

Sustainability Improvement Opportunities-Implementation Report

Recent governmental publications require army installations to comply with more stringent environmental regulations. These publications include EO 13101 “Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition”, ETL 1110-3-491 “Sustainable Design for Military Facilities”, and EO 13101 “Buy Recycled”. The purpose of this project was to identify and implement viable sustainability improvement opportunities (SIOs) specifically for the Fort Stewart installation. To this end, a broad search was performed to identify potential SIOs. The most viable options were listed below.

1. Recycled plastic: lumber, roofing, rail road ties
2. Structural insulated sandwich panels
3. ”Green” concrete
4. Insulating additives for paint
5. Soy based polymer resins
6. Synthetic wood (using biofibers)
7. Plant fiber reinforcing for composites and concrete
8. Recycled Carpeting / Spray polymer carpeting
9. RASTRA
10. Basalt fiber reinforcement for composites
11. Barnacle cement and glue

After discussions with Ft. Stewart personnel, it was decided to focus efforts on determining the viability of recycled plastic roofing materials. Ft. Stewart has many older bricks buildings that require authentic shake or slate type roofing, and the commercially available recycled plastic roofing materials were an excellent substitute in terms of cosmetics and functionality. After initial market research, five viable products were identified. These five vendors were solicited for more information via an official mail request (Appendix 1). Of the letters sent, three vendors replied with extensive product literature, cost information, independent laboratory testing results, and sample product. The information from each vendor was consolidated and the highlights recorded in spreadsheet form (Appendix 2). This information was shared with our contact at Ft. Stewart, and it was decided that the Eco-shake product would most closely match the architectural design of the selected building and provide excellent protection against the elements based on independent laboratory testing (Appendix 3). A picture of the Eco-shake product sample is shown in Figure 1.

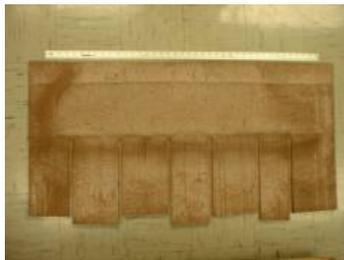


Figure 1-Sample Eco-shake Product

Further communication with the manufacturer of this product, Re-Nu Wood Inc., provided a list of the homes in the United States that have had the Eco-shake product in service for the longest period of time. CERL roofing expert, Dave Bailey, arranged a visit to inspect a roof in Huntsville, AL to determine the field durability of Eco-shake roofing in an environment similar to that of Ft. Stewart. He found the roof to be in good condition after 5 years of service with only slight discoloration of the shakes due to solar radiation. A picture of the roof is shown below in Figure 2. A copy of Dave Bailey's trip report can be found in Appendix 4.



Figure 2-Photo of Roof in Huntsville, AL with Eco-shake Product after 5 Years of Service

Having passed all initial testing, the Eco-shake product was chosen as the material to be implemented at Ft. Stewart. A sufficient quantity of shakes, ridge tiles, and sealing material was purchased and shipped to Ft. Stewart. See Appendix 5 for a copy of the purchase order. Sufficient funds were subsequently provided to Ft. Stewart via MIPR for the purpose of installation of Eco-shake roofing materials.

Technical Information

The Eco-shake product is manufactured entirely of recycled materials: 50% recycled wood and 50% recycled vinyl. The material is also doped with flame-retardants and UV inhibitors. The product has received a class "A" fire rating and class 4 impact resistance according to Underwriter's Laboratory testing results. The following ASTM standard tests have also been performed on the product: ASTM D3161 "Wind Resistance of Shingles" and ASTM G53 "Standard Practice for Operating Light and Water Exposure of Non-Metallic Materials." The Eco-shakes prevented water intrusion for wind speeds up to 110 mph and showed no visible cracking or deterioration after 5000 hours of UV/condensation exposure. Also tested according to ICBO AC07-4.8 "Temperature Cycling Test." Temperature cycles were set at 6 hours at -40°F , 2 hours at 70°F , and 14 hours at 180°F . After 25 cycles, samples showed no evidence of surface degradation

under 5X magnification. As stated previously copies, of testing results are shown in Appendix 3.

The Eco-shakes carry a 50-year limited warranty that covers defects in workmanship, termite damage, and shake rot or water intrusion due to decomposition of shake. The field shakes cost \$175/square, and the ridge shakes cost \$25/10 ft. bundle. The upfront cost of these materials are 2-3 times the cost of standard asphalt shingles that have a lifetime of 20-30 year, but are only slightly more expensive than traditional wood shingles that have a lifetime of only 20-25 years. With this information, it seems that the total material cost of the eco-shakes is much less than that for traditional wood shakes, but slightly more expensive than the product cost of asphalt shingles assuming two product lifetimes of asphalt and wood shingles compared with only 1 of the eco-shakes. Adding on the extra labor and opportunity costs associated with replacing the first set of asphalt shingles at the end of their useful life makes the total life cycle cost of asphalt shingles comparable to that of the Eco-shakes. Considering the added benefits of 100% recycled materials and improved aesthetics over asphalt shingles, the Eco-shakes are economically viable alternatives to traditional roofing materials.

