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[54] **MASONRY LAMINATE**

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[21] Appl. No.: **106,037**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 4,671, Jan. 21, 1970, abandoned.

[52] **U.S. Cl.** **52/378,** 52/391, 52/612, 161/40, 161/160

[51] **Int. Cl.**.....**E04b 1/16,** E04b 5/04

[58] **Field of Search**.....52/378, 379, 388, 389, 426, 52/597–599, 612, 391; 94/15; 52/213, 428, 410, 604; 161/37–40, 513, 161

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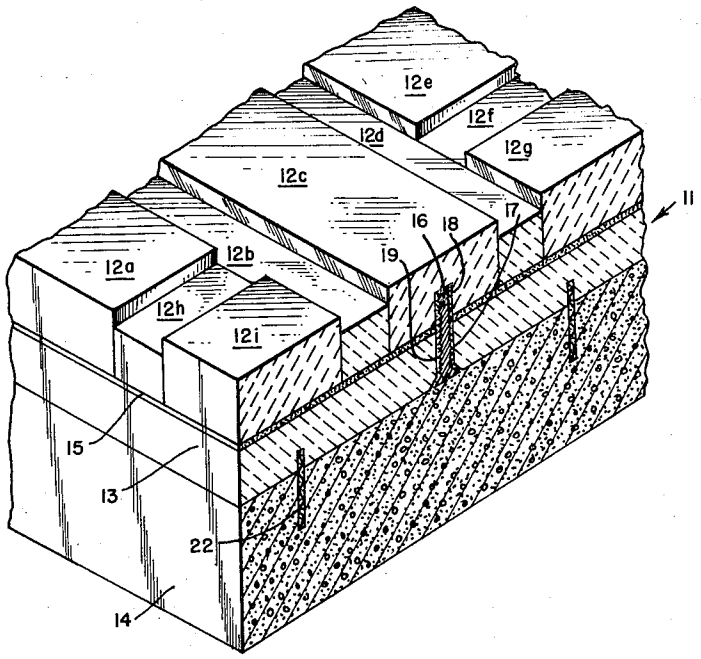
[57] **ABSTRACT**

A masonry laminate comprising a facing sheet of architectural grade marble or granite or the like, a supporting member of suitable hard stone such as marble or granite and a backing member comprising a layer of concrete or a combination of concrete and hollow blocks. The facing sheet which may optionally consist of several pieces is cemented to the supporting member by means of a thin layer of a high strength, non-shrinking, quick setting adhesive and the bond is reinforced by metal rods which pass through the supporting member and part way through the facing sheet.

