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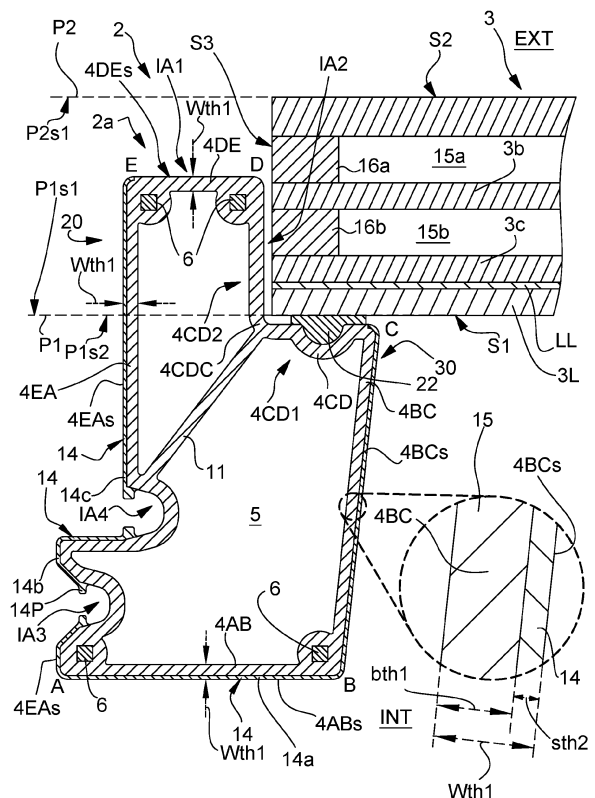
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(57) A roof window is disclosed. The roof window comprises a frame (2, 7) comprising structural, elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) comprising side profiles (2a, 7a), a top profile (2b, 7b) and a bottom profile (2c, 7c). The roof window moreover comprises an insulated glass unit (3) supported by said frame (2). The insulated glass unit (3) comprises a first exterior major surface (S1) and a second exterior major surface (S2) wherein the first and second exterior major surfaces (S1, S2) are oppositely directed. One or more of the structural elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) is a polymer frame profile comprising

- exterior polymer profile walls (4AB-4EA, 7AB-7EA), which together shape and encloses an interior profile space (5, 12), and
- metal reinforcement (6), which reinforces the polymer frame profile (2a, 2b, 2c, 7a, 7b, 7c).

One or more of said exterior polymer profile walls (4AB-4EA, 7AB-7EA) comprises a skin layer (14, 14a-14c) arranged at a structural base wall (15) so as to cover the structural base wall (15). The skin layer (14, 14a-14c) provides one or more of the exterior, visible surfaces (4BCs, 4ABs, 4EAs) of the exterior polymer profile walls (4AB-4EA, 7AB-7EA).

**Fig. 5**

Description**Background**

[0001] Generally, roof windows for installation in a roof structure of a building are popular, since such roof windows may provide e.g. increased inflow of natural light/sunlight, help to provide heating, provide ventilation options and/or the like. However, such roof windows may require a relatively complex window design in order to assure sufficient window strength and/or water tightening. Various prior art discloses insertion of elongated metal profiles with the purpose of frame profile reinforcement in roof windows. Such metal profiles comprises pre-shaped metal plates inserted or attached to a roof window frame profile. Patent document WO2021080445 A1 discloses a roof window equipped with reinforcing sections. Patent document US6427415B1 discloses a roof window comprising an insert that serves as a heat conducting insert and a reinforcing member. Patent document WO2008135048A1 discloses a roof window comprising metal insertions that may serve to strengthen a plastic profile. Patent document PL232782B1 discloses a roof window comprising a frame with metal reinforcement inserts. EP3648945B1 discloses a window profile comprising an outer layer.

[0002] The above mentioned solutions provides advantages with regard to e.g. frame profile strength and/or heat conduction handling. However, the above mentioned solutions may suffer from drawbacks with regards to e.g. window installation and/or environmental impacts.

[0003] The present disclosure e.g. provides solutions for a roof window, which may be advantageous from e.g. a roof window installation perspective and/or may provide a more environmentally friendly solution.

Summary

[0004] The present disclosure relates to a roof window. The roof window comprises a frame comprising structural, elongated frame profiles comprising side profiles, a top profile and a bottom profile. The roof window comprises an insulated glass unit supported by the frame. The insulated glass unit comprises a first exterior major surface and a second exterior major surface wherein the first and second exterior major surfaces are oppositely directed. One or more of the structural elongated frame profiles is a polymer frame profile comprising:

- exterior polymer profile walls, which together shapes and encloses an interior profile space, and
- metal reinforcement, which reinforces the polymer frame profile.

One or more of the exterior polymer profile walls comprises a skin layer arranged at a structural base wall so as to cover the structural base wall. The skin layer provides one or more of the exterior, visible surfaces of the exterior polymer profile walls.

[0005] The present inventors have found that the above-mentioned frame profile design may help to enable providing a lightweight and at the same time strong roof window frame construction which may also provide aesthetically advantageous features due to the skin layer. The skin layer may hence hide the base wall that may not be desired to be visible to the human end user.

[0006] The above mentioned solution may help to enable providing an aesthetically pleasing frame profile design where the overall weight of the roof window may be reduced. This may e.g. enable easier installation and/or enhance working environment during roof window installation. The requirements to the structural strength of roof windows are often high, as the roof window may be needed, as a safety precaution, to be able to carry the weight of a person, the weight of a thick layer of snow and/or the like. A structurally strong base wall may e.g. help to obtain this.

[0007] Some roof windows may be designed and configured to be installed in inclining roofs having e.g. a roof pitch above 20 degrees. These types of roof windows may comprise a movable frame and be of the top hung or centre hung type, or they may be un-openable. Such roof windows may be installed manually, in some occasions by one or more persons lifting one or more parts of the roof window from the interior of the building to the roof aperture to be covered by the roof window, prior to fixating the roof window in the roof structure. The present disclosure may enable providing a more lightweight roof window for such an installation method, or generally, where installation personnel may need to carry parts of the window. This may e.g. provide advantages as persons need to carry a lower weight to carry to the building loft/upper room part and to lift into the roof aperture.

[0008] Additionally or alternatively, the frame profile design according to various embodiments of the present disclosure may enable less frame profile material use, which may provide a more environmental friendly roof window solution with regards to reducing CO₂ emission. The reduced material use may relate to one or both of polymer frame wall material use and/or metal reinforcement material use.

[0009] Enhanced reuse options of the frame at end of life of the profile may also be obtained by embodiments of the present disclosure.

[0010] The skin layer and base wall material may bond to each other, e.g. as a result of a co-extrusion process.

[0011] The metal reinforcement e.g. provide one or more advantages relating to one or more of structural strength in high temperature roof environment, recycling options and carbon footprint.

[0012] In one or more embodiments of the present disclosure, the skin layer may be interrupted at one or more interruption areas around the exterior boundary of the respective elongated frame profiles.

[0013] This may help to reduce the use of skin layer material, such as reduce the use of new/virgin skin layer material.

[0014] The skin layer may in embodiments comprise or consist of new material/virgin material.

[0015] The skin layer may in embodiments comprise or consist of recycled material.

[0016] The skin layer may additionally or alternatively provide improved resistance to the environment exterior to the profile, which may hence help to improve window lifetime.

[0017] In one or more embodiments of the present disclosure, less than 95%, such as less than 80%, such as less than 60% of the exterior surface of the total exterior boundary of the frame profile may be provided by the skin layer.

[0018] In one or more embodiments of the present disclosure, between 40% and 95%, such as between 50%, and 90%, such as between 50% and 70% of the exterior surface of the total exterior boundary of the frame profile may be provided by the skin layer.

[0019] In one or more embodiments of the present disclosure, between 30% and 95%, such as between 40%, and 90%, such as between 50% and 60% of the exterior surface of the total exterior boundary of the frame profile may be provided by the skin layer.

[0020] In one or more embodiments of the present disclosure, the skin layer comprises a plurality of discrete skin layers which are distributed around the exterior boundary of the respective elongated frame profile.

[0021] This may e.g. help to even further reduce the skin layer material use.

[0022] Discrete skin layers may hence be separated by said interruption areas where the skin layer is omitted. These interruption areas may be arranged at locations which, during normal roof window use (such as when the window is in a closed or open position, if comprising a movable frame), may not be visible to a human user, e.g. due to being covered by a movable frame, a fixation frame, one or more covers and/or the glass unit.

[0023] In embodiments of the present disclosure, said interruption may comprise or be covered by one or more seals such as gaskets. This seal/seals may be retrofitted or coextruded.

[0024] In embodiments of the present disclosure, the skin layer(s) may extend substantially in the full length of the respective profile.

[0025] In embodiments of the present disclosure, the base wall material is exposed at the profile exterior where the skin layer is interrupted.

[0026] This may e.g. help to provide a simplified frame profile. This may e.g. help to increase cost efficiency and/or improve environmental advantages and/or improve options at "end of life time" recycling of the frame profile.

[0027] In embodiments of the present disclosure, the base wall material substantially provides the total wall thickness of the wall at the one or more interruption areas. Said total wall thickness at the interruption area may in further embodiments of the present disclosure substantially correspond to the total wall thickness provided by sum of the thickness of the skin layer and the thickness of the base wall that is covered by the skin layer.

[0028] This may e.g. be an advantage in relation to profile manufacturing, such as co-extrusion where base wall and skin layer(s) is/are extruded together, it may provide mechanical advantages and/or the like.

[0029] In one or more embodiments of the present disclosure, the general wall thickness of the exterior polymer profile walls which together provides the outer boundary of the profile is may be substantially the same at exterior walls comprising the skin layer and at exterior walls comprising the interruption areas.

[0030] The total thickness may be determined at locations where no elongated elevations, metal reinforcement or the like is present. For example a total thickness of a generally flat exterior wall part.

[0031] In one or more embodiments of the present disclosure, said frame comprises a rectangular, movable frame of the roof window, wherein the movable frame is movably attached to a fixation frame of the roof window by means of a hinge arrangement comprising one or more hinges.

[0032] In one or more embodiments of the present disclosure, the hinge arrangement may be configured to provide a rotation axis for the movable frame.

[0033] The rotation axis may generally, in various embodiments of the present disclosure, be substantially parallel to the longitudinal direction of the top profile and bottom profile of the movable frame may be perpendicular to the longitudinal direction of the side profiles.

[0034] The rotation axis may generally, in various embodiments of the present disclosure, be substantially perpendicular to the longitudinal direction of the side profiles.

[0035] The skin layer may in embodiments of the present disclosure cover the base wall at one or more exterior walls of the movable frame which is/are configured to be visible when the movable frame is in a closed position and/or in an open position,

[0036] Additionally or alternatively, the skin layer may in embodiments of the present disclosure cover the base wall at one or more exterior walls of the fixation frame which is/are configured to be visible when the movable frame is in a

closed position and/or in an open position.

[0037] This may e.g. help to obtain an aesthetically desirable roof window solution comprising a movable frame.

[0038] The movable frame may support the insulated glass unit which may be attached to the movable frame. The fixation frame supports the movable frame, e.g. by means of the hinge arrangement.

[0039] In embodiments of the present disclosure, all the exterior walls of the respective profile may comprise the base wall material, for example both the at interruption areas and at the areas comprising the skin layer that covers the base wall. The base wall material may hence provide a unitary structural profile wall structure (e.g. obtained by extrusion) extending uninterrupted around the entire cross sectional profile shape, and may hence also be present at the profile corners.

[0040] In one or more embodiments of the present disclosure, one or more covers of the roof window, such as external covers, is/are arranged to cover and hide one or more of said interruption areas.

[0041] In one or more embodiments of the present disclosure, said one or more covers comprises one or more of

- an elongated water cover
- a drain channel profile and/or
- a side cover configured to cover a side part of an exterior surface of a fixation frame profile wall surface facing away from a fixation frame opening.

[0042] This may e.g. provide a more cost efficient and/or environmentally friendly yet aesthetically desirable roof window design.

[0043] Roof windows use external covers also known as cladding to ensure a water tight assembly and to provide long weather resistant finish. There may e.g. be substantially no skin present at the locations overlapped by said external covers. The covers extend from the exterior edge of the glass and extend to the roof covering surface.

[0044] In one or more embodiments of the present disclosure, said skin layer may be arranged to at least provide an exterior surface of an exterior wall of the frame profile that is configured to face the interior of the building and arranged to be visible after roof window installation. In one or more embodiments of the present disclosure, said skin layer may moreover be arranged to provide an exterior surface at an exterior wall of the frame profile that faces and is proximate the frame opening provided by the frame, such as wherein said skin layer overlaps a corner where said exterior walls meet.

[0045] Such surfaces are desirable to be covered by the skin layer in order to obtain an aesthetically pleasing frame profile design and a durable weather resistant surface increasing the service life of the window.

[0046] In one or more embodiments of the present disclosure, said skin layer may comprise or consist of an acrylonitrile styrene acrylate (ASA) material.

[0047] Such skin layer material may be advantageous for use as skin layers.

[0048] In one or more embodiments of the present disclosure, said skin layer may comprise or consist of a polypropylene (PP) material skin layer.

[0049] Such skin layer material may be advantageous for use as skin layers.

[0050] In one or more embodiments of the present disclosure, the skin layer comprises or consist of a polypropylene (PP) material arranged to cover a polypropylene (PP) base wall, such as a polypropylene (PP) base wall comprising reinforcing fibres embedded therein.

[0051] In one or more embodiments of the present disclosure, the skin layer comprises or consist of an acrylonitrile styrene acrylate (ASA) material arranged to cover a polyvinyl chloride (PVC, CPVC) base wall, such as a base wall comprising or consisting of a chlorinated Polyvinyl chloride (CPVC) material.

[0052] Such material combinations may e.g. be advantageous from a compatibility point of view and hence e.g. be advantageous for use e.g. during profile extrusion. The materials may additionally or alternatively be advantageous for roof window use due to e.g. heat resistance and structural properties at higher temperatures. Roof windows may be exposed to double light intensity compared to vertical windows.

[0053] In one or more embodiments of the present disclosure, the skin layer and the structural base wall may together provide the total thickness of the respective exterior polymer profile wall, wherein the skin layer has a thickness of between 1% and 40%, such as between 10% and 30%, for example between 20% and 27% of the total thickness of the respective of the exterior wall.

[0054] This may e.g. provide an advantageous trade off between skin layer robustness, wall strength and base wall material use.

[0055] In some embodiments of the present disclosure, the skin layer may have a thickness between 0.2 mm and 1 mm, such as between 0.3 mm and 7 mm, such as between 0.4 mm and 0.6 mm.

[0056] In one or more embodiments of the present disclosure, the thickness of the skin layer and the thickness of the structural base wall together may provide the total wall thickness of the respective exterior polymer profile wall.

[0057] This may help to provide a lightweight yet strong frame profile design.

[0058] In one or more embodiments of the present disclosure, said total wall thickness may be between 1 mm and 4

mm, such as between 1.3 mm and 2.5 mm, such as between 1.7 mm and 2.3 mm.

[0059] This may help to provide a lightweight yet strong and aesthetically acceptable frame profile design. It may e.g. additionally or alternatively help to reduce carbon footprint and/or provide a more cost efficient solution.

[0060] In some embodiments, the exterior profile wall(s) comprising the skin layer may consist of the base wall material and the skin layer.

[0061] In one or more embodiments of the present disclosure, the metal reinforcement comprises a plurality of discrete, elongated metal bars which each extend in the longitudinal direction of the polymer frame profile, wherein the discrete, elongated metal bars are secured to one or more of the exterior polymer profile walls,

[0062] In one or more embodiments of the present disclosure, the discrete, elongated metal bars are secured to one or more of the exterior polymer profile walls by means of being embedded therein.

[0063] This may e.g. help to enable a frame profile design where metal reinforcement material usage may be reduced, thereby e.g. obtaining environmental advantages or a more lightweight roof window. Embedding the metal profiles may e.g. additionally or alternatively provide advantages with regards to cost efficiency may be obtained.

[0064] Embedding the metal reinforcement bars in the exterior polymer profile walls may e.g. in some embodiments, be obtained by means of co-extruding the base wall, skin layer and metal bars.

[0065] In one or more embodiments of the present disclosure, the discrete, elongated metal bars are secured to one or more of the exterior polymer profile walls by means of being engaged in one or more slot tracks formed as integrated parts of the polymer profile walls.

[0066] This may e.g. help to enable a frame profile design where metal reinforcement material usage may be reduced, thereby e.g. obtaining environmental advantages or a more lightweight roof window.

[0067] Securing the metal reinforcement bars in slot tracks may in some embodiments be obtained by means of protrusions (e.g. in the base wall material) that extends into the interior profile space.

[0068] In one or more embodiments of the present disclosure, the total weight of metal reinforcement per meter of the polymer frame profile may be less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg. per meter frame profile.

[0069] This may e.g. help to obtain environmental advantages and/or a more lightweight roof window.

[0070] In one or more embodiments of the present disclosure, the total weight of polymer wall material per meter of the polymer frame profile, such as per meter of one or more of a side profile, a top profile and/or a bottom profile of the frame, may be less than 1.1 kg, such as less than 0.9 kg, such as less than 0.7 kg per meter frame profile.

[0071] This may e.g. help to obtain environmental advantages and/or a more lightweight roof window. In embodiments where the polymer comprises polypropylene, a further reduced weight advantage may be provided.

[0072] In one or more embodiments of the present disclosure, the total weight of the profile wall material and metal reinforcement per meter of the polymer frame profile, such as per meter of one or more of a side profiles, a top profile and/or a bottom profile of the roof window, may be less than 1.5 kg, such as less than 1.2 kg per meter polymer frame profile.

[0073] This may e.g. help to obtain environmental advantages and/or a more lightweight roof window. This may exclude any weight of e.g. a hinge arrangement, heat insulation material provided in the interior profile space (if present) and/or the like.

[0074] In one or more embodiments of the present disclosure, the first exterior major surface may be configured to face the building interior and the second exterior major surface may be configured to face the exterior of the building when the roof window is installed in a building roof structure.

[0075] In one or more embodiments of the present disclosure, the first exterior major surface is comprised in a first plane and the second exterior major surface is comprised in a second plane.

[0076] In one or more embodiments of the present disclosure, the second plane may be un-penetrated by the polymer frame profile

[0077] In one or more embodiments of the present disclosure, the first plane may be un-penetrated by the polymer frame profile.

[0078] In one or more embodiments of the present disclosure, the exterior, visible surface of said skin layer may be uncoated and provide the exterior surface of the respective wall that faces away from the interior profile space.

[0079] In one or more embodiments of the present disclosure, the frame comprises a fixation frame and a movable frame. The fixation frame may comprise structural, elongated fixation frame profiles comprising side profiles, a top profile and a bottom profile, wherein said fixation frame profiles together provides a fixation frame opening.

One or more of the elongated fixation frame profiles may be a polymer frame profile comprising:

- exterior polymer profile walls enclosing an interior fixation profile space, and
- metal reinforcement, which reinforces the polymer frame profile,

The metal reinforcement of the fixation frame may comprise a plurality of discrete, metal bars, which extends in the longitudinal direction of the fixation frame profile and which are secured to one or more of the polymer profile walls.

[0080] One or more of said exterior polymer profile walls of the fixation frame may comprise a skin layer and a structural

base wall, wherein said skin layer provides one or more of the exterior, visible surfaces of the exterior polymer profile walls of the fixation frame profiles.

[0081] In one or more embodiments of the present disclosure, said skin layer may cover a base wall of one or more fixation frame profiles at areas which are configured to be visible (to a human end user) when the movable frame is in a closed position and/or in an open position.

[0082] In one or more embodiments of the present disclosure, the elongated frame profiles may each have a longitudinal direction, a width and a height.

[0083] In one or more embodiments of the present disclosure, one or more of the elongated frame profiles, such as the side profile and/or the top profile, comprises

- a first corner, a second corner, and an exterior wall part interconnecting said first and second corner, and
- a third corner, and an exterior wall part interconnecting said second and third corner. In some embodiments, said exterior wall interconnecting said second and third corner faces the frame opening.

[0084] In one or more embodiments of the present disclosure, one or more of the elongated frame profiles, such as the side profile and/or the top profile, moreover comprises:

a fourth corner, and an exterior wall part which interconnects said third and fourth corner, wherein the exterior wall part which interconnects said third and fourth corner comprises a recessed portion extending in the longitudinal direction of the profile, wherein the recessed portion is provided by means of

- a first wall portion of the exterior wall part interconnecting said third and fourth corner, which first wall portion faces and supports a part of an exterior major surface of the insulated glass unit, and
- a second wall portion, which is placed opposite to a side surface of the insulated glass unit.

[0085] In one or more embodiments of the present disclosure, one or more of the elongated frame profiles, such as the side profiles and/or the top profile, moreover comprises:

a fifth corner and an exterior wall part interconnecting said fourth and fifth corner, and an exterior wall part interconnecting said fifth and first corner,

wherein the interior profile space is placed between the exterior wall interconnecting the fifth and first corner and the exterior wall interconnecting the second and third corner, wherein the exterior wall interconnecting the fifth and first corner comprises an exterior surface facing away from the frame opening.

[0086] In one or more embodiments of the present disclosure, the exterior wall interconnecting the fifth and first corner comprises an exterior surface that faces away from the frame opening and faces towards a frame profile of a fixation frame.

[0087] In one or more embodiments of the present disclosure, a metal bar of the metal reinforcement may be arranged at one or more of the first corner, the second corner, the fourth corner and/or the fifth corner.

[0088] In one or more embodiments of the present disclosure, the metal reinforcement comprises, such as consist of, less than ten elongated metal bars, such as less than seven metal bars, such as five metal bars or less.

[0089] In one or more embodiments of the present disclosure, said metal reinforcement comprises between two and ten metal bars, such as between two and five metal bars (including both end points).

[0090] In one or more embodiments of the present disclosure, said metal bars may each have a cross sectional area that is less than 25 mm^2 such as less than 15 mm^2 , such as less than 10 mm^2 .

[0091] In one or more embodiments of the present disclosure, the metal bars may have a diameter less than 5 mm, such as 4 mm or less, for example 3 mm or less.

[0092] In one or more embodiments of the present disclosure, said metal bars each have a cross sectional area that is between 1 mm^2 and 30 mm^2 such as between 2 mm^2 and 15 mm^2 , such as between 3 mm^2 and 10 mm^2 .

[0093] In one or more embodiments of the present disclosure, the total cross sectional area of metal reinforcement may be between 4 mm^2 and 115 mm^2 , such as between 14 mm^2 and 60 mm^2 , such as between 20 mm^2 and 40 mm^2 .

[0094] In one or more embodiments of the present disclosure, the one or more skin layers and a structural base wall may be are co-extruded wall parts providing the respective wall.

[0095] In one or more embodiments of the present disclosure, the thickness of the skin layer may be lower than the thickness of the base wall.

[0096] In one or more embodiments of the present disclosure, one, more or all of said polymer profile walls which together shapes the outer boundary of the profile may be exterior structural walls.

[0097] In one or more embodiments of the present disclosure, the skin layer may have a substantially insignificant contribution to the structural integrity of the profile.