APPENDIX 1

April 23, 2001

Welsh Mountain Slate, Inc.
PO Box 11, Station "B"
Ottawa, Ontario, Canada K1P 6C3

Dear Sir or Madam:

Over the last few years, interest has increased regarding the incorporation of sustainability based concepts and products at military installations and elsewhere throughout the United States Federal sector. Examples of policy directives along these lines are Executive Orders 13101 "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition" and 13123 "Greening the Government Through Efficient Energy Management" as well as the Engineer Technical Letter 1110-3-491 "Sustainable Design for Military Facilities."

Within the U.S. Army Corps of Engineers research laboratory command, collectively known as the Engineer Research and Development Center, there are eight separate laboratories each focusing on different technical areas. The Construction Engineering Research Laboratory (CERL), located in Champaign, IL, is concerned mainly with infrastructure and installation issues. As a Principal Investigator at CERL with experience in recycled-plastic lumber products, I would like to request information about your roofing products that contain at least some portion of recycled materials. Any information would be appreciated, but technical details and independent test reports, preferably in accordance to national standards, pertaining to the following are of greatest interest:

1. Specific type or types of recycled materials used (non-proprietary information),
2. Percent or relative quantity of recycled content of the finished, as delivered product,
3. Test results of long-term (or accelerated) weather exposure and other performance tests that might be indicative of long-term performance,
4. Some locations and/or case studies where your roofing product has been in service for a significant amount of time, in a variety of climates, and, in particular, where an inspection visit might potentially be arranged at a later date,
5. The materials cost of your product, as delivered, and, as installed,
6. Recommended installation procedures,
7. A non-binding, representative and detailed cost breakdown for roofing a new, one story, residential, wood framed building with a simple gabled roof located in East Central Illinois. Assume this example building to be 50-ft. x 190-ft. with a 4-in-12 pitch and a total roof area of 10,000 sq. ft. (100 squares). Solid sheathing should be assumed to already be in place and no penetrations or

roof mounted equipment are needed. Please be sure to include all labor and especially labor hours separately. If a technician or factory inspector is needed, please also break out this cost.

8. Any non-returnable samples of your actual roofing products that you would like to include.

This information should be sent to:

Mailing:

U.S. Army ERDC-CERL
Attn: CEERD-FL-M (R. Lampo)
P.O. Box 9005
Champaign, IL 61826-9005

Shipping:

U.S. Army ERDC-CERL
Attn: CEERD-FL-M (R. Lampo)
2902 Farber Drive
Champaign, IL 61822-1076

Thank you in advance for providing this product information. CERL is not in the market to directly buy and install roofing materials so this inquiry does not in any way constitute a purchase obligation. However, research engineers here at CERL quite often field questions from Army and Air Force installations about roofing so familiarity with the latest new products is expected.

If you have any questions regarding this request for information, please call or e-mail me at (217) 373-6765 or r-lampo@cecer.army.mil.

Sincerely,

Richard Lampo
Materials and Structures Branch

Distribution List

1. Crowe Building Products, Ltd.
116 Burris St.
Hamilton, Ontario Canada L8M 2J5
Phone: (905)529-6818
Fax: (905)529-1755

2. Welsh Mountain Slate, Inc.
P.O. Box 11, Station "B"
Ottawa, Ontario Canada K1P 6C3
Phone: 1-800-865-8784
Fax: (613)591-6587

