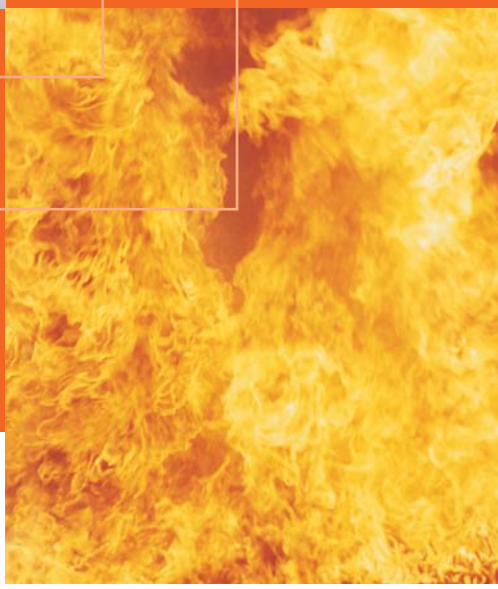
hebel

Preventive explosion and fire protection using HEBEL components



Xella

Be on the safe side with aerated concrete

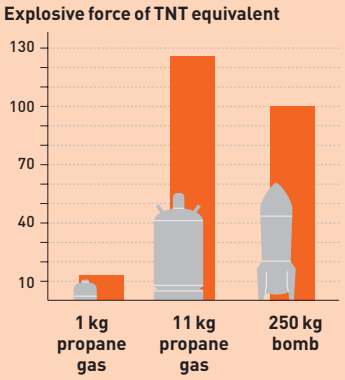
Structural fire protection is laid down in national building regulations. This is generally just in the form of minimum requirements.

The residents of a small German town will remember the fire engine sirens, sounds of detonation and the smell of fire from one night in February 2006 for a long time. A warehouse of a forwarding agency was ablaze, and two natural gas tanks next to the building exploded due to the effects of heat. The warehouse, in which medical accessories and toys were stored, was totally destroyed, along with the associated office complex and an adjacent flat.

April 2006: At a fire in a West German DIY store, the fire service was unable to save the store or the adjacent garden centre – although they arrived just seven minutes after the alarm was raised. By this time, the building was ablaze. Silver lining: The fire fighters were, however, able to prevent the explosion of about 100 propane gas cylinders stored by carrying them outside. The actual consequences of this action become clear when you see the explosive force of standard propane cylinders. They can often release more energy than a 250 kg bomb.

The fire fighters were therefore able in this case to avert a really serious catastrophe. In order to be able to prevent such a disaster, they have to arrive at the scene early and take suitable measures. In the case of the fire mentioned at the start, these conditions were obviously not met. The fire broke out shortly after midnight and was able to develop undiscovered – at least for some time.

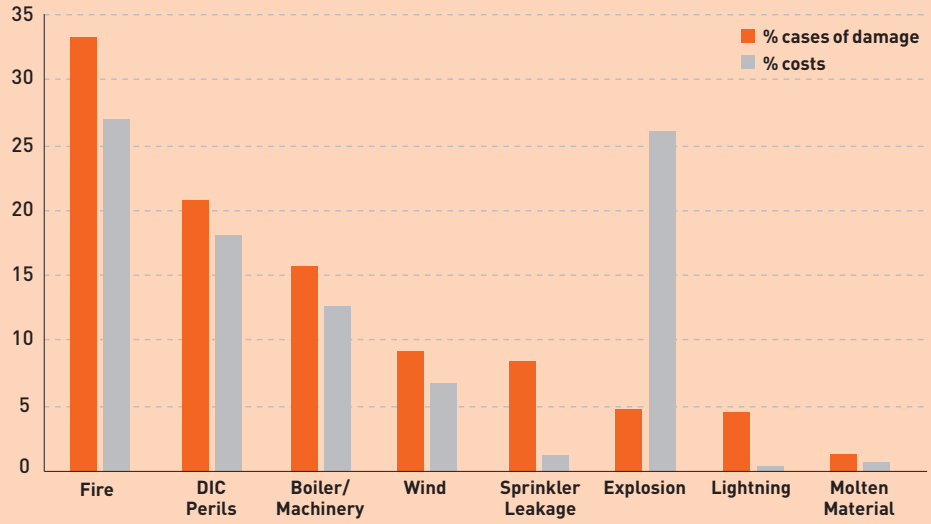
Explosive forces compared



Explosive propane gas cylinders: The strength of an explosion is generally given as a TNT equivalent, a unit of measurement in which the energy released in an explosion is compared with the explosive force of trinitrotoluol (TNT). According to this, one kilogram of propane gas has the equivalent explosive force of 11.61 kg of TNT.

