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DESCRIPTION

[0001] The invention relates to a system for fire protection of a structural element in accordance with the introduction to claim 1. The invention also relates a method of providing such a fire protection system. From NL-A-8301318 a system according to the preamble of claim 1 is known.

[0002] In building areas with access for people it is often a requirement that walls and other structural elements have a hard and point impact resistant surface. This is often achieved by using heavy walls made of e.g. concrete or by using light walls made of e.g. steel profiles provided with gypsum plates. Some buildings are based on a load bearing steel structure comprising beams and columns made of steel. For safety reasons the steel beams and columns must be protected against fire so that the structure can withstand a fire for e.g. 60, 90 or 120 minutes before the structure collapses. This fire protection can be achieved by enveloping the beams and columns with fire protection boards, e.g. mineral wool boards known under the name Conlit® which are produced by the applicant of this patent application. However, in areas with access for persons there is often a requirement for a hard and point impact resistant surface, which is not achievable with the mineral wool boards alone. Conventionally, fire protection of steel structures in this area is obtained by using hard fire protection boards based on vermiculite or cement. However, these products form a lot of dust when they are cut to the correct sizes, and they must therefore be cut outside the building and with protecting garment for the persons who work with them. Alternatively, it is known to provide fire protection of steel structures by means of three layers of gypsum plates, which, however, requires a lot of cutting and adjusting to size. Thus, these conventional ways of providing a fire protection with a hard and point impact resistant surface are relatively expensive, so there is a need for a new solution in this field.

[0003] It is therefore an object of the present invention to provide a new and less work requiring solution for obtaining a hard surface in relation to fire protection of a structural element.

[0004] This object is achieved by arranging the system for fire protection of a structural element as mentioned in claim 1 and by the method described in claim 6.

[0005] By arranging the system as stated in claim 1 is first of all achieved a solution that is cheaper than the known solutions, since cheaper materials can be used in the system and still provide a fire-protection system which satisfy regulatory fire protection standards for buildings, such as EN 13381 part 4.

[0006] By using fire protection boards made of mineral wool, preferably stone wool bonded by a binder, the dusting problem associated with vermiculite or cement based boards is eliminated which means that the boards can be cut and adjusted right at the site of the structural element. Instead of stone wool the mineral wool fire protection boards might be made of glass wool or a hybrid of stone and glass wool.

[0007] Preferably the mineral wool boards have a density of between 50 or 60 and 250 kg/m³, preferably between 90 and 200 kg/m³, and more preferably between 110 and 160 kg/m³. Mineral wool boards with these densities show excellent fire resistant properties and are sufficiently rigid to be easily handled and attached to the structure that need fire protection. In a presently particularly preferred embodiment boards of approx. 150 kg/m³ are being used.

[0008] The hard plates are preferably gypsum plates, preferably provided with a paper fleece on one or both sides. Such gypsum plates show excellent properties in relation to impact resistance, especially when they are supported on the rear side as it is the case in the invention where they are glued to the fire protection boards. The use of gypsum boards is particularly advantageous since the gypsum liberates water when being exposed to a fire.

[0009] The glue used in the system should be non-combustable and is preferably an adhesive that is based on cement. An adhesive of this type is made of inorganic material which is advantageous with resistance to fire and will therefore ensure a firm adhesion between the fire-protection boards of mineral wool and the hard plates, such as the gypsum plates so that this fire protection laminate structure is maintained during a fire and thereby prolongs its fire protective properties.

[0010] The invention can be used at various structural elements, but preferably the structural element is a part of a steel structure for a building, such as a steel beam or steel column. Alternatively, the structural element is a ventilation duct, a wall structure or the like. The structural elements may be beams or columns made of I- or H-shaped profiles.

[0011] The invention will be described in the following with reference to the drawings in which

Figure 1 shows a steel profile with a fire protection according to a first, basic embodiment of the invention,

Figure 2 shows a steel profile with a fire protection according to a second embodiment of the invention,

Figure 3 shows a steel profile with a fire protection according to a third embodiment of the invention, and

Figure 4 shows photograph of the invention used on a ventilation duct.

[0012] Figure 1 shows a steel profile 1 also known as a so-called H or I profile. Many buildings today comprise a bearing structure made of such steel profiles 1, where they often are arranged as horizontal beams or vertical columns. The steel profiles may of course also be inclined and the cross-section can differ from the H- or I-shape shown in Figure 1. Since the steel profiles constitute the bearing structure of the building it is important to protect them against fire, so that the building does not collapse too fast due to softening of the profiles caused by the heat of a fire. Generally, the fire protection should be able to prevent the building from collapsing before 60, 90 or 120 minutes, so that there is sufficient time for people to leave the building before it collapses.