3. Re-New Wood, Incorporated
104 N.W. 8th
PO Box 1093
Wagoner, OK 74467
Phone: 1-800-420-7576

4. Ecostar, Inc.
230 Center Drive #201
Vernon Hills, IL 60061
Phone: 1-800-211-7170
Fax: (888)780-9870

5. US Century, LLC
1100 N.E. Loop 410 Suite 617
San Antonio, TX 78209
Phone: 1-877-FLEXSHAKE

APPENDIX 2

Information Regarding Recycled Roofing Materials Received as of June 22, 2001

Company	EcoStar, Inc.	Re-New Wood, Inc.	Welsh Mountain Slate, Inc.
Products	1. Majestic Slate 2. Celestial Slate 3. EuroSlate	Eco-Shake	Welsh Mountain Slate
Recycled Content	1. Majestic Slate(100%) 2. Celestial Slate(80%) 3. EuroSlate(60%)	100% recycled materials	100% recycled materials
Materials Used	proprietary polymer Starloy, a blend of recycled rubber and industrial plastic	50% recycled wood, 50% recycle vinyl, flame retardant and UV inhibitors	47% recycled car tire rubber 47% recycled polypropylene 4% coloring agents 2% UV inhibiting polymers
Time In Field	Not specifically addressed, but makes reference to Starloy being used in roofing tiles for over 10 years. Contact Fred Creed for more info.	Not specifically addressed, but testimonial sheet includes customers from Boulder, CO; Marietta, GA; Black Canyon of Gunnison National Park; Dallas, TX. GA customer claims roof withstood hurrican Opal.	Installations ranging from Kodiak, Alaska to Florida the oldest of which is about 5 years. Some newer installations have been built in IL that may be close enough to drive to. Contact Jon Sheaf for more info.
Testing Results	Copies of ANSI/UL 790 "Tests for Fire Resistance of Roof Covering Materials" on Celestial Slate. Copies of UL 2218 "Impact Resistance of Prepared Roof Covering Material" by Intertek Testing Services NA Inc. on Majestic Slate. References made to the following testing: Fire Resistance: ASTM E-108 Passed to a level of Class "C" Wind Driven Rain: ASTM E331-93 No leakage detected at conditions equivalent to wind of 140 mph Nail Pull Through: ASTM D3163 Nails pulled through tiles at 107 lbf Prolonged UV Exposure: ASTM 626-95 After 500 hrs. of UV with intermitten water spray, surface sheed faded evenly with no other indications of change. No further evidence of change after an additional 1500 hrs.	Copies of the following test results: UL 790 - Received Class "A" fire rating. UL 2218 - Received Class 4 impact resistance. Passed wind loads testing specified in Section 120 of texas Department of Insurance's Windstorm Resistant Construction Guide. ASTM D3161 "Wind Resistance of Shingles": Two shingles lifted at common seem due to missing nail starting at 70 mph, some fish mouths appeared starting at 90mph, but all shingles reaxed to a normal position after test, no water intrusion was observed. Max. wind speed was 110 mph with 8.8 in/hour of rain. ASTM G53 "Standard Practice for Operating Light and Water Exposure for Exposure of Non-metallic Materials": 4 specimens were exposed to 5000 hours of UV/condensation environment. The 4 specimens were examined after 5000 hours and showed no visible cracking or deterioration. ICBO AC07-4.8 "Temperature Cycling Test": At end of 25 cycles, the sample was examined at 5X magnification and showed some discoloration but no evidence of surface degradation. cycles were 6 hr at -40F, 2 hr at 70F, 14 hr at 180F.	No copies of test results were included, but results of several tests were included on the brochure: Wind Driven Rain Water Penetration: Modified ASTM E331-96, no leaks at wind speeds up to 158 mph. Vapor Permeance: Tested to ASTM 96-95. Results- .97 ng/(Pa*s*m^2), virtually no water permeance. Wind Uplift: Tested to ASTM 6381-99. Tile performed well at both 90 deg. F and at -4 deg. F. Nail Pull and Material Tear Strength: material tear strength of 1270 N(285 lbf) and nail pull through test of 960 N(217 lbf) correspond to wind speeds of 204 mph. Prolonged Exposure to UV light: Tested to ASTM G26-96. After 3000hours of UV exposure with intermittent water spray, the surface sheen faded evenly. Freeze/Thaw: Tested to ASTM C666-97. No visible change of specimen. Fire: Tested to ASTM E-84. Tiles have Class "C" fire rating.
Material Cost	Please see attached Price list for more information.	Field Shakes- \$175/square Ridge Shakes- \$25/10 foot bundle	light, medium, and dark grey tiles-\$1.35 ea. Green tiles-\$1.50 ea.
Usefulness of Installation Guide	Gives several different design options along with several different til shapes (traditional, beaver tail, mitered edge, and chisel-point). Installation of actual tile is self-explanatory, instructions are included in mold and are present on every tile. Simply line up top of previous row to line on current tile for your desired exposure. 6" and 7" marks are fabricated on the tiles along with spots where nails should be driven. Tiles must be place 3/8" apart. Requires installation of ice and water shield in all valleys, eave edges, vertical flashing details, and areas where venting. Also 30 lb felt underlayment required. Diagrams and pictures included.	Thorough, but text only. Describes how to begin starter course and do all the weather sealing necessary. Requires placement of one ply of 30# organic UL tested ASTM D-226 Type II (non-perforated) felt underlayment over areas not protected by ice dam protection with ends and edges weather lapped a minimum of 6". Shakes have fabricated markings for 3 nail spots and for 8", 9", or 10" exposures. Regular installation calls for 10" weather exposure. Specific instruction for coastal regions are included. Tiles should be blende among palettes to ensure color randomness.	Does good job with flashing details, but neglects to explain how to lay starter course. Gives genear details of how to lay the tiles. Two nails are driven into marked spots on the tiles. The nails actually go through the tile beneath the one being placed as well, so all tiles eventually receive 4 nails. Marks are fabricated indicating 6" or 7" exposures. Also spacer tabs are gabricated on the tiles to ensure proper spacing (min. 1/4") Also discusses temperature effects. Thermal expansion is typically 5/32" per foot for 0F to 200F temperature change. On colds days then, tiles should be layed with an extra 1/8" between them.

