

## 2.2 TRAFFIC MANAGEMENT AND CONTROL

### TRAFFIC MANAGEMENT IN EUROPE'S BUSIEST 4-TUBE MOTORWAY TUNNEL IN HAMBURG

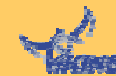
**By Matthias Richter**

**Ministry of Construction and Transport,  
Amt für Bau und Betrieb, Hamburg**

**[matthias.richter@bbv.hamburg.de](mailto:matthias.richter@bbv.hamburg.de)**



**Freie und Hansestadt Hamburg**



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**Introduction**

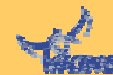
**Implementation of Traffic Control Equipment  
in Elbe Tunnel**

**Implementation: Link and Lane Control  
on Motorways A7/A23**

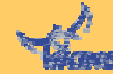
**Study: Risk Reduction and  
Congestion Prevention in Tunnels**

**Integration of the 3 Projects**

**Conclusions**



## Introduction -1- Location of Elbe Tunnel



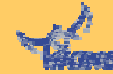
## Introduction -2- Location of Elbe Tunnel in Hamburg



**Length: 3000 m**

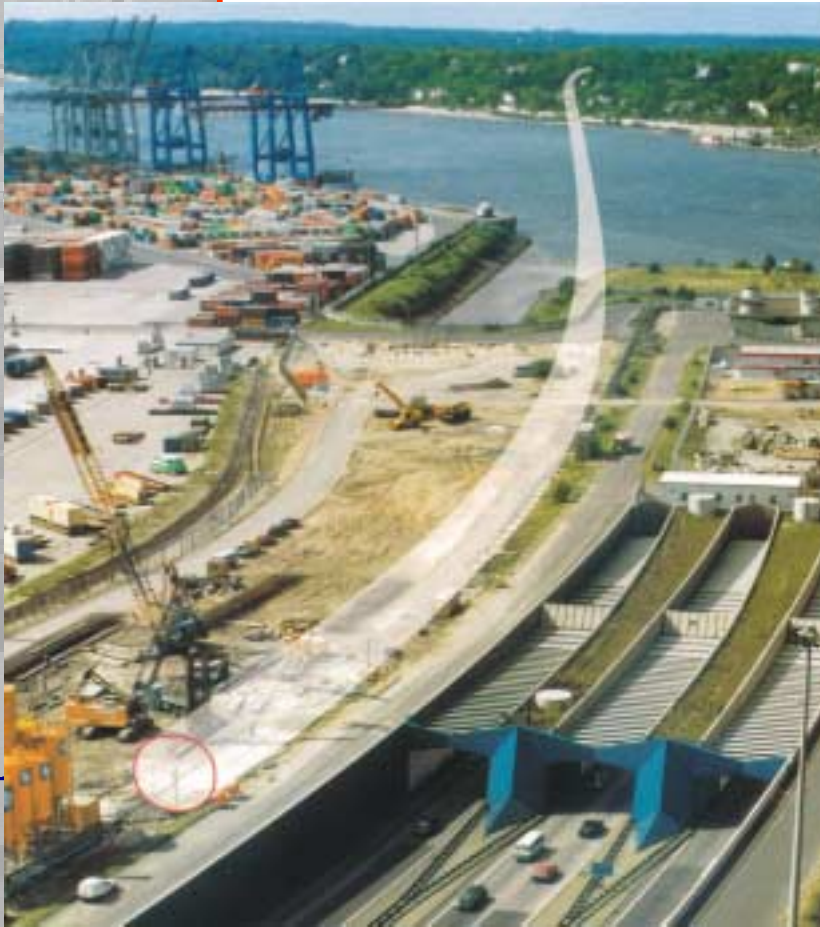
**max. Depth: 34m**

**max. Gradient:  
3,5%**

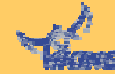


## Introduction -3-

# The Elbe Tunnel in Hamburg



- Motorway tunnel
- Four tubes (8 lanes)
- 4th tube operation since end of 2002
- 140 000 ADT



