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(54) **PREFABRICATED STRUCTURAL ELEMENT FOR BUILDINGS**

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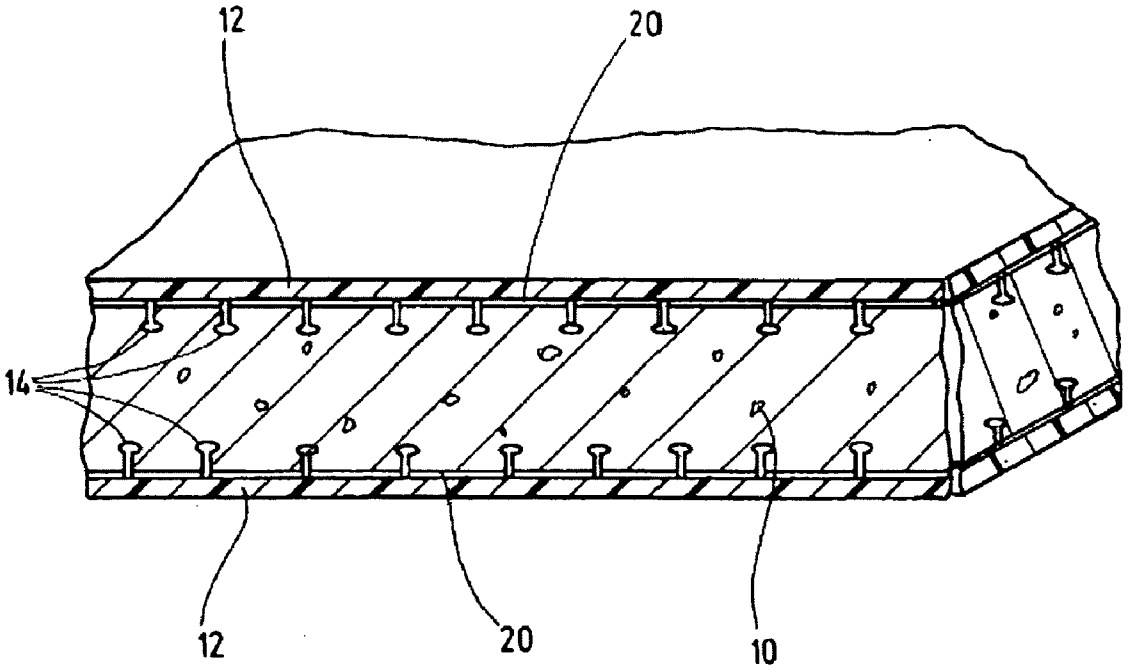
(57) **ABSTRACT**

The invention relates to a prefabricated construction element for buildings in prefabricated construction, comprising a core element (**10**) and at least one reinforcement element (**12**). In order to absorb high tensile and transverse forces without the danger of developing cracks, the reinforcement element is configured as a flat material element (**12**) from fiber-reinforced plastic that is fixated on a lateral face (**20**) of the core element (**10**) in a form-fit and/or a material fit.



