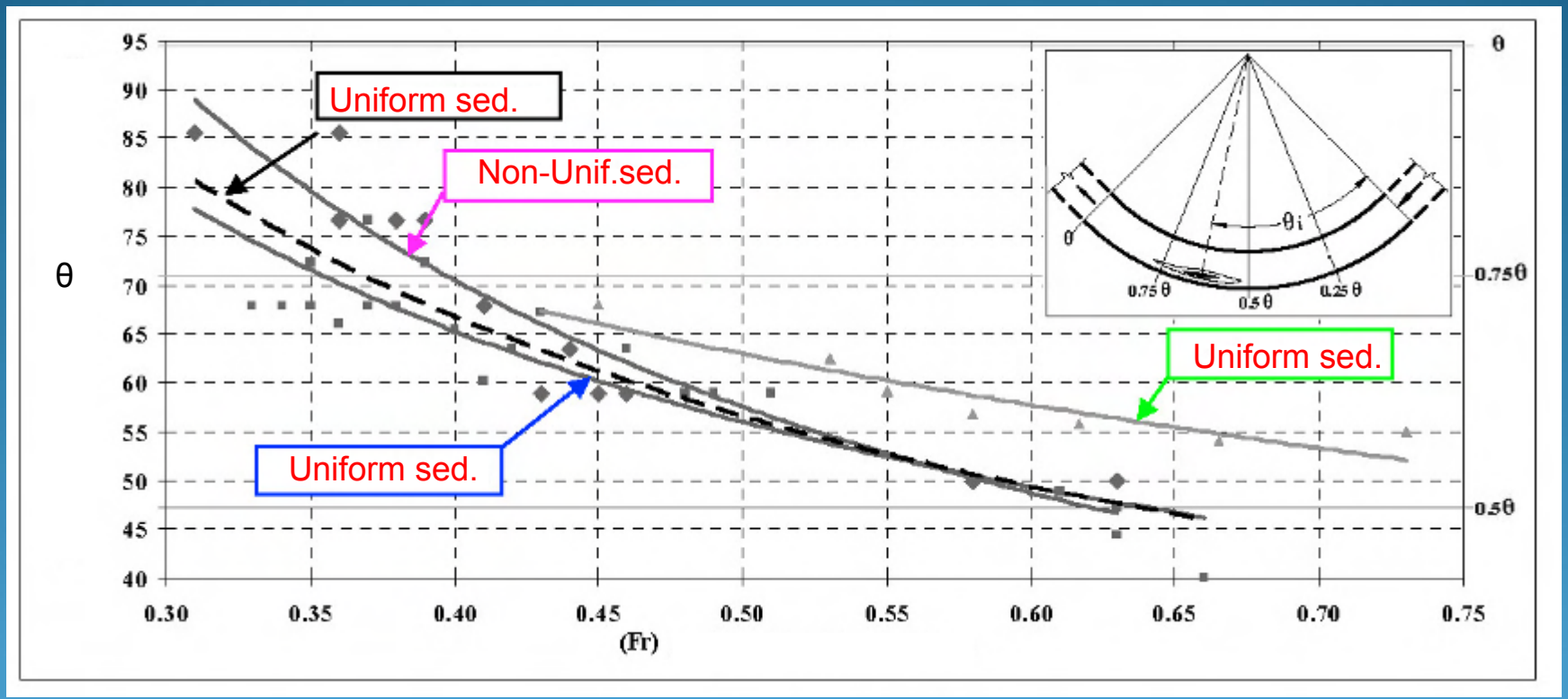
Meandering Channel

- Experimental (1)
- Sediment diversion
- Froud Number
- Sediment diameter (d_{50}=2.5, d_{50}=3.42)
- Location of intake
- Diversion angle

