February/March 1999 $4.00

Hawaii Pacific Architecture

Green Architecture

PMP Company, Ltd., Publishers
1034 Kilani Ave., Ste. 108
Wahiawa, HI 96786

*****************************5-DIGIT 96816
ALAN H NEMIROFF
1465 MOKUNA PL
HONOLULU HI 96816-2715

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Volume 6, Number 1

February/March 1999

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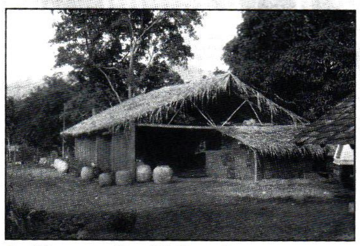

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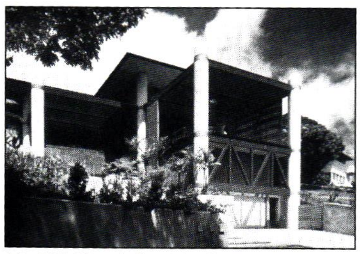

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IN THIS ISSUE...

According to Kermit the Frog, "it's not easy being green," but a dedicated group of Hawaii professionals who are promoting green architecture may disagree with that statement. In fact, environmentally responsible design and construction practices do not have to be expensive and may be easily attainable in Hawaii, as the articles in this issue point out.

COVER: A rural structure in Thailand built of bricks from on-site soil integrates with the environment both ecologically and aesthetically. Could this technology be used in Hawaii? See the story on page 5.

Hawaii Pacific Architecture is the bi-monthly journal of the AIA Hawaii State Council. Subscriptions are $24 per year. Foreign subscriptions: $48. Opinions expressed by authors do not necessarily reflect those of either the AIA Hawaii State Council or the publisher. The appearance of advertisements or new products and service information does not constitute an endorsement of the items featured.

AIA Hawaii State Council and AIA Honolulu
1128 Nuuanu Avenue, Honolulu, Hawaii 96817 (808) 545-4242

AIA Hawaii Island
P.O. Box 491, Hilo, Hawaii 96721
(808) 961-0374

AIA Maui
P.O. Box 929, Wailuku, Hawaii 96793
(808) 244-9574

PMP Publishing Company, Ltd.

Publisher
Peggi Marshall Murchison

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 Postmaster: Send change of addresses to *Hawaii Pacific Architecture* (ISSN 1089-4470), 1034 Kilani Ave., Suite 108, Wahiawa, Hawaii 96786.

Choices now and for the future

Saving Energy Economically

by Nick H. Huddleston, AIA

"Energy codes," "green architecture" and "sustainable building" are concepts that allow society to meet its needs without compromising the ability of future generations to meet theirs. These concepts sound very high-minded, but can we afford such niceties when many people find existing housing costs beyond their means?

Some building professionals have doubts. For example, the building industry locally and nationally has resisted the imposition of energy codes for residential construction, largely due to concerns about upfront costs and market payback.

Strategies for saving energy while preserving comfort levels and affordability will be explored this year through a U.S. Department of Energy "Energy Efficiency Guidelines" grant. The grant was obtained through the efforts of the Honolulu Chapter AIA Energy and Environment Committee and the Department of Business, Economic Development and Tourism.

A key goal of the grant is to work with a builder or developer in partnership to build a model demonstration house to test energy-saving measures. Design input and monitoring of the model house's environmental comfort levels will be provided by the grant.

The grant and model house will encourage home builders to voluntarily adopt energy saving measures and environmentally sensitive construction techniques that are cost-effective and marketable with minimal impact on upfront delivery costs. The house will be open for six months for public tours to acquaint buyers with the concept of "green" energy efficient building and to encourage island home builders to build green and use environmentally sensitive design and energy efficiency as marketing tools.