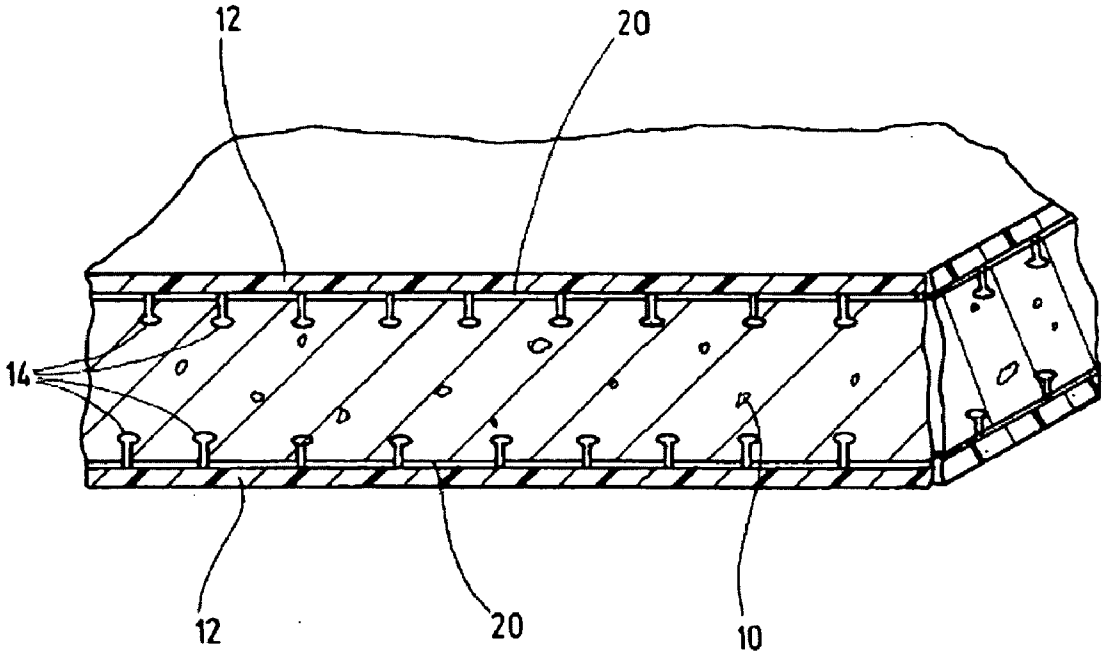


Fig.1

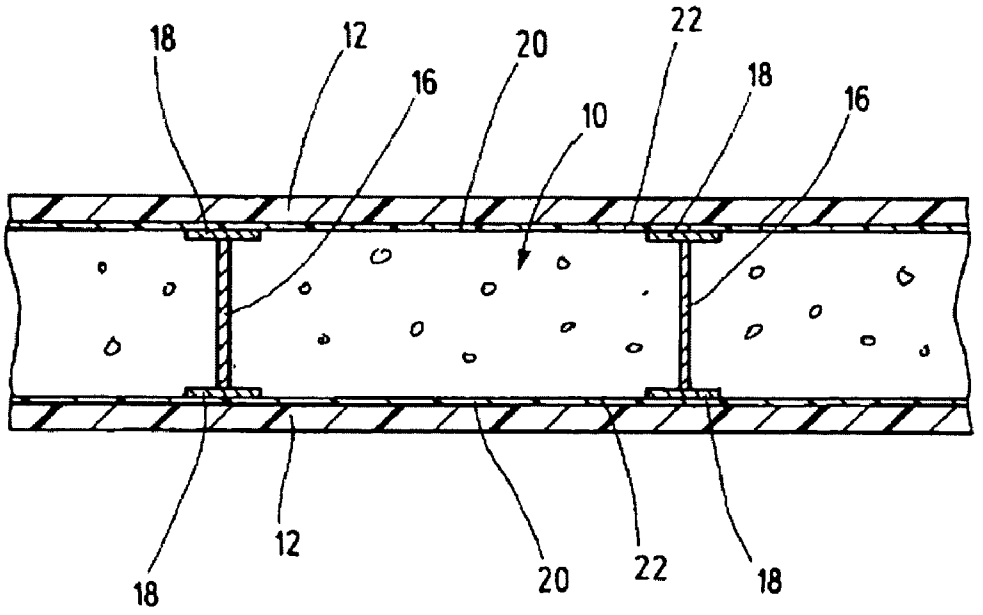


Fig.2

PREFABRICATED STRUCTURAL ELEMENT FOR BUILDINGS

[0001] This is a Continuation of application Ser. No. 10/468,647 filed Aug. 21, 2003, which in turn is a National Phase of Application No. PCT/EP02/00179, filed Jan. 10, 2002, which claims the benefit of DE 101 08 375.0 and DE 101 36 633.7, filed Feb. 21 and Jul. 26, 2001, respectively. The disclosures of the prior applications are hereby incorporated by reference herein in their entirety.

DESCRIPTION

[0002] The invention relates to a prefabricated structural element for buildings, preferably in pre-fabricated construction, with a core element and at least one reinforcing piece to carry tensile forces.

[0003] Panel structural elements of the above-indicated type are used in prefabricated construction as wall or ceiling elements. Usually they contain a slab core made from lightweight concrete that is reinforced with a reinforcing grid embedded in the concrete slab. The purpose of the reinforcement is to carry any tensile or shearing forces arising in the ceiling or wall elements, while the concrete is intended to carry compressive forces. The strength values can be increased by adding concrete to the slab core.

