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(54) **COMPOSITE ROOF AND WALL SYSTEM --  
THREE IN ONE -- FIREPROOF,  
INSULATION, AND WATERPROOFING**

(57) **ABSTRACT**

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A composite roof and wall system, three-in-one: fireproof, insulation and waterproofing, which combines fireproof, waterproofing and insulation into one system comprising expanded polystyrene (EPS) foam insulation board; tough waterproofing membrane applied onto the board surface; polyester woven mesh, the reinforcement medium laid over tough waterproof surface; covered by the tough cover, the system's protective part applied onto the mesh. This system can be directly applied onto any existing roof and wall substrate; or pre-constructed into boards, shingles and tiles using tough water proof material to adhere to the existing roof or wall substrate. This system is nail free to avoid leaking problems, survives physical and weather damages. Pigment can be either mixed with the tough cover or applied onto the surface of the cover. It provides an environmentally safe, lightweight, comparatively inexpensive, energy saving, form flexible and long lasting roof and wall systems, which conserve natural resources.

(21) Appl. No.: **10/826,976**

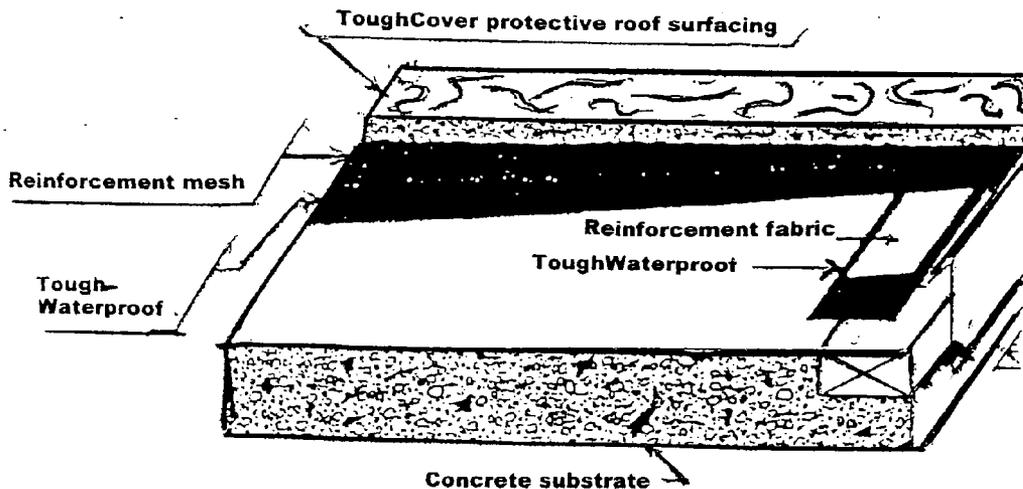
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(52) **U.S. Cl.** ..... **52/794.1; 52/309.8**