[0098] In one or more embodiments of the present disclosure, the skin layer may provide a minor contribution to the

structural integrity of the profile.

[0099] The present disclosure moreover relates to a building comprising one or more roof windows installed in a roof structure of a building, wherein said one or more roof windows is a roof window:

- 5 - according to any of the preceding embodiments,
- according to any of the items and/or
- according to one or more of the claims.

Figures

[0100] Aspects of the present disclosure will be described in the following with reference to the figures in which:

fig. 1 : illustrates a roof window comprising a polymer frame profile according to embodiments of the present disclosure,

fig. 2 : illustrates a roof window comprising a polymer frame profile according to further embodiments of the present disclosure,

fig. 3 : illustrates a roof window comprising a polymer frame profile and a glass unit overlapping a large part of the profile width, according to embodiments of the present disclosure,

fig. 4 : illustrates a roof window comprising a fixation frame and a movable frame, according to embodiments of the present disclosure,

fig. 5 : illustrates a roof window comprising a polymer frame profile comprising one or more skin layers, according to embodiments of the present disclosure,

fig. 6 : illustrates a roof window comprising a fixation frame and a movable frame, according to further embodiments of the present disclosure,

fig. 7 : illustrates a polymer top profile of a roof window according to further embodiments of the present disclosure,

fig. 8 : illustrates a polymer bottom profile of a roof window according to further embodiments of the present disclosure,

fig. 9 : illustrates a roof window comprising a fixation frame and a movable frame, according to still further embodiments of the present disclosure,

fig. 10 : illustrates a roof window comprising a polymer frame profile comprising slot tracks with metal bars arranged therein, according to embodiments of the present disclosure,

figs. 11-13 : illustrates a roof window comprising a polymer frame profile comprising embedded metal bars according to various embodiments of the present disclosure,

figs. 14-15 : illustrates a roof window comprising a polymer frame profile comprising slot tracks with metal bars arranged therein, according to further various embodiments of the present disclosure,

fig. 16 : illustrates a building comprising roof windows installed in a building roof structure, according to embodiments of the present disclosure,

fig. 17 : illustrates a roof window comprising slot tracks that secures plate shaped metal bars at external profile walls, wherein the metal bars have a width that extends diagonally inside the polymer frame profile, according to embodiments of the present disclosure, and

fig. 18 : illustrates a roof window comprising slot tracks that secures metal bars at external profile walls, where the metal bars have a width that extends along an interior surface of an exterior frame profile wall.

Detailed description

[0101] Fig. 1 illustrates schematically a part of a frame 2 of a roof window 1 according to various embodiments of the present disclosure.

[0102] The frame of the window 1 comprises structural, elongated frame profiles 2a, 2b, 2c comprising side profiles 2a, a top profile 2b and a bottom profile 2c (see e.g. fig. 9).

[0103] A cross section of the side profile 2a is illustrated in fig. 1. The side profiles, top profile and bottom profile together provides a frame opening 2d through which light such as sunlight entering through the insulating glass unit can pass.

[0104] The cross section is provided transverse to the longitudinal direction of the profile 2a.

[0105] An insulating glass unit 3 is supported by the frame 2. The insulating glass unit 3 may be attached to the frame 2 by means of fastening means (not illustrated) such as comprising mechanical fastening means (e.g. screws, clamping, a clips system and/or the like) and/or an adhesive, such as be adhered to the frame by a bond seal and/or an adhesive. Such fastening means are not illustrated in fig. 1.

[0106] The insulating/insulated glass unit 3 comprises a plurality of glass sheets 3a-3c, and insulating gaps 15a, 15b are provided between the glass sheets. The insulated glass unit 3 in the illustrated embodiment comprises three glass sheets 3a-3c. Fewer or more glass sheets 3a-3L may be provided in other embodiments. These glass sheets have major surfaces arranged parallel to each other. The insulating glass unit 3 comprises a first, outer glass sheet 3a, a third glass sheet 3c, and a second intermediate glass sheet 3b. The second intermediate glass sheet 3b is placed between the first glass sheet 3a and the third glass sheet 3c. Generally, the first glass sheet 3a may be configured to face the exterior EXT of the building when the roof window 1 is installed in a roof structure of the building and may provide the exterior major surface S2. A first insulating gap 15a is provided between an inner, major surface of the first outer glass sheet 3a and a major surface of the second, intermediate glass sheet 3b. The first insulating gap 15a is sealed by means of a first edge seal 16a. A second insulating gap 15b is provided between another major surface of the second, intermediate glass sheet 3b, and a major surface of the third glass sheet 3c. The second insulating gap 15b is sealed by means of a second edge seal 16b. The edge seals 16a, 16b of the insulated glass unit 3 may in embodiments of the present disclosure comprise spacer bars. Such spacer bars, that may be common, comprises a metal profile, a composite profile, a structural foam or TPS (thermoplastic) and/or the like. Other spacer bars may be used. Spacer bar may in some embodiments comprise a desiccant for absorbing moisture. The edge seal 16a, 16b functions as a gas barrier sealant to keep an insulating gas (commonly argon) in the insulating gap 4a, 4b for the lifetime of the insulated glass unit 3. The edge seal(s) 6a, 6b may also structurally hold the glass panes 3a-3c joined as a single, insulating glass unit 3. One or more of the glass sheets 3a-3c may be thermally tempered or may be annealed glass sheets.

[0107] In other embodiments of the present disclosure (not illustrated), the glass unit 3a may be a vacuum insulated glass (VIG) unit a reduced pressure is provided in one or more gaps 15a, 15b, and where a plurality of support structures/spacers are distributed in the gap to maintain distance between the glass sheets, due to the reduces pressure.

[0108] The insulating glass unit 3 may in further embodiments be a laminated glass unit as illustrated. Hence, a further lamination glass sheet 3L is attached to the exterior surface of the third glass sheet 3c that faces away from the gap 15b by means of a lamination layer LL, such as an adhesive. The lamination layer LL may for example comprise EVA (Ethylene Vinyl Acetate) or PVB (Polyvinyl butyral) and should be transparent to visible light so that sunlight can pass through the insulated glass unit 3. Other types of lamination materials may be used. These lamination material should preferably be transparent to light in at least the visible spectrum. The lamination of the insulated glass unit 3 may provide safety, and may e.g. be advantageous in roof windows. Although the glass sheet 3c may be considered the inner glass sheet of the insulated glass unit 3, the lamination glass sheet 3L is often arranged as the innermost glass sheet of the window (when the movable frame, if present, is in a closed position), and may provide the exterior major surface S1 of the insulating glass unit for facing, such as abutting, the interior INT of the building.

[0109] The lamination glass sheet 3a may be configured to face the building interior. The lamination glass sheet 3L in fig. 1 may comprise the major surface S1.

[0110] The insulated glass unit 3 comprises a first exterior major surface S1 and a second exterior major surface S2. The first and second exterior major surfaces S1, S2 are oppositely directed and substantially parallel. The surface S1 is configured to face the interior of a building INT.

[0111] The surface S1 is configured to face the exterior EXT of a building. This may e.g. be the case if the frame 2 is an unmovable frame (i.e. where no hinge arrangement is provided between the frame 2 and a fixation frame (see e.g. fixation frame 7 in figs 4 or 5). If the frame is a movable frame that is connected to a fixation frame, the surface S1 is configured to face the building interior INT when the movable frame is in a closed position.

[0112] The frame profile 2a is a structural, elongated frame profile, and is a polymer frame profile. The polymer frame profile comprises polymer profile walls 4AB-4EA. These may be exterior walls as illustrated. The exterior walls 4AB-4EA together shape and enclose one or more longitudinally extending interior profile spaces 5. In case more than one space 5 is provided, the spaces are separated by one or more interior partition walls 11.

[0113] The exterior polymer profile walls 4AB-4EA are structural walls and together these shapes the outer boundary of the profile. A skin layer (skin layer is not illustrated in fig. 1 but is described in more details further below) may be provided and in this case provide a surface of the outer boundary.

[0114] The profile 2a may in embodiments of the present disclosure be an extruded profile that is manufactured by means of extrusion.

[0115] The profile 2a moreover comprises metal reinforcement, which reinforces the polymer frame profile 2a. The metal reinforcement comprises a plurality of discrete metal bars 6 such as discrete solid metal bars. Each of these bars 6 extend in the longitudinal direction of the frame profile 2a and are secured to one or more of the polymer profile walls 4AB-4EA. In fig. 1, the metal bars 6 extend in the longitudinal direction of the frame profile 2a are secured to one or more of the polymer profile walls 4AB-4EA by being embedded therein. In this case, this may e.g. be obtained by for example co-extruding the metal bars 6 and the profile walls 4AB-4EA.

[0116] In embodiments of the present disclosure, the structural frame profile 2a consists of polymer profile walls 4AB-4EA, 11 and the metal reinforcement.

[0117] In one or more embodiments of the present disclosure, the polymer frame profile 2a consists of polymer profile walls, said metal reinforcement and one or more skin layers 14 (see e.g. fig. 5 and the description relating thereto).

[0118] The illustrated profile may as illustrated also comprise, in some embodiments, comprise one or more partition walls 11. This/these may be integrated in the profile and also be provided by means of/during profile extrusion. Such partition walls provides a plurality of longitudinally extending interior profile spaces within the polymer frame profile.

[0119] In some embodiments of the present disclosure, the number of longitudinally extending interior profile spaces within the polymer frame profile may be less than six, such as less than five, such as less than four, such as less than three, such as less than two. In fig. 1, two longitudinally extending interior profile spaces are provided, these are separated by the partition wall 11 that is an integral part of the profile 2a.

[0120] One or more of the one or more longitudinally extending interior profile spaces which is/are enclosed by the exterior walls 4AB-4EA may in embodiments of the present disclosure be filled with a heat insulation material. This may e.g. comprise one or more of a natural fibre insulation such as a wood fibre insulation, an expanded polymer insulation such as an expanded polystyrene insulation, a fibre insulation, such as a glass fibre insulation and/or the like.

[0121] The profile 2a may hence be a hollow structural profile that is filled with a heat insulating material in one or more interior longitudinally extending profile spaces.

[0122] In some embodiments, one or more longitudinally extending interior profile spaces may be left empty and hence only filled with air.

[0123] The U_{frame} value of the polymer frame 2, such as the polymer frame profile, (with or without heat insulating material in the profile interior 5) may in embodiments of the present disclosure be below $1.2 \text{ W/m}^2\text{K}$, such as below $1.0 \text{ W/m}^2\text{K}$.

[0124] In other embodiments of the present disclosure, one or more of the discrete metal bars 6 may be secured to one or more of the polymer profile walls by being engaged in one or more slot tracks formed as integrated parts of the polymer profile walls (see e.g. one or more of figs. 10, 14-15 and 17-18 and the description thereto).

[0125] The elongated metal bars 6 may as illustrated be solid metal bars. The metal bars 6 may extend in parallel, longitudinal directions and may thus be parallel to each other.

[0126] In fig. 1, the metal bars 6 are positioned at different corner portions A-E of the profile cross section. Two of the exterior polymer profile walls 4AB-4EA meet at these corner portions. The metal bars 6 may as illustrated be positioned at a plurality of different corner portions A-E of the profile 2a.

[0127] One or more of the metal bars 6 may as illustrated be positioned at a corner portion A-E providing exterior wall surfaces 4BCs, 4ABs extending with a mutual angle α_1 larger than 180° such as larger than 250° . This is in the illustrated example e.g. the case for the corners A, B, C, D, E. This may depend on the roof window design. For example, if the roof window comprises a fixation frame and the frame profile 2a is a part of a movable frame, The fixation frame may be arranged to cover some of the exterior profile 2a surfaces.

[0128] The metal bars 6 are in fig. 1 positioned in or at a wall 4AB, 4BC and/or a corner A,B,C which comprises an exterior surface 4ABs, 4BCs configured to be visible and face interior INT of a building and/or the frame opening 2d provided by the polymer frame profiles of the frame.

[0129] For example, the walls 4BA and 4AB meet at the second corner B. These walls comprises surfaces 4ABs, 4BCs configured to be visible and face interior INT of a building and the frame opening 2d provided by the polymer frame profiles of the frame, respectively. The corner B hence provides the transition between an exterior wall surface 4ABs that faces away from the plane P1, and a wall surface 4BCs facing the frame opening.

[0130] The wall surfaces 4BCs, 4ABs at the corner portion B may in embodiments extend from the corner B portion with a mutual angle α_1 that is larger than 180° , such as larger than 250° (as is the case in fig. 1).

[0131] In fig. 1, the angle α_1 between the exterior wall surfaces meeting at the respective corner portions A, B, C, D, E all extend with a mutual angle α_1 that is larger than 180° , such as larger than 250° .

[0132] It is understood that the exterior wall surfaces 4ABs, 4BCs, 4DEs, 4EAs faces away from the profile interior 5.

[0133] The second exterior major surface S2 of the glass unit 3 is configured to face the exterior EXT of the building when the window 1 is installed (according to installation instructions) in a building roof structure. The second exterior major surface S2 is comprised in a second plane P2. This may also be understood as the surface S2 provides/defines the second plane P2.

[0134] The second plane P2 is in fig. 1 un-penetrated by the polymer frame profile 2a. Hence the exterior surfaces 4DEs, of the exterior polymer profile walls 4DE of the polymer frame profile 2a which is placed proximate the second plane P2 faces and is placed with a distance DIS1 to the side P2s of the second plane P2 which faces the first plane P1. The first plane P1 is defined by the exterior major glass unit surface S1.

[0135] The first plane P1 has a first side P1s1 that faces the second plane P2 and a second side P1s2 that faces away from the second plane P2. The second plane P2 has a first side P2s1 that faces the first plane P1 and a second side P2s2 that faces away from the first plane P1.

[0136] The metal bars 6 at the corners E and D are positioned at a position opposite to a side surface S3 of the insulating glass unit 3. This side surface 3 extends between the first exterior major surface S1 and the second, oppositely directed, exterior major surface S2 of the insulated glass unit 3. The side surface S3 extends over/opposite to a plurality of side edges of the glass sheets 3a-3L and over the edge seals 16a 16b.

[0137] In some embodiments, at least two metal bars 6 of the metal reinforcement may be secured to the same polymer profile wall. This is in the illustrated example the case for the wall 4AB where three metal bars 6 are secured to the same polymer profile wall (one metal bar 6 at each corner A, B, and one bar 6 between the corners A, B). At wall 4DE, two metal bars 6 are secured to the same polymer profile wall 4DE.

[0138] The insulated glass unit 3 comprises the side surface S3 which extends between the first exterior major surface S1 and the second exterior major surface S2. A frame profile part 20 of the polymer frame profile 2a, 2b is arranged opposite to the side surface S3 of the insulated glass unit. This provides that a part of the interior profile space 5 extends to a position opposite the side surface S3.

[0139] In fig. 1, the metal bars 6 are secured to an exterior wall 4CD2, 4DE, 4EA, such as a corner D, E, of the frame profile part which is arranged opposite to the side surface S3.

[0140] One or more of the metal bars 6 may hence be positioned at the side P1S1 of the first plane P1, which faces the second plane P2. This is the case for the metal bars at corner portions E and D in fig. 1. These metal bars may in further embodiments, as illustrated in fig. 1, be placed between the planes P1, P2, which is the case in fig. 1.

[0141] One or more, such as all, of the metal bars 6 may extend substantially along the total frame profile length.

[0142] In the roof window, the insulating glass unit 3 may be arranged substantially on top of the frame 2 and the frame 2 may substantially extend below and away from the insulating glass unit 3. Hence, after window installation, the profile 2a carries a part of the glass unit weight, which is transferred to the profile by mean of a major surface S1 of the glass unit.

[0143] The polymer profile walls 4AB-4EA enclosing the interior profile space 5 are integrated walls.

[0144] In one or more embodiments of the present disclosure, the weight ratio between the total weight of metal reinforcement 6 per meter of the polymer frame profile and the total weight of the polymer wall material per meter of the polymer frame profile 2a may be less than 1, such as less than 0.6, such as less than 0.5.

[0145] In one or more embodiments of the present disclosure, the ratio between the total weight of metal reinforcement 6 per meter of the polymer frame profile 2a and the total weight of the polymer wall material Wpw per meter of the polymer frame profile 2a, 2b, 2c may be less than 0.5, such as less than 0.4, such as less than 0.2.

[0146] In one or more embodiments of the present disclosure the ratio $\left(\frac{W_{mre}}{W_{pw}}\right)$ between the total weight of metal reinforcement 6 per meter of the side profiles 2a and the total weight of the polymer wall material per meter of the side profiles 2a may be at least 1.5 times larger, such as at least 1.9 times larger, such as at least 2.1 times larger than the ratio between the total weight of metal reinforcement 6 per meter of the top profile 2b and/or bottom profile 2c and the total weight of the polymer wall material Wpw per meter of the top profile 2b and/or bottom profile 2c.

[0147] The total weight of the profile wall material and metal reinforcement per meter of the polymer frame profile 2a, 2b, 2c such as per meter of one or more of the side profiles 2a, the top profile 2b and/or the bottom profile 2c of the roof window, may be less than 1.5 kg, such as less than 1.2 kg per meter polymer frame profile 2a, 2b, 2c. See e.g. also figures described below (such as e.g. figs. 7-8) relating to embodiments of a top frame profile and a bottom frame profile respectively, according to embodiments of the present disclosure.

[0148] The total weight of polymer wall 4AB-4EA, 11 material per meter of the polymer frame profile, such as per meter of one or more of the side profiles 2a, the top profile 2b and/or the bottom profile 2c of the frame 2 of the roof window, may in embodiments of the present disclosure be less than 1.1 kg, such as less than 0.9 kg, such as less than 0.7 kg per meter frame profile 2a, 2b, 2c.

[0149] In one or more embodiments of the present disclosure, the total weight of polymer wall material per meter of the polymer frame profile 2a, such as per meter of one or more of the side profiles 2a, the top profile 2b and/or the bottom

profile 2c, may be at least 0.3 kg, such as at least 0.4 kg, such as at least 0.5 kg, such as at least 0.7 kg per meter frame profile.

[0150] For example, the total weight of polymer wall 4AB-4EA, 11 material per meter of the polymer frame profile, such as per meter of one or more of the side profiles 2a, the top profile 2b and/or the bottom profile 2c of the frame 2 of the roof window 1, may in embodiments of the present disclosure be between 0.3 kg and 1.1 kg, such as between 0.4 kg and 0.9 kg, for example between 0.5 kg and 0.9 kg.

[0151] In some embodiments of the present disclosure, the total weight of polymer wall 4AB-4EA, 11 material per meter of the polymer frame profile, such as per meter of one or more of the side profiles 2a, the top profile 2b and/or the bottom profile 2c of the frame 2 of the roof window 1, may in embodiments of the present disclosure be between 0.4 kg and 0.9 kg, such as between 0.4 kg and 0.7 kg.

[0152] In one or more embodiments of the present disclosure, the total weight of metal reinforcement 6 per meter of the polymer frame profile, such as one or more of the side profiles 2a, the top profile 2b and/or the bottom profile 2c may be less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg. per meter frame profile 2a, 2b, 2c.

[0153] In one or more embodiments of the present disclosure, the density of the polymer wall 4AB-4EA material is between 1100 kg/m³ and 1800 kg/m³, such as between 1300 kg/m³ and 1600 kg/m³, such as between 1400 kg/m³ and 1600 kg/m³.

[0154] In one or more embodiments of the present disclosure, the density of the metal of the metal reinforcement may be between 5800 kg/m³ and 9000 kg/m³, such as between 6800 kg/m³ and 8500 kg/m³, such as between 7750 kg/m³ and 8050 kg/m³.

[0155] The metal of the metal reinforcement may in embodiments of the present disclosure be or comprise steel such as stainless steel or surface coated metal, such a galvanized metal such as for example galvanized steel.

[0156] In one or more embodiments of the present disclosure, the volume of the polymer profile wall material 4AB-4EA, 11 per meter of said polymer frame profile is between 2.0E-4 m³/m and 1.0E-3 m³/m, such as between 2.0E-3 m³/m and 8.0E-4 m³/m, such as between 3.0E-4 m³/m and 6.0E-4 m³/m.

[0157] In one or more embodiments of the present disclosure, the volume of the metal of the metal reinforcement per meter of the polymer frame profile may be between 1.0E-5 and 5.0E-5 m³/m, such as between 1.0E-5 m³/m and 4.0E-5 m³/m, such as between 1.1 E-5 m³/m and 3.6E-5 m³/m.

[0158] In one or more embodiments of the present disclosure, in the thickness Wth1 of one or more of the polymer profile walls 4AB-4EA extending between adjacent metal bars 6 may be less than 1.4 times, such as less than 1.2 times, the thickness such as the diameter D1 (dependent of metal bar cross sectional shape), of the metal bars. In some embodiments of the present disclosure, the thickness of one or more of the polymer profile walls 4AB-4EA extending between adjacent metal bars 6 may be smaller than the thickness, such as smaller than the diameter, of the metal bars.

[0159] In fig. 1, the metal bars 6 are, according to some embodiments of the present disclosure, enclosed by wall material of the polymer profile walls 4AB-4EA. In fig. 1, a part 25 of the wall material enclosing the respective metal bar 6 provides an elongated elevation, extending into the interior profile space 5 and along the profile length.

[0160] The metal bars 6 are in fig. 1 and several of the figures described below enclosed by the wall material parts 25, 4AB-4EA of the polymer profile walls. Here, the total thickness Th2 of the metal bar 6 and the wall material enclosing the metal bar 6 may in embodiments be larger, such as at least 1.8 times larger, such as at least 2.5 times larger, than the wall thickness Wth1 of the adjacent profile wall 4AB-4EA extending between adjacent metal bars.

[0161] The profile walls 4AB-4EA comprises the discretely arranged elongated elevations 25 which each extends into the profile interior 5 and in the longitudinal direction of the profile, and the discretely arranged elongated elevations each encloses a part of a metal bar 6.

[0162] In one or more embodiments of the present disclosure, the elongated frame profiles each have a longitudinal direction, a width W1 and a height H1. In fig. 1 illustrating a side profile 2a embodiment, the side profile comprises a first corner A, a second corner B, and an exterior wall part 4AB interconnecting said first A and second B corner. The profile 2a moreover comprises a third corner C, and an exterior wall part 4BC interconnecting said second and third corner B, C. The exterior wall 4BC interconnecting said second and third corner B, C faces the frame opening 2d and comprises a surface 4BCs abutting the frame opening.

[0163] A similar design may be provided for a top and/or side profile 2b, 2c of the frame.

[0164] The profile 2a moreover comprises a fourth corner D, and an exterior wall part 4CD interconnecting said third C and fourth corner D.

[0165] The wall 4CD comprises a recessed portion. This recessed portion is provided by a first wall portion 4CD1 which faces and supports a part of an exterior major surface S1 of the insulated glass unit, and a second wall portion 4CD2 which is placed opposite to a side surface S3 of the insulated glass unit. The recessed portion is elongated and extend along the profile 2a length. The side surface S3 of the glass unit is placed opposite to and faces the second wall portion 4CD2.

