SYNTHETIC ROOF COVERING SYSTEMS

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Synthetic steep-slope roof covering systems are an outgrowth of manufacturers' research and development to stay competitive while offering advantages over traditional products. The essence of the synthetic roof systems is to match in general appearance the traditional shingles, shakes, tiles, and slate roof covering systems. The materials used to manufacture the synthetic products include galvanized steel, composites of Portland cement with organic and inorganic fibers, aluminum, copper, wood hardboard, and polymer composites combined with rigid urethane. This paper includes tabular data presenting general information for representative products; it does not include all synthetic roofing products. The paper includes a general description of the products, including the materials, dates the product was first made and first used in the United States, regions where the product has been installed, minimum roof slope requirements, fire and wind ratings, and manufacturers guarantee information. It also includes product size and weight as well as average material costs, and lists some of the advantages, limitations, and installation considerations. The information presented herein can be used as a starting point for anyone contemplating the use of synthetic steep-slope roof coverings.

KEYWORDS

Design, steep-slope roof coverings, synthetic metal systems, synthetic shingles, shakes and slate, synthetic steep-slope roof coverings, synthetic tiles.

INTRODUCTION

In the past, designers of steep-slope roofing have relied on the traditional steep-slope roof coverings which include asphalt shingles, wood shingles and shakes, concrete and clay tile, slate, cement asbestos shingles, corrugated cement asbestos panels, and metal panel roof systems. Over the past decade, however, new products have been introduced into the market as alternatives for the traditional steep-slope roof coverings. This paper reviews a number of these alternative coverings.

The demand for synthetic coverings has been stimulated by various factors. The major factors are described below:

- Cost is the major factor to stay competitive in the steep-slope roofing market. Synthetic coverings are the result of manufacturers' research and development to introduce new technology while still being cost competitive relative to traditional steep-slope roofing products.
- Asbestos roofing products are no longer used in the United States. This has eliminated cement asbestos shingles and corrugated cement asbestos panels.
- Weight is especially important in reroofing environments where the structural capacity of the existing framing precludes the use of slate, clay or concrete tile.
- Performance attributes are also an important consideration in the development of alternative roof coverings. For example, many coverings are marketed as providing the look of wood shingles and shakes without the combustibility of wood products which have not been treated with fire retardant. Also, the homogenous nature of many synthetic roof coverings decreases the likelihood of irregularities in the product.

The purpose of this paper is to inform the reader of some of the synthetic roof coverings available, but it is not intended to be an all inclusive survey of products. This paper is not intended to persuade designers to use or not to use any of these coverings. As always, the designer of record (whether he is an owner, architect, engineer, roofing consultant, or contractor) has the responsibility for selection of the appropriate covering. Each project should be addressed separately to evaluate the benefits and risks of using any traditional or synthetic roof covering. The selected covering should provide the end user with the most feasible roof covering at a reasonable cost for the conditions and constraints specific to the project.

The tables included contain a substantial quantity of data. These data were obtained by reviewing manufacturer's published information, interviewing manufacturers by telephone to obtain additional information, and on-site observations by the authors and their staff. Where N/A appears in the tables, the information was not available from the manufacturer at the time of this paper.

DATA TABLES

Table 1 gives a general description of the synthetic steep-slope roof covering products considered in this paper, including the material, coating, dates the product was first made and first used in the United States, regions where the product has been installed, minimum roof slope requirements, fire and wind ratings, and manufacturer's guarantee information. It also includes product size and weight as well as average material costs.

Table 2 contains a summary of some of the advantages and limitations of the products and some comments regarding installation. The advantages and limitations of the products were those expressed by manufacturer's representatives and/or listed in manufacturer's data. Wherever possible the authors attempted to compare similar advantages and limitations; however, some manufacturer's representatives expressed advantages that could not be directly compared to some of the other products.

DESIGN CONSIDERATIONS

The designer of steep-slope roof coverings for new roofs or for reroofing must review each project for its own particular requirements, and select a system for use based on the project needs, including aesthetics, performance, and cost. Consideration of fire requirements should be a standard part of the roof system evaluation and selection process. Recent experience with fires, such as the Oakland Hills Fire, Oakland, Calif., in 1991, has led many building departments to require Class A fire ratings for roofing systems. Almost all of the synthetic roof coverings included can be constructed in a manner to have a Class A fire rating which makes them acceptable in most jurisdictions, and it gives them a competitive edge over traditional systems that do not have this rating. To obtain a Class A rating some synthetics have limitations of slope and underlayment requirements. The designer should verify that the roof system he selects has the desired rating for the specific project.

