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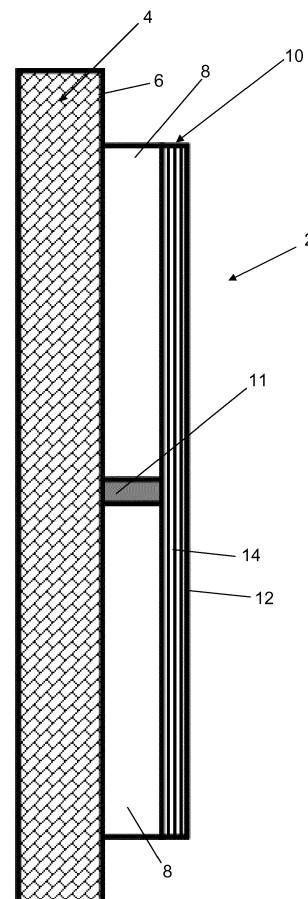
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(54) **METHOD FOR TREATING DAMPNES IN MASONRY AND INSTALLATION OBTAINED BY IMPLEMENTING THE METHOD**

(57) A method for treating dampness in masonry (4), characterised by:
- covering the surface to be treated (6) of said masonry (4) with a plurality of panels (8) of mineralized wood arranged next to each other,
- applying a reinforcement covering (11) at the joints between the adjacent panels (8),
- applying a restoration plaster (14) onto said panels (8) such as to define a plaster layer (10) which presents a thickness equal to or greater than about 0.5 cm at all its points.

FIG. 1



Description

[0001] The present invention relates to an improved method for treating dampness in masonry, and an installation obtained by implementing the method.

[0002] The restoration of damp masonry is one of the building operations which have always attracted the particular interest and attention of technicians and operators in this sector. In this respect, effectively solving the problems connected with the presence of dampness in masonry would enable masonry degradation to be prevented such as to maintain its appear unaltered, and this besides being important in particular for buildings of historical and architectural value, would enable the maintenance costs of the structures to be reduced.

[0003] In particular, the presence of dampness in masonry is due to phenomenon of capillary rising, i.e. to the fact that the water in the ground penetrates by capillarity into the porosity of the material with which the foundations and masonry are made, until it also concerns the elevated part of the masonry, i.e. outside the ground. This problem is displayed on the masonry by the surface appearance of salt formations, by the detachment of paintwork or decorative coatings, and by the crumbling of plaster and mortar, until arriving at the crumbling of the building material itself.

[0004] In greater detail, the presence of rising damp in masonry leads to a series of drawbacks, and in particular:

- poor hygiene within rooms because of the constant presence of a high level of air humidity, which also favours formation of mildew, the spores of which are notoriously damaging for the human respiratory system,
- the presence of salt formations on surfaces, detachment of paint and crumbling of plaster, and structural damage caused by disintegration of masonry constituents,
- greater energy consumption due to the considerable reduction in the thermal insulation of the damp masonry,
- the need to renovate plaster and decorations,
- environmental damage due to the disposal of demolition residues, and due to the release of carbon dioxide into the atmosphere consequent on the production of the materials used in the maintenance work.

[0005] Currently, the solutions which have already been proposed for solving the problem of masonry suffering from capillary rising comprise:

- interventions aimed at preventing rising damp by means of so-called barriers; these types of intervention include insertion of a lead and tar barrier (particularly widespread in the Venetian context), cutting the masonry and inserting impermeable products of metal and/or resin-based type, chemical barriers of

slow diffusion or pressure type (for example soaking the capillary structure of the masonry base with hydrophobicizers based on silanes, siloxanes and their mixtures, in aqueous dispersion or solvents, emulsifiable epoxy resins, etc.), and other types of intervention which utilize in different manner the polarity of water or electrical or magnetic fields,

- preliminary anti-salt treatment (primer) for opposing the negative effect of the hygroscopic salts present in the masonry,
- application of anti-salt rendering based on cement or with mixed binders, followed by application of dehumidifying plasters; in particular, this solution is characterised by the cyclic application, in accordance with a suitable succession or sequence, of a series of products using cement binders.

