

# Belgian Inland Waterways



ir. Peter Van Besien, Lock Maintenance Workshop, St. Louis (USA), 9 feb 2010

# Belgian Inland Waterways

## 1. Situation in Belgium / W&Z

ports, waterways and traffic  
working area, indicators

## 2. Major projects of W&Z

Seine-Schelde, New Lock Evergem

## 3. Lock inspection

why – how and major defects

## 4. Lock maintenance

## 5. Innovative projects



# 1. Situation in Belgium / W&Z

- ☞ Flanders Port Area
- ☞ Waterways
- ☞ Traffic
- ☞ Working area of Waterwegen en Zeekanaal NV
- ☞ Indicators

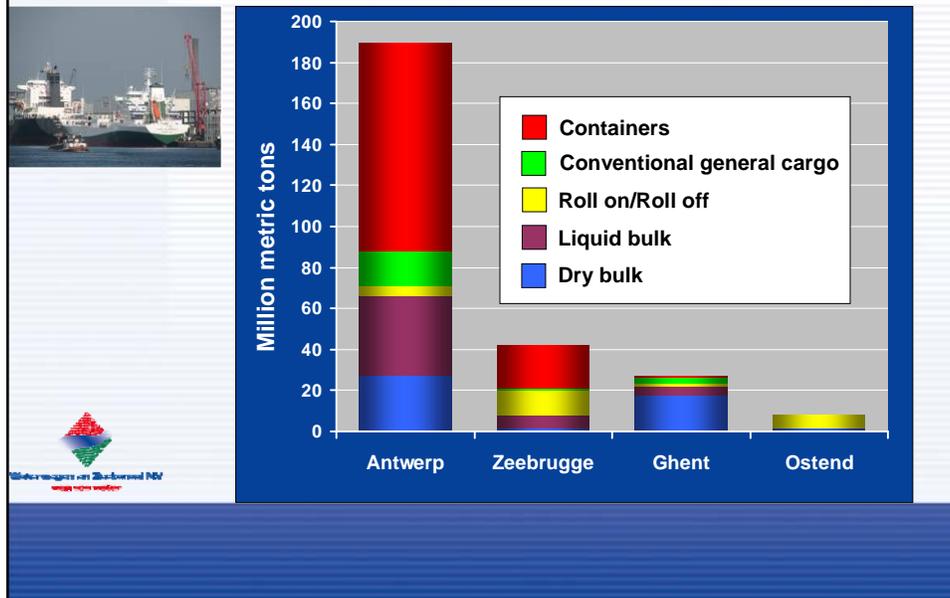


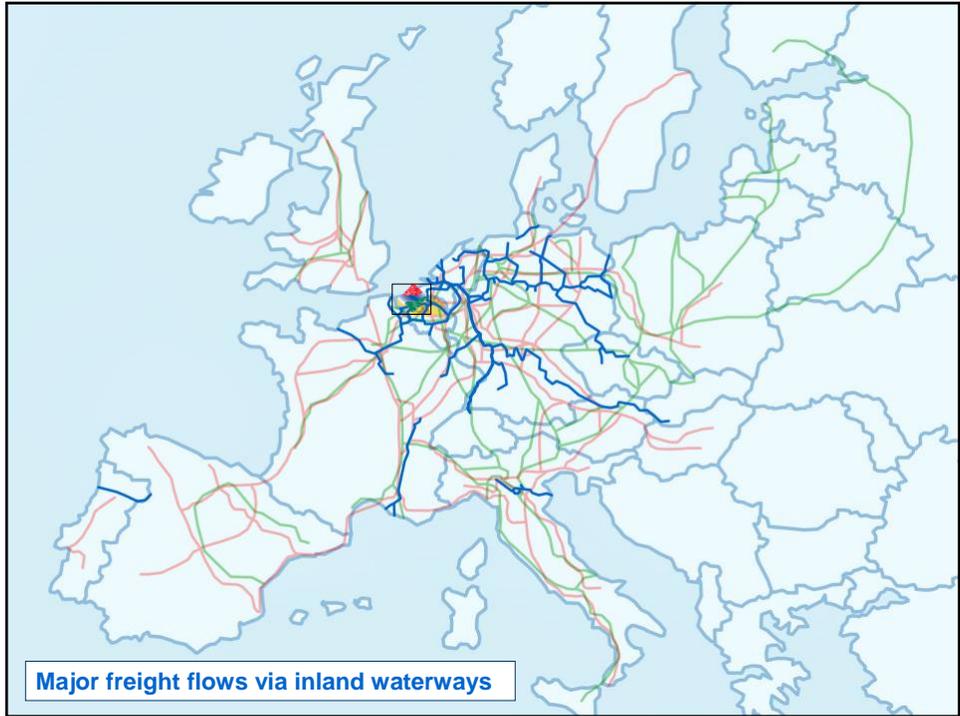
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# 1. Situation in Belgium / W&Z

