

technology *scanning*



PD&R

U.S. Department of
Housing and Urban Development
Office of Policy Development
and Research



Finding New Ideas For Housing

*Cover Photographs courtesy of:
J.J. Dittmer, Alivisatos Lab/UC
Berkeley; Dynasys Technologies,
Inc.; and the U.S. Army.*



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May 2004



Finding New Ideas For Housing

Prepared for:

U.S. Department of Housing and Urban Development
Office of Policy Development and Research
Washington, D.C.

Prepared by:

Newport Partners L.L.C.
Davidsonville, MD

One of PATH's major research support services is Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning* published by the U.S. Department of Housing and Urban Development/PATH and prepared by Newport Partners LLC is updated as technology developments dictate.

These issues of *Technology Scanning* are one in a series. Each issue in the series falls into one of the following categories:

- *Design and Internet Tools*
- *Safety*
- *Surfaces and Interior Finishes*
- *Building Envelope Technologies*
- *Heating, Ventilating, and Air Conditioning*
- *Energy/Power Systems Generation*
- *Basic Materials*
- *Information Technology*
- *Thermal and Moisture Protection*
- *Indoor Environmental Quality*

For other available Technology Scanning issues, log onto www.pathnet.org.

Description

The Partnership for Advancing Technology in Housing (PATH) is a program designed to improve the affordability and value of new and existing homes through the use of technology. Through public and private efforts, PATH adds value to seven of the nation's key housing attributes: affordability, energy efficiency, environmental impact, quality, durability and maintenance, hazard mitigation, and safety.

One major research support service that PATH provides is called Technology Scanning. Technology Scanning is a set of activities to identify technology developments in different industries, from other nations, and from other building sectors that may have application in residential construction.

The ongoing scanning efforts involved site visits with

manufacturers, internet searches, and review of reports and publications on new and existing technologies from private industry, research universities, and government laboratories, both domestically and internationally. Through this effort, it is PATH's objective to facilitate interaction between manufacturers and builders on new R&D efforts, and to develop building-specific applications and technology transfer opportunities.

Technology Scanning results continue to identify new and emerging technologies in multiple areas ranging from energy use to materials to information technology. We suggest that building product manufacturers review these findings for new ideas. Likewise, we believe those of you who do not typically work in the building industry will realize the great opportunities and markets available in housing.

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Notice

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technology scanning

Heating, Ventilating, and Air Conditioning

Listed in this section are the technology findings that directly or in part could be applied to the mechanical infrastructure (heating, ventilating and air conditioning) of housing.

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A/C Power Economizer

Airsure, Inc. distributes an "electronic smart box that maximizes the cooling effect of air conditioners" and can be installed on existing units. The A/C Powermizer works by taking advantage of variations in efficiency during the cooling cycle; this unit cuts the compressor off before the thermostat is satisfied, then turns it back on in order to maximize operation at the highest efficiency range. The company distributes a report describing test results from Florida claiming energy savings of around 10-20%.

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acpowermizer@prodigy.net
www.acpowermizer.com

Condensing Oil Furnace

This oil furnace has a rated 95 AFUE. Until recently, oil furnace efficiencies above the low to mid 80s were rare. The availability of high efficiency oil furnaces could have a significant impact on energy use through installation in new homes or as replacement units. Dornback, a manufacturer in Garfield Heights, Ohio, reports that the Dornback condensing oil furnace has a 95 AFUE rating. To overcome sooting problems with earlier

versions of this technology, the Dornback model was specifically designed with front and rear clean-outs so soot can be easily removed.

Contact:
Dornback Furnace Division
9545 Granger Road
Garfield Heights, OH 44125
Phone: (216) 662-1600
Fax: (216) 587-6807

Metal Duct with Silver Coating

SPIRO+AgION is a new type of antimicrobial protection for sheet metal ductwork. According to the manufacturer, Lindab, the product provides a controlled and continuous release of silver (Ag) ions when moisture is present. The silver ions provide an added measure of cleanliness where mold, fungi, and bacteria are a concern. Current applications include schools, hospitals, supermarkets, and similar environments. The product could be applied to provide the same level of protection to residential metal ductwork. The product is registered with the U.S. Environmental Protection Agency and is recognized by the U.S. Food and Drug Administration as an acceptable additive in food contact polymers.

Contact:
Lindab USA
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Preface

PATH, the Partnership for Advancing Technology in Housing, is proud to present this latest collection of innovative technologies for potential application to the construction, repair, remodeling, maintenance or operation of homes. This document is one in a series on technologies identified under the PATH Technology Scanning activities. Other scanning reports can be accessed through www.pathnet.org.

PATH is advancing the homes we live in by improving their affordability and value. Through public and private efforts in technology research, information dissemination, and barrier analysis, PATH is adding value to seven important housing attributes:

- Affordability
- Energy efficiency
- Environmental impact
- Quality
- Durability and maintenance
- Hazard mitigation, and
- Safety

Scanning is one of the tools PATH employs to identify technologies that can help achieve improvements in these areas. Scanning includes meeting with research organizations and manufacturers; mining technical literature, trade literature and related reports; and conducting internet searches of databases and other resources. The information collected during the scanning efforts is compiled and disseminated to the appropriate sectors of the industry to further accelerate product improvements and R&D in general.

This document is one of the vehicles for disseminating scanning results to the building industry. This issue is slightly different than past issues in that many of the technologies (but not all of them) are much earlier in their developmental stage than previous scanning report technologies. In some ways, this reflects the need for PATH to begin to step further out and help bring longer-term improvements to the housing industry.

We invite you to read through the technology descriptions. Manufacturers, builders, and others who are interested in working with specific technologies are encouraged to contact PATH and to work with us in helping to improve our existing and future supply of homes.

Design and Internet Tools

This category highlights new applications in design, software, and associated tools, as well as internet-based tools.

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3D Virtual Reality Simulation Systems

Immersion Corp. is developing, licensing and marketing technology and products that enhance human interaction with digital devices using the sense of touch. Immersion's technology is applicable to computing, entertainment, training, automotive and 3D simulation. Their "Haptic" workstation was developed for automotive engineers so that they could experience the "feel" of a new technology prior to producing expensive prototypes. This type of technology eventually could be introduced into new technology development in the building industry and even into the sales process to enable virtual house walk-throughs.

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www.immersion.com

Remote Construction Monitoring Systems

The Photo-Net II remote construction monitoring system uses Web cameras and software to allow anyone with an Internet connection to visually access the construction site. According to the owner, the system can be used to plan, control and monitor construction projects. The



Simulated automotive steering using the Haptic Workstation.

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system records real time images and stores them in a database. It works around the clock, from beginning to completion of a project. The database enables a manager to generate a movie of the entire construction project.

Contact:

PHOTO-NET II
421 Griffith St.
London, ON N6K 2S3
Phone: (519) 657-2277 (Canada)
Fax: (519) 433-8351(Canada)
www.photonet2.com

Safety

Safety technology applications include ideas that reduce or eliminate hazards related to the building or during construction.

