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(54) **PREFAB PANEL, MODULAR FACADE, AND MOUNTING METHOD THEREOF**

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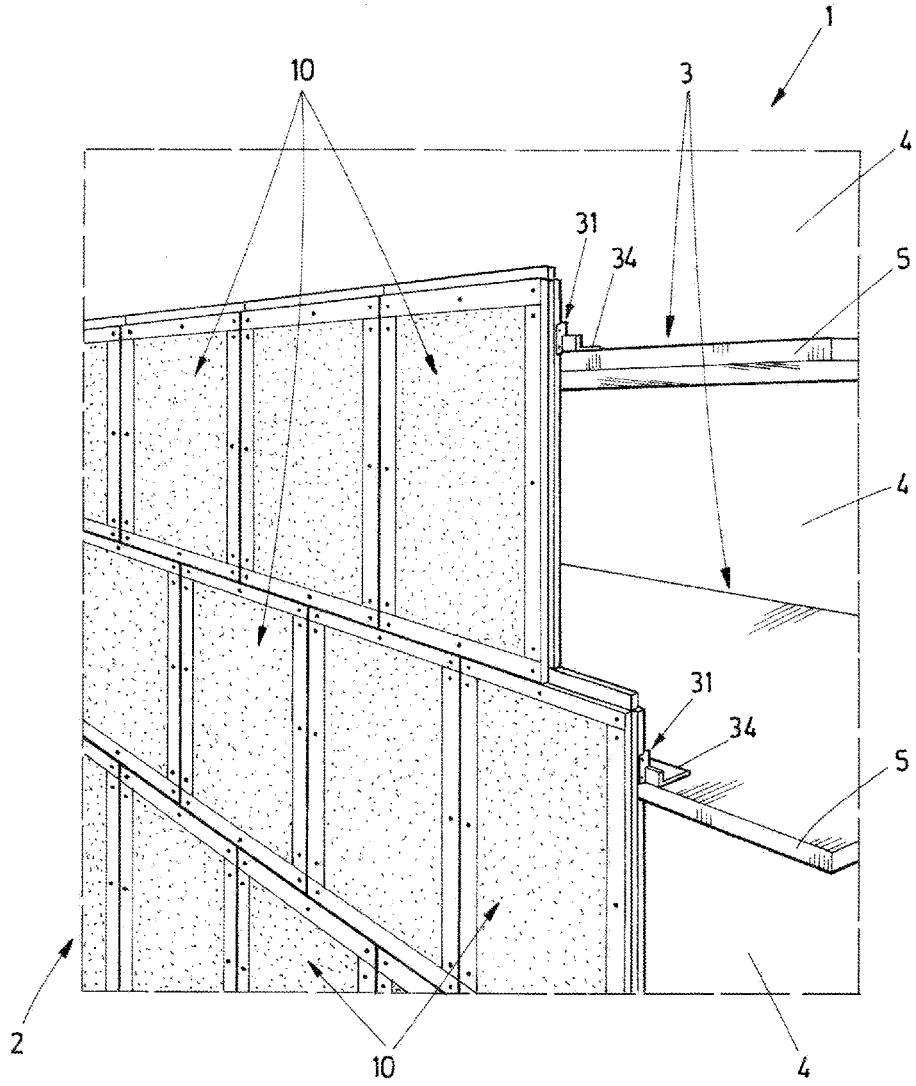
(57) **ABSTRACT**

The modular facade is made of prefab panels comprising a frame structure with horizontal and vertical profiles. The prefab panel includes an outer cladding attached to the frame structure by attaching means. The horizontal and the vertical profiles have a matching shiplap design. A method of mounting the modular facade relies upon the steps of installing brackets to a building structure, for levelling position of the prefab panels, and an anti-tipping element in an upper part of the building structure, so that not very demanding lifting means, such as a small crane, suffices, for suspending subsequent adjacent prefab panels from an upper story.