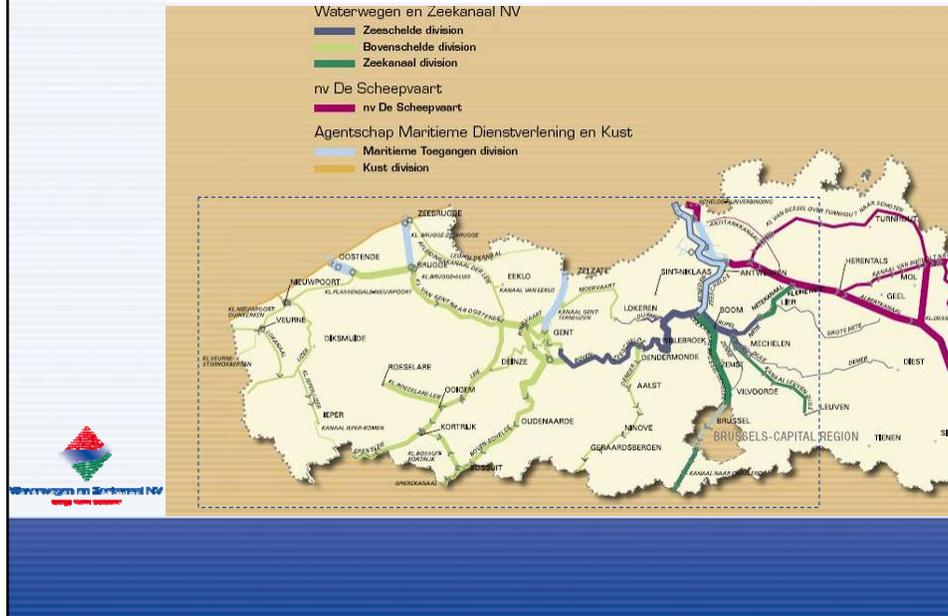




# 1. Situation in Belgium / W&Z



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## Key figures of W&Z:

- 623 miles of waterways, of which 469 miles navigable
- 72 locks
- 652 bridges

## Traffic (2009):

- 930 mil. ton-miles
- 29 mil. tons
- 37.136 loaded ships
- 146.052 20 ft-containers
- 53.590 lock operations (recreation)

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## 2.1 Seine-Schelde connection

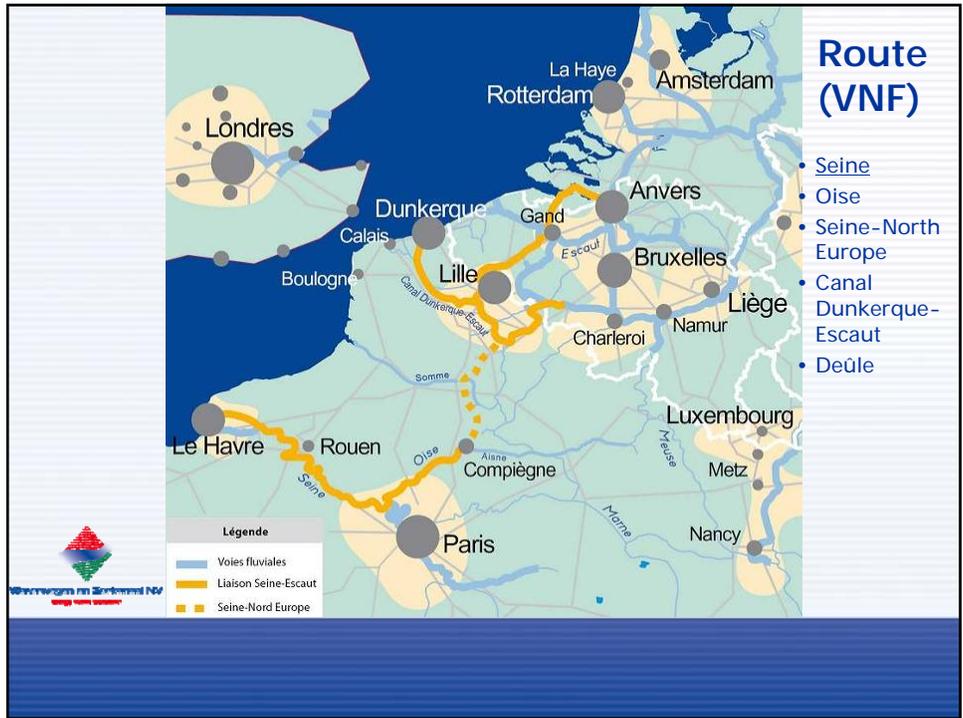
### Inland waterways transport connection