Flashing Details	<p>Few Details Valley: EcoStar suggests open copper valley flashing, but closed valleys may be used. Ice and water shield must be used in all valleys prior to installation of valley flashing. Contact EcoStar Technical staff for approved valley flashing designs.</p> <p>Ridge: EcoStar recommends and strongly encourages the use of ridge style venting systems on all Majestic SlateRoof Systems. Install the ridge vent per the manufacturers applicationinstructions then install the majestic slate ridge tile over the ridge vent. Majestic Slate ridge tiles should always be installed with a 6" exposure. DO NOT USE 7". Contact EcoStar Technical service group for list of approved ridge vent products. Hip: No mention, but probably use ridge tiles on this joint.</p>	<p>Gives good details on metal valley flashings. Produce Eco-Shake ridge pieces and tell how to install for ridge and hip locations.</p>	<p>Valleys: Describes the metals needed and installation requirements. Also need ice and water shield.</p> <p>Hip and Ridge: Manufacture hip and ridge tiles. Gives great detail on how to install them and suggest that metal flashing and/or ice and water shield should be used for additional protection at the hip and ridge areas.</p>
Contractor Requirements	<p>Contractor must be certified by EcoStar. Contractor must fill out application. Must have been a licensed contractor in business for 2 years. Must complete on-site installation training prior to or in conjunction with application of any EcoStar product. Training takes 4-8 hrs. Within continental US, no cost for initial training but \$250/day for additional training if needed.</p>	<p>No special contractor certification is needed and no post job inspection or pre-job training is required</p>	<p>No special contractor training or certification required. No post job inspection required.</p>
Warranty	<p>50 years for damage from natural elements including hail and winds up to 100 mph if all conditions are met, roof is installed by certified contractor using approved materials, proper color blending of the tiles is achieved, and the roof passes a post inspection by an EcoStar rep.</p>	<p>50 years for 1. Free of defects in materials or workmanship. 2. Will not be damaged by termites. 3. Will not rot or allow passage of water due to decomposition or decay of the shingle. Warranty does NOT include appearance or damage caused by acts of God. During first year of warranty, seller will pay for installation costs in addition to material costs, but after a year, installation costs are the responsibility of the owner.</p>	<p>50 years including hail damage. No specific info was given, this was taken directly off of company's brochure.</p>
Appearance with Exposure	<p>According to test referenced above, tiles faded evenly after 500 hrs of UV exposure and no further changes were noted 1500 hrs thereafter.</p>	<p>Not specifically addressed.</p>	<p>According to test above, tiles faded evenly after 3000 hrs of UV exposure.</p>
Personal POC	<p>Sales: All Weather Products, Inc. Attn: Fred Creed 8 South 365 Madison Hinsdale, IL 60521 Office: 630-655-4449 Cell: 630-464-6500 Tech. Rep: Spence Bardeen 800-211-7170 Spence@ecostarinc.com</p>	<p>No personal POC associated with this package.</p>	<p>Jon P Sheaff WMS Sales 800-865-8784 705-653-0128 (fax) www.welshmountainslate.com</p>
Typical IL house Scenario	<p>Not addressed.</p>	<p>Not addressed.</p>	<p>Using example 4/12" pitch roof, 50 ft by 190 ft, gable end, 6" tile exposure is recommended (200 tiles per square). A drip ledge at the eve is recommended. Ice and water shield underlayment is recommended over the eve area to prevent ice damming. The rest of the roof can have 30 lb. felt underlayment. One row of starter tile will start the tiling at the eve (190ft.*2 sides, 1 tile per foot), 2 ridge cap tiles will be required for every foot of ridge. Total tiles required then is 100 squares * 200 tiles/square + 190 ft. * 2 sides * 1 tile/ft. + 190 ft. * 2 tiles/ft. of ridge = 20,760 tiles. Installation price per square is approx. \$80/square. Freight costs for 20,000 lbs. on 12 pallets to IL is approx. \$950. They don't sell drip ledge, ice and water shield or felt paper, but they should cost approx. \$1000.</p>
			<p>Total Cost= Tile Cost + Freight + Labor Cost + Accessories</p>
			<p>Total Cost= 20,760*1.35 + 950 + 100*80 + 1000</p>
			<p>Total Cost = \$37,976</p>

APPENDIX 3

Inspection of Eco-Shake roof at Huntsville Alabama, 26 OCT 2001

Dave Bailey

Eco-Shake shingle products have been selected by CERL as a candidate recycled roofing product for demonstration at a FORSCOM installation during FY02. The selection of this product was made based on review of information requested from several companies that market recycled roofing products. The information included manufacturer's product description literature, cost data, installation instructions, standard warranty information, and product job lists.

Re-New Wood, Inc. of Wagoner, OK (POC Kim Turnice, (918) 485-5803) provided a list of residences located in the Southeastern US which have been roofed with Eco-Shakes. The Charles Neal residence in Huntsville AL, which was reroofed with the product in NOV of 1996, was selected for inspection. I inspected the roof for the purpose of evaluating the performance of the product based on visual examination and discussion with the owner and installer. I met Mr. and Mrs. Neal and Larry Chambers (the installer) at the Neal home on 26 October to perform the inspection.

We discussed the Neals' satisfaction with the roof. The reason that they selected the product to replace their 25-year-old wood shake roof was to keep the shake appearance while eliminating the growth of fungus and to achieve a longer service life than the previous roof. They have been very happy with the performance of the roof, really like its appearance and have had no roof leaks or problems to date.

I was able to get onto the roof from a stepladder. The roof was about 3000 sq. ft. in size composed of three main gable sections. The predominate roof slope was about 12 in 12 (figure 1). The roof was covered with pine needles, leaves and lots of debris from the large surrounding trees. The majority of the roof seems to be shaded from the sun throughout the day (figure 2). Despite this, there was no appearance of fungal growth or mold, just lots of loose debris. The shingle units were sitting flat on the substrate except for some minor lifting of some of the tabs (figure 3). This lifting did not seem to pose any problem and may have been there from the time of construction. The excessive shading of the roof from natural sunlight may be part of the reason for the relatively minor amount of fading of the shingle after six years (figure 4).

Flashing details typical of wood shake roofs (figure 5) were used for the roof penetrations and appeared to be performing well. The valleys were constructed of v-crimped copper sheet metal and the drip edges were made of copper also. The gable ridges were roofed with a special two sided ridge cap shingle (figure 6).

I asked the installer about the ease of installation. He said that he did not receive any training by the manufacturer but was provided with installation instructions. He said that the installation was not difficult and he was able to use standard wood shake roofing procedures. Upon lifting up some of the tabs in the front of the house, it was apparent that he shingled the underlayment between successive courses of shingles, as is common practice for wood shakes. However, on the backside of the roof it appeared that the

underlayment was placed flat on the substrate before shingling was started. This is typical of asphalt shingle installation and is the procedure recommended by the manufacturer. Regardless, both methods were performing fine.