[0006] The work involved using horizontal barriers is fairly complicated and costly, and has led to an increasing use of damp-protection interventions with anti-salt products and damp-protection plasters. In particular, these latter present a particularly advantageous benefit-cost relationship, in that they represent low cost for an intervention which in most cases results in a complete solution to the problem.

[0007] However, traditional restoration systems based on this type of intervention necessarily require the intervention to be repeated after a certain number of years. Because of this, a series of problems arise which derive from the effectiveness of the product used, on its interactions with the underlying support, and on the criticality (in terms of moisture and salt content, and age of the masonry) of the dampness problem.

[0008] In particular, if the restoration product used in the initial intervention results in surface degradation by the effect of the salts deriving from the dampness, but at the same time is still very well anchored to the wall support, a restoration intervention is carried out, with the same cycle or with different products or cycles, which makes it necessary to remove the mortar layer adhering to the masonry, with consequent removal also of that masonry portion indissolubly associated with the mortar to be removed.

[0009] If the restoration product used in the initial intervention reacts with the support (this is usually indicated by detachment of the restoration product with a "corrosion" effect on the wall face), the restoration intervention has to be totally repeated, with greater cost and greater environment damage due to the need to use new materials and carry out new building work.

[0010] Moreover, if the restoration product is merely sacrificial, both because of the type of binders used and because of its final characteristics, the restoration intervention has to be completely repeated, with serious cost and greater environmental damage, and with further possible inconvenience due to the masonry loss following removal of the plaster layer to be reapplied.

[0011] The object of the present invention is to identify

an improved method for treating masonry dampness which is alternative to and better than traditional methods, and which does not require either horizontal barriers against rising damp or the application of anti-salt treatment.

[0012] Another object of the invention is to identify a method which operates only on the masonry surface and which eliminates or in any event reduces chemical interaction with the masonry components.

[0013] Another object of the invention is to identify a method which can be used in virtually any context, independently of the severity thereof.

[0014] Another object of the invention is to identify a method which provides a certain, effective and lasting final result, hence reducing to a minimum the need for subsequent intervention.

[0015] Another object of the invention is to identify a method which eliminates, or at least reduces, chemical interaction with the masonry itself.

[0016] Another object of the invention is to identify a method which offers various treatment options according to specific requirements linked to the particular utilization context, such as those linked to the surface mechanical strength of the masonry, to the use of products or cycles of high ecological content, to compatibility with historic masonry, or to the need to improve thermal insulation as much as possible.

[0017] Another object of the invention is to propose an installation which is obtainable by said method, and whose implementation, erection and maintenance are particularly simple, rapid and economical.

[0018] All these objects and others which will be apparent from the ensuing are attained, according to the invention, by an improved method with the characteristics indicated in claim 1, and by an installation with the characteristics indicated in claim 9.

[0019] The present invention is further clarified hereinafter in terms of some preferred embodiments thereof with reference to the accompanying drawing, which shows a vertical section through an installation according to the invention.

[0020] The method according to the invention for dampness treatment on masonry 4 comprises a sequence of steps aimed at obtaining an installation 2 on the masonry itself.

[0021] Advantageously, the method can comprise a preliminary step in which that surface to be treated 6 of the masonry 4 is removed of plaster and cleaned, such as to eliminate any residues of mortar or of other masonry elements.

[0022] The method comprises a first step in which the surface to be treated 6 is covered completely with panels 8 of mineralized wood.

[0023] In greater detail, the panel 8 is of mineralized wood wool and presents one or more of the following characteristics:

- reaction to fire (CE) A₂ s₁ -d₀ (EN 13501-1),

- thermal conductivity λ of 0.08 W/mK (EN 13168),
- water vapour passage resistance factor μ of 3 (EN 12086),
- bending strength/compression strength ratio ≥ 5 ,
- specific thermal capacity $C_s \geq 2$ KJ/kgK.

