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(57) Abstract: A physical mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports (11), wherein the stratified structure includes at least one sealing or cover surface (10) at the extrados; in particular, the sealing or cover surface (10) is continuously connected, at its intrados, with a velcro, or hook and loop connection (13, 14) bound to the base support (11) or to the functional intermediate layers of the waterproof stratified structure.
The present invention generally relates to a physical-mechanical device which is able to fix bituminous or synthetic waterproof stratified structures and their functional layers to base support elements, which are provided on the buildings roofs or on special civil engineering handworks.

More particularly, the invention relates to a fixing system, which is based on the anchoring technology of the Velcro® connections, in order to fix bituminous or synthetic stratified structures and their functional layers to base support elements, which can be placed in a horizontal, vertical or inclined direction.

The coverage system of the present invention is also able to withstand the drawing force of the wind and it can be used in constructions for which the waterproof stratified structures require a vertical or inclined fixing.

The invention is able to link the drawing forces of the wind, acting on the waterproof stratified structures and/or on roofs of any shape and size, or the weight of the waterproof stratified structures which must be beared or the forces acting on the waterproof structures, with the extraction and shear resistance, which is calculated on the principles and use of the fixing technology that is used.

The calculation is based on the value resulting from the detachment of the fixing systems based on the Velcro® technology and is carried out in order to counter all the forces acting on said technical fields.
of the waterproof stratified structures, such as wind, gravity, lateral pressure of the ground, etc.
The waterproof layers and the functional layers of the stratified structures, which are connected through the technical principle according to the invention, are therefore bound to base support elements in different operating conditions (coverage, vertical walls, etc.) and the fixing of the layers takes place through a suitable structural calculation, based on the minimum value of extraction of the connections based on the Velcro® technology.
According to the invention, a plurality of connecting elements or bindings based on the Velcro® technology are therefore provided, according to a suitable planned arrangement, on the visible surfaces of the base support elements, depending on the drawing forces that must be opposed.
The need is to counteract, by means of physical-mechanical devices, the drawing forces of the wind acting on the waterproof stratified structures, in any coverage condition (according to the current NTC technical regulations on construction and their modifications), also dimensioning said physical-mechanical devices according to the specific requirements of the current project values, using a static calculation, for their installation, according to specific planned executive tables.
Moreover, in other construction areas for which a vertical or inclined configuration is need, it is also possible to counteract, by means of suitable physical-mechanical devices, the forces acting by gravity or due to lateral forces (such as the forces exerted on the ground by the counter-ground walls or by pantiles on
waterproof systems with discontinuous roofing) when waterproof systems are laid vertically or in an inclined direction.

Even in this case, the physical-mechanical devices of the present invention are dimensioned according to the specific needs of planned values, that are evaluated by means of a suitable engineering calculation and by means of suitable calculation tables usable for the installation.

An object of the present invention is therefore to provide a physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, which allows to provide a simple, quick and secure fixing of said stratified structures to any base support (made of concrete, wood, sheet-metal, etc.).

A further object of the invention is to provide a physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, which has a considerable competitive advantage because of the easy and quick installation and which allows to obtain a considerable reduction of operating costs, with respect to the known constructive fixing devices.

These and other objects are achieved by a physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, according to the appended claim 1.

Other detailed technical features are disclosed in the dependent claims.

Advantageously, the physical-mechanical coupling system according to the present invention ("Cold Evolution Fix" system) allows to fix waterproof systems, having a
total exposure, to the roofs or to vertical or inclined waterproof stratified structures, said waterproof systems being normally laid down with traditional methods of flaming, mechanical fastening or gluing, thanks to a constructive principle that is completely new, different and reliable, by exploiting the Velcro® technology with many embodiments and positions of the waterproof stratified structures, thus always obtaining a fixing continuity on the base support of the constructive hand-work.