[0004] In known structural elements with reinforcing grids, a disadvantage is that the tensile strength leaves something to be desired. The susceptibility of the steel reinforcing grid to corrosion is increased because of the porosity of lightweight concrete, so corrosion damage can occur prematurely. Finally, machinability is also a problem, since the reinforcement can break during drilling, leading to breakaway of material. Instability of the known prefabricated structural elements also causes problems with handling during transport and at the construction site.

[0005] Therefore the aim of the invention is to improve the known prefabricated structural elements so that by simple means they have high tensile strength and long service life, and can be transported as well as handled and worked on at the construction site without risk of breakaway.

[0006] The combination of features indicated in claim **1** is proposed to achieve this aim. Advantageous embodiments and further developments of the invention are given in the subclaims.

[0007] An essential feature of the invention is that the reinforcing piece is formed as a flat stock piece made from fiber-reinforced plastic that is fixed to a long face of the core element form-fittingly and/or by using a joining substance. A layered sheet or film can be used as a flat stock piece for this purpose. The flat stock piece conveniently has a plastic binder matrix and a fiber fabric or crossply embedded therein. It is adhesively affixed over an extensive area to at least one of the long faces of the core element, preferably with an epoxy resin.

[0008] In a preferred embodiment of the invention, the flat stock piece has a plurality of projecting knob-like anchoring members on one side, by means of which it is engaged throughout the core element, through openings in the long face, and is anchored therein form-fittingly. The anchoring members are embedded in the core element for this purpose. In manufacture of the structural element, the flat stock pieces are laid in a form against the wall of the form in such a way that their anchoring members point inward and liquid concrete is poured around them. The core element advantageously consists of concrete, lightweight concrete, cellular concrete, or gypsum.

[0009] The binder matrix of the flat stock can consist of a thermosetting plastic, for example from the group of epoxy resin, polyester resin, vinyl resin. The binder matrix preferably consists of a thermoplastic from the group of polyamide, polymethylmethacrylate, polyphenylene sulfide, polypropylene, polyethylene terephthalate, polybutylene terephthalate, polyetherimide, styrene polymer, polyetheretherketone. The fibers of the flat stock piece are conveniently selected from the group of carbon fibers, glass fibers, aramid fibers, polyethylene fibers, basalt fibers, natural fibers.

[0010] In a further preferred embodiment of the invention, several reinforcing pieces are provided that are transversely interspersed in the core element, the widened ends of the reinforcing pieces fit flush against the long faces of the core element and are bonded to the at least one flat stock piece using a joining substance, preferably adhesively. The reinforcing pieces conveniently have a double-T shape and, for example, are made of metal, in particular aluminum or steel, or else a fiber-reinforced polymer material.

[0011] In manufacture of the flat stock piece, a fiber fabric or crossply is soaked with a binder, heated up to temperature in a continuous manner, and then cooled down again and at the same time pressed, where during the manufacturing process knob-like anchoring pieces are formed on one side and are preferably pressed out from the flat stock.

[0012] The prefabricated structural elements according to the invention are preferably used as wall elements, ceiling elements, or supports for prefabricated buildings.

[0013] The invention is explained in greater detail in the following with the help of a schematically represented exemplary embodiment in the drawing. The drawing shows:

[0014] FIG. **1** a section through a panel structural element with form-fittingly anchored reinforcing pieces made from fiber-reinforced plastic;

[0015] FIG. **2** a section through a structural element with internal reinforcement and reinforcing pieces made from fiber-reinforced plastic that are adhesively bonded to the long faces.

[0016] The structural elements represented in the drawing are intended as wall or ceiling elements for buildings in pre-fabricated construction.

[0017] The panel structural elements have a core element made from concrete, lightweight concrete, cellular concrete, gypsum. Core element **10** has on each of its long faces **20** a sheet or film type flat stock piece **12** made from fiber-reinforced plastic. In the exemplary embodiment shown in FIG. **1**, flat stock piece **12**, with projecting knob-like anchoring members **14** on one side, is integrally cast into core element **10** and is thus anchored form-fittingly. In the exemplary embodiment shown in FIG. **2**, core element **10** additionally contains several reinforcing pieces **16** transversely interspersed in the core element, the widened ends **18** of which reinforcing pieces fit flush against long faces **20** of core element **10**. In this case, flat stock pieces **12** are adhesively bonded to long faces **20** of the core element and ends **18** of reinforcing piece **16** with the help of an adhesive layer **22**. For this purpose,

double-T shaped reinforcing pieces **16** can consist of metal such as aluminum or steel, or of a fiber-reinforced polymer material. In the latter case, flat stock piece **12** may also be welded to ends **18** of the reinforcing pieces using pressure and heat.