[0166] A resilient gasket 22, such as a silicone or rubber gasket, is arranged between first wall portion 4CD1 and the major surface S1 of the glass unit. In some embodiments, the glass unit 3 may be attached to the profile 2a by means

of an adhesive (not illustrated), such as a structural adhesive, for example a silicone adhesive, placed between the outer major glass unit surface S1 and the wall portion 4CD1. The glass unit 3 may support on the gasket 22, and the gasket may e.g. provide an air tightening between the frame 2 and the glass unit 3.

[0167] A similar design as illustrated in fig. 1 may be provided for a top and/or side profile 2b, 2c of the frame 2.

[0168] The wall parts 4CD1, 4CD2 meet at corner 4CDC. The mutual angle α_2 between the exterior surfaces at the wall parts 4CD1, 4CD2 providing the recess/recessed portion for receiving the glass unit 3 is less than 180° , such as less than 120° . In the illustrated example substantially 90° .

[0169] In fig. 1, the profile 2a comprises a fifth corner E and an exterior wall part 4DE interconnecting said fourth and fifth corner D, E. Also, the profile 2a comprises the above mentioned first corner A and an exterior wall part 4EA interconnecting said fifth and first corner E, A. The interior profile space 5 is placed between the exterior wall 4EA interconnecting the fifth E and first A corner and the exterior wall 4BC interconnecting the second and third corner B, C. The exterior wall 4EA interconnecting the corners EA comprises an exterior surface 4EAs facing away from the frame opening 2d and away from the profile interior 5.

[0170] In one or more embodiments of the present disclosure, the exterior wall 4EA that interconnects the fifth and first corners E, A may comprise an exterior surface 4EAS that faces away from the frame opening 2d and faces towards a frame profile of a fixation frame 7, see e.g. fig. 6.

[0171] A metal bar 6 may as illustrated be arranged at one or more of the first corner A, the second corner B, the fourth corner D and/or the fifth corner E.

[0172] A metal bar 6 may in some embodiments be arranged between said first corner A and said second corner B.

[0173] The metal bars 6 may in embodiments of the present disclosure be attached to, such as adhesively bonded to or mechanically fastened to the profile wall material. In other embodiments, this bonding/fastening connection may be omitted.

[0174] In some embodiments, said metal reinforcement of the frame 2 profile 2a may comprise or consists of less than ten metal bars 6, such as less than seven metal bars 6, such as five metal bars 6 or less.

[0175] In some embodiments, said metal reinforcement of the frame 2 profile 2a may comprise three or more metal bars 6. In some embodiments of the present disclosure, the metal reinforcement may comprise of between three and ten metal bars 6, such as between three and seven metal bars, for example between three and five metal bars 6.

[0176] In some embodiments, said metal reinforcement may consists of three or more metal bars 6. In some embodiments of the present disclosure, the metal reinforcement may consist of between three and ten metal bars 6, such as between three and seven metal bars, for example between three and five metal bars 6.

[0177] In some embodiments, the metal reinforcement may comprise less than ten metal bars 6, such as less than seven metal bars 6, such as five metal bars 6 or less. In one or more embodiments of the present disclosure, said metal reinforcement may comprise between two and ten metal bars 6, such as between two and five metal bars (including both end points). In fig. 1, five metal bars 6 are provided.

[0178] In some embodiments, the metal reinforcement may consist of less than ten metal bars 6, such as less than seven metal bars 6, such as five metal bars 6 or less. In one or more embodiments of the present disclosure, said metal reinforcement may consist of between two and ten metal bars 6, such as between two and five metal bars (including both end points). In fig. 1, five metal bars 6 are provided.

[0179] The metal bars 6 may each have a cross sectional area that is less than 25 mm^2 such as less than 15 mm^2 , such as less than 10 mm^2 ,

[0180] The metal bars may (if having circular cross section) in some embodiments have a diameter D1 that is less than 5 mm, such as 4 mm or less, for example 3 mm or less. In fig. 1, the cross section of the metal bars 6 is substantially square shaped.

[0181] The metal bars 6 may in embodiments of the present disclosure each have a cross sectional area that is between 1 mm^2 and 30 mm^2 such as between 2 mm^2 and 15 mm^2 , such as between 3 mm^2 and 10 mm^2 .

[0182] The total cross sectional area of metal reinforcement, when seen in cross section of the profile 2a as e.g. illustrated in fig. 1, may in embodiments of the present disclosure be between 4 mm^2 and 115 mm^2 , such as between 14 mm^2 and 60 mm^2 , such as between 20 mm^2 and 40 mm^2 . In fig. 1, the cross section of the metal bars are substantially identical, and hence, each metal bar 6 contribute with 1/5 of the total cross sectional area of the metal reinforcement 6. In other embodiments, however, the metal bars may have different cross sections and/or sizes of the metal bar cross section. Hence, in that case, the metal bars 6 will provide different contributions to the total cross sectional area of the metal reinforcement of the profile.

[0183] The cross section illustrated in e.g. fig. 1 may be provided by a cut-through of the profile that is substantially perpendicular to the longitudinal direction of the profile.

[0184] The polymer profile walls 4AB-4EA, 11 may in embodiments of the present disclosure comprise or be made from Polypropylene PP, and/or the polymer profile walls 4AB-4EA, 11 may comprises or is made from polyvinyl chloride PVC, such as chlorinated Polyvinyl chloride CPVC.

[0185] In some embodiments, the profile walls 4AB-4EA, 11 may comprise strengthening fibres, such as glass fibres

or carbon fibres (not illustrated) embedded in the walls 4AB-4EA, 11. For example, in some embodiments, the profile walls may be made from or comprise a PP20GF material, meaning a polypropylene wall with 20% glass fibres (by weight or by volume) embedded therein. However in other embodiments, the profile walls may be made from or comprise a PP20CF material, meaning a polypropylene wall with 20% carbon fibres (by weight or by volume) embedded therein, In some embodiments, the added amount of strengthening fibres may be between 10% and 40%, such as between 15% and 35% (by weight or by volume). It is understood that in some embodiments, the wall material may be substantially free from strengthening fibres and may e.g. comprise less than 2% or less than 1% strengthening fibres.

[0186] The polymer profile walls 4AB-4EA, 11 may in embodiments of the present disclosure comprise or be made from a polyethylene terephthalate PET polymer material.

[0187] In embodiments of the present disclosure, the profile 2a has a maximum height H1 and a maximum width W1.

[0188] The maximum height H1 may in embodiments of the present disclosure be less than 110 mm, such as less than 90 mm, such as less than 70 mm. In some embodiments, the maximum height H1 may include a height of a frame profile part 20, 4CD2 which extends opposite to the side surface S3 of the insulated glass unit 3.

[0189] The maximum width W1 may in embodiments of the present disclosure be less than 80 mm, such as less than 60 mm, such as less than 45 mm. The width W1 may in some embodiments include a width of a frame profile part 30, 4CD1 which is overlapped by a major surface S1 S1 of the insulated glass unit 3.

[0190] The profile height H1 may in embodiments, as illustrated, be determined in a direction perpendicular to a plane P1, P2 defined by a major surface S1, S2 of the insulating glass unit 3. The profile width W1 may in embodiments of the present disclosure be determined in a direction parallel to a plane P1, P2 defined by a major surface S1, S2 of the insulating glass unit 3.

[0191] In some embodiments of the present disclosure, the weight of metal reinforcement of the polymer frame profile per meter of the polymer frame profile may be lower than the weight of polymer wall material of the frame profile per meter polymer frame profile.

[0192] The exterior wall or walls, to which metal reinforcement bars 6 are secured, may have a thickness Wth1 between 1 mm and 4 mm, such as between 1.3 mm and 2.5 mm at an exterior wall part or parts 4AB-4EA extending between adjacent metal bars 6.

[0193] In fig. 1, a part of the interior profile space 5 is positioned opposite to the side surface S3 of the insulating glass unit 3. Moreover or alternatively, a part of the interior profile space 5 may as illustrated be positioned opposite to an exterior major surface S1 of the insulated glass unit 3.

[0194] The polymer frame profile 2a-2c may as illustrated comprise at least one (but more may also be provided in other embodiments) partition wall 11 arranged in the interior profile space 5.

[0195] The partition wall 11 in fig. 1 extends between the exterior wall part/part of the exterior wall 4CD interconnecting the third and fourth corner C, D and the exterior wall 4EA interconnecting the fifth and first corner A. for example, the partition wall may as illustrated extend between the corner portion 4CDC of the wall exterior wall wall 4CD interconnecting the third and fourth corner C, D and towards the exterior wall 4EA interconnecting the fifth E and first corner A.

[0196] In embodiments of the present disclosure, one or more interior polymer profile walls/partition walls 11, which separate longitudinally extending interior profile spaces from each other, may incline in a direction away from the first plane P1 comprising the glass surface S1. The one or more interior polymer profile walls/partition walls 11, which separate longitudinally extending interior profile spaces from each other, may additionally or alternatively incline in a direction away from the second plane P2 comprising the second major surface S2. This inclination may be provided with an angle α less than 90°, such as less than 80° to the plane P1, P2.

[0197] The partition wall 11 may be connected to and extend from the wall 4CD providing the recess for receiving the glass unit 3 edge. The wall 11 may for example extend from the wall part 4CD1, 4CD2 and/or from the corner 4CDC (as illustrated).

[0198] The wall 11 may as illustrated be arranged at the side P1s2 of the plane S1 that faces away from the second plane P2, and the first plane P1 may be un-penetrated by the partition wall 11.

[0199] The wall 11 may in other embodiments (not illustrated) be arranged at the side P1s2 of the plane S1 that faces away from the second plane P2, but may extend to the wall part 4CD2 opposite the side edge 3, and hence extend to a position between the first plane P1 and the second plane P2, and in that case, the plane P1 will be penetrated by the partition wall 11.

[0200] In some embodiments, the insulating glass unit overlaps at least 10%, such as at least 20%, for example at least 50% or at least 90% of the maximum width W1 of the respective side profile 2a of the frame 2.

[0201] In some embodiments, the insulating glass unit 3 may overlap at least 10%, such as at least 20%, for example at least 50% or at least 90% of the maximum width W1 of one or more of the polymer frame profiles 2a, 2b, 2c of the frame.

[0202] It is generally understood that in embodiments of the present disclosure, one, more or all of said exterior polymer profile walls 4AB-4EA which together shapes and encloses the interior profile space 5 may be structural walls.

[0203] It is generally understood that even though fig. 1 illustrates a side profile of a roof window frame according to embodiments of the present disclosure, it is understood that the same design, or at least some embodiments thereof

as described above, may be adopted for the top and/or bottom profile 2b, 2c of the frame.

[0204] Fig. 2 illustrates schematically a side profile of a frame 2 of a roof window 1 according to embodiments of the present disclosure. The profile 2a in fig. 2 is a frame side profile 2a. Here, the metal reinforcement only comprises four discrete, parallel metal bars 6 embedded in the exterior walls of the profile providing the outer frame profile boundary. When compared to fig. 1, the metal bar placed between the corners A and B is omitted.

[0205] Fig. 3 illustrates a roof window according to embodiments of the present disclosure. The illustrated frame profile is a side profile 2a of the frame 2. The same characteristics may however be adopted for the bottom profile and/or top profile too, in further embodiments.

[0206] In fig. 3, the glass unit overlaps about 5/6 of the maximum profile width W1.

It is understood that in embodiments of the present disclosure, the glass unit 3 edge may overlap more than 50%, or more than 60% of the maximum width W1 of the frame 2.

[0207] The insulating glass unit edge may in embodiments of the present disclosure overlap at least 10%, such as at least 20%, for example at least 50% or at least 90% of the maximum width W1 of one or more of the polymer frame profiles 2a, 2b, 2c.

[0208] Fig. 3 moreover illustrates a further embodiment of the present disclosure wherein the glass unit 3 is mechanically fastened to the profile 2a by means of an elongated bracket profile 70 that may be attached to the frame 2 profile 2a by means of mechanical fastening means and/or an adhesive (fastening means not illustrated).

[0209] The bracket profile 70 is in fig. 3 arranged to extend over the exterior glass unit surface S2 for facing the building exterior EXT.

[0210] The elongated bracket profile 70 provides a clamping force towards the glass unit surface S2 and thereby press the glass unit towards the profile wall 4CD. A gasket and/or adhesive 71 is placed between the bracket profile part 70a that overlap the major glass unit surface S2. The bracket profile 70 comprises a profile wall 70b that extend opposite to the glass unit surface S3, and a wall part 70c that is placed opposite to the exterior profile wall 4DA surface 4DAs. The fastening means may fasten the wall part 70c to the profile 2a.

[0211] The bracket profile 70 is attached at the exterior wall 4DA of the profile 2a that comprises an exterior surface 4DAs facing away from the frame opening 2d.

[0212] The bracket profile 70 may be a polymer profile or metal profile, such as an aluminium or steel profile. The bracket profile 70 is elongated and may extend along at least 70%, such as at least 80% or 95% of the length of the frame profile 2a.

[0213] As illustrated in fig. 3, both the first and second plane P1, P2 may in embodiments of the present disclosure be un-penetrated by the polymer frame profile. Instead, here, the bracket profile 70 extends opposite the side surface S3 and through both planes P1, P2 and overlaps the exterior major surface S2.

[0214] Fig. 4 illustrates schematically roof window 1 cross section comprising a movable frame 2 and a fixation frame 7 according to embodiments of the present disclosure. The frame profile 2a illustrated is a cross section as in figs. 1-3 described above.

[0215] The movable frame 2 is a rectangular, movable frame 2, and is movably attached to a fixation frame 7 of the roof window 1 by means of one or more hinges 10 (not illustrated in fig. 4). The one or more hinges 10 may comprise comprises a hinge part fixed to one of the side profiles 2a or to the top profile of the movable frame 2. The roof window may be of the top hung type.

[0216] The fixation frame 7 is configured to be arranged at/in a roof structure aperture, and to be fixated to the roof structure. The movable frame 2 (and the glass unit attached thereto) is hence configured to move relative to the fixation frame 7 between an open position and a closed position by means of the hinge arrangement.

[0217] As can be seen, the movable frame 2 may in embodiments of the present disclosure overlap the fixation frame 7 and be placed on top of the fixation frame 7. In fig. 4, the movable frame 2a is placed between the glass unit major surface S1 and the fixation frame 7.

[0218] The roof window 1 in fig. 4 may e.g. be a roof window for installation in a flat roof, but it may also be a roof window for installation in a roof structure having a roof pitch above 17° such as above 25° or above 35°.

[0219] Fig. 4 moreover illustrates further embodiments of the present disclosure, wherein the fixation frame 7 comprises structural, elongated fixation frame profiles. In fig. 4, side profile 7a is illustrated. The fixation frame profiles of the fixation frame 7 together provides a fixation frame opening 7d arranged between the fixation frame profiles (see e.g. fig 9).

[0220] The fixation frame profile 7a comprises polymer profile walls 13 enclosing an interior fixation frame profile space 12. Also, the profile 7a comprises metal reinforcement which reinforces the polymer frame profile. The metal reinforcement comprises a plurality of discrete, massive metal bars 6 which extends in the longitudinal direction of the fixation frame profile and which are secured to one or more of the polymer profile walls 13. This fixation may be provided by means of slot tracks or by embedding the metal reinforcement bars 6 (as is the case of fig. 4) in the frame profile walls.

[0221] The metal reinforcement of the fixation frame profile 7 may in embodiments of the present disclosure comprise less than ten metal bars 6, such as less than seven metal bars 6, such as five metal bars or less 6. In fig. 4, the fixation frame comprises 4 metal bars.

[0222] The metal reinforcement of the fixation frame profile 7 may in embodiments of the present disclosure comprise three or more metal bars 6.

[0223] In embodiments of the disclosure, the weight ratio between the total weight of metal reinforcement per meter of one or more of the polymer frame profiles 7a-7c of the of the fixation frame 7, such as the side profiles 7a, and the total weight of the polymer wall material per meter of one or more of the polymer frame profiles 7a-7c of the of the fixation frame, such as the side profiles 7a, may be less than 1, such as less than 0.6, such as less than 0.3.

[0224] In some embodiments of the present disclosure, the total weight of polymer wall material per meter of the polymer frame profile of the fixation frame, such as per meter of one or more of the side profiles, the top profile and/or the bottom profile, is less than 1.5 kg, such as less than 1.3 kg, such as less than 1 kg per meter of the respective fixation frame profile.

[0225] The total weight of metal reinforcement per meter of the polymer frame profile of the fixation frame, such as one or more of the side profiles 7a, the top profile 7b and/or the bottom profile 7c may in some embodiments of the present disclosure be less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg per meter fixation frame profile.

[0226] In the figs. 4 and 5, the frame profile part 20 of the polymer frame profile 2a arranged opposite to the side surface S3 of the insulated glass unit 3 is omitted. See frame profile part 20 in e.g. figs 1, 2 and 5-7. Hence, the frame profile neither penetrates the second plane P2, not does the profile 2a penetrate the first plane P1. The profile is hence substantially maintained at the side P1s2 of the first plane P1 facing away from the second plane, and configured to face the building interior (INT) - when the movable frame 2 (if movable) is in a closed position.

[0227] Fig. 5 illustrates schematically a roof window 1 profile 2a cross section according to embodiments of the present disclosure, where the profile 2a comprises discrete skin layers 14.

[0228] In this example, the frame comprising the profiles with skin layer 14 is a movable frame 2, but the skin layer(s) may also be provided at a fixation frame (not illustrated).

[0229] Some of the exterior polymer profile walls 4AB-4EA comprises the skin layers 14 arranged on a structural base wall 15. The skin layer 14 comprises, such as provides, an exterior, visible surface 4BCs, 4ABs, 4EAs of the exterior polymer profile walls 4AB-4EA of the frame 2.

[0230] The one or more skin layers 14 and a structural base wall 15 may be co-extruded wall parts provided during extrusion to obtain the respective exterior walls 4AB-4EA enclosing the space 5 and providing the outer profile boundary.

[0231] The wall thickness Wth1 of one or more of said exterior walls 4AB-4EA may as illustrated be provided by the sum of the thickness th1 of the base wall 15 and the thickness th2 of the skin layer 14.

[0232] The thickness sth2 of the skin layer 14 is lower than the thickness bth1 of the base wall 15. In embodiments of the present disclosure, the thickness sth2 of the skin layer 14 may be between 1%, and 40%, such as between 10% and 30%, such as between 20% and 27% of the total thickness Wth1 of the exterior wall 4AB-4EA, including the skin layer 14 thickness. The above wall thickness Wth1 is defined/determined at locations where metal bars 6 are not provided.

[0233] In some embodiments, the skin layer 14 comprises or consist of an acrylonitrile styrene acrylate (ASA) material. The ASA material may have a density of between 950-100 kg/m³, such as between 1045-1065 kg/m³. The ASA material may in embodiments of the present disclosure cover a base wall 15 that may be made from PVC such as CPVC.

[0234] In some embodiments, the skin layer 14 may comprise or consist of a polypropylene (PP) skin placed on top of a fibre-reinforced base wall 15, such as a polypropylene base wall comprising glass fibres or carbon fibres embedded therein.

[0235] As can be seen, some of the walls of the profile that may not be visible to a user after window manufacturing and installation and may thus not be provided with a skin layer, but may merely comprise the structural wall material. See for example wall 4CD and 4DE. The wall 4CD may be covered and hidden by the glass unit 3 while the wall 4DE may be covered by a water cover and/or a drain channel profile as e.g. illustrated in fig. 6.

[0236] It is generally understood that in some embodiments, the skin layer 14 may substantially not contribute to the structural integrity of the profile 2a. In other embodiments, the skin layer 14 may contribute to the structural integrity of the profile.

[0237] It is however understood that the base wall 15 may provide the major contribution to the profile stiffness and strength provided by the wall comprising the base wall 15 and skin layer 14.

[0238] In embodiments of the present disclosure, the skin layer 14 may be interrupted at one or more interruption areas IA1, IA2, IA3, IA4 around the exterior boundary of the respective elongated frame profiles 2a, 2b, 2c, 7a, 7b, 7c. The exterior boundary pf the profile defines the cross sectional outer profile contour. In fig. 5, the skin layer 14 hence comprises a plurality of discrete skin layers 14a, 14b, 14c that are distributed around the exterior boundary of the respective elongated frame profile 2a, 2b, 2c, 7a, 7b, 7c. In fig 5. Three discrete skin layers are provided, but it is understood that fewer or more discrete skin layers may be provided, e.g. dependent on the profile shape.

[0239] The base layer 15 material may as illustrated, in embodiments, be exposed at the profile 2a, 2b, 2c exterior at the interruption areas IA1, IA2, IA3, IA4. where the skin layer 14 is interrupted. At these interruption areas IA1, IA2, IA3, IA4, the base layer 15 material may substantially provide the total wall thickness Wth1 of the wall. The Total wall thickness at the interruption area IA1, IA2, IA3, IA4 may in embodiments of the present disclosure substantially correspond to the

total wall thickness W_{th1} , $b_{th1}+s_{th2}$ provided by the skin layer 14. 14a-14e thickness s_{th2} and the thickness b_{th1} of the base wall 15 that is covered by the skin layer (14. 14a-14E. Hence, the base layer thickness may be larger at the interruption areas than the base layer thickness at the part of the walls comprising the skin layer 14, 14a-14c.

[0240] In one or more embodiments of the present disclosure, the general wall thickness of the exterior polymer profile walls which together provides the outer boundary of the profile is may be substantially the same at exterior walls comprising the skin layer and at exterior walls comprising the interruption areas.

[0241] In the example of fig 5, a skin layer 14a is arranged to provide an exterior surface 4ABs at an exterior wall 4AB of the frame profile 2a-2c that is configured to face the interior of the building and arranged to be visible after roof window installation.

This skin layer 14a is moreover arranged to provide an exterior surface 4BCs at an exterior wall 4BC of the frame profile 2a-2c that faces and is proximate the frame opening 2d provided by the frame 2. This skin layer may also overlap/extend over the corner B (having angle a_1 , see description above) where these exterior walls 4AB, 4BC meet.

[0242] The skin layer 14c may as illustrated also extend over corner A and to a certain distance along the exterior wall 4EA. In fig. 5, the skin layer 14c is terminated at corner C, and abut the area IA3, that in this case is a recessed portion for receiving a seal/gasket 95 (see fig. 6).

[0243] Two further discrete skin layers 14b and 14a are provided at the exterior surface for facing a fixation frame (see fig. 6), one skin layer 14b is arranged between two areas IA3 and IA4 that comprises recesses for receiving a gasket (see fig. 6), and a further skin layer that is arranged between the area IA4 and IA1, where the area IA1 is arranged at the outer exterior of profile wall 4DE. The skin layer 14c is terminated at corner E. As can be seen, the skin layers 14a, 14b, 14c may provide protrusions 14P that are configured to act as narrowings for engaging with and holding a gasket arranged in the areas IA3, IA4, see fig. 6. These skin wall protrusions 14P may have a thickness that is lower than the wall thickness W_{th1} .

[0244] The skin layer 14, 14a-14c has a thickness of between 1% and 40%, such as between 10% and 30%, for example between 20% and 27% of the total thickness W_{th1} of the respective of the exterior wall (4AB-4EA).