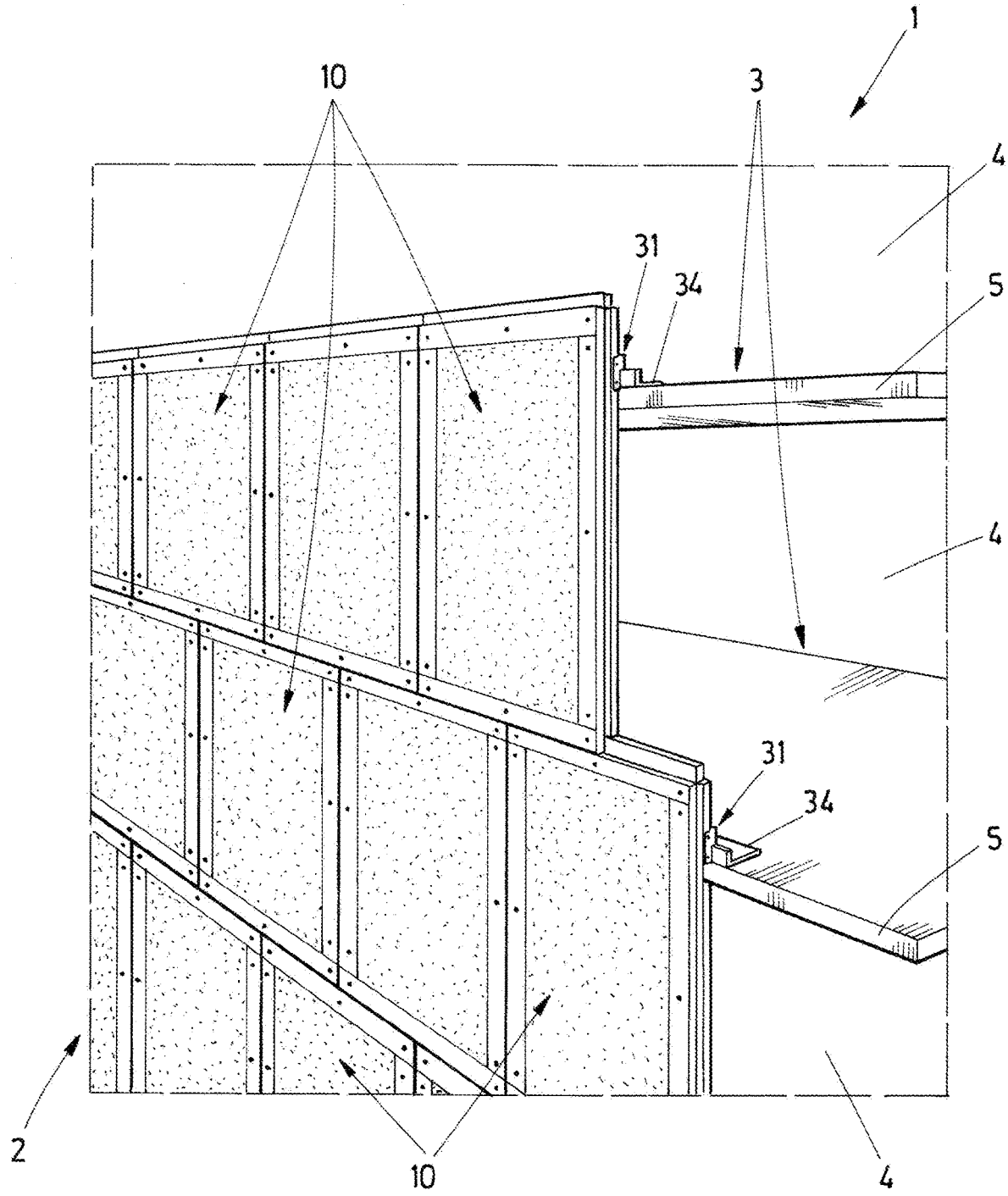


FIG. 1

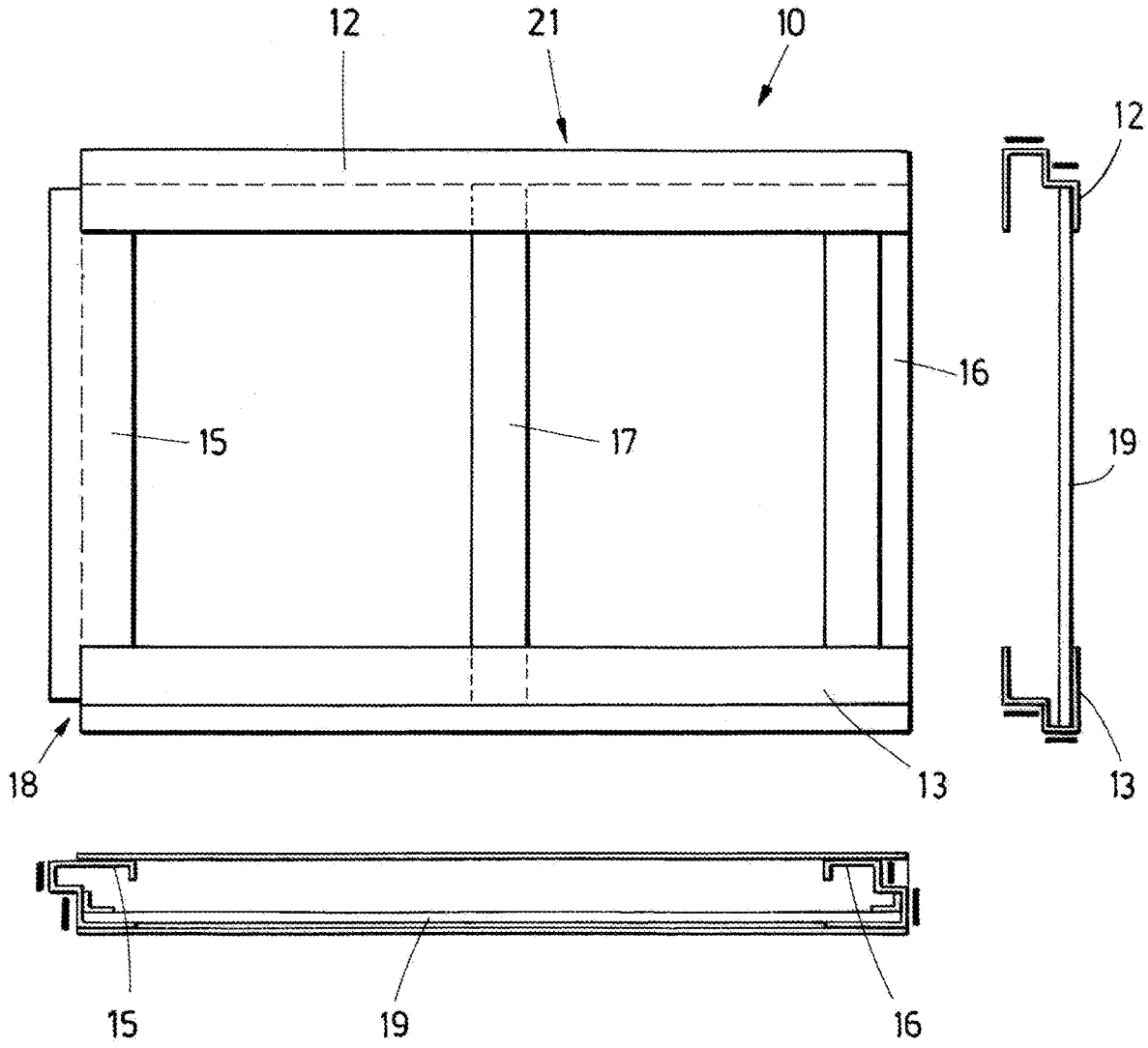


FIG. 2

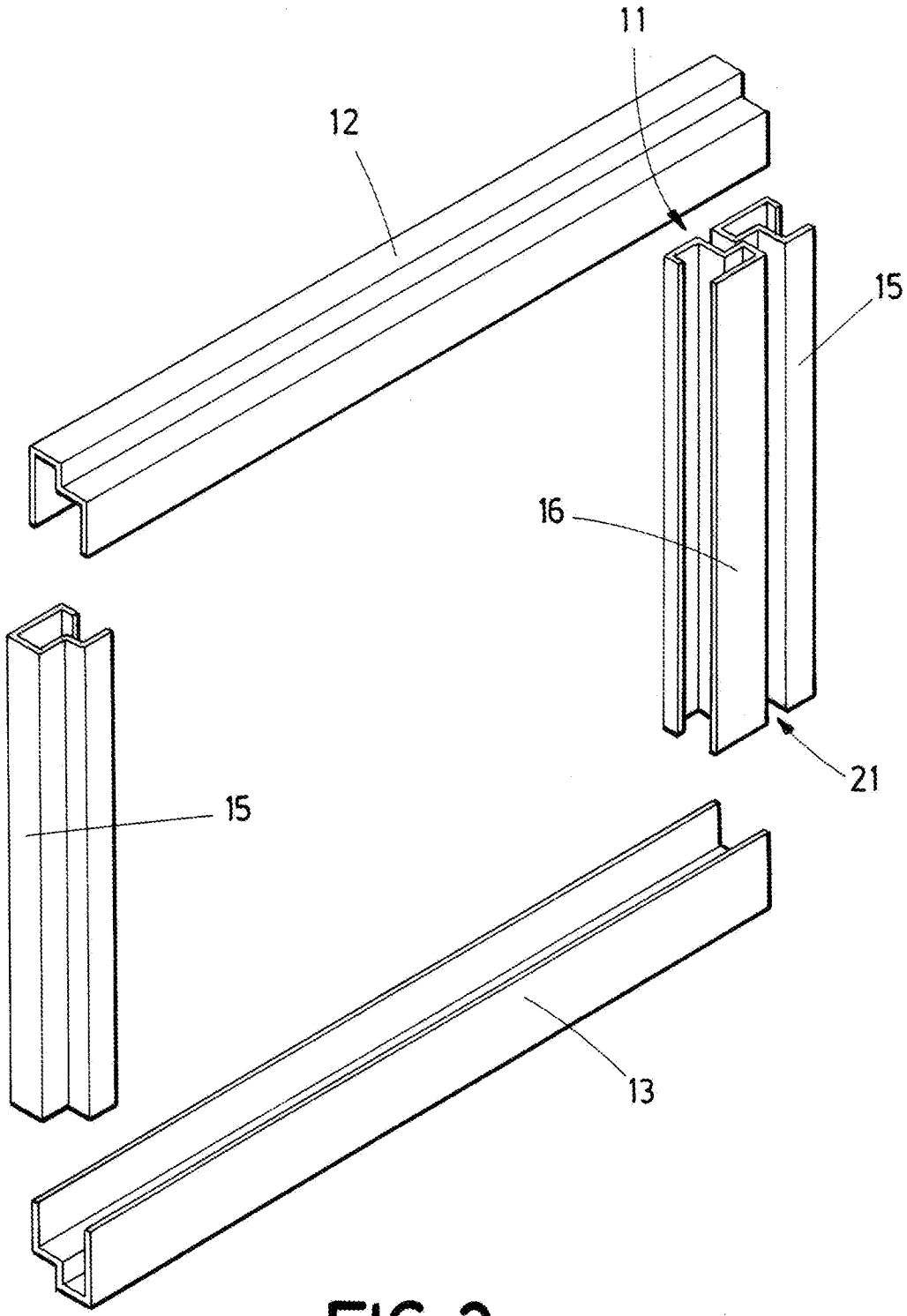


FIG. 3