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Fire Resistant Paint

International Fire Resistant Systems, Inc. produces an intumescent paint coating, called Firefree 88, that is capable of providing a fire-resistant barrier on a variety of substrates, including gypsum board, oriented strand board and other wood products, and composite architectural panels. The manufacturer claims that Firefree 88 is nontoxic and has the lowest levels of VOC's (33g/L) of the majority of paint products on the market. Firefree 88 contains a synthetic component consisting of ceramic fiber which, when heated, expands and reflects heat. The product can be sprayed, rolled, or brushed on. It can provide a one-hour fire rating when applied to 1/2" type X gypsumboard. Firefree can also be used on lumber and on completed assemblies to achieve improved fire ratings. The product may be equally applicable to new and retrofit construction.

Contact:

International Fire Resistant Systems, Inc.
580 Irwin Street
San Rafael, CA 94901
Phone: (415) 459-6488
Fax: (415) 459-6055
Email: info@firefree.com
www.firefree.com

Fire Resistant Fibers

Unifrax has developed a patented fiber for all sorts of applications that can withstand temperatures of 1260 degrees C (2300 degrees F). Isofrax 1260C Paper is manufactured by forming this fiber in a nonwoven matrix. The fibers



Demonstration of Intumescent paint product, Firefree 88®, in San Francisco.

Courtesy: International Fire Resistant Systems, Inc.

are randomly oriented and held together using a latex binder to form uniform, lightweight, flexible materials. The product is easy to shape or cut. It has low thermal conductivity and is very stable even at high temperatures. Current applications include aerospace heat shields, automotive muffler insulation, and gaskets for ovens, stoves, and heaters.

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www.unifrax.com

Surfaces and Interior Finishes

Outlined in this section are finish and surface technologies that could be applied to a wide variety of housing-related products.

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Pre-finished Composite Materials

Composite materials have been used in other industries for decades. Perhaps the best known composite technology is the honeycomb panel. The integration of new lamination techniques now brings the use of attractive, pre-finished composites closer to a reality for home building applications. Composite panels being produced by Euro-Composites of Elkwood, VA offer a variety of pre-finished choices for honeycomb panels and similar products.

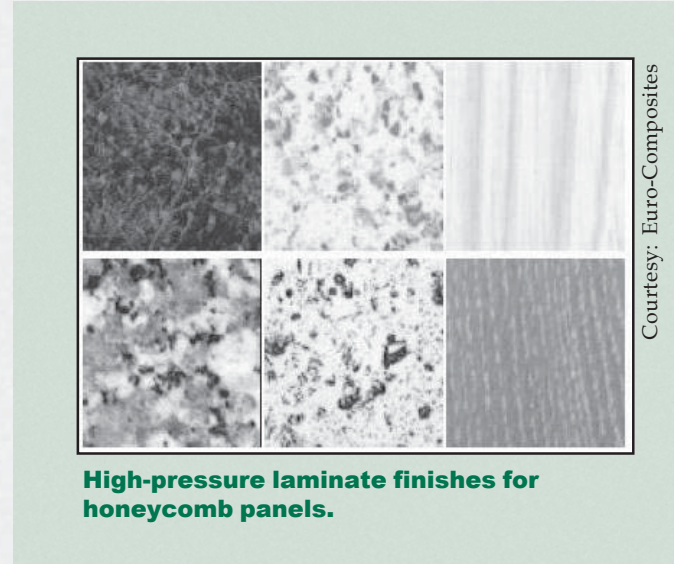
The use of high pressure laminate (HPL) technology allows the panels to be pre-finished on one or both sides. According to Euro-Composites' website, "HPL is already widely used in the furniture industry and consists of several layers of resin-coated paper together with a decorative paper and a protective coating of melamine resin. All these components are then bonded together under high pressure." Composite panels formed using this technology typical take the form of flat panels that can range in size from just fractions of an inch to 12X36 foot sheets and larger.

Contacts:

Euro-Composites
Elkwood, Virginia
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Email:
gene.edy@euro-composites.com
www.euro-composites.com

Guide Marked Gypsum Board

National Gypsum Company has introduced a gypsum board product that has guide marks to identify the location of studs, joists, rafters, or trusses. The product will make it easier to



find the location of framing members and make accurate cuts without having to draw as many lines as with conventional gypsum board. Marks are printed on the paper of the gypsum board at distances commonly used for spacing of framing members.

Gold Bond brand GridMarX is the trademark name of National Gypsum Company's gypsum board product with guide marks. The marks consist of an "X" printed on the paper surface in rows parallel to the long dimension of the board. The rows begin at each edge and at 16, 24, and 32 inches. The "X"s are spaced 4 inches apart in each row. The guide marks serve as a reference point for framing members in both horizontal and vertical installations. The manufacturer claims the marks are easily covered with paint and will not bleed through.

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Building Envelope Technologies

This category includes technologies which relate to the structure, assembly, protection, or thermal efficiency of the building envelope. Technologies are applicable to wall panels, roof and floor systems, and insulation.

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Trim-able Floor Trusses

Several manufacturers are producing or developing a trim-able floor truss that combines many of the positive features of I-joists or 2x lumber with an open web structure. The trim-able floor truss adds the flexibility of allowing the member to be shortened by as much as 12 inches on each end.

There are at least two types of trim-able floor trusses. The first type is a hybrid of truss and I-joist technology. The main part of the truss has steel webs with top and bottom cords made from Laminated Veneer Lumber or 2X lumber. The web material for a short distance on each end is made from OSB, effectively forming an I-joist on each end that can be trimmed as needed.

The second type of trim-able open-web floor truss is an all-wood truss. This product has a section of dimensional lumber on the ends as opposed to an I-joist. The cords and webs are connected using finger-jointing technology.

The trim-able end on each type of truss can be cut in the field to add flexibility to the product that does not exist with the typical open-web floor joist.

Contacts:

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Arlington Texas
Phone: (800) 238-8678
www.spacejoist.com

Open Joist 2000
Mike Beauchamp
Phone: (800) 263-7265 or
(800) 567.8644
www.openjoist2000.com

Mitek
Mike Klein
Chesterfield, MO
Phone: (314) 434-1200



Trim-able Floor Trusses are a hybrid of truss and I-joist technology.

Courtesy: Space Joist

Acrylic Pressure Sensitive Adhesive Tapes for Structural Purposes

The Center for Adhesive and Sealant Science at Virginia Tech is testing and evaluating the use of pressure sensitive tapes for use in the structure of homes. Scientists are developing a methodology for tape applications on construction sites. Virginia Tech has modeled and tested the performance of tapes for the construction of wall panels and plans to expand the program to other uses.

