fireprotection ASPECTS
05/2023

MORE SPRINKLERS FOR CLIMATE CHANGE MITIGATION?

Comparison of life cycle assessments for constructional and technical fire protection

Reflections on climate-compatible and environmentally friendly fire protection planning for investors and planners in the construction sector

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HOYER BRANDSCHUTZ
In cooperation with
ATP sustain

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1. INITIAL SITUATION

Taking a conscious look at climate change mitigation and environmental protection is now an unavoidable part of contemporary construction projects. If sustainability should become reality – and not just a buzzword – then the necessary course has to already be set at the start of planning in order to reduce CO_2 emissions during construction and operation, reduce resource consumption and make buildings recyclable.

While fire protection does not actively shape the construction process, the selection of fire protection measures has a direct impact on the building as an overall system – and thus also on its life cycle assessment. The following reflections question the role of fire protection with respect to sustainable planning and construction, and also compare constructional and technical fire protection measures directly as part of a comparative study.

The findings should then not only serve as a point of reference for decision makers, but should also be a starting point for further considerations in order to better understand and take into account the importance of preventive fire protection in the sustainable construction of buildings.

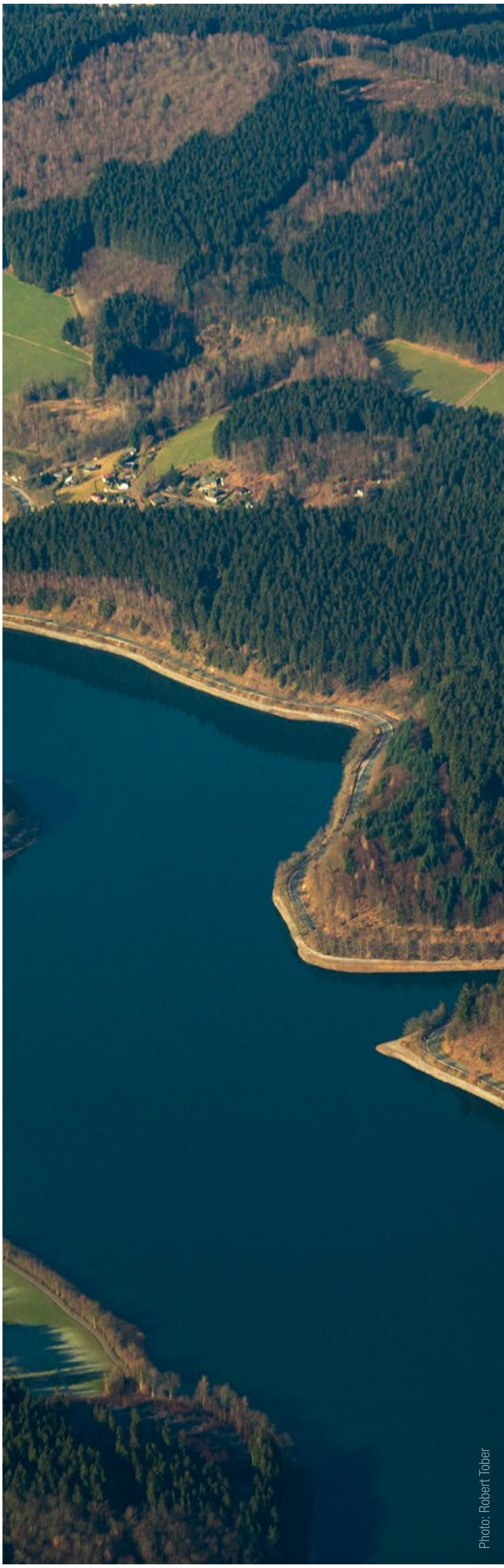


Photo: Robert Tober

Photo: Robert Tober

2. COMPARATIVE STUDY
CONSTRUCTIONAL VS. TECHNICAL FIRE PROTECTION

Michael Haugeneder and Philipp Racher, ATP sustain

2.1 Study approach

In order to compare the impacts of constructional and technical fire protection measures on the climate and environment, Hoyer Brandschutz created two different fire protection concepts for an office building in Austria with a total floor area of over 10,000 square metres. These concepts were used as the basis for the comparative study:

- **Fire protection concept version 1:** Measures focusing on constructional fire protection and small-scale fire compartmentation
- **Fire protection concept version 2:** Measures focusing on technical fire protection (sprinkler system) and larger-scale fire compartmentation

Finally, we calculated the impacts on energy consumption, red and grey emissions and investment costs for both concepts.

2.2 RESULTS

Red emissions

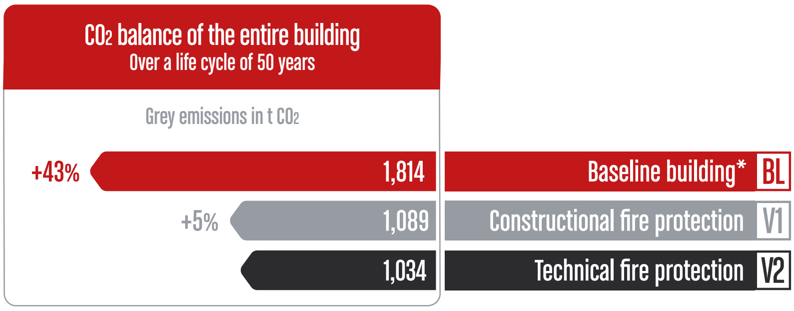
As fire compartments (and thus fire dampers) are omitted in fire protection concept version 2, ventilators have to establish a lower external pressure difference, resulting in lower energy requirements. In order to evaluate this effect, the “worst” section was inspected for both available ventilation systems – i.e., the one with the largest pressure loss. This section determines the pressure ratio in the entire system. With this in mind, the systems modelled in Revit were imported into the SOLAR-COMPUTER software in order to carry out the complex pipe network calculation.