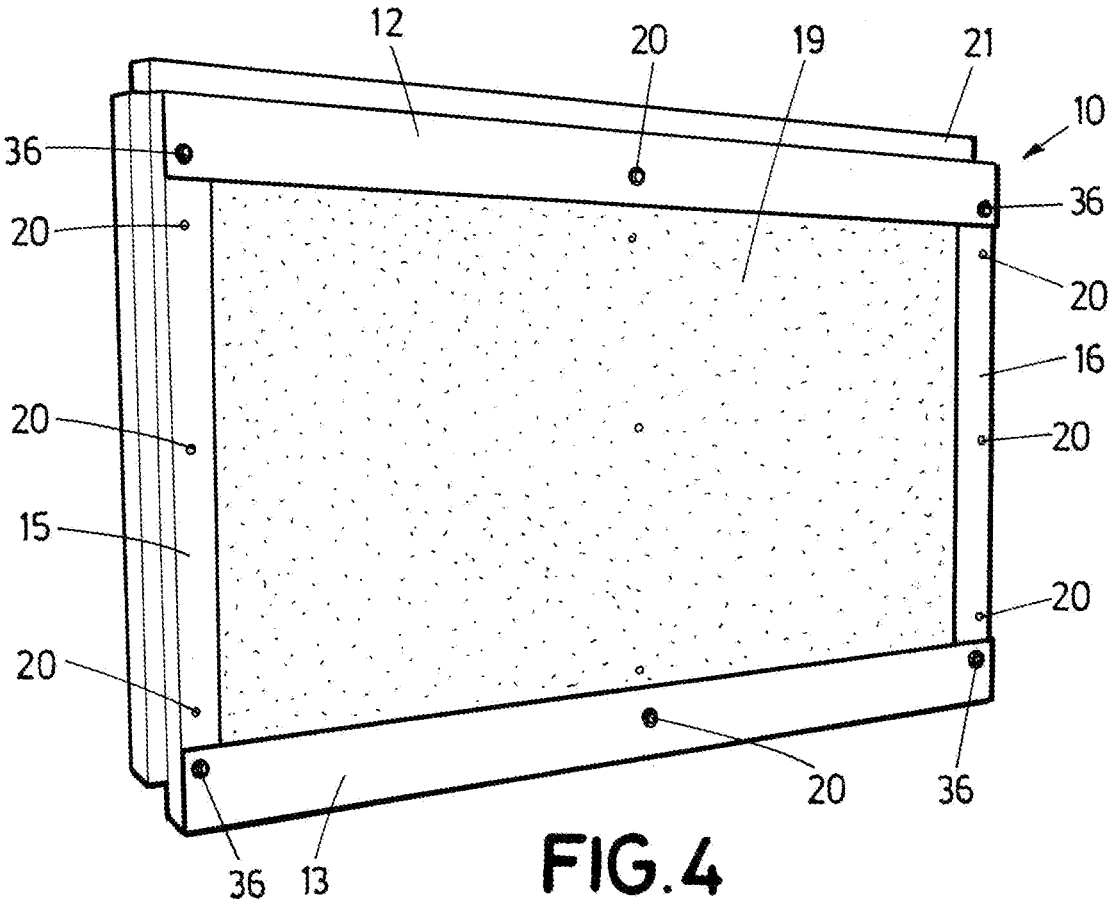

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FIG.4

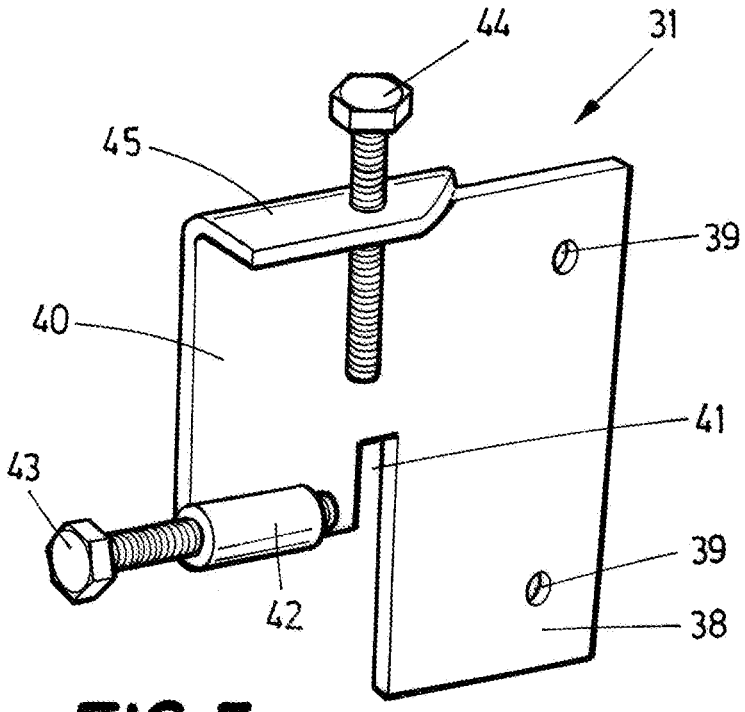