**C. ToughCover protective roof surfacing**  
**Concrete substrate**



**Figure 1**  
**C. ToughCover protective roof surfacing**  
**Concrete substrate**

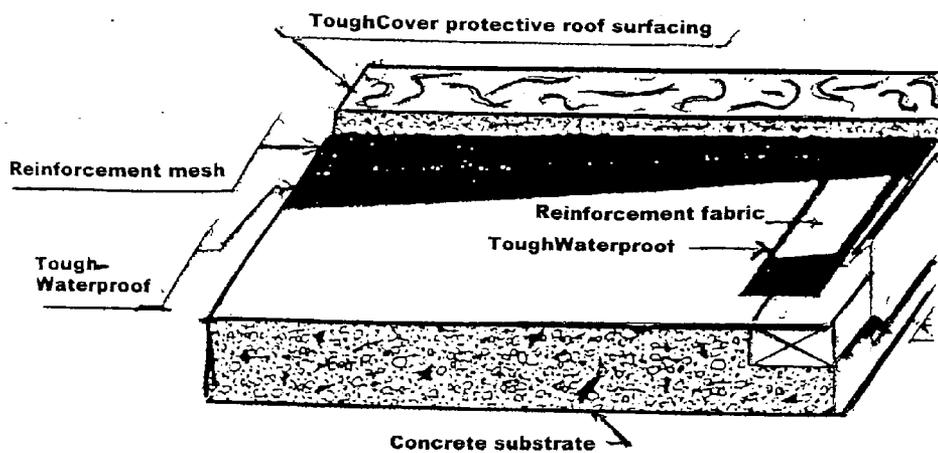
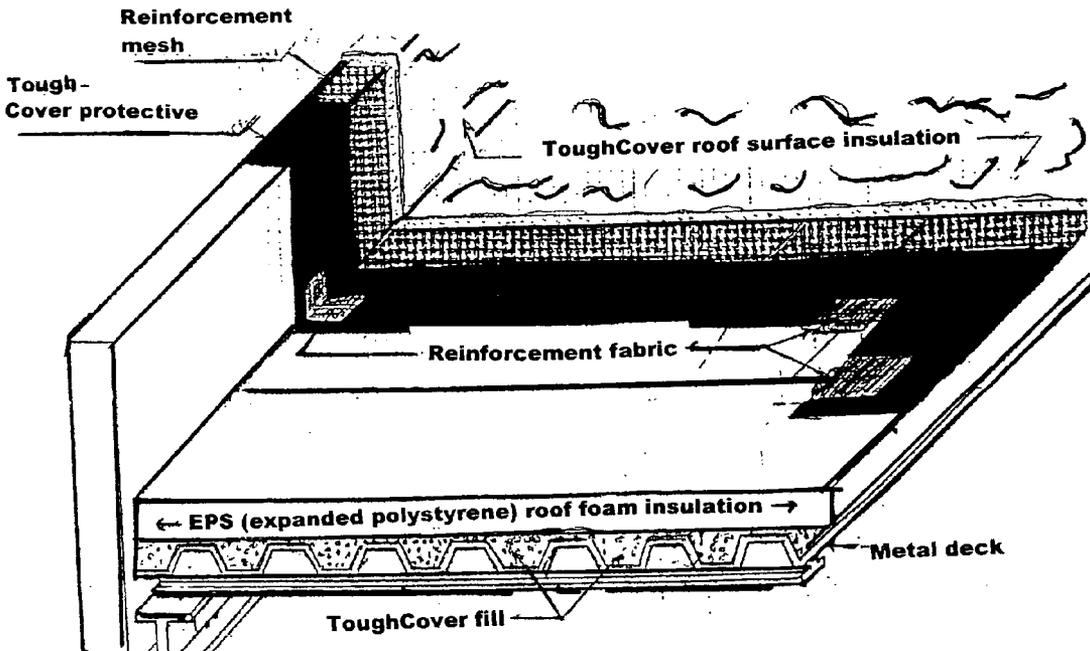


