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DESCRIPTION

[0001] The present invention relates to a structural element for constructions, for example in the building or infrastructural (bridges, flyovers, etc.) field.

[0002] As is known, concrete has excellent resistance to compression but a very poor resistance to traction.

[0003] To obviate this drawback, in the prior art it is known to apply a pre-compression load in those zones of the concrete which during use are subjected to traction due to the weight thereof or due to external loads.

[0004] In the light of this, low-sliding steel tension rods are placed in traction inside a mould which is then filled with concrete. Thereafter, the tension rods are released and consequently the compression load of the tension rods is transferred to the concrete product.

[0005] However, this solution is not free from drawbacks:

- the transfer of the load between the tension rods and the concrete is achieved through the adhesion of the tension rods to the concrete; when a high compression of the concrete is required, stranded wires (having a plurality of wires wound in a spiral fashion) are used as tension rods; this introduces bending loads; further, the specific steel-concrete pressure can become high and impose constraints on the possibility of using light concretes which would have considerable benefits for the bending-stressed elements;
- the concrete has a certain tendency to shrinkage during the steps of setting and curing; this means that a certain percentage of the load imposed on the tension rods is lost as the structural element tends to shorten;
- the metal tension rods must be protected from corrosion and as a consequence they must be positioned sufficiently internally with respect to the external surface of the products; all the concrete positioned between the tension rods and the lower external surface has the effect of making the structure heavier, but does not collaborate at the structural level;
- in structures requiring a certain level of fire resistance, it is necessary to increase the distance between the lower surface of the concrete elements and the pre-compression tension rods, as the relaxation by viscous sliding of the steel becomes significant even with relatively modest increases in temperature;
- the use of pre-compression tension rods is normally an operation that is not susceptible to a high degree of automation, and is labour-intensive. This starts from the laying steps of the tension rods and continues up to the finishing steps of the product.

[0006] Another known solution instead requires the positioning of the tension rods in special

sheaths inside the mould. Following the curing of the concrete the tension rods located internally of the sheaths are placed under traction.

[0007] This solution has the advantage of being less sensitive to shrinkage than concrete as the tension rods are not in direct contact with the concrete (since they can slide inside the sheath). This process however requires a long working time, labour and costs, so that it is used much less often and for structures of significant dimensions.

[0008] Known structural elements are also disclosed by JPH-A-07139090. US-B-6 219 991 discloses a method of repairing and strengthening a concrete column. The method includes wrapping a flexible strap of reinforcing material circumferentially around the exterior of a concrete column and longitudinally along at least a portion of the height of the concrete column, and then fastening the flexible strap of reinforcing material to itself to secure it to the concrete column such that external lateral reinforcement of the concrete column is thereby provided which increases the strength, stiffness and ductility of the concrete column..

[0009] In this context, the technical task underpinning the present invention is to propose a structural element and a method for improving structural resistance, which element and method obviate the drawbacks of the cited prior art.

[0010] In particular, one object of the present invention is to provide a structural element and a method for improving structural resistance which enable costs to be contained while at the same time increasing the resistance characteristics to external agents.

[0011] The technical task set and the objects specified are substantially attained by a structural element and a method for improving structural resistance, comprising the technical characteristics as set out in one or more of the accompanying claims.

[0012] Further characteristics and advantages of the present invention will become more apparent from the indicative and thus non-limiting description of a preferred, but not exclusive, embodiment of a structural element, as illustrated in the accompanying drawings, in which:

- figure 1 is a perspective view of a structural element according to the present invention;
- figure 2 is a cross-section view of the structural element of figure 1;
- figure 3 is a section view of a further structural element;
- figures 4 and 5 show details of structural elements according to the present invention.

[0013] A structural element for constructions is denoted in the attached figures by reference number 1.

[0014] The element 1 comprises a structure 2 made of concrete and/or geopolymer and/or alkali activated material. These materials are well known in the technical field and are therefore not described further herein. In particular, alkali activated material can refer to any bonding

system derived from the reaction of an alkaline metallic source (solid or in powder form) with a solid silicate powder. As shown by way of example in the appended figures, the structure 2 might comprise/be a beam. It is possible for the structure 2 to comprise an internal core, for example made of metal.

[0015] The structure 2 comprises at least one strip 3 made of a fibre-resin composite.