[**0018**] Flat stock pieces **10** serve to reinforce the core element and have the purpose of carrying tensile and shearing forces and preventing the concrete material from breaking away from the core element during transport, installation, and finishing.

[**0019**] In summary, we can say the following: The invention relates to a prefabricated structural element for pre-fabricated construction with a core element **10** and at least one reinforcing piece **12**. So that high tensile and shearing forces can be carried with no risk of cracking, the reinforcing piece is formed as a flat stock piece **12** made from fiber-reinforced plastic that is fixed to a long face **20** of core element **10** form-fittingly and/or by using a joining substance.

1. Prefabricated structural element, comprising:

a core element; and

at least one reinforcing piece that carries tensile forces,

wherein the reinforcing piece is formed as a flat stock piece made from fiber-reinforced plastic that is fixed to a long face of the core element form-fittingly or by using a joining substance;

wherein the flat stock piece has a plurality of projecting knob-like anchoring members on one side that are engaged throughout the core element, through openings in the long face, and is anchored therein form-fittingly; and

wherein the prefabricated structural element is utilized in a wall element, ceiling element, or support for prefabricated buildings.

2. Prefabricated structural element as in claim 1, wherein the flat stock piece has a plastic binder matrix and a fiber fabric or crossply embedded therein.

3. Prefabricated structural element as in claim 1, wherein the flat stock piece is adhesively affixed over an extensive area, to a long face of the core element.

4. Prefabricated structural element as in claim 1, wherein the core element is selected from the group consisting of concrete, lightweight concrete, cellular concrete, or gypsum.

5. Prefabricated structural element as in claim 1, wherein the anchoring members are embedded in the core element.

6. Prefabricated structural element as in claim 1, wherein both long faces of the core element have the flat stock piece made from fiber-reinforced plastic thereon.

7. Prefabricated structural element as in claim 2, wherein the plastic binder matrix consists of a thermosetting plastic from the group consisting of epoxy resin, polyester resin, and vinyl resin.

8. Prefabricated structural element as in claim 2, wherein the plastic binder matrix consists of a thermoplastic from the group consisting of polyamide, polymethylmethacrylate, polyphenylene sulfide, polypropylene, polyethylene terephthalate, polybutylene terephthalate, polyetherimide, styrene polymer, and polyetheretherketone.

9. Prefabricated structural element as in claim 1, wherein the fibers of the flat stock piece are selected from the group consisting of carbon fibers, glass fibers, aramid fibers, polyethylene fibers, basalt fibers, and natural fibers.

10. Prefabricated structural element as in claim 1, further comprising several reinforcing pieces transversely interspersed in the core element, with widened ends of which fit flush against long faces of the core element and are bonded to the flat stock piece using a joining substance.

11. Prefabricated structural element as in claim 10, wherein the reinforcing piece has a double-T shape.

12. Prefabricated structural element as in claim 9, wherein the reinforcing pieces are made of metal or fiber-reinforced polymer material.

13. Reinforcing piece, comprising:

a flat stock piece on which projecting knob-like anchoring members are formed on one side, wherein the reinforcing piece is utilized in a wall element, ceiling element or support for prefabricated buildings.

14. Reinforcing piece as in claim 13, wherein the flat stock piece is formed as a sheet, film, or grid element.

15. Method for manufacturing reinforcing pieces for prefabricated structural elements for buildings, comprising:

soaking a fiber fabric or crossply with a binder,

heating the fiber fabric or crossply to a predetermined temperature in a continuous manner, and

cooling and simultaneously pressing the fiber fabric or crossply to form the flat stock piece, wherein during the manufacturing process, knob-like anchoring members are pressed out to protrude from the flat stock piece.

16. Prefabricated structural element as in claim 3, wherein the flat stock piece is adhesively affixed with an epoxy resin adhesive.

17. Prefabricated structural element as in claim 5, wherein the anchoring members are cast integral within the core element.

18. Prefabricated structural element as in claim 10, wherein the joining substance is an adhesive.

19. Prefabricated structural element as in claim 12, wherein the metal comprises aluminum or steel.

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