16th International Symposium on Aerodynamics, Ventilation & Fire in Tunnels 2015

Seattle, Washington, USA
15 – 17 September 2015

Editor:

Norman Rhodes

ISBN: 978-1-5108-1374-8
## CONTENTS

### FOREWORD

1

### ASSESSMENT AND DESIGN

- Evaluation of the radiative hazard in tunnel fires
  
  _A Mos, CETU (Centre of Expertise on Tunnels), France_  
  
  5

- Optimization of jet fan deployment and operating conditions in lay-bys and in proximity of tunnel portals
  
  _R Gertl, J Mütterlein, D Stix, ILF Consulting Engineers Austria GmbH, Austria_  
  
  21

- Review on the configuration of outlet duct for air supply in a tunnel – aiming for safety improvement
  
  _S Masukura, R Takagi, Central Nippon Expressway Company Limited; A Kobayashi, Central Nippon Highway Engineering Tokyo Company Limited; T Chihara, K Takahashi, FITUT Laboratory Company Limited, Japan_  
  
  37

- Scaled experiments using the helium technique to study the vehicular blockage effect on longitudinal ventilation control in tunnels
  
  _W U Rojas Alva, G Jomaas, A S Dederichs, Technical University of Denmark, Denmark_  
  
  49

### FIRE

- FFFS for flammable liquid fires in road tunnels
  
  _K J Harris, J L Harder, WSP | Parsons Brinckerhoff, USA_  
  
  67

- Generic quantification of consequences of road-tunnel fires
  
  _R Brandt, N Riklin, V Butty, S Frey, HBl Haerter; M Schubert, Matrisk GmbH; N P Haj, HOJ Consulting GmbH; C Gammeter, B Gogniat, Federal Roads Office (FEDRO), Switzerland_  
  
  81

- Impact of fixed fire-fighting system on road tunnel structure
  
  _Y Li, D Hahm, I Maevski, Jacobs Engineering, USA_  
  
  97

- Managing tunnel emergency and evacuation in most populous Indian city – A case of Delhi MRTS
  
  _A Gupta, A Singh, R Jain, Delhi Metro Rail Corporation Limited, India_  
  
  113

- Tunnel fire sprinklers – then, now and future
  
  _G English, City of Seattle, USA_  
  
  127
### Performance of a state-of-the-art low pressure water spray system – results from full scale tunnel fire tests

M Lakkonen, IFAB - Institute for Applied Fire Safety Research; A Feltmann, D Sprakel, FOGTEC Fire Protection, Germany

### Characterization of electric vehicle fires

F Colella, N F Ponchaut, H Biteau, K Marr, V Somandepalli, Q C Horn, R T Long, Exponent, Inc., USA

### GUIDELINES AND THEIR APPLICATION

Minimising the height of a vent stack while still complying with EPA requirements

B Dandie, RRT Pty Ltd; A Bagis, WSP | Parsons Brinckerhoff; C Richardson, Air Noise Environment, Australia

PIARC and fixed fire-fighting systems: A report on working group activity

N Harvey, Hatch Mott MacDonald, USA; L Fielding, London Bridge Associates Ltd., UK; B Dandie, RRT Pty Ltd, Australia; R Brandt, HBI Haerter, Switzerland; N Rhodes, WSP | Parsons Brinckerhoff, USA; R Hall, Mott MacDonald, UK; H Ingason, SP Fire Research, Sweden

Development of new US standards and guidelines for tunnel ventilation

I Maevski, Y Li, Jacobs Engineering, USA

### MAJOR INCIDENTS – DESIGN AND RESPONSE

The effect of longitudinal ventilation on tenability during egress from passenger trains in tunnels during fire emergencies

M Winkler, R Carvel, University of Edinburgh, UK

The mitigation of explosion effects in confined tunnel environments

C Biotto; E Draper, Mott MacDonald; E J Meyrick, A R Dima, J F Hellander, Imperial College London, UK

### METRO AND RAIL

#### Control and Design

Consequences of a velocity increase of passenger trains for oncoming freight trains – Aerodynamic simulations and measurements for the Gotthard Rail Tunnel

M Flueckiger, P Reinke, S Nyfeler, HBI Haerter Ltd, Switzerland

Fire localization and ventilation control system of the Gotthard Base Tunnel

C Brander, Pöyry Switzerland Ltd, Switzerland

Mont-Royal Tunnel: The challenges of upgrading a century-old rail tunnel for the 21st century

I Bowman, B Kumar, C Doucette, Hatch Mott MacDonald Ltd; J-P Pelletier, Agence Métropolitaine de Transport, Canada
Full Scale Testing

Verifying the performance of emergency ventilation systems by cold smoke tests
B Ozince, Marmaray BC1 Bosphorus Crossing Project, Turkey; M Tabarra, D Abi-Zadeh, Arup, UK

Global tests of the Toulouse Metro (France)
J Veyet, F Duet, Cofely Axima GDF SUEZ, France

Simulation, Modelling and Testing

Coupling ventilation and egress analyses to design a safer station
A Louie, S Li, WSP | Parsons Brinckerhoff, USA

Cross-City-Link Zurich – Proof of proper functionality of the emergency ventilation system in the case of a fire using smoke tests, measurements and CFD simulation
R Yousaf, J Badde, S Wälchli, Pöyry Switzerland Ltd, Switzerland