Figure 2



**Figure 3**

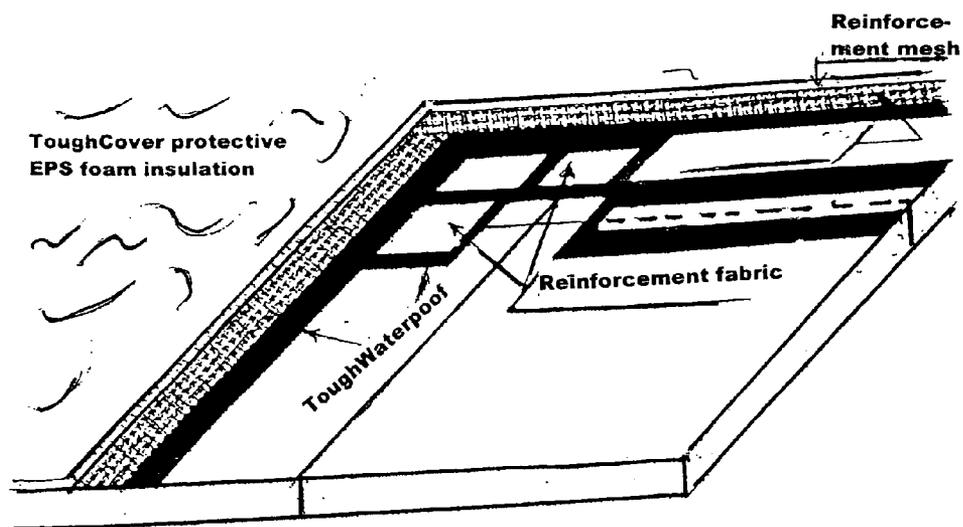
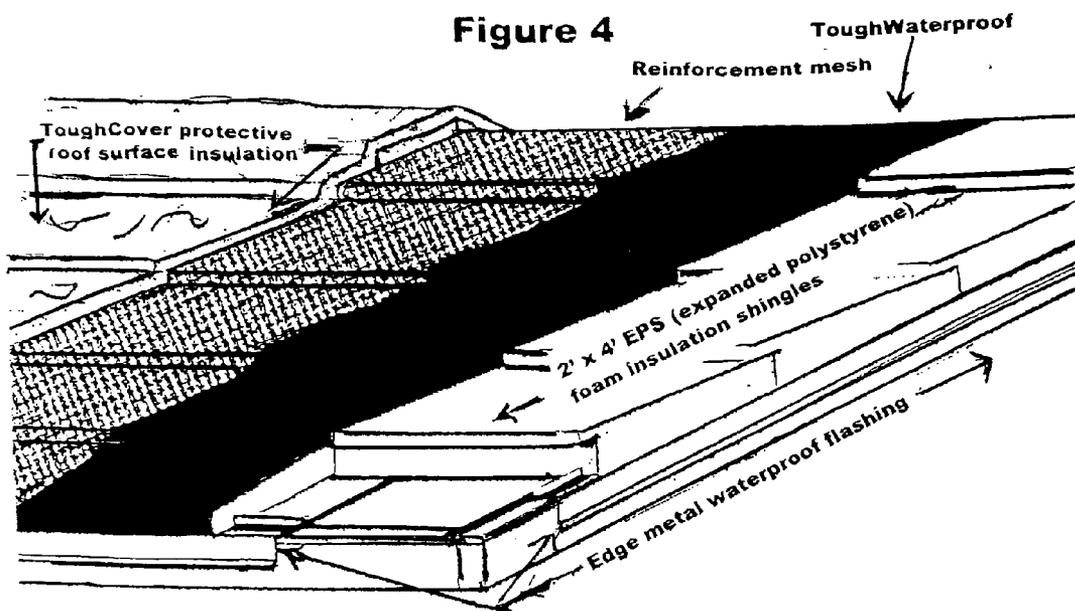
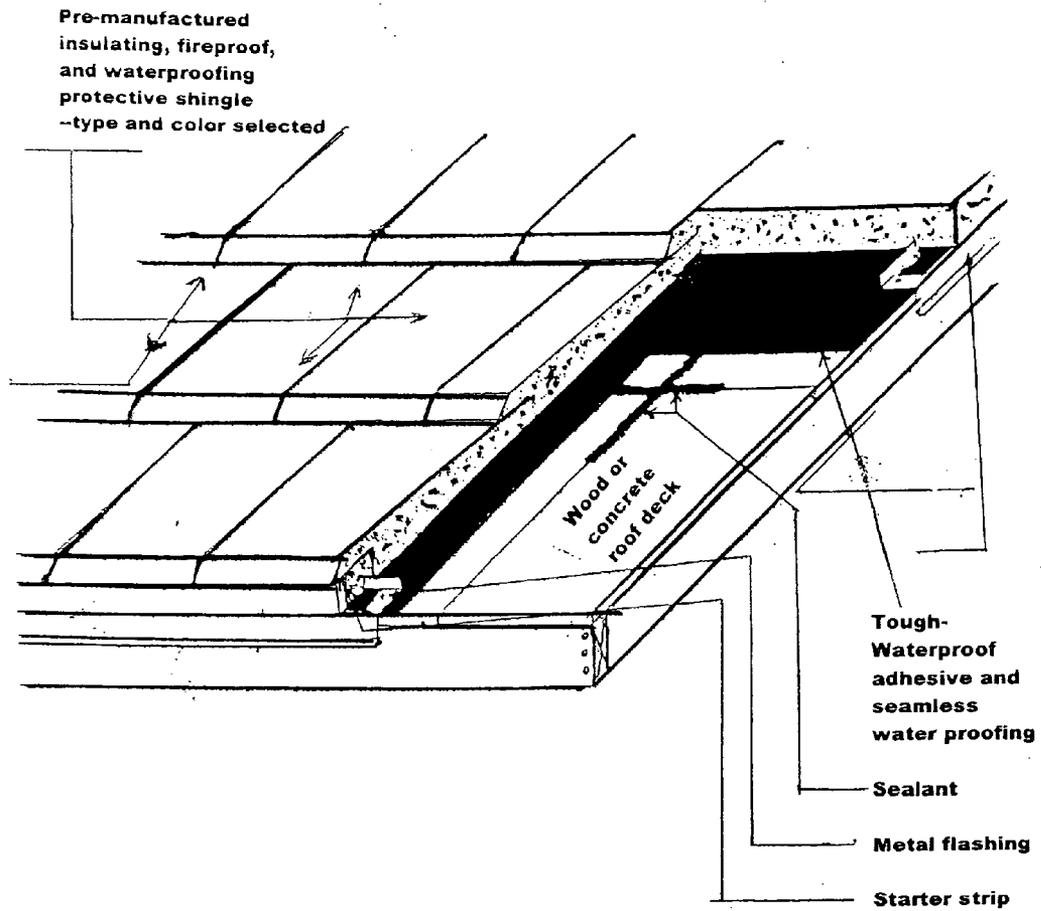


