



# Fire safety in renovation – Summary of regulations and practice in the EU

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Summary	
<p>The importance and volume of renovation of the existing building stock in Europe is all the time increasing. Fire loads at renovations sites of buildings are typically larger than in normal use which leads to the increase of fire risks. A state-of-the-art study concerning the on-site and subsequent fire safety of renovation has been made. The study included a questionnaire to European experts and a literature study of fire safety requirements and guidance.</p> <p>The most important factors of fire safety in renovation are the prevention of ignition and fire spread, safe evacuation in case of fire, and the safety of rescue and fire fighting. Conditions possibly leading to ignition shall be avoided, the amount of fire load at renovation sites shall be minimized, and combustibles shall be protected during storage, handling, installation and waste treatment. The usability of evacuation routes and emergency access routes shall be maintained throughout the renovation process. Informing and training occupants and workers are crucial in avoiding dangerous fire hazards due to ignorance or unskilled working.</p> <p>Risk-oriented approach in regulations and guidance, and co-operation and communication between the builder, the on-site responsible persons and the local authorities are essential in reaching safety goals.</p> <p>Good fire safety procedures for renovation are available. Since novel materials, products and working methods can lead to new fire hazards, fire safety of renovation needs to be continuously monitored and solutions to new fire hazards need to be found. Recommendations for further actions to improve fire safety in renovation have been given.</p>	
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## 1 Fire safety and renovation

Fire loads at renovations sites of buildings are typically larger than in normal use which leads to the increase of the risk of big fires. The time it takes for a small fire to accelerate and become a major hazard is reducing, and without adequate and comprehensive fire protection systems built in, the rapid spread of flames and toxic smoke well beyond the point of origin reduces the time available for the safe exit of the occupants, thereby putting their lives at risk. This trend also makes the rescue and fire fighting work of fire brigades more difficult and dangerous than normally.

The importance and volume of renovation of the existing building stock in Europe is all the time increasing because of the needs of energy efficiency and sustainability. Safety of people and protection of property in case of fire should not be sacrificed in this process.

This study aims to find out the state-of-the-art concerning fire safety during renovation (on-site safety) and after renovation (consequences to safety level). A benchmark across representative EU member states was planned to be made including regulatory basis, application to local level and best practices.

## 2 Questionnaire on the state of the art

The main emphasis of the project is in fire safety on-site during the renovation work and especially in the safety of people. Large buildings (in volume and height) with a large number of people do have the main fire risks. Thus apartment buildings, office buildings, commercial premises (shopping malls, sports arenas), schools and hospitals were chosen to be of main interest. Additionally, also fire safety reached by renovation (in comparison to the previous level and new buildings) is covered in this study. On this basis a questionnaire was drawn up with the following main topics:

- Regulations and official guidelines – fire safety of buildings, on-site fire safety during renovation process, application into practice on local level
- People in danger - exposure to fire during renovation
- Fire risk assessment and fire precautions during renovation
- Examples of best practices
- Statistics and case studies
- Fire safety level reached by renovation

The questionnaire included altogether about 60 detailed questions. It was sent to more than 40 experts in 15 EU member state countries. These experts represent fire regulators, national institutes of fire safety, rescues services and fire safety engineers.

As a response to the questionnaire totally 19 answers were received representing 13 countries: Austria, Czech Republic, France, Finland, Germany, Italy, Latvia, Poland, Slovenia, Spain, Sweden, the Netherlands and the UK.

### 3 Key elements for fire safety in renovation

#### 3.1 Background for fire safety requirements and guidance

In the EU, there are several directives which, in principle, do deal with fire safety in renovation. The main directives are shortly described below.

##### **Directive 89/106/EEC - construction products**

- The aim of the directive is to ensure the free movement of all construction products within the Union by harmonising national laws with respect to the essential requirements applicable to these products in terms of health, safety and stability.
- Essential requirements for safety in case of fire cover the following topics:
  - Load-bearing capacity of construction can be assumed for a specific period of time
  - Generation and spread of fire and smoke are limited
  - Spread of fire to neighbouring works is limited
  - Occupants can leave the works or can be rescued
  - Safety of rescue teams is taken into consideration

These essential requirements form a common basis for national fire regulations and guidance, at least concerning general principles.

**Construction Products Regulation** (305/2011/EU - CPR) will replace the Construction Products Directive (89/106/EEC – CPD) in July 2013. This is to ensure reliable information on construction products in relation to their performances.

Directive 89/391 – "**Framework Directive**" about the general principles concerning the prevention and protection of workers against occupational accidents and diseases

- It contains the **general principles of prevention**, lays down employers' obligations concerning the assessment of risks, the elimination of risks and accident factors, the informing, consultation and balanced participation and training of workers and their representatives.