[0245] In some embodiments of the present disclosure, the skin layer 14, 14a-14c may have a thickness between 0.2 mm and 1 mm, such as between 0.3mm and 7 mm, such as between 0.4 and 0.6 mm.

[0246] At the location of the skin layer 14, 14a-14c the thickness s_{th2} of the skin layer 14, 14a-14c and the thickness b_{th1} of the structural base wall 15 together provides the total wall thickness W_{th1} of the respective exterior polymer profile wall 4AB-4EA. The total wall thickness W_{th1} may be between 1 mm and 4 mm, such as between 1.3 mm and 2.5 mm, such as between 1.7 mm and 2.3 mm.

[0247] The exterior, visible surface 4BCs, 4ABs, 4EAs of the skin layer 14, 14a-14c may be uncoated, and this uncoated surface may provide the exterior surface 4EAs, 4ABs, 4BCs of the respective wall 4AB-4EA that faces away from the interior profile space 5. In other embodiments (not illustrated), instead of the skin layer being uncoated, the skin layer 14, 14a-14c may be applied with a coating by means of a coating process provided e.g. by the profile manufacturer. This applied coating may e.g. be a thin layer of visibly transparent protective coating material, such as a polymer layer so that the skin layer material is visible by human eye through the coating layer. The coating layer may e.g. be configured to be a permanent layer that is designed to be maintained at the roof window after installation and during use. Alternatively, the coating layer may be or comprise a temporary, removable coating such as a polymer film that is provided to reduce the risk of scratching the profile during e.g. window installation. After window installation, the film may be removed to expose the surface of the skin layer.

[0248] In one or more embodiments of the present disclosure, less than 95%, such as less than 90%, such as less than 80% or less than 60% of the total exterior surface of the total exterior boundary of the frame profile may be provided by the skin layer 14, 14a-14c.

[0249] In one or more embodiments of the present disclosure, between 40% and 95%, such as between than 50%, and 90%, such as between 60% and 80% or between 20% and 70% of the total exterior surface of the total exterior boundary of the frame profile may be provided by the skin layer 14, 14a-14c.

[0250] It is understood that the skin layer(s) 14, 14a-14c may each extend substantially in the full length of the respective profile.

[0251] As can be seen from the example of Fig. 5, all the exterior walls 4AE-4EA may comprise the base wall 15 material, i.e. both the at the interruption areas IA1, IA2, IA3, IA4 and the areas comprising the skin layer 14, 14a-14c that covers the base wall. The base wall material 15 may hence provide a unitary structural profile wall structure (e.g. obtained by extrusion) extending uninterrupted around the entire cross sectional profile 2a shape, and is also present at the profile corners A, B, C, D, E, 4CDC.

[0252] Fig. 6 illustrates a cross section of a side profile 2a, 7a of a roof window according to embodiments of the present disclosure comprising a fixation frame 7 and a movable frame 2. The roof window 1 may e.g. here be of the centre-hung type as e.g. illustrated in fig. 9.

[0253] The fixation frame 7 is rectangular and comprises parallel top and bottom profiles and parallel side profiles 7a-7c (see also fig. 9). The longitudinal extent of the side profiles 2a, 7a are perpendicular to the longitudinal extent of the

top and bottom profiles.

[0254] The movable frame 2 is a rectangular and is movably attached to the fixation frame 7 of the window 1 by means of one or more hinges 10. The one or more hinges 10 comprise a hinge part 10a fixed to one of the side profiles 2a and/or the top profile of the movable frame 2. The one or more hinges 10 also comprises a hinge part 10b fixed to one of the side profiles 7a and/or the top profile of the fixation frame. The parts 10a, 10b are then movable relative to each other, thereby enabling movement of the movable frame 2 relative to the fixation frame 7.

[0255] The fixation frame 7 comprises structural, elongated fixation frame profiles (see also fig. 9) 7a, 7b, 7c comprising side profiles 7a, a top profile 7b and a bottom profile 7c. The fixation frame profiles 7a-7c together provides a fixation frame opening 7d.

One or more of the elongated fixation frame profiles 7a, 7b, 7c is a polymer frame profile comprising exterior polymer profile walls 13 enclosing an interior fixation profile space 12, and metal reinforcement which reinforces the polymer frame profile. The metal reinforcement in fig 6 comprises a plurality of discrete, massive metal bars 6 which extends in the longitudinal direction of the fixation frame profile 7a, 7b, 7c and which are secured to one or more of the polymer profile walls 13, for example by being embedded therein (as illustrated in fig. 6), or by means of one or more slot tracks. See also description relating to fig. 4.

[0256] In embodiments of the present disclosure, the total weight of metal reinforcement per meter of the polymer frame profile 7a, 7b, 7c of the of the fixation frame 7, such as the side profiles 7a, and the total weight of the polymer wall material per meter of the polymer frame profile 7a, 7b, 7c of the of the fixation frame, such as the side profiles 7a, is less than 1, such as less than 0.6, such as less than 0.3.

[0257] In embodiments of the present disclosure, the total weight of polymer wall material per meter of the polymer frame profile of the fixation frame 7, such as per meter of one or more of the side profiles 7a, the top profile 7b and/or the bottom profile 7c, may be less than 1.5 kg, such as less than 1.3 kg, such as less than 1 kg per meter fixation frame profile 7a, 7b, 7c.

[0258] In embodiments of the present disclosure, the total weight of metal reinforcement per meter of the polymer frame profile of the fixation frame, such as one or more of the side profiles 7a, the top profile 7b and/or the bottom profile 7c may be is less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg per meter fixation frame profile 7a, 7b, 7c.

[0259] In one or more embodiments of the present disclosure, the ratio between the total weight of metal reinforcement 6 per meter of the top profile 2b and/or bottom profile 2c and the total weight of the polymer wall material per meter of the top profile 2b and/or bottom profile 2c may be less than the ratio between the total weight of metal reinforcement 6 per meter of the side profiles 2a and the total weight of the polymer wall material per meter of the side profiles 2a.

[0260] In one or more embodiments of the present disclosure, a part of an elongated water drain channel 40 may be placed opposite at least a part of the side surface S3 of the insulating glass unit 3 that extends between the first S1 and second S2 exterior major surfaces of the insulated glass unit. For example, the drain channel bottom 40a may be placed opposite the side surface S3. In fig. 6, a part of the water drain channel 40 is arranged opposite to, for example supported by and/or attached to, the exterior polymer profile wall 4DE of the polymer frame profile 2a, 2b of the movable frame which is placed proximate a second plane S2.

[0261] The water drain channel 40 is in fig. 6 provided by means of a drain channel profile 45, such as a metal profile, comprising an elongated recess. The elongated recess of the drain channel 40 is placed between side walls 42, and the drain channel bottom 40a is provided by means of a bottom wall 43 of the profile 45.

[0262] In fig. 6, the drain channel profile 45 also comprises a wall part 44 extending over/overlapping the major glass unit surface S2, and in some embodiments, this wall part 44 may be fixated, e.g. by means of an adhesive such as a structural adhesive, to the glass unit.

[0263] A skin layer 14 (see fig. 5) is not illustrated in fig 6, and it is understood that in some embodiments of the present disclosure, the skin layer may be omitted.

In other embodiments of the present disclosure, however, the skin layer 14 as e.g. described above in relation to various embodiments of fig. 5 may be provided at one or both of the movable frame 2 and the fixation frame 7. For example, if adopting the skin layer 14a-14c distribution/arrangement illustrated in fig. 5 in the embodiment of fig. 6 for the movable frame 2 profile 2a, the covers 9a and 9b (see also fig. 9) and/or the water drain channel profile 45 will hide the exposed base wall material at the wall 4DE. The glass unit 3 hides the exposed base wall material at wall 4CD2.

[0264] A side cover 90 (made from e.g. metal or a polymer) may extend over and cover a part of the exterior wall 7EA surface 7EAs of the fixation frame profile that faces away from the fixation frame opening 7d and extends between fixation profile corners 7E and 7A. The side cover 90 comprises a free edge/end edge 90a that is arranged proximate the roof structure after window installation and the side cover extends in a direction towards the roof structure. The side cover 90 may extend around and cover an outer corner 7E of the fixation frame profile 7a. If the fixation frame 7 profile 7a was provided with a skin layer, according to some embodiments of the present disclosure, a skin layer 14 at the wall 7EA beneath the side cover 90 may in some embodiments be omitted and the base wall material may be exposed here. Additionally, a skin layer may be omitted at the exterior of wall 7D-7E, as it may be covered by a part of the side cover 90 and/or water cover 9a, 9b overlapping the wall 7DE.

[0265] However, one or more of the walls 7AB, 7BC, 7CD may comprise a skin layer 14 arranged as e.g. explained above in relation to various embodiments of fig. 5. The wall 7CD comprises a first wall part 7CD1 and a second wall part 7CD2 that meet at corner 7CDC portion. The mutual angle (see example of corner 4CDC angle α_2 of fig. 1) between the exterior surfaces at the wall parts 7CD1, 7CD2 providing a recess/recessed portion for e.g. supporting a gasket/seal (when the movable frame 2 is in a closed position) is less than 180° , such as less than 120° . In the illustrated example of fig. 6, the angle substantially 90° .

[0266] A skin layer 14 (not illustrated in fig. 6) may be provided at one or both of the wall portions 7CD1, 7CD2 dependent on whether these may be visible or not after installation when the movable frame is in an open position. At least wall 7CD2 may be visible, and hence provided with a skin layer.

[0267] In some embodiments, the walls 7AB, 7BC may be covered by a skin layer 14, see e.g. example of fig. 6 and the description above relating thereto. The wall 7BC faces the fixation frame opening 7d, and the wall 7AB faces the building interior INT (after window installation). The walls 7AB, 7BC meet at the second corner 7B, and the skin layer may cover and extend around the second corner 7B. The angle at the second corner 7B (and e.g. also the first corner, 7A, the third corner 7C, the fourth corner 7D, and the fifth corner 7E) may be substantially as described in relation to angle α_1 in fig. 1. The corners 7A-7E may also be referred to as profile extremities.

[0268] As can be seen, the wall 7AB of the fixation frame 7 profile 7a may comprise an elongated step and/or recess 7X such as a slit shaped therein. This step or recess 7X is provided at the exterior surface of the wall. The step or recess 7X is configured to receive a plate part PLP (not part of the window 1) that may e.g. be a part of a drywall such as a window reveal at the finally installed window construction.

[0269] In some embodiments, the skin layer 14 may be provided at wall 7AB from the corner B and at least into the step or recess 7X. At the other side of the step or recess 7X (i.e. at wall 7AB from corner A and to recess 7X), the skin layer may be omitted. In other embodiments, the skin layer may cover the full wall 7AB between the first and second corner A, B.

[0270] It is understood that one or more of the corners A-E of the movable frame 2 profile 2a and/or one or more of the corners 7A-7E of the fixation frame 7 may be rounded, see for example corners A-E of the movable frame profile 2a. Even though the corners 7A-7E of the fixation frame 7 are not rounded in fig. 6, it is to be understood that these may be rounded in the same way as illustrated at profile 2a of fig. 6.

[0271] In fig. 6, the wall 4EA comprises two seals/gaskets 95 (but just one gasket 95 or more than two gaskets 95 may be provided in other embodiments). The gaskets 95 are configured to abut an exterior fixation frame 7 profile 7a surface of the roof window 1. This may e.g. be for water tightening and/or air tightening. The gaskets 95 may be attached in the recess of wall 4EA as illustrated after profile extrusion or may be co-extruded together with the profile and profile wall 4EA. In the latter case, the recess or recesses in the wall 4EA may in some embodiments be reduced or omitted.

[0272] Fig. 7 illustrates schematically a cross section of a top profile 2b (it may also be a bottom profile in some further embodiments), for a movable frame 2, according to embodiments of the present disclosure. The glass unit has been omitted from the figure to improve figure simplicity. As can be seen, the top profile 2b may have several features in common with the profile 2a embodiments illustrated in one or more of figs. 1, 2 5 and/or 6 as e.g. described above. A drain channel 40 (not illustrated in fig. 7, see fig. 6) may be provided in some embodiments.

[0273] The top profile 2b comprises polymer profile walls 4AB-4EA and metal reinforcement as disclosed according to various embodiments of the present disclosure above and/or below.

[0274] The top profile 11 in this embodiment does not comprise an integrated partition wall. Instead, the exterior profile walls 4AB-4EA shaping the outer boundary of the profile shapes and encloses a single, large interior space 5.

[0275] In fig. 7, it is moreover illustrated that the frame profile 2b may comprise, such as consist of, the metal reinforcement (i.e. the discrete metal bars 6 - in this case four bars 6, but more or fewer metal bars 6 may be provided as e.g. described above or below) and the profile walls 4AB-4EA (integrated partition walls 11 may also be considered part of the profile, if present), according to embodiments of the present disclosure. This may be the case for one or more of the top profile 2b, the side profile(s) 2a, and the bottom profile 2c.

[0276] Fig. 8 illustrates a cross section of a bottom profile 2c for a frame, such as a movable frame 2, of a roof window, according to embodiments of the present disclosure. The glass unit has been omitted from the figure to improve figure simplicity.

[0277] Also in this embodiment, the profile part 20 extending to a position opposite the glass unit part (as e.g. disclosed according to various embodiments of the present disclosure above) has been omitted. In some other embodiments of the present disclosure (not illustrated), the bottom profile may however comprise a profile part 20 opposite to the side surface S3. This profile part may penetrate the first plane P1.

[0278] The major glass unit surface S1 will be arranged to overlap and face the profile wall 4CD. The insulating glass unit 3 may in some embodiment overlap at least 10%, such as at least 20%, for example at least 50% or at least 90% of the maximum width W1 of the bottom profile. The recesses provided in the wall 4CD may be configured to receive parts of a gasket arrangement (not illustrated) that is to be placed between the glass unit 3 surface S1 and the wall 4CD.

[0279] In figs. 3, 4 and 8, the respective frame profile, according to embodiments of the present disclosure, comprises

four exterior profile corner A, B, C, D extremities. Some of the other figures, such as figs. 1, 2 and 5-7, the frame profile comprises five exterior profile corner A, B, C, D, E extremities. The increased number of corner exterior profile corner A, B, C, D, E extremities in the latter embodiments of figs 1,2 and 5-6 is provided due to the presence of the frame profile part 20, and the recessed portion in the wall 4CD of these embodiments.

[0280] In some embodiments of the present disclosure, a metal bar 6 of the metal reinforcement may be provided at at least two, three or four of these corner extremities.

[0281] Fig. 9 illustrates schematically a roof window 1 according to embodiments of the present disclosure. The roof window 1 according to embodiments of the present disclosure may also be known as a skylight.

[0282] The roof window 1 comprises a frame arrangement 2, 7. The frame arrangement comprises a fixation frame 7 and a movable frame 2. The movable frame 2 provides a support of an insulating glass unit 3. The glass unit 3 may as e.g. described above be attached to the movable frame. The fixation frame 7 is configured to be arranged to cover (together with the movable frame 2) a building aperture in the roof structure, and the fixation frame 7 is configured to be attached/fixated to a roof structure of a building.

[0283] The fixation frame 7 comprises parallel side profiles 7a, a top profile 7b and a bottom profile 7c placed parallel to the top profile. These profiles 7a-7c are elongated and together they provides a rectangular fixation frame opening 7d.

[0284] The movable frame 2 comprises elongated frame profiles comprising two side profiles 2a, a top profile 2b and a bottom profile 2c. The side profiles 2a are placed parallel to each other, and the top 2b and bottom 2c profiles are placed parallel to each other. These profiles 2a-2c are elongated and together they provide a rectangular frame opening 2d (see e.g. fig. 1) in the movable frame 2, so that light such as sunlight passes through this frame opening 2d. The movable frame 2 supports an insulated glass unit 3. The insulated glass unit is fixated to the movable frame 2 and covers the frame opening of the movable frame 2 that is placed between/defined by the profiles 2a-2d of the movable frame.

[0285] The movable frame 2 is movably attached to the fixation frame 7 by means of the hinge arrangement 10, in this case, a hinge arrangement 10 is placed at each side of the side profiles 2a, between the respective side profile 2a and a fixation frame profile 7a.

[0286] In fig. 9, the roof window 1 is of the centre-hung type. In centre-hung type roof windows 1, the hinge arrangement 10/ hinges 10 provides an axis of rotation RAX for the movable frame 2 that is placed between the top TO and the bottom BO of the sash/movable frame 2. This provides that the movable frame 2 is configured to be opened by the lower part/bottom part BO of the movable frame moving outwards, away from the interior of the building in which the roof window 1 is installed, and the upper part/top part TO of the movable frame 2 moves inwards into the building upon opening of the movable frame 2 from a closed position. See dashed arrows.

[0287] The rotation axis RAX of the roof window, may generally, in various embodiments of the present disclosure, be substantially parallel to the longitudinal direction of the top profile 2b and bottom profile 2c, and may be perpendicular to the longitudinal direction of the side profiles 2a. This is e.g. the case in fig. 9.

[0288] The rotation axis RAX of the roof window, may generally, in various embodiments of the present disclosure, be substantially parallel to the longitudinal direction of the top profile 7b and bottom profile 7c of the fixation frame, and may be perpendicular to the longitudinal direction of the side profiles 7a of the fixation frame 7. This is e.g. the case in fig. 9.

[0289] It is understood that the axis of rotation RAX may be arranged substantially around/at the centre of the lengths of the side profiles 2a of the movable frame 2. However, in some centre hung configurations, the axis of rotation RAX may also be displaced towards the top or bottom part of the movable frame in order to e.g. provide a balancing of the weight of the movable frame 2 or for other reasons. This is also understood as a centre hung roof window according to some embodiments of the present disclosure. Centre-hung windows may also be referred to pivot roof windows.

[0290] In roof windows of the centre-hung type, the fixation frame 7 may surround movable frame 2. In roof windows 1 of the centre-hung type, the maximum width of the movable frame 2 may be less than the interior, minimum width of the frame opening of the fixation frame 7 in order to allow top TO and bottom BO parts of the movable frame 2 to move in the frame opening of the fixation frame 7 when moving the movable frame 2 to a closed position.

[0291] The roof window 1 also comprises elongated covers 9a, 9b such as side covers. A roof window of the centre hung type 1 may comprise fixed covers 9a that is fixed to the fixation frame 7, preferably at the half of the fixation frame that is proximate the top of the fixation frame. Moreover, the window comprises movable covers 9b that is fixed to the movable frame 2 and moves together with the movable frame 2. These movable covers 9b are often placed at the half of the movable frame 2 that is located proximate the lower part/bottom part BO of the movable frame 2.

[0292] The width of the covers 9a, 9b overlaps profiles at the fixation frame 7 and also the movable frame 2 (see e.g. fig. 6) in order to improve water tightening. When the movable frame 2 is in a closed position, the fixed covers 9a and the movable covers 9b may be placed in continuation of each other.

[0293] The covers 9a, 9b extends along the sides of the roof window 1, between the top and bottom of the roof window 1. The covers 9a, 9b are exterior covers that are subjected to the weather such as rain and snow. The roof window 1 may also comprise a top cover 9c that is fixed to the fixation frame 7 and is arranged at the top of the fixation frame 7.

This top cover 9c also overlaps the top TO of the movable frame when the movable frame 2 is placed in a closed position. In fig. 9, the movable frame 2 is in an open position.

[0294] In other embodiments of the present disclosure, the movable frame 2 may be hinged in another way, for example top hung (not illustrated). In still further embodiments,

the roof window may be of the type where the insulated/insulating glass unit 3 is unmovable attached to a fixation frame 7. Also in the top hung embodiments, the rotation axis may be perpendicular to the longitudinal direction of the side profiles of the fixation frame 7a and/or the movable frame 2a.

[0295] The roof window 1 may in further embodiments be a combination (not illustrated) of Centre hung and top hung. The hinge arrangement 10 of the roof window 1 may hence comprise a hinge arrangement 10 with hinge arms extending along the movable frame 2 sides and providing a hinge connection allowing the movable frame to rotate around the rotation axis RAX as illustrated in fig. 9. The hinge arms may extend towards the top of the fixation frame 7, and here a further hinge connection is provided to enable the bottom BO of the movable frame to move outwards around a further rotation axis (not illustrated) placed at the top TO of the movable frame. This further rotation axis is substantially parallel to the rotation axis RAX.

[0296] The longitudinal directions LD of the frame profiles 2a and 2c respectively is illustrated in fig. 9. These longitudinal directions LD may be substantially perpendicular to each other.

The longitudinal directions of the two side profiles 2a are substantially parallel to each other. The rotation axis RAX may in embodiments of the present disclosure be perpendicular to the longitudinal direction LD of the side profiles 2a, and parallel to the longitudinal direction LD of the bottom and top profiles 2b, 2c.

[0297] The fixation frame profiles 7a-7c also have longitudinal directions (not illustrated in fig. 9). The fixation frame side profiles 7a have parallel longitudinal directions and the top and bottom profiles 7b, 7c of the fixation frame have parallel longitudinal directions. The rotation axis RAX may in embodiments of the present disclosure be perpendicular to the longitudinal direction LD of the fixation frame side profiles 7a.

[0298] The more longitudinally extending interior profile space 5, 12 (see e.g. figures described previously) extend in the longitudinal direction LD of the respective frame profile 2a-2c, 7a-7c.

[0299] Fig. 10 illustrates a frame profile 2 comprising metal reinforcement according to embodiments of the present disclosure. Here, the metal reinforcement comprises a plurality of discrete metal bars 6 that each are secured to one or more of the polymer profile walls 4AB-4DA by being engaged in one or more slot tracks 80. The slot tracks are provided, such as formed, as integrated parts of the polymer profile walls 4AB-4DA.

[0300] The tracks 80 extend in the longitudinal direction of the profile 2a. The slot tracks are in fig. 10 arranged at profile extremities, in the present example at corner A, B, C, D, E portions of the profile.

[0301] In fig. 10, the profile 2a is a side profile 2a of a movable frame of a roof window 1, but metal reinforcements 6 may in further embodiments be provided in slot tracks 80 at e.g. profile extremities such as corner portions of a top profile 2b or bottom profile 2c of a movable frame and/or of fixation frame (7b, 7c) or at a side profile 7a of a roof window fixation frame 7. See e.g. fig. 9.

[0302] Protrusions 81, 82, such as L-shaped (as illustrated), T-shaped, I-shaped or the like protrusions 81 (when seen in profile 2 cross section), 82 are provided during profile manufacturing such as by profile 2a extrusion. In fig. 10 the majority of the protrusions are L-shaped, and the protrusion 82 at wall 4DE is T-shaped.

[0303] The protrusions 81, 82 are integrated with the exterior walls 4AB-4EA and extend into the interior 5 of the profile 2. In the figure, each protrusion 81, 82 provides an engagement space/track 83 between the respective exterior wall and the respective protrusion 81, 82, in this case between a wall part of the protrusion providing a free end/edge of the respective protrusion wall and a wall of the profile.

[0304] The protrusions 81, 82 may in embodiments extend in the longitudinal direction of the profile, such as substantially along the entire length of the profile. The protrusions may here extend parallel to each other with the space 84 arranged between the protrusions 81, 82.

[0305] A space 84 may as illustrated be provided between the protrusions 81, 82 to e.g. enable a certain protrusion flexibility that may ease metal bar 6 insertion into the track 80.