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FIG.5

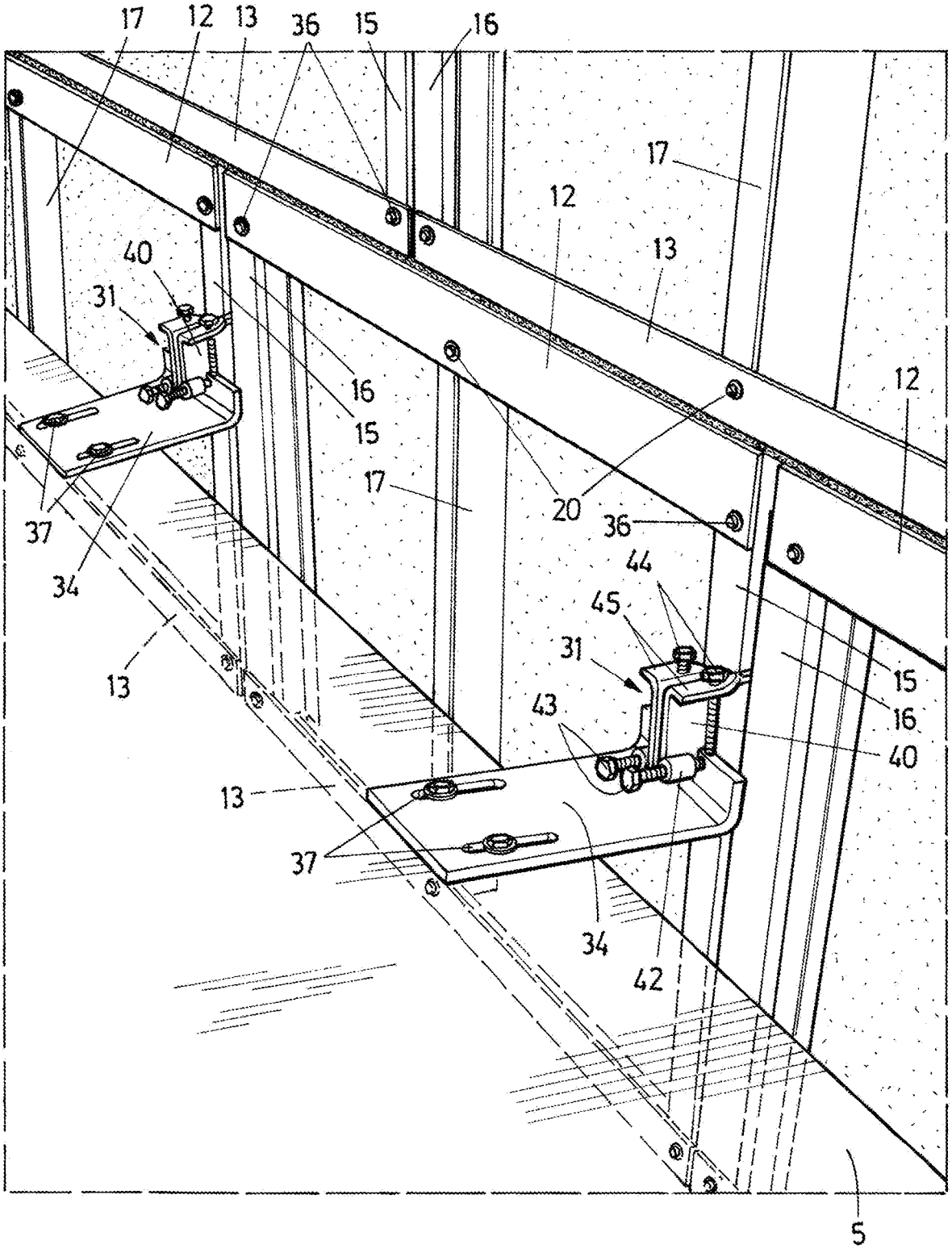
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FIG.6