[0013] The steel profile 1 comprises a centre beam 2 and two flanges 3 and 4. In order to fire protect the profile 1 fire protection boards 5 and 6 are attached to the flanges 3 and 4 by any known means. The fire protection boards 5 and 6 are preferably boards made of bonded mineral wool, e.g. stone wool boards known under the name Conlit® and produced by Rockwool® in thicknesses from 15 to 50 mm and with a density of approx. 120-150 kg/m³. In the shown example the fire protection boards 5 and 6 are arranged around a corner of the steel profile 1, and the interface between the fire protection boards at the corner is provided with glue 7. It should be understood that often the steel profile 1 is a free standing column and it will then be provided with fire protection boards 5 and 6 on all four sides (not shown) with all interfaces between the fire protection boards being glued together. This is a well-known way of attaching Conlit® fire boards to a steel profile by means of so-called Conlit® glue, which is a non-combustable adhesive based on water-glass and kaolin.

[0014] In stead of gluing the fire protection boards 5 and 6 to each other around the steel profile 1, they can be attached by mechanical means, e.g. by pins welded to the steel profile 1 and penetrating through the fire protection boards 5 and 6 (see Figure 4), and/or by hook-shaped fasteners for interconnecting the fire protection boards 5 and 6 at the corners where they meet. How the fire protection boards 5 and 6 are attached to the steel profile 1 is not important for the present invention.

[0015] If the fire protection boards 5 and 6 are made of mineral wool they conventionally have a density of between 120 and 150 kg/m³, which means that they are relatively rigid mineral wool products that have sufficient rigidity and strength to maintain a closed (or semi-closed) structure around the steel profile 1 even if they are exposed to high temperatures or small impacts.

[0016] In order to improve the resistance against point impact, two hard plates, preferably gypsum plates 8 and 9, are attached to the outer surfaces of the fire protection boards 5 and 6 by means of an adhesive 10 which preferably is a non-combustable adhesive based on cement, e.g. so-called Conlit® Cement glue. The two hard plates might be conventional gypsum plates, i.e. gypsum plates provided with a paper fleece on both sides.

[0017] Preferably the adhesive 10 is applied on the full outer surfaces of the fire protection boards 5 and 6, so that the gypsum plates 8 and 9 are fully adhered to the fire protection boards 5 and 6. This is particularly relevant for the gypsum plate 9 which covers the fire protection board 6 that spans freely between the two flanges 3 and 4 of the steel profile 1, since a full adherence contribute substantially to the rigidity and strength of the combined structure. As an example, it is found that a 25 mm thick Conlit® mineral fibre board was mounted onto a structure and covered with gypsum plates having a thickness of 13 mm would provide the same fire protection as a 40 mm thick stone wool panel and would satisfy the requirements specified in European standard ENV 13381-4.

[0018] In excess of providing a hard surface and a substantially improved resistance against point impact the gypsum plate 8 also covers the interface between the two fire protection boards 5 and 6. Thereby the inherently weakest point in the fire protection is covered and the risk of fail during a fire is further reduced.

[0019] The corner connection between the hard gypsum plates 8 and 9 may be covered by a corner profile 11 as shown in Figure 2, or the edges of the gypsum plates 8 and 9 can be interconnected by a connecting profile 12 with notches that receives the edges of the gypsum plates 8 and 9 as shown in Figure 3.

[0020] If the corner is provided with a corner profile 11 as shown in Figure 2 it is preferred to level out the surfaces by a thin layer of plaster and then subsequently apply a glass fleece and paint.

[0021] If the corner is provided with a connecting profile 12, e.g. an aluminium profile, as shown in Figure 3, it might be desired only to treat the surface of the plates 8 and 9 and leave the connecting profile 12 exposed as corner decoration and protection.

[0022] In case the hard plates 8 and 9 have finished edges a separate corner element can be omitted and the structure can be as shown in figure 1.

[0023] Figure 4 shows another example of a system according to the invention. In this case the structural element is a ventilation duct 13. The fire protection boards 5 and 6 made of mineral wool are attached to the ventilation duct 13 by pins 14 extending through the fire protection boards 5 and 6 and welded to the surface of the ventilation duct 13. At the outer end each pin 14 is provided with a disc 15 that retains the fire protection boards 5 and 6.