Contact:

David Dillard
VA Tech Center for Adhesive and Sealant Science
Blacksburg, VA
Phone: (540) 231-3971
www.cass.vt.edu

Hurricane-Resistant Sealant for Glazing

National Starch and Chemical Company has developed a specialty sealant that will allow windows to be manufactured to better resist hurricane-force winds and impacts from wind-borne projectiles. Windows glazed with the PURFECT GLAZE polyurethane hot melt sealant have been subjected to ASTM tests for weathering, water resistance, structural performance, and impact under extreme conditions. The tests also followed procedures set by Dade County, Florida. Test data show that after 24 hours the strength of PURFECT GLAZE adhesives exceeds 400 psi, far in excess of current backbedding options. More than three quarters of this strength is realized within the first three hours.

Contact:

Hari Ramsubrani
National Starch and Chemical Company
Bridgewater, NJ
Phone: (800) 797-4992
www.nationalstarch.com

Solar Control Laminated Glass

Sekisui Chemical Company has introduced a film that is intended to reduce Infrared energy and UV from the sun while permitting high levels of natural light to pass into the building. The S-LEC PVB Film is laminated between two layers of glass. The manufacturer claims it does not interfere with wireless transmissions as do metal coating systems. They further claim that it provides the same safety and security of a traditional laminated glass.

Contact:

Sekisui America Corporation
Columbus, Ohio
Phone: (614) 527-5250
www.s-lecfilm.com

Soy-Based Roof Coatings

Niemann Laboratories of Chicago, with funding from the United Soybean Board, is

researching a soy-based roof coating.

Natural Bitumen Jacket is a bright white product applied over bituminous substrates on flat-roofed buildings. It reduces the amount of energy absorbed from intense sunlight. Due to its ability to reduce the temperatures on the roof, Niemann Labs has gained an "Energy Star" approval, an Environmental Protection Agency-backed standard identifying superior energy performance.

The resin system is formulated to provide significantly greater life and durability compared to elastomeric acrylic products. It can be applied by brush, roller or by spray applicator. The manufacturer also claims it is 100 percent waterproof and, because of its excellent adhesion and flexibility, prevents UV-rays from drying and cracking roofing material, which can add years to the life of a roof.

Contact:

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Green Grip Products
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Email: niemannlab@aol.com



Sampling drums of ARCTIC infrared-reflective powders.

Courtesy: Shepherd Color Company

Heat-Reflecting Powders

Shepherd Color Company has introduced the ARCTIC brand of infrared reflective pigments. The powdered pigments are added to paints, plastics, and other materials to give them color. Unlike other products designed to reduce heat build-up, such as "cool" roofs, the color is not limited to white. According to the manufacturer, the ceramic pigments reflect infrared light and thus do not get as hot nor heat up as quickly as conventional materials. They have even introduced an infrared reflective true black pigment. The manufacturer claims corresponding energy savings while giving consumers a wide selection of roof colors. ARCTIC pigments are incorporated into roofing materials that qualify for an EnergyStar label.

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salesusa@shepherdcolor.com
www.shepherdcolor.com

Heating, Ventilating, and Air Conditioning

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4905 34th Street South, Suite 131
St. Petersburg, FL 33711
Phone: (727) 865-6479
Email:
acpowermizer@prodigy.net
www.acpowermizer.com

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Lindab USA
Two Stamford Landing
Stamford, CT 06902
Phone: (203) 325-4666
Fax: (203) 325-2111
Email: info@lindabusa.com

Wireless Thermostats

Wireless technology is replacing hard-wired components in almost every area of our lives. The wireless thermostat is no exception as attested by the offerings of several manufacturers. The typical set-up includes the thermostat itself plus one or more receivers and/or remotes. The systems offer variety in their configurations. The basic system comes with the thermostat and a receiver. The thermostat can be located anywhere in the home. More options can then be added to increase the level of control and convenience. For example, multiple remotes or receivers can be added to allow control of a single HVAC system from multiple locations, or multiple pieces of equipment could be controlled from the same system (e.g., multiple window units or baseboard heating units). They may be ideal for equipment retrofits and additions.

Contact:

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RCI Automation
San Diego, CA
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Email:
rciautomation@compuserv.com
www.rciautomation.com

Photo Courtesy: Enernet Corporation



T-9000 Wireless Thermostat by Enernet

Honeywell
Automation and Control
Solutions
Golden Valley, MN
www.honeywell.com/
yourhome
(select model T8665 under
Thermostats)

Magnetic Bearing Compressors

Magnetic bearings are high tech products designed to improve the efficiency and product life of rotating mechanical parts like compressors, fans, pumps, or other motor-driven devices. Turbocor has developed a bearing system in which the rotor shaft and impellers levitate during rotation and float on a magnetic cushion. Bearing sensors feed back real-time information to digitally controlled bearings. Centered rotation is instantaneously self-corrected and maintained with the shaft being repositioned 6 million times a minute.

Electromagnets maintain clearance between the rotating shaft and the bearings, so there is no lubricating oil. In the case of a power failure, a patented control scheme turns the motor into a generator and when coupled with onboard capacitors will allow for a normal

shutdown of the compressor. The Turbocor model TT300 is the world's first totally oil-free compressor specifically designed for the heating, ventilation, air conditioning and refrigeration industry.

Contact:

Turbocor
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www.turbocor.com



Courtesy: Turbocor

Magnetic Bearings

Energy/Power Systems Generation

Technology findings in this category relate to alternative means of power creation or distribution.

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MicroTurbines

Decentralized energy distribution is increasing as an alternative method of power generation. Several companies have introduced commercially-available microturbines, sometimes called mini-turbines. Currently, the smallest systems are about 30 kW in size, about three to six times as much electric energy capacity as is needed for a typical home. But the time may arrive when separate units will be available for an individual home.

Benefits include minimized need for connection to the grid, or elimination of this infrastructure altogether, typically a large cost in rural or isolated regions. The cost to produce electricity with a Microturbine can be half that of electricity purchased from the grid in many areas of the United States.

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www.microturbine.com

The Capstone C30 MicroTurbine system is a compact, ultra-low emission generator providing up to 30 kW of power and 85 kW of heat for combined heat and power applications.



Courtesy: Capstone Turbine

Catalytic Converter Technology

Electric power plants face stringent federal limits on emissions of carbon monoxide (CO), unburned hydrocarbons (HC) and oxides of nitrogen (NOx), especially when they are located in clean air "non-attainment" areas. A new generation of sophisticated catalytic converter systems is now entering the market. At present the only use of catalytic converters in homes is in some wood stoves (where EPA has set emission standards since the early 1990's), although residential furnaces in some geographic areas with poor air quality have had to include technology for reducing NOx. Emission controls could become

Catalytic Converter Technology,
continued

a requirement for various types of fuel burning residential appliances, particularly furnaces, boilers and water heaters, and possibly even fireplaces, as well as for lawn mowers and other equipment driven by small gasoline engines.