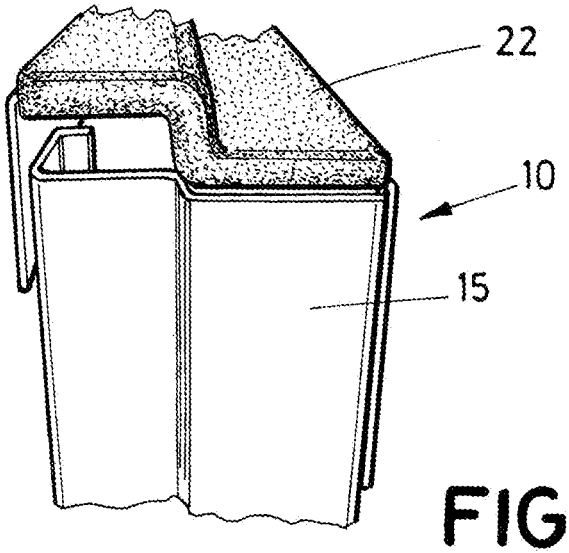

FIG. 7

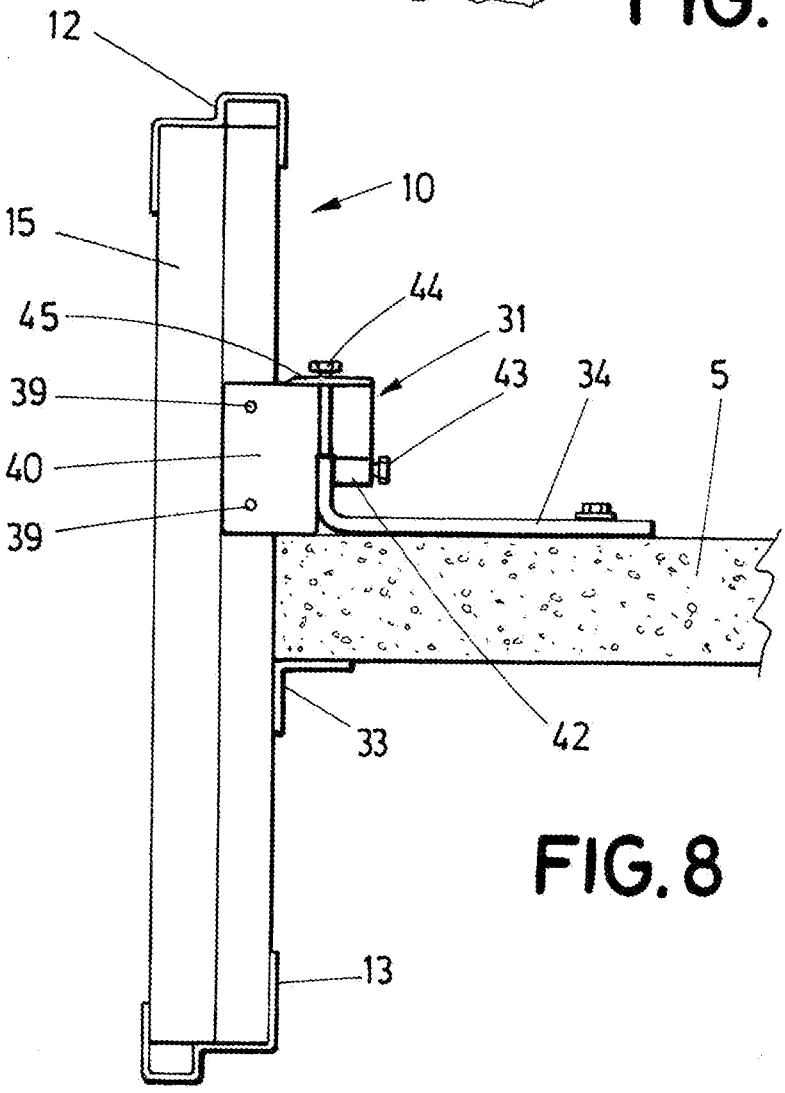

FIG. 8

PREFAB PANEL, MODULAR FACADE, AND MOUNTING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to EP Patent Application No. 22383222.1, filed Dec. 15, 2022, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention belongs to the technical field of building and construction; in particular, to the field of facade coverings. More particularly, the invention relates to, according to a first aspect thereof, a prefab panel for an off-site modular facade, as well as, according to additional aspects, a modular facade including the above-mentioned prefab panel, and a method for making the modular facade.

BACKGROUND

[0003] The construction system known as curtain walling is a building envelope intended to support only its own weight and withstand the effects of environmental forces such as wind. It is not intended to assist the structural integrity of the building. There are two main types of curtain walling construction: "stick" and "unitized". In stick construction, the curtain wall frame is constructed mainly on site with mullions and transoms supporting glass, spandrel panels, metal panels and brise-soleils, connected piece by piece. Each mullion is usually supported by floor or perimeter beams. In unitized construction, on the other hand, the curtain wall is composed of large units that are assembled in the factory, shipped to the site and erected on the building. Metal profiles, such as aluminium profiles, steel profiles or profiles made from other suitable metals, may be used to form the frame, which is normally one-story high. Opening vents, glazing and infill panels are built into units before being transported to site. As with stick construction, each unit is usually supported by the floor or perimeter beams.

SUMMARY

[0004] The present invention relates to a unitized-wall simplified construction, involving a lesser weight and simplified assembling works.

