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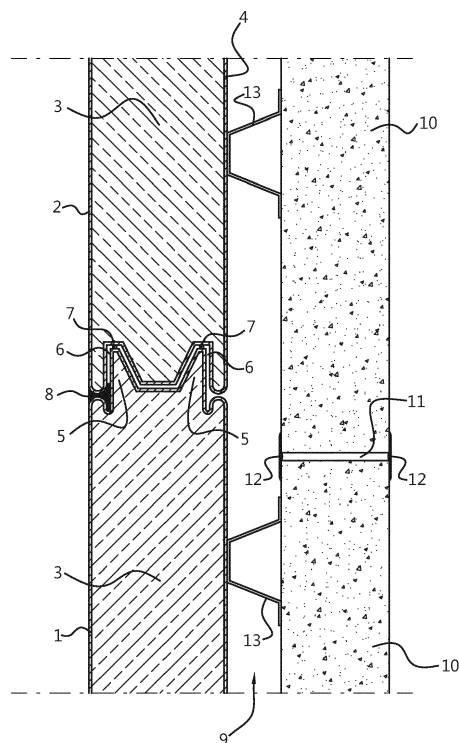
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(54) **IMPROVED WALL INSULATION FOR CLIMATE-CONTROLLED STORAGE SPACE**

(57) The present invention relates to an insulated wall for climate-controlled storage space, comprising concrete panels, profiles and sandwich panels, wherein the concrete panels are positioned on an inner side of the insulated wall, wherein the sandwich panels are positioned on an outer side of the insulated wall, and wherein the profiles are attached between the concrete panels and the sandwich panels, wherein joints between concrete panels and joints between sandwich panels are finished airtight. The invention also relates to a method for insulating a wall of a climate-controlled storage space, comprising placing concrete panels, wherein the concrete panels are positioned on an inner side of the wall; fixing profiles to the concrete panels, wherein the profiles are positioned on an outer side of the wall; fixing sandwich panels on the profiles; wherein when placing the concrete panels and when placing the sandwich panels, joints between concrete panels and joints between sandwich panels are finished airtight.

Fig. 1



Description

TECHNICAL FIELD

[0001] The invention relates to an insulated wall for climate-controlled storage space.

[0002] In a second aspect, the invention also relates to a method for insulating a wall of a climate-controlled storage space.

[0003] In another aspect, the invention also relates to a use for a climate-controlled storage space for art objects.

PRIOR ART

[0004] The long-term storage of art with a maximum guarantee of the conservation and safety of an art object is a particularly complex matter. Various environmental factors can have a negative influence on the lifespan of the art object. Too high a relative humidity can cause art objects to warp, metals or minerals in an art object to degrade or mold to develop. For example, too low a relative humidity can cause cracks in wooden art objects. Too high and too low temperatures and temperature fluctuations that are too large can cause stresses in art objects that lead to damage. Temperatures that are too high or too low can also make chemically unstable art objects unusable in a few decades or much faster.

[0005] That is why valuable art objects are stored in conditioned spaces for long-term storage. Such spaces are thermally insulated using insulation panels. In these spaces, the relative humidity and temperature are very strongly monitored and regulated with the help of extensive HVAC installations. In the "Museums, Galleries, Archives and Libraries" chapter of the handbook "American Society of Heating, Refrigeration, and Air Conditioning Engineers Inc. Handbook", 2019 edition, such spaces are divided into classes, whereby stricter requirements regarding the stability of temperature and humidity belong to a higher category. Very unique and valuable or very fragile art objects are placed in a room of the strictest category AA for long-term storage. In such a room, the average relative humidity throughout the year, independent of the seasons, is almost constant and the temperature fluctuates minimally. This requires a very complex HVAC installation that consumes a lot of energy, despite the thermal insulation of the room. The storage of an art object in such a space is therefore very expensive.

[0006] The present invention aims to solve at least some of the above problems or drawbacks.

SUMMARY OF THE INVENTION

[0007] In a first aspect, the present invention relates to an insulated wall for climate-controlled storage space according to claim 1.

[0008] The insulated wall comprises concrete panels, profiles and sandwich panels, wherein the concrete pan-

els are positioned on an inner side of the insulated wall, wherein the sandwich panels are positioned on an outer side of the insulated wall, and wherein the profiles are attached between the concrete panels and the sandwich panels. The great advantage of this insulated wall is that joints between concrete panels and joints between sandwich panels are finished airtight, so that a double airtight barrier is created, which is not the case with a prior art storage space that is only insulated with insulation panels. During a winter period humid outside air and during a summer dry outside air can penetrate to a very limited extent through the double airtight barrier into the storage space. As a result, minor fluctuations in relative humidity are obtained in the storage space. In addition, cold outside air in winter and warm outside air in summer penetrates into the storage space to a very limited extent, contributing to minor fluctuations in temperature in the storage space. It is also advantageous that, due to the minor fluctuations in temperature, fewer fluctuations in relative air humidity occur in the storage space. Due to the minor fluctuations in both temperature and relative humidity, a less complex HVAC installation is required, and energy consumption of the installation can be saved. A less complex HVAC installation also requires less maintenance.

[0009] Preferred embodiments of the construction are set out in claims 2 to 9.

[0010] In a second aspect, the present invention relates to a method according to claim 10. This method has the advantage, inter alia, that a wall of a storage space is not only thermally insulated, as is the case with a prior art storage space, but that, because when placing the concrete panels and when placing the sandwich panels, joints between concrete panels and joints between sandwich panels are finished airtight, creating a double airtight barrier. This is advantageous for reducing fluctuations in temperature and relative humidity in the storage space. As a result, a less complex HVAC installation is required, and energy consumption of the installation can be saved.

[0011] Preferred embodiments of the method are described in the dependent claims 11 to 14.

[0012] In a third aspect, the present invention relates to a use according to claim 15. This use results in an advantageous storage of art objects. Art objects can be stored in a storage space at a stable temperature and relative humidity, which means that art objects can be stored for a long time without damage or degradation, while a less complex HVAC installation is required, and a lower energy consumption for the HVAC installation can be obtained.

BRIEF DESCRIPTION OF THE FIGURES

[0013]

Figure 1 shows a sectional view of an insulated wall according to an embodiment of the present invention.

Figure 2 shows a sectional view of an insulated wall according to an embodiment of the present invention, at the top of the insulated wall.

Figure 2A shows a detail from Figure 2.

Figure 3 shows a sectional view of an insulated wall according to an embodiment of the present invention, at the bottom of the insulated wall.