6 Claims, 4 Drawing Figures



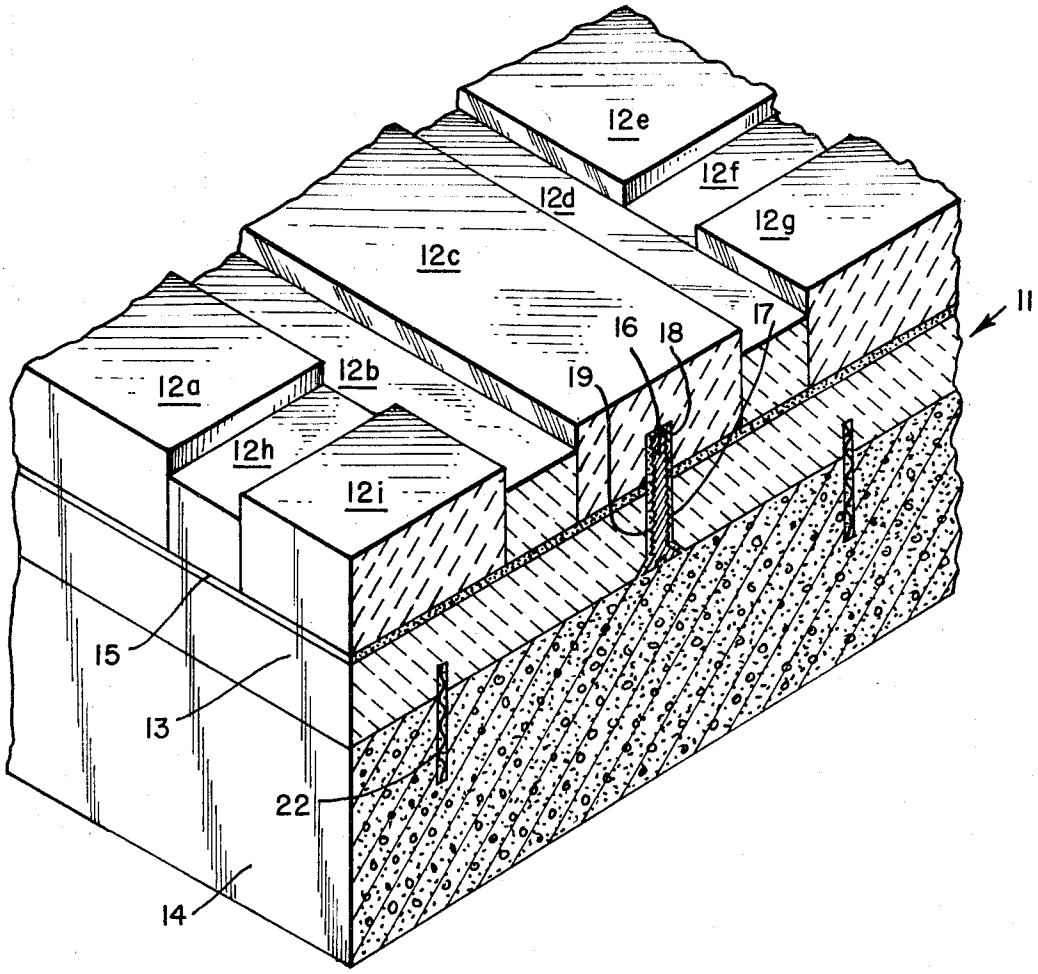


FIG. 1

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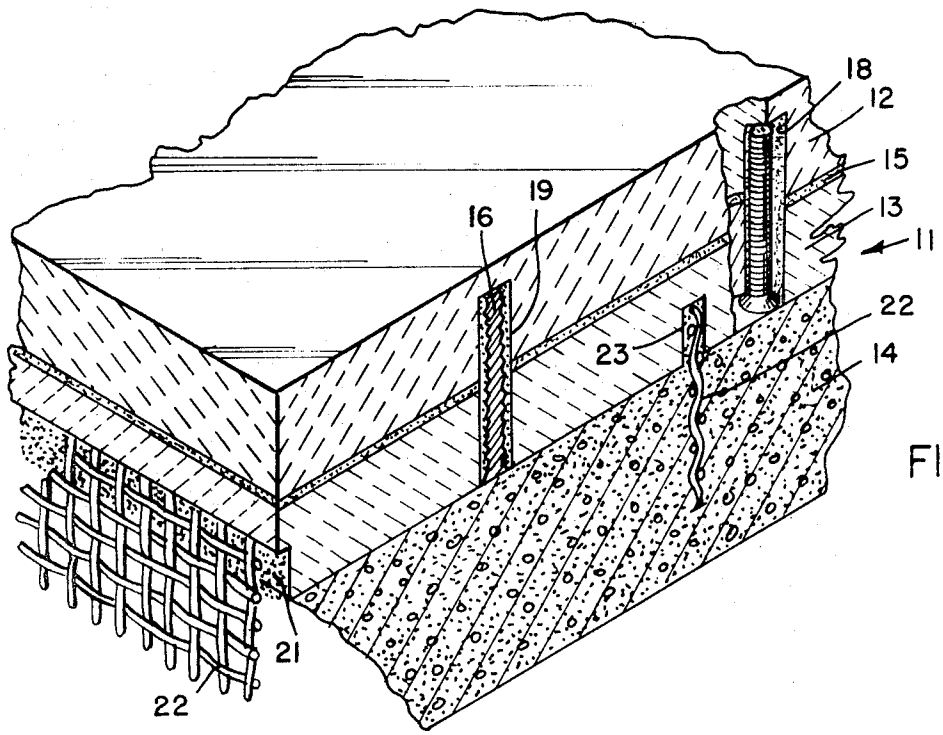