In addition to fire resistance, consideration of wind resistance is important in the design process. Some manufacturers have had their products tested by Underwriters Laboratories (UL), and achieved either UL60 or UL90 wind uplift ratings, as shown in the tables. Other manufacturers state wind restrictions for their products or systems in their published literature and ICBO reports. For example, some manufacturers state their product should not be used above a height of 40 feet for basic wind speeds over 80 mph within Exposure B as defined by the Uniform Building Code (UBC). The recent substantial hurricanes the country has experienced (including Hugo, Andrew, and Iniki), have focused attention on how roofs behave under wind loading and illustrate the need for improved performance of synthetic roof coverings. An owner should not expect a roof to survive a direct hurricane strike without some damage; however, unless winds are significantly higher than the code specified wind speeds, an owner should expect only minor damage.

Most of the synthetic roof coverings are made from aluminum, galvanized or Galvalume (aluminum zinc alloy-coated) steel, or fiber/cement composites, with integral or surface applied color. Both organic and inorganic fibers are used in a Portland cement matrix with other additives in the fiber/cement composites. According to the statements made by the manufacturers, none of the current fiber/cement products contain asbestos. In addition, there is a product made from polymer composites with a rigid urethane foam core and a product made of wood fibers.

Although field performance information for some of the synthetic products is limited, it has revealed some areas of concern. The authors have received reports of:

- cracking, surface crazing, fading, and light chalking in some fiber cement products;
- dimensional instability (e.g., swelling, warping, and curling) in products containing organic fibers; and
- poor adhesion to some synthetic product surfaces using conventional sealants and mastics at flashings.

These reports show the need for the designer to carefully research the specific products under consideration for use, and to evaluate any field performance information that is available.

Guarantees have long been offered in the roofing industry; guarantees for synthetic roof coverings range from 20 to 50 years. Guarantees are only as strong as the company who issues them, and, in the authors' experience, guarantees are no substitute for quality products that have history of successful performance. There are test methods that accelerate weathering and test other performance attributes which assist in predicting long-term performance of new products. However, there are no tests to replace a history of proven field performance. The owner should be cognizant of the risk associated with using an unproven system, even if the system is guaranteed.

The costs contained in the tables are average costs supplied to the authors by the manufacturers or California roofing supply distributors in November 1992. Costs vary from location to location throughout the country, and the costs contained herein should be used for general comparison only. The designer should obtain local prices prior to final product selection.

SYNTHETIC SHINGLES, SHAKES, AND SLATES

Asphalt shingles and wood shingles and shakes have been standards in steep-slope roofing for many years. In some parts of the country, slate is also commonly used. Asphalt shingles are traditionally the lowest initial cost steep-slope roof coverings. Laminated asphalt shingle systems have been developed to give greater dimensional relief to simulate a wood shingle or shake appearance, but the authors still consider these to be traditional asphalt shingle systems. The authors are not aware of any synthetic systems that have been developed to simulate asphalt shingles.

Many synthetic systems have been developed as alternative systems for traditional wood shingles and shakes, and also slate. These systems are made of aluminum, galvanized or Galvalume steel, fiber/cement composites, polymeric composites, or hardboard. The hardboard product is made to simulate wood shingles. Some, but not all, of these products are installed using the same techniques as the traditional materials (e.g., interlayment for shake installation).

SYNTHETIC METAL SYSTEMS

Sheet metal roofing systems with standing seams, battens, corrugations, and other configurations are also popular traditional systems. While many new proprietary sheet metal systems have come into the marketplace in recent years, they are not treated in this paper because they are considered to be an adjustment of traditional technology rather than synthetic systems. Two synthetic systems which are marketed to give the look of copper roofing are included in this paper. One is a metal shingle made from sheet copper and the other is a copper foil faced asphalt shingle. The copper shingles are installed similar to the other metal shingle systems, and the copper faced asphalt shingles are installed similar to conventional asphalt shingles.