A number of conventional (platinum/palladium) catalyst systems are presently on the market. These are designed to cut CO and HC, but are ineffective for NOx. The most advanced catalytic systems are "SCR" ("Selective Catalytic Reduction") systems, specifically designed to cut NOx emissions.

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Evacuated Heat Tube Solar Water Heater

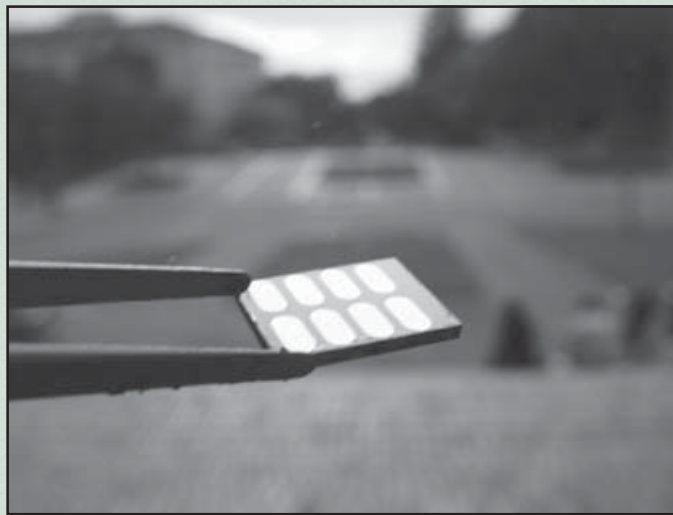
This system by Thermomax uses heat pipes and a small amount of liquid that boils in sunlight (at low pressure). Heat flows up metal assemblies to the top of the tube where the metal pieces are ganged together and the heat is transferred to antifreeze or some other conducting fluid. A residential system sized for 60 gallons per day would cost about \$5,000.

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Nanotechnology Based Solar Cells

Researchers at the University of California, Berkeley have discovered a nanomaterial that will help harness solar energy in a way that promises to be more cost-effective than traditional technologies. The discovery, reported in the journal *Science* in March 2002, involves hybrid nanocomposites, incorporating inorganic nanorods into organic



Courtesy: J.J. Dittmer, Alivisatos Lab / UC Berkeley

A panel of eight plastic solar cells based on inorganic nanorods and semiconducting polymers. The shiny ovals are the aluminum black electrodes of the individual solar cells.

semiconductor films. The elements can be mass-produced without complicated or expensive steps. The report provides details on how to make quantum rods of this material in a reliable size and get them to pack together. The quantum rods can be used as active elements in solar cells. Nanosys, Inc. is developing the technology for commercial applications. Nanosys recently announced a collaborative agreement with Matsushita Electric Works to develop next generation solar cells for the building construction market in Asia.

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Japan
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Skateboard Chassis for Utility Integration

A skateboard chassis concept could be applied to housing as a way of designing for maximum efficiency in utility installation. General Motors is pioneering such a chassis for future generation automobiles. The chassis contains all of the sedan's propulsion, transmission, steering and braking components within its 11-inch frame and provides a single electrical connection to the body. Standardizing the chassis will increase efficiency of production while enabling designers to tailor model designs to the interests and needs of the consumer. The prototype GM Hy-wire vehicle demonstrates this standardized chassis of the future. The concept of building a chassis upon which multiple designs could be placed may have application in the building industry, particularly in manufactured housing where chassis are built today to carry manufactured housing systems to the site for placement.

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Basic Materials

The Basic Materials category outlines technology in coatings, chemicals, or ingredients that improve durability and longevity; composite materials; and advanced multipurpose materials. These technologies, many of which originated at basic research levels in universities or national labs, hold promise for a variety of construction applications.

Technology Scanning

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- Indoor Environmental Quality

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Nano Materials

Nano-technology includes a broad range of disciplines where materials or processes are carried out at a very small level, often at the molecular level. It is one of the fastest growing fields in science today with applications related to materials science, solid state electronics and physics, and inorganic chemistry.

Potential applications for housing have already surfaced. Pacific Northwest National Laboratory and Oregon State University are developing revolutionary cooling systems that could be extremely small and lightweight and used as individualized heat pumps for every room of the house.

Nano-Coatings

Nano-coatings are produced by shrinking the material at the molecular level to form a denser product. Many of these materials are produced using an electrodeposition process pioneered through a collaborative effort in Ontario, Canada, and are now being produced commercially. The end result is a material that is stronger and more-durable than in its original form. Reducing the molecular structure improves nearly all of the mechanical properties of the material including yield strength, tensile strength, fatigue strength, and elongation. One downside is that nano-materials can decrease the ductility of the material.

Nano-coatings are typically designed to be applied to steel and other conductive surfaces using electro-plating processes. Still others are applied as a simple spray-on coating, or as



Courtesy: Integran

Nanocrystalline materials and coating with metallic grains up to 1000 times smaller than conventional materials - making them harder, stronger and more wear-resistant.

powders that are added to composite materials to enhance the physical properties of the base material.

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www.nanopowderenterprises.com

Nano-Ceramics

The University of Delaware has a U.S. Army-funded Center for Composite Materials. One of their objectives is to develop nano-ceramic materials. They are working on experimental techniques to develop nano-ceramics for high strain

conditions. These high-strength materials could be useful in developing advanced building technologies for housing and other uses.

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Nano-Structure Metals and Metallic Glass

The U.S. Army Research Laboratory sponsors several Centers of Excellence related to advanced materials. Johns Hopkins University (JHU) is working on high-strength nano-structure metals. With this technology, the structure of a material is denser than traditional forms of the same material. One issue with nano-structure metals is that the higher strength and durability creates low-ductility. JHU is working on lower strain hardening technologies. These high-strength materials could be useful in developing advanced building panel technologies for housing.

JHU is also developing metallic glass composite materials for anti-armor applications. This would result in a material that is impact resistant and has extremely high strength. Possible applications

include kitchen and bath fixtures, flooring, or advanced panel products.

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Coatings and Ingredient Materials

Advanced technologies have been developed by large global materials research companies to be sold into a number of applications such as coatings, chemical additives, and ingredients. They have specific engineered properties that when combined with other materials, provide a desired outcome.

Advanced Products Derived from Soybeans

Perhaps the first well-recognized soy product was automobile panels made from soy plastic by Henry Ford in 1933. The United Soybean Board (USB) publishes the *Soy Products Guide: A Listing of Soy Industrial Products*. The most recent version lists seven products that are under development for the building products arena: an ultra-low density, open-celled spray foam designed to insulate commercial and residential buildings; a spray-in-place foam insulation with no harmful emissions; a soybean-based technology that replaces a portion of the system required to make polyurethane carpet backing; a soy-based roofing coating designed to deflect ultraviolet rays; a soy-based stain that makes it possible to add the rustic look of wood to a fiber cement-sided home; a soy-based wood stain without the smell and toxicity issues of traditional stain; and a biocomposite decorative interior material.