[0306] After extruding the profile 2 with the walls 4AB-4EA (with or without a skin layer) each of the plurality of discrete metal bars 6 are introduced into the slot tracks 80 in the longitudinal direction of the profile, e.g. by means of a machine and/or by hand by pushing and/or pulling.

[0307] In fig. 10 the metal reinforcement bar 6 has an L-shaped cross section. Each metal bar 6 illustrated in fig. 10 extends along an exterior profile wall part arranged proximate an outer profile extremity. In the illustrated example, the profile extremity is a profile corner A, B, C, D, E. For example, the metal bar 6 at corner A comprises a first wall part 6W1 extending along the wall 4EA, and a second wall part 6W2 extending along the wall 4AB. The mutual angle α_3 between these wall parts 6W1, 6W2 (defined by bar surface 6IS facing away from the walls 4AB, 4EA) may in embodiments of the present disclosure be below 180° , such as below 140° , such as below 120° . In the example at corner A, the angle α_3 is approximately 90° . As can be seen in the example of fig. 10, the angle α_3 between the profile walls 6W1, 6W2 at a profile corner C may be less than 90° . As can be seen, the angle α_3 between the profile walls 6W1, 6W2 at a profile

corner B may be larger than 90°.

[0308] In the figure, the metal bars 6 are illustrated to not touch the walls or protrusions of the profile, that is to improve understanding of the figure. It is understood that in practice, the metal reinforcement bars 6 will touch one or more of the surfaces provided by the protrusions 81, 82 and/or walls 4AB-4EA to provide profile 2 reinforcement and help to increase stiffness and/or structural integrity of the profile 2.

[0309] It is understood that in some embodiments, a combination of one or more embedded metal bars (see e.g. figs 1-8) and one or more metal bars secured at the frame profile by means of a track 80 (see e.g. fig. 10) may be provided. The embedded bars 6 may be provided during profile extrusion whereas the metal bar(s) 6 in the track(s) 80 may be provided in the track after profile extrusion.

[0310] In the figures 1-8, the discrete metal reinforcements of the roof window frame profile is provided by a plurality of metal bars that are embedded in the wall exterior walls of the profile, e.g. at profile extremities such as a corner portion A, B, C, D, E. These 6 are in these illustrated embodiments solid metal reinforcement rods having a rectangular cross sectional shape, such as a square shape.

[0311] It is however understood that other rectangular shapes of the embedded metal bars 6 may be provided.

[0312] Fig. 11 illustrates schematically an embodiment of the present disclosure where an L-shaped metal bar 6 is embedded in and enclosed by the profile wall material at a corner portion B. This may e.g. have been obtained by profile extrusion or moulding.

[0313] Fig. 12 illustrates schematically an embodiment of the present disclosure where a metal bar 6 having an octagonal cross section is embedded in the exterior profile wall.

[0314] Fig. 13 illustrates schematically an embodiment of the present disclosure where rectangular metal bar 6 having a rectangular, such as square shaped, cross section is embedded in the exterior profile wall in an elongated wall elevation 25 which extends into the profile interior 5 and in the longitudinal direction of the profile. Here, the elongated elevation 25 has a shape different from curved or circular - in the present example, the shape of the elevation is rectangular and the exterior shape of the elevation 25 fits/follows the cross sectional shape of the metal bar 6. In other embodiments, as e.g. illustrated in figs. 1-8, the exterior shape of the elevation 25 may be different from the cross sectional shape of the metal bar 6. For example in fig. 1, the exterior shape of the elevation 25 is different from the cross sectional shape of the metal bar 6 as the metal bar has a rectangular cross section whereas the exterior shape of the elevation is curved/partly circular.

[0315] In figs. 1-8 and 11-13, the metal bars 6 is/are secured to the polymer profile wall(s) by being embedded therein. This embedding may e.g. be obtained by means of co-extrusion.

[0316] Fig. 14 illustrates schematically a further embodiment of a frame profile 2 comprising metal reinforcement according to embodiments of the present disclosure.

Here, the metal reinforcement comprises a metal bar 6 that is secured at the polymer profile walls 4AB-4DA by being engaged in one or more slot tracks 80 formed as integrated parts of the polymer profile walls 4AB-4DA as also illustrated in fig. 10. In fig. 14, the cross section of the solid metal bar 6 is square shaped and fits into a track 80 provided by profile wall protrusions, see e.g. the description relating to fig. 10.

[0317] The protrusions 81, 82 may in embodiments of the present disclosure, as e.g. illustrated in fig. 14, be substantially I-shaped when seen in cross section, but it is generally understood that other cross sectional shapes of the protrusions 81, 82 may be provided in further embodiments of the present disclosure, for example L shape, T shape Or the like.

[0318] Fig. 15. Illustrates an embodiment of the present disclosure wherein a metal bar 6 having an octagonal shaped cross section is secured at the polymer profile walls 4AB-4DA by being engaged in a slot track 80 formed as integrated parts of the polymer profile walls 4AB-4DA. As can be seen, the track 80 may be shaped by the wall and/or protrusion 81, 82 material of the profile to provide a shape adapted to the cross sectional shape of the metal bar.

[0319] It is understood that each of the metal bars 6 of the metal reinforcement may be secured to one or more of the polymer profile walls by positive engagement, e.g. as illustrated in one or more of the figures 1-8 and/or 10-15.

[0320] It is generally understood that the metal bars 6 have cross section. For instance, the metal bar cross section may in embodiments of the present disclosure be T-shaped, L-shaped (see figs 10-11), U-shaped, S-shaped, square shaped, rectangular shaped (see figs. 1-8 and/or figs 13-14) or otherwise polygonal (see for example fig. 12 or 15).

[0321] In certain embodiments of the present disclosure (not illustrated) the metal bar 6 cross section may be circular.

[0322] It is understood that even though figs. 11-15 discloses different embodiments of the present disclosure illustrated at the profile corner portion B or wall 4AB, it is understood that a similar solution may additionally or alternatively be provided at one or more other wall parts 4AB-4EA and/or one or more corner portions A, B, C, D, E of the profile.

[0323] It is understood that even though figs. 10-15 discloses different embodiments of the present disclosure at a frame profile of the movable frame 2, the same embodiment(s) may be provided in a fixation frame 7, see e.g. figs. 4 or 6.

[0324] In some embodiments of the present disclosure, one or both of the protrusions 81, 82 may be arranged less than 5cm, such as less than 3 cm, such as less than 2 cm or less than 1 cm. from the proximate D.

[0325] It is generally understood that the metal reinforcement material may have a thermal conductivity coefficient that is higher than the thermal conductivity coefficient of the material of the frame profile walls 4AE-4EA

[0326] Fig. 16 illustrates schematically a building 200 wherein a roof window 1 according to one or more embodiments as described above and/or illustrated in one or more of the figures 1-15 is arranged in the roof structure 250 of the building 200. The roof structure may in embodiments of the present disclosure be a flat roof or as illustrated in fig. 16 be a roof structure with a roof pitch above 17° such as above 20° such as above 25° or above 35°.

[0327] Fig. 17 illustrates schematically a further embodiment of a frame profile 2 comprising metal reinforcement according to embodiments of the present disclosure.

Here, the metal reinforcement comprises a first metal bar 6 that is secured at the polymer profile walls 4AB-4DA by being engaged in one or more slot tracks 80 formed as integrated parts of the polymer profile walls 4AB-4DA see e.g. also the description to fig. 10.

[0328] The first metal bar is arranged opposite the side surface S3 of the glass unit, is plate shaped and has a width that extends between the corner D and the exterior wall 4EA. The first metal bar extends in the longitudinal direction of the profile, such as e.g. over at least 90% or at last 95%, such as at least 95% of the profile length.

[0329] The first metal bar is placed between the planes P1, P2 and may as illustrated not penetrate neither the first plane P1 nor penetrate the second plane P2. In other embodiments, the first metal bar may penetrate e.g. the plane P1 comprising the exterior major surface S1 of the glass unit that is configured to face the building interior (e.g. when the movable frame is in a closed position).

[0330] The first metal bar extends between interior protrusions 81, 82 as e.g. described above providing a slot track 80.

[0331] The width of the first metal bar extends between the protrusions 81, 82, and does this in an inclining manner so that the metal bar width extends with an in a direction that is less than 90° to both planes P1, P2. The width of first metal bar may as illustrated extend from the wall 4EA and towards the corner D. In other embodiments, the first metal bar may extend from the wall 4EA and towards the all 4DE or towards the wall part 4CD2.

[0332] The first metal bar opposite the edge surface S3 of the glass unit may be arranged to substantially follow isotherms (not illustrated). This may e.g. be the case when it is e.g. cold outside EXT the building, such as about 0°C or below, and 20°C or more inside INT.

[0333] Fig. 17 illustrates a further embodiment of the present disclosure where the metal reinforcement comprises a second metal bar 6 that is secured at the polymer profile walls 4AB-4DA by being engaged in one or more slot tracks 80 formed as integrated parts of the polymer profile walls 4AB-4DA. This metal bar is plate shaped and has a width that extends between interior protrusions 82 as e.g. previously described. The second metal bar extends in the longitudinal direction of the profile, such as e.g. over at least 90% or at last 95%, such as at least 95% of the profile length.

[0334] The second metal bar is placed to not penetrate the first plane P1. The

[0335] The first metal bar extends in the longitudinal direction of the profile, such as e.g. over at least 90% or at last 95%, such as at least 95% of the profile length.

[0336] The second metal bar is arranged in the interior frame profile space 5. The width of the second metal bar that extends in a direction away from a first region located proximate the first plane P1 comprising the outer major S1 of the glass unit 3. The width of the second metal bar moreover extends in the interior frame profile space 5 in a direction away from a further plane P3, so that the interior space 5 is split into a first space part 5a located at a first side of the metal bar, and a second space part 5b located at a second side of the metal bar.

[0337] The further plane P3 is perpendicular to the first plane P1 (and to the second plane P2). The further plane P3 extends parallel to the longitudinal direction of the frame profile, and touches a part of an exterior surface 4BCs of the exterior wall 4BC of the frame profile that faces and is proximate the frame opening 4. In the example of fig. 17, the further plane P3 touches the surface 4BC substantially at the corner C.

[0338] As can be seen in fig. 17, the second metal bar may extend between the exterior wall 4BC that abuts the frame opening 2d and another exterior frame profile wall such as wall 4AB or 4EA, in the present example, the second metal bar extends towards the corner A.

[0339] The said other exterior frame profile wall may comprise comprising an exterior surface facing away from the frame opening 2d, in this case this is the case for exterior wall 4EA.

[0340] In other embodiments (not illustrated in fig. 17, said other exterior frame profile wall may comprise or be an exterior wall 4AB configured to face the interior of the building. This wall 4AB and the wall 4BC meet at corner B.

[0341] The second metal bar 6 may instead of extending from the wall 4BC facing the frame opening 2d in further embodiments of the present disclosure (not illustrated) extend into the interior frame profile space 7 from the frame profile wall part 4CD1 that faces an overlapping part of the glass unit 3, such as faces the first outer major surface S1.

[0342] The second metal bar 6 may in further embodiments of the present disclosure (not illustrated) extend into the interior frame profile space 7 from profile corner C frame that is placed opposite to and proximate to the exterior major glass unit surface S1.

[0343] The second metal bar may help to provide an improved heat management in the roof window. The second metal bar may for example help to form/provide a controlled thermal bridge between the exterior frame profile walls 5AB, 4BC, 4CD1, 4EA.

[0344] The second metal bar may be arranged to extend so that a first isotherm group comprising a plurality of first isotherms is crossed in the frame profile space 5, wherein the isotherms of the first isotherm group are defined at a cross sectional view of the frame profile extending perpendicular to the longitudinal direction of the frame profile in a scenario where the second metal bar is omitted and in a first temperature condition $T_1 < T_2$ where the general ambient air temperature T_1 in the room/building interior is lower than the temperature T_2 at the outer major surface S2 of the insulated glass unit. The neighbouring isotherms of the first isotherm group may have a temperature difference of 1°C, 3°C, or 5°C. The group of isotherms may in embodiments comprise at least two, at least three or at least four isotherms, such as between two and twelve isotherms, such as between three and ten isotherms.

[0345] Usually, crossing isotherms with thermal bridges such as metal parts may be desired to be avoided or reduced because it results in reduced heat insulation. However controlled crossing of isotherms may provide a benefit in roof windows both in cold weather and hot weather situations. For example, by crossing isotherms by means of the second metal bar as explained above, in a condition where a cover material of a cover such as a blind (not illustrated) at the window is closed/in a covering position, the reinforcement profile may help to hence cool a heated space between the blind and the window glass unit and/or cool the profile wall material, such as at wall 4BC and/or 4CD1.

[0346] As illustrated in fig. 17, the roof window profile may comprise both the first and second plate shaped metal bars 6 as described above in relation to fig. 17, thereby providing the three interior spaces 5a, 5b, 5c, where the first plate shaped metal bar is placed between the spaces 5c and 5b, and where the second plate shaped metal bar is placed between the space 5a and 5b.

[0347] However, in other embodiments, one of the first and second plate shaped metal bar may in further embodiments be omitted.

[0348] For example, in some embodiments, the omitted reinforcement may be the first plate shaped metal bar so only the plate shaped metal bar placed at the plane side P1s2 is provided.

[0349] For example, in some further embodiments, the omitted plate shaped reinforcement bar may be replaced with one or more metal bars as described in relation to one or more of figs 1-8 and/or 10-15.

[0350] In the figures 1-8 and 12-15, the metal bars 6 of the metal reinforcement are not plate shaped. Instead, they have another shape such as e.g. previously described.

[0351] Fig. 18 illustrates a roof window comprising slot tracks 80 that secures plate shaped metal bars 6 of the metal reinforcement at external profile walls, according to embodiments of the present disclosure. Here, the metal bars have a width that extends along an interior surface (facing the interior space 5) of an exterior frame profile wall. The metal bars have a longitudinal direction extending in the longitudinal direction of the polymer profile.

[0352] The metal 6 bars are in fig. 18 (as also in fig. 17.) plate shaped. The width of the metal bars extends between corners of the respective wall 4BB and 4DE.

[0353] A first plate shaped metal bar 6 is provided in the profile interior 5 opposite to the glass unit edge surface S3. It 6 is placed in/at the the frame profile part 20 of the polymer frame profile 2a that extends opposite to the "narrow" glass unit side edge S3. The width of the first plate shaped metal bar 6 extends in a direction away from the edge surface S3, between the corners D and E. The major surface of the first plate shaped metal bar 6 is extending parallel to the inner surface of the profile wall 4DE. At each plate shaped metal bar 6 edge, it engages with protrusions 81, 82, these provides that the plate shaped metal bar 6 is secured to the exterior walls of the profile. These protrusions 81, 82 are integrated at the walls 4CD2 and 4EA respectively. These walls 4CD2 and 4EA meet with the wall 4DE along which the plate shaped metal bar 6 extends, at the corners D, E respectively.

The plane P1 and P2 are unpenetrated by the first plate shaped metal profile. The first plate shaped metal profile may extend with the major surface substantially parallel to the first and second plane p1, P2.

[0354] A second plate shaped metal bar 6 may moreover or alternatively, as illustrated, be provided. This second plate shaped metal bar has a major surface that extends parallel to and along the wall 4AB at the side P1S2 of the plane P1 that faces away from the second plane P1. The plane P1 and P2 are unpenetrated by the second plate shaped metal profile. The second plate shaped metal profile 6 has a width that extends between the corners A and B, and protrusions 81, 82 extending into the profile space 5 are integrated in the walls 4BC, 4EA respectively so as to provide slot tracks 80 for use during securing of the plate shaped metal profile 6.

[0355] It is to be understood that in further embodiments of the present disclosure, e.g. a combination of a first plate shaped metal profile (along wall 4DE) may be provided in combination with a second plate shaped metal profile as illustrated and described in relation to embodiments of fig. 17.

[0356] It is to be understood that in further embodiments of the present disclosure, e.g. one of the first plate shaped metal profile and second plate shaped metal profile as illustrated in fig. 18 may be omitted and may in further embodiments of the present disclosure be replaced with one or more metal bars (e.g. fixated by embedding in profile wall or by means of securing by slot tracks) as illustrated in and/or described in relation one or more of figs. 1-8 and/or 9-15.

[0357] Figs. 17 and 18 moreover illustrates a further embodiment of a roof window profile comprising a skin layer 14. Here, a single skin layer 14 is provided. The skin layer 14 is interrupted at an interruption area IA1 so that the skin layer does not extend uninterrupted around the exterior boundary of the respective elongated frame profile2a. Instead, the

EP 4 379 161 A1

base wall material 15 is exposed at the surface of the exterior walls 4DE and 4CD, where a cover 9a, 9b, 45 (see e.g. fig 6) or the glass unit 3 hides the exterior profile 2a surface.

Examples

[0358] The below illustrated and/or described examples in the tables are computer simulated examples of possible roof window profile embodiments, according to various embodiments of the present disclosure. In these examples, the metal profile bars 6 was simulated to be embedded in the walls of the frame profiles 2a-2c for a movable frame 2, as e.g. illustrated in various embodiments of figs. 1-8.

Table 1: CPVC profile examples for movable frame

		Wall (side profile 2a)	Reinf. (side profile 2a)	Wall (top profile 2b)	Reinf. (top profile 2b)	Wall (bottom profile 2c)	Reinf. (bottom profile 2c)
C P V C	Density (kg/m ³)	1.50E+03	7.85E+03	1.50E+03	7.85E+03	1.50E+03	7.85E+03
	Volume (m ³ /m)	5.36E-04	3.43E-05	4.71E-04	1.21E-05	6.32E-04	1.51E-05
	Weight (kg/m)	0.80	0.27	0.70	0.10	0.95	0.12

Table 2: Metal reinforcement/CPVC profile wall weight ratio for movable frame

CPVC Weight ratio	
Side profile 2a Weight Ratio: metal Bars/CPVC wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.33
Top profile 2b Weight Ratio: metal bars/CPVC wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.14
Bottom profile 2c Weight Ratio: Metal bars/CPVC wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.13

Table 3: PP20GF profile examples for movable frame

		Wall (side profile 2a)	Reinf. (side profile 2a)	Wall (top profile 2b)	Reinf. (top profile 2b)	Wall (bottom profile 2c)	Reinf. (bottom profile 2c)
P P 2 0 G F	Density (kg/m ³)	1.04E+03	7.85E+03	1.04E+03	7.85E+03	1.04E+03	7.85E+03
	Volume (m ³ /m)	5.21E-04	2.74E-05	4.71E-04	1.21E-05	6.61E-04	1.51E-05
	Weight (kg/m)	0.54	0.22	0.49	0.1	0.69	0.12
PP20GF is a fiber-reinforced polypropylene wall material with 20% glass fibers embedded therein for improved stability and improved rigidity.							

Table 4: Metal reinforcement/PP20GF profile wall weight ratio for movable frame

PP20GF weight ratio	
Side profile 2a Weight Ratio: metal bars/PP20GF wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.41

(continued)

PP20GF weight ratio		
5	Top profile 2b Weight Ratio: metal bars/PP20GF wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.2
10	Bottom profile 2c Weight Ratio metal bars/PP20GF wall material $\left(\frac{W_{mre}}{W_{pw}}\right)$	0.17

[0359] A fixation frame 7 for a roof window may be provided by hollow polymer frame profiles according to embodiments of the present disclosure, comprising exterior polymer profile walls which together shapes and encloses an interior profile space, and metal reinforcement which reinforces the hollow polymer frame profile of the fixation frame. Also in this profile, the metal reinforcement may comprise a plurality of discrete, metal bars 6 which extends in the longitudinal direction of the hollow frame profile for the fixation frame, and which are embedded in or in other ways secured (e.g. by means of slot tracks as described) to one or more of the polymer profile walls. E.g. as described according to various embodiments above.

[0360] The side profiles for the fixation frame 7, in the case of a CPVC profile, may comprise 1.19 kg CPVC wall material and 0.22 kg metal reinforcement per meter profile. This provides a metal reinforcement/CPVC wall material ($\frac{W_{mre}}{W_{pw}}$) weight ratio for the side profile of 0.18.

[0361] The side profiles for the fixation frame 7, in the case of a PP20GF profile, may in embodiments of the present disclosure comprise e.g. 0.81 kg PP20GF wall material and e.g. 0.22 kg metal reinforcement per meter profile. This provides a metal bars/PP20GF wall material ($\frac{W_{mre}}{W_{pw}}$) weight ratio for the side profile of 0.27.

[0362] It is generally understood that a skin layer, such as one or more skin layers 14, if present at the frame profile, may substantially not contribute to the structural integrity of the profile, and have not be included in the above mentioned simulations.

Items:

[0363] Embodiments of the present disclosure are moreover described in the items below:

1. A roof window (1) comprising:

- a frame (2, 7) comprising structural, elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) comprising side profiles (2a, 7a), a top profile (2b, 7b) and a bottom profile (2c, 7c), and
- an insulated glass unit (3) supported by said frame (2), wherein the insulated glass unit (3) comprises a first exterior major surface (S1) and a second exterior major surface (S2) wherein the first and second exterior major surfaces (S1, S2) are oppositely directed,

wherein one or more of the structural elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) is a polymer frame profile (2a, 2b, 2c, 7a, 7b, 7c) comprising

- exterior polymer profile walls (4AB-4EA, 7AB-7EA), which together shapes and encloses an interior profile space (5, 12), and
- metal reinforcement (6), which reinforces the polymer frame profile (2a, 2b, 2c, 7a, 7b, 7c),

wherein one or more of said exterior polymer profile walls (4AB-4EA, 7AB-7EA) comprises a skin layer (14, 14a-14c) arranged at a structural base wall (15) so as to cover the structural base wall (15), wherein said skin layer (14, 14a-14c) provides one or more of the exterior, visible surfaces (4BCs, 4ABs, 4EAs) of the exterior polymer profile walls (4AB-4EA, 7AB-7EA).

2. A roof window (1) according to item 1, wherein the skin layer (14) is interrupted at one or more interruption areas (IA1, IA2, IA3, IA4) around the exterior boundary of the respective elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c).

2a. A roof window (1) according to item 2, wherein less than 95%, such as less than 80%, such as less than 60% of the exterior surface of the total exterior boundary of the frame profile is provided by the skin layer.

3. A roof window (1) according to item 2, wherein the skin layer (14) comprises a plurality of discrete skin layers (14a-14c) which are distributed around the exterior boundary of the respective elongated frame profile (2a, 2b, 2c, 7a, 7b, 7c).

4. A roof window (1) according to item 2 or 3, wherein the base wall (15) material is exposed at the profile (2a, 2b, 2c) exterior where the skin layer (14) is interrupted (IA1, IA2, IA3, IA4).

5. A roof window (1) according to any of items 2-4, wherein the base wall (15) material substantially provides the total wall thickness (Wth1) of the wall (4AB-4EA) at the one or more interruption areas (IA1, IA2, IA3, IA4), and wherein said total wall thickness (Wth1) at the interruption area (IA1, IA2, IA3, IA4) substantially correspond to the total wall thickness (Wth1, bth1+sth2) provided by the skin layer (14, 14a-14c) thickness (sth2) and the thickness (bth1) of the base wall (15) that is covered by the skin layer (14, 14a-14c).