The most common propane gas containers are 11 kg cylinders, which are used, for example, by roofers. If one such cylinder exploded, then the energy released would be equivalent to 130 kg of TNT. As a comparison: A 250 kg bomb, as used in the Second World War, had an explosive force of about 100 kg TNT.

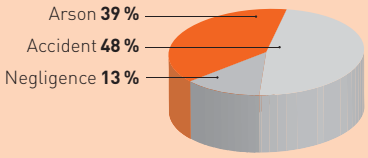
Frequency of different commercial cases of damage and the level of insurance payouts



Source: Industrial Risk Insurers Society, The Sentinal (Vol.I, No. 3)

The level of operational risk through fires and explosions is generally underestimated. In industrial businesses, the greatest amount of damage occurs as a result of fire and explosions. In addition to fire, as the most frequent cause of damage with the highest amount of damage, explosions, in spite of a lower frequency of occurrence, result in costs that are almost as high.

Causes of Fire



Source: Berlin Statistical Service (D)

Underestimated risk: Stored propane gas cylinders can release enormous amounts of energy in the case of fire.

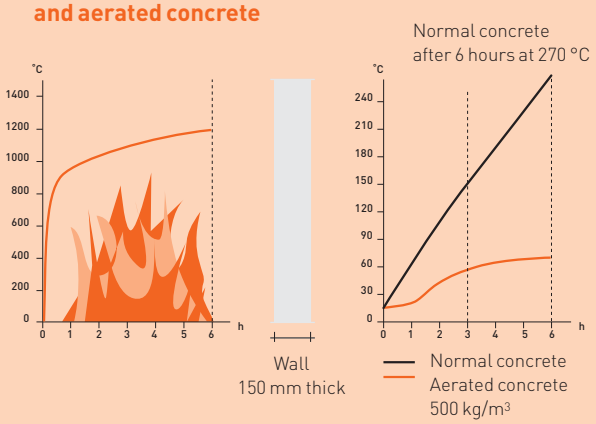
Early reporting of a fire to the fire service is one side of the coin - preventive structural fire protection is the other. Structural installations must be arranged, set up and maintained in such a way that the formation of fires is prevented, that fire and smoke cannot spread and that effective fire extinguishing is possible. The importance of these provisions is shown in numerous national building regulations that lay down minimum requirements. For industrial companies, it's generally worse – much worse. Particularly for logistics or production companies with large warehouses, centralized stores or production halls, it is critical to protect stored goods and additionally to ensure continued operation. A complete shut-down can have catastrophic economic effects.

The consequences of a fire and the resultant interruption of business can indeed be alleviated by suitable insurance. Customers, however, who are forced to change to other companies, are generally lost. Whether they will return after the fire damage is repaired is uncertain. In addition, there is the loss of image and market share.

Sections of buildings not directly affected by fire, and goods stored there, must therefore be cut off to protect them from fire, smoke, gas and heat. Only in this way can the building remain functional – at least in part – after a fire.

Aerated concrete meets all legal fire protection requirements across Europe

Comparison of thermal insulation of concrete and aerated concrete



The great thermal insulation of walls made from aerated concrete protects against spontaneous ignition when storing highly flammable goods.

In the case of a devastating gas explosion in July 2004 close to a Belgian city, 15 people died and 200 people were injured. The explosion occurred after builders inadvertently struck a hole in a gas pipeline. 100 metre high flames scorched vehicles that were parked several hundred metres away. An adjacent production building made from aerated concrete withstood both the flames and the pressure of the explosion.

The requirements set by European legislators regarding the combustion behaviour of structural materials are laid down in EN 13 501. "Because approval of the construction of a complete building lies within the responsibility of individual member states, the level of structural fire protection in European countries varies widely," explained Professor Ulrich Schneider, Manager of the Centre of Building Materials Research, Materials Technology and Fire Protection at the Technical University in Vienna. This means that legal fire safety requirements can vary enormously in European logistics centres, depending on their location.

With more than 360 minutes of fire resistance, aerated concrete offers the greatest safety in the case of fire.

