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1. Message from the new Chairman

Dear friends,

I hope you have had already recreative summer holidays and that this message finds you in a good condition back at work. Already some months have gone since the COSUF “Workshop on Complex Underground Multipurpose Facilities” has been carried out with a real success at the WTC 2013 in Geneva. If you have not had the chance to participate you can find a short summary below. Almost all presentations are available from the website.



In combination with the workshop we also held our annual General Assembly. One topic was the step-down of the previous chairman Didier Lacroix. Due to his envisaged retirement from his position at CETU (Centre d'Etudes des Tunnels, Tunnel Study Centre) – which has taken place in the meantime – he also decided to lay down his tasks within COSUF. This is much to my regret because Didier has a lot of international experience, gained not only from his involvement in the World Road Association (PIARC) but also from European research projects and regulatory initiatives which followed the Mont Blanc and Tauern tunnel fires. After having been the vice-chair of COSUF since its inception he chaired the committee during the last two years with a calm and competent hand and influenced the work in a very positive way. Within the Steering Board meetings and also in the workshops he was brilliant at analysing logical relationships and giving exact comments. We thank Didier for his work and his enthusiasm for COSUF. The Steering Board wishes all the best for his new activities!

Within the General Assembly the present members also followed the recommendation of the Steering Board and appointed me as the next chairman: Thank you all for your confidence! And on the next day the ITA General Assembly confirmed this appointment; thanks also to the ITA Member Nations for their support!

I am happy to be given the opportunity to commit myself for the objectives of ITA COSUF, which is – hopefully – for the benefit of all members. ITA COSUF has an important role in the field of operational safety of underground facilities because it does not only focus on one transport mode like roads but takes care of all underground transportation and underground structures. It is and will also be in future *the* platform for communication in that field. I am sure that my professional background as the managing director of STUVA, the German Research Association for Underground Transportation Facilities, will support in this an optimum way. The worldwide urban development in the coming decades will inevitably lead to more and even more complex un-



derground structures. So there is a need for COSUF, we have to join our forces and know-how to make underground structures safer and safer.

Concerning the development of COSUF it is important that we have to work on more visibility in the professional world. Bodies outside COSUF should recognise COSUF and its members as the experts for operational safety and security. Therefore we have to show competence e. g. by giving presentations, writing papers and last, but most important, publish guidelines and recommendations. Besides that we also have to continue to increase our membership and simultaneously enlarge the geographical scope. We have to strengthen the activity groups as the very basis of ITA COSUF. You can learn about the latest developments of the activity groups below.

The next meeting of all ITA COSUF members will be in Prague shortly, namely on 30 September for an internal workshop (see below). Our Czech members have prepared an very interesting programme. I look forward to meeting all of you there so that we can together contribute to the future of ITA COSUF for still better underground safety!

Yours

Roland Leucker

2. Report of the ITA COSUF Workshop in Geneva on 4 June 2013

The ITA COSUF Workshop on Complex Underground Multipurpose Facilities: Safety Challenges and Solutions was organised by ITA COSUF as part of the ITA-AITES World Tunnel Congress 2013 at the Centre International de Conférences in Geneva. The meeting room was a lecture theatre of an impressive size at the hearth of the building.



After a warm welcome on behalf of ITA COSUF chairman Didier Lacroix two key note lectures followed. Both lectures were focussed on new areas of interest for the COSUF community. The first one was on operational safety in the underground facilities of a deep geological disposal of nuclear waste by Denis De Winter. In this lecture two apparently divergent approaches for safety analysis were addressed. Fire barriers and confinement to prevent contamination by dangerous products on the one hand, and smoke extraction to allow evacuation of persons and action of firemen in the excavations deep under the ground on the other hand. Then the second keynote lecture on safety of CERN's underground research complex was presented by Fabio Corsanego. In this lecture the control of cryogenic spill and fire caused by a lay-out of kilometers of cable was outlined.

In the afternoon good examples of general fire safety strategies of complex underground multipurpose facilities were demonstrated. Bo Wahlström presented the Slussen project in Stockholm where metros lines, à commuters train, an end station and a road tunnel meet bus garages and shopping centres. And then Bernard Falconnat showed PIARC's first results on complex underground road networks.