By way of example and without limitative or exhaustive purposes, the areas of use of the fixing system of the invention are the following:

- single-layer or double-layer waterproofing systems, that are laid down with a total exposure on a cold roof, with a sealing surface made of a bituminous membrane (APP, SBS, APAO, etc.);
- single-layer or double-layer waterproofing systems, that are laid down with a total exposure on a warm roof, with a sealing surface made of a bituminous membrane (APP, SBS, APAO, etc.);
- waterproofing systems, that are placed under tile or under discontinuous roofing, with a sealing surface constituted by a bituminous membrane (APP, SBS, APAO, etc.);
- reconstruction of deteriorated bituminous waterproofing systems with a new sealing surface made of a single-layer or double-layer bituminous membrane (APP, SBS, APAO, etc.);
- reconstruction of deteriorated synthetic waterproofing systems with a new sealing surface made of a single-layer or double-layer bituminous membrane (APP, SBS, APAO, etc.);
waterproofing systems of vertical exposed or buried walls with a surface sealing made of a bituminous membrane (APP, SBS, APAO, etc.);
- waterproofing systems with a surface sealing made of a bituminous membrane (APP, SBS, APAO, etc.), that are laid down in engineering works where there is a need to counter the weight of the stratified structure during installation and against the forces (gravity, wind, etc.) acting on said structure in operating conditions;
- single-layer waterproofing systems, that are laid down on a cold roof with a total exposure, with a synthetic sealing surface (TPO, PVC, EVA, EPDM, etc.);
- single-layer waterproofing systems, that are laid down on a warm roof with a total exposure, with a synthetic surface sealing (TPO, PVC, EVA, EPDM, etc.);
- reconstruction of deteriorated bituminous waterproofing systems, that are laid down with a total exposure, with a new single-layer synthetic sealing surface (TPO, PVC, EVA, EPDM, etc.);
- reconstruction of deteriorated synthetic waterproofing systems, that are laid down with a total exposure, with a new single-layer synthetic surface (TPO, PVC, EVA, EPDM, etc.);
- waterproofing systems of exposed or buried vertical walls with a synthetic sealing surface (TPO, PVC, EVA, EPDM, etc.);
- waterproofing systems, that are laid down in engineering works where there is a need to counter the weight of the stratified structure during installation and the forces (gravity, wind, etc.) acting on said structure in operating condition, with a synthetic sealing surface (TPO, PVC, EVA, EPDM, etc.).

The mechanical fixing device according to the invention
allows a stable anchorage between the sealing element and the base support, as well as a stable fixing of all the functional layers belonging to the planned stratified structure, such as barriers or vapour brakes, thermal or acoustic insulation materials, split-up, clearing-up and scrolling-up layers, and other accessories of the waterproof hand-work, that is therefore completely constructed and perfectly finished.

These layers can accommodate, either partially (such as strips) either totally (for the whole surface of the intrados and/or the extrados), the fixing system according to the present invention.

Further characteristics and advantages of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, according to the present invention, will appear more clear from the description which follows, relating to a preferred plurality of embodiments of the invention, and from the enclosed drawings, which are also related to preferred embodiments of the invention, in which:

- figure 1 is a schematic sectional view of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, such as a cold roof, according to the present invention;
- figure 2 is a schematic sectional view of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, such as a warm roof, according to the present invention;
- figures 3, 4, 5, 6 and 7 show schematic sectional views of as many of the physical-mechanical fixing
device placed in different portions of the functional layers or of the base supports which constitute the waterproof stratified structures, such as concrete and/or sheet-metal supports, barriers or bituminous and synthetic vapour brakes, insulating panels, compensation, sliding and protection layers and wood layers, according to the present invention;
- figure 8 is a schematic sectional view of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, according to the present invention, where the direction of the wind forces on the plane is shown;
- figure 9 is a schematic sectional view of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, according to the present invention, where the direction of the forces acting in this operating condition on a vertical or inclined support is shown (lateral ground forces or tiles weight).

