

PIANC Workshop
13-14th September 2011



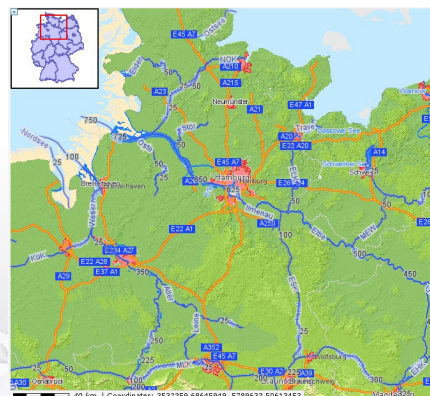
A SELF-CONTAINED HIGH-LIFT LOCK

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Setting the course

Back in the old days

- In the sixties the planning for the Elbe Lateral Canal started
- It bypasses the river Elbe and connects the port of Hamburg to the German canal network





Back in the old days

- The total height difference is 61 m: First step of 38 m near the river Elbe, second step of 23 m is located 50 km south of it at Uelzen
 - Both a double shiplift and a lock with integrated saving basins were evaluated as solutions for the step of 38 m
- ⇒ The double shiplift won the race because it is fast ...



Some decades later

- Double caissons
- 3 min lift





Today's challenges

- The amount of traffic has increased as expected
- But not the number of vessels, mainly the size has grown

=> The double shiplift lost in the end, because it is fast but too small ...



Today's challenges

- The caissons with 100 m useable length are way too short
- At the next height step at Uelzen, there are two locks with 185 m and 190 m useable chamber length

=> What about a new lock next to the shiplift?
Let's have a look ...

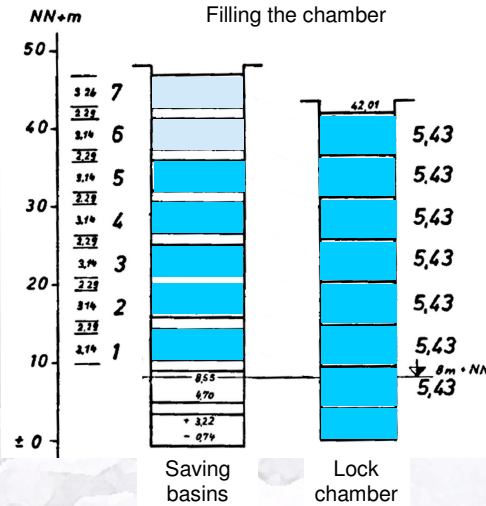
Would an additional lock be the ideal solution?

- A lock would introduce surge waves in the canal
 - The shiplift can stand only very small waterlevel variations
- => the waves would change the force balance between caissons and counterweights
- The waves could be reduced by operating the lock very slowly or
- => Keep all the water inside the lock!

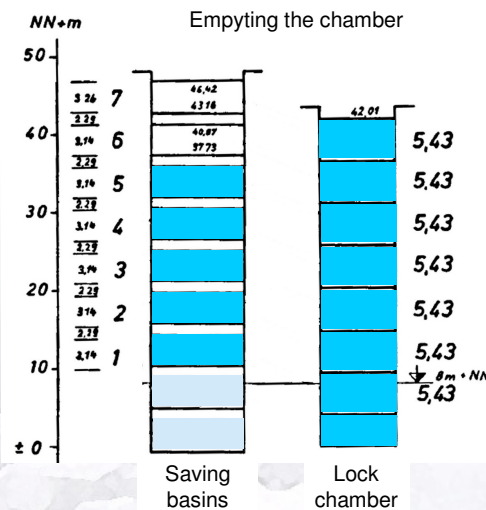
An old idea from the sixties...