[0024] After the fire protection boards 5 and 6 have been mounted on the ventilation duct 13 a layer of adhesive 10 is applied to the outer surfaces of the fire protection boards 5 and 6. Then the hard plates, such as gypsum plates 8 and 9, are put onto the glued surfaces of the fire protection boards 5 and 6 and thereby attached fully thereto. Finally, a corner profile 11 is attached to the edges of the gypsum plates 8 and 9. The final finish might then be achieved by applying a thin layer of plaster, a glass fleece and typically also a finishing paint.

[0025] The invention has been described with reference to some preferred embodiments, but it is not restricted to these specific embodiments. The invention is particularly advantageous in relation to fire protection of free standing steel beams or columns and ventilation ducts, since this requires a lot of cutting and adjustment of both the fire protection boards and the hard plates. However, by the invention it is realised that other structural elements may be protected by a system according to the invention other than steel structures. Other types of structures may include structures made of wood, aluminium, concrete, etc.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- [NL8301318A \[0001\]](#)

P A T E N T K R A V

1. System til brandbeskyttelse af et strukturelt element (1), hvilket system omfatter:
5 én eller flere brandbeskyttelsesplader (5, 6),
 et middel, der fastgør brandbeskyttelsespladerne (5, 6) til det strukturelle element (1),
 én eller flere hårde plader (8, 9), der er fastgjort til en ydre overflade af brandbeskyttelsespladerne (5, 6),
 k e n d e t e g n e t ved at brandbeskyttelsespladerne (5, 6) er lavet af mineraluld,
10 og at den ene eller flere hårde plader (8, 9) er gipsplader, og at systemet omfatter et ikke-brandbart klæbemiddel (10), som fastgør de hårde plader (8, 9) til en ydre overflade af brandbeskyttelsespladerne (5, 6).
2. System ifølge krav 1, k e n d e t e g n e t ved at mineralulden er stenudd, der er bundet med et bindemiddel.
- 15 3. System ifølge krav 1 eller 2, k e n d e t e g n e t ved at brandbeskyttelsespladerne (5, 6) har en massefylde på mellem 50 eller 60 og 250 kg/m³, fortrinsvist mellem 90 og 200 kg/m³, og mere fortrinsvist mellem 110 og 160 kg/m³.
4. System ifølge et hvilket som helst af kravene 1-3, k e n d e t e g n e t ved at gipspladerne (8, 9) er forsynet med et ikke-vævet papirmateriale på én eller begge sider.
20
5. System ifølge et hvilket som helst af kravene 1-4, k e n d e t e g n e t ved at klæbemidlet (10) er baseret på cement.
6. Fremgangsmåde til at brandbeskytte et strukturelt element (1), hvilken fremgangsmåde omfatter trinene:
25 - at fastgøre én eller flere mineraluldsbrandbeskyttelsesplader (5, 6) til det strukturelle element (1),
 - at påføre et ikke-brandbart og uhærdet klæbemiddel (10) til mindst én ydre overflade af brandbeskyttelsespladerne (5, 6),
 - at fastgøre én eller flere gipsplader (8, 9) til det uhærdede klæbemiddel
30 (10), hvor gipspladerne (8, 9) har en hårdere overflade end brandbeskyttelsespladerne (5, 6),
 - at hærde klæbemidlet (10), således at gipspladerne (8, 9) bliver limet fast til brandbeskyttelsespladerne (5, 6).
7. Fremgangsmåde ifølge krav 6, hvor brandbeskyttelsespladerne (5, 6) fastgøres til
35 det strukturelle element (1) ved at påføre et klæbemiddel (7) til kontaktfladerne mellem tilstødende overflader og/eller kanter af brandbeskyttelsespladerne (5, 6).
8. Fremgangsmåde ifølge krav 6, hvor brandbeskyttelsespladerne (5, 6) fastgøres til det strukturelle element ved anvendelse af et mekanisk fastgørelsesmiddel.
9. Fremgangsmåde ifølge et hvilket som helst af kravene 6-8, hvor brandbeskyttelsespladerne (5, 6) omfatter stenudd, der er bundet af et bindemiddel.
40