[0016] In the preferred solution the fibre is a glass fibre or a carbon fibre or a basalt fibre. The fibres are advantageously inert against corrosion and chemical attacks, so that the durability of the elements is enormously increased.

[0017] The resin can for example be a polyester, vinyl ester, epoxy, polyurethane resin.

[0018] The fibre comprises a plurality of filaments. The filaments advantageously extend flanked to one another. The filaments are preferably not intertwined to form a warp and a weft. The resin enables an optimal distribution of the load among the filaments.

[0019] The strip 3 surrounds at least part of said structure 2, compressing it. The strip 3 winds about itself, following a closed line. The strip 3 can advantageously involve the lower part of the structure 2.

[0020] Further, the strip 3 at least partly surmounts an external surface 20 of said structure 2. The term "surmount" and the term "superpose" throughout the present description are intended to mean that one element at least partly covers another element, not that it is above the other element. Compression is therefore made externally of the structure 2 and consequently a large portion of the material constituting it cooperates with the load.

[0021] The strip 3 comprises two flaps 21 which surmount one another and which adhere typically by gluing. The gluing can be determined by application of additional glue. Alternatively it can also derive only from the interaction between the two superposed flaps 21 of fibre-resin composite material. The two flaps 21 might also possibly adhere only by friction. Elements external to the blocking strip 3 of the two flaps 21 are advantageously absent. The strip comprises a plurality of superposed layers 30 made of fibre-resin composite which surround the structure 2.

[0022] The layers 30 are superposed on one another, a more external layer being glued to the more internal layer without external means for maintaining a tension of said strip 30.

[0023] The fibre-resin composite defines a barrier having a low permeability to water. This is important as it enables protecting those areas which experience micro-cracking and consequent corrosion of the steel armatures and which can be attacked by water contaminated by corrosive elements (chlorine present in the salts used for prevention of ice-forming, brackish water, etc.).

[0024] Where an even more significant impermeabilisation is required, the structural element 1 can comprise one or more sheets 4 of an organic polymer interposed between two superposed zones of said strip 3 for improving impermeabilisation to water.

[0025] As shown by way of example in figure 3, three distinct strips 3 are used, which surround corresponding parts of the concrete structure 2. Figure 3 advantageously illustrates a cladding 5 located on the structure 2.

[0026] A further object of the present invention is a method for improving a structural resistance of a structure 2 made of concrete and/or geopolymer and/or alkali activated material (also known as AAM).

[0027] The method comprises a step of applying a strip 3 made of a fibre-resin composite to the structure 2. As indicated in the foregoing, the fibre is preferably a glass fibre or a carbon fibre or a basalt fibre.

[0028] The fibre advantageously comprises a plurality of filaments. The step of applying the strip 3 includes surrounding at least part of the structure 2 with the strip 3. This also includes superposing said strip 3 at least in part on an external surface 20 of the structure 2. The step of applying the strip 3 advantageously includes extending the strip 3 by means of a suitable mechanical arm.

[0029] The step of applying the strip 3 to the structure 2 takes place after the curing of the structure 2 has terminated. The step of applying the strip 3 therefore includes a post-compression of the structure 2 (meaning the structure 2 first cures and is then compressed from outside).

[0030] The strip 3 keeps the part of the structure 2 it surrounds compressed.

[0031] The step of surrounding at least part of the structure 2 advantageously comprises superposing at least two end flaps of the strip 3 (the flaps can be retained by gluing or simply by friction). The strip 3 can possibly define a plurality of layers 30 which annularly envelop the structure 2.

[0032] In a first solution, the step of surrounding said structure 2 with said strip 3 comprises a step of compressing said structure 2. Thus the step of compression is performed at the same time as the application of the strip 3. In this case the strip 3 is thus applied tensioned.

[0033] In an alternative solution the structure 2 is mechanically compressed before application of the strip 3. Subsequently the strip 3 is applied, which in this case might be done by applying it at a lower or nil tension (it is therefore applied less tensioned than in the preceding solution even though the structure 2 will in any case be compressed).

[0034] The present invention provides important advantages.