Götz Vollmann promoted a holistic approach for assessing the need for and the efficiency of specific measures of a multipurpose facility. A safe design or a systemic upgrade will enable transparent and traceable decisions. Niels Peter Høj and Matthias Schubert showed the benefits of RAMS analyses of complex technical systems in underground facilities; a more robust system design (maximize availability) and more safety for users.

The theme of the last session was dealing with numerous people underground. Marco Bettelini underlined the importance of combining emergency management concepts with innovative Information and communication



technology. Hereto the results of the EMILI project (Emergency Management in Large Infrastructures) were presented. Max Kinateder presented field and virtual reality studies on human behaviour in severe tunnel accidents. He concluded that virtual reality behavioural training may improve tunnel evacuation and noticed that social Influence may have both positive and negative effects in the evacuation process. Finally, results from the METRO project on fire safety in metro trains and stations were presented by Daniel Nilsson.

Between the sessions, there was lively discussion by all participants. The presentations of the Workshop are [downloadable](#).



At the end of the Workshop ITA COSUF Chairman handed over the ITA COSUF Award 2013. The award consists of a medal, a certificate and prize money and is granted once a year to a young researcher who has contributed in considerable manner to the development of the safety of underground facilities. This year, the award was handed over to Enrico Ronchi for his contribution in the area of Evacuation Modelling in Road Tunnel Fires combining various evacuation models to increase the reliability of predictions regarding human behaviour, validated by tests.

We congratulate Enrico for his exceptional work. The corresponding paper of his presentation is included in this Newsletter under section 7. Details on the call for proposals for the ITA COSUF Award 2014 year will be put on <http://cosuf.ita-aites.org/> soon.

3. ITA COSUF Workshop and AG Meetings in Prague, 30 September and 1 October 2013

The next ITA COSUF workshop will be a private workshop like the ones we had in Stockholm and Amsterdam. It is co-organised by the Czech Road Society, Metrostav a.s. and SATRA spol. s r.o. and it will be held on 30 September. The workshop will be devoted to the Blanka tunnel and will include various lectures and a two hour site visit.

You are invited to register to the workshop by sending an email to the ITA COSUF Secretary. Registration is free for ITA COSUF members. The ITA COSUF Activity Group meetings will take in the

morning of the 1st of October one the day after the workshop. More information has already been sent to COSUF members by dedicated emails. The programme is so, that you should be able to travel on both meeting days.



4. Request to comment on a COSUF Research report on rail and metro safety

In Activity Group 2 a draft guideline on "Engineering Methodology for Performance-Based Fire Safety Design of Underground Rail Systems" was prepared. This document gives recommendations for the safety design of rail-bound underground infrastructure. It is planned to publish it as an ITA COSUF recommendation after discussing it in the community of experts. Therefore, this provisional paper is posted on the website under the signature of the author in order to get discussion and comments.

So if you feel entitled, please comment on this document (enclosed with this newsletter), preferably before the 31 December 2013.

The AG will publish all comments received and will issue the final document on the website in the first quarter of 2014.

5. Report from the Activity Groups

AG1 Interaction with European and international initiatives

During the last AG1 Meeting in Geneva Eric Premat, Deputy Director of Cetu was welcomed. The AG1 performance in line with ITA COSUF mission statement was redefined. Arild Petter showed a powerpoint presentation with an idea of how to manage a dynamic list with activities related to operational safety (research projects, conferences, etc.)

AG2 Regulations and best practises

AG 2 covers regulations, the state-of-the-art and best-practices in various countries. This includes discussion and comparison of regulations and best-practice procedures from different owners, networks, projects and the experience gained by them. Currently, AG2 is working on several subjects including best practice on SCADA systems, smoke removal objectives, particularly for underground stations and disabled people in emergency situation.

The activity group meeting in Geneva was mainly dedicated to discuss the pending publication of the draft guideline on "Engineering Methodology for Performance-Based Fire Safety Design of Underground Rail Systems" which is be available on the COSUF website (see section 4).

We also discussed how to create synergy with other tunnel safety organisations with regards to certain topics. In particular the issue on disabled persons in emergency situations is a subject broadly discussed also in similar working groups. A co-operation or knowledge exchange between one or more organisations could be beneficial for all parties.