[0005] In particular, the present invention discloses, according to a first aspect thereof, a prefab panel for a modular facade of a building, the prefab panel comprising: a frame structure; an outer cladding layer, made of plasterboard, attached to the frame structure; and attaching means for supporting the outer cladding to the frame structure.

[0006] In the present application, the term "prefab" is to be understood as a "stand-alone solution" ready to be used, which represents a key added value in terms of easiness efficiency and cost reduction.

[0007] The frame structure comprises first and second horizontal profile(s), as well as first and second vertical profile(s). The frame structure may further comprise third vertical profile(s) and/or third horizontal profile(s).

[0008] In the prefab panel of the invention, the first and the second vertical profile have a matching shiplap design, as well as the first and second horizontal profile have a matching shiplap design. This allows any prefab panel to be joined to adjacent upper and lower prefab panels and to adjacent further right and further left prefab panels. Furthermore, brackets are mountable to the first and second vertical profiles, for supporting the prefab panels, as explained below. Preferably one bracket is used per first and second vertical profile, but the invention may alternatively involve a different number of brackets.

[0009] The brackets may either be attached to the to the first and second vertical profiles, all together making up the above-explained prefab panel, or alternatively the invention may be provided as a kit comprising: the frame structure; the plasterboard outer cladding attached to the frame structure through the attaching means; the horizontal profiles and the vertical profiles featuring shiplap design; and the brackets, as explained above, wherein the brackets are not mounted to the first and second vertical profiles, allowing installers to attach the brackets to said first horizontal and vertical profiles themselves for building the prefab panel.

[0010] A thermal insulator may be housed within the frame structure, opposite to the outer cladding.

[0011] According to additional aspects, the invention also relates to a modular facade comprising a plurality of the above-referred prefab panels assembled together, as well as a method of building the modular facade by assembling together the prefab panels.

[0012] The present invention aims to streamline facade installation, reducing the timing and auxiliary resources used in a normal facade method. Based on this point, the main concept is the installation of the facade elements from each slab of the building with the safety measures required in each case. The present invention combines the idea of a unitized curtain wall installation with a light weight facade made of plasterboard solution concept in order to improve both systems after this combination.

[0013] The main advantages of this solution are therefore:

- **[0014]** The design of the prefab panel, allows for operating from the inner part of the building,
- **[0015]** The brackets are accessible from the inside and allow a fixing and levelling of the prefab panels,
- **[0016]** The above-referred inner operation provides a time reduction, which means reducing cost,
- **[0017]** Reduced mounting risk for installers, because of the inner operation, the slab and less needs of auxiliary elements during this process,
- **[0018]** Dry solution,
- **[0019]** Prefab solution with less wasting, and
- **[0020]** Reduction of the total weight of the building, with an important impact into the building structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The advantages mentioned above, as well as other advantages and features of the present invention, shall be better understood with reference to the following detailed description of a preferred embodiment of the invention, with due regard to the attached set of figures, which are to be construed in an illustrative, non-limitative manner, and wherein:

[0022] FIG. **1** shows a detailed perspective view of a building with a modular facade according to the invention,

[0023] FIG. **2** shows a front view of a prefab panel with two cross sections along X-X and Y-Y for a modular facade according to the invention,

[0024] FIG. **3** shows an exploded view of the prefab panel frame structure of FIG. **1**, wherein a third vertical profile has been omitted,

[0025] FIG. **4** shows a front view of the prefab panel of FIGS. **1** and **2**, FIG. **5** shows a detailed perspective view of one bracket,

[0026] FIG. **6** shows a detailed perspective of brackets mounted to the prefab panel,

[0027] FIG. **7** shows a detailed perspective of a joint sealing element applied to the prefab panel, and

[0028] FIG. **8** shows a schematic side view of the prefab panel when fixed to the building.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0029] Next a detailed description of a preferred embodiment of the present invention shall be provided, with reference to FIGS. **1-8**.

[0030] The invention relates to a unitized-wall modular facade (**2**) of a building (**1**), which is comprised by a number of prefab panels (**10**) assembled together, which will explained below. FIG. **1** shows the building (**1**), the modular facade (**2**) and the prefab panels (**10**) which are connected to floor slabs (**5**) of each floor (**4**) by means of brackets (**31**) and connecting plates (**34**).

[0031] Each prefab panel (**10**) comprises a frame structure (**11**), such as a studding, made of metal, such as galvanized steel. The frame structure (**11**) comprises a first horizontal profile (**12**) and a second horizontal profile (**13**), as well as a first vertical profile (**15**) and a second vertical profile (**16**) and, optionally, further at least one third vertical profile (**17**), between the first (**15**) and the second (**16**) vertical profile(s). Further optionally, there is at least one third horizontal profile (not shown) between the first (**12**) and the second (**13**) horizontal profile(s). If both third vertical profile(s) (**17**) and third horizontal profile(s) are present, throughgoing third vertical profile(s) (**17**) are preferred for statics. In a front part (**18**) of the frame structure (**11**), there is an outer cladding (**19**) made of a gypsum panel, also referred to as "plasterboard panel", (such as Glasroc® X) attached to the profiles (**12**, **13**, **15**, **16**, **17**), by attaching means (**20**), such as screws, for instance, Placotherm® Integra screws. The outer cladding (**19**) is a facade exterior-closing element. Joint sealing elements (**22**), preferably self-adhesive, may be outwardly attached to at least one of the horizontal profiles (**12**, **13**) and/or at least one of the vertical profiles (**15**, **16**) for guaranteeing correct function of each prefab panel (**10**) in combination with the rest of the facade (**2**). In this case, the joint sealing element(s) (**22**) are located in the whole perimeter of the prefab panel (**10**) after retiring a protective peel-off sheet (not shown), for providing airtightness and watertightness to the solution. Also, it serves to attach each prefab panel (**10**) to adjacent prefab panels (**10**) in the vertical and horizontal sides during installation. The joint sealing elements (**22**) may preferably be made of a foam, such as Norseal®.