[0035] The compression on the outside is such that almost all the material of the structure 2 cooperates with the load. Further lightened concretes can be used as the high-specific pressure zones that are generate along the tension rod-concrete contacts are eliminated. Further, the strip 3 is resistant to corrosion and chemical attacks, differently to the internal metal tension rods of the prior art. The strip further has an impermeabilisation function. The production process in the prefabrication sites is largely simplified as the post-tensioning and production steps of the structural element 1 are simpler.

[0036] The invention as it is conceived is susceptible to numerous modifications and variants, all falling within the scope of the claims.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- JPH07139090A **[0008]**
- US6219991B **[0008]**

Patentkrav**1.** Strukturelement til konstruktioner omfattende:

- i) en struktur (2) fremstillet af beton og/eller geopolymere og/eller alkali-aktiveret materiale;
- 5 ii) mindst en strimmel (3) fremstillet af et fiberresinkompositmateriale, som omgiver mindst en del af nævnte struktur (2), som sammenpresser den;

kendetegnet ved, at nævnte mindst ene strimmel omfatter en flerhed af overliggende lag (30) fremstillet af et fiberresinkompositmateriale, som omgiver strukturen (2); nævnte lag (30) ligger oven på hinanden, idet et mere eksternt lag er limet til et mere internt lag uden eksternt middel til at bevare en spænding af nævnte mindst ene strimmel (3), idet det mere eksterne lag dækker mindst delvist et mere internt lag, hvorved den mindst ene strimmel (3) mindst delvist er anbragt oven på en ekstern overflade (20) af nævnte struktur (2).

- 15 **2.** Elementet ifølge krav 1, **kendetegnet ved, at** nævnte mindst ene strimmel (3) omfatter en første og en anden flap (21), som er anbragt oven på hinanden, og som klæber ved hjælp af limning; idet den anden flap dækker mindst delvist den første flap.

- 20 **3.** Elementet ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** fiberresinkompositmaterialet definerer en barriere med en lav gennemtrængelighed for vand.

- 4.** Elementet ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det omfatter en eller flere lag (4) af en organisk polymer anbragt mellem to overliggende zoner af nævnte mindst ene strimmel for at forbedre fugtimprægning for vand.

- 5.** Elementet ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** nævnte fiber er en glasfiber eller en kulfiber eller en basaltfiber.