FIG. 2

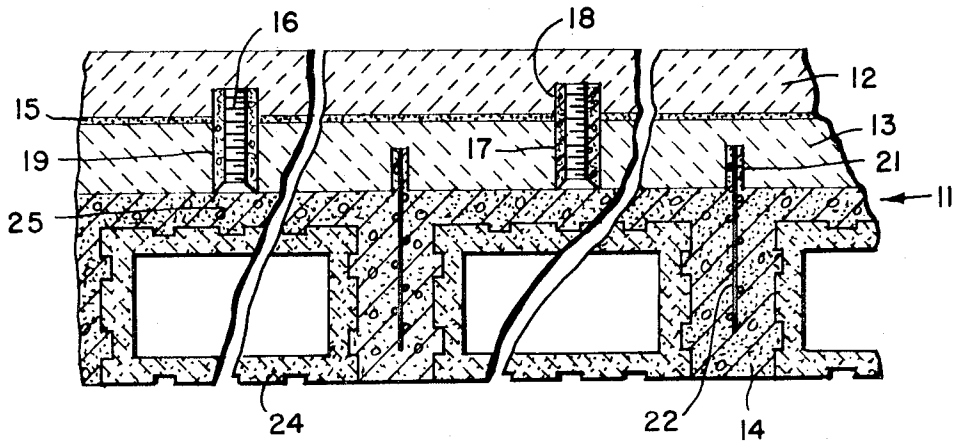

FIG. 3

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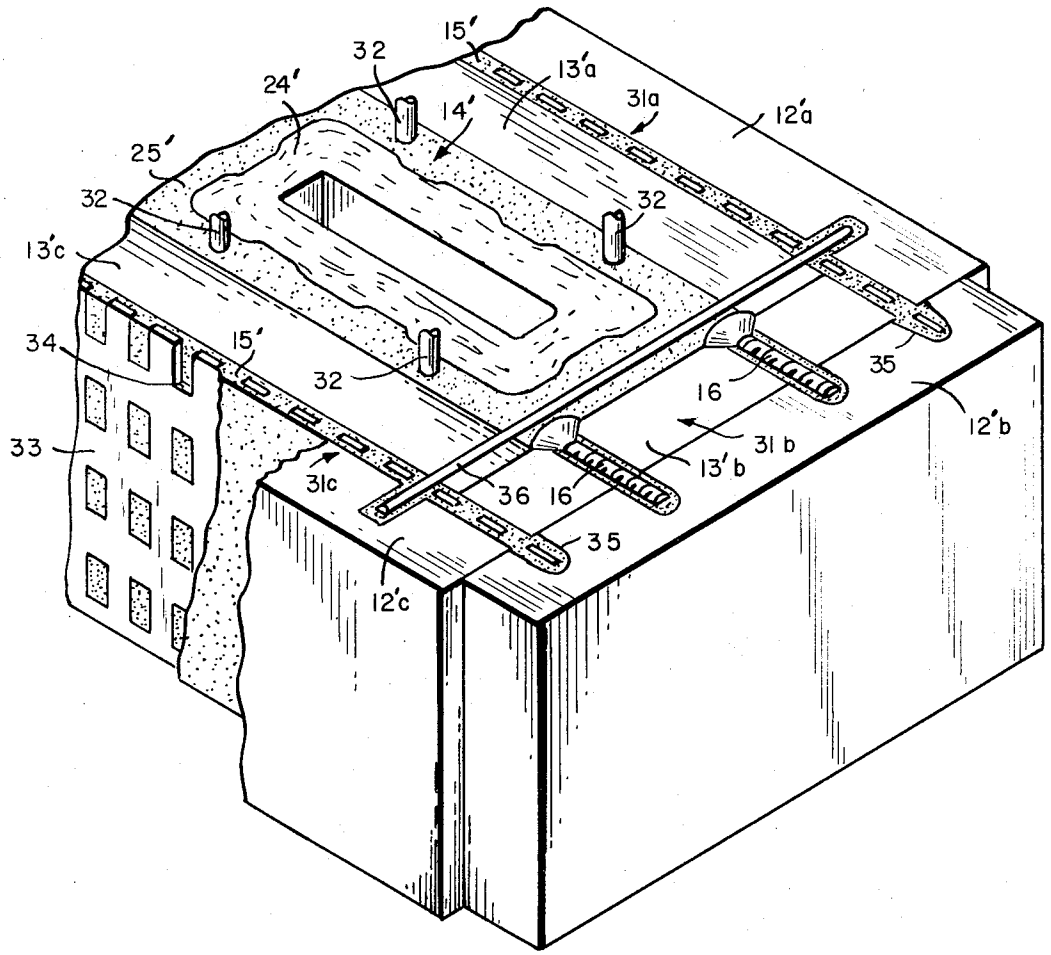

