

## **FIT DATABASES: STRUCTURED AND CONSULTABLE EXPERIENCE**

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### **ABSTRACT**

The European Thematic Network ‘FIT – Fire in Tunnels’ aims to enhance the exchange of knowledge and develop a European consensus on fire safety for road, rail and metro tunnel infrastructures.

As an essential step towards achieving these goals, FIT has introduced six consultable databases on fires in tunnels (see website <http://www.etnfit.net>):

- Database 1: Research projects on fire safety in tunnels
- Database 2: Mapping of test site facilities regarding fire and tunnel
- Database 3: Overview of numerical computer codes for fire in tunnels
- Database 4: Data on safety equipment
- Database 5: Assessment reports on fire accidents in tunnels
- Database 6: Mapping and overview of upgrade activities involving tunnels

The databases are growing to become a unique instrument for use by tunnel operators, contractors, consultancy firms, research centres as well as regulators. Every expert organisation working on fire and tunnel is invited to become a FIT corresponding member via on-line registration at <http://www.etnfit.net>, to enjoy privileged access in terms of input to, and consultation of, the 6 consultable databases.

### **1. INTRODUCTION**

Over the last few years, tunnel construction activities are accelerated in Europe in connection with the implementation of the TransEuropean Transport Network (TEN-T) and the general need for preserving the quality of the (city) environment. Increase of traffic and the trend for longer tunnels consequently result in higher risks. Safety and in particular safety in case of fires in tunnels has received tremendous attention following some recent fire incidents.

Clearly the cost and complexity of the problem needs a European approach to optimize efforts. The European Thematic Network ‘FIT – an acronym for Fire in Tunnels’ was launched following the catastrophic fires that occurred in 1999 in the road tunnels of Mont-Blanc (between France and Italy) and Tauern (Austria). Its topicality was dramatically illustrated in following years by several new fire disasters that took place in Austrian tunnels, in the St Gotthard tunnel and the Daegu subway system in Korea.

FIT aims to establish and develop European networking and optimise efforts on fire safety in tunnels. The network’s ambition is to enhance the exchange of knowledge and develop a European consensus on fire safety for road, rail and metro tunnel infrastructures.

As an essential step towards achieving these goals, FIT has introduced six consultable databases on fires in tunnels. The six databases are on-line and can be consulted at the FIT website <http://www.etnfit.net>.

- Database 1: Research projects on fire safety in tunnels
- Database 2: Mapping of test site facilities regarding fire and tunnel
- Database 3: Overview of numerical computer codes for fire in tunnels
- Database 4: Data on safety equipment
- Database 5: Assessment reports on fire accidents in tunnels
- Database 6: Mapping and overview of upgrade activities involving tunnels

The databases collect essential information on fire and tunnels: the aim is to provide information, improve knowledge transfer, enhance to collaboration and support benchmarking to the experts on fire and tunnel. For instance, the listing of all research projects with objectives or achievements should improve synergy and avoid duplication; the presentation of numerical models should improve selection and benchmarking.

The databases feature attachments, links to web pages, search tools and keywords to make them efficient and useful. The databases rely on an interaction between consultation and input. Being structured by the responsible FIT database managers, the value of each database depends on the input of records and information. This input is looked for within the specialised international experts: research institutes, education, consultants, code developers, material producers, contractors, emergency services and end-users.

The FIT Consultable databases are as successful as the information included in them:  
**The Thematic Network ‘FIT – Fire in Tunnels’ encourages people to consult and feed the different databases – to make them as valuable as possible !!!**

## 2. DATABASE INPUT AND APPROVAL PROCEDURE

Every expert organisation working on fire and tunnel is invited to become a FIT corresponding member via on-line registration at <http://www.etnfit.net>, to enjoy privileged access in terms of input to, and consultation of, the 6 consultable databases. Actually the FIT network has more than 535 registered FIT Corresponding members.