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Surface Engineered Polymers

SICOR is a new process that has made it possible to permanently bond, print and paint components made from low-cost environmentally friendly polypropylene and other plastics. The concept involves oxidizing the surface of a polymer followed by the deposition of special types of chemicals (such as silanes and others), which form 'chemical connector' molecules on the surface of the originally 'smooth' and chemically inert plastic. The technology was invented at the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. This breakthrough means that a new generation of components can now be manufactured from polypropylene. CSIRO has established a spin-off company, Polymer Surface Technology Pty Ltd to commercialize SICOR bonding technology.

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Composite and Structural Materials

Composite material and process technologies are among the fastest growing new material applications. Composites are combinations of materials and resins that orient fibers, mats, or matrix structures in the desired area and direction to take advantage of their individual properties. Composites are usually stronger and lighter in weight than the materials they replace. Currently, the automotive industry is the



SICOR bonding technology allows the sticking together of previously unbondable or hard to bond materials.



Courtesy: U.S. Army Research Lab

From left to right: 1) Transparent ceramics for sensor windows 2) Sapphire-based transparent armor prototype 3) Vehicle transparent armor windshield laminate system

biggest user of new applications. The construction industry is emerging as the next big target for the composites industry.

Kevlar Storm Room

DuPont Kevlar® is a silky, soft man-made fiber that is stronger than steel on an equal weight basis, combining great strength with great lightness. Kevlar® is best known for its application in the field of bullet-resistant personal body armor. DuPont recently introduced a "storm room" concept that could use these reinforced fibers in the residential building industry. Application of the Kevlar® reinforcing system to a room will protect it from penetrations due to wind borne debris from a major hurricane or tornado event.

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Transparent Ceramics

Transparent ceramics are being developed by the Army Research Laboratory (ARL) for armor applications. The materials exhibit enhanced thermal and mechanical properties while maintaining clear vision. The Army

envisions a wide range of end use applications to include face shields, windshields, and windows.

Ceramics typically are opaque because their trapped pore structure scatters light. Transparent ceramics are manufactured with minimum porosity resulting in transmission of clear images. However, current materials of this type are prohibitively expensive using today's production methods. ARL is investigating development of low-cost transparent ceramic-based materials to replace current soda/lime/silica glass processes and polycarbonate materials. ARL estimates more-advanced single-crystal and polychrystalline materials will reduce weight of transparent ceramic materials by 30% and thickness by 40%.

ARL's goal is improved protection of soldiers. Thus, the focus is on uses in ground vehicles, soldier protection equipment, and other armor systems that require transparency. However, there are numerous commercial applications for this technology such as glazing in the housing market.

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Plastic and Renewable Fiber Composite Systems

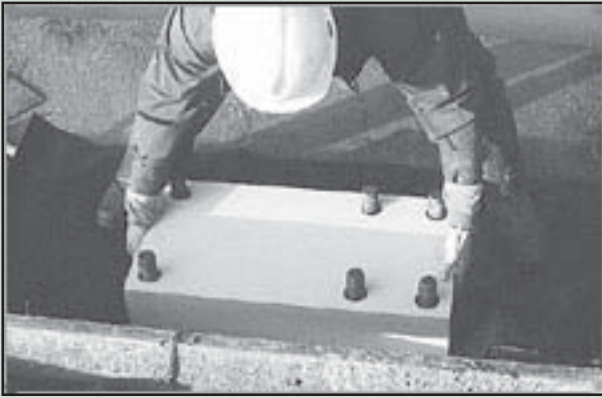
Under the trade mark FLAXOPROP®, a range of products have been developed that combine the use of natural fibers and plastic fibers. By incorporating new technologies, these products use natural renewable resources, such as flax, hemp, sisal, jute or kenaf as reinforcement fibers and binders for recycled man-made fibers like polypropylene. Applications include dividing walls, re-usable temporary shuttering, and interior wall paneling.

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Resin Transfer Molding of Fiber Reinforced Plastics

Whitewater Composites, Ltd is opening up opportunities to expand the use of fiber reinforced plastics through an innovative manufacturing process. Resin transfer molding involves placing fibers into a mold. Then, a thermosetting resin is injected into the mold. This process allows the flexibility to manufacture complex shapes and forms, including curves. It produces products that are strong and lightweight. Typical installations include facades and



Courtesy Photo: General Plastics Manufacturing Co.

R-9300, a polyurethane bearing block, is designed to support heavy structural loads while insulating a building interior from the supporting ground.

Molding Compounds have since found niches in electrical and power tool markets, as well as for high-temperature parts for large and small home appliances. With the addition of specific polymers, BMC, Inc. is now gaining acceptance for countertops, sinks, and other housing applications.

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[Resin Transfer Molding of Fiber Reinforced Plastics](#),
continued

architectural details on commercial buildings, particularly franchises that are repetitively built.

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www.whitewatercomposites.com

Polyurethane Bearing Blocks

General Plastics Manufacturing Company produces R-9300 high-density bearing blocks, providing thermal isolation for steel roof columns in refrigerated buildings. This product can also be used to isolate warm structures in very cold environments as well. Made with a high-strength polyurethane, R-9300 blocks provide insulation and structural support at the base of columns, with "R"-values of approximately 2 per inch of thickness. Because the blocks are closed cell, they are resistant to the penetration of water. A range of available densities allows for structural-support loads of up to 1800 psi.

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www.generalplastics.com

Unsaturated Polyester Molding Compounds

The manufacture of electrical equipment using unsaturated polyester molding compounds dates to the late 1970s. A range of auto applications for bulk molding compounds emerged in the 1980s with dimensional stabilities at elevated temperatures. They are designed to meet automotive industry requirements for ten year/150,000 mile durability. Bulk

Woven Strapping Materials

Polyester and similar wove materials being produced by CordStrap, LLC, provide a material that is strong, flexible, comes in a roll, and has a wide variety of uses. The main current use of these products is for strapping to bundle building products and other supplies. They are also used for agricultural applications. CordStrap sees other potential uses in homebuilding such as hangers for plumbing or ductwork, or to structurally tie a building together.

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www.cordstrapping.com



Polyester strapping material is used to wrap bundles of lumber.

Courtesy: CordStrap, LLC

Information Technology

This category includes innovations in wireless and other information technology areas.

Technology Scanning

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Electro-Textiles

Electro-textiles are conductive materials that are woven or integrated into fabrics. These fabrics offer alternative methods for data and power transmission than are currently in use. They can be used to produce such diverse and imaginative applications as roll-up keyboards, jackets that interface with your mobile phone or pc, a television remote control sewn into the arm of a sofa, or light switches embedded in curtains and carpets.

The U.S. Army and several companies are working to integrate these materials into military clothing. This would enable clothing to transmit signals to equipment a soldier is carrying. This technology will turn otherwise passive clothing and other fabrics into an integral part of the soldier's electronic/communications systems. One project focused on integration of a USB cable into fabrics, since USB is commonly used with desktop computers. The cable arrangement was manufactured as a thin, flexible material.