6. A roof window (1) according to any of the preceding items, wherein said frame (7, 2) comprises a rectangular, movable frame (2) of the roof window (1), wherein the movable frame (2) is movably attached to a fixation frame (7) of the roof window (1) by means of one or more hinges (10),

wherein said skin layer (14, 14a-14c) covers the base wall (15) at one or more exterior walls (4AB, 4BC, 4EA) of the movable frame (2) which is/are configured to be visible when the movable frame (2) is in a closed position and/or in an open position,

6a. A roof window (1) according to any of the preceding items, wherein said skin layer (14, 14a-14c) covers the base wall (15) at one or more exterior walls (7AB, 7BC, 7CD, 7CD1, 7CD2) of the fixation frame (7) which is/are configured to be visible when the movable frame (2) is in a closed position and/or in an open position.

7. A roof window (1) according to any of items 2-6, wherein one or more covers (9a, 9b, 45, 90) of the roof window (1), covers and hides one or more of said interruption areas (IA1, IA2, IA3, IA4), such as wherein said one or more covers (9a, 9b, 45) comprises one or more of

- an elongated water cover (9a, 9b)
- a drain channel profile (45) and/or
- a side cover (90) configured to cover a side part of an exterior surface of a fixation frame (7) profile wall surface (7EAs) facing away from a fixation frame (7) opening (7d).

8. A roof window (1) according to any of the preceding items, wherein said skin layer (14, 14a) is arranged to at least provide an exterior surface (4ABs) of an exterior wall (4AB) of the frame profile (2a-2c) that is configured to face the interior of the building and arranged to be visible after roof window installation, wherein said skin layer (14, 14a) is moreover arranged to provide an exterior surface (4BCs) at an exterior wall (4BC) of the frame profile (2a-2c) that faces and is proximate the frame opening (2d) provided by the frame (2), such as wherein said skin layer overlaps a corner (B, a1) where said exterior walls (4AB, 4BC) meet.

9. A roof window (1) according to any of the preceding items, wherein said skin layer (14, 14a-14c) comprises or consist of an acrylonitrile styrene acrylate (ASA) material, or wherein the skin layer (14, 14a-14c) comprises or consist of a polypropylene (PP) skin layer (14, 14a-14c).

10a. A roof window (1) according to any of the preceding items, wherein the skin layer (14, 14a-14c) comprises or consist of a polypropylene (PP) material arranged to cover a polypropylene (PP) base wall (15), such as a polypropylene base wall (15) comprising reinforcing fibres embedded therein.

10b. A roof window (1) according to any of the preceding items, wherein the skin layer (14, 14a-14c) comprises or consist of an acrylonitrile styrene acrylate (ASA) material arranged to cover a polyvinyl chloride (PVC, CPVC) base wall (15), such as a base wall (15) comprising or consisting of a chlorinated Polyvinyl chloride (CPVC) material.

11. A roof window (1) according to any of the preceding items, wherein the skin layer (14, 14a-14c) and the structural base wall (15) together provides the total thickness (Wth1) of the respective exterior polymer profile wall (4AB-4EA),

wherein the skin layer (14, 14a-14c) has a thickness of between 1% and 40%, such as between 10% and 30%, for example between 20% and 27% of the total thickness (WTh1) of the respective of the exterior wall (4AB-4EA).

11a. A roof window (1) according to any of the preceding items, wherein the skin layer has a thickness between 0.2 mm and 1 mm, such as between 0.3mm and 7 mm, such as between 0.4 and 0.6 mm.

12. A roof window (1) according to any of the preceding items, wherein the thickness (sth2) of the skin layer (14, 14a-14c) and the thickness (bth1) of the structural base wall (15) together provides the total wall thickness (WTh1) of the respective exterior polymer profile wall (4AB-4EA) and/or wherein the total wall thickness (WTh1) is between 1 mm and 4 mm, such as between 1.3 mm and 2.5 mm, such as between 1.7 mm and 2.3 mm.

13. A roof window (1) according to any of the preceding items, wherein the metal reinforcement comprises a plurality of discrete, elongated metal bars (6) which each extend in the longitudinal direction of the polymer frame profile (2a-2c),

wherein the discrete, elongated metal bars (6) are secured to one or more of the exterior polymer profile walls (4AB-4EA),

such as

wherein the discrete, elongated metal bars (6) are secured to one or more of the exterior polymer profile walls (4AB-4EA) by means of being embedded therein (4AB-4EA) or by means of being engaged in one or more slot tracks (80) formed as integrated parts of the polymer profile walls.

14. A roof window (1) according to any of the preceding items, wherein the total weight of metal reinforcement per meter of the polymer frame profile (2a, 2b, 2c), is less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg. per meter frame profile (2a, 2b, 2c).

15. A roof window (1) according to any of the preceding items, wherein the total weight of polymer wall material (15, 14, 14a-14c, 4AB-4EA, 11) per meter of the polymer frame profile (2a, 2b, 2c), such as per meter of one or more of a side profile (2a), a top profile (2b) and/or a bottom profile (2c), is less than 1.1 kg, such as less than 0.9 kg, such as less than 0.7 kg per meter frame profile (2a, 2b, 2c).

16. A roof window according to any of the preceding items, wherein the total weight of the profile wall material (15, 14, 14a-14c, 4AB-4EA, 11) and metal reinforcement (6) per meter of the polymer frame profile (2a, 2b, 2c), such as per meter of one or more of a side profiles (2a), a top profile (2b) and/or a bottom profile (2c) of the roof window, is less than 1.5 kg, such as less than 1.2 kg per meter polymer frame profile (2a, 2b, 2c).

17. A roof window according to any of the preceding items, wherein the first exterior major surface (S1) is configured to face the building interior and wherein the second exterior major surface (S2) is configured to face the exterior (EXT) of the building when the roof window (1) is installed in a building roof structure,

wherein the first exterior major surface (S1) is comprised in a first plane (PI), wherein the second exterior major surface (S2) is comprised in a second plane (P2),

wherein the second plane (P2) is un-penetrated by the polymer frame profile (2a, 2b, 2c).

18. A roof window (1) according to any of the preceding items, wherein the exterior, visible surface (4BCs, 4ABs, 4EAs) of said skin layer (14, 14a-14c) is uncoated and provides the exterior surface (4EAs, 4ABs, 4BCs) of the respective wall (4AB-4EA) that faces away from the interior profile space (5).

19. A roof window according to any of items 6-19, wherein the fixation frame (7) comprises structural, elongated fixation frame profiles (7a, 7b, 7c) comprising side profiles (7a), a top profile (7b) and a bottom profile (7c), wherein said fixation frame profiles (7a-7c) together provides a fixation frame opening (7d),

wherein one or more of the elongated fixation frame profiles (7a, 7b, 7c) is a polymer frame profile comprising:

- exterior polymer profile walls (13) enclosing an interior fixation profile space (12), and
- metal reinforcement, which reinforces the polymer frame profile,

wherein the metal reinforcement comprises a plurality of discrete, metal bars (6), which extends in the longitudinal direction of the fixation frame profile (7a, 7b, 7c) and which are secured to one or more of the polymer profile walls (13),

wherein one or more of said exterior polymer profile walls of the fixation frame (7) comprises a skin layer (14) and a structural base wall (15), wherein said skin layer provides one or more of the exterior, visible surfaces of the exterior polymer profile walls of the fixation frame profiles.

20. A roof window according to any of items 6-19, wherein said skin layer (14, 14a-14c) covers a base wall (15) of one or more fixation frame (7) profiles (7a-7c) at areas which are configured to be visible when the movable frame (2) is in a closed position and/or in an open position.

21. A roof window according to any of the preceding items, wherein the elongated frame profiles (2a, 2b, 2c), each have a longitudinal direction, a width (W1) and a height (H1), wherein one or more of the elongated frame profiles (2a, 2b, 2c), such as the side profile (2a) and/or the top profile (2b), comprises

a first corner (A), a second corner (B), and an exterior wall part (4AB) interconnecting said first and second corner (A, B), and
a third corner (C), and an exterior wall part (4BC) interconnecting said second and third corner (B, C),
wherein said exterior wall (4BC) interconnecting said second and third corner (B, C) faces the frame opening (2d).

22. A roof window according to item 21, wherein one or more of the elongated frame profiles (2a, 2b, 2c), such as the side profile and/or the top profile, moreover comprises:

a fourth corner (D), and an exterior wall part (4CD) which interconnects said third and fourth corner (C, D)
wherein the exterior wall part (4CD) which interconnects said third and fourth corner (C, D) comprises a recessed portion extending in the longitudinal direction of the profile, wherein
the recessed portion is provided by means of

- a first wall portion (4CD1) of the exterior wall part (4CD) interconnecting said third and fourth corner (C, D), which first wall portion (4CD) faces and supports a part of an exterior major surface (S1) of the insulated glass unit, and
- a second wall portion (4CD2), which is placed opposite to a side surface (S3) of the insulated glass unit (3).

23. A roof window according to item 21 or 22, wherein one or more of the elongated frame profiles (2a, 2b, 2c), such as the side profiles (2a) and/or the top profile (2b), moreover comprises:

a fifth corner (E) and an exterior wall part (4DE) interconnecting said fourth and fifth corner (D, E),
an exterior wall part (4EA) interconnecting said fifth and first corner (E, A),
wherein the interior profile space (5) is placed between the exterior wall (4EA) interconnecting the fifth and first corner (E, A) and the exterior wall (4BC) interconnecting the second and third corner (B, C), and wherein the exterior wall (4EA) interconnecting the fifth and first corner (E, A) comprises an exterior surface (4EAs) facing away from the frame opening (2d).

24. A roof window according to item 23, wherein the exterior wall (4EA) interconnecting the fifth and first corner (E, A) comprises an exterior surface (4EAs) that faces away from the frame opening (2d) and faces towards a frame profile of a fixation frame (7).

25. A roof window according to any of items 21-24, wherein a metal bar (6) of the metal reinforcement is arranged at one or more of the first corner (A), the second corner (B), the fourth corner (D) and/or the fifth corner (E).

26. A roof window according to any of the preceding items, wherein the metal reinforcement comprises, such as consist of, less than ten elongated metal bars (6), such as less than seven metal bars (6), such as five metal bars (6) or less.

27. A roof window according to any of the preceding items, wherein said metal reinforcement comprises between two and ten metal bars (6), such as between two and five metal bars (including both end points).

28. A roof window according to any of the preceding items, wherein one or more of said interruptions interruption

areas comprises or are covered by one or more seals and/or gaskets (22, 95).

29. A roof window according to any of the preceding items, wherein said metal bars have a cross sectional area that is less than 25 mm^2 such as less than 15 mm^2 , such as less than 10 mm^2 , and/or wherein the metal bars have a diameter (D1) less than 5 mm, such as 4 mm or less, for example 3 mm or less.

30. A roof window according to any of the preceding items, wherein said metal bars (6) each have a cross sectional area that is between 1 mm^2 and 30 mm^2 such as between 2 mm^2 and 15 mm^2 , such as between 3 mm^2 and 10 mm^2 .

31. A roof window according to any of the preceding items, wherein the total cross sectional area of metal reinforcement is between 4 mm^2 and 115 mm^2 , such as between 14 mm^2 and 60 mm^2 , such as between 20 mm^2 and 40 mm^2 .

32. A roof window according to any of the preceding items, wherein the one or more skin layers (14) and a structural base wall (15) are co-extruded wall parts providing the respective wall (4AB-4EA).

33. A roof window according to any of the preceding items, wherein the thickness (th2) of the skin layer (14) is lower than the thickness (th1) of the base wall (15).

34. A roof window according to any of the preceding items, wherein one, more or all of said polymer profile walls (4AB-4EA), which together shapes the outer boundary of the profile are exterior structural walls.

35. A roof window according to any of the preceding items, wherein the skin layer (14) has a substantially insignificant contribution to the structural integrity of the profile.

36. A building comprising one or more roof windows installed in a roof structure of a building, wherein said one or more roof windows is a roof window according to any of the preceding items.

In general, it is to be understood that the present disclosure is not limited to the particular examples described above but may be adapted in a multitude of varieties within the scope of the disclosure as specified in e.g. the claims and/or the items. Accordingly, for example, one or more of the described and/or illustrated embodiments above may be combined to provide further embodiments of the disclosure.

Claims

1. A roof window (1) comprising:

- a frame (2, 7) comprising structural, elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) comprising side profiles (2a, 7a), a top profile (2b, 7b) and a bottom profile (2c, 7c), and
- an insulated glass unit (3) supported by said frame (2), wherein the insulated glass unit (3) comprises a first exterior major surface (S1) and a second exterior major surface (S2) wherein the first and second exterior major surfaces (S1, S2) are oppositely directed,

wherein one or more of the structural elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c) is a polymer frame profile (2a, 2b, 2c, 7a, 7b, 7c) comprising

- exterior polymer profile walls (4AB-4EA, 7AB-7EA), which together shapes and encloses an interior profile space (5, 12), and
- metal reinforcement (6), which reinforces the polymer frame profile (2a, 2b, 2c, 7a, 7b, 7c),

wherein one or more of said exterior polymer profile walls (4AB-4EA, 7AB-7EA) comprises a skin layer (14, 14a-14c) arranged at a structural base wall (15) so as to cover the structural base wall (15), wherein said skin layer (14, 14a-14c) provides one or more of the exterior, visible surfaces (4BCs, 4ABs, 4EAs) of the exterior polymer profile walls (4AB-4EA, 7AB-7EA).

2. A roof window (1) according to claim 1, wherein the skin layer (14, 14a-14c) is interrupted at one or more interruption areas (IA1, IA2, IA3, IA4) around the exterior boundary of the respective elongated frame profiles (2a, 2b, 2c, 7a, 7b, 7c).

3. A roof window (1) according to claim 2, wherein the skin layer (14) comprises a plurality of discrete skin layers (14a-14c) which are distributed around the exterior boundary of the respective elongated frame profile (2a, 2b, 2c, 7a, 7b, 7c).

4. A roof window (1) according to claim 2 or 3, wherein the base wall (15) material is exposed at the profile (2a, 2b, 2c) exterior where the skin layer (14) is interrupted (IA1, IA2, IA3, IA4).

5. A roof window (1) according to any of claims 2-4, wherein the base wall (15) material substantially provides the total wall thickness (Wth1) of the wall (4AB-4EA) at the one or more interruption areas (IA1, IA2, IA3, IA4), and wherein said total wall thickness (Wth1) at the interruption area (IA1, IA2, IA3, IA4) substantially correspond to the total wall thickness (Wth1, bth1+sth2) provided by the skin layer (14, 14a-14c) thickness (sth2) and the thickness (bth1) of the base wall (15) that is covered by the skin layer (14, 14a-14c).

6. A roof window (1) according to any of the preceding claims, wherein said frame (7, 2) comprises a rectangular, movable frame (2) of the roof window (1), wherein the movable frame (2) is movably attached to a fixation frame (7) of the roof window (1) by means of one or more hinges (10),

wherein said skin layer (14, 14a-14c) covers the base wall (15) at one or more exterior walls (4AB, 4BC, 4EA) of the movable frame (2) which is/are configured to be visible when the movable frame (2) is in a closed position and/or in an open position,

and/or
wherein said skin layer (14, 14a-14c) covers the base wall (15) at one or more exterior walls (7AB, 7BC, 7CD, 7CD1, 7CD2) of the fixation frame (7) which is/are configured to be visible when the movable frame (2) is in a closed position and/or in an open position.

7. A roof window (1) according to any of claims 2-6, wherein one or more covers (9a, 9b, 45, 90), such as external covers, of the roof window (1) is/are arranged to cover and hide one or more of said interruption areas (IA1, IA2, IA3, IA4),
such as wherein said one or more covers (9a, 9b, 45) comprises one or more of

- an elongated water cover (9a, 9b)
- a drain channel profile (45) and/or
- a side cover (90) configured to cover a side part of an exterior surface of a fixation frame (7) profile wall surface (7EAs) facing away from a fixation frame (7) opening (7d).

8. A roof window (1) according to any of the preceding claims, wherein said skin layer (14, 14a) is arranged to at least provide an exterior surface (4ABs) of an exterior wall (4AB) of the frame profile (2a-2c) that is configured to face the interior of the building and arranged to be visible after roof window installation,
wherein said skin layer (14, 14a) is moreover arranged to provide an exterior surface (4BCs) at an exterior wall (4BC) of the frame profile (2a-2c) that faces and is proximate the frame opening (2d) provided by the frame (2), such as wherein said skin layer overlaps a corner (B, a1) where said exterior walls (4AB, 4BC) meet.

9. A roof window (1) according to any of the preceding claims, wherein said skin layer (14, 14a-14c) comprises or consist of a acrylonitrile styrene acrylate (ASA) material,
or
wherein the skin layer (14, 14a-14c) comprises or consist of a polypropylene (PP) skin layer (14, 14a-14c).

10. A roof window (1) according to any of the preceding claims, wherein the skin layer (14, 14a-14c) comprises or consist of a polypropylene (PP) material arranged to cover a polypropylene (PP) base wall (15), such as a polypropylene base wall (15) comprising reinforcing fibres embedded therein,
or
wherein the skin layer (14, 14a-14c) comprises or consist of a acrylonitrile styrene acrylate (ASA) material arranged to cover a polyvinyl chloride (PVC, CPVC) base wall (15), such as a base wall (15) comprising or consisting of a chlorinated Polyvinyl chloride (CPVC) material.

11. A roof window (1) according to any of the preceding claims, wherein the skin layer (14, 14a-14c) and the structural base wall (15) together provides the total thickness (Wth1) of the respective exterior polymer profile wall (4AB-4EA), wherein the skin layer (14, 14a-14c) has a thickness of between 1% and 40%, such as between 10% and 30%, for

example between 20% and 27% of the total thickness (WTh1) of the respective of the exterior wall (4AB-4EA).

12. A roof window (1) according to any of the preceding claims, wherein the thickness (sth2) of the skin layer (14, 14a-14c) and the thickness (bth1) of the structural base wall (15) together provides the total wall thickness (WTh1) of the respective exterior polymer profile wall (4AB-4EA),
and/or
wherein the total wall thickness (WTh1) is between 1 mm and 4 mm, such as between 1.3 mm and 2.5 mm, such as between 1.7 mm and 2.3 mm.

13. A roof window (1) according to any of the preceding claims, wherein the metal reinforcement comprises a plurality of discrete, elongated metal bars (6) which each extend in the longitudinal direction of the polymer frame profile (2a-2c),

wherein the discrete, elongated metal bars (6) are secured to one or more of the exterior polymer profile walls (4AB-4EA),
such as

wherein the discrete, elongated metal bars (6) are secured to one or more of the exterior polymer profile walls (4AB-4EA) by means of being embedded therein (4AB-4EA) or by means of being engaged in one or more slot tracks (80) formed as integrated parts of the polymer profile walls.

14. A roof window (1) according to any of the preceding claims, wherein the total weight of metal reinforcement per meter of the polymer frame profile (2a, 2b, 2c), is less than 0.7 kg, such as less than 0.5 kg, such as less than 0.3 kg. per meter frame profile (2a, 2b, 2c).

15. A roof window (1) according to any of the preceding claims, wherein the total weight of polymer wall material (15, 14, 14a-14c, 4AB-4EA, 11) per meter of the polymer frame profile (2a, 2b, 2c), such as per meter of one or more of a side profile (2a), a top profile (2b) and/or a bottom profile (2c), is less than 1.1 kg, such as less than 0.9 kg, such as less than 0.7 kg per meter frame profile (2a, 2b, 2c)

and/or

wherein the total weight of the profile wall material (15, 14, 14a-14c, 4AB-4EA, 11) and metal reinforcement (6) per meter of the polymer frame profile (2a, 2b, 2c), such as per meter of one or more of a side profiles (2a), a top profile (2b) and/or a bottom profile (2c) of the roof window, is less than 1.5 kg, such as less than 1.2 kg per meter polymer frame profile (2a, 2b, 2c).