Figure 4



**Figure 5**



**Installation detail**

**COMPOSITE ROOF AND WALL SYSTEM --  
THREE IN ONE -- FIREPROOF, INSULATION,  
AND WATERPROOFING**

REFERENCES CITED [REFERENCED BY]

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- [0003] U.S. Pat. No. 4,965,977 October, 1990 White; Daniel R.
- [0004] U.S. Pat. No. 5,215,805 June, 1993 Pavia, Jr.; Alfred
- [0005] U.S. Pat. No. 5,251,416 October, 1993 White; Daniel R.
- [0006] U.S. Pat. No. 5,735,092 April, 1998 Clayton; Thomas M.; Letts; John B.
- [0007] U.S. Pat. No. 5,787,668 August, 1998 Carkner; Philip M.; Corley; Todd L.; Dudley; Hubert T.; Kersey; Timothy L.
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- [0009] U.S. Pat. No. 6,044,604 April, 2000 Clayton; Thomas M.; Letts; John B.
- [0010] U.S. Pat. No. 6,110,846 August, 2000 Brzozowski; Kenneth J.; Chernotowich; Ken
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- [0012] U.S. Pat. No. 6,256,957 July, 2001 Kelly; Thomas L.
- [0013] U.S. Pat. No. 6,398,976 June, 2002 Sandoval; Christopher Paul; Bauer; Mary Margaret Georgene
- [0014] U.S. Pat. No. 6,418,687 July, 2002 Cox; Stanley Alfred

TECHNICAL FIELD

[0015] This invention relates to the art of roofing and wall systems, and more particularly to the application of fireproof, insulation and waterproof three-in-one roof and wall protective system.

BACKGROUND OF THE INVENTION

[0016] Waterproofing has been one of the main concerns and improvement objections in roofing and building development and so inventions have taken place all the time. However, serious problems still remain such as leaking, roofing and other related materials are too heavy, or energy costly, or not environmentally conscious, and or economically costly. Some attempts have been made to solve one or some of these problems. Examples to see are: U.S. Pat. Nos. 4,965,977; 5,215,805; 5,735,092; 6,044,604; 6,177,024; 6,398,976 and 6,418,687.

[0017] U.S. Pat. No. 4,965,977 describes a panelized roof system comprising a foam insulation board with a protective rubber-modified bitumen-saturated synthetic fiber mat

bonded to the foam board using rubber-modified bitumen-saturated synthetic fiber strips applied with hot-mopped asphalt to render waterproof.

[0018] U.S. Pat. No. 5,215,805 describes a construction panel comprising a closed cell, expandable foam material having a first surface with two coatings to enhance fire resistance abrasion resistance and a second surface to connect the panel to underlying structure. This construction panel of cellular structural foam is objected to be a replacement for ceramic and /or cast concrete roofing tiles.

[0019] U.S. Pat. No. 5,251,416 describes an insulated panelized roofing system comprising a foam insulation board with synthetic fiber mat and a rubber sheet bonded to the top surface completed with a plurality of fasteners penetrates the sides of the panels and rendered waterproof by a plurality of synthetic fiber reinforced rubber strips applied with adhesive or adhesive tape to the panels' joints.

