Development of an Original Measurement Method for the Toulouse Metro (France)

By Julien LEQUENNE
Chapter 1
Project Context

Chapter 2
Measurement Methods Used for Testing Tunnel Ventilation Systems

Chapter 3
Developed Method Implementation
1. Project Context

**TOULOUSE CITY**

Location in France

Metro Network
1. Project Context

UPGRADING TUNNEL VENTILATION SYSTEM

Operating Mode in Case of a Fire

Ventilation Shaft after Renovation

Metro Line Separated by Motorized door
2. Measurement Methods Used for Testing Tunnel Ventilation Systems

Velocity Measurement

Log-Tchebycheff Distribution

Scanning Method

Fixed-mesh Method
2. Measurement Methods Used for Testing Tunnel Ventilation Systems

Method Comparison

- **Scanning Method**
  - ✔ Short preparation time
  - ✔ Low amount of equipment
  - ✗ Low reliability
  - ✗ Low repeatability
  - ✗ Long measurement time

- **Fixed-mesh Method**
  - ✗ Long preparation time
  - ✗ High amount of equipment
  - ✔ Good reliability
  - ✔ Good repeatability
  - ✔ Short measurement time
2. MEASUREMENT METHODS USED FOR TESTING TUNNEL VENTILATION SYSTEMS

METHOD IMPROVEMENT

- **Requirements**
  - Suitable for all tunnel sections
  - Wide range mesh construction
  - Prompt and repeatable installation

- **Steps**
  - Anemometer positioning
  - Mobile-mesh design
  - Equipment transportation
2. Measurement Methods Used for Testing Tunnel Ventilation Systems

ANEMOMETER POSITIONING

- Mesh of 9 Measuring Points
- CFD Analysis Using ANSYS CFX
  - Modelling of 30 tunnel segments
  - Comparison with Log-Tchebychev distribution

\[ \text{Mesh Error} = 6\% \]

\[ \text{Mesh Error} = 4.5\% \]
2. Measurement Methods Used for Testing Tunnel Ventilation Systems

**Mobile-mesh Design**

- Foldable and Rolling Support Frame
- Guiding System Compatibility
2. MEASUREMENT METHODS USED FOR TESTING TUNNEL VENTILATION SYSTEMS

Equipment Transportation Thanks to Modified Electric Vehicle → SPEED’AIR

- **Metro Application**
  - Axle with track enlarged
  - Side and central guiding wheels
  - Doubled battery capacity

- **Safety features**
  - Blocked steering
  - Speed limitation

- **Passenger Comfort**
  - Rear spot light
  - Rear-view camera
3. **DEVELOPED METHOD IMPLEMENTATION**

**TESTING**

- 67 operating modes
- 20 measurement positions
- 7 nights of 4 working hours
3. DEVELOPED METHOD IMPLEMENTATION

FINAL COMPARISON

- Mobile-mesh Method
  - ✔ Long preparation time
  - ✗ High amount of equipment
  - ✔ High reliability
  - ✔ High repeatability
  - ✔ Short measurement time
3. DEVELOPED METHOD IMPLEMENTATION

Overview

- Short Video

Project Contact Details

- Project Manager: Pierre-Yves MOULIN – pierre-yves.moulin@engie.com
- Design Engineer: Julien VEYET – julien.veyet@engie.com
Thank You for Your Attention

Any Questions?

- For any Information on Tunnel Ventilation Systems
  - Tunnel Department General Manager: Thibaud CHARDINY – thibaud.chardiny@engie.com
  - General email address: tunnels@engie.com