10. Fremgangsmåde ifølge et hvilket som helst af kravene 6-9, hvor brandbeskyttelsespladerne (5, 6) har en massefylde på mellem 50 og 250 kg/m³, fortrinsvist mellem 90 og 200 kg/m³, og mere fortrinsvist mellem 110 og 160 kg/m³.
- 5 11. Fremgangsmåde ifølge et hvilket som helst af kravene 6-10, hvor gipspladerne (8,9) forsynes med et ikke-vævet papirmateriale på én eller begge sider.
12. Fremgangsmåde ifølge et hvilket som helst af kravene 6-11, hvor klæbemidlet (10) er baseret på cement.
13. Fremgangsmåde ifølge et hvilket som helst af kravene 6-12, hvor mindst to gipsplader (8,9) placeres, således at de mødes ved et hjørne, hvorefter ét eller flere 10 hjørneforstærkningsprofiler (12) fastgøres til tilstødningen af de to ydre overflader af de to tilstødende gipsplader (8, 9).
14. Fremgangsmåde ifølge et hvilket som helst af kravene 6-13, k e n d e t e g n e t ved at det strukturelle element (1) er en del af en stålstruktur til en bygning, såsom en stålbjælke eller en stålsøjle.
- 15 15. Fremgangsmåde ifølge krav 14, k e n d e t e g n e t ved at det strukturelle element (1) er en bærende struktur til bygningen, såsom et I- eller H-formet profil.
16. Fremgangsmåde ifølge et hvilket som helst af kravene 6-13, k e n d e t e g n e t ved at det strukturelle element (1) er en ventilationsskakt.
- 20 17. Fremgangsmåde ifølge et hvilket som helst af kravene 6-13, k e n d e t e g n e t ved at det strukturelle element (1) omfatter en plan overflade, såsom en vægstruktur, på hvilken brandbeskyttelsen fastgøres.

DRAWINGS

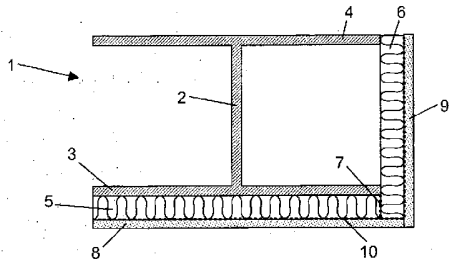


Figure 1

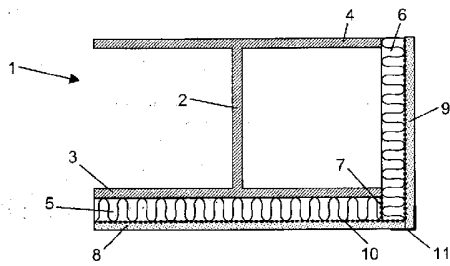


Figure 2

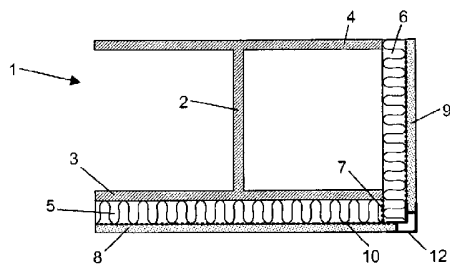


Figure 3

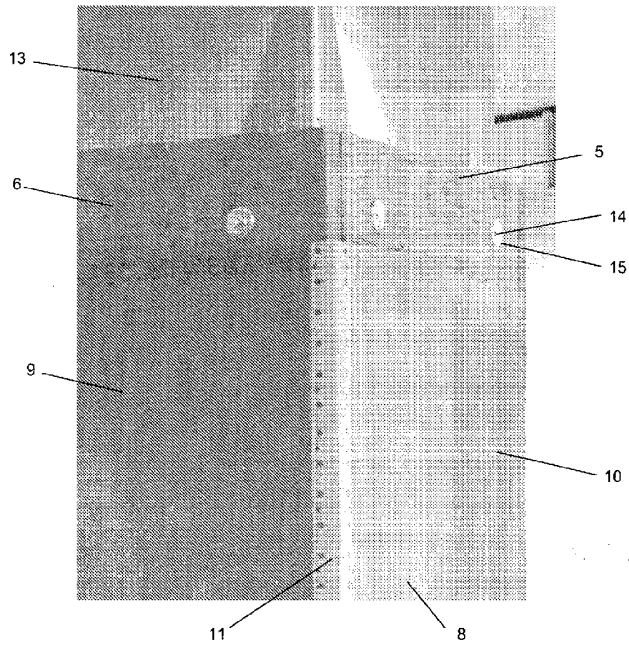


Figure 4