Computational analysis to assess the performance of on-board high pressure water mist systems for rail cars for improving survivability
I Ong, Hatch Mott MacDonald; T Eng, G Kildare, Los Angeles County Metropolitan Transportation Authority (Metro), USA

The worst fire location in tunnel fires with natural ventilation
Z Yuan, B Lei, H Bi, Southwest Jiaotong University, China

Smoke/thermal control of a transit terminal: An integrated and optimization design process
A X Wang, N Rhodes, WSP | Parsons Brinckerhoff, USA

Thermodynamics and Cooling

Acceptability of air velocity from a human thermal comfort and safety perspective
M Legg, M Gilbey, WSP | Parsons Brinckerhoff, UK

Application of heat recovery to long tunnels
J Thompson, M Gilbey, M Legg, WSP | Parsons Brinckerhoff, UK

Diesel locomotive operation with steep grade, high ambient temperature, and long consist
A Bagis, WSP | Parsons Brinckerhoff; B Dandie, RRT Pty Ltd, Australia

Interaction between station openings and environmental control systems
C Graham, C Gonzalez Mesa, M Gilbey, WSP | Parsons Brinckerhoff, UK
PRESSURE TRANSIENTS

The behaviour of long entrance hoods for high speed rail tunnels
A E Vardy, University of Dundee; R Sturt, Arup; C J Baker, D Soper, University of Birmingham, UK

Dynamic pressure tightness of very high speed train CRH380D
M Sima, B Schulz, P Gölz, E Thoss, Bombardier Transportation, Germany

Reduction of the pressure gradient in railway tunnels using vented tunnel portals
D Heine, G Lauenroth, S Huntgeburth, K Ehrenfried, German Aerospace Center DLR Göttingen, Germany

RISK ASSESSMENT

Risk assessment of zero-flow ventilation strategy for fires in bidirectional tunnels with longitudinal ventilation
I Nakahori, T Sakaguchi, Sohatsu Systems Laboratory, Japan; B Kohl, C Forster, ILF Consulting Engineers, Austria; A Vardy, University of Dundee, UK

Methodologies for accurate risk modeling in the context of integrated quantitative risk analysis
C Forster, B Kohl, ILF Consulting Engineers; S Wiesholzer, Austrian Ministry for Transport, Innovation and Technology, Austria

ROAD AND RAIL

Flow Challenges

On the prediction of pressure losses in complex flow scenarios using CFD
J Prince, J Peiro, Imperial College; M Tabarra, J Alexander, Arup Ltd, UK

Smoke confinement velocity and back-layering distance in tunnel fires
F Colella, J S Rosen, N F Ponchaut, Exponent, Inc., USA

ROAD TUNNELS

Operation and Management

Development and implementation of performance metrics for operations and maintenance: Port of Miami tunnel project, a public private partnership
D Dirgins, WSP | Parsons Brinckerhoff; D Markt, Q-Free Open Roads, USA

An owner’s perspective: using practical engineering to retrofit existing roadway tunnels in Seattle with an eye to performance, operability, maintainability, and best value
D Haight, Z Griffith, A Chepel, Washington State Department of Transportation; P Bennett, Sound Transit, USA
ROAD TUNNELS

Ventilation Control

A long urban road tunnel that has longitudinal and transversal ventilation systems combined in it
S Kubota, H Saito, Metropolitan Expressway Company Limited; Y Mikame, Shutoko Engineering Company Limited; H Yanagi, Echoplan Company Limited; A Mizuno, Kogakuin University Tokyo, Japan

Outline of ventilation control strategy for urban tunnel
S Kume, K Kanazawa, H Hara, Hanshin Expressway Company Limited, Japan

Ventilation of the E4 Stockholm Bypass
R Brandt, E Engman, S Lucchini, HBl Haerter, Switzerland; L Elertson, C Berg, Swedish Transport Administration; U Malmros, AF Consulting Engineers, Sweden

Ventilation simulation of a large and complex road tunnel: A safe journey – E4 the Stockholm bypass project
L Elertson, Swedish Transport Administration, Sweden

On effective close-loop control of longitudinal ventilation in road tunnels in case of fire
P Altenburger, I Riess, R Brandt, HBl Haerter AG, Switzerland

On transient issues in road-tunnel ventilation design and control
M Bettelini, S Rigert, Amberg Engineering Ltd, Switzerland

Coordinating two-tunnels ventilation control for maintaining air pollution at portals facing each other
I Kon, Nippon Expressway Research Institute Company Ltd; M Yuhara, AMEC Consultants Co., Ltd; A Mitani, Sohatsu Systems Laboratory Inc., Japan

(In)appropriate control of road tunnel ventilation systems
A E Vardy, University of Dundee, UK

Application of air purification system in road tunnel projects
S K H Lai, WSP | Parsons Brinckerhoff, Hong Kong; W Y M Xie, WSP | Parsons Brinckerhoff, Singapore
SEATTLE

Optimization of mechanical ventilation operations for State Route 99 Tunnel
Y Liu, S Cassady, HNTB Corporation; S Everett, Washington State Department of Transportation, USA

Final testing of fire detection and fire suppression systems at Mount Baker Ridge and First Hill Tunnels in Seattle
I Maevski, B Josephson, R Klein, Jacobs Engineering; D Haight, Z Griffith, Washington State Department of Transportation, USA

Sizing of extraction ventilation system and air leakage calculations for SR99 tunnel fire scenarios
Y Liu, S Cassady, HNTB Corporation, USA

AUTHOR INDEX