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6

APPENDIX 4



RE-NEW WOOD INC
 MRS K TERNES
 104 NW 8TH ST
 WAGONER OK 74454

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your Assignment.



PREPARED ROOFING MATERIAL
 SHINGLES - CLASS A*
 CLASS 4**

Issue No. G-810,134

*DEGREE OF RESISTANCE TO EXTERNAL FIRE AND
 FLAMMABILITY LIMITS
 IN ACCORDANCE WITH UL STANDARD 790
 ** CLASS 4 IMPACT RESISTANCE
 IN ACCORDANCE WITH UL STANDARD 2218
 WHEN APPLIED IN ACCORDANCE WITH
 INSTRUCTIONS INCLUDED WITH THIS ROOFING

eco-shake

manufactured by Re-New Wood, Inc.

For information on placing an order for UL Listing Cards in a 3 x 5 inch card format, please refer to the enclosed ordering information.

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service.

UL
 a 501(c)(3) organization

Laboratory
 P.O. Box
 1220
 Northbrook, IL 60062
 312-490-5400

TEXAS DEPARTMENT OF INSURANCE

Engineering Services / MC 103-3A 333 Guadalupe Street P.O. Box 149104 Austin, Texas 78714-910
Phone No. (512) 322-2212 Fax No. (512) 463-6693

PRODUCT EVALUATION RC-4

Effective January 15, 1998

The following product has been evaluated to withstand the wind loads specified in Section 120 of the Texas Department of Insurance's Windstorm Resistant Construction Guide. This product shall be subject to reevaluation 3 years after the effective date.

This product evaluation is not an endorsement of this product or a recommendation that this product be used. The Texas Department of Insurance has not authorized the use of any information contained in the product evaluation for advertising, or other commercial or promotional purpose.

This product evaluation is intended for use by those individuals who are following the prescriptive portions of the Texas Department of Insurance's Windstorm Resistant Construction Guide. This product evaluation does not relieve a Texas registered engineer of his responsibilities as outlined in the Texas Engineering Practice Act.

Eco Shake® Shingles manufactured by **Re-New Wood Inc.** of Wagoner, Oklahoma will be acceptable in areas inland and seaward of the Intracoastal Waterway when installed in accordance with the manufacturer's installation instructions and this product evaluation.

PRODUCT DESCRIPTION

Eco Shake® Shingles are made from two post-industrial waste feedstocks: recycled plastic and recycled wood. **Eco Shake®** shingles are pre-packed in random widths of 5, 7, and 12 inches and are 22 inches in length.

LIMITATIONS

This product shall not be installed at heights greater than 30 feet above natural grade. **Eco-Shake®** shingles shall not be installed on roof slopes less than 2 inches per foot. **Eco-Shake®** shingles shall be installed over a solid roof deck. The roof deck must meet the requirements outlined in the Texas Department of Insurance's *Windstorm Resistant Construction Guide*.

INSTALLATION INSTRUCTIONS

Eco-Shakes® shingles shall be installed per the manufacturer's installation instructions with the following exceptions:

The underlayment shall be installed as specified in the installation instructions for "coastal regions"

Eco-Shake® shingles shall be fastened to the deck by using three (3) minimum 1¼ inch in length by ⅝ inch diameter head galvanized roofing nails, with a ⅝ inch shank diameter. The side laps on the starter course shall be sealed with RT600 Urethane Lap adhesive or equivalent.

Note: The manufacturer's installation instructions shall be available on the job site during installation.



ROOFING TEST LABORATORY REPORT

Job No. 257394-A

Re-New Wood
104 N.W. 8th St.
Wagner, OK. 74467

Wind Resistance of Re-New Wood Eco Shake Shingles

Method: *ASTM D5161, "Wind Resistance of Shingles (modified Fan-Induced Method)"*

Re-New Wood Eco Shake 12" x 22" Gray Plastic Shingles.

Installed on a 50" x 60" Ply wood Deck with 30 lb. felt underlayment fastened using 1 1/4" x 3.8" ring shank roofing nails and urethane adhesive per Mfg. installation inst.

Modified ASTM 5161

The Test Machine is capable of delivering a horizontal stream of air through a rectangular opening 22" wide and 7" high at a velocity of 110 MPH - or - 5% as measured at the orifice. The machine is equipped with an adjustable stand capable of receiving a 50" x 60" test panel and positioning the test panel at any desired slope, at any horizontal distance from the lower edge of the duct opening, and at various angles incident to the wind direction.

Dwyer No. 6 U Tube Manometer cat. no. 1225-16 and a Dwyer Pitot Tube cat. no. 160-18

Timer (capable of timing 2 hours to the nearest minute.) (SEE PHOTOS)

Construction: *The test deck was constructed using 2" x 4" framing sheathed with 1/2" CDX plywood. Underlayment was 30 lb. Type II, fastened with 1 1/4" x 3.8" roofing nails and 45 gauge tin tabs. The Underlayment was laid with 19" head laps (double layer) and nailed 6" OC. Re-New Wood Eco Shakes were fastened with three 1 1/4" x 3.8" roofing nails and the side laps were sealed with RT600 Urethane Adhesive (per the manufactures installation instructions).*

Conditioning: *The RT 600 Urethane Lap Adhesive was allowed to set for 7 days prior to testing.*

See page two

Information for the information of the client, it may be used in its entirety for the purpose of securing product acceptance from constituted approval authorities; however, this report or the name of Center For Applied Engineering, Inc. shall not be used for publicity or advertising.