Directive 89/654/EEC concerning the **minimum safety and health requirements for the workplace** includes among others the requirement for the employers to ensure that

- **Traffic routes** to emergency **exits** and the exits themselves are kept clear at all times
- **Safety equipment** and **devices** intended to prevent or eliminate hazards are regularly maintained and checked.

Directive 92/57/EEC – **temporary or mobile construction sites**

- This directive lays down minimum safety and health requirements for temporary or mobile construction sites and intends to prevent risks by establishing a chain of responsibility linking all the parties involved
  - Fire hazards need to be taken into account
  - General instructions on fire detection and fire fighting given.

Directive 2006/32/EC on **energy end-use efficiency and energy services**

- No fire safety related topics mentioned, neither in the proposal for new directive on energy efficiency (2011).

Directives give the framework which has to be implemented into national regulations and guidance. A European level guidance on safety and health concerning temporary or mobile construction sites is given in the following document:

- Non-binding guide to good practice for understanding and implementing Directive 92/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile construction sites (European Commission 2010).

There are examples of guidance documents on the European level (Fire prevention on construction sites, CFPA-ENo 21:2009) and on national level (UK – Fire safety in construction, Guidance for clients, designers and those managing and carrying out construction work involving significant fire risks. HSG168, Health and Safety Executive: 2010; Finland – Fire safety during renovation of a building, SPEK opastaa 25: 2011) giving instructions on managing fire safety during renovation.

On national level, the main stakeholders for advising and promoting best practices in renovation are fire, rescue and health & safety regulators, insurance companies/associations and rescue associations.

### 3.2 Risk oriented approach for fire and evacuation safety

In the course of a renovation process, many different materials and conditions posing fire risks are involved, e.g. fire loads at renovation sites of buildings are typically larger than in normal use. Furthermore, human factors on renovation sites can lead to risky situations. Therefore, risk oriented approach is recommended for estimating and preventing fire hazards. The fire risks on renovation sites shall be evaluated, precautions shall be taken to avoid fire incidents, and on-site practices shall be documented in fire safety plans. The importance of risk oriented approach can be seen also on the results of the questionnaire: several countries have guidance on fire safety aspects of construction sites and/or renovation sites.

The fire triangle, shown in Figure 1, is a simple model for illustrating the ingredients necessary for combustion. A fire requires three elements: fuel, heat and oxygen. The fire can be prevented or extinguished by removing any one of these elements. On renovation sites, oxygen is practically always available. Therefore, ignition and fire spread can be prevented by controlling fuel and heat.

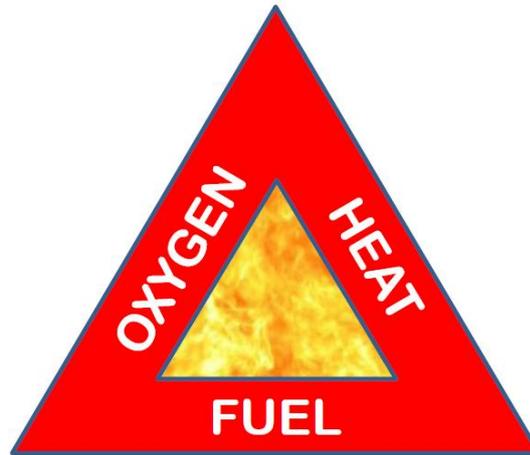


Figure 1. Fire triangle showing the necessary elements of combustion.

### 3.2.1 Prevention of ignition

Conditions possibly leading to ignition shall be avoided. All works where flames or other heat sources are used or sparks can occur require special caution, and whenever possible alternative work methods not involving a fire hazard should be considered. Attention must be paid to hot work procedures in all phases, including monitoring after completion of hot works. Smoking should be prohibited at renovation sites, or a smoking place without any combustibles nearby should be arranged.

Building products can contain large amounts of fuels. The related ignition risks can be reduced by the use of protected combustible construction products, and by appropriate storage and handling of combustible construction products and waste materials. Also the storage of flammable liquids and gas cylinders must be arranged properly to avoid ignition.

Construction and renovation sites, and especially their storage areas, are vulnerable to arson. The risks can be significantly reduced by site security actions, e.g. protective hoarding, locked gates, regular out-of-hours security patrols or a permanent security presence.

### 3.2.2 Prevention of fire spread

The amount of fire load on renovation sites should be minimized. For instance, the storage of combustible building products can be reduced by just-in-time ordering whenever possible. It is very important to prevent the availability of directly ignitable materials, i.e. unprotected combustibles. Combustible materials, e.g. plastic insulation, shall be always protected, either by using prefabricated products including the protection or by using temporary protection storage.