AG2 is always looking for active members who wish to get involved in tunnel safety. So, please if you want to get involved with any of the current or any other topics within the scope of the AG2, do not hesitate to contact any of the two co-leaders.

AG3 Research and new findings

Currently AG3 working on a new structure of our meetings as well as a new agenda and a different approach of our overall work. In the course of our last meeting in Geneva the participants brainstormed about a possible future agenda of AG3 and how we'd like to see ourselves (as an activity group) and which points of interest we'd like to emphasize in the near future. As soon as the next AG-meeting in Prague we will be able to provide our members with a first draft of a list of expertise that each member institute provides as well as a list of pos-



sible research topics that we'd like to look into in the course of future research programs such as "Horizon 2020".

AG4 European Tunnel Safety Officers

During the AG4 meeting in Geneva considerable progress was made with regard to the organisation of the third TSO-Forum that is planned for March 2014 and will take place in Luxembourg. The theme of the forum is: "Tunnel safety, a joint effort". The Forum will be a two day event during which also a tunnel project will be visited. The programme will consist of a plenary session on multi disciplinary exercise and workshops on the following topics: maintenance & tunnel safety, training for communications and critical safety functions. In the coming months the programme is developed in more detail. During the coming meeting of AG4 in Prague on October 1st 2013 the programme will be finalised.

6. Future ITA COSUF events

ITA COSUF workshops and activity group meetings

- 30 September 1013 **ITA COSUF Workshop and AG meetings, Prague (Czech Republic)**
and 1 October 2013 This two-day event will include a technical visit to the Blanka Tunnel in the afternoon of the 1st day, AG meetings on the morning of the 2nd day.
- Spring 2014 **ITA COSUF Workshop in Düsseldorf**

Other events organised or endorsed by ITA COSUF

- March 2014 **3rd European Forum of Road Tunnel Safety Officers**
AG4 is currently preparing this 3rd Forum, which should be co-organised with the European Commission and PIARC like the two previous ones. The working title is "Tunnel safety: a joint effort". The venue and exact dates are not decided yet.
- 12-14th March 2014 **[6th International Symposium on Tunnel Safety and Security, Marseille, France](#)**
Tunnel safety and security is a challenge for both private and public sectors. ISTSS provides a forum over 2½ days to discuss current practice and emerging trends and research in the field of tunnel safety and security. Each day will be opened by invited Keynote Speakers, leaders in their field, providing an overview of their topic of expertise as an introduction to the themes of the day.

For all enquiries to ITA COSUF membership please contact Ben van den Horn: ben.vandenhorn@arcadis.nl



7. Paper of ITA COSUF Award Winner 2013 Enrico Ronchi

EVACUATION MODELLING IN ROAD TUNNEL FIRES

Enrico Ronchi¹

Evacuation modelling is a multi-disciplinary subject focused on the simulation of human behaviour during emergencies. In recent years, evacuation models capabilities have been evolving rapidly, allowing the simulation of ever more complex scenarios and environments, including road tunnel fires. The existing simulation tools are based on different modelling assumptions and a dedicated evaluation of the model capabilities is required for the study of road tunnel fire safety. To address this issue, a Phd project was carried out, namely "Evacuation Modelling in Road Tunnel Fires" [1]. The overall objective of the project was to guide users towards an informed model selection. In fact, the first decision that a safety designer faces prior to an egress modelling study is the selection of the appropriate approach. It may vary from simple analytical calculations to a computational model or a combination of different methods.

The study of road tunnel fire evacuations requires the analysis of many complex factors and processes related to human behaviour, such as pre-evacuation times (e.g., reluctance to leave the vehicle), interactions between occupants, interactions between occupants and smoke, etc. However, models have different capabilities and may represent a different sub-set of the factors listed. Each model has its own specific features and model users need access to detailed information on the variables that are (not) represented in each model, how these variables interact, and how this affects the results; i.e., models have limitations, which may be exaggerated by the expertise of the user.