DRAWINGS

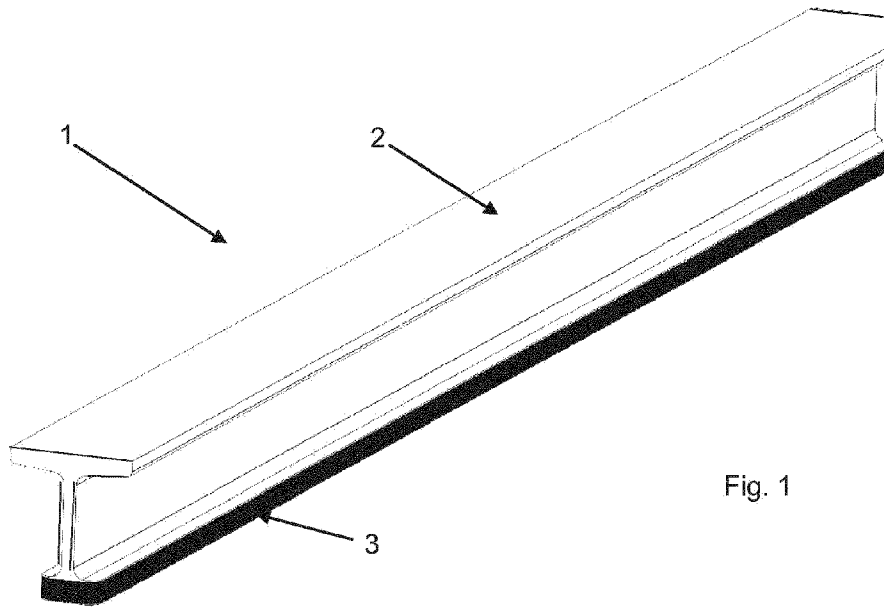


Fig. 1

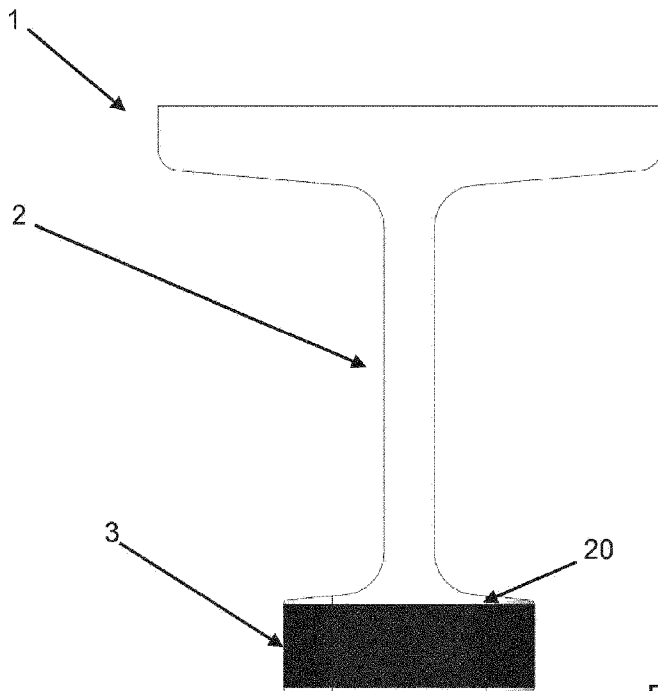


Fig. 2

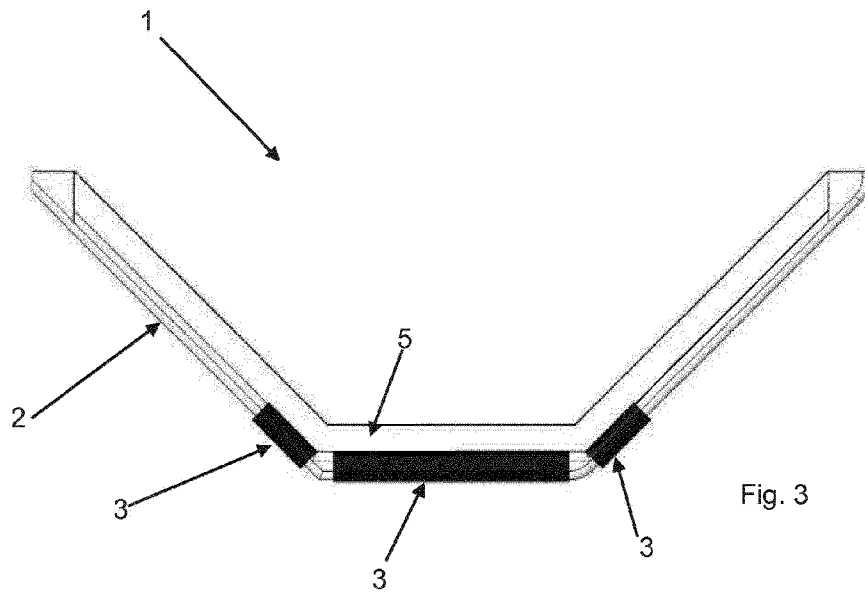


Fig. 3

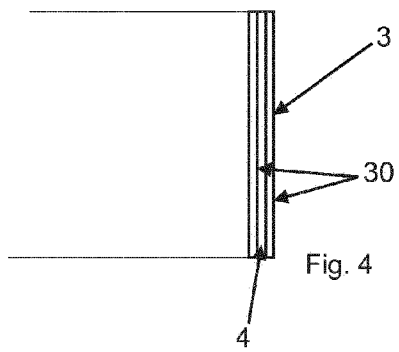


Fig. 4

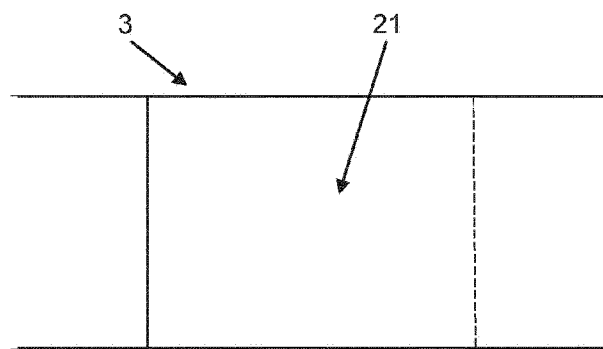


Fig. 5