Database content and structure were determined by the six database managers in close collaboration with the FIT Network. The database managers have been selected on account of their accumulated experience on the relevant topic. They are responsible for the continuous quality of the database: they accept or reject database entries for approval. A record listed as ‘under approval’ can be edited in the database (orange button). After a one-month consultation period of the database entry by the FIT Network, the database manager will mark the record as approved (green button).

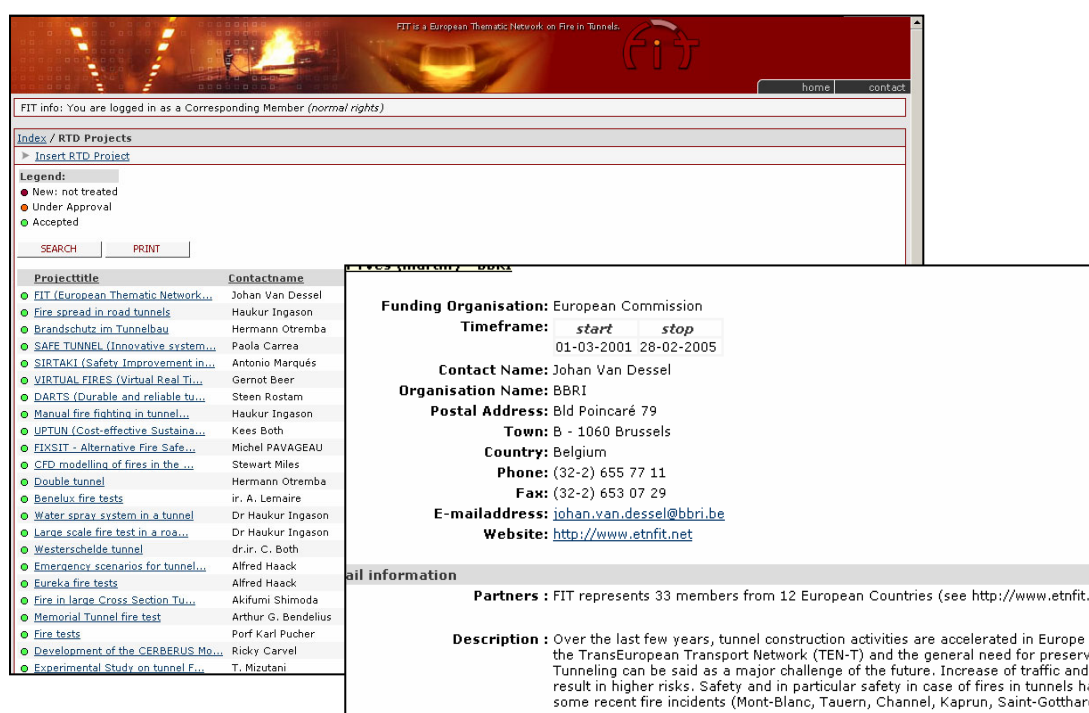
### 3. STATUS OF THE SIX CONSULTABLE DATABASES

#### 3.1 Database 1 Research projects on fire safety in tunnels

This database's aim is to collect useful information concerning research projects - national, European and international - on fire safety in tunnels. The FIT research database aims to improve synergy between all on-going research or shortly finished projects. For that reason, the database also focuses on national and international research projects, in particular national or company-driven research projects about which little is known at present. The research database provides an overview of partners, reference publications and enclosed articles. Research project descriptions state project objectives, intermediate (public) results and achieved output depending on the specific project stage.

Actually, there are about 30 research projects on fire safety in tunnels referenced in the database 1 (Figure 2). Information concerning the European research projects on this topic is available in 1/3 of the records, the other 2/3 are national or company related projects. The database already provides a complete overview on European research, but still lacks input on national or company based projects relevant to fire safety in tunnels. Also research projects of smaller size are looked for in order to obtain a more useful and complete database.

Yves Martin ([yves.martin@bbri.be](mailto:yves.martin@bbri.be)) at BBRI is responsible for maintaining FIT Database 1 'Research'.