	PRESSURE LOSS Pa		ELECTRICITY CONSUMPTION kWh/a		CO_2 EMISSIONS kg/a	
	System I	System II	System I	System II	System I	System II
V1 Constructional fire protection	341	345	25,300	25,400	1,961	1,968
V2 Technical fire protection	310	273	24,602	23,719	1,903	1,835
Difference	-31	-72	-698	-1,681	-58	-133
Difference in %	-9%	-21%	-3%	-7%	-3%	-7%

Result: In version 1, three fire compartments were traversed in system I and four in system II. As the plant room also remains as an independent fire compartment in version 2, it is possible to omit all fire dampers except one in both systems. In fire protection concept version 2, this results in annual electricity savings of around 700 kilowatt hours in system I and 1,700 kilowatt hours in system II (based on 2,700 full load hours per year). In system II, this corresponds to just over 7% of the electricity consumption for the ventilation system. As a result, both systems together save around 190 kilograms of CO_2 per year in the Austrian electricity mix.

Grey emissions and life cycle assessment

Fire protection concept version 1 poses further demands in terms of partition walls, facades and doors due to the fire compartments, which has a direct impact on the life cycle assessment of the building. Gypsum board, mineral wool or firestops are examples of materials and products that are used regularly in constructional fire protection, but offer no recycling possibilities in addition to their high levels of grey energy. While partition walls in fire compartments have double planking with gypsum board and internal mineral wool insulation, we decided on interior walls made of clay boards with wooden profiles and wood-fibre insulating boards in version 2. In the facade, we used cellulose fibres as insulating material instead of mineral wool. These insulating materials absorb CO_2 and can be recycled after demolition of the building due to their low pollution load, whereas mineral wool and gypsum board currently must be disposed of as landfill. The sprinkler system itself is made of metal and thus has an increased CO_2 balance. However, as this is a single-origin system, the material can be reused very easily.



Result: All components were calculated over the entire life cycle of 50 years using One Click LCA software, whereby the potential for recycling (life cycle phase D) was also taken into consideration. In fire protection concept version 2, a total of 45,400 kilograms of CO_2 in grey emissions are saved through the selection of building materials and 9,500 kilograms of CO_2 in red emissions are saved by the ventilation system. In comparison, a new Volkswagen Golf 7 would have to drive around 460,000 kilometres to emit this volume of CO_2 – in other words, to the moon or eleven times around the equator. In our comparison, this means that around 5% of the life cycle emissions of the entire building are saved. This is particularly impressive when you consider that sustainable construction methods were already adhered to when planning the building, and that version 1 already has a life cycle assessment that is 40% better than a baseline building. Thanks to the significantly improved life cycle assessment in version 2, compliance with EU taxonomy is also established earlier, meaning the long-term economic risks of "not being green" are reduced and the financial feasibility of the construction project is increased.

Costs

The additional and reduced costs when using a sprinkler system vary greatly depending on the system. However, while only the direct additional costs for technical fire protection are often mentioned, the reduced construction costs must not be neglected. In our example, we have compared the costs of all affected components: On one hand, additional costs result from the sprinkler piping, plus the tanks, retention and processing of the extinguishing water. On the other hand, costs are reduced through lower requirements and the elimination of fire walls, facades and doors, the omission of soft firestops, fire dampers or pressure ventilation systems in the stairwells, and by reducing the ventilation rate of fire smoke dilution in the garage from 12x to just 3x. The lower costs of the fire alarm control panel and fire controls due to fewer data points were also taken into consideration.

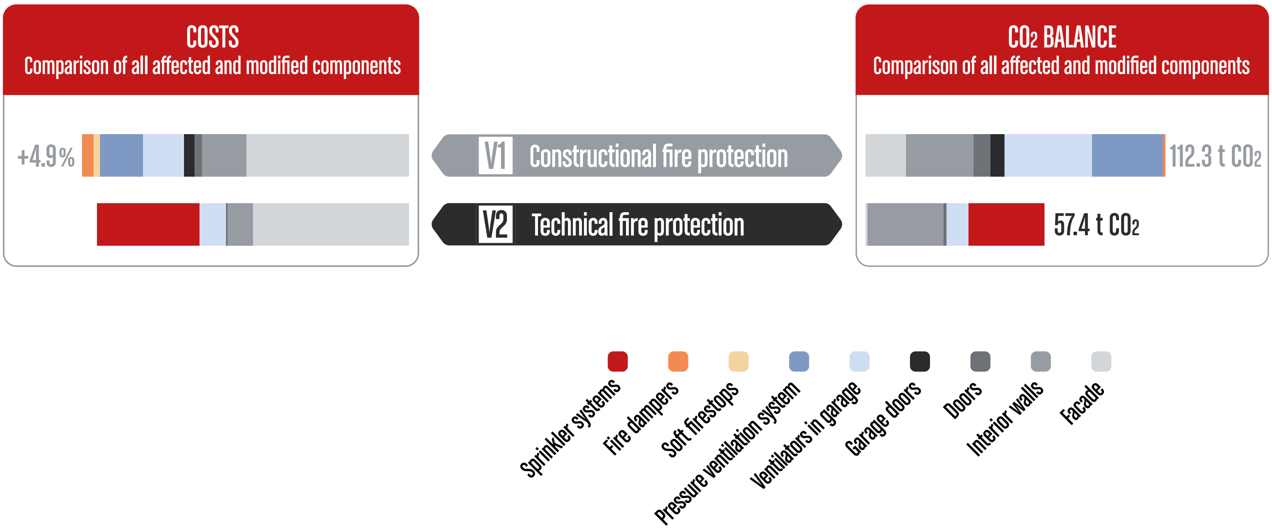
worth knowing

Red and grey emissions

Red (operational) emissions occur during the operation of buildings, whereas grey (material) emissions are created during the extraction, production, transport, storage, maintenance, dismantling and disposal of the building materials used.

* Baseline building: A "business as usual" new building according to the assessment of the World Business Council for Sustainable Development (WBCSD) with 1,000 kg CO2/m2 in the construction phase

Result: Following a cost assessment of all affected and modified components, savings of around 4.9% were achieved in version 2. This corresponds to reduced costs in the low six figures (in euros).



Maintenance

It is assumed that annual maintenance costs will be similar in both fire protection concepts. However, as annual maintenance in version 1 means that the functionality of each individual fire damper and door in the entire building must be checked, whereas in version 2 only the sprinkler equipment room and tank are taken into account, the time needed for maintenance in the latter case will be significantly lower. However, in an emergency the biggest savings achieved in version 2 are through the reduction in the extent of the damage. Extinguishing a fire using the sprinkler system, where only sprinklers above the source of the fire are triggered, results in a significantly reduced volume of water – and thus water damage – compared to major extinguishing efforts made by the fire brigade.