NVLAP

Accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program for Acoustical Test Services and Thermal Insulation Materials.

ACOUSTICAL, FIRE, PHYSICAL AND
THERMAL MEASUREMENTS LABORATORIES

TEST OBSERVATIONS MDC #110

Slope: 2" in 12"

Air Temp:

49 deg. F

Deck Conditioning: Not required

Air Velocity: 35 MPH Simulated Rainfall: 8.8 ins/hr Time: 15 min

No lift or movement of any shingles.

No water intrusion observed.

Air Velocity: OFF Simulated Rainfall: OFF Time: 10 min

No water intrusion observed.

Air Velocity: 70 MPH Simulated Rainfall: 8.8 ins/hr Time: 15 min

Course #3 in field 2 shingles lifted about 1"

No water intrusion observed.

Air Velocity: OFF Simulated Rainfall: OFF Time: 10 min

No water intrusion observed.

Air Velocity: 90 MPH Simulated Rainfall: 8.8 ins/hr Time: 15 min

Course #3 in field 2 shingles lifted at seam due to missing seam nail.

Course 8, 9, 11 & 12 fish mouths opened to 1/4"

No water intrusion observed.

Air Velocity: OFF Simulated Rainfall: OFF Time: 10 min

No water intrusion observed.

Air Velocity: 110 MPH Simulated Rainfall: 8.8 ins/hr Time: 5 min

No additional lift observed.

No water intrusion observed.

SUMMARY OF OBSERVATIONS

Underside of Deck: *No water intrusion occurred.*

Roof Top Surface: *Two shingles lifted at their common seam due to a missing nail. Some fish mouths appeared. All shingles relaxed to a normal position after test.*

Test Conduct By

[Signature]

Date: *2/9/95*

Approved By:

[Signature]

Date: *2/28/95*



Center For Applied
Engineering, Inc.

SM Materials Testing Services

PHYSICAL TESTING REPORT

Client: Re-New Wood, Inc.
104 N.W. 8th St.
Wagner, OK 74467

MTS Job No.: 25-7173

Project: UV Exposure of Eco-Shake Tile

Test Method: ASTM G53, "Standard Practice for Operating Light- and Water-Exposure (Fluorescent UV-Condensation Type) For Exposure of Non-Metallic Materials"

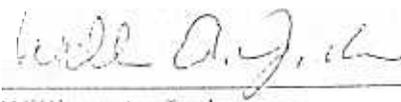
Test Completion Date: October 4, 1995

Sample Material: "Eco-Shake Tile"

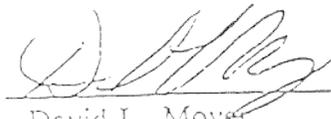
Four (4) specimens of "Eco-Shake Tile" were exposed to 5000 hours of UV/Condensation environment. These specimens were placed in an Atlas UVCon, which exposed the specimens to 4 hours of ultraviolet light at 60°C and to 4 hours of condensation at 50°C. These intervals were repeated throughout the entire 5000 hours of exposure. The lamps that provided the ultraviolet light were from Q-Panel and were identified as UVB313 280 to 315 nm. Two lamps were replaced at every 400 hours of light exposure according to ASTM G53.

Results: The four (4) specimens were examined after 5000 hours UV/Condensation exposure and they showed no visible cracking or deterioration.

Tested by:


William A. Jackson
Research Technologist

Approved by:


David L. Moyer
Research Engineer

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NVLAP
ACOUSTICAL, FIRE, PHYSICAL
MEASUREMENTS LABORATORY



ROOFING TEST LABORATORY REPORT

MTS Job No. 257394E

Client: *Re-New Wood*
104 N.W. 8th St.
Wagner, OK. 7446

Project: *Temperature cycling of Re-New Wood Eco Shake Plastic Shingles*

Test Method: *ICBO AC07- 4.8 Temperature cycling - Test*

Sample Description: *Re-New Wood Eco Shake 12" x 22" Gray Plastic Shingles.*
Installed on a 24" x 36" Ply wood Deck with 30 lb. felt underlayment fastened
using ring shank roofing nails and urethane adhesive per Mfg. installation inst.

Equipment: OVEN
Despatch Oven Model No. V-35 30" x 36" x 60"
Thermometer Bi-Therm 0/220 Model No. 6215 Calibrated 9/26/95

WATER SPRAY

The Water spray apparatus was fabricated at CAE using a Blue White Ind.
Model No. 9508 (0 to 1 GPM) Flow Meter
and an A M International 2.5 GPM Max. spray nozzle.
The setup allowed a 7' water drop distance
The Water spray apparatus was Calibrated on 9/26/95 by weighing and timing
the water output.

ENVIRONMENTAL CHAMBER

So-Low Environmental Equipment Co. Inc.
Model No. A30-100 8" x 26" x 48" chamber
Calibrated 10/4/94

Results At the end of twenty five cycles the sample was examined at 5 X magnification.
The Re-New Wood Eco Shake sample showed some discoloration but there was
no evidence of surface degradation.