SYNTHETIC TILE SYSTEMS

Synthetic tiles are made from most of the same materials as synthetic shingles, shakes, and slate. Some concrete tile manufacturers make tile with concrete made with light-

weight aggregate and inorganic fibers; generally, lightweight tile was not included in this paper because it is merely a lightweight version of the traditional concrete tile system and not a synthetic system. Included is one lightweight concrete tile for the purpose of providing a comparison to the other systems included.

Most synthetic tile systems are manufactured in larger modules/panels simulating many tiles rather than individual tiles as traditional systems. This allows for fewer pieces to handle on the roof, and faster, more efficient installation. Colors for these systems simulate conventional tiles, but there are many more colors available in the synthetic versions than in the traditional versions.

SPECIFIC SYSTEMS

The materials contained in the tables are briefly described below. Refer to the tables for more specific data.

Metal Products

Metal products are made to simulate wood shingles, shakes, and concrete or clay tile. These products are die-stamped from sheet aluminum or steel (galvanized or Galvalume). Some products have a painted exposed surface and other products are coated with acrylic resins and stone granules. (See Photos 1-6.)

In addition, two products are included that simulate copper roofs by forming a patina as they weather. These products are installed in a non-traditional manner for copper roofs; therefore, they are included as synthetic steep roof covering systems. One product is a metal shingle die-stamped from copper and is installed in the same manner as the other die-stamped shingle products. The other product is an asphalt shingle composite that is surfaced with a thin copper sheet; this material is installed similar to asphalt shingles.

Fiber Cement Products

These products are made to simulate wood shakes, tile, or slate. Some products are made of Portland cement and wood fiber, others are made of Portland cement and inorganic fibers. (See Photos 7-9.)

Wood Fiber Product

This product is made to simulate wood shingles. It is made from wood fiber hardboard that has the exposed surface shaped to give the appearance of shingles. (See Photo 10.)

Polymer Composite Product

The product in this category is made to simulate wood shakes or slate. It is made from a polymeric composite over a rigid polyurethane foam core. (See Photo 11.)

SUMMARY

This paper presents some of the synthetic steep-slope roof coverings that are currently on the market. Comparative data are presented for the reader to evaluate. Where do all these data lead us? Synthetic roof coverings will not replace their traditional counterparts; however, at least some of these synthetic systems will be around for some time. The included information is a starting point for understanding the various products available. The designer of synthetic steep-slope roof coverings must consider all relevant information to select the most appropriate system for the constraints of the project. There is a need for improved test methods for service life assessment, as well as development of ASTM standards for synthetic roofing products.