2.3 Conclusions

The present investigation has shown that, while keeping a uniform level of safety in terms of fire protection, CO_2 emissions can be significantly reduced by focusing on technical measures. A further reduction in emissions during operation is also conceivable as optimisations to technical systems are possible, whereas the grey emissions associated with constructional measures are released into the atmosphere at the point of production, transport and building construction. Which system is used is ultimately the decision of the building owner. However, alternatives to classic constructional fire protection should be examined as these could result in further financial, safety-related, constructional or architectural advantages.

Fundamentally, it can be said that the examination of various possible solutions – in this case, relating to fire protection – requires uniform, structured balancing methods. The life cycle assessment used in the present example contains grey and red emissions, and should demonstrate that only an overall balancing framework applied across the full life cycle of a property and under transparent conditions actually shows which measure has which ecological impact.

The topic of resource conservation is not considered in the assessment as the corresponding change has still not been taken into account in the balancing of the life cycle assessment. Looking forward, installed resources are specified that can be passed on for pollutant-free reuse or recycling in order to achieve an improved life cycle assessment. Considering European goals for climate change mitigation, in the future the consideration of variables should then also always be made from a carbon footprint perspective.

2.4 Study design

In order to calculate the CO_2 balance across the entire life cycle of a building, the grey (tied) emissions that occur when constructing a building and the red emissions that occur through energy consumption during operation have to be balanced. In the present comparative study, particular attention was paid to the feasibility of the calculation steps. In this way, all components used were read out directly through the integral planning of the affected building using Building Information Modelling (BIM), and were then assigned an emission factor via a database stored in the software that takes into account all life cycle phases of the component and its materials. By using a sprinkler system, it will be possible to select materials with lower fire protection requirements for the partition walls or facade, whereas constructional fire protection is tied to materials with a high CO_2 balance.

As the ventilation sections were also drawn using BIM, it was possible to simulate operation of the system with and without fire dampers in the corresponding fire compartments, thus resulting in a complex pipe network calculation being carried out. As fire dampers involve a loss of pressure in the system, the omission of dampers means ventilators have to establish a lower pressure difference, which then saves electricity. This saving results in reduced red emissions across the entire life cycle of the building. The curve of ventilator performance according to the necessary pressure build-up was calculated for the study by the manufacturers of the ventilation devices.

In order to compare the costs of both fire protection concept versions, a quotation was obtained for a sprinkler system for this project. The components were calculated based on the BKI catalogue for building costs in a new building.

Thanks to this approach, high accuracy can be guaranteed at all calculation steps to achieve the most valid results possible, with only minimal scope for manipulation by the person creating the calculations.

3. SUSTAINABILITY
IN THE CONSTRUCTION SECTOR AND FINANCE

Michael Haugeneder, ATP sustain

3.1 Fire protection within the context of climate, resources and economic resilience

The energy crisis and terrible war in Ukraine have highlighted the vulnerability of the European economy. Time will tell how resilient its capacity to respond is. As construction and real estate is one of the largest economic sectors and also has a stabilising effect on our entire economic area, the question arises as to the direction it will take in terms of energy requirements, resources and emissions. The necessary requirements for building safety, such as fire protection, are often not considered from this perspective. Currently, fire protection – either constructional or technical, depending on preference – is usually implemented without being checked, despite the fact that the impacts on resources and climate change mitigation also have to be considered here.

Constructional vs. technical fire protection

Constructional fire protection ties up a large quantity of usually mineral and above all chemically treated resources as these, seen subjectively, are not prone to ageing and thus often function without any problems despite a lack of maintenance or supervision. In contrast, technical systems – which, in principle, reach the same safety level – have a higher risk through human intervention in the form of poor maintenance or even manipulation, which is why they are traditionally seen as “not being as safe”. If we are to take climate change mitigation and resource conservation seriously, then we have to take the necessary measures in the areas of tied CO_2 emissions and operating emissions into account. This means that climate change mitigation is not solely the job of the operating company, but above all requires a reduction in the material input of CO_2-intensive products.

Ensuring recyclability

To stabilise the European economy, attention also has to be paid to drastically reducing the consumption of primary resources and drastically increasing the use of secondary resources in addition to climate change mitigation. To implement this transition to the circular economy, a significant reduction in material requirements is the first step – as is the case for red emissions. In the second step, it must be ensured that the materials used remain pollutant-free: All chemical materials that are in conflict with reusing the raw material are ideally not used at all, or are only used to the extent that they can be separated again completely without major outlay.

However, toxic substances are used by all trades – above all in constructional fire protection and for preventing the penetration of fire compartments – as these ensure a fire is contained for the prescribed time in extreme conditions. Even if material such as reinforced concrete is widely used – which can be recycled under extremely high energy input – the amount of inseparable pollutants on the building components is extremely high following penetration of the fire compartments. In turn, this means that these mineral building materials cannot be recycled. As things stand, this makes the massive reduction of such materials necessary, together with the increased use of technical measures to ensure safety levels are maintained.

Reduced resource consumption, increased stability

Protecting the environment and conserving resources play a major role in making the European economy more resilient against interfering factors. The European Green Deal in combination with taxonomy regulations is thus not only a declaration of political intent, but also lays the foundation for increased stability and greater resilience across the European Economic Area. As previously mentioned, the construction industry is a major driving force here as it is the sector with the highest input of primary resources and also produces the greatest quantities of waste (i.e. primary resources that can no longer be used as secondary resources due to contamination). In addition to requesting that the building material industry manufacture products with a drastic reduction of CO_2 in mind, planners can also define the extent to which resources are used in line with their quality demands in terms of fire protection, building physics and durability, and whether technical measures can achieve savings in resources used.