Several companies are producing pressure sensitive fabrics which also may hold great promise for applications in housing. Pressure sensitive fabrics are produced using quantum tunnelling composites (QTC) with unique pressure controllable switching properties. In their normal state these fabrics are insulators. However, when pressure is applied, the resistance decreases until the fabric achieves metal-like conductivity. With the use of these products, interior environmental conditions can be changed using wearable switches or by touching wall coverings. These fabrics can also be used as sensors to monitor the



Courtesy: U.S. Army

A Universal Serial Bus (USB) cable was manufactured into a thin, flexible and wearable cable with flat, low-profile connectors that can be integrated into clothing.

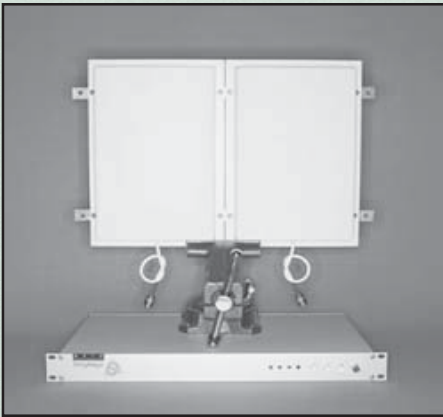
occupancy of interior spaces as a means of saving energy.

To date the vast majority of applications for electro-textile materials has been in the apparel industries. A potential use in homes is wiring imbedded into construction materials.

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Sensatex (smart textile manufacturer - smartshirt system)
New York Office
494 Broadway, 2nd Floor
New York, NY
Phone: (212) 334-2525



An example of a RFID Reader.

Typical RFID tags, shown below, have the size and flexibility of an address label and allow remote reading and writing from up to several meters without requiring a clear line of sight between reader and tag.



Courtesy: Dynasys Technologies, Inc.

Fax: (212) 334-2324
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Radio Frequency Identification Devices

RFID creates an automatic way to collect information about a product, place, time or transaction quickly, easily and without human error. It provides a contactless data link, without need for line of sight or concerns about harsh or dirty environments that restrict other auto ID technologies such as bar codes. In addition, RFID is more than just an ID code, it can be used as a data carrier, with information being written to and updated on the tag.

RFID systems consist of a number of components including tags, handheld or stationary readers, data input units and system software. The tags are the backbone of the technology and come in all shapes, sizes and read ranges including thin and flexible "smart labels" which can be laminated between paper or plastic.

The idea for Radio Frequency Identification (RFID) technologies has been around for

decades, but their application has been held back in part by the expense of the tags, which ranges from just under \$1 to \$20. Now the potential cost has dropped to about a nickel, as sponsors of the commercially funded Auto-ID Center at Massachusetts Institute of Technology have figured out ways to produce inexpensive chips in quantity based on developing standards.

RFID technology could be used in construction for inventory control, improving inspection efficiency, and to track job progress.

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Fax: (617) 253-1643
www.autoidcenter.org

Savi Technology
Mountain View, CA

Phone: (650) 934-8000
www.savi.com

CECOM (Army Communication Electronic Command)
Research and Development Engineering
Fort Monmouth, NJ
Phone: (908) 532-0353

Manufacturers:

Texas Instruments, Dallas, TX
www.ti-rfid.com

Intermec, Everett, WA
www.intermec.com

Alien Technology,
Morgan Hill, CA
www.alientechnology.com

Philips Semiconductors,
Eindhoven, Netherlands
www.philips.com

SCS
San Diego, CA
www.scs-corp.com

Video Encoder/Decoder Cards

Coastcom's new Encoder and Decoder Video II cards use state-of-the-art technology to achieve superior picture quality. These enhanced cards function with over two times the quality/bandwidth of the latest and most popular standards - H.263 and MPEG-4. Typical current applications include transportation monitoring, video conferencing, and remote video surveillance. A videoconferencing set-up can include Video Encoder/Decoder Channel Cards, video cameras, PCs, and audio equipment at each site. A company with multiple offices could use videoconferencing to enhance communication and promote employee interaction. Continued enhancements of this technology could lead to building industry applications in the areas of enhanced project management tools and remote construction

inspection systems.

Contact:

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Fax: (510) 523-6150
www.coastcom.com

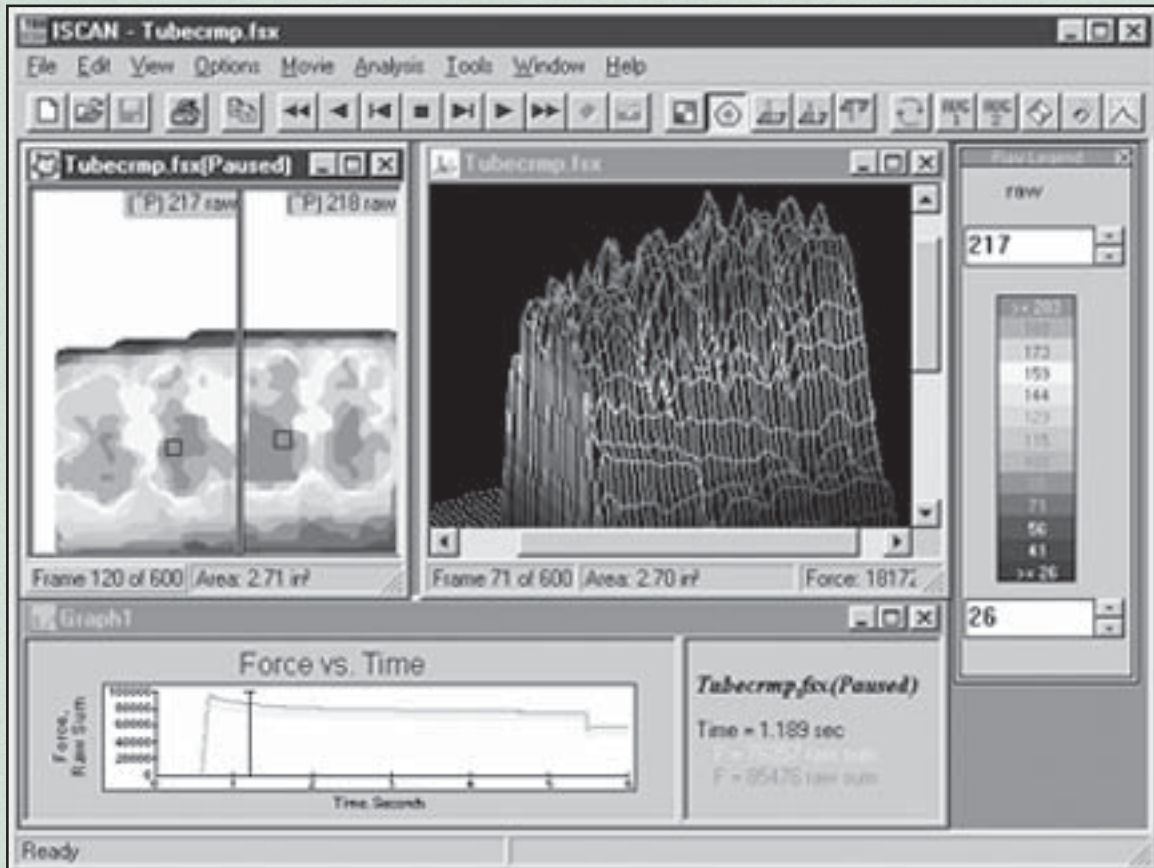
Tactile Pressure Sensors and Measurement Systems