During the first step of the project, the most used simulation tools, their field of applications and the community of model users have been identified through a survey [2] performed at www.evacmod.net, an online portal on evacuation modelling. Results of the survey identified that evacuation modelling is a novel field and most users may be inexpert. In addition, many model users are unaware of other models.

In a second step, a set of the most used models were used to perform a wide comparison between different models and approaches [3, 4, 5, 6]. The predictive capabilities of evacuation models have been studied through both the analysis of their claimed characteristics as well as different model applications in the context of road tunnel fire evacuation (see Figure 1). Two main aspects affecting human behaviour in road tunnel fire evacuations have been investigated in detail, namely 1) the influence of smoke on walking speeds and [5] 2) the impact of way-finding installations on exit choice [6]. Among the tests performed, an *a priori* vs *a posteriori* simulation study (simulations are performed before and after the collection of experimental data) was made [7]. This analysis was based on data collected during a tunnel evacuation experiment performed in Stockholm by the Department of Fire Safety Engineering and Systems Safety at Lund University, Sweden [8].

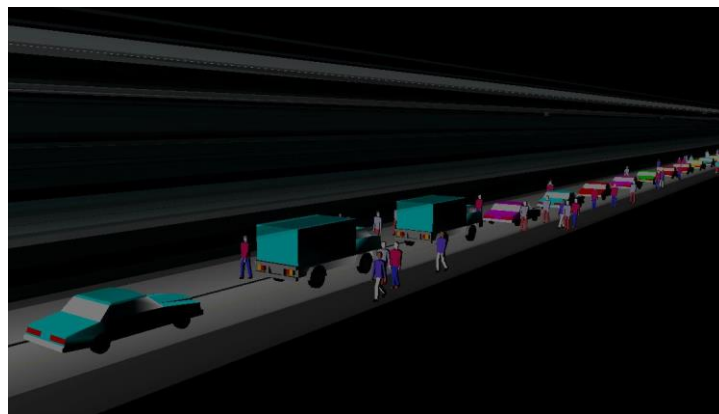


Figure 1. Screenshot from an application of the evacuation model STEPS [9] for the study of road tunnel evacuation scenarios.



Different degrees of modelling sophistication were used for the study of tunnel evacuation scenarios (see Figure 2). Evacuation times were predicted through the use of the analytical calculations presented in the Society of Fire Protection Engineering handbook [8]. The same scenarios were studied using evacuation models independently. Model inputs were calibrated either using default settings or based on the literature available on each specific variable.

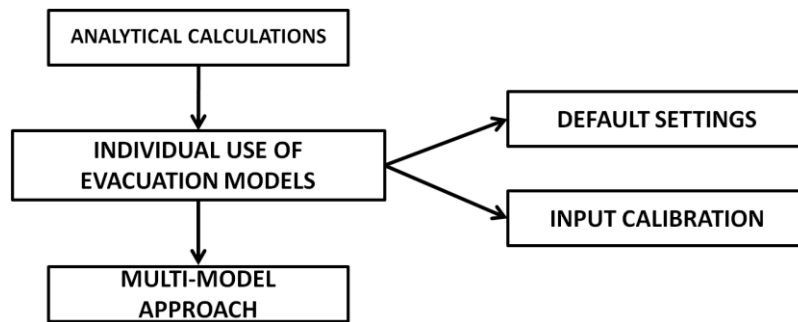


Figure 2. Degrees of modelling sophistication adopted for the study of tunnel evacuation scenarios.

The third step was the identification of the sources of uncertainty in the models, e.g., different modelling assumptions and algorithms, etc. This analysis has been performed through a sensitivity analysis and comparisons between model results and experimental data. A novel method has also been presented, the multi-model approach. The multi-model approach consists of a combined and synergistic use of different models so that the strengths of each model can compensate each other's weaknesses. In this method, model users adjust the values of model input through an iterative process of configuration using other models as a benchmark i.e. the sub-algorithms of each model makes it possible to better configure the inputs of the others.

The fourth and last step dealt with the identification of an efficient use of different approaches in relation to the differences among the methods employed. The scope was to allow model users to select the right approach to study road tunnel evacuation scenarios of increasing complexity.