- European context

#### *Trans-European Network*

*Upgrading the Seine-Schelde connection = one of the 30 priority projects (TEN-T)*





## 2.1 Seine-Schelde connection

- Basic principles
  - *Depth class Vb = max. 3.50 m (600 ft long)*  
→ *Maintenance of current water line (b = 50.70 m)*
- River rehabilitation:
  - = *"All the measures for rehabilitating or strengthening the structures and processes contributing to the dynamic equilibrium within the river's eco-system"*
  - connect the old meanders of the river



## 2.1 Seine-Schelde connection

### Timing & project cost

- *Timing of works*
  - *Inland waterways transport: 2009 - 2016*
  - *River rehabilitation: 2009 - 2015 - 2021 - 2027*
- *Cost estimation*

|                                    |                        |
|------------------------------------|------------------------|
| <i>waterways transport section</i> | <i>EUR 200 million</i> |
| <i>River rehabilitation</i>        | <i>EUR 100 million</i> |
| <i>TOTAL</i>                       | <i>EUR 300 million</i> |



# 2.2 New Lock at Evergem



# 2.2 New Lock at Evergem



## 2.2 New Lock at Evergem

### Why a new lock?

- Traffic (waiting times)  
16 mil. tons ('96) with max capacity of 16,7 mil. tons
- Redundancy  
economical importance of the lock  
access for Port of Ghent to France
- Larger ships  
*Seine-Schelde* project
- Age  
need for structural maintenance



## 2.2 New Lock at Evergem

| Old lock                                | New lock                             |
|---|--------------------------------------|
| 1965                                    | 2009                                 |
| 136m x 16m                              | 230m x 25m (Vb)                      |
| one lock chamber                        | partitioning doors<br>110+90m saving |
| Short culverts                          | water valves in gates                |
| miter gates (us) + vert. lift gate (ds) | 3 identical miter gate - pairs       |
|   | 32 mil. euro                         |



## 2.2 New Lock at Evergem

chamber wall  
landside

Werkvloer in schraal beton

Sluisvloer in onderwaterbeton

Diepwand

Raster van trekprofielen die droogzetten van de sluis in de uitvoeringsfase en definitieve fase moet toek

in combinatie met de sluisvloer met de draagtechniek

chamber floor



Design: underwater concrete 1,5m thick  
Execution: floor with pre-tensioned soil anchors