The I-Scan® System by Tekscan is a versatile pressure measurement system using Tekscan's patented thin-film pressure sensing technology. At the system's heart is a tactile sensor capable of measuring pressures as low as 5 mmHg and as high as 175 MPa. Sensors measure approximately 0.1 mm in thickness. Output can be monitored in 2-D or 3-D on a computer using software provided by Tekscan. Tekscan's wide pressure range has enabled them to pursue applications

varying from mattress design to stress analysis of concrete support structures. Potential applications include door seal force measurement, high-speed impact studies, gasket and seal analysis, fastener and clamp load analysis, and fabric and material density measurement. Specific housing applications may include monitoring during or after events such as earthquakes or hurricanes.

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Courtesy: Tekscan, Inc.

The I-Scan® software system displays the pressure and force information as it happens (in 'real time') on the computer screen, in vibrantly colored 2D or 3D images. Dynamic tests can also be recorded as a "movie", and played back with operating controls similar to a home VCR.

Thermal and Moisture Protection

This category outlines technologies that could be applied to thermal or moisture protection in homes to keep people more comfortable and protect the building from the elements.

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Electro-Osmotic De-Moisturizing (EODM) Technology

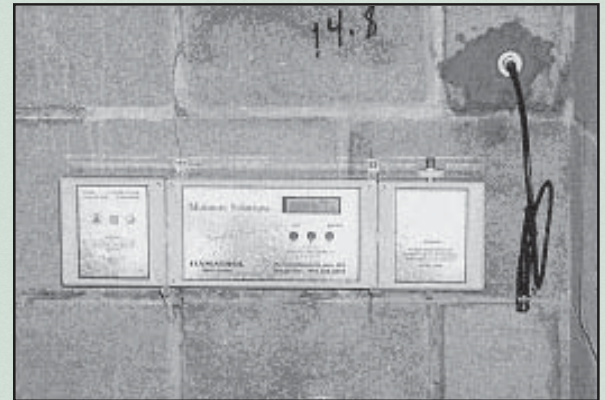
EODM technology provides a low-energy method of moving moisture through soils. Moisture Solutions L.L.C. claims to use this technology to prevent moisture in the ground from entering a structure through sub-grade concrete and masonry structures. As a result, mold, mildew, and related odors, and other indoor air quality problems can be reduced or eliminated. The method has been used for 15 years in Europe and demonstrated by the U.S. Army on a limited basis. EODM takes advantage of the electrical properties of the earth, water and concrete to impede the intrusion of ground moisture. It sets up a virtual electronic shield around a building to keep moisture out. The system does not employ chemicals and is minimally invasive. It generates energy levels far below those of a cellphone or cordless phone.

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www.moisture-solutions.com/home.asp

Remote Freeze and Water Alarm System

Control Products distributes a plug-in alarm system that can be used to remotely monitor temperatures in critical locations. When the temperature drops below 45 degrees the



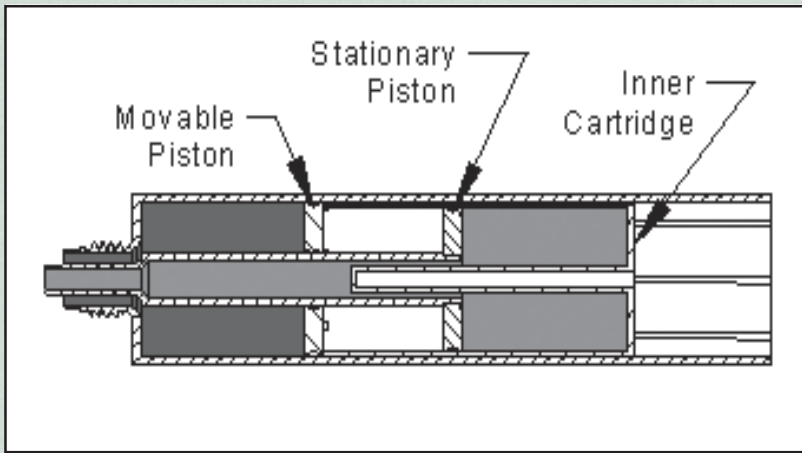
Moisture Solutions Control Unit (EODM)

Courtesy Photo: Moisture Solutions LLC

Freeze Alarm System calls out to another telephone and plays a prerecorded message (MSRP \$104). An upgrade model calls up to three numbers (MSRP \$210). A remotely controlled switch can be used to turn on a heater in a crawl space during a cold spell, control the HVAC in a vacation home or cabin, or simply function as an alarm system. The Water Alarm is an add-on that is designed to detect water on floors.

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Courtesy: TAH Industries

Two-Part Universal Sealant Cartridge

Two-Part Universal Sealant Cartridge

Use of two-part caulks or sealants has always been limited because of the need for mixing and metering of the individual components. A new product now opens up many more durable sealants to the industry by eliminating the need for special mixing or applicator tools. The two-component cartridge is designed to fit into a conventional caulk gun. The design will make it much more practical to use two-part sealants including many urethane products. TAH Industries has developed the TAHplus Universal Cartridge to deliver two-part sealants using a standard 1/10 gallon single component caulking gun. The cartridge will hold 250 ml in a 1:1 ratio of each component. This allows it to hold an equivalent amount to a single component adhesive. Other similar products designed to fit into a conventional caulk gun are only applicable to high ratios that are not mix sensitive, require adaptor tools, or have much smaller capacities. The TAHplus provides accurate metering at the 1:1 ratio. A cartridge for 2:1 ratio components is also under development.

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Construction Drying Systems

Munters provides a desiccant-based construction drying system. The technology addresses construction site moisture problems with dehumidification, instead of relying on propane heaters or the building's A/C system. Munters' dehumidifiers continuously replace humid air inside the building with air which has been dehumidified. This extremely dry air accelerates moisture removal from wet surfaces, such as from flooring, walls, stored building materials, etc. Munters provides a turnkey moisture reduction and management process for the builder during critical construction phases. Munters provides a desiccant dehumidifier to the job site and temporary ductwork to run throughout the construction project. The system shows promise for reducing moisture or mold-related problems.

