A roof deck construction involves trays and decking units fabricated from glass-fiber-reinforced gypsum. The decking units preferably are coated with a foamed plastic covering which is in turn factory-coated with at least one ply of roofing felt.

15 Claims, 7 Drawing Figures
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GLASS-FIBER-REINFORCED GYPSUM ROOF DECK

BACKGROUND OF THE INVENTION

1. Field of the Invention
   This invention relates to building components fabricated from glass-fiber-reinforced gypsum and to roof deck constructions utilizing the components.

2. Description of the Prior Art
   Glass-fiber-reinforced gypsum is described in British Pat. No. 1,204,541.

SUMMARY OF THE INVENTION

The object of the invention is to provide a fire resistant roof deck having useful span capabilities, having an aesthetically attractive undersurface which can be employed directly as a ceiling for the subjacent building space, and having inherent installation economies to permit the construction of low cost roof deck.

According to one embodiment of the present invention there is provided a roof-deck structure comprising tray units of glass-fiber-reinforced gypsum, and decking units also of glass-fiber-reinforced gypsum mounted on or against said tray units and secured thereto.

The present invention also provides a decking unit, for use in the construction of a roof deck as above described, comprising an element of glass-fiber-reinforced gypsum, a coating of foamed plastics material over said element and a covering layer of weather resistant plastics material over said foamed plastics layer. There may be a layer of conventional roofing felt or the like weatherproofing material over said covering layer.

Conveniently the glass-fiber-reinforced gypsum (hereinafter sometimes referred to as GRG) is the product described in British Patent specification No. 1,204,541 which contains approximately ten per cent by weight of randomly oriented chopped glass fibers. The remainder of the GRG composition is fully hydrated calcium sulphate, i.e., CaSO$_4$·2H$_2$O, formed by combining the hemihydrate CaSO$_4$·½H$_2$O with sufficient water, e.g., about 18.6 per cent by weight. The composition also may contain other incidental additives for achieving smoothness, whiteness, desired colorings, improved bonds with the glass-fiber-reinforcement, etc. Such additives might include, for example, powdered clay, pigments, dyes, sizes, binders, surfactants, reactive silicone primers or mold release agents.

As described in the aforementioned British Pat. No. 1,204,541, GRG compositions possess useful flexural strength, impact resistance, tensile strength and densities. The materials are suggested in British Patent No. 1,204,541, for "making glass fibre reinforced gypsum plaster boards, mouldings or extrusions for constructional use, for example, in the manufacture of wall, floor, ceiling or roof structures, doors or cabinets. Such articles can be arranged to have good fireproof characteristics and high strength, particularly flexural strength and impact strength."

BRIEF DESCRIPTION OF THE DRAWING(S)

FIG. 1 is a perspective illustration of a tray unit; FIG. 2 is a perspective illustration of a decking unit; FIG. 3 is a fragmentary perspective illustration of a roof deck structure employing the tray units of FIG. 1 and the decking units of FIG. 2; FIG. 4 is a perspective illustration of an alternate embodiment of a roof deck structure employing the tray units of FIG. 1 and the decking units of FIG. 2; FIG. 5 is a cross-sectional illustration showing a preferred side joint connection of the decking units of FIG. 2; FIGS. 6 and 7 are enlarged fragmentary cross-sectional illustrations of the roof deck structures of FIGS. 3 and 4 respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS(S)

Referring to FIG. 1, there is illustrated a typical tray unit 10 which is formed from GRG so as to have a flat base 11, formed vertical side walls 12, and re-entrant flanges 13. The width of the tray unit 10 between the vertical side walls 12 is selected as a convenient construction module, for example, 45 centimeters. The height of the tray unit 10 from the bottom of the base 11 to the top of the re-entrant flange 13 likewise is selected according to the strength requirements of the tray unit 10 and may be about 4 centimeters, although deeper trays of 6 centimeters and more are comprehended. The re-entrant flanges 13 have a width approximately 2.5 centimeters each. The thickness of the tray unit 10 from skin to skin is conveniently carried by two workmen.