- Many canal locks in Germany are built with water saving basins in order to reduce the required pumping (since a century)
 - Why shouldn't it be possible to add additional basins to avoid the exchange of water with the reaches completely?
- => Extension of the well known principle of a lock with water saving basins

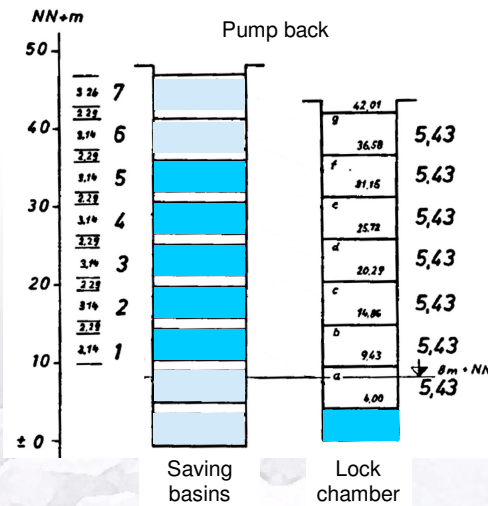
The concept from the sixties



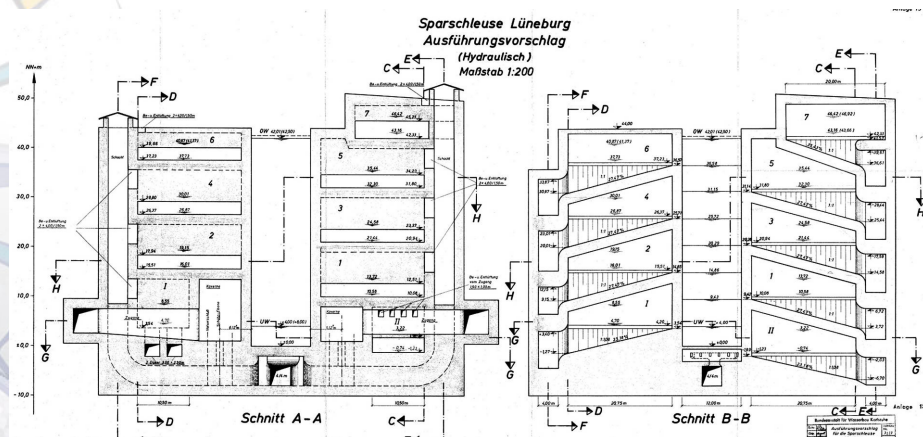
The concept from the sixties



The concept from the sixties



The final concept



Laboratory model made in 1968

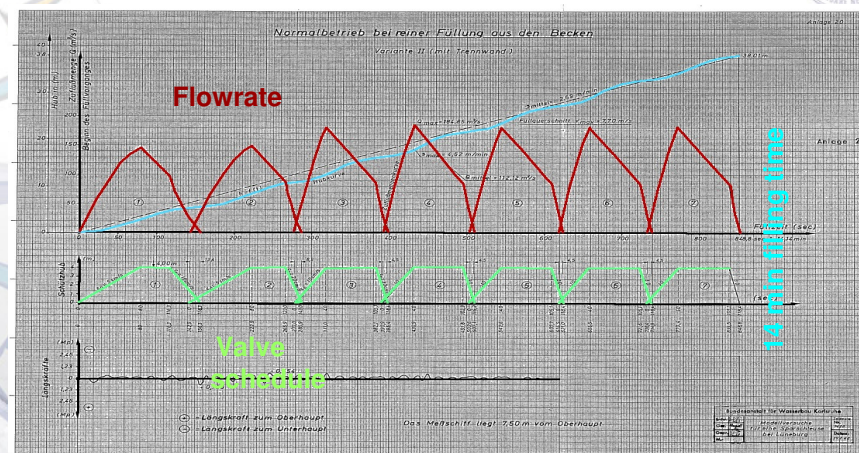


Filling batteries in the chamber



Completed model
Scale 1:20

Laboratory model results



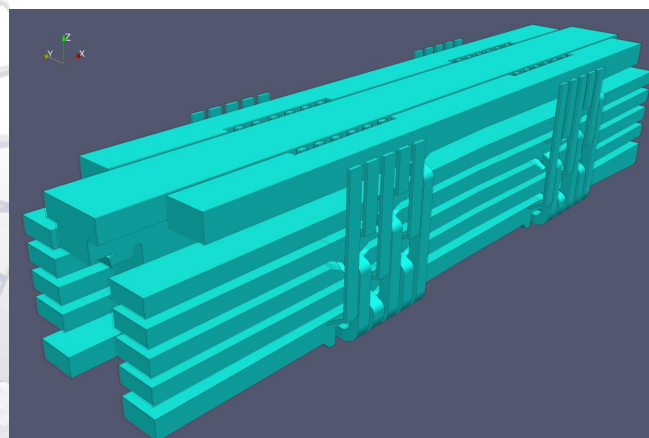
Filling the chamber

Transition to the next millenium: Shifted objectives