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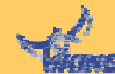
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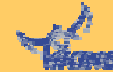
## Implementation of Traffic Control Equipment in Elbe Tunnel -1-

### VIKING project Phase 4, MIP 01-03

Financing: Ministry of Transport, Building and Housing

- Replacement and adaptation to 4 tubes operation
- Inner tubes can be operated northbound, southbound or bi-directional
- Single lanes can be closed

➤ 21 operation states



## Implementation of Traffic Control Equipment in Elbe Tunnel -2-

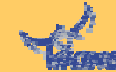
Betrieb	4. tube	3. tube	2. tube	1. tube	Fahrstr.-Betrieb	
H1	↓↓↓	↓↓↓	↑↑↑	↑↑↑	4+4 RV	day time
H2	↓↓↓	×××	×××	↑↑↑	2+2 RV	at night
H3	×××	↓↓↓	×××	↑↑↑	2+2 RV	at night
H4	↓↓↓	×××	↑↑↑	×××	2+2 RV	at night
B1	×××	↓↓↓	↓↑	↑↑↑	3+3 GV	long-term 1-tube closure during day time
B2	↓↓↓	×××	↓↑	↑↑↑	3+3 GV	long-term 1-tube closure during day time
B3	↓↓↓	↓↑	×××	↑↑↑	3+3 GV	long-term 1-tube closure during day time
B4	↓↓↓	↓↑	↑↑↑	×××	3+3 GV	long-term 1-tube closure during day time
B5	×××	↓↓↓	↑↑↑	↑↑↑	4+2 RV	short-term 1-tube closure during day time
B6	↓↓↓	×××	↑↑↑	↑↑↑	4+2 RV	short-term 1-tube closure during day time
B7	↓↓↓	↓↓↓	×××	↑↑↑	4+2 RV	short-term 1-tube closure during day time
B8	↓↓↓	↓↓↓	↑↑↑	×××	4+2 RV	short-term 1-tube closure during day time
B9	×××	×××	↓↓↓	↑↑↑	2+2 RV	long-term 2-tube closure
B10	×××	↓↓↓	↑↑↑	×××	2+2 RV	long-term 2-tube closure
B11	↓↓↓	↑↑↑	×××	×××	2+2 RV	long-term 2-tube closure
B16	×××	×××	↓↑	×××	1+1 GV	special cases
B17	×××	↓↑	×××	×××	1+1 GV	special cases

- Change of operation states without stopping traffic
- 272 operation state changing plans

? *How is the change managed?*

Figure by:

**JAAKKO PÖYRY INFRA**  
Heusch Boesefeldt Verkehrsconsult

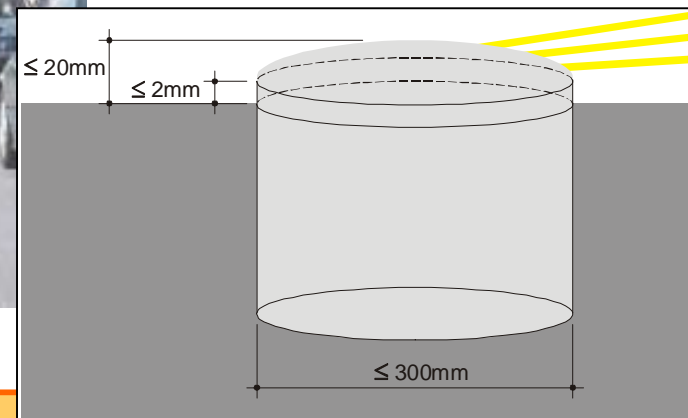


## Implementation of Traffic Control Equipment in Elbe Tunnel -3-

- 500 Lane signals

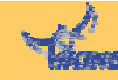


- 260 Variable message signs
- 22 Movable barriers
- 685 Inset lights (light emitting road studs)