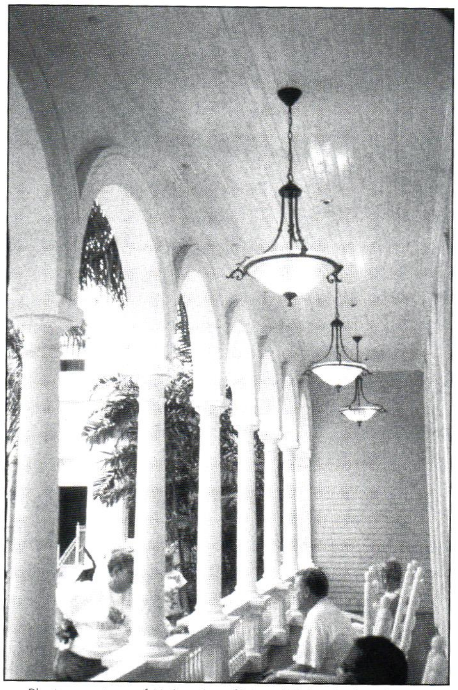


Photo courtesy of University of Hawaii School of Architecture

Shaded lanais, shown here at the Sheraton Moana Surfrider, protect openings, interiors and occupants from the sun and the elements.

A number of factors make this challenge easier than you might think. Some energy-saving features can be implemented with little or no cost. Others have clear cost/benefit advantages or solve more than one problem, providing benefits in the areas of sustainability, cost control and environmentally-sensitive design as well as saving energy.

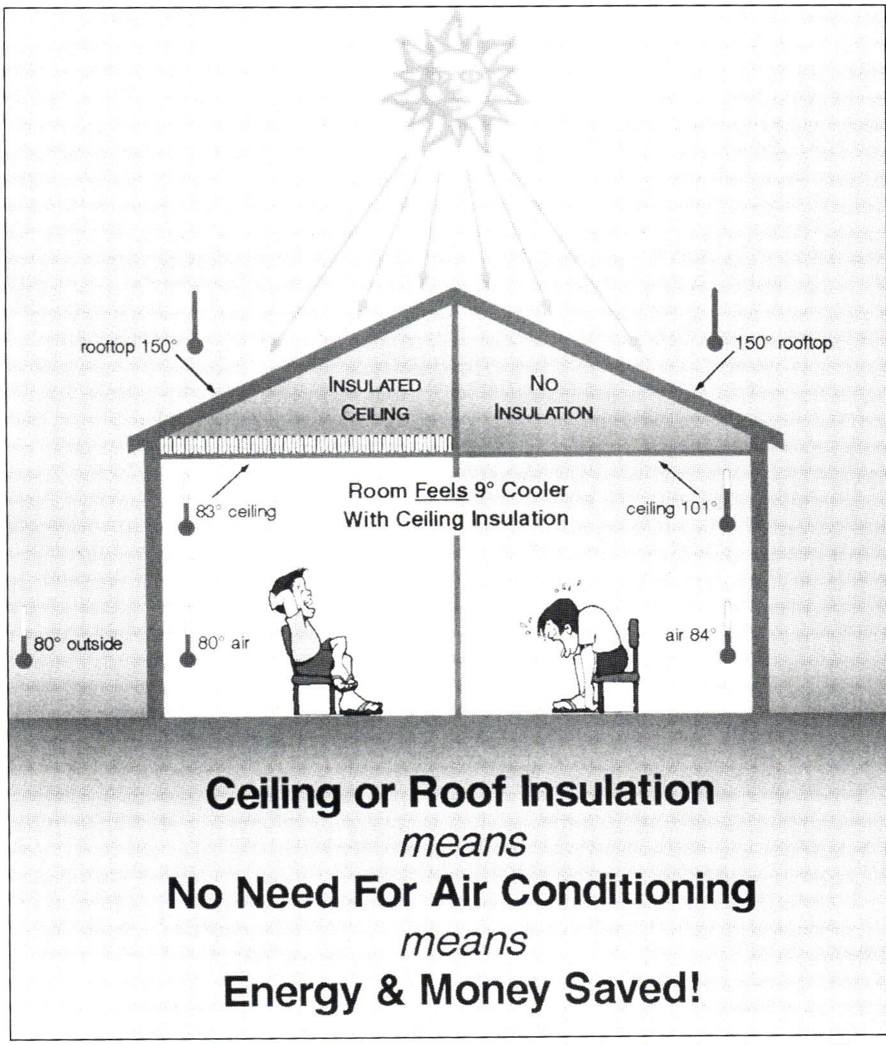
Natural Versus Mechanical Cooling

The Hawaii Model Energy Code, developed several years ago under a separate DOE grant, illustrates the importance of finding ways to build homes that are comfortable without requiring air conditioning. The code's recommendations for non-air conditioned, low-rise residential construction include good cross ventilation and/or ceiling fans, light-colored roofing and the installation of ceiling insulation or a radiant barrier that takes advantage of the reflective properties of aluminum foil.