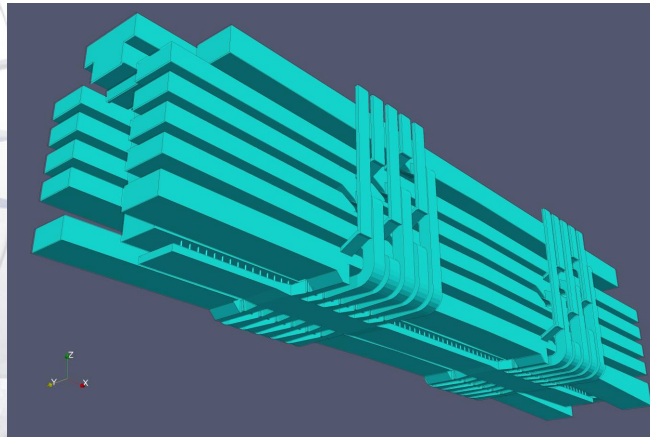
- Pumping costs have increased
- Vessels are larger
- For fast transits, there is additionally the shiplift

New hydraulic design



Hydraulically relevant surfaces

New hydraulic design



Hydraulically relevant surfaces

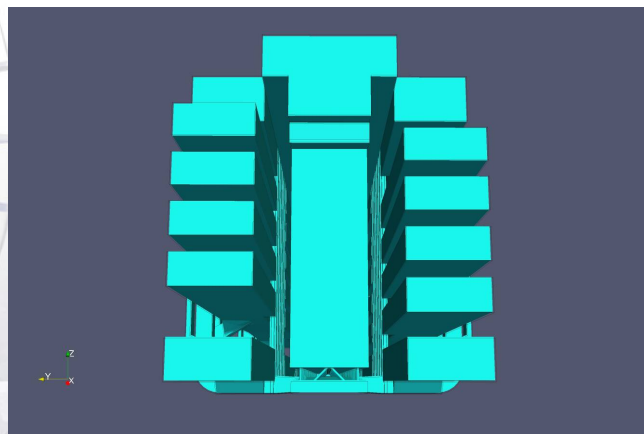
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New hydraulic design



Hydraulically relevant surfaces

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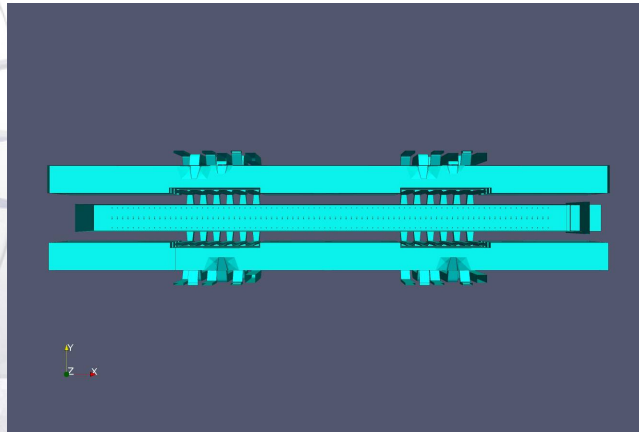
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New hydraulic design



Hydraulically relevant surfaces

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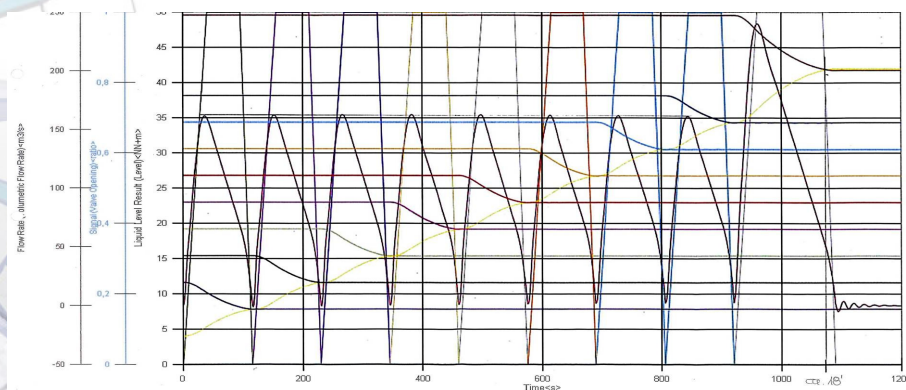
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Initial hydraulic studies: 1D network model results