[0024] The wooden panel 8 is conveniently non-rotting, non-attackable by insects and moreover is eco-sustainable by using completely natural materials.

[0025] Preferably, the panels 8 have a thickness greater than about 8 mm and dimensions substantially of 50 x 200 cm.

[0026] These panels are fixed mechanically to the masonry 4, preferably by fixing plugs. In particular, these plugs for mechanically fixing the panels can be of different types and materials (for example of galvanized steel, stainless steel, nylon, etc.) and preferably have a minimum diameter of about 6 mm, a minimum length of about 80 mm, and are advantageously provided with a suitable washer of metal or plastic.

[0027] In greater detail, each panel is fixed to the masonry 4 by at least six plugs, of which four are positioned in proximity to the corners, while the remaining two are positioned at the centre of the panel, but always at its edges.

[0028] The panels 8 can be mounted either vertically or horizontally with offset joints.

[0029] The method according to the invention then comprises a second step, in which a reinforcement covering 11, not represented, is applied at the joints between the adjacent panels 8.

[0030] In particular, this covering 11 consists of strips of reinforcement mesh of alkali resistant glass fibre. In greater detail, the strips have a height not less than 20 cm, are positioned straddling the joints of the panels 8, and are fixed to these using a mortar obtained by mixing with water the restoration plaster 14 used in the next step.

[0031] The method according to the invention then comprises a third step of applying a restoration plaster 14 onto the panels 8.

[0032] In particular, the application of the plaster 14 is such as to define a plaster layer 10 of thickness not less than about 0.5 cm at all points of the surface and can either be plumb or follow the shape of the panels 8.

[0033] Preferably, the restoration plaster 14 specifically contains mineral nano-particles based on a natural colloidal aluminium silicate modified by a specific process, as a replacement for the traditional stearates, oleates, silanes, etc., this giving it a low value of water absorption by capillarity.

[0034] In greater detail, the restoration plaster 14 comprises cement binders, natural or non-natural hydraulic lime, air-hardening lime, various inerts of a suitable particle size curve, and specific additives. The physico-chemical characteristics of an experimental plaster 14, obtained from a product which after mixing contained 25% of incorporated air, are substantially as follows:

- mechanical compression strength, at 28 days of curing, about 4.5 N/mm²,
- capillarity coefficient of about $C = 0.06 \text{ kg}/(\text{m}^2\text{min}^{1/2})$ in accordance with EN 1015-18,
- depth of water penetration into the test piece, substantially 1-1.5 mm after 24 hours of contact, and
- volumetric mass of hardened product, about 1.45 kg/l.

[0035] The method according to the invention then comprises a fourth step of finishing and decorating the outer surface 12 of the plaster layer 10.

[0036] Finally, after substantially at least seven days, the outer surface 12 is finished with suitable fine civil finishing mortars and/or breathable finishes (for example Macroraso Calce, Tonacal, Tonachello Silox, Silicalce Tonachello), and is then painted with high breathability and restoration specific products, such as Aqualit, Ekosil, Silicalce Pittura.

[0037] Preferably, the panels 8 and/or restoration plaster 14 of the installation according to the invention correspond to those marketed under the name "DETEC".

[0038] To evaluate and appreciate the advantageous performance of the installation obtained by the method according to the invention, a series of laboratory tests were then carried out.

[0039] In particular, vapour permeability tests in accordance with the current standard EN 1015-19 were carried out on an installation 2 according to the invention of overall thickness 2 cm and in which the panel 8 and the restoration plaster 14 present the previously defined characteristics, (corresponding respectively to the panels and plasters sold and marketed under the name "DETEC").

[0040] The permeability value μ resulting from these tests was found to be equal to 12, i.e. in line with the current standard for restoration plasters, and in particular was less than the values obtainable using traditional methods, in which they generally exceed 18. In this regard, it should be noted that the measured permeability value μ is indicative of an overall permeability which comprises both the rendering and the plaster 14 of the layer 10, and consequently not to be confused with the permeability values μ of restoration plasters considered alone.