With particular reference to the enclosed figures 1, 2, 8 and 9 showing two diagrams of the preferred stratified structures used in the system, according to the invention ("Cold Evolution Fix" system), which is able to lay down and to fix bituminous or synthetic waterproof stratified structures to base supports in some operating conditions, 10 schematically indicates a sealing cover or surface (extrados) of the bituminous or synthetic waterproof stratified structure, to which a portion of the system according to the present invention, called "Loop" and consisting of a series of connection slots or loops 13, is continuously connected; on the other hand, a corresponding plurality of anchoring mechanical devices or hooks 14, which also
belong to the structure of the present invention, called "Hook", are bound to the base support 11 or to the functional layers of the waterproof stratified structure, depending on the requirements of the waterproof hand-work; the above mentioned structure can also be made in opposite conditions (the "Loop" portion connected to the base support 11 and the "Hook" portion connected to the sealing surface 10), depending on design requirements according to the present invention.

In particular, said mechanical fixing devices are fixed to the sealing surface or membrane 10 through a continuous connection, which is formed by a "Loop"-type Velcro® portion or female element 13 and by a "Hook"-type Velcro® portion or male element 14, thus allowing the attachment to a generic base support 11 or to other functional layers, such as insulation panels 15 (as shown in the embodiment of the enclosed figure 2), by means of mechanical or gluing constraints, depending on design requirements.

Starting from the above mentioned basic stratified structure, according to the present invention, the "Loop" or female portion 13 is connected to the continuous waterproofing surface 10 over the whole intrados surface, with the exception of the continuous selvages, while the "Hook" or male portion 14, from time to time (when the portion 14 is already fixed to the base support or to the functional layer 11, by means of mechanical fastening systems or special adhesives), is able to connect the whole waterproofing system, thus ensuring a stability's mechanical constraint.

The single connection layer can also be repeated for all the functional layers of the stratified structure,
from the bottom upwards, always by dimensioning the structure as necessary.
The extraction value (arrow E in the enclosed figure 8) between the "Loop" portion or tape 13 and the "Hook" portion or tape 14 is the physical-mechanical limit for a primary connection and constitutes the extraction reference value (in N/mm²) that is necessary for planning each force acting on the waterproof stratified structures.

Moreover, referring to the enclosed figures 8 and 9, the arrow S shows the sucking force of the wind with a total exposure of the structure (see enclosed figure 8), the arrow G shows the weight of the waterproofing system applied in a vertical or inclined direction (see enclosed figure 9), the arrow G+P (see enclosed figure 9) shows the weight of the waterproofing system applied in a vertical or inclined direction and having counter-ground lateral forces, the arrow P shows the lateral force, the arrow T shows the cutting, the arrow Z shows the peeling and the arrow N shows the traction.

Therefore, the extraction value (E force) must be dimensioned so as to oppose the forces S or G or G+P.

Furthermore, all secondary connections between the "Hook" tape 14 and the functional layers or base supports 11, or between the "Loop" tape 13 and the waterproof layers 10 and/or other functional layers or base supports, must have extraction values CS (in N/mm²) greater than the extraction value E (in N/mm²) of the primary connection.

Laboratory trials to test the tightness of adhesion between the different elements of the stratified structure were conducted on samples or specimens consisting of two aluminum grips connected to a
dynamometer and comprising a bituminous membrane, coupled to a "Loop"-type Velcro® tape, and a "Hook"-type Velcro® tape connected to a simulated base support or to a functional layer which was in turn bound to a support base.

All the tests have been carried out in pure tension (with speed of removal of the grips of 300 mm/rnin-), since the extraction stresses caused by the wind are transmitted to the waterproof stratified structures in a direction that is perpendicular to the coverage or sealing surface plane.

The operating conditions which create forces other than perpendicular forces, namely the cutting forces T that arise in vertical or inclined structures and the peeling forces Z that arise for external stresses acting according to a very small angle with respect to the reference plane of the sealing surface, were considered negligible and satisfied a priori, since the values of extraction/separation are significantly greater than the value of the perpendicular force.