FIG. 4

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MASONRY LAMINATE

The present invention is a continuation-in-part of the copending application of Albert L. Castellarin, Ser. No. 4,671, filed Jan. 21, 1970 and now abandoned.

SUMMARY OF THE INVENTION

This invention relates to the art of providing structures with a veneer or facing of stone, such as marble or granite or the like. Such facings are generally formed as slabs of stone generally about 2 inches thick, although the thickness can vary from about ½ inch to 4 inches or more with one face of the stone slabs finished in the desired manner. Usually the slabs are rectangular with squared and finished edges so that the adjoining slabs may be assembled together in close proximity.

In recent years several different methods have been used for mounting such slabs in place on the wall of the structure. The earliest of these involves the use of the so-called split tie. Here the slabs of stone are provided at convenient locations in each of the edges with carefully placed holes that extend perpendicular to the edge in question at a point intermediate the two faces. The holes are arranged so that the location of each hole in one slab coincides with the location of the corresponding hole in each adjoining slab. Typically there are two or more such holes on each side. The tie member is a T-shaped piece of metal with the cross arms of the T designed to enter the opposed holes in adjoining slabs, and the stem of the T designed to be incorporated in the mortar of a brick or block wall. In using the split tie the bottom row of slabs is set up on a suitable base with the ties in place between adjoining slabs and with the stems of these ties extending toward the rear. While the slabs are supported in precisely the desired location, a masonry wall is constructed behind the slabs in contact with the back of the slabs. The ties are incorporated in the mortar joints of the wall. This process continues row upon row of stone slabs until the wall is completed. The slabs of stone normally are mounted with a small space between each (normally equal to the diameter of the stem of the ties) to permit for the thermal expansion of the slabs. These spaces or cracks are filled with a mastic to inhibit the entry of water.

This has been a very successful method for mounting a facing of stone. The major difficulty is that it is a slow and expensive method since in essence the slabs of stone have to be lined up and held in place from one side as the wall is constructed from the other. Another problem is that if the mortar behind the slabs does shrink even slightly fissures for water to seep into will result — a condition which may cause difficulties especially under freeze and thaw conditions.

In addition, the slabs can react or warp since they are actually supported only at separated positions about the periphery of the slab at the locations of the ties, although in this case the back of the slab may rest against the masonry wall.

Because of the expense of the split tie type of construction the use of the disk or round tie has become popular in recent years. In this type of construction a cement block wall is constructed first with so-called baskets located at appropriate places. Each basket consists of two U-shaped wire pieces with the base of each U arranged vertically and with a slidable horizontal cross piece mounted therebetween. The basket is about

the size of the face of a single block so that the arms of the U-shaped wire pieces can be buried in the motor joint between adjoining blocks. The basket is normally mounted in the wall backed by a half thickness block so that there is a couple of inches of space behind the cross piece. The face of the cross piece is mounted substantially in line with the face of the wall. The cross piece is provided with a horizontally extending slot in which is mounted an internally tapped mounting bracket adapted to receive the mounting rod for the split tie. The cross piece can be moved up and down and the mounting bracket right and left, so that the mounting bracket can be located at almost any point within the cavity occupied by the basket. The tie consists of a disk of metal a couple of inches in diameter axially mounted on a threaded rod several inches long.

In this case instead of providing the edges of the stone slabs with holes at carefully spaced locations, the slabs are provided with semi-circular slots designed to receive the disk tie. The erection of the stone facing using this method is surprisingly rapid. The slabs in the bottom row are erected one by one on a suitable back with the base face of these slabs separated several inches or so from the face of the block wall. This, among other things, permits clamps to be used to support the slab until the disk ties are actually located. Since the cross piece moves up and down, since the mounting bracket moves right and left, and since the mounting rod can be moved in or out by rotation; each disk can be very accurately positioned thus assuring very precise alignment of the stone slabs. Once the tie has been positioned the cavity behind the basket is filled with mortar to insure that the mounting bracket and tie are locked into place. The space between the back of the slab and the front of the block wall is left unfilled and the cracks between adjoining slabs is filled with caulking compound to discourage the entry of water.