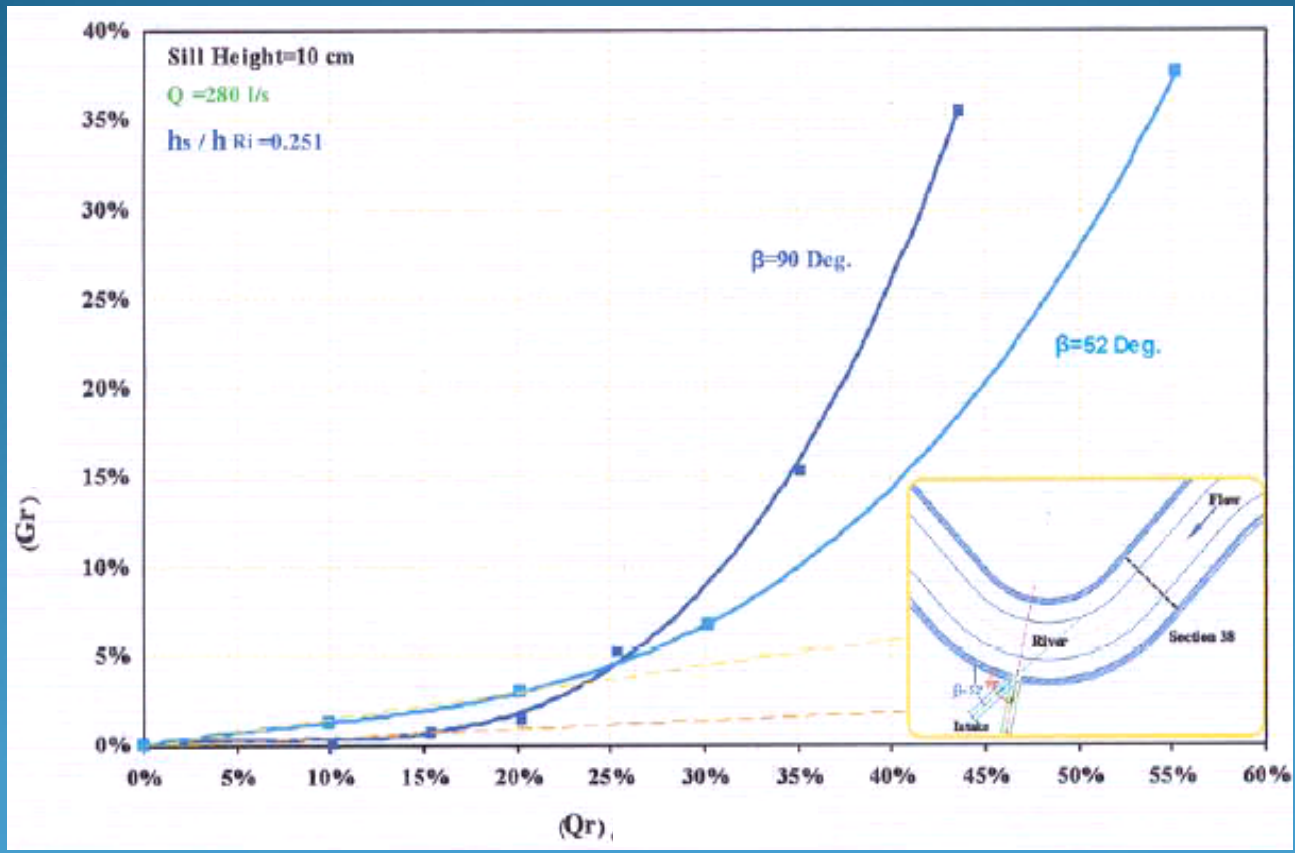
Experimental Setup of Meander Channel (Abolghasemi 2006)



Meander Channel – Intake Location



Meander Channel - Intake Angel



Conclusions

- Use outer bank of bend reach of a river for lateral intake.
- In U-bend channel, the intake should be located at $\theta = 115°$ to $135°$.
- The diversion angle of $60°$ is recommended.
- Sill can reduce the sediment diversion up to 30%. However, its height should be limited to 0.3 Y.
- Submerged vanes are very effective in reducing sediment diversion, even up to 80% and best performance is achieved by:
- $H/h = 0.33$, $\alpha = 20°$, $\delta_s/H = 10$, $\delta_n/H = 1.5$.

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- Izadpanah, Z, 1997. Analysis of sediment transport at lateral diversion in river bend. PhD. Thesis, Tarbiat Modarres University, Tehran, Iran.
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- Safarzadeh, A., 2005, Numerical Study on Flow Pattern on Lateral Diversion in 180 Degree Bend., Msc. Thesis, Tarbiat Modares University, Iran.

Thank you for your attention

Abbassi work