Abstract: A panel for cladding (1) comprises a cladding upper layer (2) and a supporting lower layer (3) bonded to each other, wherein the lower layer is a sandwich panel comprised of a pair of calendered sheet-metal plates (4, 5) between which a layer (6) of thermoinsulating and noise-barrier material is arranged. The lower layer (3) has a plurality of reinforcing elements (9) arranged in connection between said upper and lower sheet-metal plates (4, 5), said reinforcing elements (9) being also spacers suitable for maintaining the distance between said upper and lower sheet-metal plates (4, 5) constant. The panel (1) for cladding has a mechanically simple and strong structure, being able to combine characteristics of lightness to an external cladding of high quality, such as, for example, natural stone, at competitive costs with respect to the solutions of the prior art.
SANDWICH CLADDING PANEL AND METHOD FOR ITS MANUFACTURING

The present invention relates to a panel for cladding and particularly to a panel for cladding provided with a sandwich structure and to a method for its manufacturing.

Cladding panels are used in the field of building for making claddings and insulation walls both in indoor and outdoor environments such as, for example, elevators, ceilings, floors and the like, where at the same time a lightness of the cladding and an agreeable aesthetic aspect are required. Natural stone is one of the most used cladding materials thanks to its characteristics of long duration, workability, cleanup and the like, however, since it has a rather high density, numerous application have been developed in which thin layers of natural stone are fixed on light supporting structures such as, for example, alveolar structures.

Document JP 2001132136 A2 discloses, for instance, a light double-wall panel for external walls and a method for its manufacturing. The panel includes a shaped plate obtained through a rolling process and comprised of a front portion, a side portion, a back portion, an anchoring protrusion and an anchoring dent. A polyurethane foam is injected between the front and the back portion of the plate thus obtaining a sandwich panel. On the front portion of the sandwich panel a layer of natural stone is then anchored, which is in turn fixed to a wavy plate. The stone layer and the wavy plate are fixed to the sandwich panel by means of and adhesive and a hook.

Document EP 0585663 B1 discloses cladding elements for walls/ceilings mounted on supporting stripes and provided with a honeycomb supporting plate. The honeycomb supporting plate is arranged in a sandwich-like manner between an upper cladding plate and a lower cladding plate and may be filled with an insulation material. The two plates are connected to each other by means of tighteners, e.g. screw tighteners. The honeycomb plate is so arranged to form protrusions on at least two edges of a supporting plate and recesses on the other two edges. In such a way composite panels may be obtained being able to be fitted one into the other in order to form a cladding.

Document US 4840825 discloses stone tiles that have a relatively thin layer of stone bonded to a substrate comprised of three layers. The first layer is completely
aligned with the stone layer and glued thereon by means of epoxide adhesives, whereas the second and the third layer are so arranged to form a system of such protrusions and recesses to allow the engagement of the tiles in order to accomplish a cladding.

Document WO 2005/102696 A1 discloses a sandwich panel comprised of a layer of natural or artificial stone having a thickness comprised between 5 and 20 mm, and a layer of cured polyurethane having a thickness comprised between 5 and 100 mm. The density of the polyurethane layer is comprised between 45 and 500 kg/m³. The two layers are bonded together by means of an adhesive layer. The lower polyurethane layer is reinforced with a grid made of mineral or synthetic fibers.

The manufacturing techniques of the above-described panels for cladding suggest different solutions to the general problem of providing cladding structures made of natural stone and having a limited weight at the same time. However, known panels have the drawback that in order to guarantee the safety of the anchoring of the cladding layer without making excessively heavy structures, there are strict limitations to the size of the cladding. For instance, cladding layers of natural stone can not exceed 100 x 60 cm with thicknesses of about 3 cm. Moreover, supporting structures must be very rigid and strong in order to withstand the load of the cladding layers applied, resulting in a consequent increase of the costs and/or the manufacturing complexity. Honeycomb supporting structures, which are very used in the manufacturing of claddings of a high-level, are very expensive both due to the materials employed, e.g. aluminum alloys or techno-polymers, and to the complexity of the design and their manufacturing.

It is therefore an object of the present invention to provide a panel for cladding which has a mechanically simple and strong structure, suitable to combine characteristics of lightness with an external cladding of high quality, such as for instance natural stone, at competitive costs with respect to the solutions of the prior art. Said object is achieved with a panel for cladding and a method for its manufacturing, whose main features are disclosed in claim 1 and claim 17 respectively, while other features are disclosed in the remaining claims.

The panel for cladding according to the present invention has a supporting structure manufactured by starting from a traditional sandwich panel, a cladding element known for its lightness, manufacturing simplicity and low manufacturing cost.
This structure is reinforced in prescribed points in order to withstand the load of a panel for cladding fixed thereto.