Figure 3A shows a detail from Figure 3.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meaning as commonly understood by a person skilled in the art to which the invention pertains. For a better understanding of the description of the invention, the following terms are explained explicitly.

[0015] In this document, "a" and "the" refer to both the singular and the plural, unless the context presupposes otherwise. For example, "a segment" means one or more segments.

[0016] The terms "comprise", "comprising", "consist of", "consisting of", "provided with", "include", "including", "contain", "containing", are synonyms and are inclusive or open terms that indicate the presence of what follows, and which do not exclude or prevent the presence of other components, characteristics, elements, members, steps, as known from or disclosed in the prior art.

[0017] Quoting numerical intervals by endpoints comprises all integers, fractions and/or real numbers between the endpoints, these endpoints included.

[0018] In the context of this document, relative humidity is the ratio of a pressure that water vapor has in the air, vapor pressure, and a saturation pressure, or the maximum possible vapor pressure, at the prevailing temperature. The relative humidity is therefore dependent on the temperature. Relative humidity (RH) is expressed as a percentage or a number without units.

[0019] In a first aspect, the invention relates to an insulated wall for climate-controlled storage space.

[0020] According to a preferred embodiment, the insulated wall comprises concrete panels, profiles and sandwich panels.

[0021] The concrete panels are concrete panels cast in situ or precast concrete panels. Preferably, the concrete panels are precast concrete panels. The concrete panels are preferably reinforced. The concrete panels are positioned on an inner side of the insulated wall. The inner side of the insulated wall refers to the side that faces the climate-controlled storage space. The concrete panels are stacked next to and on top of each other to form the insulated wall. The concrete panels are preferably attached to each other. Joints between the concrete panels are finished airtight. Because concrete is airtight and the joints between the concrete panels are finished air-

tight, the concrete panels form a first airtight barrier.

[0022] The sandwich panels comprise a layer of insulation material and two protective metal layers. The layer of insulation material is sandwiched between the two protective metal layers. Thanks to the insulation material and the metal layers, the sandwich panels are airtight. The sandwich panels are positioned on an outer side of the insulated wall. The outer side of the insulated wall refers to the side that faces the environment around the climate-controlled storage space.

[0023] The profiles are attached between the concrete panels and the sandwich panels. The profiles are preferably attached to the concrete panels. The profiles are screwed, nailed or glued to the concrete panels. Preferably, the profiles are screwed to the concrete panels. The sandwich panels are preferably attached to the profiles. The sandwich panels are screwed, nailed or glued to the profiles. Preferably, the sandwich panels are attached to the profiles by means of screws and a cover. The cover is advantageous for protecting a screw head of the screw and for closing off a screw opening in the sandwich panel. The profiles are wooden, plastic or metal profiles. Preferably, the profiles are metal profiles. Preferably, the profiles have a substantially U-shaped cross-section. The U-shape comprises a base and two legs. The legs of the U-shape have folded back parts at the free ends. The folded back parts are substantially parallel to the base of the U-shape. The folded back pieces extend in a direction away from the opening between the legs of the U-shape. Such a U-shape is advantageous for attaching sandwich panels to the profiles, wherein a possible thermal bridge between sandwich panel and concrete panel is as small as possible. The profiles form a grid against the concrete panels. The grid comprises profiles in substantially horizontal and/or vertical direction. The use of the profiles creates a space between the concrete panels and the sandwich panels. This space is advantageous as a cavity, so that better thermal insulation of the insulated wall is obtained.

[0024] The sandwich panels at least completely cover the concrete panels on the outer side of the insulated wall. Joints between the sandwich panels are finished airtight. Because a sandwich panel is airtight and the joints between the sandwich panels are finished airtight, the sandwich panels form a second airtight barrier. In addition, the insulation material contained in the sandwich panels is advantageous for thermally insulating the storage space. Likewise advantageous, the two metal layers of the sandwich panels are watertight, preventing moisture from penetrating through the insulated wall, if at all.

[0025] The great advantage of an insulated wall according to the present invention is that, in addition to the thermal insulation provided by the cavity and the insulation material in the sandwich panels, the insulated wall forms a double airtight barrier, which is not the case with a prior art storage space which is only insulated with insulation panels. During a winter period humid outside air

and during a summer dry outside air can penetrate to a very limited extent through the double airtight barrier into the storage space. As a result, minor fluctuations in relative humidity are obtained in the storage space. In addition, cold outside air in winter and warm outside air in summer penetrates into the storage space to a very limited extent, contributing to minor fluctuations in temperature in the storage space. It is also advantageous that, due to the minor fluctuations in temperature, fewer fluctuations in relative air humidity occur in the storage space. Due to the minor fluctuations in both temperature and relative humidity, a less complex HVAC installation is required, and energy consumption of the installation can be saved. A less complex HVAC installation also requires less maintenance.

[0026] According to an embodiment, joints between concrete panels are finished airtight by means of airtight adhesive tape. Airtight adhesive tape is known from the prior art. The airtight adhesive tape is applied over a joint and on concrete panels lying next to said joint. The joint has a length. The airtight adhesive tape is applied over the full length of the joint. Airtight adhesive tape is advantageous because differences in level between concrete panels can be easily accommodated.

[0027] According to a preferred embodiment, joints between concrete panels are filled with PUR foam or cement as a joint backer and the joints on a side facing the sandwich panels are finished with an airtight coating. Due to the joint backer, a joint is substantially completely filled, so that a thin layer of airtight coating is sufficient for an airtight finish of the joint. The joint has a length. The airtight coating is applied over the full length of the joint. The airtight coating is applied to the joint backer and from the joint onto concrete panels lying next to said joint. The airtight coating is applied from said joint over a distance, in a direction perpendicular to the longitudinal direction of said joint, of at least 5 cm, preferably at least 10 cm, more preferably at least 15 cm, even more preferably at least 20 cm and even more preferably at least 25 cm. The airtight coating is applied in a layer with a thickness of at most 1 mm. An airtight coating with a thickness of at most 1 mm is advantageous because the airtight coating can deform without cracks under the influence of expansion and contraction of the concrete panels. An airtight coating is advantageous because it can be applied quickly and does not come off the concrete panels over time.