[0020] U.S. Pat. No. 6,044,604 describes composite roofing recovery boards having improved dimensional stability and related methods comprising a foam board with a facer reinforced with a group of materials and comprising a sheet consisting of reinforced polymer and cellulosic materials reinforced with a material selected from glass strands, glass fibers and mixtures thereof and gypsum board applied to the opposite major surface of the foam core.

[0021] U.S. Pat. No. 6,398,976 describes a single ply membrane roofing system including a single ply roofing membrane adhered to the major surface of an insulation board coated with a latex coating comprising clay, sodium silicate and latex.

[0022] U.S. Pat. No. 6,418,687 describes an insulated roofing system comprising a closed sell foamed in place insulation applied over the roof deck or existing substrate. The preferred foamed in place insulation is a urethane foam.

[0023] All these above and some others teach use of panelized or closed cell foam board roofing systems.

[0024] All efforts objected to achieve better roofing systems, which can replace the conventional type of roofing systems comprising natural materials, which are less and less in supply and so more and more expensive to afford and, in most cases, cannot or are difficult to survive from weather deteriorations. Improvement and progress have been made to make the roofing systems less expensive but more better in terms of weight, energy saving and life span. However, problems of leaks, environmental worries, limited flexibility and some others still exist and need to be solved. A complete, flexible, environmentally safe, economically inexpensive and fireproof, insulation and waterproofing three-in-one composited roof or wall system is needed.

DISCLOSURE OF THE INVENTION

[0025] In accordance with the present invention, applicant provides a composite fireproof, insulation and waterproof three-in-one roof and wall system for application over a roof or wall substrate comprising a protective surfacing material ToughCover, waterproof material ToughWaterproof, a synthetic fiber mat or any other non-combustible woven reinforcement material, named mesh in this invented system and insulation material expanded polystyrene (EPS) foam insulation board. The flexibility of this system allows the system

applied directly onto a roof or wall surface at a construction site or pre-constructed into boards, shingles, tiles and any other shaped forms and using ToughWaterproof material to adhere them to the existing roof or wall surface at the construction site. The flexibility of this invented system also helps to make a heat resistant roof or wall without using EPS foam board to insulate as the protective cover material ToughCover has the function to prevent not just fire but resist heat or cold as well. Plus, the elongation ability of the waterproofing material ToughWaterproof helps out the system to survive the damages of thermal changes.

#### Four Materials Employed and Their Application Methods

**[0026]** 1. A rubber like fluid named ToughWaterproof, waterproofing membrane material applied as an emulsion product. It is odorless, self-adhesive and brush, spray or roller applied. The characteristics of this coating are environmentally safe, excellent protection to avoid weather damages to the surface membranes, easy to apply using spray, brush or roller at a suitable viscosity and comparatively inexpensive. The cured ToughWaterproof's characteristics typically are: a. elongation 200-800%; b. durometer (Die-C) 20-80; c. non-permeable; and d. self adhering.

**[0027]** 2. A reinforcement medium, constructed of polyester or other type of non-combustible, mold and mildew resistant fibers, which is in woven mesh form and, when it is embedded into a film of elastomeric coating, shall become totally adhered and wrinkle free. This medium is strong enough to hold the lightweight concrete like covering material, ToughCover in place, and it is placed between ToughWaterproof and ToughCover. The mesh plays the role of reinforcement supporting the attachment of ToughCover to ToughWaterproof to make the system strong and long lasting.

**[0028]** 3. ToughCover is the protective surface of the three-in-one composite roof and wall system. It is mainly a composition of cement, clay, perlite, sand, etc. At job or construction sites, ToughCover is mixed with water to make it into paste form, which is sprayed or rolled onto the mesh, which is overlaid on the ToughWaterproof, the waterproofing part of the three-in-one system. This protective surfacing may be applied from one-sixteenth ( $\frac{1}{16}$ th) inch to one (1) inch thick, and it is sufficiently strong to support normal pedestrian traffic. This ToughCover coating resists fire; weather damages including ultraviolet (UV) and ozone degradation, winds' uplift, rain, hail, and other dropped objects' ruin and provides insulation values by resisting heat buildup and/or absorption.