By leaving a space of at least several inches between the back of the slabs of stone and the front of the block wall the likelihood of freeze-thaw damage is greatly reduced. On the other hand, in this type of construction each individual slab is supported only at the spaced locations of the disk ties so that the likelihood of reaction or warpage is considerable.

The most recent method in widespread use involves the mounting of the slabs of stone on precast concrete forms. In a typical installation curtain wall elements of concrete about four inches thick are precast and thereafter sections of stone slab about 2 inches thick are adhered thereto using a relatively thick layer of about one-half inch thick of an elastic mastic. An insulating and moisture-resistant membrane may be incorporated into the mastic layer. The advantage of this method is that suitable sections of the wall can be preassembled at a suitable location away from the construction site and thereafter trucked in and raised into place as a unit. In addition it is much more convenient to use irregular pieces of facing in this method than in either of the methods mentioned above. Suitable mounting brackets, such as are used for any precast concrete curtain wall construction can be incorporated into the precast concrete backing layer. The difficulty with this construction is that the slabs of stone are separated from the precast concrete backing by a rela-

tively thick elastic layer. This permits the stone to react or warp and over a period of time cause either the stone slab or the concrete to pull away from the elastic interlayer permitting the entry of water and the possibility of damage under freeze-thaw conditions.

As indicated above one of the problems is that all stone has a tendancy to react or warp when exposed to the weather. The degree or extent of this reaction varies with the type of stone and more particularly with the particular quarry from which this stone was derived. The degree of reaction in a particular stone also varies with the direction in which the slab is cut from the mass. This latter is particularly critical in the case of decorative stone such as marble for the most desirable cuts from a decorative point of view are very much more reactive than slabs cut at right angles thereto.

I have discovered a new masonry laminate which eliminates the difficulties present in these prior structures. My invention will be more easily understood by reference to the drawings and to the detailed description which follows.

REFERENCE TO THE DRAWINGS

FIG. 1 is a vertical section in perspective of a typical masonry laminate of the present invention;

FIG. 2 is a vertical section in perspective similar to FIG. 1 but in greater detail;

FIG. 3 is a vertical section in perspective of a variation of the laminate of the present invention in which the backing layer includes cement or terracotta blocks;

FIG. 4 is a horizontal section in perspective of a second variation wherein the bond between the facing sheet and the supporting sheet additionally includes a sheet of perforated metal.

DETAILED DESCRIPTION

The basic structure of the present invention is shown in FIG. 2. Laminate **11** comprises a facing sheet **12**, a supporting or stabilizing member **13** and a backing member **14**. Facing sheet **12** is preferably of an architectural grade stone such as polished or finished marble, granite or the like.

Supporting member or stabilizing slab **13** comprises a slab of marble or other suitable hard stone of any desirable size. Backing member **14** comprises a layer of Portland cement concrete which normally is co-extensive with the supporting member. In the alternative, as will be discussed hereafter, backing member **14** may contain hollow blocks or the like for the reduction of the weight of laminate.

Facing sheet **12** is laminated to supporting member **13** by means of intermediate layer **15** of a quick setting non-shrinking adhesive such as a fast setting cement, mastic or epoxy cement. In addition the laminate comprising facing sheet **12** and supporting members **13** is reinforced at suitable intervals by reinforcing members **16** each of which passes through a hole **17** provided in supporting member **13** into a matching cavity **18** provided in the rear face of facing sheet **12**. Hole **17** and cavity **18** are slightly over-sized and reinforcing members **16** are fastened into place by means of a layer **19** of quick setting adhesive such as the one used in intermediate adhesive layer **15**. The exterior surface of reinforcing member **16** is preferably provided with protrusions such as those of a screw in order to provide a firmer bond. Reinforcing member **16** is preferably threaded rod or a flat headed screw of stainless steel, brass or bronze. After assembly facing sheet **12** and supporting member **13** are held firmly together as by clamping means until the cement has set up.