Referring to FIG. 2, the decking unit includes a GRG decking unit 14, a factory applied coating 15 of foamed organic resin such as foamed polysiocyanurate or foamed polyurethane, and a covering layer 16 of weather resistant plastics substance such as a urethane elastomer film or PVF or PVC film. Optionally and preferably the covering layer 16 also includes one factory applied layer 29 or conventional roofing felt on top of a suitable weather resistant coating. The GRG decking unit 14 includes a substantially flat web 17 presenting a substantially flat top surface 17a; a central pedestal 18 which is merely a thickened integral region of the unitary GRG decking unit 14; and end connection portions generally designated by the numerals 19, 20. In a preferred embodiment illustrated in FIG. 2, the end connection portion 19 includes, as shown more particularly in FIG. 5, a terminal shoulder 21 extending horizontally from the web 17 and having its upper surface coplanar with the bottom surface of the web 17; a channel 22 having a first side wall 23 connecting its bottom with the web 17; a second side wall 24 connected to the terminal shoulder 21 to provide a groove 25 disposed lengthwise of the GRG decking unit 14 between the terminal shoulder 21 and the web 17. The channel 22 extends below the bottom surface of the terminal shoulder 21.

The corresponding lateral end connection 20 includes a lateral pedestal portion 26 which constitutes a thickened rib integral with the web 17. Extending to the side of the web 17 is a tongue 27 with a terminal depending rib 28. The rib 28 engages the groove 25 whereby the tongue 27 rests upon the terminal shoulder 21. The undersurface of the terminal shoulder 21 is coplanar with the undersurface of the lateral pedestal portion 26 whereby a lateral pedestal can be formed by connecting the lateral end connections 19, 20. The lateral pedestal includes the underside of the terminal shoulder 21 and the underside of the lateral pedestal.
portion 26. The upper surface of the web 17 is essentially flat. Typically the thickness of the web 17 will be 0.5 to 0.6 centimeter, but it may be more or less. The thickness of the central pedestal 18 may be 1.0 to 1.2 centimeter as may the thickness of the lateral pedestal 26. The effective or cover width of the GRG decking unit 14 is twice the width of the tray unit 10 of FIG. 1. Accordingly, if the tray unit 10 of FIG. 1 is, as preferred, about 45 centimeters, then the preferred width of the decking unit 14 of FIG. 2 will be about 90 centimeters.

The GRG decking unit 14 may be formed as a continuous element which is cut into lengths of 4 to 8 meters, which can be conveniently handled by two workmen. The thickness of the organic foamed resin coating 15 is preferably 1.0 to 2.0 centimeters. The width of the central pedestal 18 along its underside about 6 centimeters, i.e., more than the width of two reentrant flanges 13 appearing in FIG. 1.

A preferred embodiment of the roof deck structure is illustrated in FIG. 3 wherein the roof is supported by generally parallel purlins 30. Individual tray units 31a, 31b are installed on the purlins 30 in spaced-apart relation by means of suitable spacing jigs. The tray units 31a, 31b are secured to the purlins 30 by means of suitable fasteners such as explosive-driven pins 32, or screws, extending through the base of the trays 31a, 31b and through a flange of the purlin 30.

A decking unit 34a is applied above the pair of the tray units 31a, 31b. The central pedestal 18 rests upon the reentrant flange 13a of one tray unit, and the terminal shoulder 21a rests upon the reentrant flange 13b of the said tray unit 31a. The channel side wall 24a (see FIG. 5) abuts the inboard edge of the re-entrant flange 13b. The tongue 27c, of the decking unit 34c, rests upon the shoulder 21a of the neighboring decking unit 34a. It will be observed (FIG. 3) that the organic foamed resin coating 15a of the decking unit 34a abuts the corresponding foamed resin coating 15b, 15c, respectively, of the decking units 34b, 34c. Similarly the outer covering layers 16c, 16a, 16b of the decking units 34c, 34a, 34b, respectively, is buttted along joints 35, 36 to form a more or less continuous compliant top surface for the roofing assembly.

