Runehamar Test Tunnel
R&D of Tunnel Technology and the Need of Full Scale Tests

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Number/length of tunnels in Norway

941
831
760
780
800
820
840
860
880
900
920
940
960

1
2
Statistics of Tunnel Fires

- 57 fires the last 7 years
- Predominance of HGV
- 1/3 due to accident
- Predominance of elderly vehicles
- Internationally ca 40 – 50 “cathastrophy fires”
- 3 - 5 dangerous goods involved

International Tunnel Fires

Tunnel Fires in Norway

Tunnel Safety

- Few fires
- Few accidents
- More safety
- More equipment
- Higher reliability
- Less acceptance of down time
- Consequences can be cathastrofatic if ...........
Incidents in Road Tunnels

Runehamar Test Tunnel

Available as a future site for full-scale fire testing and other tunnel safety tests.
RUNEHAMAR 2003

Open for traffic up to 1990

Large scale fire tests 2003
The purpose of the Runehamar tests

- Fire development in semi-trailers (HGV)
- Influence of ventilation on peak HRR and fire growth rate
- Production of smoke and toxic gases from various goods
- Fire spread between vehicles
- Possibility for rescue services to fight HGV fires
- Temperature development in ceiling

Tunnel protection

Wood and plastic pallets

Furniture and plastic/cardboard cartons
• “Ordinary” goods leads to very high HRR

• The HRR from a semi-trailer with wood pallets is equal with a HGV fire after a very short time

The extension of the “non-rescue zone”
Conclusions Fire Tests 2003

- Four tests, mixture of cellulose and plastics, with different heat release curves
- Ordinary commodities can give heat release rates equal to those in tank fires
- HRR max > 200 MW
- Very high temperatures > 1350° C
- Pulsations
- Increasing intensity of the fire caused decrease of velocity leading to backlayering

Runehamar Test Tunnel 2005

Runehamar Test Tunnel

- PVC membrane (water-protection)
- Diesel-pool 600 l in 12 sqm
- HRR approx. 20 MW (contribution from membrane 40% the first 15 min.
- 60 min
- Gas temp. approx. 1100 ° C (peak)
Full scale test I 2006

- Complete lining PE-foam protected with 80 m.m. sprayed concrete with PP-fiber
  
  Steel-fibre reinforcement

- 6000 l Diesel in a 20 sqm pool

Full scale test II 2006

- 20 m complete lining PE-foam protected with 80 m.m. sprayed concrete with PP-fibre
  
  Mesh reinforcement

- 11000 l Diesel in a 40 sqm pool

Full scale test I 2006

- 90 min. fire
- HRR aprox. 50 MW
- Gas temp aprox. 1250ºC
- No spalling

Full scale test II 2006

- HHR aprox. 100 MW
- Gas temp aprox. 1250 ºC
- Large areas exposed for 1100 ºC for more than 2 hrs.
- Almost no spalling
Static pressure in large fires

- The frequency of the pressure oscillation is about 0.5 Hz, and the amplitude is about +/- 100 Pa. The elevated static pressure is reaching 100 Pa, which gives the maximum peak pressure of about 200 Pa.
- An elevated pressure of 100 Pa, will provide a velocity of about 14 m/s (50 km/h) to the ambient pressure.

100 Pa is probably at the limit for human to open hinged doors.

- The static pressure is depending on the pressure provided by the ventilators, temperature rise in the tunnel and the length.
- This numbers are very preliminary and they are subjected to be adjusted during more detail data processing from the experiment.

**Why full scale tests?**

- Verify controllable laboratory tests
- The only way to test a complete concept!
- Verify reliability under realistic conditions -transferring industrial technology into tunnels
- Testing materials in “real life” environment and surroundings

**Why Do Full-Scale Fire Testing?**

- Lab-scale testing gives controlled test conditions for classification
- Lab-scale testing is limited to test small segments (test specimen)
- Full-scale testing allows verification of laboratory tests on real constructions and installations
- Hazard load from real fires are different compared to lab-scale fires (e.g. heat load, pressure and smoke conditions)
- Full scale testing is very costly, but on several matters, there are no alternatives, either small-scale testing or by mathematical simulations (e.g. spalling of concrete or fire suppression)
Runehamar Test Tunnel – The Future

- Large scale fire tests
- Size of fires influencing accept criterias
- Size of fires and structural response
- Accept criterias for evacuation in tunnel smoke
- Static pressure of large fires – influence on design of escape ways?
- Tests of insulation materials
- Mitigation measures

Conclusions

- Equipment based on necessary needs
- Documentation
- Full scale tests
- Maintainability

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- The reliability chane

Thank you for your attention!