I have discovered that by firmly laminating two sheets of stone as described, the reaction is substantially reduced even though both sheets have a relatively great reactivity. Preferably I use as my supporting or stabilizing member, a hard stone of relatively low reactivity in which case the effective reactivity of the laminate becomes essentially that of the supporting member.

The rear face of supporting member **13** is provided with elongated grooves or slots **21** to receive one edge of screens **22**. Screens **22** are locked into grooves **21** by means of a layer **23** of a quick setting adhesive such as fast setting cement mastic or epoxy cement. The free edges of screens **22** serve to lock the joined facing sheet **12** and supporting member **13** to backing member **14** which, in the case of the structure of FIG. **2**, is a layer of Portland cement or concrete. Screens **22** are provided of a width that they will penetrate a substantial distance through the thickness of backing member **14**. Since the concrete of backing member **14** is permitted to cure in place the solid mass extends through the interstices of the screens providing a very firm bond. Backing member **14** may be provided with bolts or other anchoring members (not shown) which can be secured into place to provide for the easy attachment of the composite structure to its support. Where added strength is required it may also be provided with conventional reinforcing rods (also not shown).

A variation of the composite member is shown in FIG. **3** where instead of backing member **14** being a solid concrete slab as in FIG. **2** backing member **14** is provided with hollow blocks **24**. This permits the desired over-all thickness of the composite to be maintained but with a substantial reduction in weight. In assembling this variation a layer **25** of mortar or concrete about 1 inch thick is placed on the backside of supporting member **13** which is provided as usual with a plurality of screens **22**. Blocks **24** are then placed on layer **25** between screens **22** allowing a substantial distance between the block **24** on either side of a given screen **22**. Mortar or concrete is placed between blocks **24** surrounding screen **22** preferably leaving the rear side of block **24** exposed as shown. In other words the blocks are grouted to the top of the block to form an even slab. After assembly the entire backing layer is permitted to harden and cure into a unitary whole.

FIG. **1** shows how my invention can be used to advantage in preparing decorative facings composed of a plurality of pieces of stone. In this embodiment a number of pieces of stone identified as **12***a*, *b*, *c*, *d*, etc., are fastened to a single supporting member **13** in the manner described above with adhesive layer **15** and reinforcing members **16**. Supporting member **13** is laminated to backing member **14** in the usual manner. This is of great convenience in any situation where a design or pattern calls for a number of relatively small pieces of stone. Rather than having to assemble these on the job, the use of my invention permits the assembly to be made in the shop on a supporting member

of suitable size with the composite thereafter being installed on the job as a single unit. Other materials can be used in addition to hard stone in providing such a decorative facing. These include such things as granulated materials such as terrazo which could be spread and cured in place if desired, clay products such as brick or ceramics, sheets or pieces of various metals, enameled products and the like.

The masonry laminate of the present invention can be assembled quite readily in the following manner:

Stabilizing slab **13** is placed in a level position and facing sheet **12** or the components thereof are assembled thereon and secured thereto with cements, mastics or epoxies. If mastics or epoxies are used as the securing means the slabs have to be absolutely clean and dry. On the other hand, if a liquid containing cement is used the mating surfaces should be dampened. After the two components are secure the assembly is turned upside down. Thereafter holes **17** are drilled from the back through supporting member **13** and part way through facing sheet **12**. Reinforcing members **16** are then inserted in each of the holes **17** and are embedded in cement, mastic or epoxy. Slots **21** are then cut in the rear surface of supporting member **13** to receive screen **22**. The wire mesh or screens **22** are secured in the slots again with either cement, mastic or epoxy adhesive.

The masonry is then applied to the back of supporting member **13**. The back surface of supporting member **13** is first cleaned and primed for assurance of bond. If concrete is used as backing member **14** it is applied directly to the back of supporting member **13** which, of course, has been provided with a suitable mold. The concrete of backing member **14** is permitted to harden in place. Clamps or other means may be used to prevent the concrete of backing member **14** from any spontaneous reactions before hardening. If blocks are used they are laid on a bed of mortar approximately 1 inch thick. The joints between blocks are then grouted to the top of the block to form an even slab. Backing member **14** may include reinforcing rods, either stressed or non-stressed as the occasion demands.