The decking units are joined to each other and to the underlying tray units in the manner more clearly illustrated in FIG. 6 wherein a suitable fastener 37 is driven through the tongue 27a, the shoulder 21b and a reentrant flange 13b. The decking unit 34a and the underlying tray unit 31a may be joined by a fastener 38, driven through the central pedestal 18 and through the re-entrant flange 13a. The fasteners 37, 38 may be explosive-driven pins or threaded fasteners or any other suitable fastening devices. A cylindrical core (not shown) may be removed from the covering layer 16 and the organic foamed resin coating 15 to provide access for mounting fasteners 37, 38. The number and spacing of the fasteners 37, 38 will be determined by the spacing between purlins 30 and the anticipated loading of the structure.

Considering the roof structure of FIG. 3 from the underside, it should be apparent that a viewer located in the subjacent building space can observe only the relatively smooth flat undersurface of the base 11 of the tray units 31a, 31b and the relatively smooth undersurface of the decking unit 34a which is located between (for example) the side walls 12a, 12b. Because of the smooth, relatively attractive appearance of GRG materials, no additional finishing is required to complete the ceiling structure. If desired, the undersurface may be painted or otherwise decorated.

The alternative embodiment of a roof structure, shown in FIG. 4, employs abutted ones of the tray units of FIG. 2 as the supporting component of the roof structure in contrast to the spaced-apart tray units presented in FIG. 3. It will be observed that the roofing structure of FIG. 4 differs from the roofing structure of FIG. 3 by the inclusion of additional tray units identified by the numerals 40, 41. The numeral 42 has been assigned to the supporting purlin in FIG. 4. The corresponding joint elements of the roof structure of FIG. 4 are presented in FIG. 7 wherein the side walls 12c of the tray unit 41 abuts the side wall 12a of the tray unit 31a. The re-entrant flanges 13c, 13a have co-planar upper surfaces which engage the undersurface of the central pedestal 18. Suitable fasteners 43 are employed to secure the base 11d of the tray unit 41 to the purlin 42. Suitable fasteners 44 extend through the central pedestal 18 and the re-entrant flange 13e. The fasteners 44 are installed in staggered relation with the fasteners 38 in order to minimize development of localized stresses in the central pedestal 18.

The tray unit 41 has its side wall 12d in abutment with the side wall 12b of the tray unit 31b. A suitable fastener 45 is provided to extend through the lateral pedestal portion 26 and the re-entrant flange 13d. The fasteners 45 are provided in staggered relation with the fasteners 37 to minimize the development of localized stresses in the joint assembly.

Referring to the roof structure of FIGS. 4 and 7, it will be noted that the undersurface as viewed by an observer located in the subjacent building space presents for inspection an essentially flat undersurface consisting of the bottom surfaces of the abutted tray units 31a, 41, 31b.

One of the properties of GRG articles is a sensitivity to moisture. It will be observed that the GRG components of the present roofing structure are disposed in such manner that they are protected from moisture. In the final assembly of a roof, two or more layers of roofing felt will be applied by the building installers over the covering layer 16 of the assembled decking elements.

The present building roof components are delivered to the job site in a ready-to-install condition. The roof is assembled from essentially two components plus fasteners, i.e., the tray unit of FIG. 1 and the decking unit of FIG. 2. Subsequent application of additional plies of roofing felts complete the installation. Because one ply of the roofing felt can be shop installed, less on-site labor is required to complete the roof.

Because the roofing structure consists essentially of non-combustible components, the structure of FIG. 3 will achieve one-half hour fire ratings and the structure of FIG. 4 will easily achieve one hour fire ratings. The present roofing structure is intended to span distances of about 4 meters. By providing somewhat deeper tray units, i.e., deeper than 4 centimeters, spans of up to 7 meters can be readily achieved with an assembly according to the invention. The factory installed organic foam coating 15 provides acoustical and thermal insulation for the resulting roof structure.