Tested by:

Raymond H. Brown
Senior Laboratory Technician

Approved by:

D. M. [Signature]
Research Engineer

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NVLA9

APPENDIX 5

SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL ITEMS OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, AND 30				1. REQUISITION NUMBER W81EWF-1241-5141		PAGE 1 OF 4	
2. CONTRACT NO. DACA42-01-P-0286		3. AWARD/EFFECTIVE DATE 25-Sep-2001		4. ORDER NUMBER		5. SOLICITATION NUMBER	
7. FOR SOLICITATION INFORMATION CALL						a. NAME	
9. ISSUED BY VDBG CONSOLIDATED CONTRACTING CHAMPAIGN OFFICE P O BOX 9005 CHAMPAIGN IL 61826-9005 TEL: (217)373-6748 FAX: (217)373-6773						CODE DACA42	
10. THIS ACQUISITION IS <input type="checkbox"/> UNRESTRICTED <input checked="" type="checkbox"/> SET ASIDE: 100%FOR <input checked="" type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> SMALL DISADV. BUSINESS <input type="checkbox"/> 8(A) SIC: 5033 SIZE STANDARD: 500				11. DELIVERY FOR FOB DESTINATION UNLESS BLOCK IS MARKED <input type="checkbox"/> SEE SCHEDULE		12. DISCOUNT TERMS Net 30	
13 a. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)				13 b. RATING C9E		14. METHOD OF SOLICITATION <input type="checkbox"/> RFQ <input type="checkbox"/> IFB <input type="checkbox"/> RFP	
15. DELIVER TO FT STEWART - DEPT OF PUBLIC WORKS FRED CAVEDO BLDG 1114 FT STEWART GA 31314				16. ADMINISTERED BY CERL-DMB DIANE M BIGGS (217) 352-6511 EXT 7575 FAX (217) 373-6773 D-BIGGS@CECER.ARMY. MIL CHAMPAIGN IL		CODE CERL-DMB	
17 a. CONTRACTOR/ OFFEROR RE-NEW WOOD, INC KIM TERNES 104 N.W. 8TH STREET/ PO BOX 1093 WAGONER OK 74467 TEL 1-800-420-7576		CODE 1VFA1 FACILITY CODE 1VFA1		18 a. PAYMENT WILL BE MADE BY USACERL %U.S. ARMY CORP OF ENG FINANCE CENTER 5722 INTEGRITY DRIVE MILLINGTON TN 38054-5005		CODE DISB	
<input type="checkbox"/> 17 b. CHECK IF REMITTANCE IS DIFFERENT AND PUT SUCH ADDRESS IN OFFER				18 b. SUBMIT INVOICES TO ADDRESS SHOWN IN BLOCK 18 a. UNLESS BLOCK BELOW IS CHECKED <input type="checkbox"/> SEE ADDENDUM			
19. ITEM NO.		20. SCHEDULE OF SUPPLIES/ SERVICES		21 QUANTITY		22. UNIT	
		SEE SCHEDULE				23. UNIT PRICE	
						24. AMOUNT	
25. ACCOUNTING AND APPROPRIATION DATA See Schedule						26. TOTAL AWARD AMOUNT \$9,852.00	
27 a. SOLICITATION INCORPORATES BY REFERENCE FAR 52.212-1, 52.212-4, FAR 52.212-3 AND 52.212-5 ARE ATTACHED.						ADDENDA <input type="checkbox"/> ARE <input type="checkbox"/> ARE NOT ATTACHED	
27 b. CONTRACT/PURCHASE ORDER INCORPORATES BY REFERENCE FAR 52.212-4, FAR 52.212-5 IS ATTACHED.						ADDENDA <input type="checkbox"/> ARE <input type="checkbox"/> ARE NOT ATTACHED	
28. CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN <input type="checkbox"/> TO ISSUING OFFICE. CONTRACTOR AGREES TO FURNISH AND DELIVER ALL ITEMS SET FORTH OR OTHERWISE IDENTIFIED ABOVE AND ON ANY ADDITIONAL SHEETS SUBJECT TO THE TERMS AND CONDITIONS SPECIFIED HEREIN.				29. AWARD OF CONTRACT: REFERENCE <input type="checkbox"/> OFFER DATED . . . YOUR OFFER ON SOLICITATION (BLOCK 5), INCLUDING ANY ADDITIONS OR CHANGES WHICH ARE SET FORTH HEREIN, IS ACCEPTED AS TO ITEMS:			
30 a. SIGNATURE OF OFFEROR/CONTRACTOR				31 a. UNITED STATES OF AMERICA <i>Wayne T Kurokawa</i> (SIGNATURE OF CONTRACTING OFFICER)			
30 b. NAME AND TITLE OF SIGNER (TYPE OR PRINT)		30 c. DATE SIGNED		31 b. NAME OF CONTRACTING OFFICER (TYPE OR PRINT) WAYNE T KUROKAWA / CONTRACTING OFFICER		31 c. DATE SIGNED 25-Sep-2001	
32 a. QUANTITY IN COLUMN 21 HAS BEEN <input type="checkbox"/> RECEIVED <input type="checkbox"/> INSPECTED <input type="checkbox"/> ACCEPTED, AND CONFORMS TO THE CONTRACT, EXCEPT AS NOTED				33. SHIP NUMBER <input type="checkbox"/> PARTIAL <input type="checkbox"/> FINAL		34. VOUCHER NUMBER	
32 b. SIGNATURE OF AUTHORIZED GOVT. REPRESENTATIVE				32 c. DATE		35. AMOUNT VERIFIED CORRECT FOR	
32 b. SIGNATURE OF AUTHORIZED GOVT. REPRESENTATIVE				32 c. DATE		36. PAYMENT <input type="checkbox"/> COMPLETE <input type="checkbox"/> PARTIAL <input type="checkbox"/> FINAL	
32 b. SIGNATURE OF AUTHORIZED GOVT. REPRESENTATIVE				32 c. DATE		37. CHECK NUMBER	
41 a. I CERTIFY THIS ACCOUNT IS CORRECT AND PROPER FOR PAYMENT				38. S/R ACCOUNT NUMBER		39. S/R VOUCHER NUMBER	
41 b. SIGNATURE AND TITLE OF CERTIFYING OFFICER				41 c. DATE		40. PAID BY	
41 b. SIGNATURE AND TITLE OF CERTIFYING OFFICER				41 c. DATE		42a. RECEIVED BY (Print)	
41 b. SIGNATURE AND TITLE OF CERTIFYING OFFICER				41 c. DATE		42b. RECEIVED AT (Location)	
41 b. SIGNATURE AND TITLE OF CERTIFYING OFFICER				41 c. DATE		42c. DATE REC'D (YY/MM/DD)	
41 b. SIGNATURE AND TITLE OF CERTIFYING OFFICER				41 c. DATE		42d. TOTAL CONTAINERS	