## 2.2 New Lock at Evergem

miter  
gate



## 2.2 New Lock at Evergem

upper  
hinge  
+ anchors



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# 3. Lock Inspection

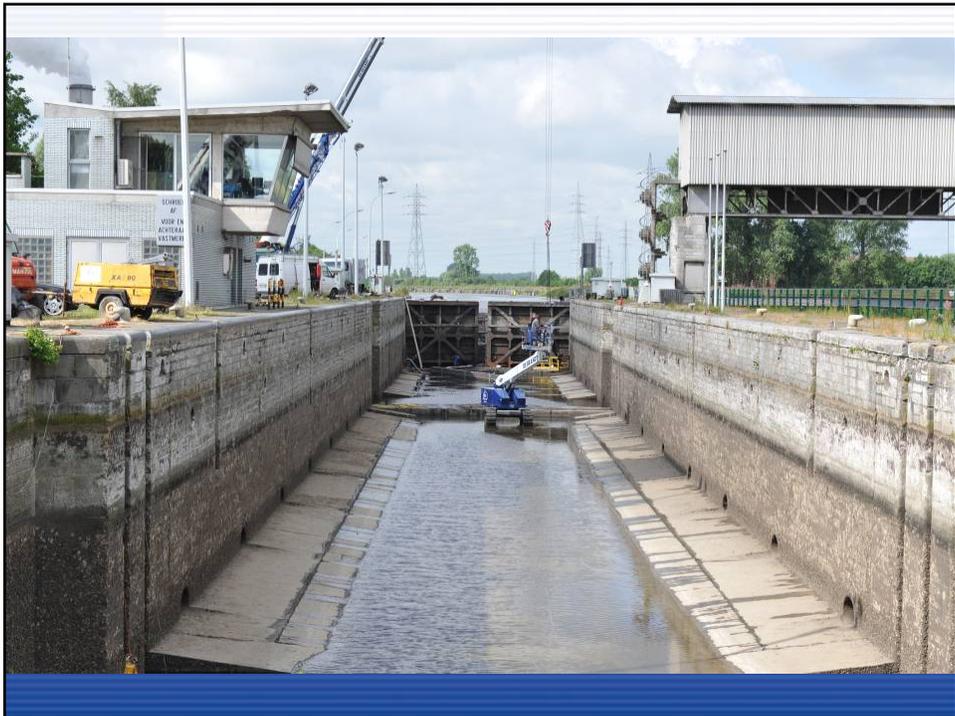
## Why inspections?

- Prevent sudden failure  
→ safety and stability
- Inspection-based maintenance  
→ durability and asset management

## When?

- Each 4 years: global inspection:  
visual inspection of the dry elements  
measurement of settlement, movement when needed
- Detailed inspection of an empty lock (in the dry)
- Diving inspections for special problems





### 3. Lock Inspection




**with caisson to inspect and replace gate supports (lower hinge)**



### 3. Lock Inspection

**Main defects:**

- Gate hinges: cracks, weldings, position




Chamber wall

Miter gate



### 3. Lock Inspection

Main defects:

→ broken hinge



### 3. Lock Inspection

Main defects:

→ broken threaded rod



### 3. Lock Inspection

Main defects:

- Position of support blocks

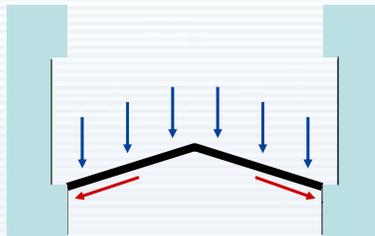


### 3. Lock Inspection

Main defects:

closed position, under hydraulic pressure  
∅ support blocks must take the force  
not the hinge!

→ broken anchor rods, concrete blocks, ...



### 3. Lock Inspection

Main defects:

→ crushed concrete anchor block (fatigue)



### 3. Lock Inspection

Main defects:

reconstruction of the anchor block:

bigger reinforced concrete block



or anchored steel block



### 3. Lock Inspection

Main defects:

- Cracks in steel plate



origin: debris on the floor, steel fatigue



Waterschap en Zeehaven NV  
water voor iedereen

### 3. Lock Inspection

Conclusions:

- Regular inspection of locks
- Spare parts available
- Good adjustment of the door position
- Optimised upper hinge design



Waterschap en Zeehaven NV  
water voor iedereen

### 3. Lock Inspection

New design:



### 3. Lock Inspection

Optimised new hinge design:



flexible connection

sliding rod support

armoured concrete blocks



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# 4. Lock maintenance

## Maintenance planning:

- Inspection-based maintenance (when needed or low service level)
- Renewal of mechanics/electronics (10 - 20y)
- Renovation of sill and sealings (15 - 25y)



## 4.1. Renovation of Kerkhove Lock (2009)

Dry inspection of the lock chamber,

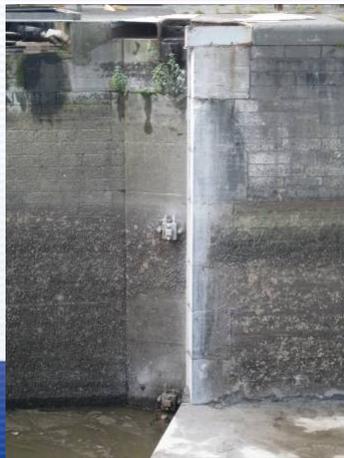
Removal of the lock doors



## 4.1. Renovation of Kerkhove Lock (2009)

Strengthening of the sill and sealings:

- Removing damaged brickwork with diamond-bladed saw
- Strengthening with concrete and steel plates



## 4.1. Renovation of Kerkhove Lock (2009)

### Renewal of the bottom support and sealings:

- Thrust bearings on door and floor
- Wood and rubber sealings



## 4.2. Renovation of Demey Lock (2009)

### Renewal of the doors and driving mechanisms:



## 4.2. Renovation of Demey Lock (2009)

New concrete blocks on top of the brickwork walls  
→ foundation for the hydraulic cylinders



## 4.2. Renovation of Demey Lock (2009)

Large cast-iron hinges  
small space for mechanics and soil anchors not possible



## 4.2. Renovation of Demey Lock (2009)

Renewal of thrust bearings, support blocks and upper hinge



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## 5. Innovative projects

5.1 Replacement of the bottom rails of a rolling gate (Kallo Lock) while in-use

5.2 Renovation of the Van Cauwelaert lock



### 5.1 Replacement of bottom rails (in-use)

#### Kallo lock

- only connection between Scheldt and port on left river bank
- Continuously in use since 1981 (> 4.000 operations/y)
- 380mx50m (1.250ft x 164 ft)
- 4 rolling gates on bottom rails
- Diving inspections → weir of the rails and wheels



## 5.1 Replacement of bottom rails (in-use)

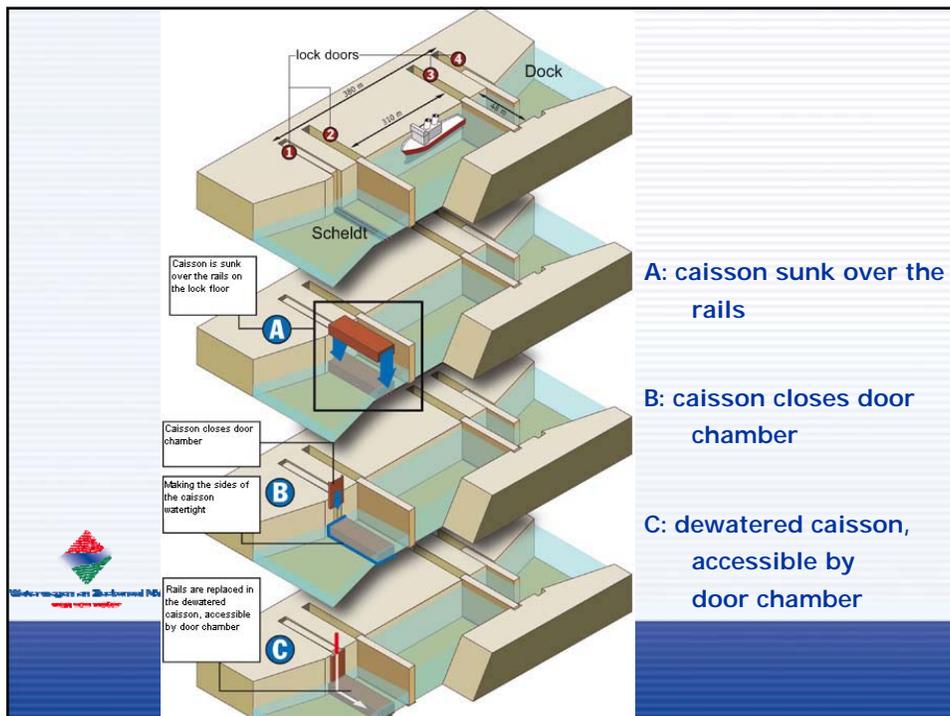
Solution: replacement of the rails and wheels

- Construction of a caisson (8 ft high)
- Modularity (useable on other locks)
- Navigation possible (high tide) when not working
- Communication and planning

→ little impact on traffic



Waterwegen en Zeekanaal NV  
water voor iedereen



Waterwegen en Zeekanaal NV  
water voor iedereen

## 5.1 Replacement of bottom-rails



## 5.2 Renovation of Van Cauwelaert lock

### Van Cauwelaert lock

- connection between Scheldt and port on right river bank
- 270mx35m (886ft x 115 ft)
- 4 rolling gates with bottom rails
- In use since 1928