[0032] In the case that the outer profiles, i.e., the first (**12**) and second (**13**) horizontal profile, and the first (**15**) and second (**16**) vertical profile, overlap the cladding (**19**), there is one and only one first (**12**) and second (**13**) horizontal profile, and also there is one and only one first (**15**) and second (**16**) vertical profile.

[0033] A thermal insulator (not shown) made of mineral wool, for instance, is housed in the frame structure (**11**), behind the outer cladding (**19**).

[0034] The first (**12**) and second (**13**) vertical profiles, as well as the first (**15**) and second (**16**) horizontal profiles, have a matching shiplap (**21**) design. Preferably, the shiplap (**21**) design of the horizontal profiles (**12**, **13**) is designed for clamping fit of the outer cladding (**19**).

[0035] The third horizontal and/or vertical (**17**) profile(s) may be C standard facade profiles centrally located for increasing the plasterboard resistance and improve stability of the prefab panel (**10**). Preferably, their profile width is selected among: 50 mm, 75 mm and 100 mm.

[0036] Brackets (**31**) are attachable to the vertical profiles (**15**, **16**, **17**), for connecting the prefab panel (**10**) to a floor slab (**5**) of the building (**1**) by means of a connecting plate (**34**) made of metal which is interspersed between the brackets (**31**) and the floor slab (**5**), for supporting the prefab panels (**10**), in particular, the frame structure (**11**) thereof, and the facade loads. In the figures, the brackets (**31**) are shown attached to the vertical profiles (**15**, **16**, **17**). In general, each prefab panel (**10**) includes at least one bracket (**31**) mounted to the first vertical profile (**15**), and at least one bracket (**31**) mounted to the second vertical profile (**16**). Preferably, there are two brackets (**31**), which are attached one to each of the first (**15**) and second (**16**) vertical profiles of each prefab panel prefab (**10**). The brackets (**31**), as seen in FIG. **5**, are metallic and shaped in the form of a plate, with:

[0037] a longer first portion (**38**), attached to a side of the first (**15**) or the second (**16**) vertical profiles, preferably by means of screws (not shown) insertable in two holes (**39**) of the first portion (**38**); and a shorter second portion (**40**), with a vertical slot (**41**), for allocating a curved upper part of the connecting plate (**34**), as well as fixing means (**42**, **43**), such as a threaded bushing (**42**) and a fixing screw (**43**), for fixing the connecting plate (**34**) to the slot (**41**), and also levelling means (**44**, **45**), such as a levelling screw (**44**), located at an upper flange (**45**) of the second portion (**40**), for levelling the connecting plate (**34**) in height.

[0038] FIG. **6** shows an arrangement of two brackets (**31**) of two adjacent prefab panels (**10**), where the brackets are located one at the first (**15**) and one at the second (**16**) vertical profile. In particular, one same connecting plate (**34**) is preferably shared by a pair of brackets (**31**), each one of the brackets (**31**) belonging to the first (**15**) or second (**16**) vertical profile of adjacent prefab panels (**10**).

[0039] The horizontal profiles (**12**, **13**) are located perimetrically, at the top and at the bottom, of the frame structure (**11**), for closing the prefab panel (**10**) and protect the board from weather damage, and also for guaranteeing the stability of the prefab panel (**10**) connected to the vertical profiles (**15**, **16**, **17**).

[0040] The dimensions of the horizontal profiles (**12**, **13**) and the thickness thereof, are determined based on the loads, which, in turn, depend on several factors, such as: location of the building (**1**); total height of the building (**1**); height of each floor (**4**) (distance between two anchor points); and location of the prefab panel (**10**), i.e., on a corner or at a central area, of the facade (**2**).

[0041] The horizontal profiles (**12**, **13**) are fixed to the vertical profiles (**15**, **16**, **17**) at profile fixing points (**36**) at the ends of the vertical profiles (**15**, **16**, **17**) which, for the first (**15**) and second (**16**) vertical profiles, are preferably located on all four corners of the prefab panel (**10**). At the profile fixing points (**36**) various means for fixing the horizontal profiles (**12**, **13**) to the vertical profiles (**15**, **16**, **17**) may be used, such as mechanical means (screws or similar) or gluing. Using screws or similar is preferable, so

that the outer cladding (**19**) is protected by metal elements and fixed to the frame structure (**11**) directly in the four corners and also in the perimeter of the said outer cladding (**19**). In a central area of the prefab panel (**10**), a reinforcing profile (not shown), such as a "C" reinforcing profile, is located to increase load capability of the prefab panel (**10**) and to guarantee stability of the prefab panel (**10**). The outer cladding (**19**) is fixed directly to this "C" reinforcing profile.

[0042] The prefab panel (**10**) preferably features a width dimension equal to a typical width dimension of a gypsum cladding, such as 1200 mm, as well as a height dimension equal to the intended story height of the building (**1**).

[0043] The prefab panel (**10**) is previously assembled in a factory, and later transported to the construction site, ready to be coupled. Coupling of the prefab panels (**10**) is made from within the building (**1**), by suspending the panels (**10**) from the above-referred floor slab (**5**) of an upper story (**3**), and then fixing the prefab panels (**10**), both to each other as well as to a building structure, such as the floor slab (**5**), as explained below.

[0044] In particular, the pair of brackets (**31**) mounted to each first (**15**) and second (**16**) vertical profiles, serve to attach the prefab panel (**10**) to the floor slab (**5**). To that end, the connecting plate (**34**), comprising first slotted holes (**37**) is to be fixed to the brackets (**31**). The first slotted holes (**37**) are corresponding to second slotted holes (not shown) in the floor slab (**5**), preferably in corbels (not shown) attached to the floor slab (**5**), for absorbing assembling tolerances.

[0045] According to another aspect, the invention also relates to a method for mounting a modular facade (**2**) by coupling a plurality of the above-referred prefab panels (**10**).