AUTHORIZED FOR LOCAL REPRODUCTION

STANDARD FORM 1449 (10-95)
Prescribed by GSA
FAR (48 CFR) 53.212

SECTION SF 1449 CONTINUATION SHEET

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001	1 SQUARE UMBER ECO-SHAKE ROOFING TILES FFP - 1 SQUARE UMBER ECO-SHAKE ROOFING TILES PURCHASE REQUEST NUMBER W81EWF-1241-5141	48.00	Each	\$175.00	\$8,400.00

NET AMT \$8,400.00

ACRN _ Funded Amount \$8,400.00
TAC:
Case

See Exhibit

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002	1 BUNDLE OF UMBER ECO-SHAKER RIDGE TILES FFP - 1 BUNDLE OF UMBER ECO-SHAKER RIDGE TILES. PURCHASE REQUEST NUMBER W81EWF-1241-5141	11.00	Each	\$25.00	\$275.00

NET AMT \$275.00

ACRN _ Funded Amount \$275.00

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003		1.00	Lump Sum	\$1,100.00	\$1,100.00
	FREIGHT TO DELIVER MATERIALS TO FT STEWART GA FFP - SHIPPING TO DEPT OF PUBLIC WORKS; ATTN: FRED CAVEDO, BLDG 1114, FT STEWART GA. PHONE 912-767-5034. PURCHASE REQUEST NUMBER W81EWF-1241-5141				

NET AMT \$1,100.00

ACRN Funded Amount \$1,100.00
TAC:
Case

See Exhibit

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004		1.00	Each	\$77.00	\$77.00
	GEOSILL SEALANT FFP - GEOSILL SEALANT PURCHASE REQUEST NUMBER W81EWF-1241-5141				

NET AMT \$77.00

ACRN _ Funded Amount \$77.00
TAC:
Case

See Exhibit

DELIVERY INFORMATION

CLINS	DELIVERY DATE	UNIT OF ISSUE	QUANTITY	FOB	SHIP TO ADDRESS
0001	31-OCT-01	Each	48.00	Dest.	FT STEWART - DEPT OF PUBLIC WORKS FRED CAVEDO BLDG 1114 FT STEWART GA 31314
0002	31-OCT-01	Each	11.00	Dest.	Same as CLIN 0001

0003	31-OCT-01	Lump Sum	1.00	Dest.	Same as CLIN 0001
0004	31-OCT-01	Each	1.00	Dest.	Same as CLIN 0001

INSPECTION AND ACCEPTANCE TERMS

Supplies/services will be inspected/accepted at:

CLIN	INSPECT AT	INSPECT BY	ACCEPT AT	ACCEPT BY
0001	N/A	N/A	N/A	N/A
0002	N/A	N/A	N/A	N/A
0003	N/A	N/A	N/A	N/A
0004	N/A	N/A	N/A	N/A

ACCOUNTING AND APPROPRIATION DATA

AMOUNT:	2112020000 088140	26CB007HSM43701862000	E3RE 22079	000000000000
	\$8,752.00			

AMOUNT:	2112020000 088140	22NL007HSM43701862000	E3RE 22079	000000000000
	\$1,100.00			

FUNDING	JOB ORDER NO	QUANTITY
ACRN:		
AMOUNT:		

CLAUSES INCORPORATED BY REFERENCE:

52.211-17	Delivery of Excess Quantities	SEP 1989
52.212-4	Contract Terms and Conditions--Commercial Items	MAY 2001
52.212-5	Contract Terms and Conditions Required to Implement Statutes or Executive Orders--Commercial Items	MAY 2001
52.232-33	Payment by Electronic Funds Transfer--Central Contractor Registration	MAY 1999
52.243-1	Changes--Fixed Price	AUG 1987
52.249-1	Termination For Convenience Of The Government (Fixed Price) (Short Form)	APR 1984
252.212-7001	Contract Terms and Conditions Required to Implement Statutes or Executive Orders Applicable to Defense Acquisitions of Commercial Items	DEC 2000