→ operating lifetime of 80y reached  
total renovation



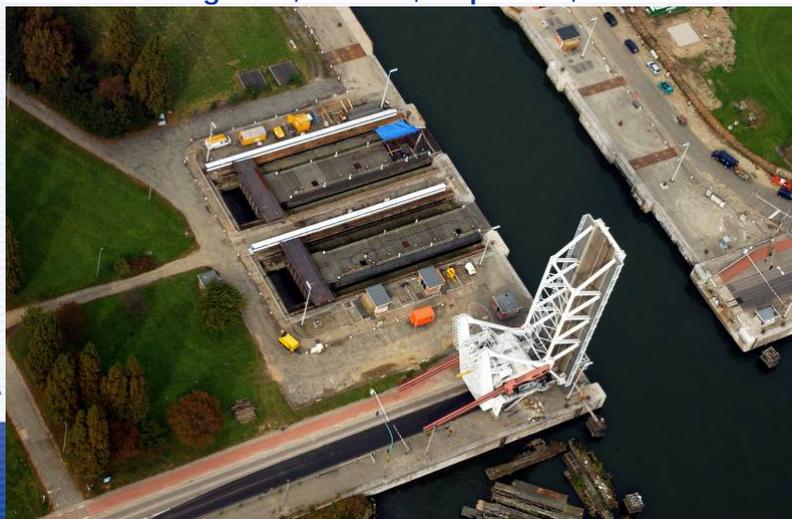
## 5.2 Renovation of Van Cauwelaert lock



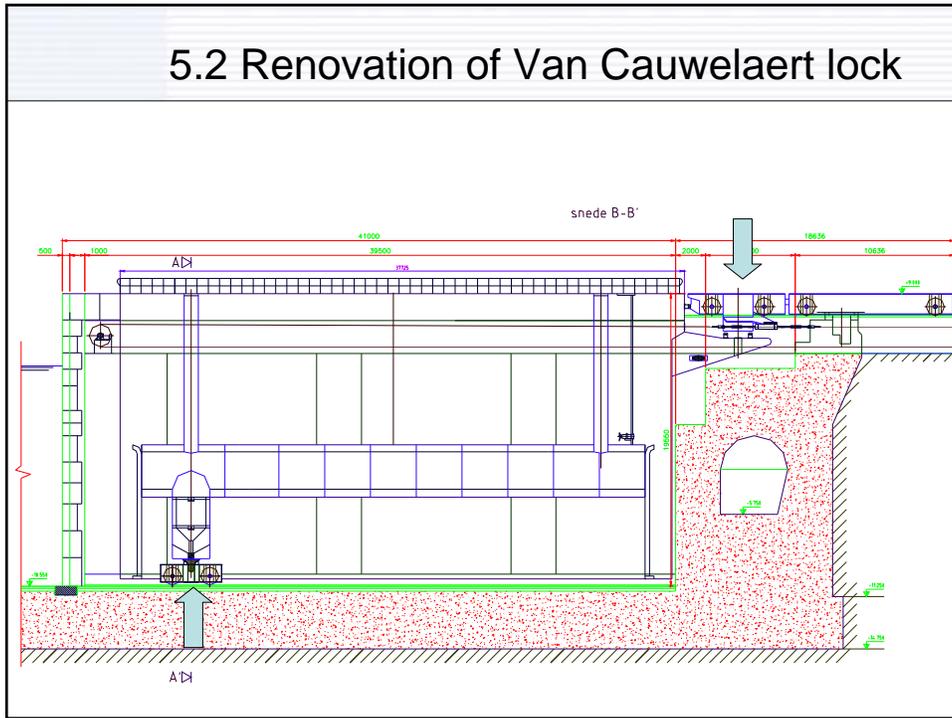
## 5.2 Renovation of Van Cauwelaert lock

