Protection against hail damage

CFPA-E Guideline No 09: 2023 N

CFPA EUROPE®
Fire Safety | Security | Natural Hazards

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The CFPA Europe develops and publishes common guidelines about fire safety, security, and natural hazards with the aim to achieve similar interpretation and to give examples of acceptable solutions, concepts, and models. The aim is to facilitate and support fire protection, security, and protection against natural hazards across Europe, and the whole world.

Today fire safety, security and protection against natural hazards form an integral part of a modern strategy for survival, sustainability, and competitiveness. Therefore, the market imposes new demands for quality.

These Guidelines are intended for all interested parties and the public. Interested parties include plant owners, insurers, rescue services, consultants, safety companies and the like so that, in the course of their work, they may be able to help manage risk in society.

The Guidelines reflect best practice developed by the national members of CFPA Europe. Where these Guidelines and national requirements conflict, national requirements shall apply.

This Guideline has been compiled by the Natural Hazards Group and is adopted by the members of CFPA Europe.

More information: www.cfpa-e.eu

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Key words: hail, hazards, assessment, protection, resistance

1 Introduction

Due to the long-term experience, natural hazards can endanger life, health, and the environment and cause considerable property damage. Therefore, protection against natural hazards is an essential task for society, which the Natural Hazards Group (NHG) of CFPA Europe has also taken on since 2012. Furthermore, natural hazards are also affected by ongoing climate change, so protection against natural hazards plays a vital role in climate change adaptation and sustainability. Its impacts are increasingly expected in the ongoing climate change due to scientific studies and visible and realized. These negative consequences can be caused by extreme weather events and changes in meteorological parameters, e. g. regionally and seasonally rising of average temperatures, increasing, or/and shifting of precipitation distributions.

Therefore, concepts and measures for protection against natural hazards should be regularly checked in risk management and adapted, if necessary. This adaptation should take regional and local differences in impacts of climate change, regional and local exposure, and vulnerability to natural hazards into account. And the resilience of society, ecology, economy, each as a system, e. g., infrastructure, must be considered as the objective within all adaptation concepts to ensure or maintain the necessary system function.

Concepts and measures to protect against natural hazards should also be sustainable according to the sustainable development goals of the United Nations, especially in terms of climate action (mitigation and adaptation), resilient infrastructure, sustainable cities and communities, and quality education. Related to the topic of the current guideline and due to recent experiences, a flood caused by heavy rain and flash flood can also seriously endanger the existence of many companies because of significant damages, a prolonged business interruption, and potential loss of market share.

Hail damage can be effectively limited and minimised, due to experiences and among other things with the aid of structural and organisational measures. Loss prevention through the use of hail-resistant building materials and components is particular importance. Everyone should therefore take protective measures against hail damage for their buildings depending on the technical and financial possibilities.

In this guideline, typical hail damages to buildings are described and protective measures as instructions and suggestions for practice are recommended. These recommendations are based on the current knowledge of construction technology and will be revised if fundamental changes occur.

2 Scope

The recommendations contained in this guideline apply in general to the planning, construction, and operation of new buildings according to object-related protection requirements.

In case of existing buildings, protective measures against hail damage should be realised as far as possible, e.g., in course of repairs or conversion measures.

3 Definitions

Hail: precipitation in the form of ice balls or ice lumps with a diameter of 5 to 50 mm (in extreme cases more than 10 cm)

Note: Solid precipitation of less than 5 mm diameter is referred to as sleet.

Hail resistance: Degree to which a building material or part is resistant to hail impacts under standardised conditions and, in particular, does not suffer any damage (functional and/or optical).

4 Hazard characteristics and assessment

Hailstones can cause direct damage to buildings and outdoor facilities as a result of their impact. In particular, roof and façade structures and components as well as installed systems at roof and façade are exposed, as the following pictures show.