**Projecttitle**      **Contactname**

- FIT (European Thematic Network...
- Fire spread in road tunnels
- Brandschutz im Tunnelbau
- SAFE TUNNEL (Innovative system...
- SIRTAKI (Safety Improvement in...
- VIRTUAL FIRES (Virtual Real Ti...
- DARTS (Durable and reliable tu...
- Manual fire fighting in tunnel...
- UFTUN (Cost-effective Sustaina...
- FIXSIT - Alternative Fire Safe...
- CFD modelling of fires in the ...
- Double tunnel
- Benelux fire tests
- Water spray system in a tunnel
- Large scale fire test in a roa...
- Westerschelde tunnel
- Emergency scenarios for tunnel...
- Eureka fire tests
- Fire in large Cross Section Tu...
- Memorial Tunnel fire test
- Fire tests
- Development of the CERBERUS Mo...
- Experimental Study on tunnel F...

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**Partners :** FIT represents 33 members from 12 European Countries (see <http://www.etnfit.net>).

**Description :** Over the last few years, tunnel construction activities are accelerated in Europe the TransEuropean Transport Network (TEN-T) and the general need for preserv Tunneling can be said as a major challenge of the future. Increase of traffic and result in higher risks. Safety and in particular safety in case of fires in tunnels has some recent fire incidents (Mont-Blanc, Tauern, Channel, Kaprun, Saint-Gotthard).

Figure 1 Snapshot of FIT Database 1 'Research Projects'

### 3.2 Database 2 Mapping of test site facilities regarding fire and tunnel

The second database aims to gather descriptions of suitable testing facilities or test sites around the world for experiments involving tunnel fires. The overview of test site facilities includes not only tunnel test sites, but also tunnel-like fire test facilities, other fire test rigs for tunnel fire research and leading technical centres with experience in performing such tests.

The database structure is straightforward and includes aspects such as contact details and technical features (equipment, capacity, etc.). As an optional feature, the test site database also carries a visual presentation of the location and test facility.

Actually the database contains about 20 entries concerning test site facilities regarding fire and tunnel, mostly located in Europe: France, UK, Spain, Italy, Norway, Switzerland, Germany and The Netherlands. Most records are available for real tunnel facilities (3) and tunnel-like fire test facilities (11).

Database 2 'test facilities' is the responsibility of Guy Marlair (guy.marlair@ineris.fr) at Ineris, France. Ineris also operates a large-scale fire testing facility comprising a tunnel-shaped section.



*Figure 2 Engelsk tunnel (Norway)*

### 3.3 Database 3 Overview of numerical computer codes for fire in tunnels

The objective of database 3 is to provide an evolving and dynamic summary of the numerical models available for the study and analysis of the consequences and impact of fires in tunnels: CFD models (see figure 4), Zone models, Structural response models, one-dimensional flow models, etc. Such fire modelling is being increasingly used as a general tool for fire safety engineering and, more specifically, for tunnel related studies.

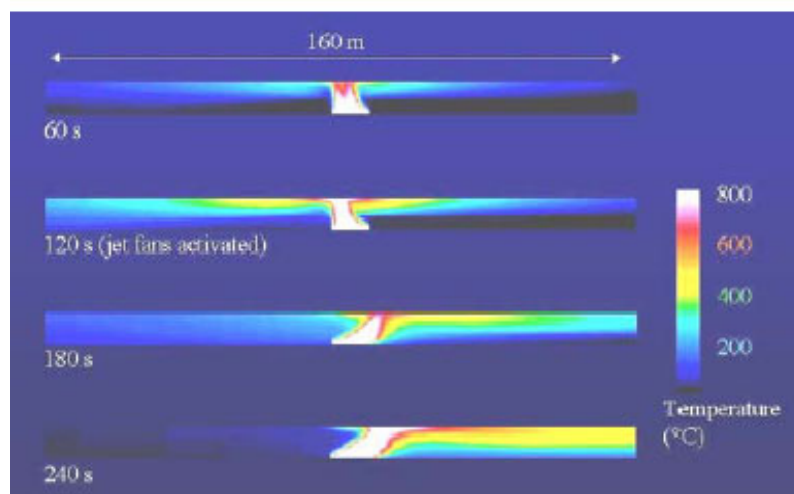
Database 3 offers a wide range of applications of numerical codes: smoke, fire, ventilation, structural response, evacuation, egress, fire suppression, cost analysis, ... The database contains a general section and a more detailed model description. The model description focuses on problem specification, result generation and presentation, area of applicability and limitations. Furthermore, users can introduce details of 'practical applications' or 'comparisons between experiments' that have been performed during tunnel and fire simulations on a given numerical model. This is designed to ensure dynamic database content.