**[0029]** This three-in-one composite system fits both roof and wall systems and both the materials used and the steps involved for using them are the same.

**[0030]** 4. Expanded polystyrene (EPS) foam insulation board is used to insulate this three-in-one roof and wall system, if it is desired for an existing roof or wall, or it is used as the base for pre-constructing said system into tile or shingle and flat or shaped board forms. While EPS foam board is required to be used as the base of the pre-constructed system in shingle, or tile or board forms, it is optional when dealing with flat or slightly sloped roofs or walls when insulation is not needed or wanted. EPS foam board gives the three-in-one roof or wall system a surplus of insulation. The composite roof and wall system is simply done as following:

**[0031]** For the non-sloped flat roof, the EPS foam board is pre-cut precisely according to the slop degree needed to suit water draining needs of the existing roof. Then, the pre-cut EPS foam board is glued on the roof surface using ToughWaterproof as the glue or adhesive material.

**[0032]** When this fourth material-EPS foam board-is used, the water-proofing of this three-in-one roof and wall system takes place after the EPS foam board is placed on the surface of the existing roof or wall, it (ToughWaterproof) is sprayed on or rolled on the surface of the EPS foam board. And, the reinforcement medium material "mesh" is laid on the ToughWaterproof membrane applied over the EPS foam board. The last step is to spray or roll on the protective material ToughCover onto the reinforcement medium material mesh applied on the EPS foam board.

**[0033]** To make this three-in-one composite roof and wall system tiles or shingles or wallboards, the first step is to spray or roll ToughWaterproof onto the pre-cut EPS foam board and place the pre-cut mesh onto the fresh and wet surface of the ToughWaterproof applied on the surface of the EPS foam board. Then, ToughCover pre-mixed paste is brushed or rolled onto the mesh placed on the ToughWaterproof. After the tiles or shingles or the wallboards are made, they can either be dried naturally or put into a pre-heated oven to dry to the cured degree. The ToughWaterproof is used to glue these tiles or shingles or wallboard onto the existing roof, and no nails are needed or allowed.

**[0034]** These tiles or shingles or wallboards are shaped to overlap or interlock with each other and the waterproofing material ToughWaterproof is applied between the EPS foam board as the base and ToughCover as the surface of the tile or shingle or the wallboards. A waterproofing membrane on the surface of the existing roofs or walls is unnecessary, however, as ToughWaterproof material is used to adhere the pre-constructed shingles, tiles, or boards to the existing roof or wall substrate. So, the ToughWaterproof is well rolled or brushed or sprayed onto the existing roof or wall surface to adhere the pre-constructed shingles, or tiles or walls to the existing roof or wall surface; in the meantime it doubles the waterproofing of the roofs or walls.

#### SUMMARY OF THE INVENTION

**[0035]** The object of this invention is to provide a "Composite Roofing and Wall System-Three-in-One—Fireproof, Insulation and Waterproof," which is energy saving, environmentally safe, weather resistant rendered, economically inexpensive with a longer dependable life span.

**[0036]** In this objected fireproof, insulation and waterproof three-in-one composite roofing and wall system, EPS foam insulation board is optional in the case of applying directly onto the existing roof or wall substrate. ToughWaterproof material can be directly applied onto the existing roof or wall substrate reinforced by non-combustible polyester woven mesh and covered by ToughCover, the protective cover material and the objected three-in-one composite roof or wall system is constructed. However, the EPS foam insulation board is recommended to gain energy saving and to help the waterproofing membrane to last longer.

**[0037]** This invented system is also objected to pre-construct a fireproof, insulation and waterproof three-in-one composite system in shingle, tile or panelized board forms,

comprising a pre-cut EPS foam insulation board in the shape and size desired or wanted, ToughWaterproof applied onto the EPS foam board surface to get waterproof membrane done, then the reinforcement medium mesh is laid over onto the ToughWaterproof material; and ToughCover, the protective cover material is applied onto the mesh and the fire-proof, insulation and waterproof three-in-one composite roof or wall system is constructed in shingle, or tile or panelized board forms. And, at the job or construction site, they can be easily adhered to the existing roof or wall substrate using ToughWaterproof as the adhesive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. 1: This system is installed onto the substrate of existing wood, concrete, metal and many other kinds of roofs or walls.