I claim:
1. A roof deck structure comprising a plurality of tray units of glass-fiber-reinforced gypsum, and decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto, the decking units each have an effective width twice the width of a tray unit and each comprises a substantially flat web, a central pedestal constituted by a thickened region of said web, and an end connection portion; the connection portion at one end comprising a terminal shoulder extending horizontally from and beneath the flat web, and a channel extending lengthwise of the tray unit between said web and said terminal shoulder; and the connection portion at the other end comprising a thickened rib integral with the web, a tongue extending horizontally from said thickened rib and terminating with a depending rib which engages in a channel of the adjacent deck unit with said tongue resting upon the terminal shoulder of the adjacent deck unit.

2. A roof deck structure comprising a plurality of tray units assembled side by side above roof supporting beams, each such tray unit being fabricated from glass-fiber-reinforced gypsum and including a generally horizontal flat base, generally vertical side walls and horizontal flanges extending inwardly from the tops of the said side walls over the said flat base, and also including a plurality of decking units disposed above the said tray units, each of the said decking units having an effective width which is twice the width of the tray unit and each deck unit comprising a substantially flat web, a central pedestal constituted by a thickened region of the said web, and end connection portions; the end connection portion at one end comprising a terminal shoulder extending horizontally from and beneath the flat web, and a channel extending lengthwise of the tray unit between the said web and the said terminal shoulder; and the end connection portion at the other end comprising a thickened rib integral with the web, a tongue extending horizontally from said thickened rib and terminating with a depending rib which engages in a channel of the adjacent deck unit with the said tongue resting upon the said terminal shoulder of the adjacent deck unit;

fastening means extending between a said horizontal flange and the said central pedestal; and fastening means extending between a said horizontal flange and the said thickened rib.

3. The roof structure of claim 2 wherein the top of each deck unit is coated with a layer of foamed organic plastics and a layer of weather-resistant plastic coating is applied to the top of the said layer of foamed organic plastics.

4. The roof deck structure of claim 3 wherein a layer of roofing felt is applied to the top of the said weather-resistant plastic coating.

5. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, generally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto, said decking units presenting overlapping longitudinal edge portions which overly a longitudinal edge portion of a subjacent tray unit and which are secured thereto.

6. The roof deck structure of claim 5, wherein said tray units have a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base.

7. The roof deck structure of claim 5, wherein said decking units include substantially flat top surfaces, a layer of foamed plastics material covering the top surfaces of the glass-fiber-reinforced gypsum, and a layer of weather-resistant plastics material applied to the top of said layer of foamed plastics material.

8. The roof deck structure of claim 7, wherein the said layer of foamed plastics material is foamed polyisocyanurate.

9. The roof deck structure of claim 5, wherein said preformed decking units each have a longitudinal edge coincident with a longitudinal edge of one tray unit.

10. The roof deck structure of claim 5, wherein said tray units are assembled in side abutted relation.

11. The roof deck structure of claim 5, wherein said tray units are assembled in spaced-apart relation.

12. The roof deck structure of claim 5, wherein said tray units and said decking units are assembled in mutually parallel relation.

13. The roof deck structure of claim 5, wherein the space between said decking units and said tray units remains empty.

14. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, generally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto; said tray units having a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base, said tray units being assembled in spaced-apart relation; and said decking units each including a substantially flat web, and a central pedestal constituted by a thickened region of said web; one horizontal flange of each tray unit being engaged with and secured to the central pedestal of one of said decking units.

15. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, generally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto; said tray units having a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base, said tray units being assembled in side abutted relation; and said decking units each including a substantially flat web, and a central pedestal constituted by a thickened region of said web; adjacent horizontal flanges of certain adjacent side abutted tray units being engaged with and secured to said central pedestal.