

Natural Catastrophes

Engineering and construction solutions for the prevention of potential damage to buildings due to hail, rain, wind and snow

Abstract

The main goal of this thesis is to find, show and solve problems in which meteorological happenings have damaged buildings. The first part of the thesis will discuss the connection between the fluctuation in climate and the increase in insurance payments over the past two decades.

In order to obtain a better understanding of how and where buildings were damaged, 300 houses in Upper Austria were inspected and rated concerning their vulnerability due to changes in weather conditions in terms of more extreme events. Resistance to wind storms, hail, snow and rain were carefully analyzed. Relating to the lack of prior analyses of this type, 1.150 claim files of an Upper Austrian insurance company were scouted during this study. The main focus of this work was to determine where the costs caused by natural events came from and how high these amounts were in relation to the area of the building affected.

Concerning hail, the study discusses the comparison between frequency and intensity of happenings that occurred in Austria. As a result of this analysis, the costs that occur through hail damage at houses roughly can be connected to the size of hailstorm that affected the damage. Hail resistance of different materials still can't be proven through this, but a slight tendency about materials and its hailresistance could be found and is shown in this thesis.

The conclusion will discuss any questionable areas within the studies. These points have been separately described followed by solutions for preventive steps and further explanation.

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Hail-simulation-gun

The IGS – Institut für geprüfte Sicherheit has a study conducted to figure which meteorological happenings like- hail, rain, wind and snowfall- are damaging buildings most. To see where and how buildings were damaged, 300 houses in Upper Austria were inspected by the IGS for this study after natural catastrophes. As a short conclusion and a major point that can be shown in the case study it is outstanding that almost a third of the damage in total goes back to hail.

To get a better understanding for how house-shelling materials react to high dynamic loads hailstones create, the IGS in a first step built a hail-simulation-gun, which allows to shoot ice-balls on facade- and roofing materials.

A second step that is in progress and possible to be launched by April 2012 is, that the ZAMG (ZentralAnstalt für Meteorologie- the number one meteorological institute in Austria) is working on a hail hazard map. This map will show the expected size of hailstones that may occur in the next years, specific for different areas. The map will be covering Austria, like the already existing hazard maps for snow and wind do.

If this step is taken, the third step will be, to inform people to use the right materials for the zone they are building at. So if a house is build in a higher or endangered risk zone, it will be important that they use materials that are proven to resist the expected occurring hail.

As a really good example Switzerland has to be mentioned, because there is a hazard map for hail existing already.

Together with the Swiss colleagues the IGS is monitoring the swiss-austrian hail protection register which is located online and accessible to everyone. This register shows the tested materials with the specific hail resistance. So everybody, starting out at, Architects and builders all the way down to owners of buildings, are able compare, products in terms of hail resistance. In order to that it gives them the necessary tool to find materials which sustain expected hail at their location.

The following text is a short summary and overview about how the hail-simulation gun operates, in terms of, how products are classified. If further information is necessary there is also a contact address at the end.

Target group:

Any company which would like to test their products in relation of hail resistance.

Facts:

Product classification - possibility to get registered in the hail protection register

Shoot test in accordance with the Swiss test requirements

Classification accordance to HW (hail resistance)



Facts of the hail machine:

Hardware: operating pressure-0,2- 4,0 bar (boost pressure)
Builders: Prototype made by IGS and partners all over Austria

Projectile characteristics:

Bullet diameter: 30-70 mm
Material: ice
Temperature: -17 till -23° degrees
Other: free of cracks, transparent

Test set:

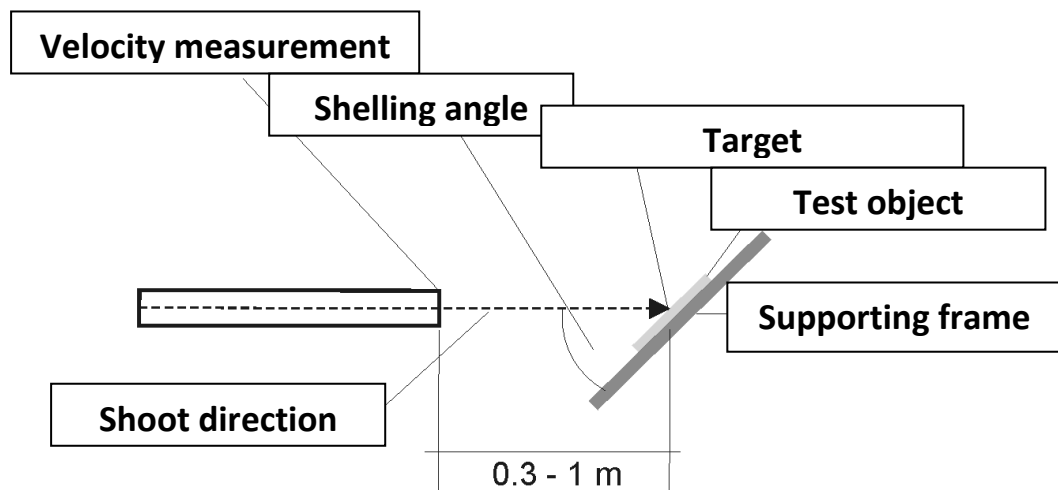
Shelling angles

Facades: 45°
Roof products 90°
Test specimen size: approx. 1.0 m x 1.0 m
Fixing at the test frame: according to agreement approval, realistically as possible

Running the test:

We are able to shoot laboratory made ice balls up to a diameter of 70mm, pneumatic with a striking speed up to 140 km/h at the test object. This velocity corresponds to the natural fall velocity of hailstones.

Why up to 70mm? Because 70mm represents currently the size of hail which occurred in Austria so far.



Test velocities are measured by optical lasers. According to the mass of the ice ball and the velocities the impact energy (joule) occurring at the tested object is determined.



The classification:

In general it has to be mentioned that by now there exist 28 specific testing regulations for every different products. This regulations show how the test has to be held. Further the regulations describe the necessary component functions and in order to that, in terms of damage the conclusion shows, whether the proven component is valid and intact or damaged after the testing.

Due to the fact, that the tested objects in reality have to fulfill several functions, it is necessary, that this is considered in the classification. In fact this means, that the classification criteria are different if a roofing shingle is proven, or a dormer.

The following component functions are required in the test specifications:

Water tightness	The component protects against ingress of water.
Light transmission	The component allows the transmission of light.
Light shielding	The component protects from light.
Mechanics:	The component has a physical-mechanical function.
Aesthetic:	The component has an aesthetic function.

The test report describes all the necessary specifications and shows the energy where the tested object is free of failure.

Why classification

The test is a standardized procedure, based on existing Swiss requirements. The classifications have to be uniformly and reproducibly perform on the highest quality level. All the single component functions are tested as realistic as possible. Each of the measurement process is logged and documented electronically.

Leading factors for the stress components during hail storms are the ice balls size, impact velocity and the angle the ice ball hits the shelling. With the results of the audit and the product classification, the producer may advertise his products and making reference to the hail protection register.

The hail protection register

In the hail protection register are all components transparent, standardized and comparable published. Every consumer and architect is having an objective comparison of resistance of every



single component in relation of hail and is able to choose them individually as they are needed and useful.

Test your products

The test will be held at IBS – Institut für Brandschutztechnik und Sicherheitsforschung, Petzoldstraße 45, 4017 Linz

The components are tested directly in our test hall by our experts, which can also be accompanied by the client.



Non- tentative offer

It will be our pleasure to put together a non- tentative offer for you, to test your products.

Contact details

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