Figures by:

**JAAKKO PÖYRY INFRA**  
Heusch Boesefeldt Verkehrsconsult



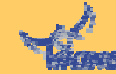
## Implementation of Traffic Control Equipment in Elbe Tunnel -4-

### Tunnel Control Centre

- **Control of traffic and safety systems**
- **Operated 24 hours**
- **72 CCTV monitors**



Figure: kwod Design GmbH



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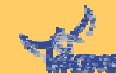
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**Integration of the 3 Projects**

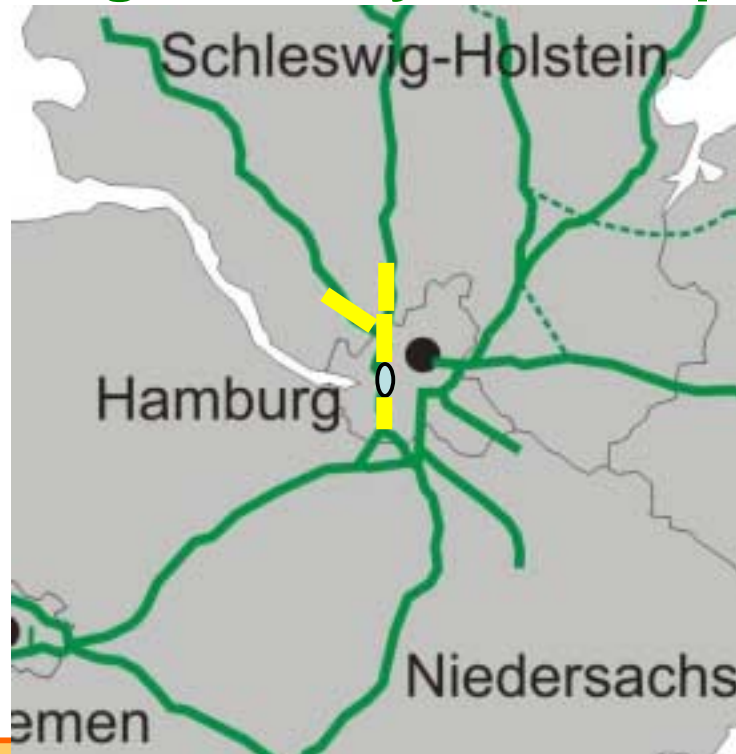
**Conclusions**



## Implementation: Link and Lane Control on Motorways A7/A23 -1-

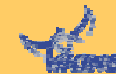
### VIKING project Phase 4, MIP 01, 02: part of tunnel control project

Financing: Ministry of Transport, Building and Housing



Motorway sections  
approaching Elbe Tunnel

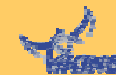
- South: 11 km on A7
- North: 18 km on A7  
(9 km both directions)
- 10 km on A23