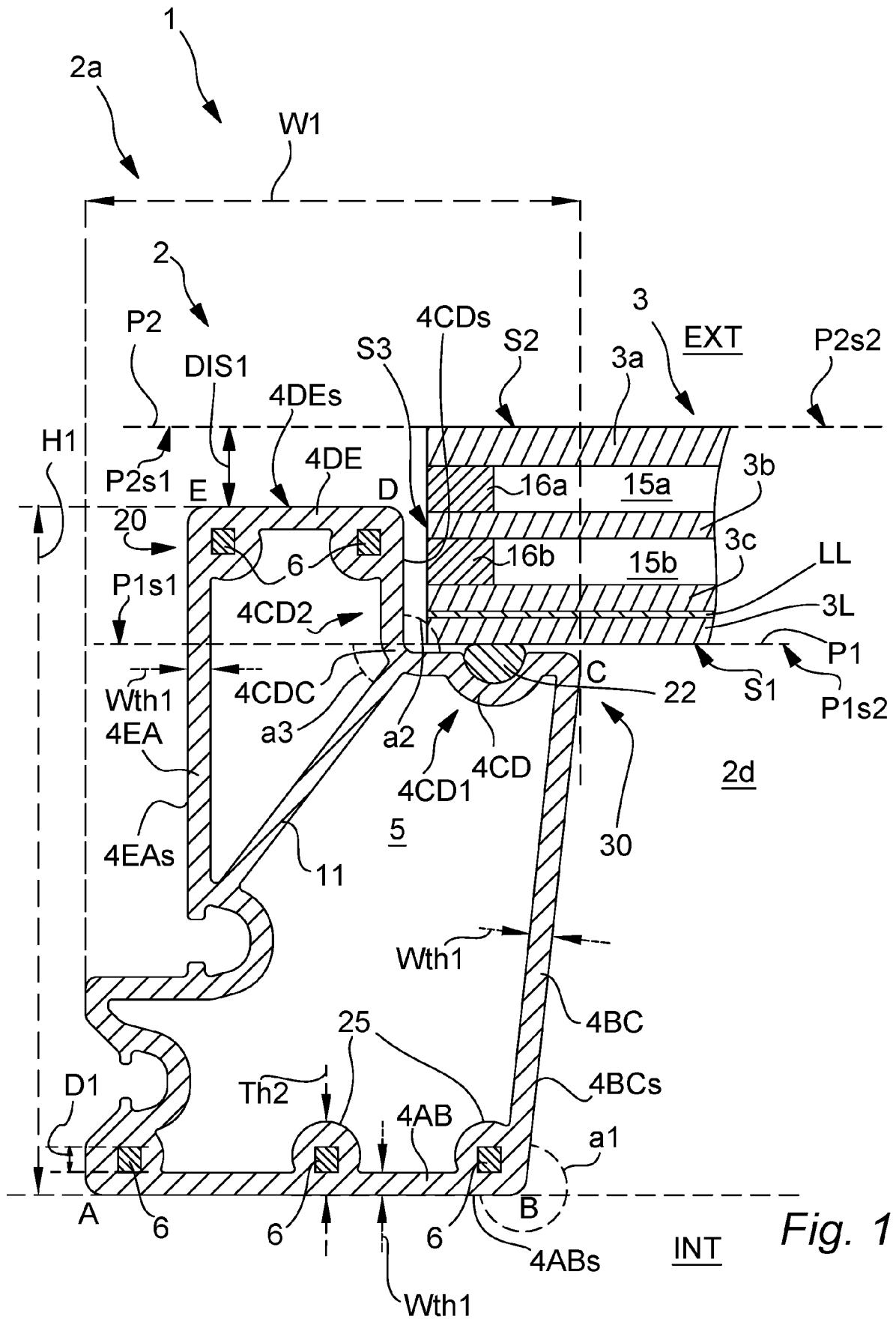


Fig. 1

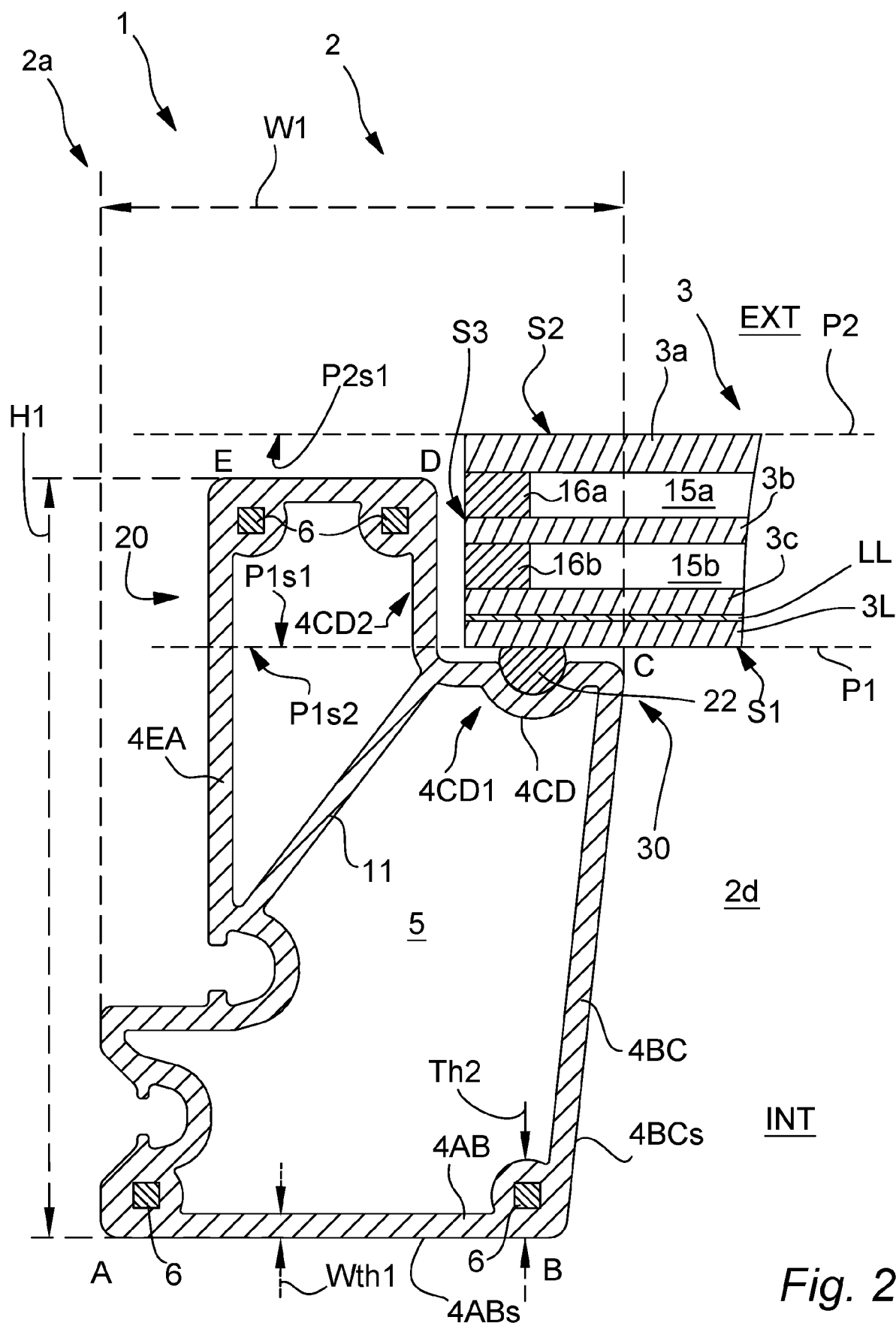


Fig. 2

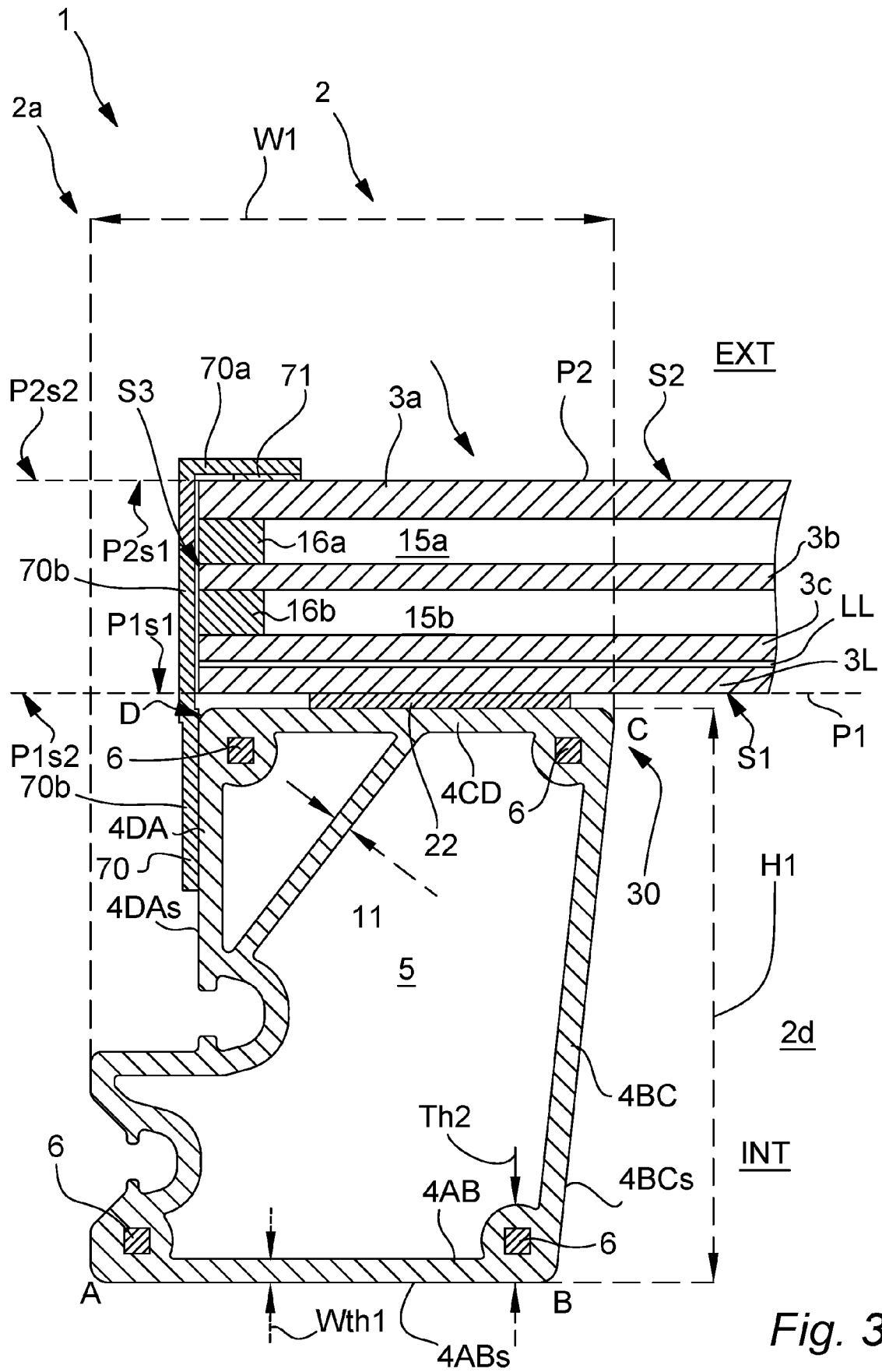
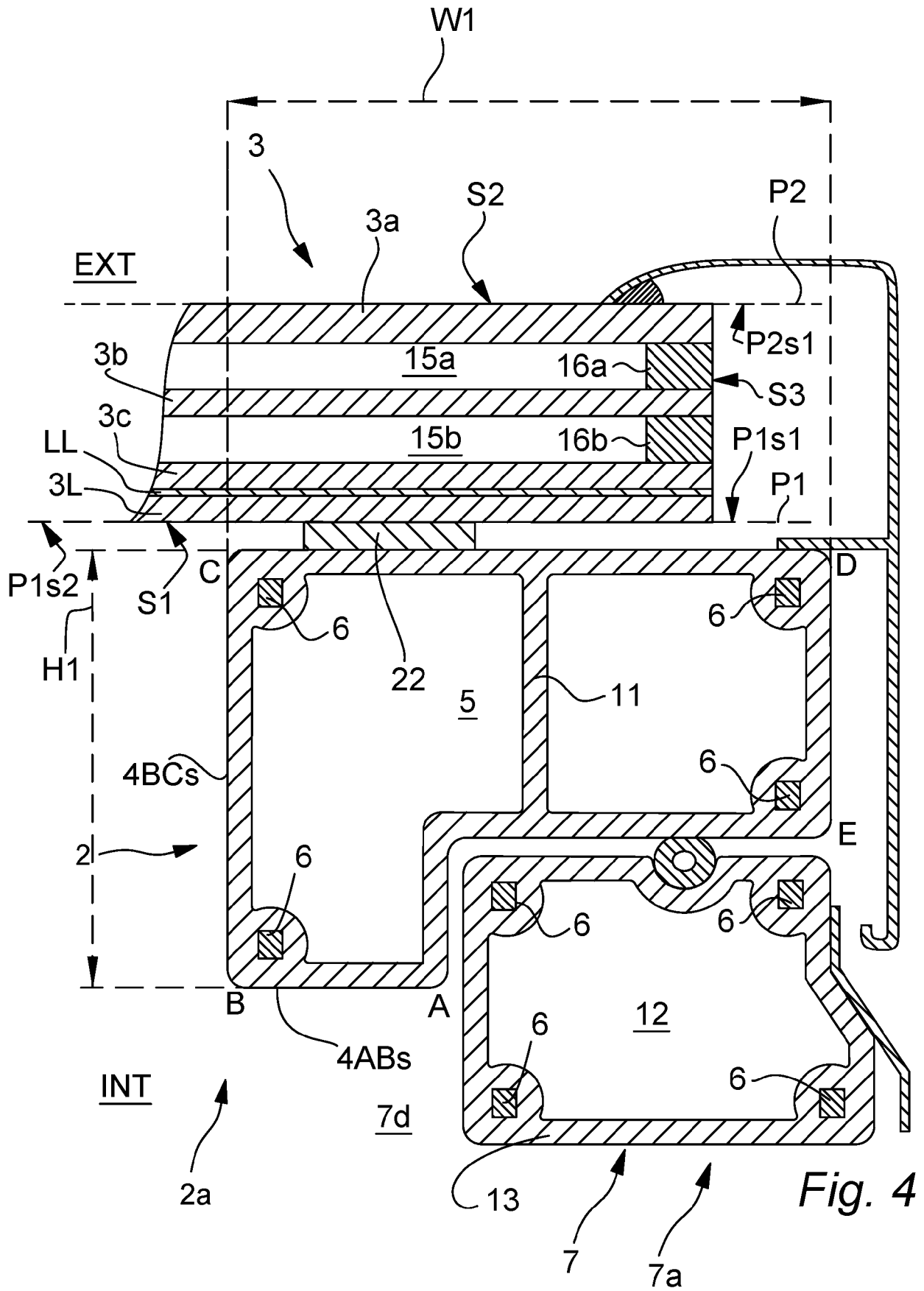


Fig. 3



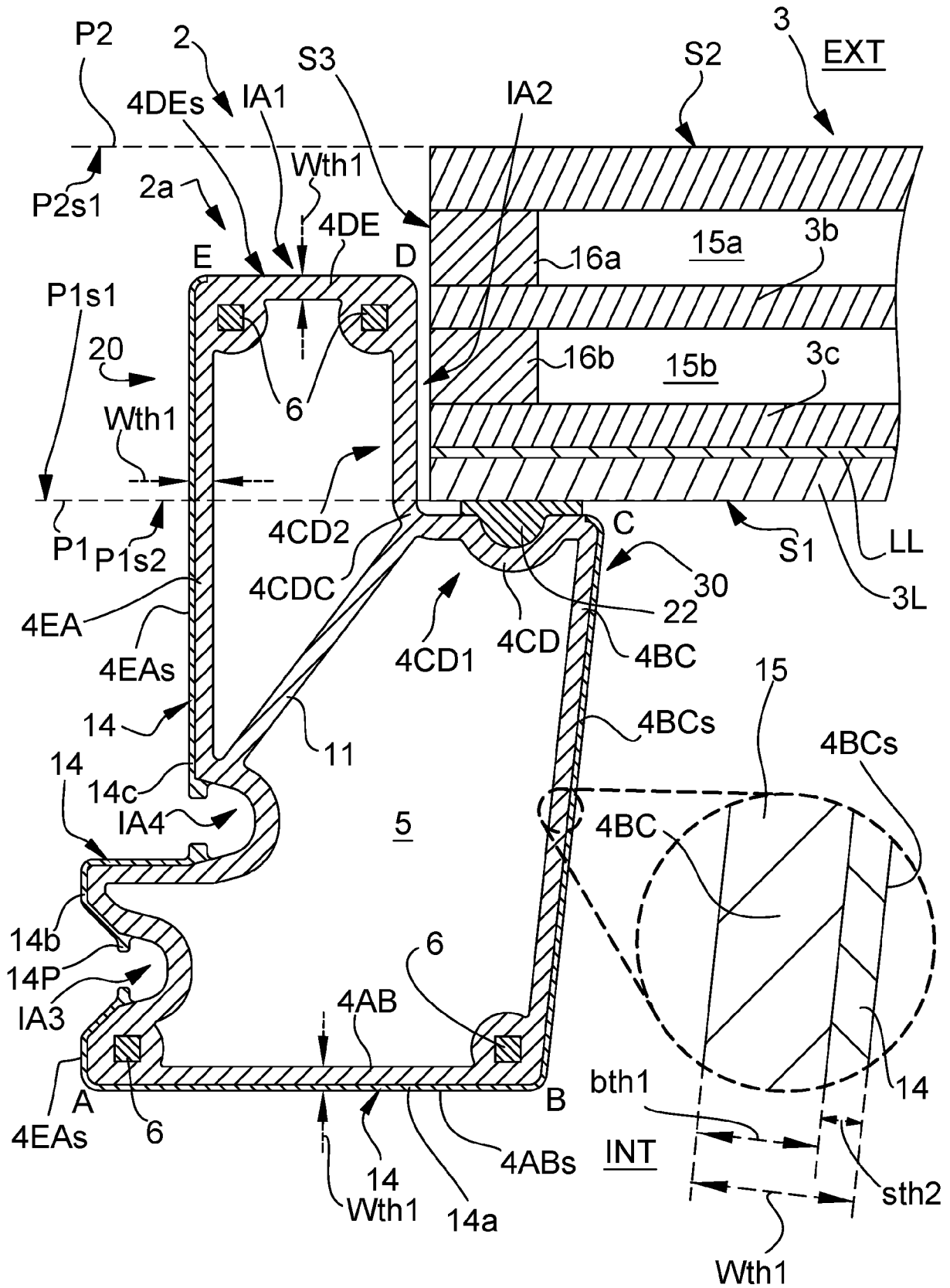
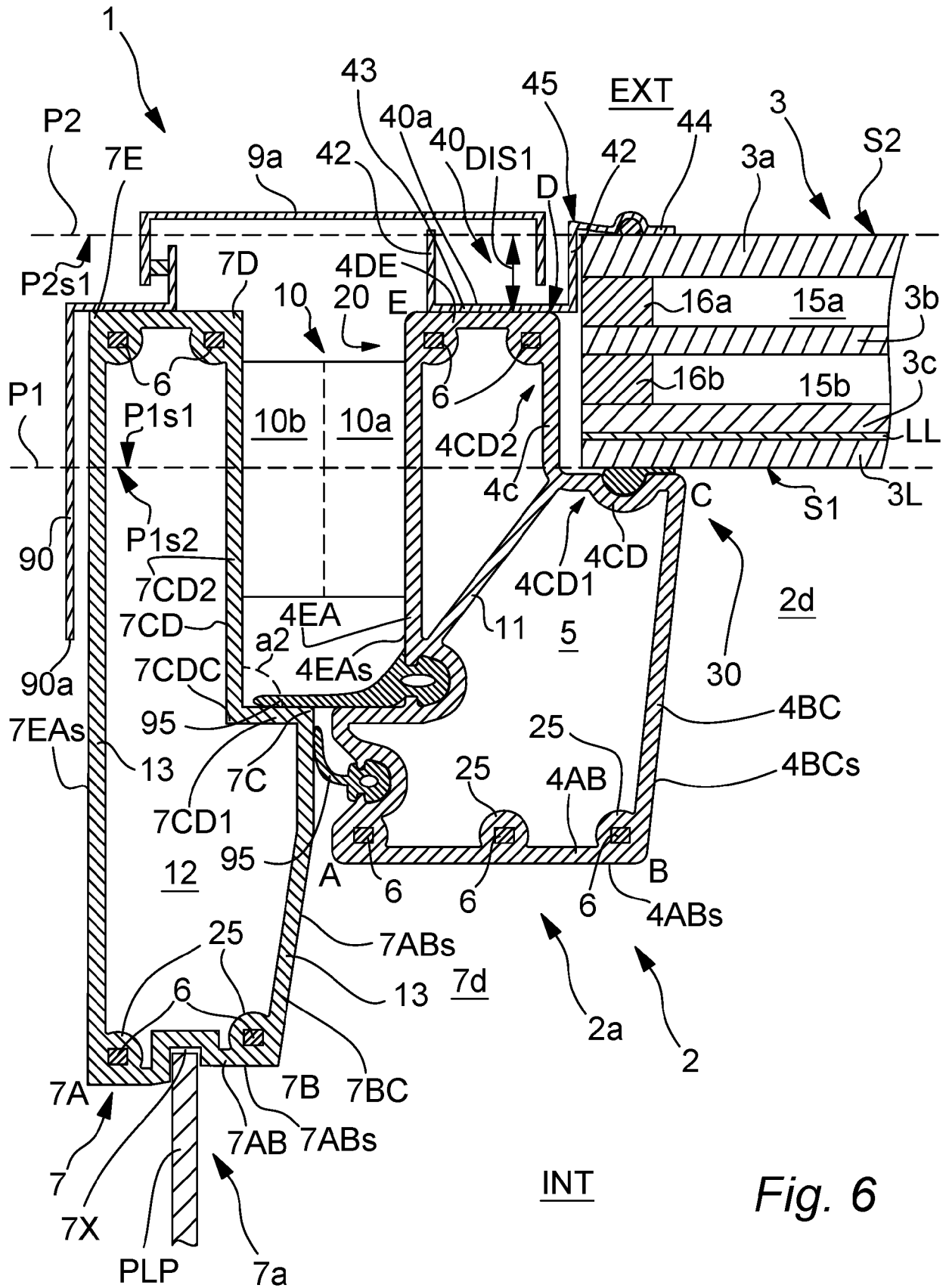