Figure 1 Example of hailstones (source: EPZ = Elementarschaden Präventionszentrum/Elemental dampage prevention center, Austria)

Figure 2 Example of damages on building (source: EPZ)

Figure 3 Example of roof destroyed by hail (source: GDV = German Insurace Association)

Figure 4 Example of a skylight and plastic roof foil cover destroyed by hail (source: GDV)

Figure 5 Example of some PV models partly damaged by hail (source: GDV/EPZ)

Figure 6 An air condenser system on roof damaged by hail (source: GDV)

Figure 7 Aluminium lamellas of an air condenser system damaged by hail: detailed view (source: GDV)

Figure 8 Roofing exhauster as additional roofing equipement damaged by hail (source: EPZ)

Figure 9 Visible damage of metal-sheet roofing (source: EPZ)

Figure 10 Thermal insulation system damaged by hail (source: EPZ)

Figure 11 Plastic roller shutter for windows destroyed by hail (source: GDV)

Figure 12 View of a facade destroyed by hail (source: GDV)

Figure 13 Many small hailstones block dewatering systems (source: EPZ)

The situation in figure 13 might also be a problem on flat roofs if water can't drain anymore and it therefore gets overloaded.

The penetration of rainwater via the damaged roof can cause considerable damage to the inventory and equipment. In addition, roof, property, and road drainage inlets can be clogged with hailstones, leaves, sludge, and debris what reducing water drainage. Precipitation water can then no longer flow off in a controlled manner. Estates, parts of buildings (roofs, cellars, underground garages, terraces) and roads can be flooded, people can be endangered, and property can be damaged.

Figure 14 Examples of machine and apparatus protected against rainwater by film (source: GDV)

Figure 15 Examples of damage at roof covering (source: Kamila Kempna/Czech Republic)

The total damage caused by individual hailstorms can be considerable. On 27 and 28 July 2013, the hailstorms caused insured losses of € 1.6 billion in property insurance. Following Hurricane "Kyrill" in 2007, the floods of August 2002 and of June 2013, this event ranks fourth among the ten most expensive natural catastrophes in property insurance in Germany since 1997.

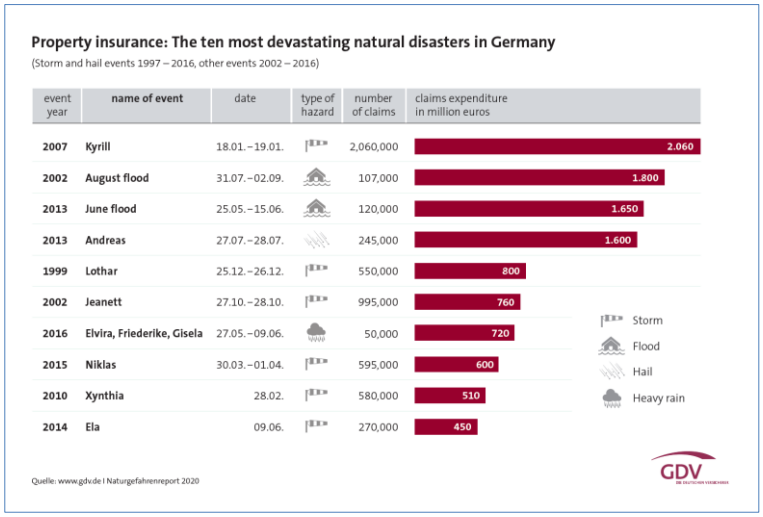

Figure 16 The ten most devastating natural disasters in Germany (source: GDV)

5 Protection concept and measurements

In frame of a holistic hail protection concept protection measures should complement each other, amongst others constructional, organisational and, if necessary, technical measures. For object-related determination of necessary protection measures, local hail hazard must be assessed, and object-related protection objectives and strategies must be defined first.

5.1 Hazard assessment

In some European countries, mappings of hail hazards are available, which are characterised, among other things, by the event return period[1] and hailstone size, e. g. in Switzerland and Austria (See figure 17). In Germany, a simplified approach is used to roughly assess the locally possible hail hazard, based on an existing approach of internationally active transport insurers, and validated with available data from abroad and inland.