Fire doors on renovation sites must be kept closed to prevent fire spread from a fire compartment to another. Automatic door closing devices are the best solution. It is noted that fire doors must never be wedged open in any circumstances.

First extinguishing equipment shall be available at renovation sites, and the workers shall be trained to use them. If the automatic suppression system of the building is switched off, special measures shall be taken to prevent fire spread, e.g. the compartmentation must be ensured and fire watch must be arranged after hot works.

Fire spread to neighbouring buildings shall be prevented by keeping combustibles at sufficient distances from buildings. For instance, combustibles must not be stored or trash pallets placed between buildings with a short distance.

### 3.2.3 Evacuation in case of fire

Escape routes need to be available for everyone on the site. During the course of renovation, escape routes are likely to change and possibly become unavailable. It is important that replacement routes are identified and provided. Escape routes need to be clearly signed, and kept free of obstruction. Training shall be given frequently, especially when the escape routes change.

Information on the evacuation in case of fire shall be given to the occupants (if present) and the workers. Language versions of the evacuation instructions shall be produced when needed to ensure that all occupants and workers can understand the evacuation procedures.

### 3.2.4 Safety of rescue and fire fighting

To ensure operational preconditions for rescue services, the usability of emergency access routes at the renovation site shall be maintained throughout the renovation process. The routes must be kept clear of obstacles like stored materials, trash pallets, etc.

Inside the renovated building, access to the areas with risk of fall or other hazards shall be prevented for the work safety of fire fighters. Furthermore, the fire load inside the building shall be minimized to reduce explosion hazards and risks of extensive fire spread.

### 3.2.5 Protection of property

Fire on a renovation site can cause large economic losses. It can also have environmental consequences, and cause risks to the health and safety of occupants, workers, and people in the neighbourhood. The public image of the builder and the building owner can suffer due to a fire incident.

## 4 State-of-the-art in Europe

### 4.1 Elements of fire safe renovation

In defining categories of countries in terms of fire safety of renovation, three aspects were considered: 1) risk orientation in regulations, guidance and practice, 2) co-operation between the builder, the on-site responsible persons and the local authorities, and 3) possible relaxations in reached safety levels. The evaluation of the criteria was based on selected questions of the questionnaire on fire safety in renovation and background information collected from different countries (e.g. guidance documents). The results of the evaluation are presented in Annex 1.

#### 4.1.1 Risk orientation

On the 13 countries studied, topics of risk-oriented fire safety approach were included in regulations and guidance extensively in five countries and to some extent in two countries. In three countries, these topics were not at all or very little present in regulations and guidance. The information from three countries was insufficient for drawing conclusions.

Best practices for fire safety of renovation sites and communication between site management and the authorities were somewhat less common than risk orientation in regulations and guidance. Best practices exist in five countries. It is noted, however, that regulations/guidance and best practices can be connected: the regulations or official guidelines can define the practices.

The answers to the question whether the practices in renovation are different from regulations or guidelines must be interpreted with some caution. It is possible that some respondents are reluctant to reveal deviations, or they have limited knowledge on the subject.

#### 4.1.2 Co-operation

Co-operation between the builder and the local building and rescue authorities takes place regularly in five countries. In four countries, the co-operation is not a common practice. In another four countries, some co-operation with the authorities can take place but not regularly.

Written emergency procedures for renovation sites are used in four countries, and in seven countries not. In one country, the existence of written emergency procedures depends on the case.

#### 4.1.3 Relaxations

It is very common that relaxations in the reached safety levels of renovated buildings can be allowed in the case of historical buildings. This building type is excluded from the results presented in Annex 1. Concerning other building types (apartment buildings, office buildings, shopping malls, sports arenas, schools and hospitals), five countries allow some relaxations and six countries do not.

#### 4.1.4 Statistics

There are no renovation specific fire statistics available. The knowledge is limited to some case studies which would be valuable for further analysis of the causes and consequences of fires.

## 4.2 Status in the countries of this study

On the basis of the criteria introduced above, the countries studied were divided to two categories. Group A includes the countries where good procedures concerning fire safety issues of renovation are widely applied, both in regulations and in practice. Group B includes the countries where these good procedures are lacking, are not well-established, or sufficient information was not obtained in the questionnaire. It is noted that the fire safety regulations and practices can vary regionally within a country.

Group A includes Austria, Czech Republic, Finland, Latvia and the UK.

Group B includes France, Germany, Italy, the Netherlands, Poland, Slovenia, Spain and Sweden.

As a conclusion on the evaluation of the criteria for fire safe renovation, good procedures concerning fire safety issues of renovation are followed in some countries. However, these procedures should become more common and widespread throughout Europe. The fire safety of renovation can be improved in the countries of both Group A and Group B.