Need for political action

In addition to industry and planners, the authorities also have to assume responsibility and take ecological aspects into account in their assessments with a forward-looking Europe in mind. In principle, EU rules in the form of building product regulations and the basic principle of only constructing buildings that do not have a negative impact on users, local residents or the environment mean that low-emission, resource-compatible and environmentally friendly measures are always preferred to other measures. An important step will be achieved when buildings are not only assessed in the future according to their energy standard in the form of energy certification, but that this will only form a small part of CO_2 e-certification. This means that planners are free to choose which measures they use to achieve the lowest carbon footprint under the same framework conditions. By introducing limit thresholds, this overall emission value will be continuously reduced, meaning only buildings with a low carbon footprint will be granted approval in future as a result.

Applying the right leverage

At the centre of this project is the reduction of primary resource consumption, which could be achieved in fire protection by enforcing technical measures instead of constructional ones. The next step focuses on the “greening” of the building materials used, primarily in the use of secondary and biogenic raw materials. In my opinion, the goal of reducing the carbon footprint can only be achieved with these measures as the leverage here is many times greater than the potential savings resulting from the reduction of red emissions or compensation through regenerative energies. This process is still in its infancy in Europe. It is now up to the building materials industry, planners and the authorities to steer these measures in the right direction. It is also the responsibility of those in finance to correctly evaluate the risks of not reaching climate goals, and thus favour investments that are compatible with climate change mitigation over those that would not meet European goals.

3.2 Systems engineering as the building blocks for taxonomy-compliant real estate

Through the introduction of the European Green Deal as a declaration of political intent by the member states of the European Union, the topic of sustainable building has now also reached the financial sector, with the corresponding technical guideline – Taxonomy Regulation 2020/852 – containing binding criteria for the declaration of green investments. Through the introduction of taxonomy in connection with the Sustainable Finance Disclosure Regulation (SFDR), green investments are thus not only a question of personal preference but are also an additional non-financial quality benchmark in the financial risk assessment of business activities.

Minimising risks

Broken down to the construction industry and the real estate sector, this means that taxonomy-compliant business activities pose a lower risk in terms of financing, which in turn also leads to preferential conditions in credit and financing. The impacts can be seen in the lower risk assessment, but also more importantly in the attraction of financial institutions to investors, meaning the institutes can offer significantly better conditions for different financial products if it can be proven that technical, non-financial quality criteria have been adhered to.

While fire protection and the associated constructional, technical and organisational measures are not included as quality criteria for green investments in the taxonomy, they have an influence on the criteria contained therein, such as the ease of dismantling, recyclability, life cycle assessment, environmental protection, low emissions and the resilience to climate change. Through these new reflections on real estate and technical qualities, it will become increasingly important to ensure buildings have a longer service life, are more flexible, more resilient against risks resulting from climate change, and are low in emissions and CO_2.

Changing processes

As the dominant approach in Central Europe, constructional fire protection is a challenge for certain areas of the EU taxonomy as material usage under the aforementioned criteria is high and thus has an impact on the assessment of real estate. Technical fire protection may be a solution for reducing this material usage, thus resulting in taxonomy-compliant real estate. It is thus necessary to not simply accept fire protection concepts as a given, unchangeable basic condition in the future, but instead as an integral part of the development of real estate across its entire life cycle.

Photo: Robert Tober

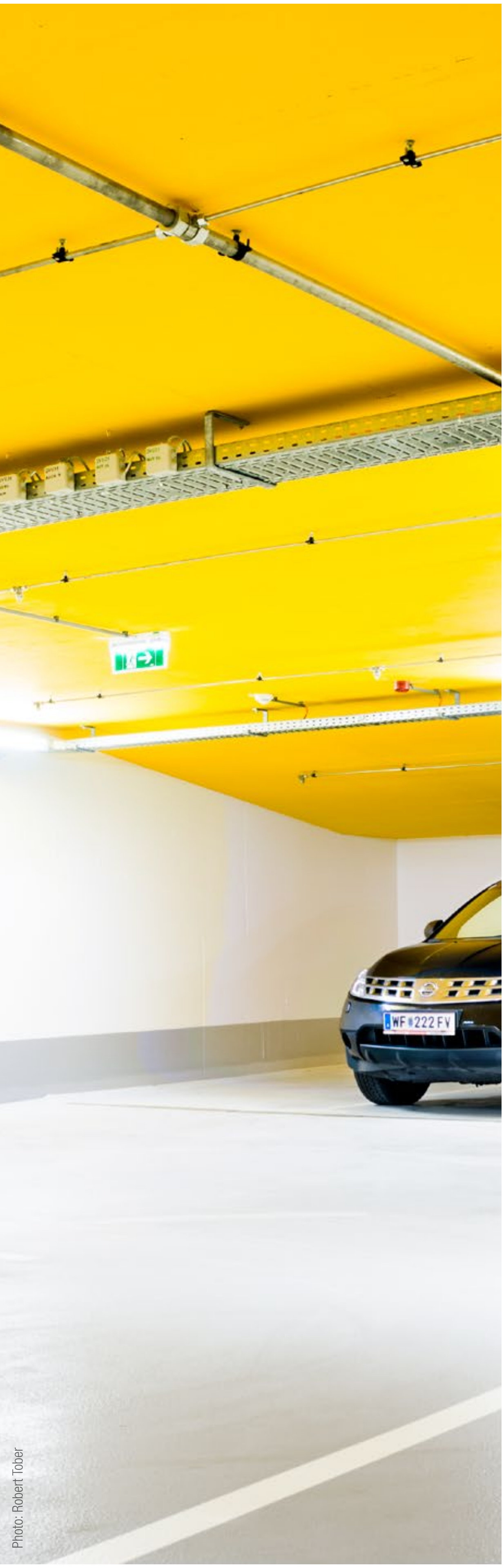


Photo: Robert Tober

4. SPRINKLER SYSTEMS
QUO VADIS?

Werner Hoyer-Weber, Hoyer Brandschutz

4.1 Fire protection and its social responsibility

When we came together with ATP sustain and decided to take a closer look at the impacts of constructional and technical fire protection on the climate, environment and resources, I was still unaware of the rethinking processes that this comparative study could entail. While I had my suspicions about the possible findings in this comparison, the end results were then surprisingly clear-cut. The figures show in black and white – and in some cases, clearly – that a new building uses less electricity, causes fewer CO_2 emissions, uses fewer resources, and creates less hazardous waste when the focus is on systems engineering for fire protection. As a specialist planner, the question of what this means in terms of socially responsible fire protection planning is then unavoidable.