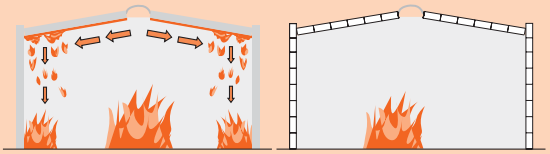
A comprehensive fire protection concept for logistics companies and distribution centres always consists of the efficient interaction of different, mutually independent components. The legal requirements regarding fire protection vary from country to country. In general, one must be aware that building materials can make a significant contribution to a fire. For the sake of clarity, the inspections to which building materials are subject before licensing are uniformly regulated within Europe.

Aerated concrete is a class A1 non-flammable material and meets all the requirements of standard fire resistance classes. HEBEL building components far exceed even these. The material resists fire for 360 minutes without any functional impairment. Materials ranked in class A1 are non-flammable materials under European standards (EN 13 501-1). Material class A1 is the only one for which a new test procedure is not required on the introduction of the new European standard.

For internationally active logistics companies, this classification means that with aerated concrete they will be on the safe side regarding fire safety in Europe, America and Asia – in short, worldwide. This also applies for the protection of people and goods – important from a business management point of view.

With the same wall thickness, walls made from aerated concrete protect against fire and heat significantly longer than walls made from concrete. The great thermal insulation of aerated concrete means low temperatures on the side facing away from the fire.

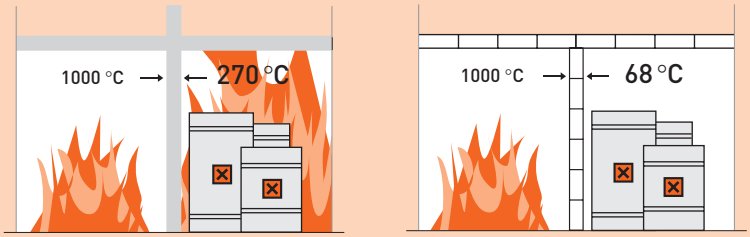
Prevention of secondary fires



Other building materials: Spread of fire by melting and burning material dripping down.

Aerated concrete does not melt in the case of fire and does not drip burning material.

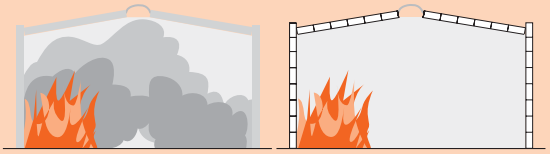
Heat penetration in the case of fire after approx. 6 hours



Concrete, 150 mm wall thickness

Aerated concrete, 150 mm wall thickness

No smoke generation by the building material



Other building materials: Often heavy smoke emissions.

In the case of fire, aerated concrete does not produce any smoke or toxic gases.

In components made from aerated concrete, no cracks or gaps form, even under great heat, and walls and roofs remain tight against smoke and gas. Practical experiments have shown that walls made from aerated concrete not only seal off fires effectively but their great thermal insulation also dampens the temperature difference between the two sides of a wall.

Even in the case of fires that have burned for many hours, the heat penetration through aerated concrete is so low that the temperature of the side facing away from the fire hardly exceeds 60 °C. People and goods located here are thus not endangered – explosive materials are not subjected to dangerous heat.

Aerated concrete does not burn or drip in the case of fire, and neither does it produce smoke or toxic gases.

Six hours of fire resistance: A safe basis for large-scale building work

The significance of structural fire protection increases with the size of the building.

Fire tests according to current standards have proven that HEBEL components can withstand a fire by far longer than most other materials.

For many years, fire walls made from HEBEL components have proven themselves in logistics companies and distribution centres. The extent to which they actually provide security was shown by a fire behaviour test at a German material testing institute for the construction industry (Institute of Building Materials, Solid Construction and Fire Protection at the Technical University of Braunschweig):

After six hours (360 minutes), the test was ended because the wall withstood the fire stress on one side without its stability being impaired.

With the increasing size of centralised stores and logistics centres, structural fire protection concepts become more demanding. Intelligent separation of fire sections, fire-fighting sprinkler technology and a material that seals off adjacent rooms from the heat of fire for longer than other materials will all prevent the spread of fire.

Fire walls made from HEBEL aerated concrete

In the case of the NIKE central warehouse in Laakdal, Belgium, which is shown, HEBEL fire walls are not only used for sealing off areas. They also separate functional areas as part of the whole building design. External walls made from HEBEL components provide maximum safety by preventing flashover from outside the building.

Consistent separation or delimitation of fire sections using aerated concrete walls will limit damage in the case of fire.

Professor Ulrich Schneider, Manager of the Centre of Building Materials Research, Materials Technology and Fire Protection at the Technical University in Vienna, observed, "In Europe, there is a tendency towards larger areas, of between 20,000 and 60,000 square metres."

