



Witt&Sohn AG Apr-14

40 years progress in Tunneling 4th Tube of the Elbtunnel at Hamburg



- The Elbtunnel is connecting the southern urban area of Hamburg and the north.
- Almost 124.000 vehicles a day are passing through four tubes and make the Elbtunnel one of the busiest road tunnels in Europe.
- Due to its well recognized saftey concept Elbtunnel is also one of the safest road tunnels worldwide.



Combining improved ventilation concepts



- The 4th tube was built by drilling under the river Elbe with the biggest boring machine at the time with Ø 14.2 meters.
- Apart from first 3 tubes, with focus on pollution requiring ventilation, the focus at the 4th tube is on smoke extraction because of the lower emissions of modern vehicles and higher awareness of tunnel safety meanwhile.









The Ventilation Concept of the 4th tube

- 64 Jet Fans realize necessary ventilation under normal operational conditions
- 8 Axial Fans and 196 dampers extract smoke in case of a fire at both ends of the tunnel



ADVANTEGES:

- Smoke extraction via separated smoke duct
- Avoid mixing of fresh air and toxic smoke inside the tunnel
- Fresh air streaming from both sides of the fire
- People can be rescued from both sides of the fire
- Exhausting from the ceiling uses the updraft of the smoke

Dampers at the ceiling Cleverly using the laws of physics



- Extracting smoke at the tube ceiling through a duct in the top section is the key safety concept of the 4th tube.
- Suspended ceiling made of stainless steel and fire insulation withstanding up to 1200°C
- 196 Dampers arranged in groups of 4 every 63 meters at 49 control sections along the tube.
- Gravity release system for the dampers by
 - Thermo control wire along the tube
 - Camera supervision of the tunnel
 - Smoke sensors
 - Temperature activated by a melting fuse





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Smoke extracting right at the hot spot

- 8 Axial fans Ø 2000 are used to extract smoke at both ends of the Tunnel in case of a fire with a maximum volume flow rate 252.000 m³/h.
- P_{total} 2350 Pa
- Motor power 250 KW, completely insulated with fresh air inlet
- Noise 71 dB (A)/1m
- Weight ~4.500 Kg
- Fire proof 500°C/90 minutes plus 700°C/ 90 minutes acc. EN 12101-3





Smoke extraction with Axial fans at the north and south end of the tunnel







Jet Fans enforcing the air exchange on demand

64 Jet Fans Ø 1120 in groups of 4 for:

- longitudinal ventilation (normal mode)
- balancing of airflow towards the exhaust dampers (fire case)
- Thrust 1100 N
- Volume flow rate 35 m/s
- Power 30 KW
- Weight 630 Kg
- Material 1.4571 stainless steel
- Secured by stainless steel wires
- Tested acc. ISO 13350







Intensive Testing under toughest conditions

- Due to the high safety standards of the project testing and documentation have been extensive. Especially the axial fans were tested comprehensively.
- A prototype was tested in a heat chamber at accredited Laboratories at Metz, France for 90 minutes at 700°C acc. EN 12101-3.
- Every delivered fan is tested according Witt & Sohn's quality assurance specifications at the factory with complete documentation.







Fire simulation on site. Proving the theory.

- Before the final opening of the tunnel a fire simulation was carried out
- 7,5 MW fire (~burning motor caravan) was set up in the middle of the tunnel
- Dampers opened automatically
- Outspread of Smoke was prevented
- Areas upstream and downstream the fire were kept free of smoke







Proven in daily practice.

- In average 150 accidents occur every in all 4 tubes of the Elbtunnel. Not all as serious like the one on 31. March 2011, were a truck burnt down in the 4th tube.
- Once more the safety concept has been proven.
- Smoke was extracted right at the hot spot.
- People escaped through safety tunnel, no one was injured.
- Fire brigade and other forces reached the fire nearly unhindered.
- Tunnel could be re-opened to traffic after inspection within days.