The main advantage offered by the present invention is that it is possible to provide a panel for cladding with a supporting structure much cheaper than known supporting structures, ensuring at the same time a structural strength adequate to the applications.

In addition, it is possible to reinforce the base structure of the starting sandwich panel in prescribed points on the basis of the characteristics of weight of the cladding layer applied and of the characteristics of the structure to which the finished cladding panels will be applied, with the consequent possibility of accomplishing specific products for the application without significantly increasing the manufacturing costs.

The panel according to the present invention offers the further advantage of allowing to fix cladding layers of a larger size with respect to the cladding layers of the prior art, thanks to the use of special adhesives possibly reinforced by means of layers of fabric.

Still another advantage of the panel according to the present invention is that it is possible to combine the supporting structure with any type of cladding layer, such as natural stone, artificial stone and the like.

Further advantages and features of the panel for cladding according to the present invention will become clear to those skilled in the art from the following detailed and non-limiting description of an embodiment thereof with reference to the attached drawings, wherein:

- figure 1 shows a perspective view of the cladding panel according to the invention;
- figure 2 shows a cross-sectional view H-II of the panel of figure 1;
- figure 3 shows, in a cross-sectional view, the steps of making the holes in the sandwich panel and of fitting the reinforcing elements into the panel of figure 1; and
- figure 4 shows a detailed view of section U-EE of the panel of figure 1.

Figure 1 shows a panel for cladding 1 according to the present invention. The panel for cladding 1 is comprised of a cladding upper layer 2, e.g. made of natural stone,
and a lower layer 3 bonded to each other. Lower layer 3 is in turn comprised of a pair of calendered plates 4 and 5 between which a layer 6 of polyurethane foam is arranged. The lower layer 3 so formed is a sandwich panel, known in the art as a construction element for claddings and insulation.

A sandwich panel is manufactured by starting from two rolls of sheet-metal plate, e.g. having a thickness of 0,5 mm. The manufacturing process two rolls of sheet-metal plate are arranged on a support with their axes parallel to each other and at a suitable distance from each other, then they are unrolled and inserted at the same time into a calender that provides the sheet-metal plates with the desired profiles. The shaped sheet-metal plates proceed in parallel at a suitable distance from each other and subsequently a polyurethane foam is injected between them completely filling the volume comprised between the sheet-metal plates. Suitable polyurethane foams for the manufacturing of sandwich panels have a density of at least 38 kg/m³.

In order to effectively counteract the thrust of the expanding polyurethane foam, the shaped sheet-metal plates are subsequently made to pass through a press with heated rolls. The press keeps the distance between the sheet-metal plates constant and the heat of the rolls enhances the curing of polyurethane, which bonds the sheet-metal plates to each other thanks to the presence of a primer type paint covering the sheet-metal plates. The assembly sheet-metal plate - polyurethane foam - sheet-metal plate thus obtained forms a sandwich structure that is finally cut into panels having a desired length. Typical thicknesses of the sandwich panels are equal to at least 25 mm.

As shown in the drawing, the lateral edges of the lower layer or sandwich panel 3 respectively have a protrusion 7 and a recess 8 suitable for allowing to block one panel into the other in order to make a cladding surface.

This construction of the sandwich panel is particularly inexpensive and simple to manufacture and thus constitutes a valid starting base for the development of the cladding panel according to the present invention.

The structure of the lower layer or sandwich panel 3 so obtained is subsequently drilled in several points in order to form a pattern of transverse passages suitable for fitting a series of reinforcing elements 9 between one sheet-metal plate and the other.

As shown in figure 2, reinforcing elements 9 accomplish a fixed connection
between sheet-metal plates 4 and 5, thus providing lower layer 3 with a remarkable rigidity and strength to shear stresses, which can not be obtained with a traditional sandwich panel. Moreover, as shown in the drawing, reinforcing elements 9 also accomplish the function of spacers, therefore in addition to their reinforcing function they keep the distance between sheet-metal plates 4 and 5 constant.

In traditional sandwich panels, layer 6 of polyurethane foam accomplishes a bonding function between sheet-metal plates 4 and 5 in addition to the thermal insulation and the noise-barrier function, however, due to its structure, the layer filled with polyurethane can not provide the panel with a high rigidity and strength to shear stresses. Therefore actions of pulling, pressing and shearing on the panel can deform its structure even greatly. For this reason sandwich panels can not be used as supporting structures for the manufacturing of cladding panels.

On the contrary, in the panel according to the present invention the base structure of the sandwich panel is reinforced and stiffened by means of reinforcing elements 9, therefore layer 6 made of polyurethane foam is set completely free from its bonding function between the plates and accomplishes only a function of thermal insulation and/or noise-barrier. Thus, the structure so reinforced can withstand mechanical loads, such as for instance the load of a cladding layer 2 made of stone applied thereto.