Jörg Schröder, Managing Director of ProLogis Deutschland: "Properties must always be economical and practical for us, and naturally also for the customer, which means that building costs, ancillary costs and the operative business of the customer must be optimised." ProLogis maintains, owns and manages over 2,340 logistical and commercial facilities in North America, Europe and Asia.

In addition to the conditions under building regulations, the conditions in each country regarding urban development and planning law must be taken into consideration. In Europe, a tendency towards larger areas of up to 60,000 square metres and over can be seen. The logistics sector is profiting from these dimensions, because the larger a hall is, the more economically it can be set up and the more flexibly it can be used.

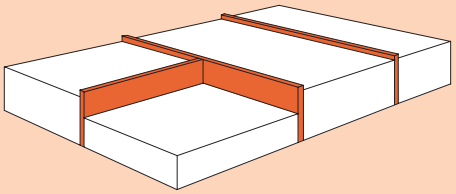
In the planning of buildings of this size, fire prevention plays an enormous role. This also includes structural fire protection measures in addition to measures involving organisation and installation technology. Then it's not just a single wall, or a single building section that has to meet the demands of fire protection, but the whole building. The behaviour of the materials and components in the case of fire is also of greater significance, for example with reference to load bearing capacities or the development of smoke.

These tasks can be easily and convincingly solved using HEBEL components. A non-flammable building material, flexible components and fire-safe details: they are all easily incorporated in any building concept – and make it safe.

Solid constructions mean lower insurance premiums

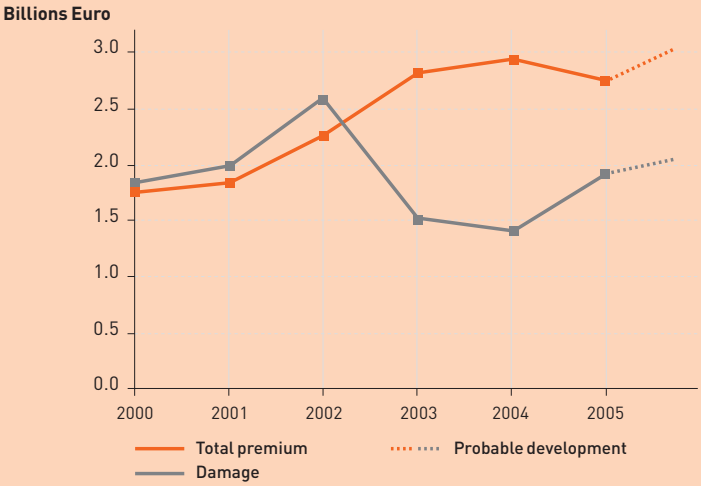
Fires cannot be ruled out 100%. Insurance policies, however, reward particularly efficient fire protection concepts.

Separation of fire sections



Sensibly arranged fire walls are demanded by insurance companies and guarantee lower premiums. Separable areas could be the warehouse, production or administration areas.

Development in premium costs for insurance



Source: GDV sector statistics for industry and fire, FBU, EC and all-risks, accumulated 2000-2005

The cost of insurance premiums has risen in recent years – also as a result of the events of 11 September 2001. This is even though the absolute number of cases of damage has fallen. Further increases are likely. It is all the more worthwhile to reduce your own risk and thus your own insurance contributions through structural measures. As an example, this could be spatial separation of areas, or a sprinkler installation.

Just-in-time production, outsourcing of warehouse goods and Internet trade have drastically changed the demand for the availability of all types of goods in recent years. The number and size of distribution halls have grown, the value of the goods in them has increased continually and can easily reach € 100,000 per square meter. Accordingly, the risks have also increased, which in turn is seen in the costs for insurance against fire and interruption of business.

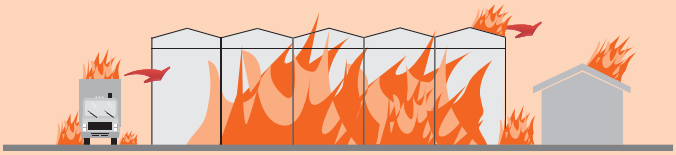
In calculating premiums, insurance companies focus on the warehouse goods and their packaging, the existing technical fire protection installed (including sprinklers, smoke and heat extraction units) and the type of construction, amongst other things. "There are three building classes for this in Germany. These are the discountable, the neutral and the surcharge classes." Dirk Tabel, fire protection engineer at the insurance company Helvetia Deutschland, explains. "Solid constructions can be ranked in the discount class and steel-sandwich elements in the surcharge class."