[0039] FIG. 2: This system is installed onto an intermediate rigid foam substrate base surface. The rigid foam is installed onto ToughCover filled metal deck flutes. However, the foam may also be mechanically attached directly to the metal deck. The installed rigid foam insulation becomes the base for receipt of this system.

[0040] FIG. 3: The system is installed onto a previously installed rigid foam insulation base.

[0041] FIG. 4: This system is applied onto single-shaped rigid foam insulation shingle, or tile or flat or shaped board. The completed shingle or tile or board is then installed onto properly sloped roof deck or vertical wall substrates.

[0042] FIG. 5 The system is applied onto shingle-shaped rigid foam insulation shingle. The completed shingle is then installed onto properly sloped roof deck or vertical wall substrates.

What is claimed is:

1. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, comprising an expanded polystyrene foam board adhered onto the existing roof deck or wall by using a tough modified bitumen waterproofing membrane coating as the adhesive to glue onto the existing roof or wall substrate and connected with each other by construction tape, such as butyl tape, or by using the modified bitumen waterproofing membrane coating to seal the seams between the foam boards; the waterproofing membrane is fully brushed, rolled or sprayed over the foam boards with a mesh material placed over said tough waterproof membrane coating for reinforcement; and a composition of cement, clay, perlite, sand, etc. to form a tough cover is placed over the mesh by brushing or rolling or spraying onto said system to protect if from fire, physical and weather damages.

2. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, comprising according to claim 1 wherein said expanded polystyrene foam board must be rigid and non-flammable and is between 2 inches to 8 inches in thickness, placed on the surface of said tough waterproof membrane coating freshly and well brushed or rolled or sprayed onto the surface of the existing roofs or walls as the first waterproofing coating.

3. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, comprising, according to claim 1 wherein said tough waterproofing material is made of modified asphalt emulsion with natural and syn-

thetic resins, applying two to three times onto the roof or wall surface using 0.125 to 0.25 gallon per square yard.

4. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claim 1 wherein said reinforcement medium mesh is woven polyester type of mold and mildew free and non-flammable or non-combustible having a weight between 0.01 to 1 ounces per square yard depending on the needs.

5. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claim 1 wherein said lightweight tough coat comprising cement, clay, silicate (perlite), sand, etc., mixed with water to make it into paste form at job site and having a thickness of said paste between 0.125 inches to 0.75 inches, using said lightweight tough coat mixture between 3 to 10 pounds per square yard and allowing twenty days or so to be fully cured.

6. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claim 1, claim 2, claim 3, claim 4 and claim 5, said tough waterproofing membrane coating having excellent elongation ability and tough cover featuring fire and ultra violet related weather resistance, said foam board insulation being not necessary needed for the flat or inclined roofs or walls.

7. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claims 1 through 5, said system also being pre-constructed into the forms of boards, shingles or tiles.

8. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claim 1, claim 2 and claim 6, said expanded polystyrene foam boards used as the base of said boards, shingles or tiles.

9. A composite roof and wall system, three-in-one: fire-proof, insulation and waterproofing, according to claim 1, claim 3 and claim 7, tough waterproofing coating is applied to the surface of said board by brushing, rolling or spraying onto the surface of said board, playing the waterproofing role of said system.

10. A composite roof and wall system, three-in-one: fireproof, insulation and waterproofing, according to claim 1, claim 4 and claim 8, said mesh material is laid over the surface of the tough waterproof coating when freshly applied.

11. A composite roof and wall system, three-in-one: fireproof, insulation and waterproofing, according to all the above claims, said tough cover, a protective lightweight concrete coating material being brushed, or rolled or sprayed onto said mesh laid over the surface of tough waterproof membrane coating to avoid any physical or weather damages, said system of said boards, shingles and tiles being formed after a natural curing period of 20 days at 10.0 or higher centigrade degrees.

12. A composite roof and wall system, three-in-one: fireproof, insulation and waterproofing, according to claim 11, said system of pre-constructed boards, shingles and tiles laid over the existing roofs or walls, using a tough waterproof membrane coating to adhere and said tough waterproofing coating being well applied onto the surface of the existing roofs or walls to double the waterproofing of said composite roof and wall system, whereby a structure will have strong three-in-one: fireproof, insulation and waterproofing, system.