## Implementation: Link and Lane Control on Motorways

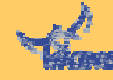
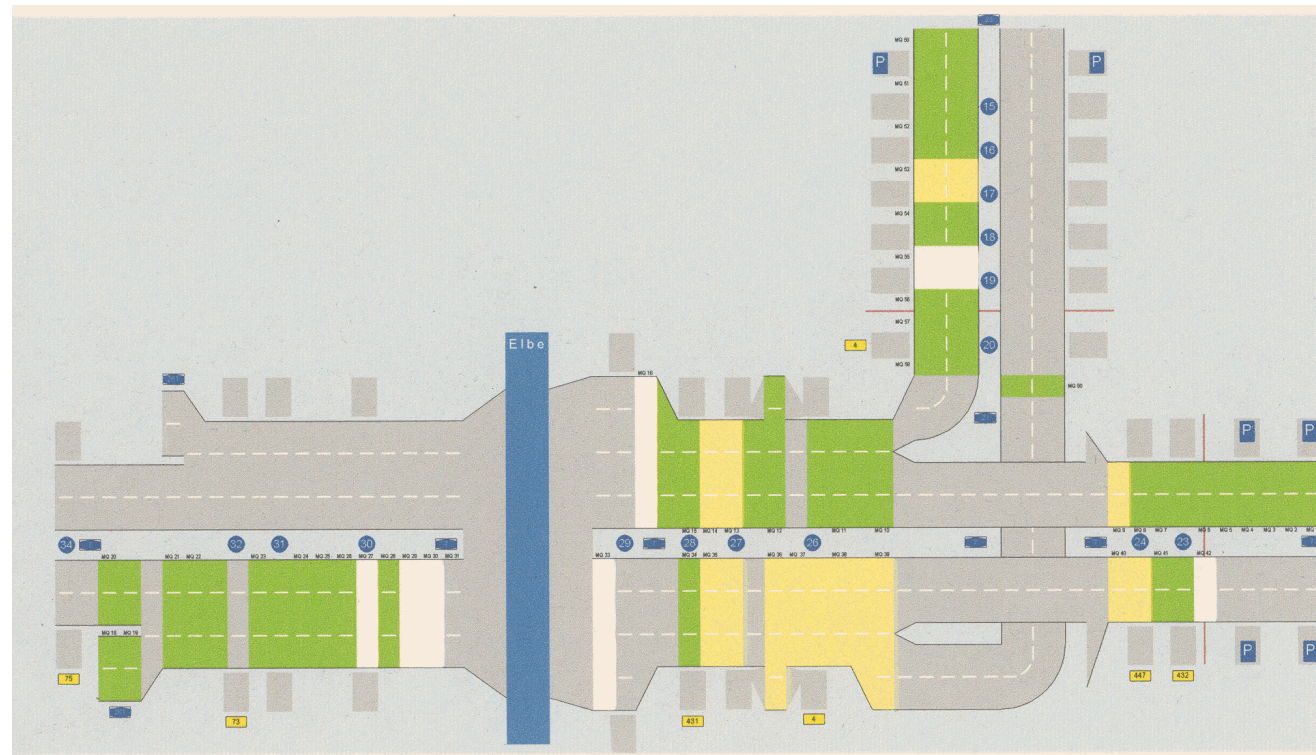
### A7/A23 -2-

- Lane signals (34 gantries)
- Variable message signs (speed limits, congestion warnings, no overtaking signs, weather related warnings)
- Inductive loop and radar detectors
- Weather detection



## Implementation: Link and Lane Control on Motorways A7/A23 -3-

- Automatic operation
- Supervision by Hamburg Traffic Control Centre



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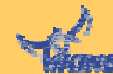
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## Study: Risk Reduction and Congestion Prevention in Tunnels -1-

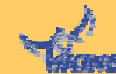
### Phase 4: Risk Reduction Measures in Tunnels Based on Traffic and Incident Management

#### MIP 01: Feasibility Study on Tunnel Safety Systems

#### MIP 02: Simulation

#### continued in MIP 03-06

- Investigation of costs, technical feasibility and influence on traffic
- 13 of 16 measures potentially applicable to Elbe Tunnel



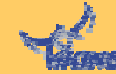
## Study: Risk Reduction and Congestion Prevention in Tunnels -2-

### Examples for Measures:

- No overtaking rule for lorries
- Ramp metering in peak hours
- Extension of merging areas (4  $\Rightarrow$  3 lanes)

### Investigation by Simulation

- Microscopic model PARAMICS
- No overtaking rule (lorries) and extension of merging areas recommended