Actually, about 20 numerical models have been introduced in the database 3. This is somewhat more than half of the models being applied to tunnels.

The missing models are identified and listed and should be introduced by the code developer (preferably) or experienced users.

The details of 'practical applications' and 'comparison between experiments' receive much less attention, although they could contribute a lot to benchmarking and dissemination.

FIT Database 3 on numerical codes is managed by Stewart Miles ([MilesS@bre.co.uk](mailto:MilesS@bre.co.uk)) at BRE (UK); BRE is the code developer of CRISP and Jasmine.



*Figure 3 CFD simulation of a tunnel fire (BRE)*

### *3.4 Data on safety equipment*

The database 4 concerns an important component in tunnel safety: the technical equipment. The database is structured in accordance with the following functional categories: monitoring, detection, extinguishing (see figure 6), communication, ventilation, indication, traffic control, rescue, and protection. Several sub-categories are also identified.

The 'safety equipment' database is designed for specific equipment types. Individual trade names are housed together under the relevant equipment type, e.g. 'water mist extinguishing systems' or 'video identification systems'. The recorded information presents the application, its installation requirements, plus references and links to the different manufacturers. In addition to the input of new equipment types, the user also has the opportunity to add data on abnormal events, experiences and reliability for each equipment type.

At present, some 70 equipment records are available on-line. Some main categories are however not yet enough filled in: protection equipment for structure or installation, ventilation equipment, communication installation, etc.

FIT Database 4's manager is Horst Hejny ([hejny@dmr.de](mailto:hejny@dmr.de)) at DMT (D). DMT is a large technical service provider which conducted the ADAC 2000 investigation into tunnel safety.

### *3.5 Assessment reports on fire accidents in tunnels*

The database 5 provides a compilation of assessment reports on fire accidents in tunnels. It distinguishes between fire accidents in road tunnels and fire accidents in rail and metro tunnels.



The database is organised into three sections:

- identification of the tunnel,
- configuration of the tunnel and galleries (length, ventilation, equipment, etc.)
- accident reporting (type of fire event, severity of fire, causes and main circumstances, fire detection, human factors, after-effects, etc.)

Both the 'tunnel configuration' and 'accident reporting' sections contain a long and detailed list of short (often binary) answers. This allows impartial and scientific data assessment. An additional field allows additional information to be listed, where necessary. Database 5 allows different fire incidents to be logged for the same tunnel. Lessons from fire accidents in tunnels can be drawn from both small and large fires, major incidents and success stories. For that reason, database 5 aims to include all kinds of tunnel fire incidents.

Since the information contained in database 5 on fire accidents in tunnels may be difficult to understand or interpret for a wider audience, database 5 is alone in offering the possibility of restricted access; if this option is ticked in the database input, the accident-reporting fields are then accessible to FIT co-opted members and FIT members only.

A parallel document (Excel sheet with the main information) has been added in the database. This informative sheet references the fire accidents in tunnel with very short information (date of accident, name of the tunnel, type of tunnel, country, length of tunnel, vehicle involved, casualty). An indicator identifies if full information is included in the DB5. At the moment, about 125 entries were put in the parallel document together with about 35 detailed records in the database. The new and recent tunnel fire accidents since 2002 are all included in detail.