The variation shown in FIG. **4** shows how the structure of the present invention can be used to form multisurfaced members such as beams (as shown), architraves, pillars and the like. Beam **30** shown in FIG. **4** has three laminates **31***a*, *b* and *c*, each comprising a facing sheet **12'***a*, *b* and *c*, respectively, and a stabilizing member **13'***a*, *b* and *c*, respectively, on a common rectangular backing member **14'**. Backing member **14'** as shown comprises a layer of mortar **25'** surrounding a terracotta block **24'**. The use of hollow block **24'** is desirable in order to minimize the weight of the total structure although a solid concrete backing member could equally as well be used. In addition where the multisurfaced member is to be used as a facing, for example, on a steel beam the backing member may be formed with a central cavity as by omitting block **24**. In either case should the beam have any substantial length, it is desirable to provide the backing member **14'** with a suitable number of reinforcing rods (preferably stressed) indicated at **32**.

Laminates **31***a* and **31***c* on the side of the beam **30** are laminated in the normal way with adhesive layer **15'** and reinforcing members **16** (not shown). It has been found that an even greater resistance to reaction is obtained if adhesive layer **15** or **15'**, as the case may be, is provided with an intermediate perforated metal sheet **33**. This is applicable not only to the variation shown in FIG. **4** but also to the variations of my invention shown in FIGS. **1** to **3**. When the intermediate perforated metal sheet **33** is used the adhesive of adhesive layer **15** or **15'** should be applied on both sides of sheet **33** and should extend through perforations **34** to insure a firm bond. Any normal perforated metal sheet may be used. In forming beams the use of tie rods **36** is preferred extending at suitable intervals across the beam from the back of facing sheet **12'***a* to facing sheet **12'***c* through stabilizing members **13'***a* and **13'***c* and mortar **25'** of backing member **14'**.

The end laminate **31***b* may or may not be so joined, although it is preferable in any event to employ reinforcing members **16** as shown depending on the width of the facing sheet **12'***b*. If the width of facing sheet **12'***b* in a beam **30** is relatively small, it is sufficient to bond facing sheet **12'***b* by extending both perforated metal sheets **33** beyond the extent of facing sheets **12'***a* and **12'***b* into grooves **35** formed in the back of facing sheet **12'***b*. In such instance the back side of facing sheet **12'***b* should overlap the edges of facing sheets **12'***a* and **12'***c*.

I claim:

1. A masonry structure for use as an architectural element such as a curtain wall element and the like having a veneer or facing of stone, said masonry structure comprising a backing member of concrete or bonded blocks having on an exposed face thereof a facing sheet comprising a plurality of pieces of architectural grade hard natural stone in edge-to-edge relation and a supporting and stabilizing member comprising a single slab of hard natural stone traversing a number of the pieces of said facing sheet, said facing sheet, said supporting and stabilizing member and said backing member being substantially coextensive, said masonry structure having means bonding each said piece of said facing sheet to said supporting and stabilizing member and means bonding said supporting and stabilizing member to said backing member.

2. A masonry laminate as claimed in claim **1** wherein said means bonding said facing sheet to said supporting and stabilizing member includes reinforcing members, each said reinforcing member passing through said supporting member and partially through said facing sheet.

3. A masonry laminated as claimed in claim **2** wherein each said reinforcing member is a metal rod inserted through a hole in said supporting and stabilizing member and extending into a cavity in the rear of said facing sheet, said rod being cemented to both said facing sheet and said supporting member.

4. A masonry laminate as claimed in claim **3** wherein said rod is provided with surface protrusions to provide a firm bond.

5. A masonry laminate as claimed in claim **1** wherein said means bonding said supporting and stabilizing member to said backing member includes wire screens, each said screen inserted into a groove provided in the rear of said supporting member and cemented therein and extending a substantial way through said backing member.

6. A masonry laminate as claimed in claim 1 wherein the means bonding said facing sheet to said supporting and stabilizing member includes an adhesive layer and said adhesive layer is provided with an intermediate perforated metal sheet, said adhesive layer extending on both sides of said sheet and through said perforations.

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