

# Sprinkler protection for personal safety

Ir. Ruud van Herpen MSc. FIFireE,  
fellowFSE TU/e  
Claudia Rojas Garces MSc., Nieman  
Consultants



## INTRODUCTION

Sprinkler protection is gaining popularity. In stead of creating fire compartments with fire resistant separation constructions and a fire resistant load bearing structure it is possible to prevent fire spread by a sprinkler protection. In fact, this is much more effective than fire compartmentation, because a sprinklered fire is only a localized fire with a low thermal load on building elements.

When a sprinkler protection is succesful in reducing the thermal load on building elements, then it might be also succesful in reducing the personal risk of building occupants, caused by thermal and toxic pollution of the smoke. This is exactly the topic of the research project 'Benefits of sprinkler protection for personal safety'. The goal of this research project is to determine whether or not sprinkler protection influences evacuation safety.

Sprinkler protection limits the spread of fire but not necessarily the spread of smoke. Nevertheless a sprinkler protection might have a positive influence on evacuation safety, because limiting fire development means also limiting smoke production. Besides, a sprinklered fire decreases the temperature development in the fire room compared to an unsprinklered fire. That means a reduction in the overpressure in the fire room, the driving force for smoke propagation in a building. Escape routes can be kept free of smoke for a long time in case of a sprinklered fire.

The research was carried out with Cfast multizone simulations for three different cases. All cases were simulated with and without a sprinkler protection:

1. Evacuation safety in a large compartment with a stratified smokelayer
2. Evacuation safety in a large compartment with smoke mixed in the compartment volume
3. Evacuation safety in a small room connected to a corridor

In this article only the results of the small room connected to a corridor are discussed, see figure below. This case is especially interesting because in both health care and residential functions for elderly people this is a frequently used lay-out. For this kind of less self-reliant building occupants long evacuation times will be needed. The more evacuation time available, the safer the situation is for building occupants.

## ASSESSMENT CRITERIA

The assessment criteria for personal safety depend on the definition of evacuation safety. In most building codes the building occupants are supposed to be self reliant. This means that safe evacuation is implicitly defined as reaching a safe area without serious health damage. This corresponds to the following assessment criteria:

- Radiative flux < 2.5 kW/m<sup>2</sup>
- Convective heat < 70 oC
- Visibility > 5 m

In small rooms the sprinkler is activated too late to improve visibility, compared to a non-sprinklered fire. However, the sprinkler protection can be of value when instead of an assessment on health damage an assessment on lethality is applied:

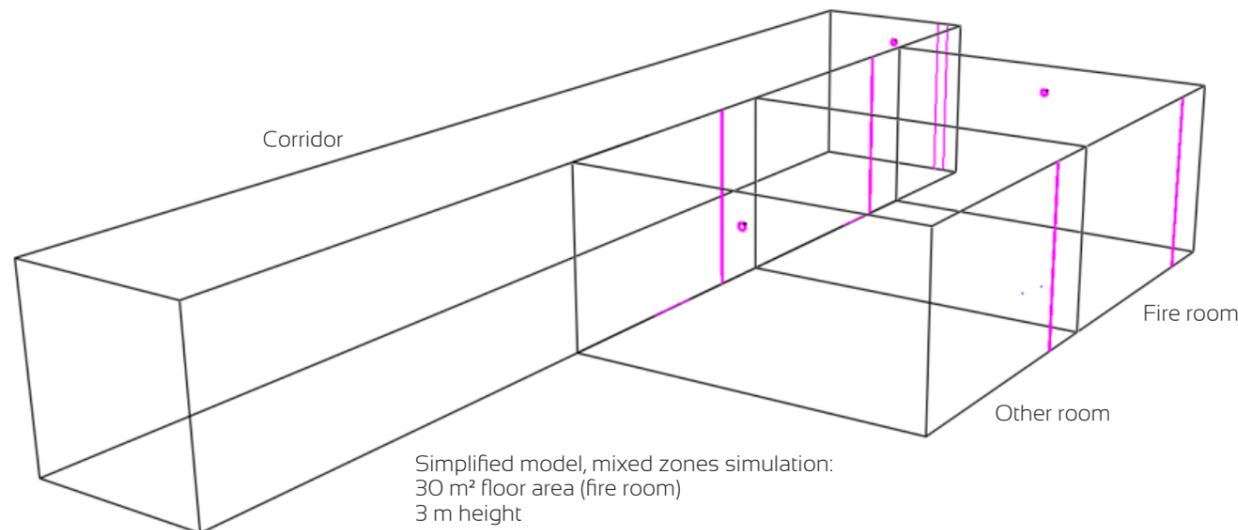


Figure 1. Isometric wire model of the corridor, connected to small compartments

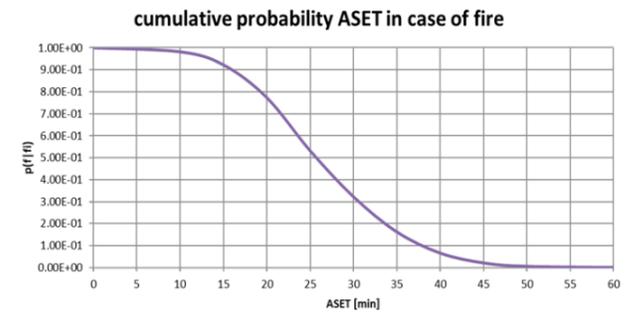
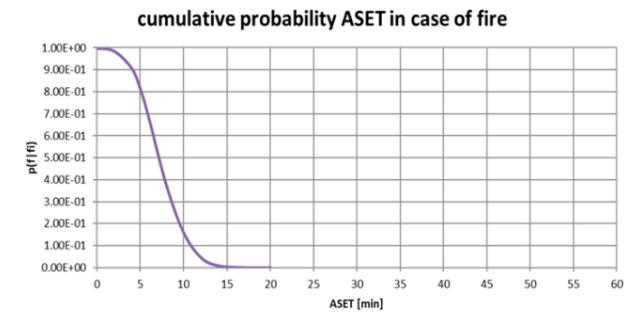


Figure 2. Cumulative distribution functions of ASET in the small fire room, CO-dose criterion (lethality). The left graph shows the cumulative distribution without fire protection; the right graph shows the cumulative distribution with sprinkler protection.

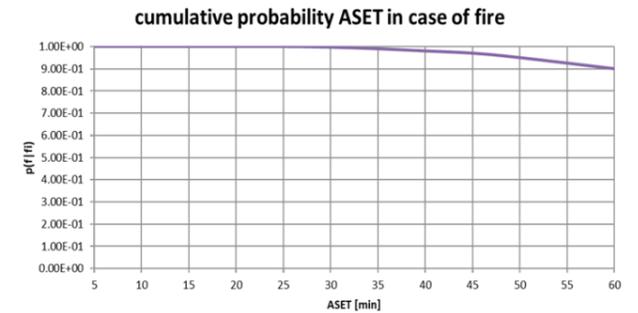
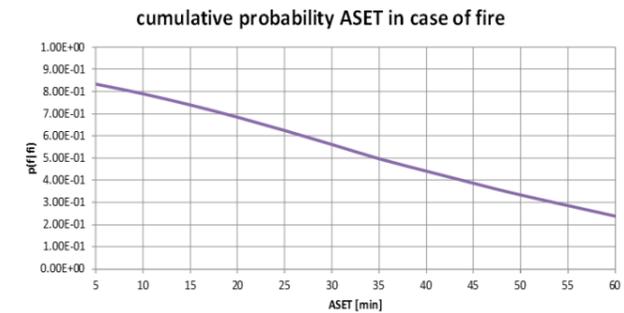


Figure 3. Cumulative distribution functions of ASET in corridor, visibility criterion (health damage). The door to the fire room is opened at t = 5 min. after fire start. The left graph shows the cumulative distribution without fire protection; the right graph shows the cumulative distribution with sprinkler protection

- CO-dose < 35,000 ppm.min.
- O<sub>2</sub> concentration > 60,000 ppm

The available safe egress time (ASET) is defined as the time during which all assessment criteria are fulfilled.

## RESULTS

The results for large compartments are clear: sprinkler protection improves the reliability for evacuation safety by improving the available safe egress time ASET.

In small compartments the influence of sprinkler protection seems to be negligible when the ASET is assessed on health damage criteria. However, when the ASET is assessed on lethality criteria the influence of sprinkler protection is obvious, even in small compartments. (Fig. 2)

For the corridor, being the escape route out of the connected fire compartments, personal safety is related to health damage criteria. The ASET in the corridor appeared to be much longer in a sprinklered situation than in the non-sprinklered situation. (Fig. 3)

## CONCLUSION

Sprinkler protection influences the available safe egress time in a positive way. In small compartments the benefit for self-reliant building occupants is less than in large compartments. However, the smoke propagation to escape routes and to other compartments is delayed by a sprinkler protection. And maybe more important: the probability of surviving a fire increases a lot when a sprinkler protection is applied.

So sprinkler protection is not only valuable for damagecontrol and protecting the separation constructions and load bearing structure, but also valuable for personal safety of building occupants. ■

The research report is available on [www.sprinkler.nl](http://www.sprinkler.nl)