Neutrality is everything

As an engineering office, we always remain neutral in our observations. We have no preference for certain measures, and have to (and want to) be open-minded to all possibilities. If I am asked whether I think wood is a good choice as a building material or whether I prefer concrete for fire protection, my answer is always the same: "Both are possible – each case is different and I would be happy to advise you about your options and how we can keep damage to a minimum if the worst happens." This is no different when taking constructional and technical fire protection into consideration.

Role in society

Nonetheless, it must be noted at this point that those of us in the field of fire protection not only act in terms of the statutory protection goals, but also in a societal context as well. Usually, this leads to discussions about the point at which a building is sufficiently safe, whether there are too many deaths as a result of fire, or what the socially acceptable risks are in terms of damage caused by fire. Other issues of how we live together are linked to the topic of fire protection, such as how we deal with demographic change in Austria and the fact that there are increasing numbers of older, less-mobile people in the event of fire. Other increasingly important aspects seen in recent years include climate change mitigation and environmental protection.

Taking into account this development and the results of the comparative study on the life cycle assessment in fire protection, I believe it makes sense for us to pay more attention to the topic of systems engineering. First and foremost, this means that we have to advise the decision makers in the construction industry accordingly and provide them with all the relevant information so that they are not only able to assess whether wood or concrete is suitable, but can also weigh up whether a sprinkler system may be a sensible option in a building project.

Sprinkler systems in Austria

Austria has always been a country dominated by constructional fire protection, and this remains the case today. While sprinkler systems in countries such as the USA, Great Britain and Norway are not only used more often but also in a wider variety of buildings, their use in Austria is mostly limited to the area where they were first used at the end of the 19th century – in the industrial sector. In other words, where there are significant fire loads, where high-value items are protected, and where prolonged downtimes should be prevented.

Apart from the industrial sector, sprinkler systems have not yet made a widespread breakthrough here on the domestic market. They are currently seen most often in event locations, office buildings or garages, which has to do with them being increasingly used to compensate for constructional measures with the emergence of fire protection concepts. Sprinkler systems are also increasingly seen in accommodation, with this trend being passed on from companies based in America. These systems are an established part of company policy at many American hotel operators, as they give their guests a good feeling of safety and the companies want to rule out the scenario of a hotel fire – with possible deaths and injuries – from the outset.

Sprinkler systems are also found in high-rise buildings as they are now established as a binding measure in building regulations. In my opinion, there was no alternative to this obligation. With possibilities for fighting a fire from the outside by the fire brigade limited in high-rise buildings, sprinkler systems are the only way of preventing the spread of fire through the facade. However, this step was preceded by intensive discussions about whether the use of sprinklers is feasible in apartments – in other words, in private use.

In Austria, there is no significant prevalence of installation for other uses at present, nor is there a tendency towards considering sprinkler systems more often than before – in contrast to Germany, for example. While constructional fire protection has also been dominant up to now in our neighbouring country, sprinkler systems are now being installed in many hospital renovations. In applications like this, people have realised that sprinkler systems significantly increase occupant safety compared to constructional fire protection.

Asking the important questions

It has been statistically proven that buildings with automatic sprinkler systems show a significant reduction in terms of personal injury, the extent of loss and claims figures. While the installation of a sprinkler system can pay off in several ways, the decision as to whether such a system will be installed should not be left solely to the authorities, but instead be made consciously by the building owners. To be able to scrutinise all of the different perspectives, they should be aware of the benefits of sprinkler systems: What are the construction costs of the building? What are the building costs in operation? What does the individual risk assessment look like? What does it mean for my building – and also for me – if there is a fire?

Risk assessment

When talking about projects with sprinkler systems, the common killer argument is that they are automatically too expensive. However, the comparative study – at least in the example given – comes to a different conclusion. This shows that not only the immediate investment costs of the sprinkler system have to be taken into account during budgeting, but also those savings that can be achieved in other areas (such as in construction) through these technical measures.

I therefore don't want to go into further detail on the cost aspect, but would rather address the risk assessment. There are four important points for building owners to consider here:

1. ***Occupant safety:*** As sprinkler systems usually restrict fires to the area where they began, the large majority of people in the building are safe. This is not guaranteed

in the event of fire in buildings with purely constructional measures and without technical fire protection – for example, if there is no fire alarm system.

2. ***Extent of damages:*** Building owners have to ask themselves how great the largest possible or acceptable extent of damage is. According to building regulations, fire compartments may be up to 1,600 square metres. If only constructional fire protection is in place, then a large area may quickly be affected if an entire fire compartment is destroyed. In contrast, a sprinkler system keeps fires small and usually contains or extinguishes a fire with only a few sprinklers.

3. ***Downtimes:*** At a certain size, fires always result in interruptions to operation or downtimes – whether in industry, residential buildings, hotels, warehouses or shopping centres – and it takes a certain time until the affected area is back up to speed. With a sprinkler system, it can normally be assumed that the interruption is much shorter than when using classic, constructional fire compartments.

4. ***Economic risk:*** Interruptions and downtimes cost money, as do the measures for rectifying the damage. The larger the damage, the greater the economic loss – and with it the serious risk to the further existence of the company.

In individual cases, other factors may also be included in the risk assessment, for example the protection of irretrievable goods or when even one significant fire would result in irreparable damage to the reputation of the company.

Rethinking decision-making processes

The weighing up of all these costs, benefits and risks always has to be made on a case-by-case basis, and doesn't necessarily result in the installation of a sprinkler system at the end of it. However, it is critically important that these considerations are made in the first place, and that they are not only limited to the construction phase but are also extended to use and operation. Currently, it is often the case that sprinkler systems are ruled out in advance or are not considered seriously if they are not explicitly required by building regulations. This not only has an impact on building safety, but also takes us back to the question of whether fire protection is a societal issue. As society changes, the way in which we build also has to change too. In the past, we have reacted to changes in fire risks, the demand for higher safety standards in buildings and the emergence of new usage habits. In my opinion, it is only logical that systems engineering will become a more important decision-making criterion in fire protection in contemporary building projects, and will also include important aspects relating to the climate and environment.