4 new rolling gates with lower AND upper rails

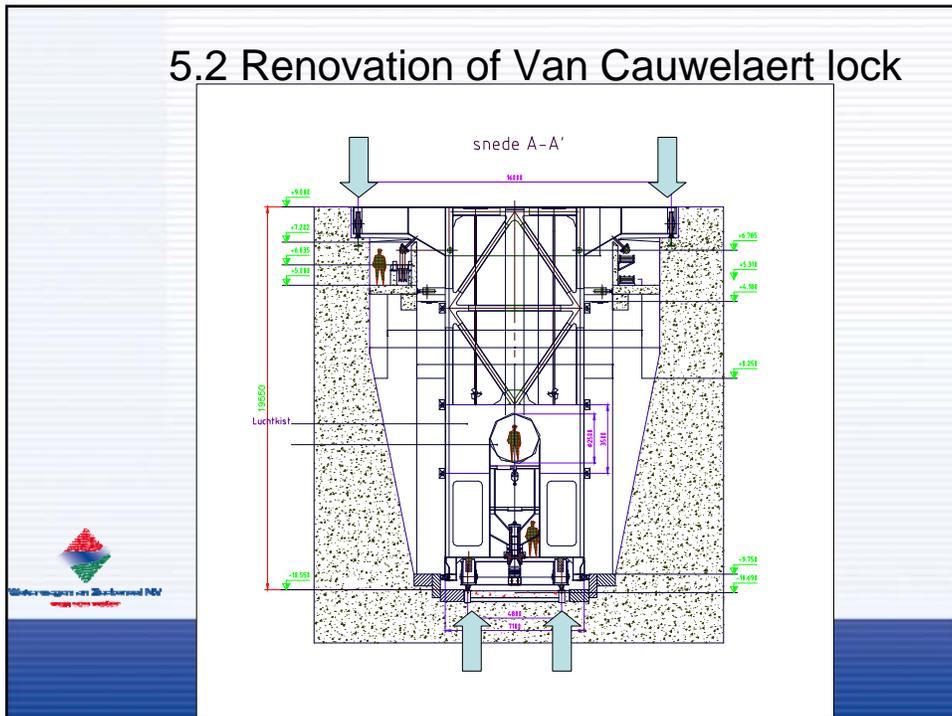
++ interchangeable, balance, inspection, maintenance



## 5.2 Renovation of Van Cauwelaert lock



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## 5.2 Renovation of Van Cauwelaert lock

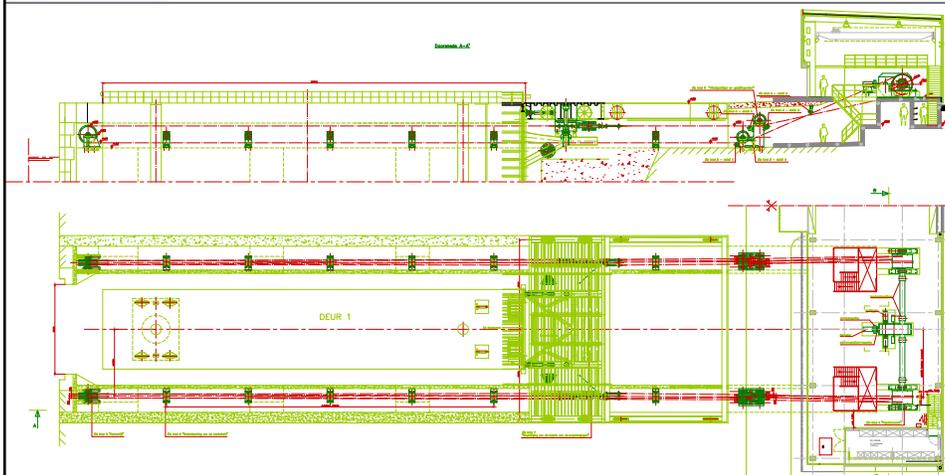
### Innovation:

- Propellers to prevent sedimentation on doors
- Airlift installation to prevent sedimentation on rail holes
- Measurement of door balance  
→ minimising wearing of rails and wheels by adjusting floating chamber
- Movement by cables (no wagons)



Waterwegen en Schiphol NV  
weg naar water

## 5.2 Renovation of Van Cauwelaert lock



## 5.2 Renovation of Van Cauwelaert lock



## 5.2 Renovation of Van Cauwelaert lock



## 5.2 Renovation of Van Cauwelaert lock

### Key figures:

- 2008-2011 (3 years)
- Only 1/3 (13 months) out of service
- Total cost: 58 mil. EUR



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Thank you!