In addition, the size of the fire section is considered. "The smaller the section, the lower the premium." The latter now goes against the needs of the logistics sector, but it is possible to be as flexible as possible and yet reduce insurance premiums through the use of a comprehensive fire protection concept, the use of aerated concrete and an intelligent arrangement of fire sections. Ideally, this could be in the order of ten percent - a cost reduction which could mean a five-figure sum saved each year for each warehouse.

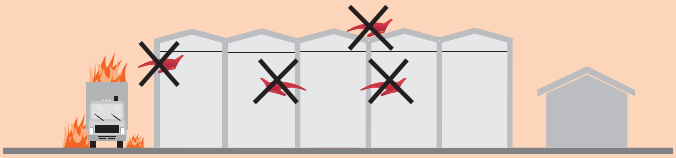
The risk potential of explosive materials should not be underrated.

After an explosion in a gas pipe in Belgium, vehicles several hundred metres away also went up in flames. However, the fire was not able to spread to adjacent buildings. An aerated concrete external wall offered safe protection from the penetration of fire and heat.

The spread of fire without walls and roofs made from HEBEL aerated concrete



HEBEL aerated concrete protects against the spread of fire



Walls and roofs made from aerated concrete prevent the spread of fire within buildings and the spread of fire over roofs. In addition, external walls made from aerated concrete have the same duration of fire resistance from the start as fire walls do. This gives also an effective protection against penetration from fires outside the building.

Damages caused through an interruption in business are about three times as high as the actual material damage.

"In calculating the premium, even the roof plays a great role," explained Dirk Tabel, "because secondary fires can develop through burning components dripping or falling." In addition, there is the risk that the flames may spread to other parts of the building or adjacent houses via the roof. This risk can be prevented if the non-flammable building material aerated concrete is used for the roof, as well as the walls.

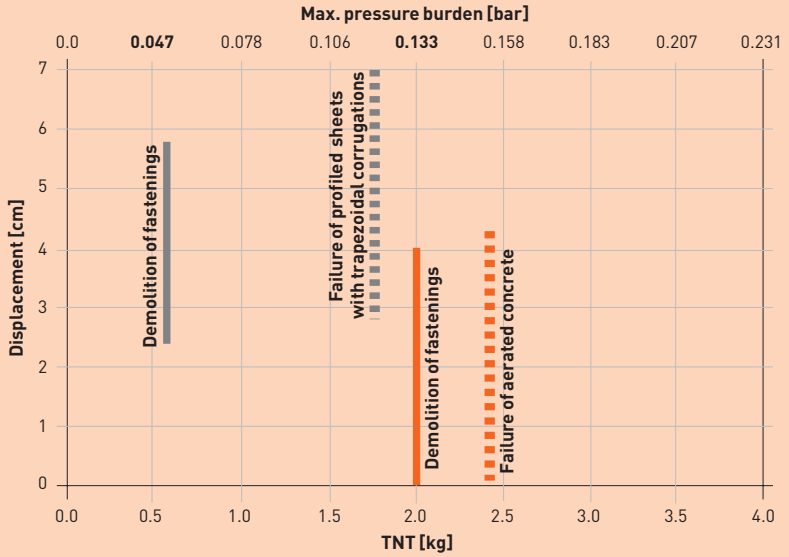
Explosive materials hold additional potential risk. This includes not only gas cylinders but also paints and varnishes, cigarette lighters and spray canisters. Blast waves generated by explosions produce an enormous destructive force and also endanger adjacent buildings. Splinter and other pieces of material hurled around by a detonation can cause further damages.

The forces that occur in an explosion and can have an effect on the building have been investigated by the Institute for Solid Construction and Building Materials Technology at the University of Karlsruhe in a "Simulated explosion of light clad hall constructions."

Being a solid material, HEBEL aerated concrete compensates the emerging pressure load and provides extra safety in the case of explosions compared to typical light weight building materials.

