METRO
A research project about fires and explosions in metro systems (underground)

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Outline

• Background
• Introduction
• WPs
• Participants
• Funding bodies
• Time plan
• More information
Background

• Critical infrastructure protection
  - Metro systems (underground)
  - Fires and explosions - devastating consequences
    • King’s Cross fire
    • Baku fire
    • London bombings
    • and more...

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Introduction

• Swedish research project about **fires** and **explosions** in metro systems (underground)
• Multidisciplinary - Social science to Engineering
• Total budget: € 1.5 mil.
• Three years: Dec 2009 - Dec 2012
Introduction

• Overall aim of the project
  - Safer metro systems in the future
  - Develop design recommendations
    • Fire safety design, Explosion protection, Evacuation, Rescue operations, etc

• Relevance - accident investigation
  - New data and knowledge - fire damage, human behaviour, etc
WPs

• Work Packages (WPs)
  - WP1 - Design fires
  - WP2 - Evacuation
  - WP3 - Integrated fire control
  - WP4 - Smoke control
  - WP5 - Extraordinary strain
  - WP6 - Rescue operations
  - WP7 - Project management

METRO - A joint Safety in Infrastructure Project
WPs

• WP1 - Design fires
  - Develop design fires
  - Mathematical models
  - Measure temperature, species, etc
    (relevant for accident investigation)

• Relevance - accident investigation
  - Fire development
  - Fire damage
WPs

• WP1 - Design fires
  1. Single burning item (bags, strollers, etc)
  2. Model-scale tests
  3. Full-scale tests
  4. Correlation models
WPs

- WP1 - Design fires
  - Full-scale tests
  - Real tunnel
    - Brunsberg tunnel
WPs

• WP1 - Design fires
  - Full-scale tests
  - Real tunnel
    • Brunsberg tunnel
  - Real trains (3)
    • X1 furnished as C20
WPs

• WP2 - Evacuation
  - Develop design recommendations
  - More accurate computer modelling
  - Special focus on
    • Senior citizens
    • People with movement disabilities

• Relevance - accident investigation
  - Theoretical framework, walking speeds, input for egress models, etc
WPs

• WP2 - Evacuation
  1. Literature review - accidents

Example:
  King’s cross fire
  - fire in escalator
  - 31 fatalities

Conclusions
  - roles important
  - inaction initially
  - police/fire service

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WPs

• WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators

Example topics
- installations
- training
- organisational
- suggested research

METRO Questionnaire

<table>
<thead>
<tr>
<th>Stations, safety instructions and exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following two questions relate to your station. Safety instructions and exercises. The purpose is to gather information about tunnel occupant's evacuation possibilities. Please observe that we are only interested in information about your underground stations. If your station includes stations above ground we therefore ask you to disregard these stations when answering the following questions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many stations have platforms with only one everyday exit?</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g. 13 stations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many stations have platforms with two everyday exits?</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g. 13 stations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many stations have platforms with three or more everyday exits?</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g. 13 stations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are there instructions for passengers how to behave in fire emergencies, i.e., safety instructions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>You may choose more than one alternative. If safety instructions are provided elsewhere, please state so in the text box.</td>
</tr>
<tr>
<td>□ Yes, at stations</td>
</tr>
<tr>
<td>□ Yes, at platforms</td>
</tr>
<tr>
<td>□ Yes, on trains</td>
</tr>
<tr>
<td>□ Yes, inside tunnel tubes</td>
</tr>
<tr>
<td>□ No, there are no safety instructions</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

METRO - A joint Safety in Infrastructure Project
WPs

• WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators
  3. Laboratory experiment - train to track
WPs

• WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators
  3. Laboratory experiment - train to track
  4. Laboratory experiment - tunnel
WPs

• WP2 - Evacuation
  - Similar to previous experiments (in a road tunnel)

  Studied aspects
  - walking speed
  - behaviour
  - way-finding
  - installations
WPs

• WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators
  3. Laboratory experiment - train to track
  4. Laboratory experiment - tunnel
WPs

- WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators
  3. Laboratory experiment - train to track
  4. Laboratory experiment - tunnel
  5. Evacuation - Stockholm METRO
WPs

- WP2 - Evacuation
  1. Literature review - accidents
  2. Questionnaire survey - METRO operators
  3. Laboratory experiment - train to track
  4. Laboratory experiment - tunnel
  5. Evacuation - Stockholm METRO
  6. Develop egress model (computer)
Outline

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Participants

• Nine (9) organisations take part in METRO
Funding bodies

• Five (5) organisations fund METRO
  - Brandforsk
  - Swedish Civil Contingencies Agency (MSB)
  - Stockholm METRO (SL)
  - Swedish Transport Administration
  - Swedish Fortifications Agency

• Total budget: € 1.5 mil.
Time plan

• Start of project - Dec 2009
• Literature reviews - Spring 2010
• Evacuation experiment - Fall 2010 - Spring 2012
• Large-scale fire experiments - Summer 2011
• Seminar - Dec 2012
• Final report - March 2013
More information

• If you want more information about METRO:

www.metroproject.se

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