Filling time of 18 min is fast enough

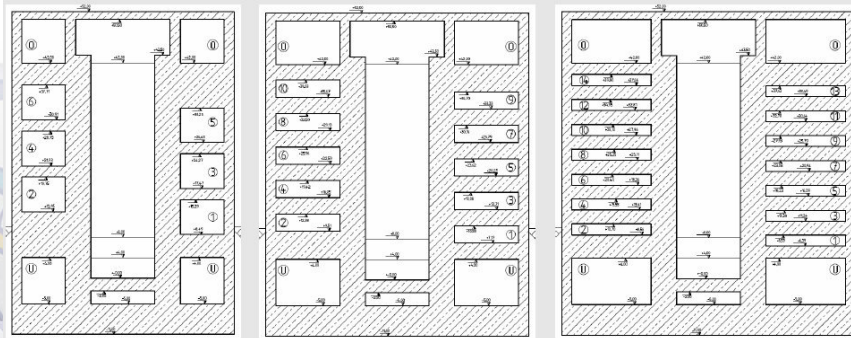
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Optimization of the hydraulic concept



Which number of saving basins to choose?

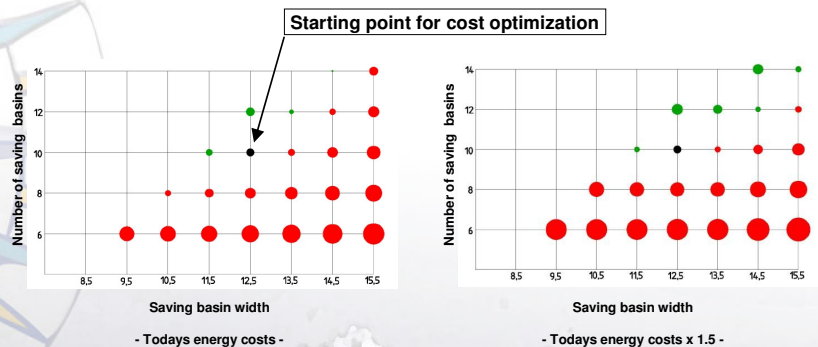
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Cost optimization



Increase the number of saving basins: Energy consumption is more important than filling time!

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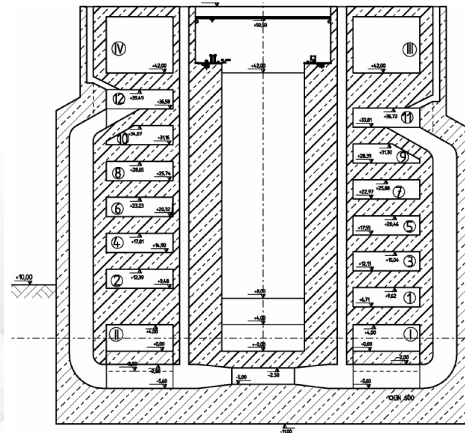
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New hydraulic system

- 12 layers of water saving basins
- 2 layers for exchange water
- Filling time increases to 24 min
- Sturdy, fault tolerant construction



Hydraulic studies

- Water hammer on structures
 - => Overfilling of saving basins
 - => Emergency closing of valves
- Filling time
 - => Model values calibrated on lab model "Minden"
- Chamber wave generation
 - => Threedimensional flow model for filling system



Conclusions

- A self-contained lock can be a feasible solution, if surge waves in the reaches are a problem
- Optimization goals can shift significantly in a few decades (in the sixties energy costs were much less important)
- The presented system is now to be evaluated by the ministry of transport.