[0028] According to a preferred embodiment, joints between concrete panels are finished airtight on both sides of the concrete panels. By both sides is meant a first side facing the outer side of the insulated wall and a second side facing the inner side of the insulated wall. The joints are finished airtight on both sides, analogous to one of the previously described embodiments. Alternatively, the joints are finished airtight on a first side according to a first of the previously described embodiments and on a second side according to a second of the previously described embodiments. Finishing joints between concrete

panels airtight on both sides is advantageous for avoiding an air leak in the first airtight barrier in case the airtight finish of the joints between the concrete panels is damaged during, for instance, placing the sandwich panels.

[0029] According to an embodiment, the sandwich panels comprise a tongue at a first end and a groove at a second end. A tongue and groove are advantageous for overlappingly connecting adjacent sandwich panels, thus avoiding a gap between adjacent sandwich panels. This is advantageous for the thermal insulation of the insulated wall. This is also advantageous for a structural strength of a wall formed from sandwich panels. Preferably, the sandwich panels comprise a double tongue at a first end and a double groove at a second end, or at both ends both a tongue and a groove.

[0030] According to an embodiment, joints between sandwich panels are finished airtight by means of airtight adhesive tape. The airtight adhesive tape is applied in a similar manner and has similar advantages as in a previously described embodiment with concrete panels.

[0031] According to a preferred embodiment, at least one butyl rubber seal is placed in joints between two sandwich panels and the joints on the outer side of the insulated wall are sealed. A joint has a length. The butyl rubber seal is placed over the full length of a joint. The butyl rubber seal is clamped between two adjacent sandwich panels. Butyl rubber seals are advantageous in that they are both watertight and airtight. The sandwich panels not only form an airtight barrier, but also a watertight barrier. The joint is sealed over the entire length on the outer side of the insulated wall. The joint is preferably sealed with a watertight and airtight silicone. This prevents water and air from penetrating between the sandwich panels. Sealing the joint is also advantageous when sandwich panels do not connect properly when installed, as a result of which a butyl rubber seal is only partially clamped between sandwich panels and does not form a complete airtight and watertight barrier.

[0032] Butyl rubber seals are particularly advantageous in combination with a previously described embodiment in which sandwich panels comprise a tongue at a first end and a groove at a second end. The butyl rubber seal is preferably placed between tongue and groove of adjacent sandwich panels. The butyl rubber seal is clamped between the tongue and the groove and abuts against the adjacent sandwich panels. When, as in a previously described embodiment, a sandwich panel has two tongues or two grooves or a tongue and a groove at one end, a butyl rubber seal is preferably placed between each tongue and groove of adjacent sandwich panels.

[0033] According to a preferred embodiment, the concrete panels have a thickness of at least 10 cm and a volumetric heat capacity of at least 2000 kJ/m³K. Preferably, the concrete panels have a thickness of at least 11 cm, more preferably at least 12 cm, more preferably at least 13 cm and even more preferably at least 14 cm. The thickness is measured in a direction substantially

perpendicular to the insulated wall. Preferably, the concrete panels have a volumetric heat capacity of at least 2050 kJ/m³K, more preferably at least 2100 kJ/m³K and even more preferably at least 2200 kJ/m³K.

[0034] Due to the high volumetric heat capacity, a concrete panel is very suitable for absorbing heat into the concrete panel. Due to the high volumetric heat capacity, a concrete panel with a limited volume can absorb or release a lot of heat at a minor temperature difference. The concrete panel serves as a heat buffer which, if the temperature in a storage space is higher than the temperature of the concrete panel, absorbs heat and which, if the temperature in a storage space is lower than the temperature of the concrete panel, releases heat. Temperature fluctuations in a storage space are hereby reduced compared to a prior art storage space. Smaller temperature fluctuations also lead to smaller fluctuations in relative humidity. The smaller temperature fluctuations and fluctuations in relative humidity allow a reduction in complexity and energy consumption of an HVAC installation. A concrete panel with a thickness of at least 10 cm has a sufficient thermal mass to reduce temperature fluctuations in a storage space. Because sandwich panels, as described above, are positioned on the outer side of the insulated wall, the functioning of the concrete panels as a heat buffer is not disturbed by the sandwich panels. Heat stored in the concrete panels is not released by the sandwich panels to an environment around the storage space.

[0035] According to a preferred embodiment, the sandwich panels comprise PIR insulation. The total thickness of the sandwich panels is at least 6 cm, preferably at least 7 cm, more preferably at least 8 cm, even more preferably at least 9 cm and even more preferably at least 10 cm. The sandwich panels have an R-value of at least 4.00 m²K/W, preferably at least 4.25 m²K/W, more preferably at least 4.5 m²K/W, even more preferably at least 4.75 m²K/W and even more preferably at least 5.00 m²K/W.

[0036] An R-value of at least 4.00 m²K/W is advantageous because sandwich panels find it difficult to absorb and transfer heat, for example from a storage space to an environment around the storage space or vice versa. The sandwich panels are therefore a good thermal insulator of the storage space, so that less energy is required to cool or heat the storage space.

[0037] According to a preferred embodiment, a lying insulation panel is placed at the top of the insulated wall. The lying insulation panel is, for example, a sandwich panel. The lying insulation panel extends from the outer side to at least the inner side of the insulated wall. The lying insulation panel forms an airtight seal at the top of the insulated wall of the space between the sandwich panels and the concrete panels. This space has previously been described as a cavity. The airtight sealing off of the cavity at the top according to the present embodiment is advantageous in order to avoid that the airtight barrier formed by the sandwich panels is broken through an opening at the top of the insulated wall. This is the

case, for example, if the insulated wall at the top is not covered by, for example, a roof, such as with a flat roof, where the insulated wall projects above the flat roof.

[0038] Joints between two adjacent sandwich panels and between a lying insulation panel and a sandwich panel at the top of the insulated wall are finished airtight. Preferably, these joints are finished airtight, as in previously described embodiments.

[0039] According to a further embodiment, a vapor barrier of a roof is glued to a concrete panel under the lying insulation panel. The vapor barrier extends to the space between the concrete panels and the sandwich panels. This space has previously been described as a cavity. This embodiment is particularly advantageous in a storage space with a flat roof where the insulated wall projects above the flat roof. In this situation, concrete panels at the top of the insulated wall are at least partially above the roof. Joints between the concrete panels on the inner side of the insulated wall of a section above the roof are finished airtight. As in previously described embodiments, these joints are finished airtight. If these joints of the said part of the insulated wall are not finished airtight on the inner side, a leak will occur in the airtight barrier formed by the concrete panels. There is no additional airtight barrier formed by the sandwich panels at said part of the insulated wall. By sticking the vapor barrier under the lying insulation panel, the vapor barrier extends from the roof of the storage space along said part of the insulated wall. As a result, the vapor barrier forms an additional airtight and vapor tight barrier for the said part of the insulated wall. Preferably, the vapor barrier is also glued to the said part of the insulated wall on the inner side.