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Formed-In-Place Gasketing Systems

Gaskets are critical components that must perform under extremely difficult conditions. They often are the last line of resistance between interior and exterior, hot and cold, or wet and dry. What is more, they must be absolutely reliable and have the longest possible service lives. Wacker Silicones has developed a series of technologies called formed-in-place gaskets (FIPG), compressive or "cured-in-place" gaskets (CIPG), and liquid-injected seals (LIS). The automotives and electronics sectors both include highly specialized applications that make extreme demands on the sealing materials used. They include engine gaskets, control unit gaskets, electronic encapsulation and special elements for decoupling noise and vibrations. The Wacker technology injects silicones into these products to create the gasket. Potential applications in the building industry are window and door installations, as well as any product or material that penetrates the building envelope.

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Portable Infrared Thermal Imaging Systems

Infrared thermal imaging systems are now more portable, powerful, and accurate than ever. Handheld units for on-site inspections have efficient firewire connecting ports with supporting software. High performance units, such as the TVS-8500 by CMC Electronics Cincinnati, display critical temperatures on the built-in 5" liquid crystal screen. High fidelity images are acquired at 120 frames per second over a temperature range of -40 degrees C to 900 degrees C with options to extend beyond 2000 degrees C. More portable units for specific industrial applications are available from FLIR Systems through its ThermaCAM E-Series. Infrared systems can help to identify loose connections, roofing leaks, predict sources of future malfunctions, detect corroded connectors, verify proper corrective maintenance, find faulty fuse connections, or discover insulator defects. Some of the portable units have the ability to store data for later viewing and analysis on a computer. Builders or remodelers could use the technology to verify the house's thermal protection system.

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Prefabricated Drainage Systems

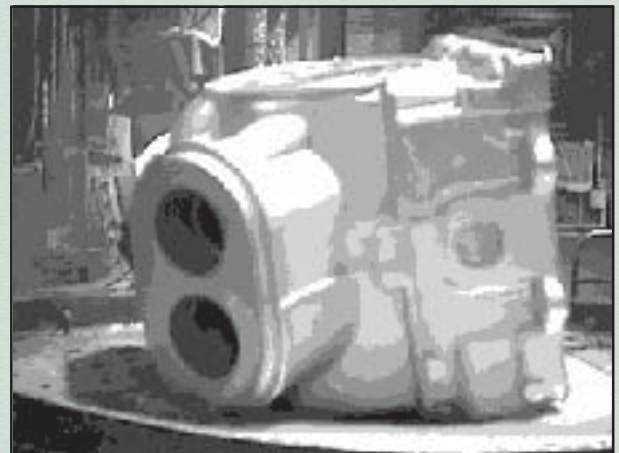
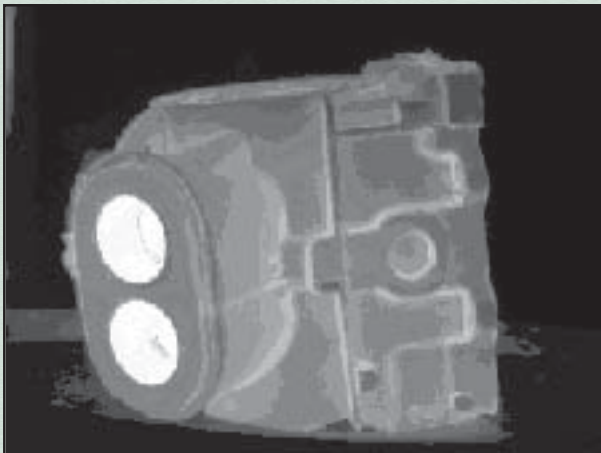
EZflow produces prefabricated drainage systems designed specifically to replace stone aggregate systems in a variety of applications. The aggregate used in EZflow Drains is recycled expanded polystyrene (EPS) - the same material commonly used for drink cups and packaging. Non-degradable EPS is light in weight.

The basic unit of EZflow Drain is a 10-foot length of 4-inch perforated, corrugated plastic pipe surrounded by EPS aggregate held in place by a

cylindrical shaped polyethylene netting either 6, 10, or 12 inches in diameter. EZflow Drain systems replace stone aggregate subsurface drains in such applications as foundation drains, embankment drains, retaining walls, road underdrains, vertical drains, and perimeter drains. They are also used in septic systems.

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Infrared images of cooling process in Engine Block Molding.

Indoor Environmental Quality

Indoor environmental quality includes technologies that hold potential for improving the health and comfort for occupants of homes.

Technology Scanning

One of PATH's major research support services is Technology Scanning. *Technology Scanning* tells us about technology developments in other industries, from other nations, from federal laboratories, and from other building sectors. PATH looks for breakthroughs in other industries that could be transferred and applied to housing. *Technology Scanning*-published by the U.S. Department of Housing and Urban Development/PATH and prepared by Newport Partners LLC-is updated as technology developments dictate.

This issue of *Technology Scanning* is one in a series. Each issue in the series falls into one of the following categories:

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Enhanced Catalytic Oxidation/Photoionization

Advanced anti-microbial air purification technology used to destroy micro-organisms in food processing plants is now available for the home-building industry. The PHI CELL Probe™ is easily integrated into the air conditioning and heating system's air ducts, and is designed to reduce indoor air pollution and sick-building-syndrome risks. By engineering the proper light wavelength, RGF Environmental claims to have effectively created an anti-microbial air purification system. The process utilizes a combination of UV rays, passive ozone, hydro-peroxides, hydroxyl radicals, and super oxide ions. These "friendly" oxidizers travel throughout the home, helping to neutralize gases and odors, and cleansing the air of mold, bacteria, germs and other pollutants.

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Aerosol Decontamination Systems

Foster-Miller, Inc. has developed an aerosol system for decontaminating soldiers and spaces exposed to chemical contamination. Their ECADS (electrostatically charged aerosol decontamination system) process is the delivery system for a variety of decontamination media. Foster-Miller is working with a company from California called EnviroSystems to evaluate using ECADS to deliver a cleaner/disinfectant for biological contaminants.

This technology may have application to house mold problems. It may be possible to

use it to economically decontaminate a complete home or various parts of the home like a basement or attic.

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Air Quality Sensors and Related HVAC Controls

A new breed of air quality sensors is being installed in automobiles with control strategies that automatically operate the outside air inlet door. The aim is to reduce the amount of pollution carried into the vehicle cabin through the HVAC system by closing the intake port when the vehicle enters high pollution areas. This provides significant health, safety and comfort benefits for drivers and occupants of motor vehicles and significantly extends the life of cabin air filters. Manual operation of the recirculation switch is not as effective as an air quality sensor because of the limitations of the human ability to detect pollution. Drivers can only detect the odor of some gases that are coincident with harmful gases, but many noxious gases are odorless. Similar sensors could be used in residential buildings to detect the presence of various pollutants - both indoors and outdoors - and operate control strategies through the HVAC system.

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