According to what stated above it is clear that the panel according to the present invention can be manufactured in a very simple and inexpensive way, by starting from the known and well consolidated technology of sandwich cladding panels.

As shown in figure 3, on lower layer 3, or sandwich panel, first holes 10 are made by starting from anyone of the two sheet-metal surfaces 4 or 5, e.g. sheet-metal 5, until reaching the inner surface of the opposite sheet-metal plate, e.g. sheet-metal plate 4. On this sheet-metal plate, i.e. sheet-metal plate 4, second holes 11 are then made, being respectively coaxial to first holes 10 but having a smaller diameter, hi each one of the first holes 10 the female part 12 of a reinforcing element 9 is completely fitted, the head of which abuts onto the external surface of sheet-metal plate 5. On the contrary, the male part 13 of reinforcing element 9 is fitted into the second hole 11, i.e. from the opposite side with respect to female part 12, and is fixed in said female part 12, for instance, by interference fit or by means of a thread profile. Once fixed, the stem of
female part 12 of reinforcing element 9 abuts the inner surface of sheet-metal plate 4, therefore reinforcing element 9 also accomplishes the function of a spacer between sheet-metal plates 4 and 5.

The drawing also shows that each one of sheet-metal plates 4, 5 comprises a plurality of longitudinal grooves 14 defining recesses in the surfaces. Such grooves 14 are formed during the step of calendering of sheet-metal plates 4 and 5 and have the function of stiffening sheet-metal plates 4 and 5. The drawing shows that the first and second holes 10, 11 are made in correspondence to grooves 14. By suitably dimensioning the depth of grooves 14, it is possible to make the heads of the female and male parts 12, 13 of reinforcing elements 9 be completely contained in grooves 14, without protruding from sheet-metal plates 4 and 5. Therefore a reinforcement of the structure of the sandwich panel is obtained by maintaining unchanged the total thickness of the cladding panel. Moreover, the surface available for glueing cladding upper layer 2 is the maximum possible.

Subsequently to the operations of drilling and assembling of the reinforcing elements 9, the application of cladding layer 2 goes on, e.g. a layer made of thin stone having a thickness comprised between 3 and 12 mm, or made of glass, ceramic material and still other materials well known to those skilled in the art. Either of the two surfaces of sheet-metal plates 4, 5 and the surface of cladding layer 2 which must be contacted are accurately mechanically cleaned, e.g. smoothed, and/or chemically cleaned, e.g. by means of a solvent, then an adhesive is applied such as an epoxide adhesive and then cladding layer 2 is applied.

As shown in figure 4, in order to improve the efficacy of the glueing a fabric layer 15 is arranged between cladding layer 2 and lower layer 3. Such a fabric layer 15 has the function of retaining the adhesive in the area underlying cladding layer 2 and also increases the surface contact area between cladding layer 2 and lower layer 3. In order to enhance the curing process of the adhesive, the glueing step is carried out in a press at controlled temperature. Once curing has occurred, fabric layer 15 also provides a reinforcing structure of the adhesive, thus bestowing better characteristics of rigidity, tear strength and impact strength. Suitable materials for fabric layer 15 are for instance glass fiber fabrics.
The adhesive layer allows the bonding of cladding layer 2 to lower layer or sandwich panel 3 in an optimal way, further allowing the application of cladding layers 2 of a much wider surface with respect to known cladding panels, with a size viewed from above up to 300 x 160 cm.

In a preferred embodiment of the manufacturing method according to the present invention, cladding layer 2 is made of natural stone and is applied at the same time on two sandwich panels 3. A plate of natural stone having a thickness greater than the final one, is cut and trimmed on the basis of the size of the finished cladding panel 1 and then washed and dried in an oven. Subsequently, a multilayer structure is prepared comprised of the natural stone plate and two reinforced sandwich panels 3 that are glued on the upper and lower surfaces thereof. The multilayer structure so-formed is put into a press at controlled temperature for curing the adhesive and then inserted into suitable machines where a cutting operation is carried out at the mid-plane of the natural stone plate. Such a cutting operation, which is carried out, for example, by diamond wire, has the purpose of separating the multilayer structure into two finished cladding panels 1, each provided with a thin cladding layer 2 of natural stone.

Upon the application of cladding layer 2 it is possible to carry out calibration processings in order to obtain the desired thicknesses of cladding layer 2, and/or smoothing processings in order to reduce the surface roughness of the cladding and/or polishing it.

Various elements for the assembling to the structures to be cladded may be added to the cladding panels 1 so manufactured, such as for example anchoring clamps. Such assembling elements are fixed on the sheet-metal plate opposite to the one on which cladding layer 2 has been glued, e.g. by means of rivets.