[0040] The vapor barrier has a vapor diffusion resistance or Sd value that is at least 1200 m, preferably at least 1300 m, more preferably at least 1400 m and even more preferably at least 1500 m. An Sd value of 1200 m means that the vapor barrier has a resistance to water vapor diffusion equal to the resistance to water vapor diffusion of a layer of air 1200 m thick.

[0041] According to a further embodiment, insulation is placed on the inner side of the insulated wall against said part of the insulated wall protruding above the roof. The insulation is preferably a PIR sheet with a thickness of at least 40 mm, preferably at least 45 mm, more preferably at least 50 mm, even more preferably at least 55 mm and even more preferably at least 60 mm. The insulation covers the entire said part of the insulated wall. Preferably, the lying insulation plate extends on the inner side of the insulated wall to over the said insulation on the inner side of the insulated wall. This embodiment is advantageous because it prevents concrete panels projecting at the top of the insulated wall above the roof from forming a heat or cold bridge between the storage space and an environment around the storage space.

[0042] According to a preferred embodiment, concrete panels at the bottom of the insulated wall extend at least to below a concrete floor surface. A continuous roof is

placed between the concrete floor surface and the concrete panels and between the concrete floor surface and a foundation or underlying retaining wall underlying the concrete panels. The continuous roofing is advantageous to prevent moisture from entering the storage space through the joint between the retaining wall or foundation and the concrete panels. Joints between the concrete panels and the underlying foundation or underlying retaining wall are finished with an airtight coating. This prevents a leak in the airtight barrier formed by the concrete panels at the bottom of the insulated wall.

[0043] According to a preferred embodiment, the airtight coating comprises polymer emulsion, wherein the airtight coating has an air permeability of at most 50 liters of air per hour per square meter or $0.05 \text{ m}^3/(\text{h} \cdot \text{m}^2)$, preferably at most $0.04 \text{ m}^3/(\text{h} \cdot \text{m}^2)$, more preferably at most $0.03 \text{ m}^3/(\text{h} \cdot \text{m}^2)$. The polymer emulsion is preferably applied in two layers. A layer has a thickness of at most 1 mm, preferably at most 0.9 mm, more preferably at most 0.8 mm, even more preferably at most 0.7 mm, even more preferably at most 0.6 mm. A polymer emulsion is advantageous because the airtight coating can be applied quickly and easily with the help of a brush or with a paint sprayer, while a good airtightness is obtained.

[0044] It will be apparent to one skilled in the art that one or more embodiments of the present invention may be advantageously combined.

[0045] In a second aspect, the invention relates to a method for insulating a wall of a climate-controlled storage space.

[0046] In a preferred embodiment, the method comprises the steps of:

- placing concrete panels, wherein the concrete panels are positioned on an inner side of the wall;
- fixing profiles to the concrete panels, wherein the profiles are positioned on an outer side of the wall;
- fixing sandwich panels on the profiles;

[0047] The inner side of the insulated wall refers to the side that faces the climate-controlled storage space. The outer side of the insulated wall refers to the side that faces the environment around the climate-controlled storage space.

[0048] The concrete panels are stacked next to and on top of each other to form the insulated wall. The concrete panels are preferably attached to each other. Joints between the concrete panels are finished airtight. Because concrete is airtight and the joints between the concrete panels are finished airtight, the concrete panels form a first airtight barrier.

[0049] The profiles are screwed, nailed or glued to the concrete panels. Preferably, the profiles are screwed to the concrete panels. The profiles are attached to the concrete panels in a grid. The grid comprises profiles in substantially horizontal and/or vertical direction. The use of the profiles creates a space between the concrete panels and the sandwich panels. This space is advantageous

as a cavity, so that better thermal insulation of the insulated wall is obtained.

[0050] The sandwich panels are screwed, nailed or glued to the profiles. Preferably, the sandwich panels are attached to the profiles by means of screws and a cover. The cover is advantageous for protecting a screw head of the screw and for closing off a screw opening in the sandwich panel. The sandwich panels at least completely cover the concrete panels on the outer side of the insulated wall. Joints between the sandwich panels are finished airtight. Because a sandwich panel is airtight and the joints between the sandwich panels are finished airtight, the sandwich panels form a second airtight and also vapor tight barrier. In addition, the insulation material contained in the sandwich panels is advantageous for thermally insulating the storage space.

[0051] This method has the advantage, inter alia, that a wall of a storage space is not only thermally insulated, as is the case with a prior art storage space, but that, because when placing the concrete panels and when placing the sandwich panels, joints between concrete panels and joints between sandwich panels are finished airtight, creating a double airtight barrier. This is advantageous for reducing fluctuations in temperature and relative humidity in the storage space. As a result, a less complex HVAC installation is required, and energy consumption of the installation can be saved.

[0052] According to a preferred embodiment, joints between concrete panels are filled with PUR foam or cement as a joint backer and the joints on a side facing the sandwich panels are finished with an airtight coating.

[0053] Due to the joint backer, a joint is substantially completely filled, so that a thin layer of airtight coating is sufficient for an airtight finish of the joint. The joint has a length. The airtight coating is applied over the full length of the joint. The airtight coating is applied to the joint backer and from the joint onto concrete panels lying next to said joint. The airtight coating is applied from said joint over a distance, in a direction perpendicular to the longitudinal direction of said joint, of at least 5 cm, preferably at least 10 cm, more preferably at least 15 cm, even more preferably at least 20 cm and even more preferably at least 25 cm. The airtight coating is applied in a layer with a thickness of at most 1 mm. An airtight coating with a thickness of at most 1 mm is advantageous because the airtight coating can deform without cracks under the influence of expansion and contraction of the concrete panels. An airtight coating is advantageous because it can be applied quickly and does not come off the concrete panels over time.

[0054] According to a preferred embodiment, two butyl rubber seals are placed in joints between sandwich panels and the joints on the outer side of the wall are sealed.

[0055] A joint has a length. The butyl rubber seal is placed over the full length of a joint. The butyl rubber seal is clamped between two adjacent sandwich panels. Butyl rubber seals are advantageous in that they are both watertight and airtight. The sandwich panels not only form

an airtight barrier, but also a watertight barrier. The joint is sealed over the entire length on the outer side of the insulated wall. The joint is preferably sealed with a watertight and airtight silicone. This prevents water and air from penetrating between the sandwich panels. Sealing the joint is also advantageous when sandwich panels do not connect properly when installed, as a result of which a butyl rubber seal is only partially clamped between sandwich panels and does not form a complete airtight and watertight barrier.

