

**PIANC Workshop
15-16th October 2009**



Part 4: STRUCTURE

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Technical aspects, principles and methodologies in design process



- **What's new ?**
- **Focus on structural design**
- **General remarks on safety concept**
- **Actual needs**
- **Actual possibilities**
- **Construction types**



Safety Concept

Semi probabilistic approach

- partial safety factors (amplification / reduction)
- different load factors (permanent, traffic,...)
- different design situations (persistent, transient,...)
- different limit states (ULS, SLS)



Ultimate limit state

- earthquake
- fatigue !



Ultimate limit state

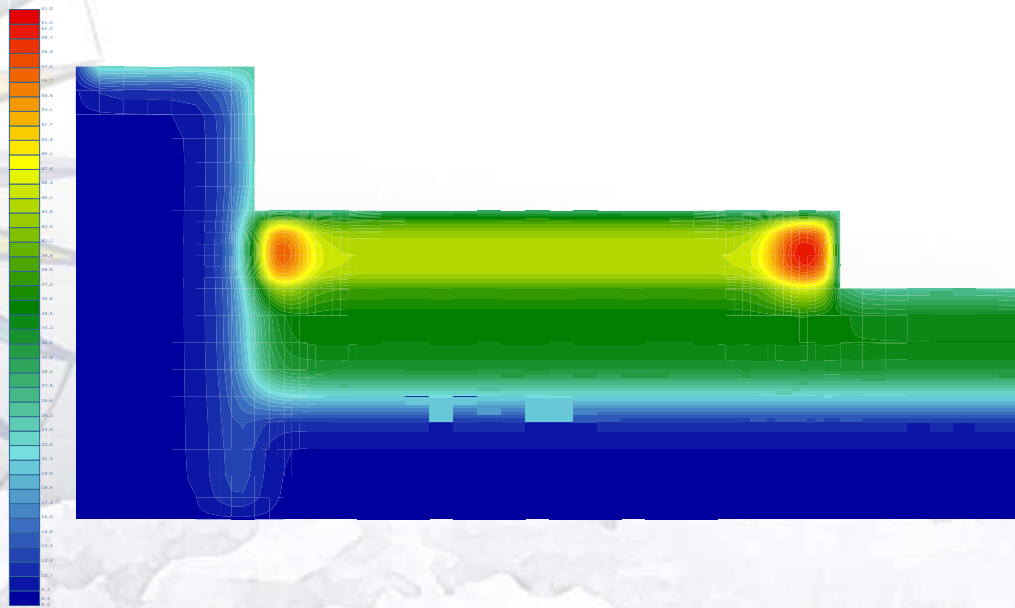


Serviceability limit state

- more important than before
- for concrete structures: crack width
- more time and effort (e.g. nonlinear analysis for thermal induced cracking)



Serviceability limit state

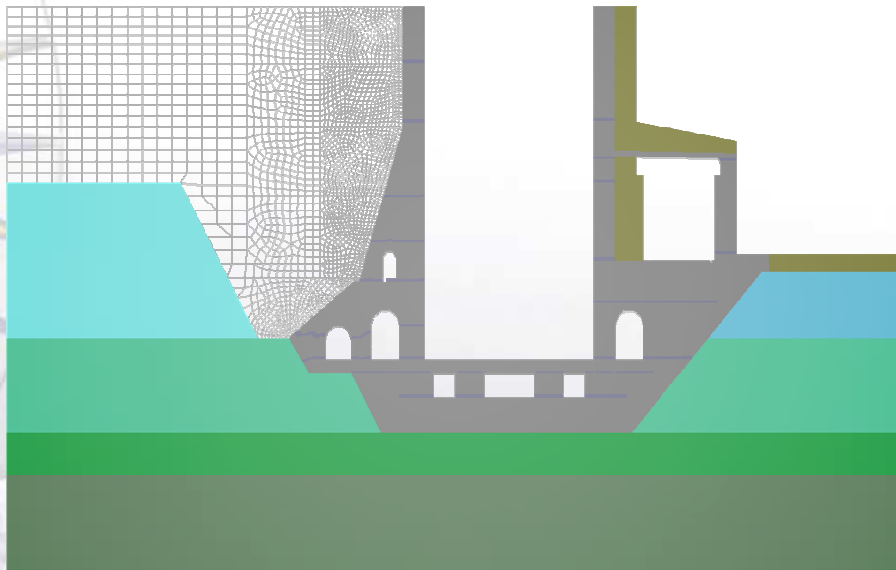


Possibilities

- numerical modeling (FEM, 2D, 3D)
- soil-structure-interaction
- seepage and groundwater modeling
- behaviour of material (e.g. for durability purposes
frost-thaw-resistance of concrete)
- treatment of soil



Possibilities



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9

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Combination of excavation support walls and chamber walls



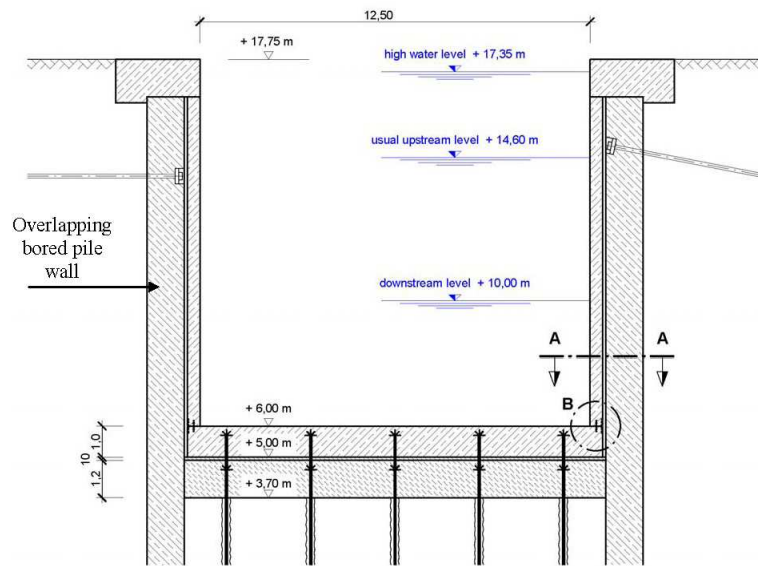
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10