[0041] In addition, the installation 2 according to the invention also presents good thermal insulation, given that it has a thermal conductivity λ equal to 0.08 W/mK.

[0042] Other tests were carried out, both chemical and physical, to verify, monitor and identify any modifications which take place on the installation 2, comprising the panel 8 and the plaster layer 10, once this is brought into contact with a continuous source of dampness and salinity.

[0043] In greater detail, these tests were aimed at identifying and monitoring the presence and time migration of certain ionic species, in particular of chloride and sulphate anions, within the combination defined by the panel

and plaster, and to evaluate the variations in the degree of dampness with time within this combination.

[0044] The results of these tests showed good correlation between the behaviour of the installation 2 when applied to bricks maintained under constant rising salt water (4 and 9 months) and that obtained while maintaining the installation under both static and dynamic dampness conditions (in this case the contact takes place only with air having a moisture content close to saturation).

[0045] In particular, the panel 8 maintained under static dampness conditions demonstrated a dampness value which gradually increases with time along a curve which tends asymptotically towards the value of 18%, i.e. the value obtained by placing the panel in direct contact with the damp brick.

[0046] However, in both situations, the plaster layer 10 remained dry, with dampness values less than 2%.

[0047] Moreover, after nine months of constant contact between a brick 4 comprising the installation 2 according to the invention, and a saline solution simulating sea water, it was found that the chloride and sulphate anions were significantly present in the panel 8, whereas they were not greatly transferred to the plaster layer 10. In fact, in that layer, chlorides were not analytically appreciable, whereas the soluble sulphates were at 0.2% and hence virtually negligible.

[0048] These results confirm that the installation 2 according to the invention effectively performs the separator and filter function in transferring salinity from the damp masonry 4 to the plaster layer 10, hence maintaining the plastered surface 12 healthy, dry and free of any damaging salt.

[0049] In greater detail, this improved performance is achieved by virtue of the specific combination of the elements of the installation 2 according to the invention, which mutually interact such as to present optimal chemical stability of their binding part towards the aggressive salts originating from the damp masonry 4 while, at the same time, preventing deposition of salts such that their porosity level remains constant, so ensuring that the restoration function, i.e. of transferring dampness towards the environment remains constant with time.

[0050] The results of these laboratory tests were also confirmed by the analytical results of a two-year experiment carried out on masonry of a building in Venice.

[0051] In particular, this experiment showed no emergence of salinity, not even between the panel 8 and the masonry 4. This indicates that the dryness of the masonry 4, when treated by the method according to the invention, takes place gradually and under virtual stationary conditions of humidity and temperature, hence disfavours any accumulation of salinity on the surface 6 of the masonry, as instead usually takes place on Venice masonry exposed to the air. This aspect is particularly important in that if on the one hand it prevents accumulation of damaging salts in the cortical region of the masonry, on the other hand, precisely because of this equilibrium is maintained, it maximizes moisture exchange between

the masonry 4 and the outer environment.

[0052] Essentially, this experiment confirms the solution to the problems of masonry dampness, without causing phenomena of degradation of the installation according to the invention and in particular in total absence of pulverization or crumbling of the surface finishes or painting of the masonry.

[0053] From the foregoing, it is apparent that the method according to the invention, and the installation resulting from the use of this method, are more advantageous than those of the traditional art, in that:

- they enable a high vapour exchange capacity to be achieved between the masonry and the environment,
- they are not sensitive to the moisture and salinity content of the masonry,
- they are easy to install,
- they do not require the masonry to be subjected to any irreversible anti-salt treatment which could be required to be removed by control authorities; nor do they present the drawback of anti-salt treatments relative to possible poor treatment uniformity deriving from the appearance of the applied treatment itself,
- they do not need a substance which reacts with the salts present in the masonry capillarity, which disadvantageously involves permanent modification of the masonry,
- they do not involve waiting time between the possible application cycles, with the only exception of the time linked to the final finish and decoration,
- they are of low cost and, in particular, enable the building site to be adequately and economically managed,
- they can be used within the context of more or less serious or complex problems,
- they reduce interaction with the masonry to a minimum, and in particular they do not degrade it and do not generate either thaumasites or ettringites, i.e. those deleterious substances which are generated respectively by interaction between the hydrated calcium silicates and aluminates, and the sulphates provided by the rising damp,
- they can be removed without causing any modification to the original appearance of the masonry, this being particularly important if used on historic masonry,
- they have a life, in terms of time, substantially corresponding to that of normal plastering of masonry not subject to dampness problems,
- they allow plasters of various types to be applied according to specific needs, for example extreme restoration plasters, thermal plasters with high vapour permeability, lime based plasters, etc.
- they can also be used on masonry from which the plaster has not been previously removed, hence reducing the internal living space by only 2-2.5 cm,
- they are particularly eco-sustainable, i.e. both be-

cause the treatment according to the invention is more lasting, and hence reduces the need to carry out subsequent treatments, and because it uses ecological materials and is carried out more rationally, these factors leading in the final analysis to an overall reduction in environmental pollution during both execution and installation.

10 Claims

1. A method for treating dampness in masonry (4), **characterised by:**

- covering the surface to be treated (6) of said masonry (4) with a plurality of panels (8) of mineralized wood arranged next to each other,
- applying a reinforcement covering (11) at the joints between the adjacent panels (8),
- applying a restoration plaster (14) onto said panels (8) such as to define a plaster layer (10) which presents a thickness equal to or greater than about 0.5 cm at all its points.

2. A method as claimed in claim 1, **characterised in that**, before covering the surface (6) to be treated with said panels (8) of mineralized wood, the surface (6) of said masonry (4) is preliminarily removed of plaster and cleaned.

3. A method as claimed in one or more of the preceding claims, **characterised in that** said panels (8) are fixed mechanically to the masonry (4).

4. A method as claimed in one or more of the preceding claims, **characterised in that** said reinforcement covering (11) comprises strips of reinforcement mesh of alkali resistant glass fibre which are positioned straddling the joints of the adjacent panels (8), and are fixed to these with a mortar obtained by mixing said restoration plaster (14) with water.

5. A method as claimed in one or more of the preceding claims, **characterised in that** said restoration plaster (14) of said plaster layer (10) comprises mineral nano-particles based on a natural colloidal aluminium silicate modified such as to give the plaster a low value of water absorption by capillarity.

6. A method as claimed in one or more of the preceding claims, **characterised in that** said restoration plaster (14) of said plaster layer (10) presents at least one of the following physico- chemical characteristics:

- mechanical compression strength, at 28 days of curing, substantially of 4.5 N/mm²,
- capillarity coefficient, substantially of 0.06

kg/(m²min^{1/2}) in accordance with EN 1015-18,
 - depth of water penetration into the test piece,
 substantially of 1-1.5 mm after 24 hours of con-
 tact, and
 - volumetric mass of hardened product, substan- 5
 tially of 1.45 kg/l.

7. A method as claimed in one or more of the preceding
 claims, **characterised in that** said panel (8) is of
 mineralized wood wool and presents at least one of 10
 the following characteristics:

- reaction to fire (CE) A₂ s1 -d₀ (EN 13501-1),
 - thermal conductivity λ of 0.08 W/mK (EN 13168), 15
 - water vapour passage resistance factor μ of 3
 (EN 12086),
 - bending strength/compression strength ratio $\geq$
 5, and
 - specific thermal capacity Cs $\geq$ 2 KJ/kgK. 20

8. A method as claimed in one or more of the preceding
 claims, **characterised by** comprising, after said step
 of applying said restoration plaster (14), a step of
 finishing and decorating the outer surface (12) of the 25
 plaster layer (10).