[0056] According to a preferred embodiment, a lying insulation panel is placed at the top of the wall, wherein the lying insulation panel extends from the outer side to at least the inner side of the wall, and wherein the lying insulation panel forms an airtight seal for a space between the sandwich panels and the concrete panels.

[0057] This space has previously been described as a cavity. The airtight sealing off of the cavity at the top according to the present embodiment is advantageous in order to avoid that the airtight barrier formed by the sandwich panels is broken through an opening at the top of the insulated wall. This is the case, for example, if the insulated wall at the top is not covered by, for example, a roof, such as with a flat roof, where the insulated wall projects above the flat roof.

[0058] Joints between two adjacent sandwich panels and between a lying insulation panel and a sandwich panel at the top of the insulated wall are finished airtight. Preferably, these joints are finished airtight, as in previously described embodiments.

[0059] According to a further embodiment, a vapor barrier of a roof is glued to a concrete panel under the lying insulation panel. The vapor barrier extends to the space between the concrete panels and the sandwich panels. This space has previously been described as a cavity. This embodiment is particularly advantageous in a storage space with a flat roof where the insulated wall projects above the flat roof. In this situation, concrete panels at the top of the insulated wall are at least partially above the roof. Joints between the concrete panels on the inner side of the insulated wall of a section above the roof are finished airtight. As in previously described embodiments, these joints are finished airtight. There is no additional airtight barrier formed by the sandwich panels at said part of the insulated wall. By sticking the vapor barrier under the lying insulation panel, the vapor barrier extends from the roof of the storage space along said part of the insulated wall. As a result, the vapor barrier forms an additional airtight and also vapor tight barrier for the said part of the insulated wall. Preferably, the vapor barrier is also glued to the said part of the insulated wall on the inner side.

[0060] According to a further embodiment, insulation is placed on the inner side of the insulated wall against said part of the insulated wall protruding above the roof. The insulation covers the entire said part of the insulated wall. Preferably, the lying sandwich plate extends on the inner side of the insulated wall to over the said insulation

on the inner side of the insulated wall. This embodiment is advantageous because it prevents concrete panels projecting at the top of the insulated wall above the roof from forming a heat or cold bridge between the storage space and an environment around the storage space.

[0061] According to a preferred embodiment, concrete panels are placed at the bottom of the wall in such a way that the concrete panels extend at least below a concrete floor surface, wherein a continuous roof is placed between the concrete floor surface and the concrete panels and between the concrete floor surface and a foundation or retaining wall lying under the concrete panels and wherein joints between the concrete panels and the underlying foundation or retaining wall are finished with an airtight coating.

[0062] The continuous roofing is advantageous to prevent moisture from entering the storage space through a joint between the foundation or retaining wall and the concrete panels. Joints between the concrete panels and the underlying foundation or retaining wall are finished with an airtight coating. This prevents a leak in the airtight barrier formed by the concrete panels at the bottom of the insulated wall.

[0063] One skilled in the art will appreciate that the insulated wall according to the first aspect is preferably obtained by performing a method according to the second aspect and that a method according to the second aspect is preferably performed to obtain an insulated wall according to the first aspect. Each feature described in this document, both above and below, can therefore relate to any of the three aspects of the present invention.

[0064] In a third aspect, the invention relates to a use of an insulated wall according to the first aspect or a method according to the second aspect for a climate-controlled storage space for art objects.

[0065] This use results in an advantageous storage of art objects. Art objects can be stored in a storage space at a stable temperature and relative humidity, which means that art objects can be stored for a long time without damage or degradation, while a less complex HVAC installation is required, and a lower energy consumption for the HVAC installation can be obtained.

[0066] In what follows, the invention is described by means of non-limiting figures illustrating the invention, which are not intended or should be interpreted to limit the scope of the invention.

DETAILED DESCRIPTION OF THE FIGURES

[0067] Figure 1 shows a sectional view of an insulated wall according to an embodiment of the present invention.

[0068] In the figure, the outer side of the insulated wall is on the left side, the inner side on the right side. Sandwich panels (1) are positioned on the outer side of the insulated wall. The sandwich panels (1) comprise an insulation material (3) and two metal layers (2) and (4). The sandwich panels have two tongues (5) at one end

and two complementary grooves (6) at an opposite end. The sandwich panels (1) are placed on top of each other, wherein tongues (5) of a first sandwich panel (1) engage grooves (6) of a second sandwich panel (1). A butyl rubber seal (7) is clamped between the tongues (5) and grooves (6). Joints between sandwich panels (1) are finished airtight. The joint is sealed with a watertight and airtight silicone (8). In this figure, the joint between the sandwich panels (1) is a horizontal joint. The sandwich panels (1) form a watertight and airtight barrier. The sandwich panels (1) are mounted on profiles (13), which in turn are mounted on concrete panels (10). Thanks to the profiles (13), a cavity (9) is formed between the sandwich panels (1) and the concrete panels (10). Joints between the concrete panels (10) are filled with PUR foam as a joint backer (11). The joints between the concrete panels (10) are finished airtight over their entire length using an airtight coating (12). In this figure, the joint between the concrete panels (10) is a horizontal joint and the joint is finished airtight on both sides of the concrete panels (10). **[0069]** Figure 2 shows a sectional view of an insulated wall according to an embodiment of the present invention, at the top of the insulated wall.

[0070] The insulated wall is analogous to the insulated wall in Figure 1. This figure shows how a vertical joint between concrete panels (10) is finished airtight with the aid of an airtight coating (12). The joint is finished airtight on both sides of the concrete panels (10). The insulated wall extends above a roof. The roof is formed by concrete vaults (18). The concrete panels (10) are partly higher than the roof. A vapor barrier (23) has been glued to the concrete vaults (18). The vapor barrier (23) is also glued to the portion of the concrete panels (10) that is above the roof and on top of the concrete panels (10) at the top of the insulated wall. The vapor barrier (23) here forms an airtight and vapor tight barrier. Insulation (16) has been placed on the vapor barrier (23). The portion of the concrete panels (10) located above the roof and insulation (16) is insulated by insulation (15). A lying insulation panel (14) is placed at the top of the insulated wall. The lying insulation panel (14) extends from the outer side of the insulated wall to above the insulation (15). A pleated steel roof edge (24) is arranged on the lying insulation panel (14). The steel roof edge (24) protects the insulation panel (14). The roof is finished watertight with a PVC seal (17) which is glued to the insulation (16), insulation (15) and the steel roof edge (14).