Fig. 5



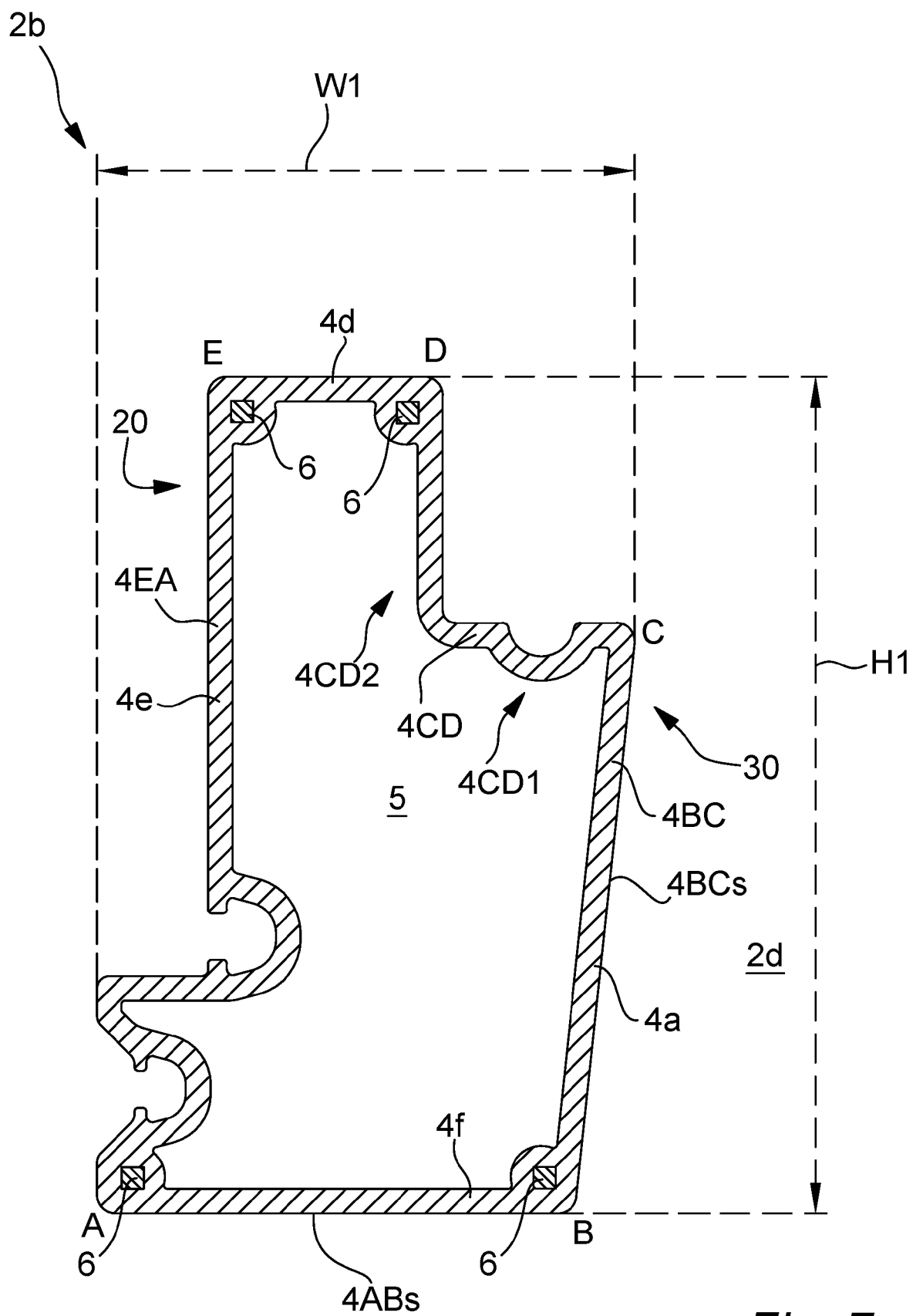


Fig. 7

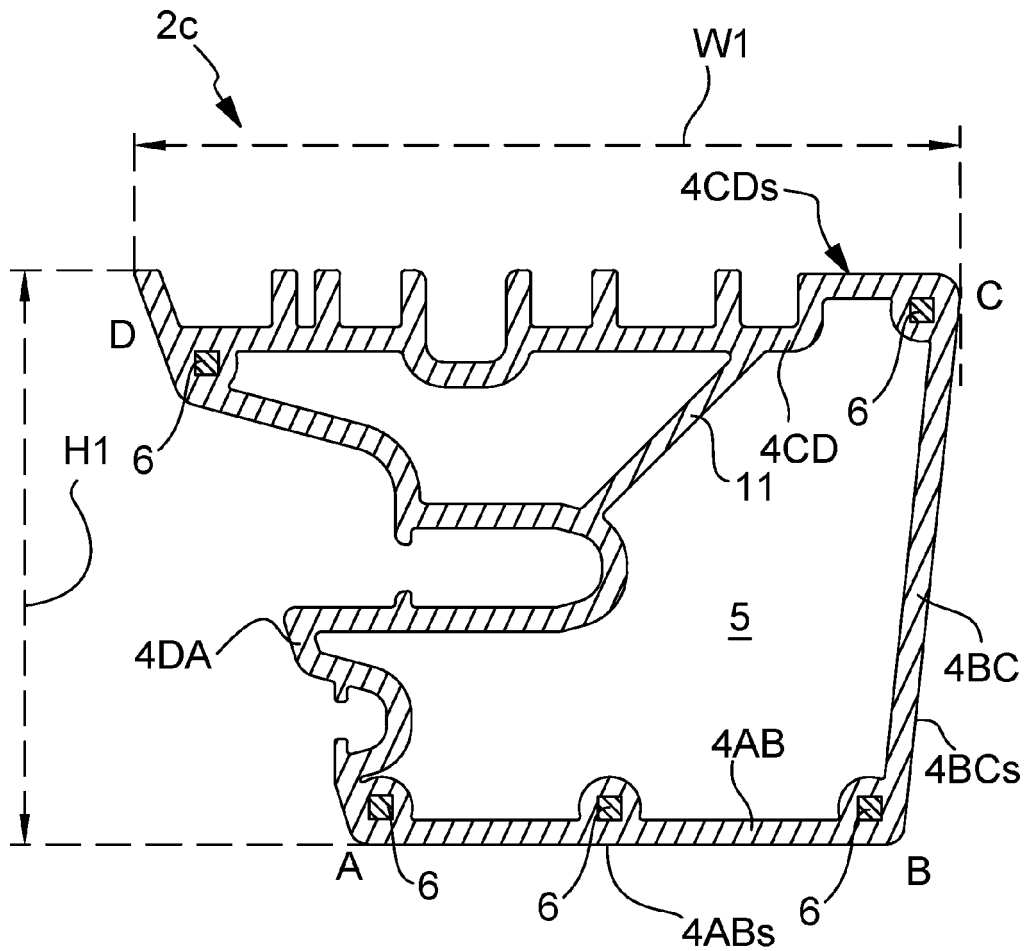


Fig. 8

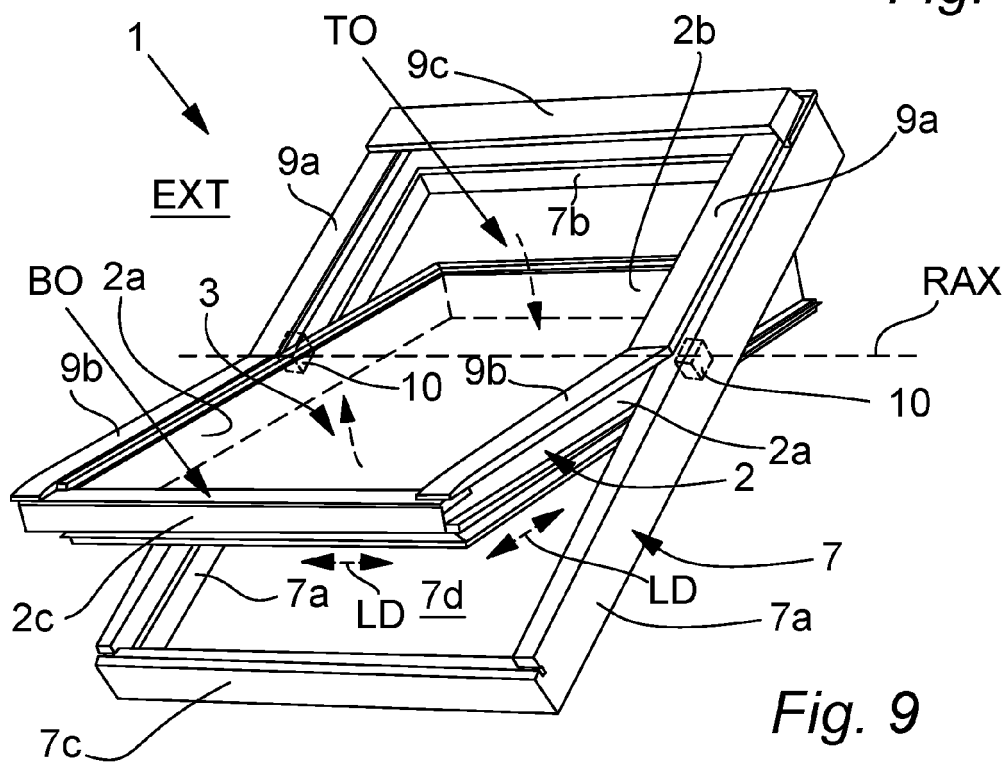


Fig. 9

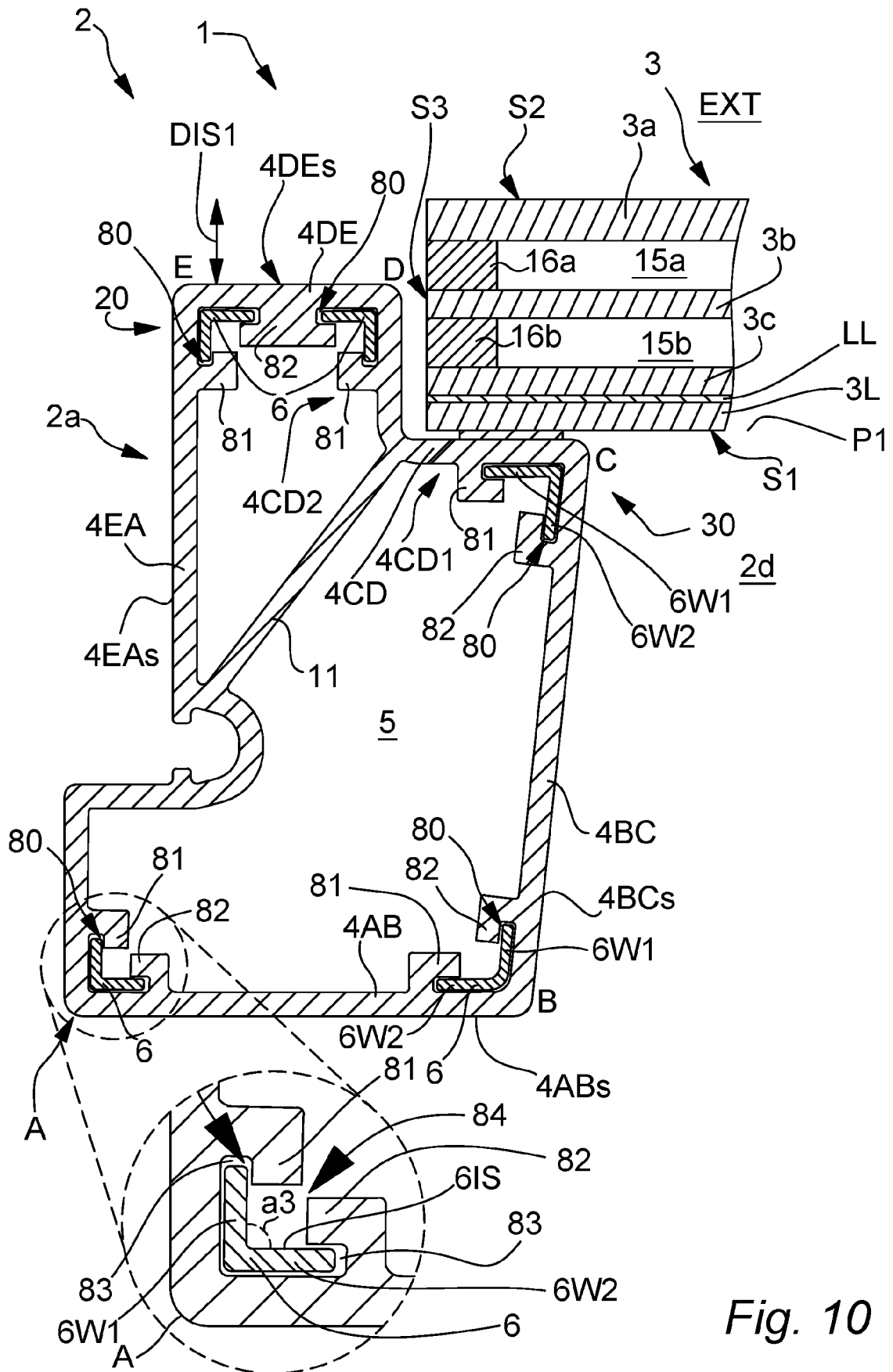


Fig. 10

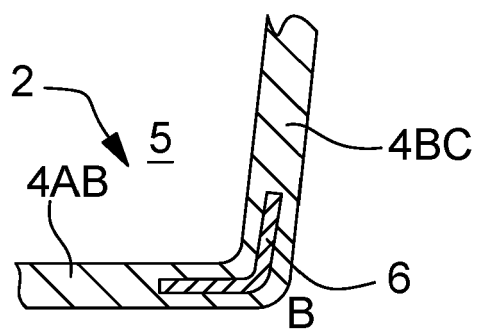


Fig. 11

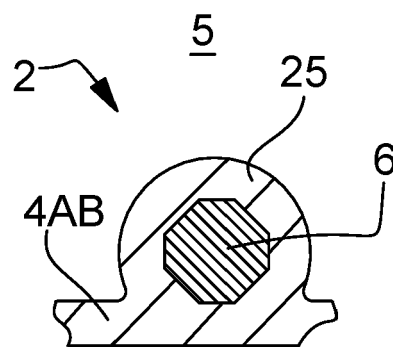


Fig. 12

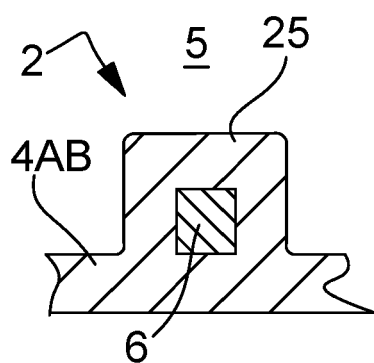


Fig. 13

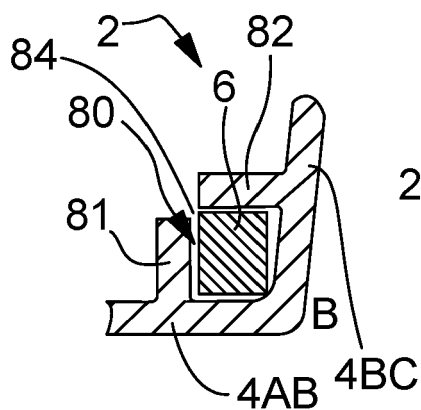


Fig. 14

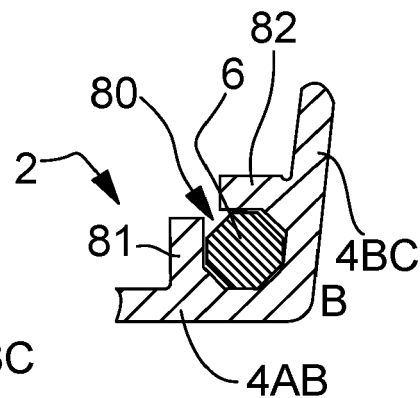


Fig. 15

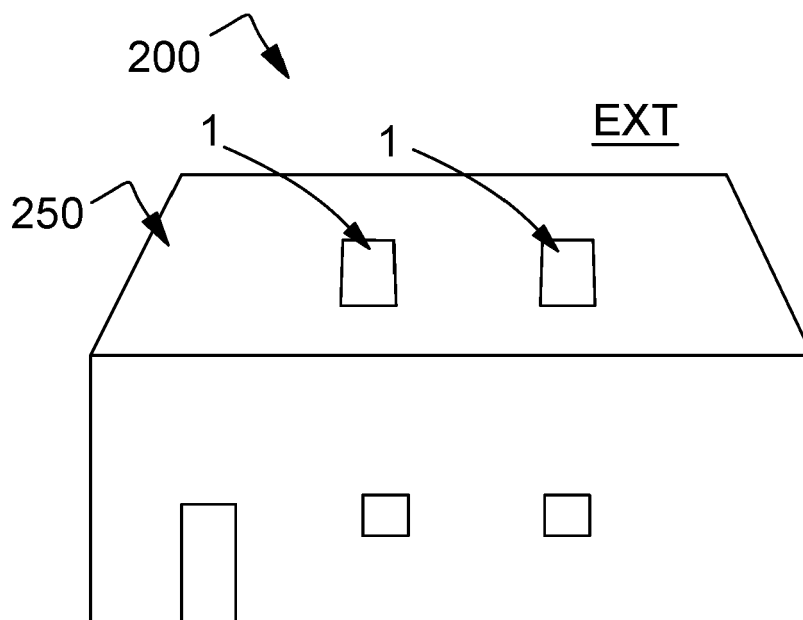


Fig. 16

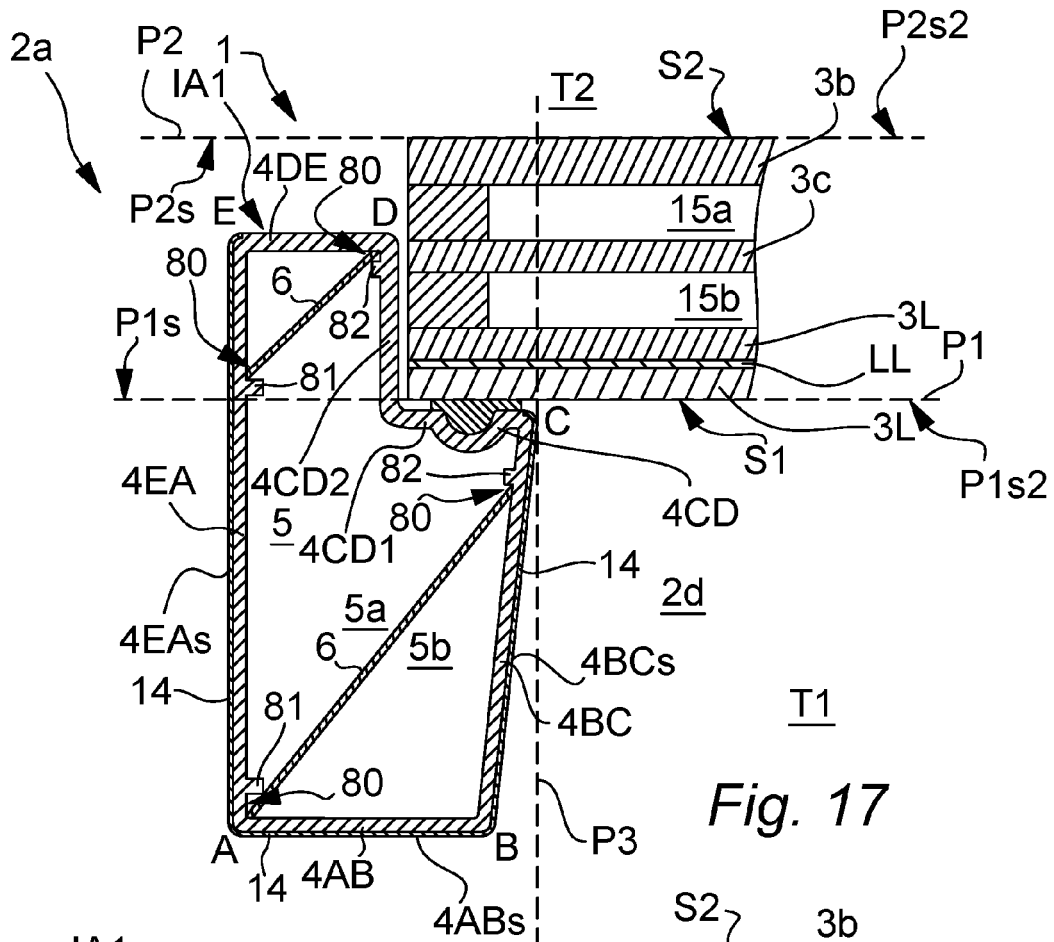


Fig. 17

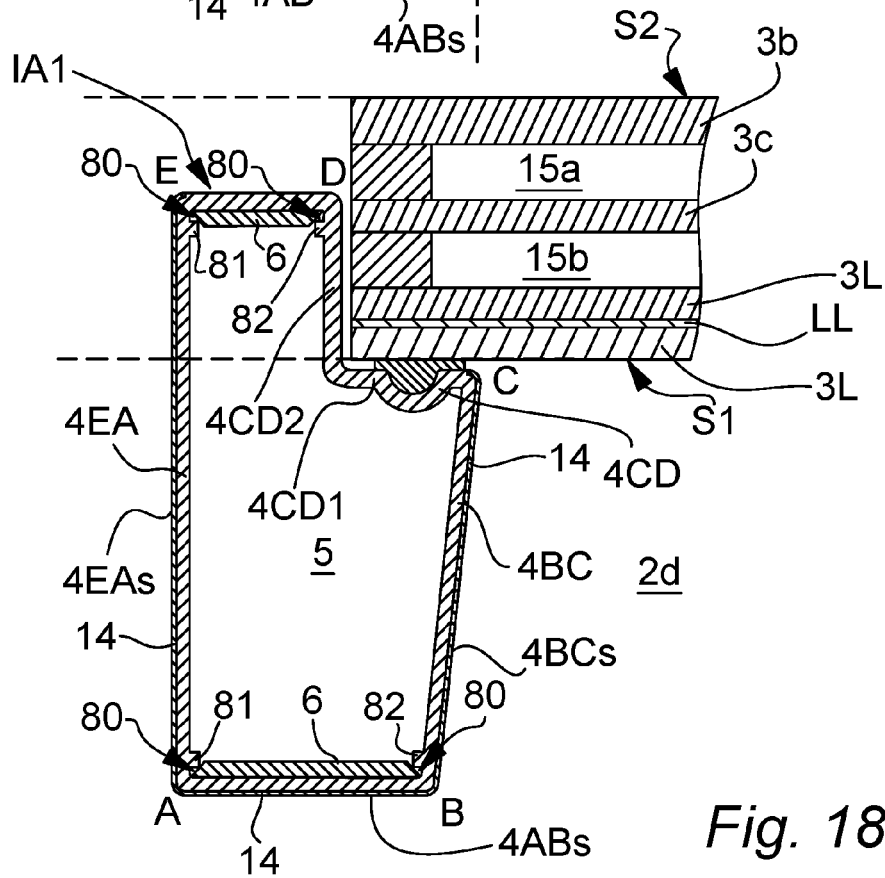


Fig. 18



EUROPEAN SEARCH REPORT

Application Number

EP 22 21 0133

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	US 6 427 415 B1 (ROSENKRANZ ERICH [DE]) 6 August 2002 (2002-08-06) * figure 1a *	1-4, 6-15	INV. E04D13/03 E06B3/30 E06B3/22
A	-----	5	
Y	WO 2021/156313 A1 (VKR HOLDING AS [DK]) 12 August 2021 (2021-08-12) * figure 4 *	1-4, 6, 8-15	
A	-----	5	
Y	WO 98/22683 A1 (RASMUSSEN KANN IND AS [DK]; DYRBY ERIK BJOERN [DK] ET AL.) 28 May 1998 (1998-05-28) * page 3, last paragraph; figure 1 *	1-4, 6-8, 11-15	
Y	CN 105 008 648 A (DUSPOHL MASCHB GMBH) 28 October 2015 (2015-10-28) * figure 1 *	1-4, 9-15	
Y	GB 2 564 502 A (VEKA PLC [GB]) 16 January 2019 (2019-01-16) * figure 1 *	1-4, 9-15	
Y	EP 3 252 249 A1 (VKR HOLDING AS [DK]) 6 December 2017 (2017-12-06) * figure 12 *	1	TECHNICAL FIELDS SEARCHED (IPC) E04D E06B B29C
A	DE 20 2019 107047 U1 (REHAU AG & CO [DE]) 18 March 2021 (2021-03-18) * paragraph [0017]; figure 1 *	1-15	
A	DE 197 41 788 A1 (PIP AG [CH]) 16 April 1998 (1998-04-16) * figure * *	1-15	
The present search report has been drawn up for all claims			

1

EPO FORM 1503 03:82 (P04C01)

Place of search

The Hague

Date of completion of the search

12 May 2023

Examiner

Leroux, Corentine

CATEGORY OF CITED DOCUMENTS

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ON EUROPEAN PATENT APPLICATION NO.**

EP 22 21 0133

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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12-05-2023

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6427415	B1	06-08-2002	NONE
WO 2021156313	A1	12-08-2021	EP 4100591 A1
		WO 2021156313 A1	14-12-2022
			12-08-2021
WO 9822683	A1	28-05-1998	AT 213048 T
		AU 5048098 A	15-02-2002
		CA 2270449 A1	10-06-1998
		CZ 9901774 A3	28-05-1998
		DE 69710366 T2	13-12-2000
		DK 131996 A	19-09-2002
		EP 0948694 A1	20-05-1998
		HU 0000092 A2	13-10-1999
		JP 3990462 B2	28-05-2000
		JP 2001504185 A	10-10-2007
		PL 183113 B1	27-03-2001
		US 6578326 B1	31-05-2002
		WO 9822683 A1	17-06-2003
			28-05-1998
CN 105008648	A	28-10-2015	CN 105008648 A
			28-10-2015
		DE 102013100588 A1	24-07-2014
		EP 2946058 A1	25-11-2015
		US 2015308181 A1	29-10-2015
		WO 2014111353 A1	24-07-2014
GB 2564502	A	16-01-2019	NONE
EP 3252249	A1	06-12-2017	DE 202017007251 U1
			29-04-2020
		EP 3252249 A1	06-12-2017
		PL 3252249 T3	10-01-2022
DE 202019107047	U1	18-03-2021	NONE
DE 19741788	A1	16-04-1998	CH 691498 A5
			31-07-2001
		DE 19741788 A1	16-04-1998

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2021080445 A1 [0001]
- US 6427415 B1 [0001]
- WO 2008135048 A1 [0001]
- PL 232782 B1 [0001]
- EP 3648945 B1 [0001]