The results of the tests are related to the value of collapse/detachment of the Velcro® tape, with respect to the forces acting during operating conditions and without any breakage of the connections linking the functional layers of the stratified structure in different operating conditions and/or fields of use.

Considering that the mean stresses caused by the wind vary depending on the area and the shape of the building, it is necessary to size the axis of the physical-mechanical fixing device applied to the stratified surface in order to have a contrast of said forces.

It has thus been found that the physical-mechanical
fixing device as described may be used quickly, safely and economically, for fixing waterproofing systems in a horizontal configuration and with a total exposure, as well as in a vertical configuration and subjected to own or induced gravitational forces.

In particular, referring to the state of the art, the present invention completely or almost completely eliminates (in bituminous systems with a total exposure) the use of flames for making a coverage, entrusting to the hooking system the burden of ensuring the whole waterproofing structure (surface or membrane) against the extraction force caused by the wind. Furthermore, such burden, so far reached in an empirical way and not always with satisfactory results by using adhesive membranes (bituminous systems) or by bonding the sealing surfaces (synthetic systems) to the base supports, is met thanks to a structural dimensioning of the stratified structure as a function of the forces to counteract; the structure is defined on the basis of a preliminary planning which is implemented in accordance with actual regulations or their evolutions, as well as taking into account all the boundary conditions (area, building height, building type, etc.) and safety factors required for assuring a durable physical-mechanical anchoring.

Additionally, the invention allows, especially in vertical applications, to have a quick hooking of the waterproof material during the unwinding of the membrane and before the final welding, thus obtaining a self-bearing capacity, which improves the working during the waterproofing operations of the building component.

A quick fixing is also useful for making sealing
surfaces with a total exposure, as it provides quick safety for the stratified structure against any drawing forces, even during the laying down of the coverage. The hooking system according to the invention, with respect to the known fixing systems, also allows to minimize or eliminate the immissions during the installation phase, such as combustion fumes of the bituminous membrane or the solvents fumes coming from the adhesive materials used for bonding the synthetic sealing surfaces, thus improving the safety for the operator and the environment.

The system also allows, due to its convenience, to maintain the extraction values of the structure and to speed up the waterproofing work of building components, thus enabling better logistics and planning of the construction sites.

Furthermore, the composition of the fixing system and its reliability do not depend on temperature and humidity and, more generally, on the weather conditions existing when the structure is layed down.

The advantages of the system are also maintained even in the event of a momentary interruption of the laying down operations due to adverse weather conditions.

Finally, the technology of the system allows to remove the waterproofing system without damaging it, for example due to a wrong placement of the waterproofing material or due to an extraordinary maintenance of the stratified structure; moreover, it also possible to perform repositioning and recovery of each layer.

The waterproofing systems that are bound by means of the fixing system of the present invention may also provide continuous welds on the sealing surface and/or adhesive systems, which obviate almost totally the use
of the flame for fixing the coverage membranes and which allow to make further technical finishing details (accessories, vertical embossments, etc.).

From the above description, the technical characteristics of the physical-mechanical device for fixing bituminous or synthetic waterproof stratified structures to base supports, object of the present invention, are clear, as well as the advantages are also clear.

Finally, different variations may be made to the physical-mechanical fixing device of the invention, without departing from the principles of novelty inherent in the inventive idea according to the appended claims, just as it is clear that, in the practical embodiment of the invention, the materials, shapes and dimensions of the technical details may be any according to requirements and the same may be replaced with other elements that are technically equivalent.
1. Physical-mechanical device for fixing waterproof bituminous or synthetic stratified structures to base supports (11), wherein the stratified structure includes at least one sealing or cover surface (10) at the extrados, characterized in that said sealing or cover surface (10) is continuously connected, at its intrados, with a plurality of connection slots (13), while a corresponding plurality of mechanical anchoring devices (14) are bound to the base support (11) or to the functional intermediate layers of said waterproof stratified structure, or, vice-versa, -said sealing or cover surface (10) is continuously connected, at its intrados, with a plurality of mechanical anchoring devices (14), while a corresponding plurality of connection slots (13) are bound to the base support (11) or to the functional intermediate layers of the waterproof stratified structure.