[0071] Figure 2A shows a detail labeled 'II A' on Figure 2.

[0072] Figure 3 shows a sectional view of an insulated wall according to an embodiment of the present invention, at the bottom of the insulated wall.

[0073] The insulated wall is analogous to the insulated wall in Figure 1. The concrete panels (10) extend at the bottom of the insulated wall to below a concrete floor surface (19). A continuous roof (20) is placed between the concrete floor surface (19) and the concrete panels (10) and between the concrete floor surface (19) and a

retaining wall (22) lying below the concrete panels (10). The concrete floor surface (19) rests on a bottom surface (25). The retaining wall (22) is incorporated into the bottom surface (25). This figure shows how a vertical joint between concrete panels (10) is finished airtight with the aid of an airtight coating (12). The joint is finished airtight on both sides of the concrete panels (10). The horizontal joint between the concrete panels (10) and the underlying retaining wall (22) is also finished airtight with the airtight coating (12). The cavity (9) is closed at the bottom with the aid of a drip profile (21).

[0074] Figure 3A shows a detail labeled 'III A' on Figure 3.

Claims

1. Insulated wall for climate-controlled storage space, comprising concrete panels, profiles and sandwich panels, wherein the concrete panels are positioned on an inner side of the insulated wall, wherein the sandwich panels are positioned on an outer side of the insulated wall, and wherein the profiles are attached between the concrete panels and the sandwich panels, **characterized in that** joints between concrete panels and joints between sandwich panels are finished airtight.
2. Insulated wall according to claim 1, **characterized in that** joints between concrete panels are filled with PUR foam or cement as a joint backer and the joints on a side facing the sandwich panels are finished with an airtight coating.
3. Insulated wall according to claim 1 or 2, **characterized in that** at least one butyl rubber seal is placed in joints between sandwich panels and the joints on the outer side of the insulated wall are sealed.
4. Insulated wall according to any of the preceding claims 1-3, **characterized in that** the concrete panels have a thickness of at least 10 cm and that the concrete panels have a volumetric heat capacity of at least 2000 kJ/m³K.
5. Insulated wall according to any of the preceding claims 1-4, **characterized in that** the sandwich panels comprise PIR insulation, wherein the total thickness of the sandwich panels is at least 6 cm and wherein the sandwich panels have an R-value of at least 4.00 m²K/W.
6. Insulated wall according to any of the preceding claims 1-5, **characterized in that** a lying insulation panel is placed at the top of the insulated wall, wherein the lying insulation panel extends from the outer side to at least the inner side of the insulated wall, and wherein the lying insulation panel forms an air-

tight seal for a space between the sandwich panels and the concrete panels.

7. Insulated wall according to claim 6, **characterized in that** a vapor barrier of a roof is glued to a concrete panel under the lying insulation panel, wherein the vapor barrier extends up to the space between the concrete panels and the sandwich panels. 5
8. Insulated wall according to any of the preceding claims 2-7, **characterized in that** at the bottom of the insulated wall, concrete panels extend at least up to below a concrete floor surface, wherein a continuous roofing is placed between the floor surface and the concrete panels and between the floor surface and a foundation lying beneath the concrete panels or underlying retaining wall, and wherein joints between the concrete panels and the underlying foundation or underlying retaining wall are finished with an airtight coating. 10 15 20
9. Insulated wall according to any of the preceding claims 2-8, **characterized in that** the airtight coating is polymer emulsion, wherein the airtight coating has an air permeability of at most $0.05 \text{ m}^3/(\text{h} \cdot \text{m}^2)$. 25
10. Method of insulating a wall of a climate-controlled storage space, comprising:
 - placing concrete panels, wherein the concrete panels are positioned on an inner side of the wall; 30
 - fixing profiles to the concrete panels, wherein the profiles are positioned on an outer side of the wall; 35
 - fixing sandwich panels on the profiles;

characterized in that when placing the concrete panels and when placing the sandwich panels, joints between concrete panels and joints between sandwich panels are finished airtight. 40
11. Method according to claim 10, **characterized in that** joints between concrete panels are filled with PUR foam or cement as a joint backer and the joints on a side facing the sandwich panels are finished with an airtight coating. 45
12. Method according to claim 10 or 11, **characterized in that** at least one butyl rubber seal is placed in joints between sandwich panels and the joints on the outer side of the wall are sealed. 50
13. Method according to claim 10, 11 or 12, **characterized in that** a lying insulation panel is placed at the top of the wall, wherein the lying insulation panel extends from the outer side to at least the inner side of the wall, and wherein the lying insulation panel 55

forms an airtight seal for a space between the sandwich panels and the concrete panels.

14. Method according to any of claims 10-13, **characterized in that** concrete panels are placed at the bottom of the wall in such a way that the concrete panels extend at least below a concrete floor surface, wherein a continuous roof is placed between the floor surface and the concrete panels and between the floor surface and a foundation or retaining wall lying under the concrete panels and wherein joints between the concrete panels and the underlying foundation or retaining wall are finished with an airtight coating.
15. Use of the insulated wall according to any of claims 1-9 or the method according to any of claims 10-14 for a climate-controlled storage space for art objects.