Database 5 is maintained by Guy Marlair ([guy.marlair@ineris.fr](mailto:guy.marlair@ineris.fr)) at Ineris (F). Ineris was also involved in the technical investigations following the Mont Blanc disaster.

### *3.6 Mapping and overview of upgrade activities involving tunnels*

The aim of the database 6 is to compile measures for upgrading tunnels in order to improve fire protection. Within this database, experiences relating to upgrade measures in many European tunnels are compiled and considered for further evaluation. The database includes the following information:

- Basic data regarding the specific tunnel upgrade
- Description of upgrade measures and related costs.

Users are requested to include information about improvements to the tunnel lining, ventilation systems, lighting, communication and equipment for fire fighting and fire detection as well as aspects such as the construction of cross galleries and emergency exits. At the top of each field, useful pointers are provided to assist the person filling in the data.

At the moment about 30 entries have been put in the database 6, provided from a limited number of sources.

Alfred Haack ([a.haack@stuva.de](mailto:a.haack@stuva.de)) at STUVA (D) is the coordinator of database 6.

## **4. FIT WEBSITE – PUBLIC DOCUMENTS**

The FIT website (<http://www.etnfit.net>) is the basic tool for dissemination and communication as well for internal as for external purposes. It is an attractive and professional tool providing information concerning the FIT Network, the coming events, the FIT working documents, the access to the consultable databases, general documents such as the newsletters or the joint comments on the EU proposal for a Directive on safety requirements for tunnels, etc.

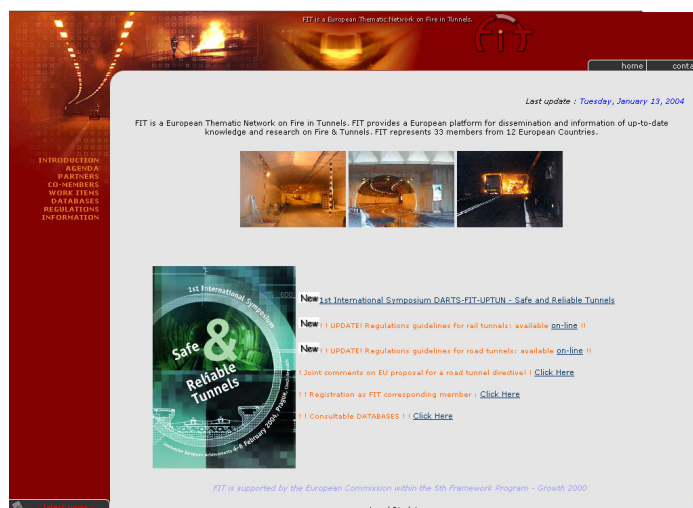


Figure 4 Homepage of the FIT website (<http://www.etnfit.net>)

The website is structured with different access control levels to allow FIT communication with all levels in the Network and external organizations. Also the output of the FIT activities will be put on the FIT website and available for the registered corresponding members. The FIT Public Working Documents are available for the FIT Corresponding members for consultation, input and comment. Actually, the following reports are already presented:

- Design Fire Scenario's (part of chapters road and rail)
- Fire Safe Design: Listing and compilation of regulations and guidelines
  - road tunnels
  - rail tunnels
  - metro tunnels
- Best practice for safe operation and fire response management (part of chapters)

A professional statistic tool is linked with the FIT website and the FIT databases since January 2002. It gathers reliable statistics about the frequentation and use of the FIT website. There is a continuous increase of the number of visitor sessions and downloads on the FIT website. The number of 1500 visitor sessions in a month shows that FIT is aiming at his objective to have a continuous exchange of knowledge.