New challenges

The question of whether we should consider installing sprinkler systems more often in the future has also been raised following other developments. There are currently many existing buildings – such as Gründerzeit houses – where the constructional circumstances mean that extinguishing a fire makes more sense from the inside than from the outside by the fire brigade. Extinguishing a fire from the outside is also becoming increasingly difficult due to urban development. In addition, specialist planners are also constantly confronted with design issues in existing buildings which cannot be managed using constructional fire protection, but can be renovated to an adequate level of safety with the addition of technical measures. This requires open-mindedness towards renovation concepts that also allow for the use of systems engineering in verifying the required fire resistance rating of components. The alternative of demolishing buildings that cannot be renovated and building new ones in their place is contrary to all climate goals – and is thus no alternative at all.

In growing cities, technical fire protection will play a significant role in renovation concepts in future.

A look into the future

So, where is the journey taking us? There are many reasons to believe that technical fire protection – including sprinkler systems – will become increasingly common in buildings across Austria. There is the argument that buildings in countries with a more prominent sprinkler culture are constructed differently, such as the prevalence of lightweight construction in the USA or the larger number of timber houses in Norway. However, in my opinion this argument falls short. On the one hand, sprinkler systems are not only used for protecting assets but also protecting people – an aspect that is often neglected. As a result of increasing safety demands (which we are also seeing in other areas) and demographic development, this will play a greater role in the future. On the other hand, sprinkler systems can establish a level of protection in certain buildings or applications that cannot be achieved by constructional fire protection alone. This can bring further advantages, including in terms of architectural design, flexibility in use or – as indicated by the comparative study – the implementation of higher benchmarks in climate change mitigation and environmental protection.

4.2 Reservations towards sprinkler systems from the planner's perspective

Outside of the industrial sector, sprinkler systems are currently not a standard measure seen in preventive fire protection in Austria. This is not only down to the importance of constructional fire protection in our country and cost reasons, but is also the result of fundamental scepticism towards the systems – something which I see time and again in practice. As these reservations are – in my opinion – unfounded from a professional perspective, I would like to take this opportunity to address them here in more detail.

How a negative image is created

"Sprinkler systems have so many problems" is a sentence I hear repeatedly. The most common reservations in this direction include the fear of false alarms or the system being triggered accidentally when there is no fire, the contrasting fear that they won't be triggered on time or effectively in the event of fire, and the assumption that the maintenance of sprinkler systems requires so much effort that this is reason alone to choose constructional fire protection instead – which is incidentally also considered as being much more reliable. These reservations are compounded by the fact that only very few people have in-depth knowledge of how sprinkler systems work. Even in master's degrees in building technology, teaching material on sprinkler systems still remains thin. Then there are the stereotypes reinforced by the media, such as films where sprinkler systems flood the whole building or when the sprinkler systems malfunction for no apparent reason and the building burns down.

The human factor

The successful deployment of a sprinkler system in a fire depends on three criteria – responsible planning, correct installation and prudent maintenance. If these requirements are met, you can count on the sprinkler system working correctly and effectively. The technology is well established and all components undergo strict testing in order to receive approval from independent testing institutes. Due to these strict requirements, there is also no downgrading in the field of sprinklers – a common sight in other areas of the construction industry where corners have to be cut. So, if the technology works, why are there still problems? In my experience, I can say that the failure of sprinkler systems is almost exclusively the result of human failure. In other accidents too, close analysis usually reveals that it is not the technology that is at fault, but instead the person using it.

Quality in planning and execution

Such errors can occur right at the outset during the planning phase, which is why sprinkler systems should always be planned by specialists. This not only involves the selection of the correct system type – wet, dry, wet/dry in combination, spray, ESFR (early suppression, fast response), high-pressure or low-pressure water mist, and so on – but also the correct planning of the water supply, pumps and pipeline dimensions. This requires know-how, experience and product-independent consideration in order to draft a sprinkler project that brings together all technical demands, the requirements from the authorities and insurance companies, plus other specific aspects of the project into a coherent plan. Unfortunately, this is not always adhered to in practice, which can lead to sprinkler systems not being designed according to applicable guidelines, the emitted volume of water being insufficient for bringing a fire under control, sprinkler heads having spray shadows due to incorrect positioning, or pipes bursting in sub-zero temperatures – leading to the much-feared water damage – because planning did not take into account that part of the system was in an area at risk of freezing.

However, good planning only pays off when quality is also ensured during implementation. As the installation of the sprinkler system is a critical moment, specialist supervision is recommended in order to keep a close eye on the project on site from installation right through to completion.

Technology needs care and maintenance

In my opinion, the most common problems with sprinkler systems occur when organisational fire protection is not given the necessary attention. This isn't especially surprising – after all, planning and installation take up relatively little time in the life

In 2002 I worked for one of the largest sprinkler companies in the world. Among my other responsibilities was dealing with customer complaints. At the time there were perhaps 150 million sprinklers installed in Europe, at least a third of them came from us. I got about five complaints on my desk a year from all over Europe, which is roughly one incident for every ten million sprinklers installed. During the five years I held this role, half the complaints came in the spring. Analysis of the returned sprinkler parts showed they had been distorted, probably because a wet pipe system had been allowed to freeze. In other cases, it was obvious that something had damaged the sprinkler. We had a manufacturing error just once due to a single bad batch of sprinklers, where there was porosity in the body castings. Today, 20 years later, the likelihood of that happening again is even less, as manufacturing processes have improved and sprinkler heads and components are subjected to even more rigorous testing before leaving the factory. But I assume that wet pipe systems still freeze today. And I know that some installers still use the wrong tools to screw in sprinklers or continue to attach them to the pipes before hanging them, even though the sprinklers can be damaged in the process.