The findings suggested that the impact of default settings is crucial on evacuation model results. In particular, the behavioural aspects investigated - the impact of smoke on movement speeds and exit choice - showed that variability in the use of default settings may lead to significant differences in modelling results. In contrast, a careful model input calibration permitted a better estimation of evacuation times. These results indicated the importance of the calibration of the model input and its dependence on the expertise of model users, the capabilities of the models and the availability of experimental data.

Recommendations on the appropriate approach (e.g. which model(s) to choose) in relation to the evacuation scenario under consideration have also been provided. Analytical calculations may be used if the evacuation scenarios are simple, i.e., model users need to simulate human flows along a single evacuation route. The use of a single evacuation model may be sufficient for the simulation of scenarios where the layout of the road tunnel is not complex. Hence, evacuees have to choose between multiple exits but the road network is simple. The use of a single evacuation model is sufficient only if the tool employed embeds the features needed to simulate the scenarios under consideration.

The multi-model approach is recommended in the case of very complex scenarios and layouts, as in the case of a complex road tunnel network including innovative way-finding installations, high occupant densities, etc. The application of this approach allows the modeller to use the strengths of each model and apply the most suitable algorithms to simulate each specific behavioural variable. Although this approach requires high degree of modelling effort and user expertise, the benefits deriving from its application is that the model users become aware of the sources of uncertainty linked to each single model and use them at their best. This method increases the reliability of model results since it makes use of the strengths of different models.



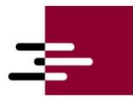
¹This research study has been carried out at the Department of Roads and Transportation, Polytechnic University of Bari (Italy), the GIDAI Group at University of Cantabria (Spain) and the Department of Fire Safety Engineering and Systems Safety, Lund University (Sweden). Email: enrico.ronchi@brand.lth.se

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8. ITA COSUF member introduction: (BAM nv)



beheersmaatschappij
antwerpen mobiel

The Beheersmaatschappij Antwerpen Mobiel, BAM nv, founded by the Flemish government in 2003, was entrusted with the coordination and realisation of the Masterplan Mobility Antwerp. The Masterplan had been issued in 2000 to alleviate the massive traffic problems, which threaten to cripple the Antwerp region. This vast urban environment with its one and a half million inhabitants is also a crucial economic cluster for the surrounding regions and Belgium as a whole. This is due to the presence of the harbor, the Albert canal and many industrial zones.

BAM's tasks were revised in 2010 when the Masterplan was updated into the Masterplan 2020. Today BAM is responsible for a few of the biggest infrastructure projects in Flanders, one of which is the Oosterweelink.

The Oosterweelink project

Today the ring road around the city of Antwerp (R1) is incomplete and the main road river crossings are oversaturated. Therefore the R1 faces structural congestions due to overuse and structural safety issues because of the combination of traffic on the main road network and the urban functions.

The Oosterweelink has 3 goals:

- To increase the capacity to cross the Scheldt-river other than the oversaturated Kennedytunnel
- To close the R1, thus completing the ring road
- To connect the economically vital harbor and the north side of the city with the main road network



The project extends over a distance of approximately 10 km and encloses the ring road around the city of Antwerp (R1) with several tunnels between the interchange on the left bank and the ring road on the right bank through the north of the city and the main road network. The project consists of two sets of tunnels:

- An immersed tunnel underneath the Scheldt
- Cut and cover, double deck tunnels underneath the docks

BAM nv and ITA COSUF

BAM's subsidiary, TLH nv, is operating the existing tunnel Liefkenshoek, where this organization is responsible for several aspects of its management, from safety and the inking of toll to maintenance and preservation. Furthermore, BAM is in constant collaboration with the Flemish government, which operates several tunnels in the region around Antwerp – 2 of which are part of the TERN-network.

The newly built tunnels will be part of the TERN-network. As a result of this, they will have to meet the standards set forth by the European guideline on tunnels (2004/54/EG). To do so in the most efficient and complete way possible, BAM became an ITA-COSUF member and it participates in AG4 workshops (Road Tunnel Safety Officers). BAM follows international developments in the field of tunnel safety closely and wants to contribute in a positive way to safety improvements in tunnels.

Contact

For more information on the Oosterweelink, other sites or BAM nv itself, please visit www.bamnv.be or contact:

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