Fig. 1

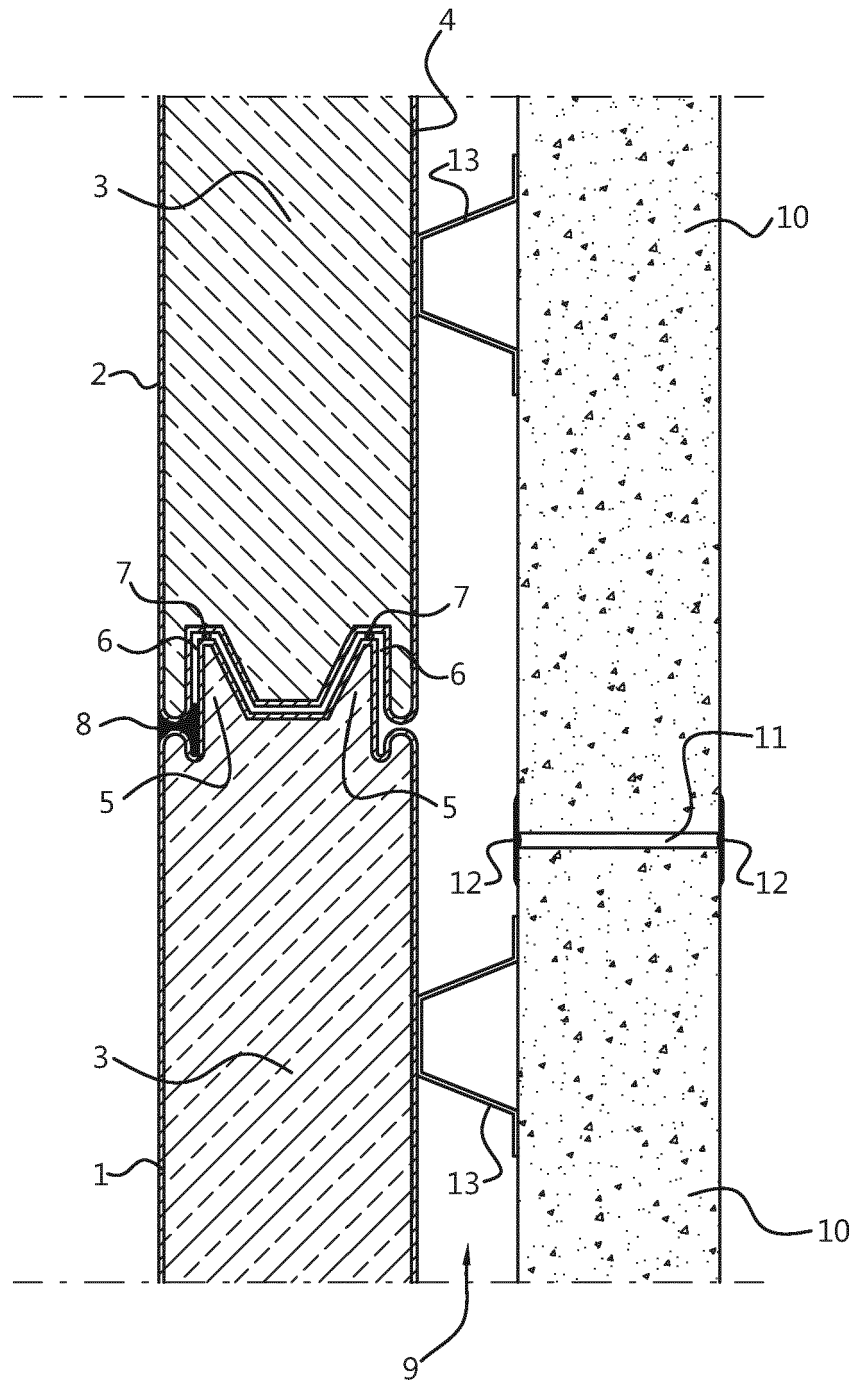


Fig. 2

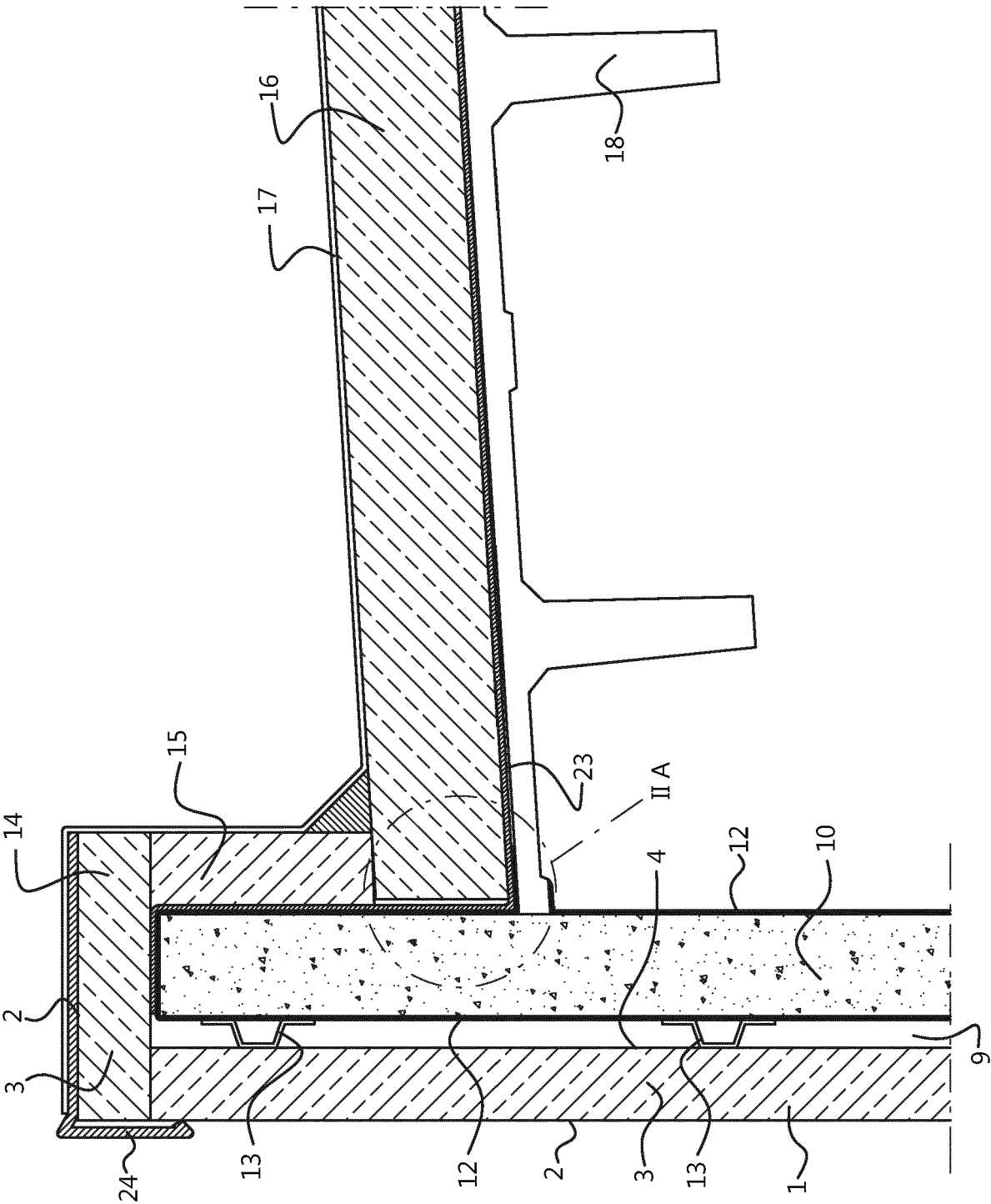


Fig. 3

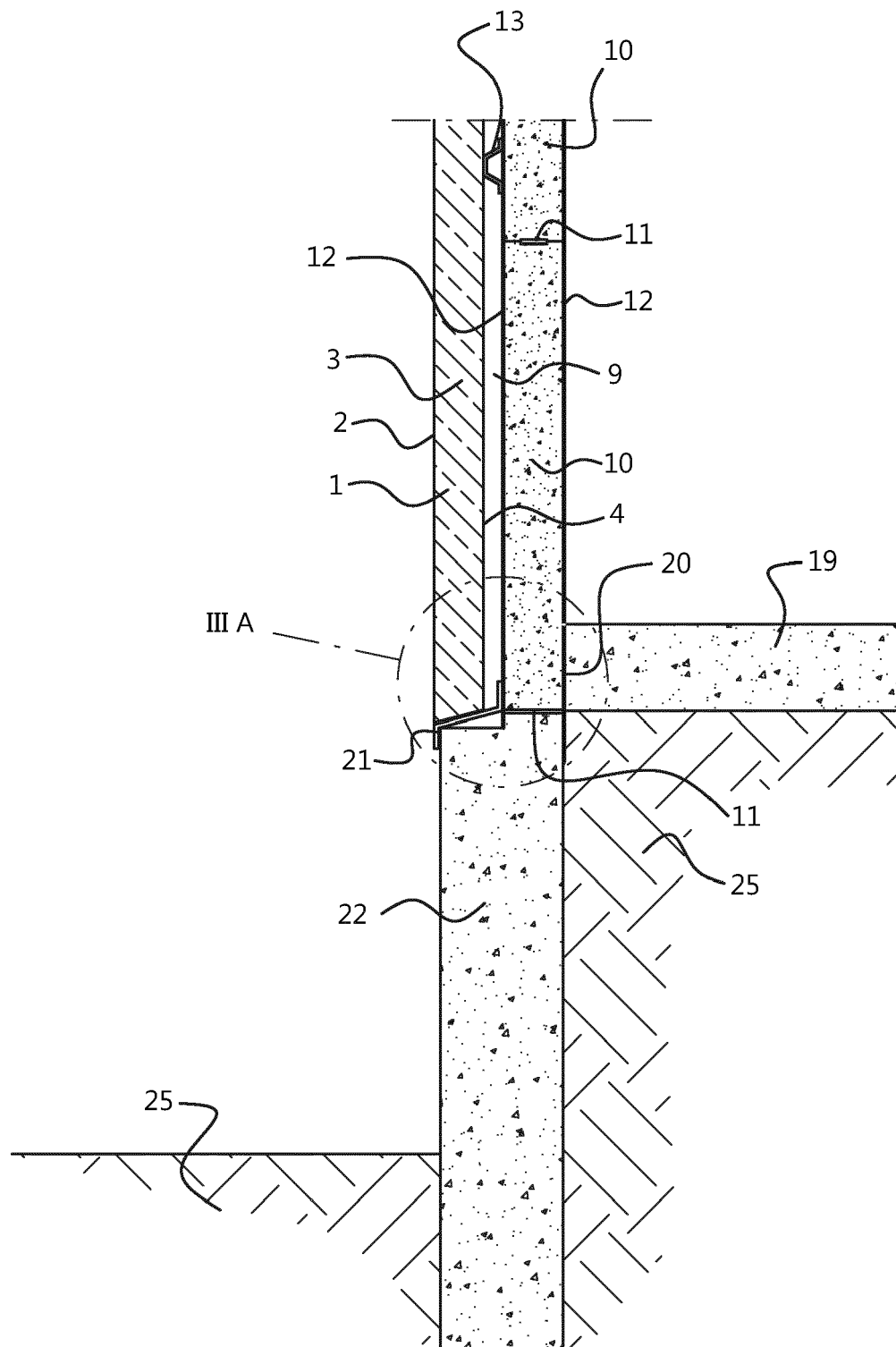