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Product Identifier	Product Simulates	Coating	Material	First Made	First U.S. Use	Regions	Min. Pitch	Panel Size	Weight lb/sq.	Material Cost/sq.	Fire Rating	Wind Uplift	Guarantee
Metal Product A1	Wood shakes	Acrylic top coat	Aluminum	1972	1972	National, Major market: CA, TX, FL	3:12 non-snow area; 4:12 snow area	12 in. x 48 in.	50	$140	Class A	80 mph	Lifetime
Metal Product A2	Wood shakes	Acrylic top coat	Aluminum	1990	1990	National	2:12 non-snow area; 3:12 snow area	9 in. x 50 in.	35	$120	Class A	80 mph	Lifetime
Metal Product B	Mission tile	Kynar 500 finish	Galvanized steel, 24 gauge	1984	1984	Northeast U.S. South - 1987	2.5:12	21 in. x 13 ft.-10 in.	140	$200	Class A	UL 90	20 year
Metal Product C1	Wood shingle	Kynar 500 finish	Galvanized steel, 24 gauge	Approx. 1972	Approx. 1972	National	6:12	12 in. x 24 in. exposure	155	$200	Class A	N/A	20 year
Metal Product C2	Wood shingle	Kynar 500 finish	Glavanized steel, 24 gauge	Approx. 1972	Approx. 1972	National	6:12	10 in. x 60 in. exposure	135	$200	Class A	In-house test UL 60 equiv.	20 year
Metal Product C3	Mission tile	Kynar 500 finish	Galvanized steel, 24 gauge	Approx. 1972	Approx. 1972	National	6:12	40 ft. maximum	256	$180	Class A	70-90 mph[3]	20 year
Metal Product C4	Victorian style metal roof	Kynar 500 finish	Galvanized steel, 26 gauge	Approx. 1972	Approx. 1972	National	6:12	8¾ in. x 12½ in. exposure	150	$200	Class A	N/A	20 year
Metal Product C5	Copper roof	Roll copper	16 oz.	Approx. 1972	Approx. 1972	National	6:12	12 in. x 24 in. exposure	150	$600	Class A	N/A	20 year
Metal Product D	Mission tile	Acrylic coat with stone granules	Galvanized steel, 26 gauge	1955 New Zealand	1972	CA, TX, FL	2.5:12	16 in. x 52 in.	150	$140	Class A	120 mph	50 year
Metal Product E	Mission tile	Acrylic resin, stone granules	Galvalume steel, 28 gauge	1982-84 Imported from Canada	1992	Canada West Coast U.S.	3.5:12	16 in. x 48 in.	130	$150	Class A	80 mph	50 year
Metal Product F	Mission tile	Acrylic resin, granules	Galvalume steel, 26 gauge	New Zealand	1961 Imported	Worldwide No. CA	2.5:12	16 in. x 46 in.	140	$130-$150	Class A	80 mph	50 year
Metal Product G	Mission tile	Fluorocarbon paint	Galvanized steel, 26 gauge	Sweden	1982	National, Major Market: AK, HI	3:12	42 in. wide 3 ft. to 16 ft. lengths	100	$120	Class A	80 mph	20 year
Metal Product H	Copper roof	Copper	Copper & asphalt composite	1982 Imported from Italy	1988	National	3:12	13 in. x 39 in.	240	$275	Class A	60 mph	30 year
Fiber Cement Product I1	Wood shingle	Integral color and UV resistant coating	Portland cement, wood fiber	1984	1984	National, Major Market: CA, CO, HI, Pacific Rim	4:12	14 in. x 15 in.	450	$132	Class A	80 mph	50 year
Fiber Cement Product I2	Wood shakes	Integral color and UV resistant coating	Portland cement, wood fiber	1990	1990	National, Major Market: CA, CO, HI, Japan, Canada	3:12	12, 7, 5 in. wide, 22½ in. long	580	$175	Class A	80 mph	50 year
Fiber Cement Product J	Wood shakes	Integral color	Portland cement, perlite, iron oxides, polyester fiber	1972	1972	Coast to coast in Sunbelt, HI	3:12	12 in. x 22 in.	560	$184	Class A	80 mph	50 year

1 = 2 inch head lap 2 = 3 inch head lap 3 = Wind uplift depends on span N/A = Not Available

***Table 1** Comparison of synthetic steep roofing system products (Part 1).*

Product Identifier	Product Simulates	Coating	Material	First Made	First U.S. Use	Regions	Min. Pitch	Panel Size	Weight lb/sq.	Material Cost/sq.	Fire Rating	Wind Uplift	Guarantee
Fiber Cement Product K	Mission tile	Integral color or cementitious coating	Portland cement, inorganic fibers	1991	1991	CA, NV, NM, AZ	3:12	13 in. x 16½ in.	780	$106/$103	Class A	80 mph	50 year
Fiber Cement Product L	Slate	Integral color and coating	Portland cement, cellulose fibers	1905 Imported from Belgium	1972	National Worldwide	3:12	11 in. x 16 in., 12 in. x 24 in.	398[1]	$225-$230	Class A	80 mph	50 year
Fiber Cement Product M1	Slate	Polyacrylic surface coat	Portland cement, organic fibers	1986	1986	National	4:12	16 in. x 20 in.	382[1]	$160-$210	Class A	UL 60	50 year
Fiber Cement Product M2	Wood shingle	Polyacrylic surface coat	Portland cement, organic fiber	1986	1986	National	4:12	23 in. x 15 in.	422[2]	$160-$210	Class A	UL 60	50 year
Fiber Cement Product M3	Slate	Polyacrylic surface coat	Portland cement, organic fiber	1986	1986	National	4:12	12 in. x 18 in.	387[1]	$160-$210	Class A	UL 60	50 year
Fiber Cement Product N	Wood shingle	Color-impregnated surface	Portland cement, sand, cellulose fiber	1907 Australia	1975	West Coast & Sunbelt	4:12	6, 8, & 12 in. x 22 in.	400	$155	Class A	75 psf uplift	50 year
Fiber Cement Product O	Mission tile	Integral color	Portland cement, cellulose fiber, silica	1986 Imported from Mexico	1986	Southwest and Southeast	3:12	24 in. x 37 in.	400	$125	Class B	80 mph	30 year
Fiber Cement Product P1	Slate	Integral color	Portland cement, non-asbestos fiber	1976 1989	1976	National	3:12	9 in. x 16 in.	500	$205	Class A	N/A	40 year
Fiber Cement Product P2	Slate	Integral color	Portland cement, non-asbestos fiber	1990	1990	National	3:12	12 in. x 23 in.	390	$256	Class A	N/A	40 year
Fiber Cement Product P3	Wood shakes	Integral color	Portland cement, non-asbestos fiber	1976 1989	1976	National	3:12	9 in. x 16 in.	500	$205	Class A	N/A	40 year
Fiber Cement Product P4	Wood shingle	Integral color	Portland cement, non-asbestos fiber	1956 1989	1956	National	3:12	12 in. x 24 in.	278	$108	Class B	N/A	40 year
Fiber Cement Product P5	Wood shingle	Integral color	Portland cement, non-asbestos fiber	1976 1989	1976	National	3:12	16 in. x 16 in.	290	$121	Class B	N/A	40 year
Fiber Cement Product P6	Wood siding	Integral color	Portland cement, non-asbestos fiber	1952 1989	1952	National	3:12	14 in. x 30 in.	365	$134	Class A	N/A	40 year
Wood Fiber Product Q	Wood shingle	No finish	Hardboard wood fiber, lignin	1981	1981	National Worldwide	4:12	12 in. x 48 in.	238	$72-$75	Non-rated	66 psf uplift	25 year
Polymer Composite Product R	Wood shingle	Elastomeric	Polymer composite rigid foam & urethane	1991	1991	So. CA	4:12	13 in. x 15 in.	110	$190	Class A	80 mph	Lifetime