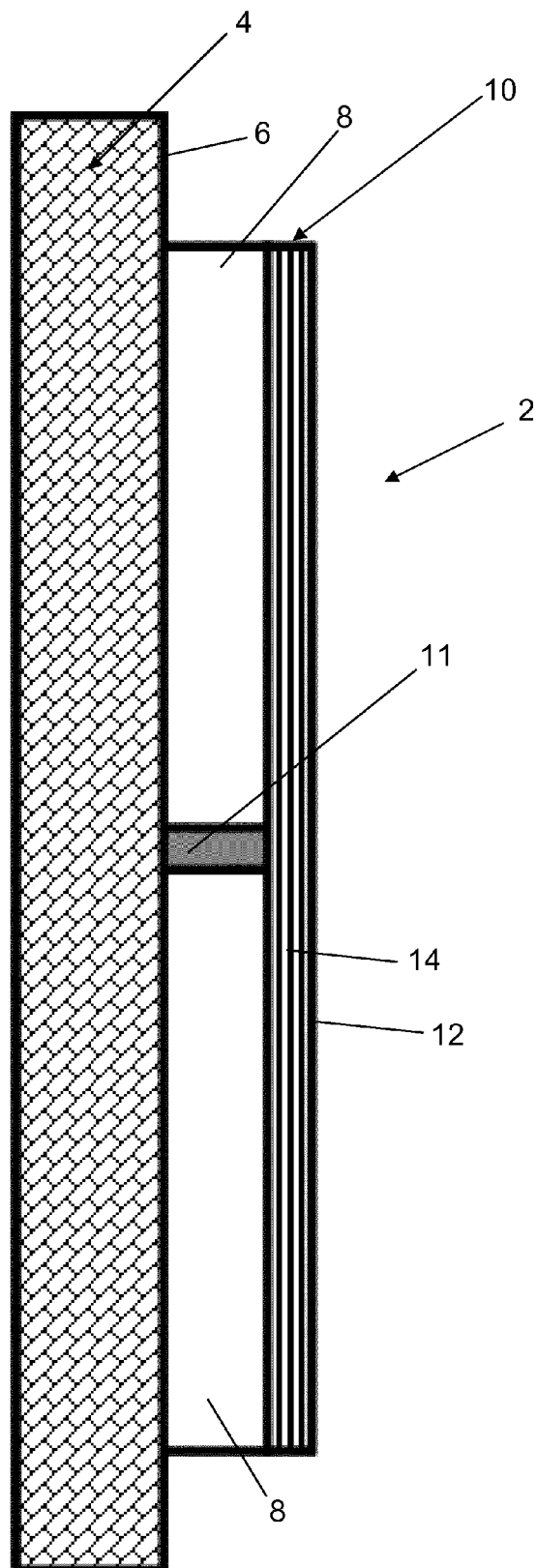
9. A method as claimed in one or more of the preceding
 claims, **characterised by** comprising, after said step
 of applying said restoration plaster (14), a step of 30
 finishing the outer surface (12) of the plaster layer
 (10) with fine mortars and/or a step of painting with
 high breathability and restoration specific products.

10. An installation (2) obtained by a method in accord- 35
 ance with one or more of the preceding claims and
 applicable onto the surface (6) of masonry (4) to be
 treated against dampness, **characterised by** com-
 prising:

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 - a plurality of panels (8) of mineralized wood
 arranged next to each other such as to totally
 cover the surface (6) to be treated of said ma-
 sonry (4),
 - a reinforcement covering (11) applied at the 45
 joints between the adjacent panels (8),
 - a layer (10) of restoration plaster (14) applied
 onto said panels (8) and having a thickness
 equal to or greater than about 0.5 cm at all its
 points. 50

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FIG. 1





EUROPEAN SEARCH REPORT

Application Number
EP 16 17 5493

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			TECHNICAL FIELDS SEARCHED (IPC)
			E04C E04B E04F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 October 2016	Examiner Arsac England, Sally
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82