Fig. 2A

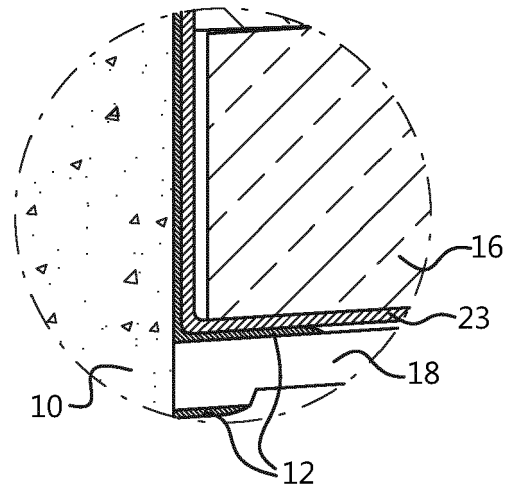
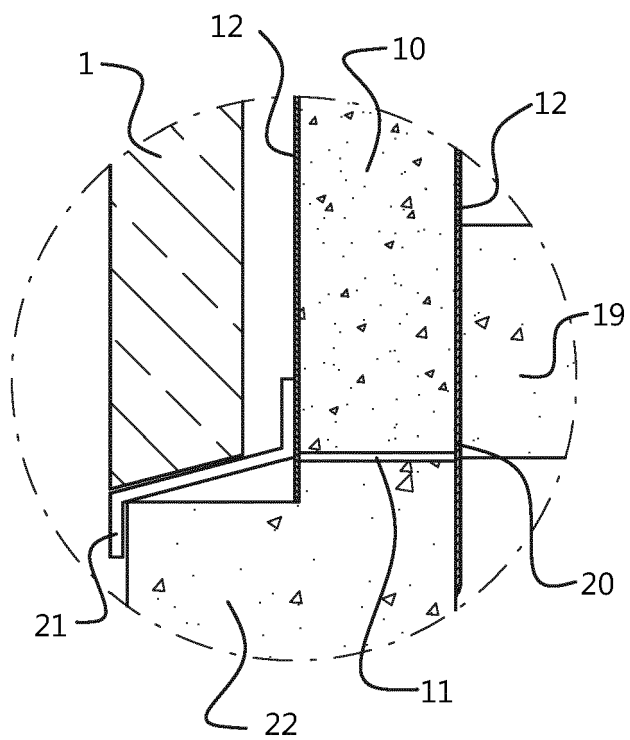


Fig. 3A





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