1 = 2 inch head lap 2 = 3 inch head lap 3 = Wind uplift depends on span N/A = Not Available

***Table 1** Comparison of synthetic steep roofing system products (Part 2).*

Identifier & Product	Advantages	Limitations	Installation
Metal Products A1 and A2	ICBO report 3147: ■ Unique 4-way lock system to resist wind blow-off. ■ Reflective material helps cooling in summer. ■ Can be used on side walls, mansards, or roofs. ■ Can be installed over existing wood shakes or shingle roof. ■ Non-combustible.	■ Metal roofs are known for noise during rain. ■ 40 ft. height limitation. ■ Aluminum cannot contact dissimilar metals, concrete, cement plaster, asbestos siding, or masonry. ■ Most products are walkable.	For Class A Roof: ½ inch thick Type X gypsum wallboard over solid sheathing. One layer of No. 30 organic felt underlayment. Each roof panel is fastened with at least three screw shank aluminum nails, one at each end and one in the center.
Metal Product B	ICBO report 4623: ■ Integral purlin gives structural strength to roof. ■ Can be installed over open framing with no underlayment.[1]	■ Finish reported to fade and chalk after 20 years.	Tile panels can be installed over open framing with no underlayment required. Reroofing—Panels can be installed over old roof.
Metal Products C1, C2, C3, C4, and C5	■ Hidden fasteners. ■ Reflects heat—energy efficient. ■ 4-way lock system.	■ No ICBO report.	Rustic shingles require solid sheathing. Bermuda shingles can be installed on open spans with snap-lock purlin.
Metal Product D	ICBO report 3409: ■ No underlayment required.[1]	■ 40 ft. height limitation. ■ Proprietary installation.	For Class A Roof: New construction is Class A. For reroofing see ICBO report.
Metal Product E	ICBO report 4970: ■ Works in extreme weather conditions. ■ Durable. ■ Corrosion resistant. ■ Over-lap installation eliminates expansion and contraction problems. ■ Can be installed over existing roofs. ■ Reflective material reduces energy costs.	■ 40 ft. height limitation. ■ No ICBO report. ■ Must walk on bottom supports.	No installation information provided by manufacturer.
Metal Product F	■ Install over existing roofing. ■ Interlocking panel system.	■ Requires a specialty roofer with sheet metal experience. ■ Installed from the top down. ■ 40 ft. height limitation.	For Class A Roof: Solid sheathing with ½ inch UL class WR-C[3] gypsum board overlay, one layer of No. 15 organic felt underlayment and 2x2 batten strips.
Metal Product G	ICBO report 3996: ■ Can be installed over existing roofing. ■ Special fastener requirements at perimeter.	■ 40 ft. height limitation.	For Class A Roof: ½ inch[2] exterior grade plywood sheathing. Plywood deck joints must be filled with asphalt emulsion and blocked with a 9 inch strip of No. 45 fiberglass felt. Underlayment is one layer of No. 45 fiberglass felt with a 2 inch head lap. Panels are installed with steel screw fasteners into wood battens or 22 gauge hat sections.