Possible variants and/or additions may be made by those skilled in the art to the hereinabove disclosed and illustrated embodiment while remaining within the scope of the following claims.
CLAIMS

1. A panel for cladding (1) comprising a cladding upper layer (2) and a supporting lower layer (3) bonded to each other, said lower layer being a sandwich panel comprised of a pair of calendered sheet-metal plates (4, 5) between which a layer (6) of thermoinsulating and noise-barrier material is arranged, characterized in that said lower layer (3) has a plurality of reinforcing elements (9) arranged in connection between said upper and lower sheet-metal plates (4, 5), said reinforcing elements (9) being also spacers suitable for maintaining the distance between said upper and lower sheet-metal plates (4, 5) constant.

2. A panel (1) according to claim 1, characterized in that said reinforcing elements (9) are each fitted in a corresponding hole (10, 11).

3. A panel (1) according to claim 1 or 2, characterized in that said upper and lower sheet-metal plates (4, 5) have a plurality of grooves (14) arranged in the longitudinal direction and suitably spaced apart from each other.

4. A panel (1) according to claim 3, characterized in that said holes (10, 11) are located in correspondence to said grooves (14).

5. A panel according to claim 3 or 4, characterized in that said longitudinal grooves (14) completely contain the heads of said reinforcing elements (9), the heads not protruding from the upper and lower sheet-metal plates (4, 5).

6. A panel (1) according to claim 1, characterized in that said cladding upper layer (2) is fixed on said lower layer (3) by means of an adhesive layer.

7. A panel (1) according to claim 6, characterized in that said adhesive is an epoxide adhesive.

8. A panel (1) according to claim 6, characterized in that said adhesive layer is reinforced by means of a fabric layer (15).

9. A panel (1) according to claim 8, characterized in that said fabric layer (15) is made of glass fibers.

10. A panel (1) according to claim 1, characterized in that said cladding upper layer (2) is a plate of natural stone having a thickness comprised between 3 and 12 mm.
11. A panel (1) according to claim 8, characterized in that said cladding upper layer (2) has a size viewed from above up to 300 x 160 cm.

12. A panel (1) according to claim 1, characterized in that said thermoinsulating and noise-barrier material is a polyurethane foam having a density of at least 38 kg/m³.

13. A panel (1) according to claim 1, characterized in that said supporting lower layer (3) has a thickness equal to at least 25 mm.

14. A panel (1) according to claim 1, characterized in that the supporting lower layer (3) comprises a protrusion (7) and a recess (8) on the lateral edges, said protrusion and recess (7, 8) being suitable for allowing the blocking of one finished cladding panel with the other in order to make a cladding surface.

15. A panel (1) according to claim 1, characterized by further comprising one or more elements for anchoring to the surfaces that must be cladded, said elements being fixed on the surface opposite to the one on which the cladding layer (2) is fixed.

16. A cladding surface, characterized by comprising a plurality of cladding panels (1) according to one of claims 1-15.

17. A method for manufacturing a panel (1) for cladding, comprising the steps of:

- manufacturing a supporting lower layer (3) in the form of a sandwich panel by calendering upper and lower sheet-metal plates (4, 5) and injecting a thermoinsulating and noise-barrier material between them;
- making a plurality of holes (10, 11) in said sandwich panel (3) in the transverse direction in prescribed points;
- inserting and fixing in said holes (10, 11) a plurality of reinforcing elements (9) also having the function of spacers; and
- fixing a cladding layer (2) on said sandwich panel (3).

18. A method according to claim 17, characterized in that said step of fixing the cladding layer (2) to the supporting lower layer (3) comprises the steps of:

- mechanically/chemically cleaning the surface of the sheet-metal plate (4, 5)
- and the surface of the cladding layer (2) that must be contacted;
- spreading a layer of adhesive on the surface of the sheet-metal plate (4, 5)
and/or of the cladding layer (2) previously cleaned;

- superimposing the cladding layer (2) to the sandwich panel (3) and curing the adhesive in a press at controlled temperature.

19. A method according to claim 18, characterized in that said step of arranging a layer of adhesive also comprises superimposing a reinforcing fabric layer (15) to the adhesive.

20. A method for the manufacturing of a panel (1) for cladding according to one of claims 17 to 19, characterized in that said cladding layer (2) is a plate of natural stone and in that two supporting lower layers (3) are fixed at the same time on the two opposite faces thereof, the natural stone plate being subsequently cut by means of a diamond wire in correspondence to its mid-plane in order to obtain two finished panels (1) for cladding.

21. A method according to one of claims 17 to 20, characterized by further comprising a final step of calibration and/or smoothing of the cladding layer (2).