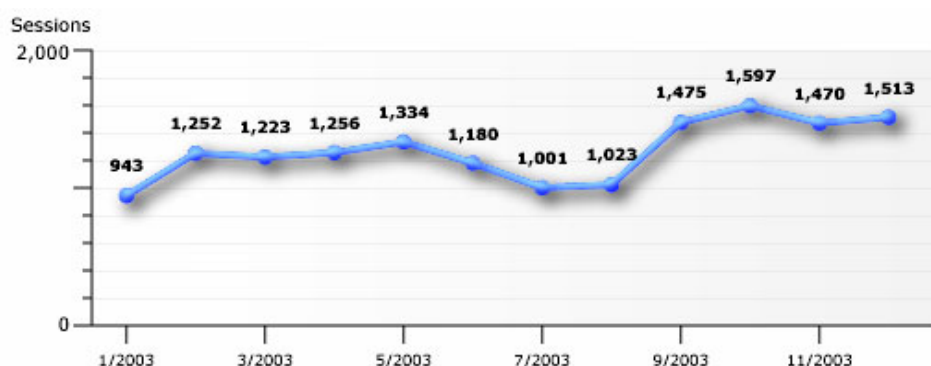
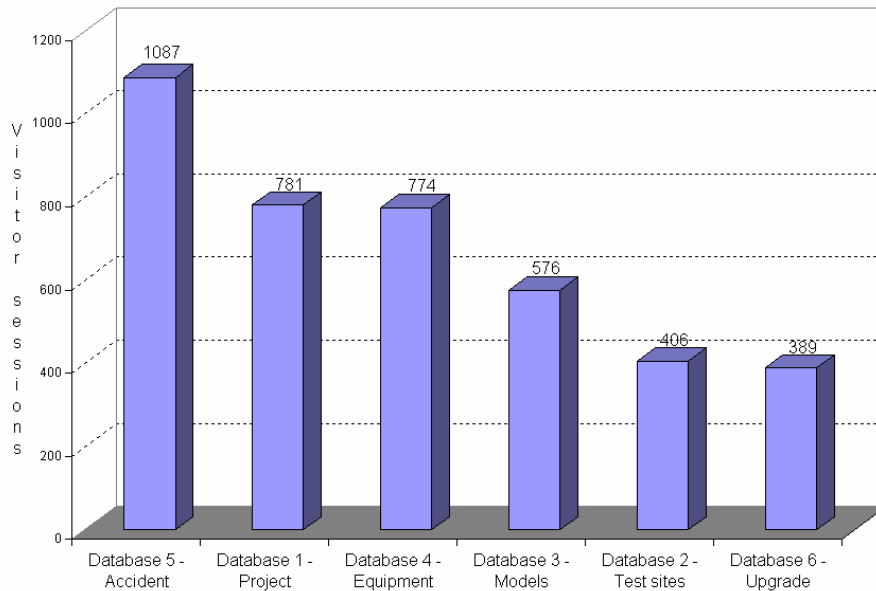


Figure 5 Visitor sessions on the FIT website (year 2003)

Statistics concerning the frequentation of the FIT databases are also available. It shows, for example, that the database 5 on fire accidents in tunnels and the database 3 on numerical codes are the most consulted.



*Figure 6 FIT Databases: visitor sessions from September - December 2003*

## 5. CONCLUSION

The Thematic Network ‘FIT – Fire in Tunnels’ has set up 6 consultable databases on fire & tunnels about research project, numerical models, test sites, equipment, fire accidents and upgrade activities. These databases are available for consultation and input by the expert organisations working on fire and tunnel. The FIT databases are growing to become a unique instrument for use by tunnel operators, contractors, consultancy firms, research centres as well as regulators.

Besides the databases, the achievements of the work in FIT are actually (partly) presented and continued updated in ‘public working documents’ that are available on the FIT website ([www.etnfit.net](http://www.etnfit.net)) for consultation, input and comment by the FIT corresponding members.

Through these actions the European Thematic Network ‘FIT – Fire in Tunnels’ aims to enhance the exchange of knowledge and develop a European consensus on fire safety for road, rail and metro tunnel infrastructures.