1. The authors do not recommend installation without underlayment.
2. Roofing products manufacturers recommended plywood thicknesses that are shown in the table. Typically, ½ inch and ⅝ inch thick plywood have been replaced by $^{15}/_{32}$ inch and $^{19}/_{32}$ inch thick material respectively. The user should contact the roofing product manufacturer regarding the acceptability of the thinner materials.
3. Water resistant, Fire Code C panels.

Table 2 *Advantages and limitations of synthetic steep roofing products (Part 1).*

Identifier & Product	Advantages	Limitations	Installation
Metal Product H	■ Resists mold and mildew. ■ Develops green patina from 6 months to 3 years.	■ No ICBO report.	For Class A Roof ½inch[2] plywood sheathing with No. 30 organic felt underlayment.
Fiber Cement products I1 and I2	ICBO report 4312: ■ Resists rot, fungus, and insects. ■ Walkable, impact resistant. ■ Cuts easily with a saw. ■ Custom coating available for special color requirements. ■ Can be used over existing roof if relatively smooth and uniform, such as asphalt composition or wood shingles. Existing framing must support increased load.	■ 40 ft. height limitation.	For Class A Roof: Solid sheathing with one layer of No. 30 felt underlayment and one ply of No. 72 mineral surfaced fiberglass cap sheet.
Fiber Cement Product J	■ Is walkable can support normal foot traffic. ■ Can be installed over composition or wood shingles. ■ Hip and ridge tile have wire mesh reinforcing. ■ Can be installed with pneumatic nails or staples.	■ Not recommended for location with freeze/thaw cycles. ■ Cannot be installed over wood shakes. ■ 40 ft. height limitation.	For Class A Roof: Solid or spaced sheathing and one layer of No. 30 organic felt interlayment.
Fiber Cement Product K	ICBO report 2093: ■ Interlocking ribs that restrict lateral movement and provide water stop. ■ Walkable. ■ Can be used over existing roofing if wood shingles (Not Class A rated).	■ Special instructions for freeze/thaw conditions and snow areas. ■ 40 ft. height limitation.	For Class A Roof: Over solid sheathing underlayment is one layer No. 30 organic felt with two inch head lap, six inch side lap. One nail per tile is used as a minimum.
Fiber Cement Product L	■ Low water absorption. ■ Can withstand freeze/thaw conditions. ■ Storm anchor system available. ■ Resists rot, fungus, and insects. ■ Pre-drilled holes.	■ 40 ft. height limitation. Under exposure B. ■ Cannot be used over existing roofing. ■ Must be used over solid sheathing.	For Class A Roof: ⅝ inch[2] thick plywood sheathing, two layers of No. 15 organic felt underlayment.
Fiber Cement Products M1, M2, and M3	■ Freeze/thaw resistance. ■ Pest resistance. ■ Pre-drilled holes. ■ Custom colors available.	■ ICBO report to be issued in 3 to 4 months. ■ Cannot be installed over existing roofing.	For Class A Roof: ½
Fiber Cement Product N	CABO report NER 406: ■ Walkable. ■ May be installed over existing shingles.	■ No freeze/thaw resistance. ■ Only nail fasteners allowed.	For Class A Roof: Solid ½ inch ACX plywood with No. 30 organic felt underlayment. Solid sheathing or spaced sheathing with No. 40 fiberglass felt underlayment and No. 30 organic felt interlayment.

1. The authors do not recommend installation without underlayment.
2. Roofing products manufacturers recommended plywood thicknesses that are shown in the table. Typically, ½ inch and ⅝ inch thick plywood have been replaced by $^{15}/_{32}$ inch and $^{19}/_{32}$ inch thick material respectively. The user should contact the roofing product manufacturer regarding the acceptability of the thinner materials.
3. Water resistant. Fire Code C panels.