[0046] The steps of the installation process are as follows:

[0047] a) Fixing the prefab panel (**10**), such as an initial prefab panel (**10**), together with the brackets (**31**) mounted thereto, to the building structure, such as the floor slab (**5**), for levelling position of the prefab panel (**10**) regarding the floor slabs (**5**) and the total height of the floor (**4**) of the current story (**3**). This step includes suspending the initial prefab panel (**10**) from the inner part of the building (**1**) by means of a crane located at an inner position on an upper story (**3**) of the building;

[0048] b) Optionally, installing an anti-tipping element (**33**) to the building structure, such as an upper part of the building structure, for instance, as the floor slab (**5**) corresponding to the current story (**3**), to reinforce the prefab panel (**10**) against tipping rotation of the prefab panel (**10**), and fixing the prefab panel (**10**) to the anti-tipping element (**33**);

[0049] c) Placing an adjacent perimetral prefab panel (**10**) in a correct position using the crane located in an inner position at an upper story (**3**);

[0050] d) Fixing said adjacent prefab panel (**10**) by means of the bracket (**31**) thereof, to the building structure, as explained above for the initial prefab panel (**10**);

[0051] e) As the case might be, fixing the adjacent prefab panel (**10**) to the ant-tipping element (**33**); and

[0052] f) Continuing the same process with the rest of the prefab panels (**10**), fixing each of the prefab panels (**10**) after a previous prefab panel (**10**), once a correct levelling of each previous prefab panel (**10**) has been performed.

PARTS LIST

[0053] **1** Building
[0054] **2** modular facade
[0055] **3** Story of the building
[0056] **4** Floor
[0057] **5** Floor slabs
[0058] **10** Prefab panel of the modular facade
[0059] **11** Frame structure of the facade element
[0060] **12** First horizontal profiles of the frame structure
[0061] **13** Second horizontal profiles of the frame structure
[0062] **15** First vertical profiles of the frame structure
[0063] **16** Second vertical profiles of the frame structure
[0064] **17** Third vertical profiles of the frame structure
[0065] **18** Front part of the prefab panel
[0066] **19** Outer cladding
[0067] **20** Attaching means
[0068] **21** Matching shiplap design
[0069] **22** Joint sealing elements
[0070] **31** Bracket
[0071] **33** Anti-tipping element.
[0072] **34** Connecting plate
[0073] **36** Profile fixing points
[0074] **37** First slotted holes
[0075] **38** First portion
[0076] **39** Holes
[0077] **40** Second portion
[0078] **41** Vertical slot
[0079] **42** Bushing
[0080] **43** Fixing screw
[0081] **44** Levelling screw
[0082] **45** Upper flange

1. A prefab panel for a modular facade of a building, the prefab panel comprising:
a frame structure comprising:
a first and a second horizontal profiles;
a first and a second vertical profile connecting the first and the second horizontal profiles at profile fixing points;
an outer cladding, made of plasterboard, attached to the frame structure; and
attaching means for attaching the outer cladding to the frame structure, wherein
the first and second horizontal profiles and the first and second vertical profiles have a matching shiplap design; and
brackets are attachable to the first and second vertical profiles so as to connect the frame structure to a floor slab of the building, for supporting the prefab panel and facade loads.

2. The prefab panel according to claim **1**, further comprising a connecting plate, interspersed between the brackets and the floor slab for connecting the frame structure to the floor slab.

3. The prefab panel according to claim **1**, wherein the shiplap design of the horizontal profiles is configured so as to allow clamping fit of the outer cladding.

4. The prefab panel claim **1**, wherein the vertical profiles are fixed to the horizontal profiles at the profile fixing points by mechanical means.

5. The prefab panel according to claim **1**, further comprising joint sealing elements outwardly attached to at least one of the horizontal profiles or at least one of the vertical profiles, for providing airtightness and watertightness, the

joint sealing elements preferably being self-adhesive, and comprising a peel-off protective sheet.

6. The prefab panel according to claim **5**, wherein the joint sealing element(s) are located in the whole perimeter of the prefab panel.

7. The prefab panel according to claim **5**, wherein the joint sealing elements are made of foam material.

8. The panel according to claim **1**, further comprising a thermal insulator housed at a rear portion of the frame structure, opposite a front part thereof comprising the outer cladding.

9. The prefab panel according to claim **1**, further comprising at least one third vertical profile, preferably a C profile centrally located, arranged between the first and the second vertical profile.

10. The prefab panel, according to Say claim **1**, wherein the brackets are metallic plates comprising:

a longer first portion, attached to a side of the first and the second vertical profiles; and

a shorter second portion, with a vertical slot, for allocating a curved upper part of the connecting plate, as well as fixing means for fixing the connecting plate to the slot, and levelling means for levelling the connecting plate in height.

11. The prefab panel, according to claim **10**, wherein the fixing means comprise a threaded bushing and a fixing screw, and

the levelling means comprise a levelling screw, located at an upper flange of the second portion.

12. A Method of mounting a modular facade comprising a plurality of the prefab panels of claim **1**, the method comprising the following steps:

a) suspending an initial prefab panel from an inner part of the building by means of a crane located at an inner position on an upper story of the building;

b) fixing the initial prefab panel, together with the brackets mounted to the initial prefab panel, to a building structure, comprising the floor slab, for levelling a position of the prefab panel regarding the floor slab and the total height of the floor of a current story;

c) placing an adjacent prefab panel in a correct position by suspending the adjacent prefab panel using the crane, located in an inner position at the upper story; and

d) fixing said adjacent prefab panel by means of the bracket of the adjacent prefab panel, to the to the building structure.

13. The method of mounting a modular facade, according to claim **12**, further comprising a step of placing joint sealing elements outwardly attached to at least one of the vertical profiles or at least one of the horizontal profiles.

14. The method of mounting a modular facade, according to claim **12**, further comprising the steps of:

mounting an anti-tipping element to a building structure, to reinforce the prefab panel against tipping rotation of the prefab panel;

fixing the prefab panel to the anti-tipping element; and, optionally,

fixing the adjacent prefab panel to the ant-tipping element.

15. A modular facade further comprising a plurality of the prefab panels of claim **1** coupled to each other and to a building structure of a building by using the method of claim **12**.

* * * * *