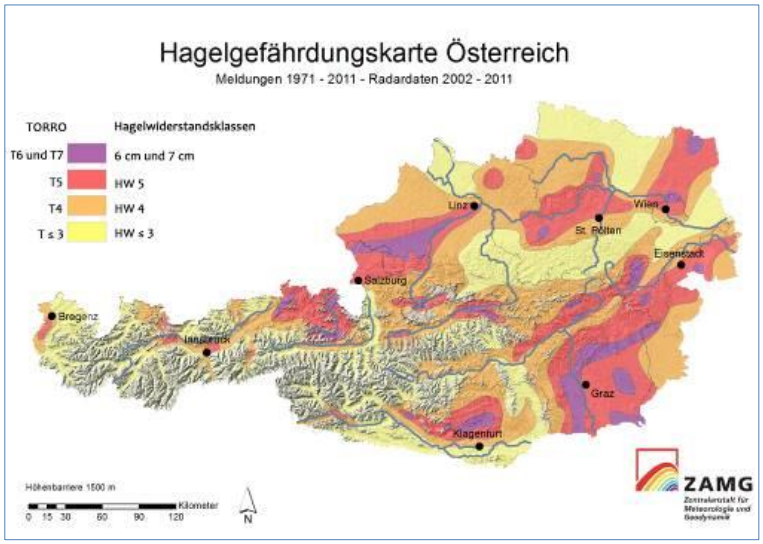

Figure 17 Hail hazard map Austria (Note: records data from 30 years)

[1] average time or an estimated average time between events

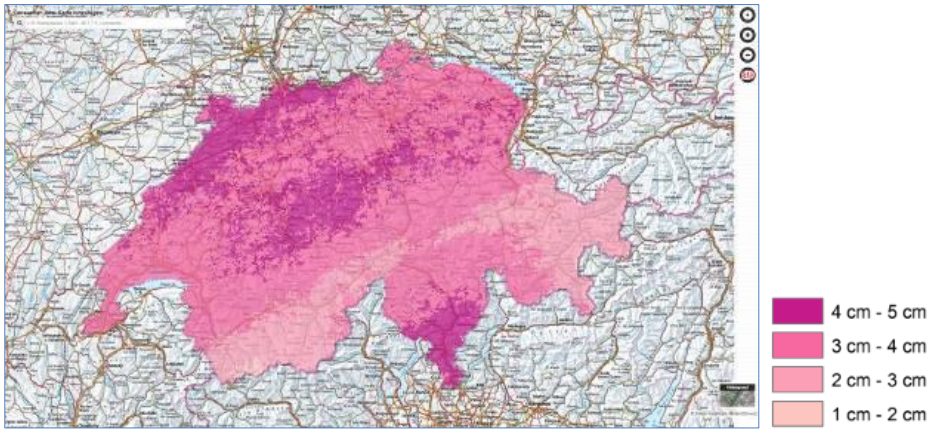

Figure 18 Hail hazards mapp Switzerland for a return period of 50 years (source: vkf = Vereinigung kantonaler Feuerversicherung/Association of Canton Fire Insurances)

5.2 Protection objectives and strategy

In order to avoid high damage and possible impairment of operational processes in the event of a hailstorm, buildings, and equipment, including the finished products, should be protected against hailstorms and possible consequential damage.

In the event of an extreme hailstorm, for example with very large hailstones, the structural and other stationary protective measures can fail. In this case, an emergency plan should be drawn up, implemented, and updated, in order to limit damage, loss and impairments to the operational processes.

5.3 Protective measures

For effective hail protection, building materials, components and equipment with proven hail resistance should be used. Sensitive components should be protected with e.g., protective covers, grilles, and nets. These protection measures must be regularly serviced and inspected in accordance with manufacturer's instructions and, if damage is detected, immediately repaired, or replaced.

Appropriate maintenance (maintenance, inspection, repair, and renewal) must be ensured by organisational measures.

Hail damage can be further minimized by the attentive pursuit of weather warning and timely removal of mobile properties, e.g., vehicles and materials and products parked outside, or stationary and mobile systems, e.g., sun protection devices. These measures must be defined in advance in accordance with the assessment of local hail hazards and within the framework of an operational emergency plan and, if necessary, practised regularly.

5.4 Interactions of protective measures

Measures in a hail protection concept should always be coordinated in order to prevent mutual interference and to maintain the planned protection.

6 Hail resistance

The extent of hail damage is essentially determined by the size of the hailstones, the influence of wind and the sensitivity of the material concerned. With the diameter of hailstones, the impact energy increases quadratically and the damaging effect increases accordingly. However, the shape, weight, and hardness of hailstones as well as the density of the hailstone also have an influence.

6.1 Classification

The hail resistance of building materials and components is classified on the basis of respective positive hail tests. The classified hail resistance is specified in the approval document.