2. Fixing device as to claim 1, characterized in that said connection slots (13) belong to at least one portion of Velcro® tape of the "Loop" or female type.

3. Fixing device as claimed in at least one of the preceding claims, characterized in that said mechanical anchoring devices (14) belong to at least one portion of Velcro® tape of the "Hook" or male type.

4. Fixing device as claimed in at least one of the preceding claims, characterized in that said functional intermediate layers include at least one insulating panel (15), which is connected to said connection slots (13) or to said anchoring devices (14) by means of mechanical or adhesive bonds.

5. Fixing device as claimed in at least one of the preceding claims, characterized in that said waterproof
stratified structures (10) include
- cold-roof waterproof systems with a sealing cover made of a bituminous membrane in a single layer or double layer, which are installed in total exposure and/or
- hot-roof waterproof systems with a sealing cover made of a bituminous membrane in a single layer or double layer, which are installed in total exposure and/or
- under-tile, under-roof tile or under discontinuous covers waterproof systems with a sealing cover made of a bituminous membrane and/or
- remaking of bituminous waterproofing systems with new sealing covers made of a bituminous membrane in a single layer or double layer and/or
- remaking of synthetic waterproofing systems with new sealing covers made of a bituminous membrane in a single layer or double layer and/or
- waterproof systems with a sealing cover made of a bituminous membrane for exposed or buried vertical walls and/or
- waterproof systems with a sealing cover made of a bituminous membrane laid in engineering works where there is a need to counter the weight of the stratified structure during installation and against the forces acting under operating conditions and/or
- cold roof waterproof systems with a synthetic sealing cover laid in total exposure in a single layer and/or
- hot roof waterproof systems with a synthetic sealing cover laid in total exposure in a single layer and/or
- remaking of waterproof bituminous systems with a synthetic sealing cover laid in total exposure in a single layer and/or
- remaking of synthetic waterproof systems with a
synthetic sealing cover laid in total exposure in a single layer and/or
- waterproof systems with a synthetic sealing cover for exposed or buried vertical walls and/or
- waterproof systems with a synthetic sealing cover laid for engineering works where there is a need to counter the weight of the stratified structure during installation and the forces acting on said structure under operating conditions.

6. Anchoring device as claimed in at least one of the preceding claims, characterized in that said waterproof stratified structure (10) includes, at least partially, further functional intermediate layers, such as barriers or vapor brakes, thermal or acoustic insulation materials, separation, compensation and sliding layers, and/or other accessories.

7. Anchoring device as claimed in at least one of the preceding claims, characterized in that said "Look"-type and "Hook"-type Velcro® tapes have a fixed value of extraction ($E$), capable of counteracting the forces of suction ($S$) and/or the gravity ($G, G+P$), in case of applications of waterproof structures (10) along vertical or diagonal directions, and/or lateral forces ($P, T, C, N$), in case of counter-ground, cutting or pulling applications.

8. Anchoring device as claimed in at least one of the preceding claims, characterized in that said extraction value ($E$) is dimensioned in order to counteract said suction forces ($S$) and/or the gravity ($G, G+P$).

9. Anchoring device as claimed in at least one of the preceding claims, characterized in that the connections between said Velcro® tapes and said functional intermediate layers have extraction values ($CS$) greater
than said extraction value $^{17} (E)$ of the connection between said "Loop"-type Velcro® tape and said "Hook"-type Velcro® tape.
**INTERNATIONAL SEARCH REPORT**

**PCT/IT2012/000401**

A. **CLASSIFICATION OF SUBJECT MATTER**

INV. E04D5/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. **FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

E04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. **DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  
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**Date of the actual completion of the international search**

6 May 2013

**Date of mailing of the international search report**

22/05/2013

**Name and mailing address of the ISA/Authorized officer**

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