***Table 2** Advantages and limitations of synthetic steep roofing products (Part 2).*

Identifier & Product	Advantages	Limitations	Installation
Fiber Cement Product O	ICBO report 3682: ■ Walkable. ■ May be installed over existing roofing.	■ 40 ft. height limitation. Under exposure B	For Class A Roof: No. 72 or No. 90 mineral surfaced cap sheet over solid sheathing.
Fiber Cement Products P1, P2, P3, P4, and P5	■ Seven styles of slate and shingles. ■ Withstands freeze/thaw conditions. ■ Rot resistant. ■ Storm anchors available.	■ Not recommended for installation over roof insulation.	Class A Roof: Solid sheathing with two layers No. 15 organic felt underlayment.
Wood Fiber Product Q	■ Walkable.	■ Material does not currently have a fire rating.	
Polymer Composite Product R	ICBO report 4978: ■ 4-way interlock system.	■ 40 ft. height limitation.	For Class A Roof: Solid sheathing substrate with No. 30 organic felt underlayment.

1. The authors do not recommend installation without underlayment.
2. Roofing products manufacturers recommended plywood thicknesses that are shown in the table. Typically, ½ inch and ⅝ inch thick plywood have been replaced by 15/32 inch and 19/32 inch thick material respectively. The user should contact the roofing product manufacturer regarding the acceptability of the thinner materials.
3. Water resistant, Fire Code C panels.

Table 2 *Advantages and limitations of synthetic steep roofing products (Part 3).*