6.2 Testing

The hail resistance test is carried out with projectiles of clear ice stone with a defined mass and impact velocity by an approved testing laboratory. The projectiles are repeatedly shot at an angle of 45° and 90° at the building material or component to be tested, whereby a standardised hail impact is simulated in the laboratory.

Figure 19 A testing facility (source: GDV)

The general and type-specific test regulations for building material and component are published on the hail register website (see also section 6.3). They are updated regularly and according to practical application experience. For normatively regulated products and systems, alternative tests may be used. If there are international test standards existing, these are dependent on the comparability considered at the hail register website.

Results from hail tests are summarised and evaluated in a test report, which forms the basis for classification (see section 6.1).

The quality of hail testing, including reproducibility and repeatability, is to be ensured by the approval of testing laboratories, which also includes participation in round robin tests and regular exchange of experience. Approved testing laboratories in Switzerland, Austria and Germany are listed on the hail register website.

6.3 Hail register

In the hail register, which is currently implemented in Switzerland and Austria as well as accepted in Germany, products such as building materials for roof components and facades, solar modules and their proven hail resistance are listed publicly accessible. The classification of tested building materials and components are carried out according to published test regulations and within the framework of the hail register.

With a country-cross landing page www.hagelregister.com, interesting users will be directed to the available hail registers:

- Switzerland: http://www.hagelregister.ch
- Austria: http://www.hagelregister.at
- Germany: http://www.hagelregister.de

Information on hail resistance is available for products and systems of the following main groups:

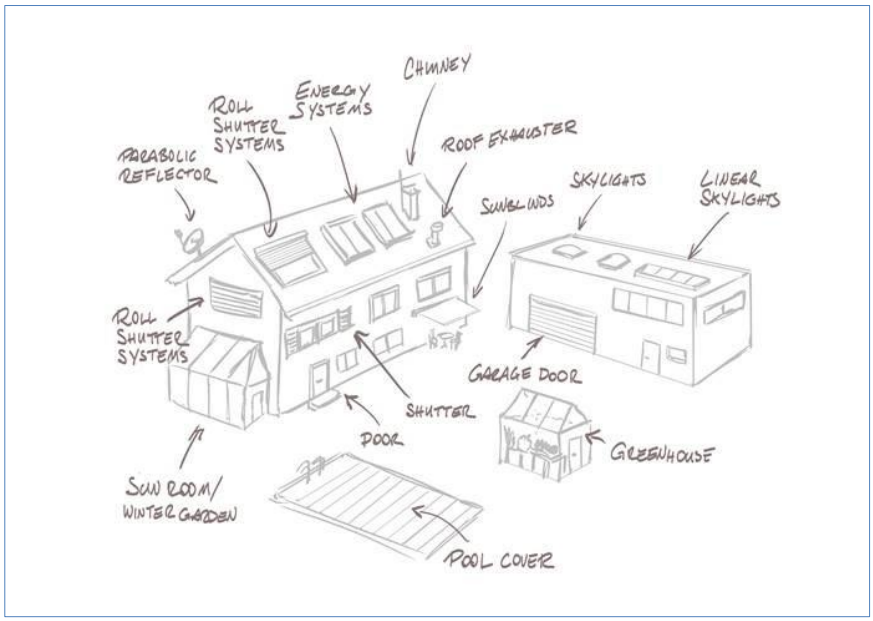

Figure 20 Illustration of exposured elements of buildings and facilities (sorce: EPZ)

Roof

- roof waterproofing membranes (material test/system test)
- shingles
- thin sheets
- fibre cement boards
- plastic sheets
- sky domes
- light band
- glazing
- brick
- concrete roof tiles
- PV modules and solar collectors
- sandwich panels
- liquid plastic sealing

Façade

- sheet metal profiles
- sandwich elements (sandwich panels)
- thin sheets
- fibre cement boards
- wood/wood-based materials
- plastic sheets
- plaster on external thermal insulation (ETICS)
- glazing

- mineral-bound panels
- roller shutter systems
- shutter
- brick
- shutter
- natural stone, clinker, and porcelain stoneware

Other

- swimming pool cover
- miscellaneous

7 Literature

Association of Cantonal Fire Insurance Companies (vkf)
Swiss Hail Register (HSR); VKF Test regulations

German Insurance Association
Building protection from hail; guideline on hazards, risks, protection concept and protective measures (VdS 6100)
VdS loss prevention publisher, www.vds.de