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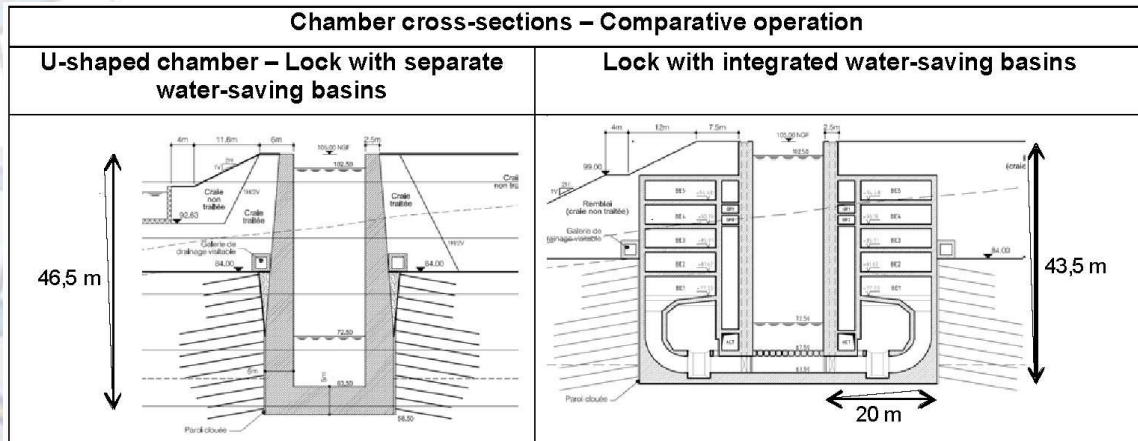
Tremie concrete slabs



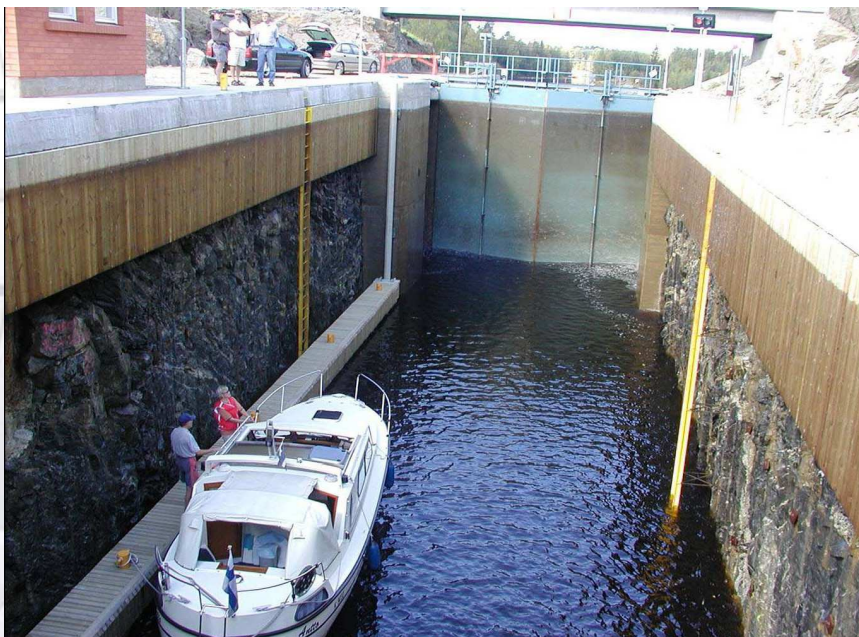
Layout of water saving basins



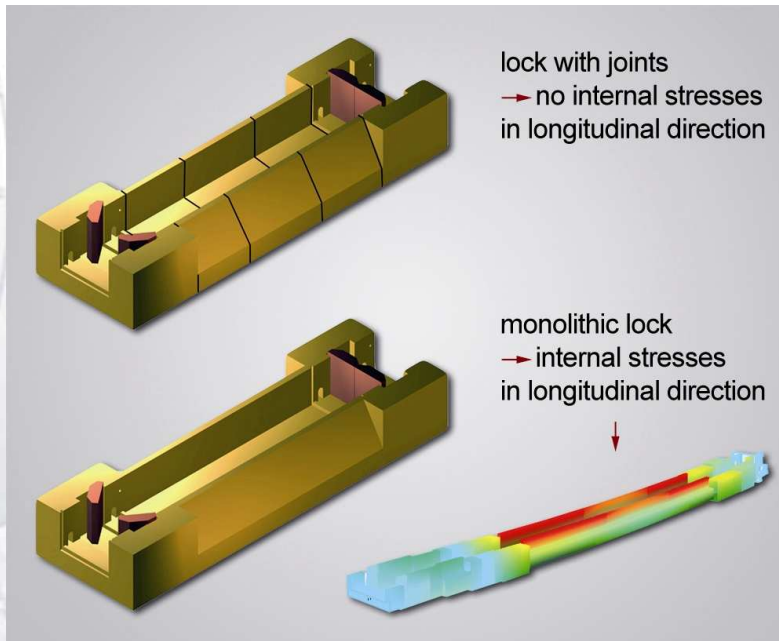
Layout of water saving basins



Locks in rock



Monolithic locks



Monolithic locks