Alan Brinson, European Fire Sprinkler Network (EFSN)

cycle of a sprinkler system, whereas maintenance has to be carried out constantly over years or decades. Every technical system has to be handled with the necessary care. When we board a plane, we count on it being serviced correctly. We have our gas boilers inspected regularly and checks made on whether the brakes or engine in our cars are working correctly. This is no different for a sprinkler system. That said, I am constantly taken aback when I hear cases of those in charge not taking their responsibilities seriously enough or not having the required knowledge. In both cases, one thing is urgently required – training. In terms of the benchmark to be aimed for, a prime example can be found in the widely used “Life Safety Systems” in the USA, for example, where great importance is attached to the regular maintenance and servicing of all safety-related equipment. This approach is something that should be regularly practised and become second nature in Austria too.

Raising awareness, sharing knowledge

If we consider how high the realistic chance of a fire is, then the majority of us will fortunately go through life without ever being affected by one. The chance of a fire occurring is decisive in establishing the perceived risk – and, from a psychological perspective, is an indication of why people who are responsible for the maintenance of fire protection systems behave carelessly. Maybe the company you work for will never be affected by a fire – or only years after the sprinkler system has been installed. As rare as fires are, the fact is that fire protection measures still have to work perfectly on any given day – something which is only possible with correct maintenance. Train-

worth knowing

Life Safety Systems

The established concept of “Life Safety Systems” in English-speaking countries refers to a combination of safety systems in buildings that are used for the protection and evacuation of people in emergencies. These include fires and earthquakes, but also other major incidents such as gas leaks, power outages or burglaries. The measures include surveillance, notification and communication systems, secured escape routes and emergency exits, evacuation plans, safety lighting, access control systems, emergency power generators, fire and smoke detectors, hand-operated fire extinguishers and – in many cases – sprinkler systems.

ing courses can raise awareness of the importance of preventive fire protection and provide the required knowledge. Among other aspects, this can be seen in the strong decline of fire damage in businesses following the introduction of the statutory obligation to employ fire safety officers.

Professional staff for the sprinkler system

In Austria, operators of sprinkler systems have to ensure that trained people – sprinkler officers – regularly carry out inspections and maintenance and, in the event of discrepancies between the current condition and target condition, immediately arrange for the necessary repairs to the system. There is specialised training for the qualification as a sprinkler officer available for those carrying out this role. While such training measures should be encouraged, everyday operations show that theory and practice are unfortunately often two very different things. We constantly observe sprinkler officers receiving the necessary information on handling sprinkler systems during the course, but who are then still unsure about how to deal with the system in their own company, are not always up to speed with its functionality, or are reluctant when it comes to testing the system. Errors then often result in internal inspection and maintenance processes that could have a negative impact in the event of fire. At this point, it is important that sprinkler officers become more familiar with their own system in order to gain the necessary certainty and routine during handling. After all, this is also practised on other technical systems that are required for smooth everyday operation.

When is a wall not a wall?

After all these explanations, you would be forgiven for agreeing with the argument that a wall with a fire resistance rating is an obstacle to a fire, regardless of whether it is serviced correctly or not. The fact that human error can lead to mistakes in technical fire protection cannot be denied. While the same applies to constructional fire protection, this is often not considered. Not only every individual sprinkler in a system has to be serviced, but also every fire door and fire damper. Each wall surrounding a fire compartment must be intact