8 European guidelines

Fire

Guideline No	1:2015 F	-	Fire protection management system
Guideline No	2:2022 F	-	Panic & emergency exit devices
Guideline No	3:2011 F	-	Certification of thermographers
Guideline No	4:2022 F	-	Introduction to qualitative fire risk assessment
Guideline No	5:2016 F	-	Guidance signs, emergency lighting and general lighting
Guideline No	6:2021 F	-	Fire safety in care homes
Guideline No	7:2022 F	-	Safety distance between waste containers and buildings
Guideline No	8:2004 F	-	This guideline was withdrawn May 2022
Guideline No	9:2012 F	-	Fire safety in restaurants
Guideline No	10:2022 F	-	Smoke alarms in the home
Guideline No	11:2015 F	-	Recommended numbers of fire protection trained staff
Guideline No	12:2012 F	-	Fire safety basics for hot work operatives
Guideline No	13:2015 F	-	Fire protection documentation
Guideline No	14:2019 F	-	Fire protection in information technology facilities
Guideline No	15:2022 F	-	Fire safety in guest harbours and marinas
Guideline No	16:2016 F	-	Fire protection in offices
Guideline No	17:2015 F	-	Fire safety in farm buildings
Guideline No	18:2022 F	-	Fire protection on chemical manufacturing sites
Guideline No	19:2009 F	-	Fire safety engineering concerning evacuation from buildings
Guideline No	20:2022 F	-	Fire safety in camping sites
Guideline No	21:2012 F	-	Fire prevention on construction sites
Guideline No	22:2022 F	-	Wind turbines – Fire protection guideline
Guideline No	23:2010 F	-	Securing the operational readiness of fire control system
Guideline No	24:2016 F	-	Fire safe homes
Guideline No	25:2010 F	-	Emergency plan
Guideline No	26:2010 F	-	This guideline was withdrawn July 2021

Guideline No 27:2021 F - Fire safety in apartment buildings
Guideline No 28:2012 F - Fire safety in laboratories
Guideline No 29:2019 F - Protection of paintings: transports, exhibition, and storage
Guideline No 30:2021 F - Managing fire safety in historic buildings
Guideline No 31:2021 F - Protection against self-ignition end explosions in handling and storage of silage and fodder in farms
Guideline No 32:2014 F - Treatment and storage of waste and combustible secondary raw-materials
Guideline No 33:2015 F - Evacuation of people with disabilities
Guideline No 34:2015 F - Fire safety measures with emergency power supply
Guideline No 35:2015 F - Fire safety in warehouses
Guideline No 36:2017 F - Fire prevention in large tents
Guideline No 37:2018 F - Photovoltaic systems: recommendations on loss prevention
Guideline No 38:2022 F - Fire safety recommendations for short-term rental accommodations
Guideline No 39:2021 F - Fire safety in schools
Guideline No 40:2022 F - Procedure to certify CFPA-E Fire Safety Specialists in building design

Natural hazards

Guideline No 1:2012 N - Protection against flood
Guideline No 2:2013 N - Business resilience – An introduction to protecting your business
Guideline No 3:2013 N - Protection of buildings against wind damage
Guideline No 4:2013 N - Lighting protection
Guideline No 5:2020 N - Managing heavy snow loads on roofs
Guideline No 6:2016 N - Forest fires
Guideline No 7:2022 N - Demountable / Mobile flood protection systems
Guideline No 8:2022 N - Ensuring supplies of firefighting water in extreme weather conditions
Guideline No 9:2022 N - Protection against hail damage

Security

Guideline No 1:2022 S - Arson document
Guideline No 2:2010 S - Protection of empty buildings
Guideline No 3:2010 S - Security systems for empty buildings
Guideline No 4:2010 S - Guidance on keyholder selections and duties
Guideline No 5:2022 S - Security guidelines for museums and showrooms
Guideline No 6:2014 S - Security guidelines emergency exit doors in non-residential premises
Guideline No 7:2016 S - Developing evacuation and salvage plans for works of art and heritage buildings
Guideline No 8:2016 S - Security in schools
Guideline No 9:2016 S - Recommendation for the control of metal theft
Guideline No 10:2016 S - Protection of business intelligence
Guideline No 11:2018 S - Cyber security for small and medium-sized enterprises

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