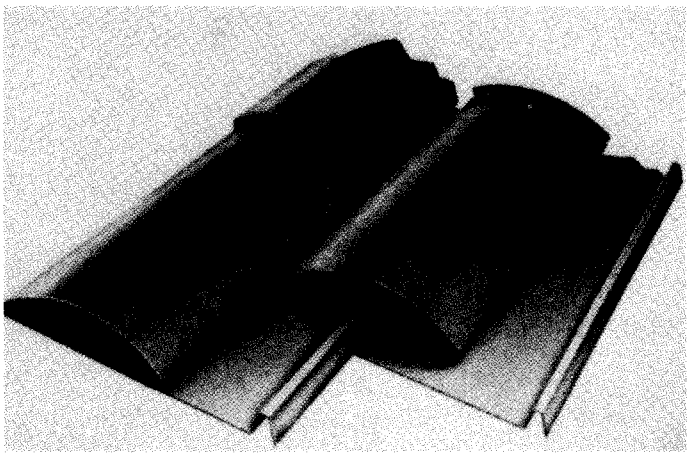

Photo 1 *Metal simulating clay or concrete tile.*

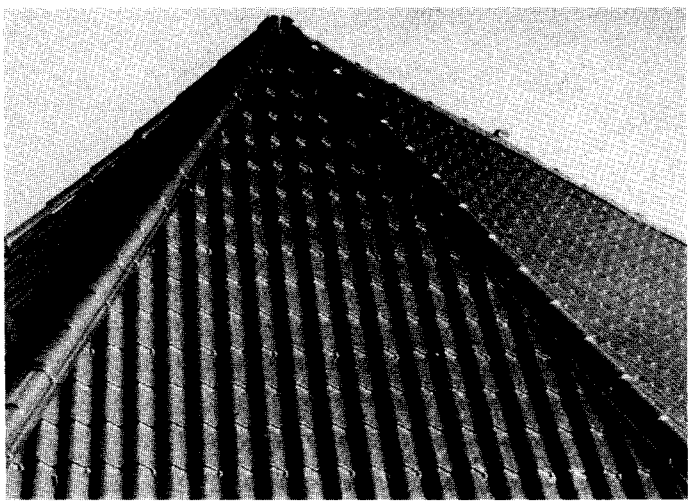

Photo 2 *Metal simulating clay or concrete tile.*

Photo 3 *Metal simulating tile.*

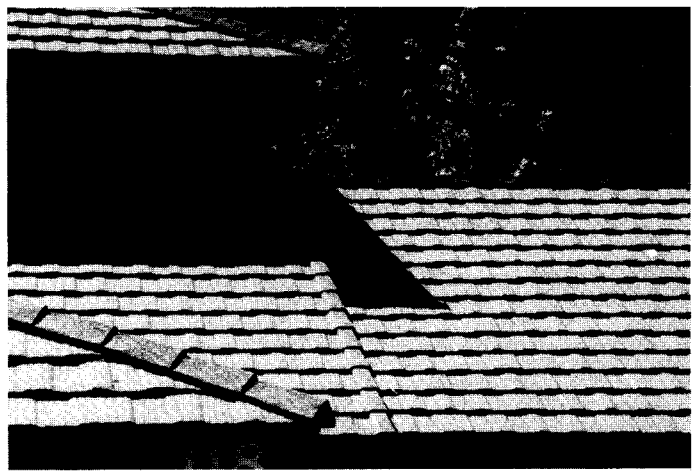

Photo 4 *Metal simulating wood shakes.*

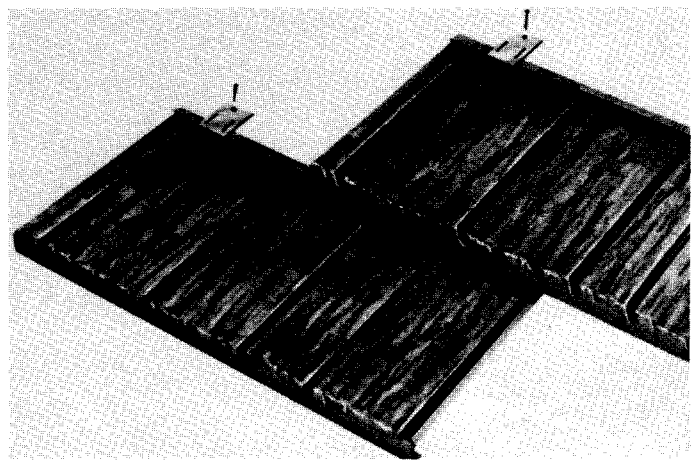

Photo 5 *Metal simulating wood shakes.*

Photo 6 *Metal shingle simulating Victorian-style metal roof.*

Photo 7 *Fiber cement simulating clay or concrete tile.*

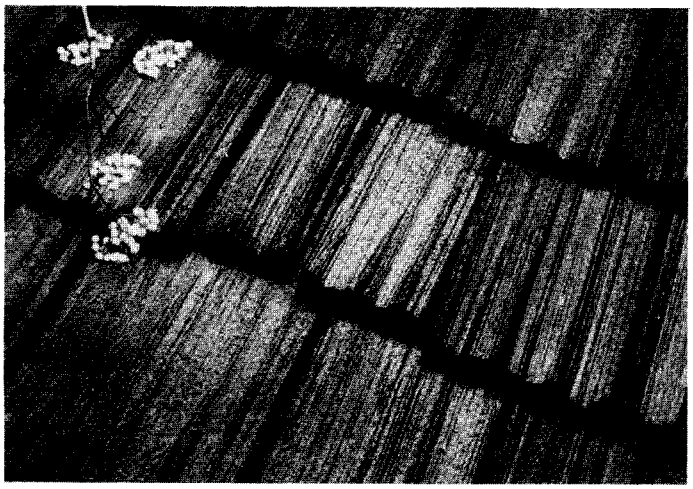

Photo 8 *Fiber cement simulating wood shakes.*

Photo 9 *Fiber cement simulating slate.*

Photo 10 *Wood fiber simulating wood shingles.*

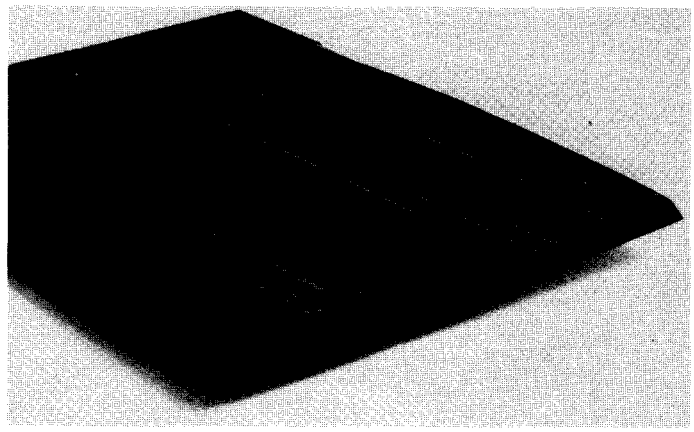

Photo 11 *Polymer composite simulating wood shakes.*