## 5 Conclusions

The most important factors of fire safety in renovation are the prevention of ignition and fire spread, safe evacuation in case of fire, and the safety of rescue and fire fighting. It is important to ensure that all these factors are in order on renovation sites. If several of them are neglected, a single problem can turn into a major disaster.

A fire requires three elements: fuel, heat and oxygen. Since oxygen is always available on renovation sites, ignition and fire spread shall be prevented by controlling fuel and heat. Special attention must be paid to hot work procedures in all phases, and to on-site smoking. Ignition risks can be reduced by protecting combustible construction products during storage, handling, installation and waste treatment. Site security actions shall be taken to prevent arson.

The amount of fire load at renovation sites should be minimized, e.g. by protection or just-in-time delivery of combustible building products. Fire doors must be kept closed to prevent fire spread from a fire compartment to another. First extinguishing equipment shall be available, and the workers shall be trained to use them.

Evacuation and emergency access routes need to be available, clearly signed and kept free of obstacles. Training shall be given frequently, especially when the

escape routes change during the course of renovation. Information on the evacuation in case of fire shall be given to the occupants and the workers.

The questionnaire on fire safety in renovation highlighted some common elements in guidance for good practices. The most important of these elements were risk-oriented fire safety approach in regulations and guidance, and co-operation and communication between the builder, the on-site responsible persons and the authorities. The fire risks of renovation sites shall be evaluated, precautions shall be taken to avoid fire incidents, and on-site practices shall be documented in fire safety plans. Awareness of fire risks by all people present on renovation site is of major importance. Informing and training occupants and workers are crucial in avoiding dangerous fire hazards due to ignorance or unskilled working.

In conclusion, good fire safety procedures for renovation are available. Since novel materials, products and working methods can lead to new fire hazards, fire safety of renovation needs to be continuously monitored and solutions to new fire hazards need to be found. The existing and new knowledge and practices need to be spread all over Europe to improve fire safety in renovation.

## 6 Recommendations for actions

To improve safety of citizens and support sustainable renovation of buildings the following recommendations for practical actions are proposed:

1. Preparation of European guidance document on fire safety in renovation to raise the safety level in all member states
  - Based on section 3 of this report and further development in co-operation with the member states and stakeholders of fire safety
  - Use of risk oriented approach including e.g. the following:
    - Restricted use of unprotected combustible products
    - Control of hot work procedures and working methods
    - Measures for safety of occupants if they stay in the building during renovation
2. Gathering statistics on fires occurring during renovation
  - Frequency, causes and consequences in a harmonised way
  - To monitor the present situation and to react on possible new needs because of new types of products or changes in building concepts
3. Existing and new knowledge and practices need to be spread all over Europe
  - Authorities, builders, manufacturers, insurance companies, safety and rescue associations, etc. need to co-operate for fire safety in renovation
4. These actions should be extended to cover also construction phase of new buildings.

## Annex

Annex 1. Evaluation of state-of-the-art for fire safe renovation

## Evaluation of state-of-the-art for fire safe renovation

Criteria	Austria	Czech Republic	Finland	France	Germany	Italy	Latvia	the Netherlands	Poland	Slovenia	Spain	Sweden	UK
<b>Risk orientation</b>													
Topics of risk-oriented approach in regulations and guidance (3.1–3.6, background information)	+	+	+	?	-	- (few)	+	+/-	+/-	- (few)	-	?	+
Best practices for fire safety of renovation sites (4.1) and communication between site management and the authorities (4.2)	-	+	+	?	-	+	-	+/-	+/-	- (few)	-	?	-
Are practices in renovation different from regulations/guidelines? (6.4)	?	no	to some extent	?	?	no	no	yes	no	yes/no	no	yes	yes
<b>Co-operation</b>													
Co-operation between builder (and representatives) and local building and rescue authorities (1C.1, 1C.3)	+	+	+	+	-/?	-	+/-	+/-	+/-	-	-	+	+/-
Written emergency procedures? (2.3)	-	+	-	?	-	+	-	+	-	-	+/-	-	+
<b>Relaxations</b>													
Relaxations in reached safety levels? (6.2)*	yes	no	yes	no	?	no	no	yes	no	no	yes	yes	?

The numbers in the parentheses refer to the questions of the questionnaire on fire safety in renovation.

\* excluding historical buildings

Group A (evidence on good procedures and outcome): Austria, Czech Republic, Finland, Latvia, UK

Group B (limited evidence or no information on good procedures and outcome): France, Germany, Italy, the Netherlands, Poland, Slovenia, Spain, Sweden