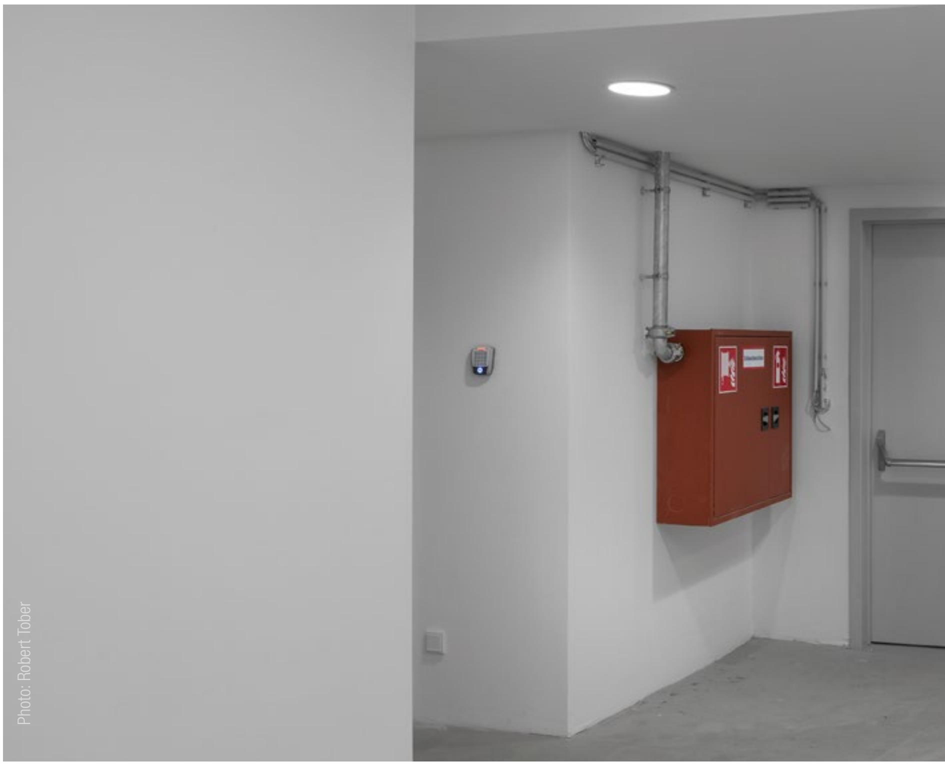


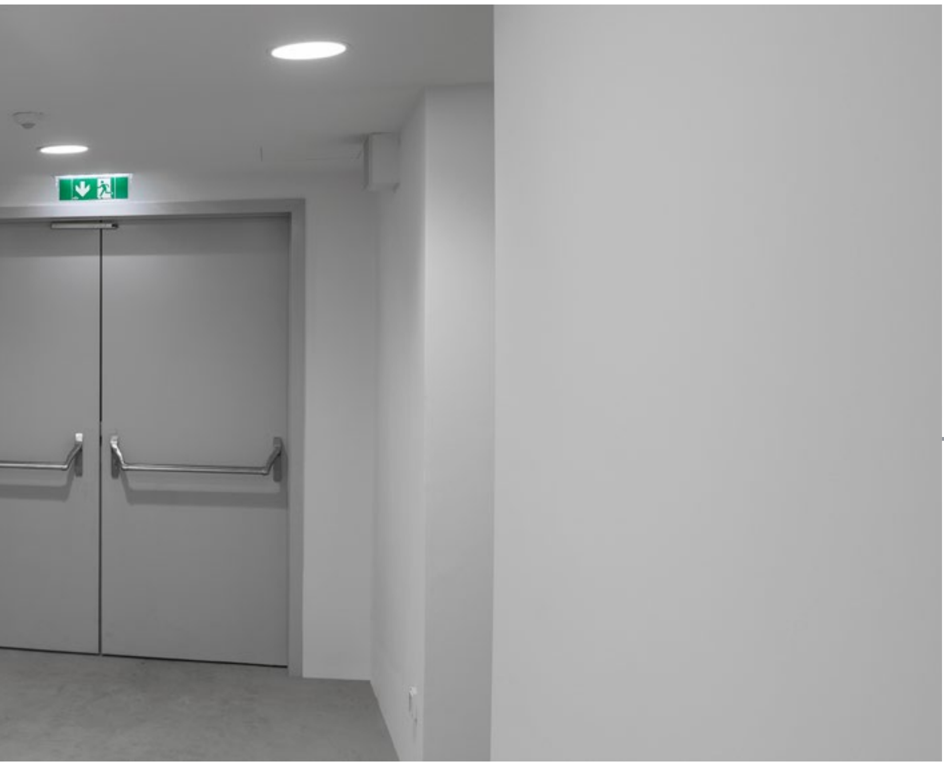
Photo: Robert Tober

in order for it to offer the necessary safety in a fire. However, if fire doors are wedged open, accessibility for maintenance is limited – as is often the case for fire dampers – or if fire compartment walls are damaged by holes when laying electrical wires and these are not sealed properly, then fire and smoke can spread between several fire compartments. Additionally, it must also be remembered that constructional fire protection often involves a high degree of technology nowadays too – such as fire doors containing complex technology, for example. The fact is that fire protection – regardless of whether this is predominantly constructional or technical – only works correctly when the necessary precautions are taken.

Water damage vs. fire damage

Finally, I would like to address something else that is heard regularly, namely that sprinkler systems cause a disproportionally large amount of water damage. Let's look at a specific example and imagine that a fire starts in a rubbish bin in an office building. Normally, the sprinkler head directly above the bin would activate, release water and extinguish the fire in a matter of seconds. It is true that water continues to be released by the sprinkler until the fire brigade arrives, confirms that the fire is out and the flow of water is disabled by the emergency personnel or trained staff on site. All in all, this takes around 20 minutes. "There's so much damage for a fire in a waste bin" is the argument that is then heard. However, shouldn't the first thought instead be that the entire floor of the office may have burned down if it wasn't for the sprinkler system?

In my opinion, focusing on water damage would only be justified in the event of regular false alarms on the sprinkler system – in other words, spontaneous and needless activation without the presence of fire. However, in my entire career as a fire protection planner, I have never seen a single case of this kind. I can't rule out something like this happening, of course. However, in my opinion it is not situations like this that we should pay attention to, but instead those errors that occur during the planning, installation and maintenance of sprinkler systems – the majority of which are preventable.



Constructional fire protection also requires regular inspection and maintenance in order to offer the planned level of safety in the event of fire. This not only includes all fire doors and fire dampers, but also the correct sealing of openings in walls surrounding fire compartments.

5. ABOUT THE AUTHORS


Photo: Robert Tober

Werner Hoyer-Weber

is Managing Director of the engineering office Hoyer Brandschutz, a certified fire protection planner and qualified specialist in preventive fire protection. With more than 25 years of project experience and expertise gained from numerous further training courses, he is one of Austria's leading experts in the field. He passes on this knowledge as a speaker and lecturer in training courses on fire protection and also represents the interests of consulting engineers as a committee member of the Engineering Office expert group at WKW.

Hoyer Brandschutz

Founded in 1990 as Austria's first engineering office for fire protection planning, Hoyer Brandschutz is an experienced partner for holistic fire prevention solutions in industrial and commercial buildings. In addition to fire protection, escape route and evacuation concepts, the planning of fire protection systems and the creation of simulations, the Vienna-based engineering office also takes care of site monitoring, auditing tasks and is a certified body for the approval of sprinkler systems. Building owners and architecture offices are supported in the development of economical and sustainable fire protection measures. In 2021, the company launched "PLAN b" – a magazine that gives deeper insights into the diverse discipline of fire protection planning.

www.hoyer-brandschutz.at

Michael Haugeneder

has been part of the Executive Board of ATP sustain GmbH since 2010, a special planning company of the ATP Group that aims to establish sustainable building as standard. Before his role at ATP sustain, the trained building and environmental engineer and certified civil engineer for building technology was active as a specialist planner in technical building equipment, predominantly for complex energy systems in major construction projects. He is ÖGNI/DGNB Auditor, Board Member at ÖGNI, EU Taxonomy Advisor, BREEAM Assessor and BREEAM In-use Auditor, and LEED AP. In the past few years, he has headed up several projects in commissioning management – usually in connection with sustainability certifications – and, as member of the Building Construction Life Cycle interest group, played a significant role in shaping the applicable specifications in the field of commissioning management.

Philipp Racher

completed his degree in renewable energy technologies at the UAS Technikum Wien, where he was heavily involved in building technology and energy-efficient construction. Thanks to his interest in technology and affinity with nature, this program proved to be a perfect match. Racher started his career at a plant manufacturer for building technology, first as a technician and later as manager for HVAC projects. Since mid-2022, he has brought his expertise to ATP sustain in the field of "research+design" in the development of sustainable energy concepts.

ATP sustain

The research and special planning company for sustainable building has offices in Germany and Austria, and is committed to exploring new ways of thinking and acting for recyclable, climate-friendly buildings. To do this, the team implements sustainable approaches from research on climate-friendly construction and operation when planning new buildings and renovating existing ones. With an in-depth analysis of the existing situation and practical optimisation concepts, customers are accompanied on the path towards better, future-proof buildings and supported with market-leading sustainability certification.

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