Aerated concrete reduces pressure load in the case of explosions

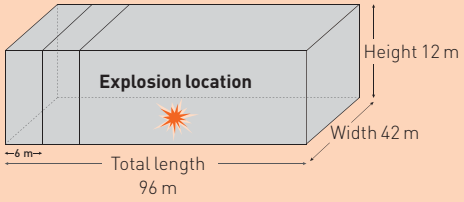
Comparison of failure loads for aerated concrete and sheets with trapezoidal corrugations (simulated explosion)



Source: Scientific paper "Simulated explosion in light clad hall constructions", 2006

Taking into consideration different failure types, the effects of an explosion in an enclosed hall construction were calculated. The load was applied in a numerical model over a time-load function to a control volume. "It is apparent that the failure in the example hall under consideration always occurred in the fastenings and that a construction clad more solidly but still classified as light (aerated concrete) reacts in a more favourable manner under an explosive load within the building than a hall made from sheets with trapezoidal corrugations." (M. Larcher, N. Herrmann, L. Stempniewski)

Model geometry of halls investigated (simulated explosion)



"As a model, we decided on a typical warehouse or logistical building with a length of 96 m, a width of 42 m and a height of 12 m, and an internal supporting structure made from 60 x 120 centimetre thick profiled steel pillars." Prof. Dr.-Ing. Lothar Stempniewski.

A solid hall made from aerated concrete reacts more favourably under an explosive load inside the building than a hall made from profiled sheets with trapezoidal corrugations.

In a professional article, the Institute for Solid Construction and Building Materials Technology at the University of Karlsruhe has investigated the failure loads for aerated concrete and sheets with trapezoidal corrugation. In order to be able to compare the effects of an explosion on building constructions, the Institute selected aerated concrete and sheets with trapezoidal corrugations as light weight materials for cladding the building.

The simulated explosion showed that in the halls under consideration, failure always occurred in the fastenings. Furthermore, the aerated concrete hall behaved significantly better under explosive stress than the construction using steel sheets with trapezoidal corrugations.

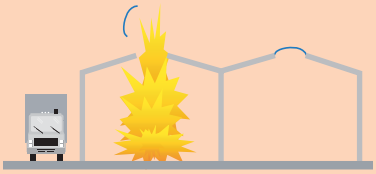
Building components made from aerated concrete are able to absorb more energy in the short term due to their greater weight. They transfer the forces of the explosion in a delayed and more balanced manner to the fastenings. The hall made from steel sheets with trapezoidal corrugations suffered significantly greater deformations. In the investigation, the aerated concrete cladding compared to sheets with trapezoidal corrugations withstood an explosion about four times as forceful.

Total protection from fires and explosions

Solid roof and wall panels with explosion relief rooflights cushion explosions. Adjacent buildings are protected.

Typical image: After a large fire, a hall made from aerated concrete rises almost unscathed from the rubble. The rest of the factory was completely destroyed by the flames.

Explosion protection using aerated concrete compared to sheet constructions



Solid roof and wall panels with explosion relief rooflights cushion explosions. Adjacent buildings are protected.

Light sheet constructions offer almost no resistance to explosions. Blast waves and burning material can spread unhindered.

Clad constructions made completely from aerated concrete for the external walls and roof offer an efficient and economical combination of preventive fire and explosion protection. The fire-safe roof made from aerated concrete is equipped with rooflights that function as explosion hatches.

In the case of an explosion, pressure is relieved through the hatches; parts flying around are caught by the roof panels and the fire is checked by the walls and roof made from aerated concrete. If the whole building shell is made of aerated concrete, then the user of the logistics centre is on the safe side in the case of a fire or explosion in the building. Fire walls made from aerated concrete also prevent fires and explosions penetrating the building from outside or being able to adversely affect the stability of the building – a risk that is often underestimated.

In many cases, fire walls made from aerated concrete prevent not only the spreading of flames, but also offer the fire service a stable platform for extinguishing work. In further cases, this building material would have been able to contribute to the protection from enormous heat of external gas tanks and propane cylinders stored inside through its thermal insulation properties alone.

The high practical demands and numerous cases that, thanks to aerated concrete "are doing well again" show that when it comes to fire security, all roads lead to aerated concrete. The decision is even easier to make because, in addition to external security, it also provides many other positive structural and physical properties at no additional cost, and the components are also easy to install.

An impressive example of the properties of aerated concrete is provided by a fire that broke out on 31 August 2005 in a German paint factory. Here a technical defect in a warehouse for paints, varnishes and tanks of chemicals triggered a fire that spread not only to the production buildings of the paint factory but also to the production hall of an adjacent textile company. The extinguishing work was delayed by the explosion of several tanks of chemicals and was additionally greatly hindered by components flying around and the development of smoke. The result: the warehouse was completely destroyed and the production hall of the paint factory was almost completely destroyed. Only the hazardous goods store and the walls of the administration building were spared. Both of these were made from aerated concrete.

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