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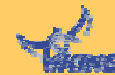
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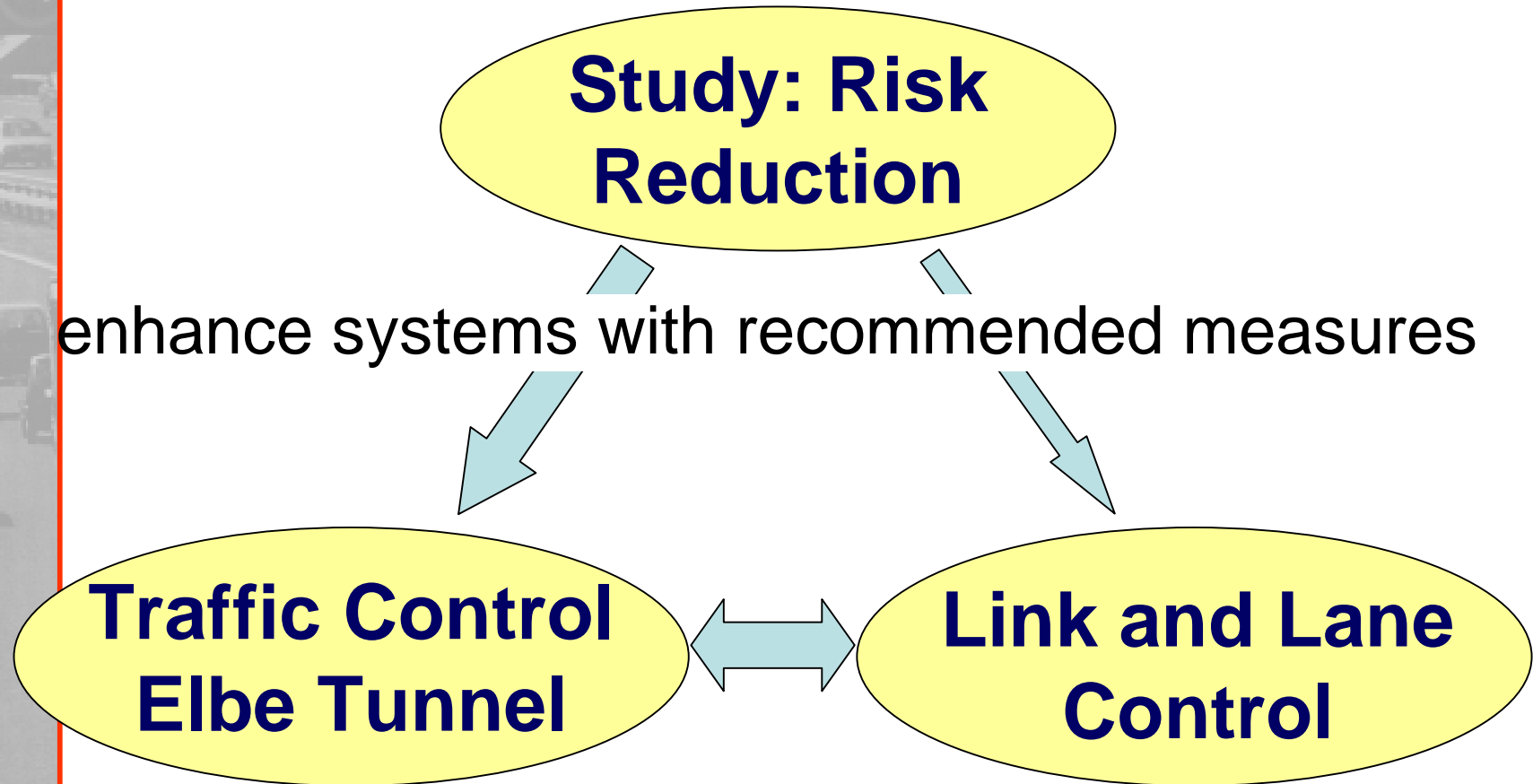
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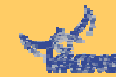
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## Integration of the 3 Projects



**interaction:  
overlap of actions at the transition points**



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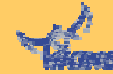
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## Conclusions

- Elbe Tunnel very important in TERN to Scandinavia
- Traffic control systems represent a pioneering solution with



- High safety level and
- Extreme complexity



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