The code's recommended requirements for air conditioned buildings are more complicated. Walls must be shaded or insulated. Shaded or tinted windows may be required, skylight areas must be limited, the building must be tightly sealed, and the air conditioning system must meet strict efficiency requirements. The added cost of these features, system installation, higher electric bills, and the cost of maintaining and eventually replacing the equipment underscore the value of creating comfortable residential interiors without the use of air conditioning.

Natural ventilation can help keep a home comfortable without air conditioning and doesn't have to be expensive. Good natural ventilation can help prevent mold and mildew and reduce indoor air pollution. Well-designed doors, windows and vents can let in Hawaii's balmy breezes and help exclude dust. Attic vents can lower attic, interior and roofing heat levels, and extend the life of roofing materials.

Ceiling fans can make a big difference, providing comfort on days when the trade winds aren't blowing. These benefits can easily justify the nominal cost of fans, particularly for the growing number of people who work at home.



Graphic courtesy of Department of Business, Economic Development and Tourism

Ceiling insulation can make a big difference in creating comfortable interiors without air conditioning.

Harnessing the Sun

Energy efficient design must use the sun's energy and find ways to protect buildings and occupants from the sun's negative effects.

With high solar insolation and electric rates, Hawaii is probably the best place in the United States for using photovoltaic systems. With available tax credits, grid connected residential PV electric systems can be used today in Hawaii without an economic penalty and are well worth a closer look.

Solar hot water heating, however, is still the most effective way to use the sun's heat to reduce energy consumption. Substantial credits are available to help make solar hot water systems more affordable. Builders can offer solar hot water heating as a option at reduced upfront costs by pre-plumbing homes for solar and providing larger hot water tanks that will work with solar collectors. Owners can then choose whether to pay for a complete system upfront or wait until a later date.

A number of low-cost approaches are available for controlling the sun's effects on building materials and occupants. Light-colored roofs don't cost any more than dark ones and they provide lower inside and outside air temperatures. Lower outside air temperatures improve building occupant comfort and can help to reduce air pollution which is aggravated by high temperatures.

Ample roof overhangs, arcades and covered lanais serve to shade walls and windows and reduce interior heat gain and the risk of water infiltration through openings and finish systems. Generous overhangs also reduce water and sun damage to finishes and building components.

Ceiling insulation and radiant barriers are tougher to retrofit and add to the cost of new construction. However, if these measures together with ceiling fans and better ventilation keep homeowners comfortable without air conditioning, the benefits in utility cost savings and happier clients can be worth the expense.

Raising the Floor

Old plantation-style homes derived multiple benefits from raising floors above ground level. Ample air space below the floor framing allows cooling air to flow under the home. It also opens up the possibility of letting fresh air in through floor vents if a homeowner doesn't want heavy winds and dust blowing in from the windward side of the building. Good sub-floor ventilation reduces rot, mold and mildew. And, a raised floor makes it much easier to remodel a home.

In addition, lifting the floor off the ground offers a degree of protection against Hawaii's ever-present termites. Concrete support piers can be highly termite-resistant and if they are tall enough to allow easy inspection, it is much easier to control the risk of ground termite infestation. These advantages can reduce or eliminate the need for chemical ground treatment.

Reducing the use of chemical treatments such as soil poisons has important benefits. These treatments are expensive and owners expect long-term protection. Unfortunately, tests at the University of Hawaii indicate that many of the currently approved soil poisons lose their effectiveness in three to five years depending on soil conditions and where the home is located. This is a lose/lose situation. The poison doesn't give owners the protection they expected and toxic material is added to the site and may find its way into the water supply.

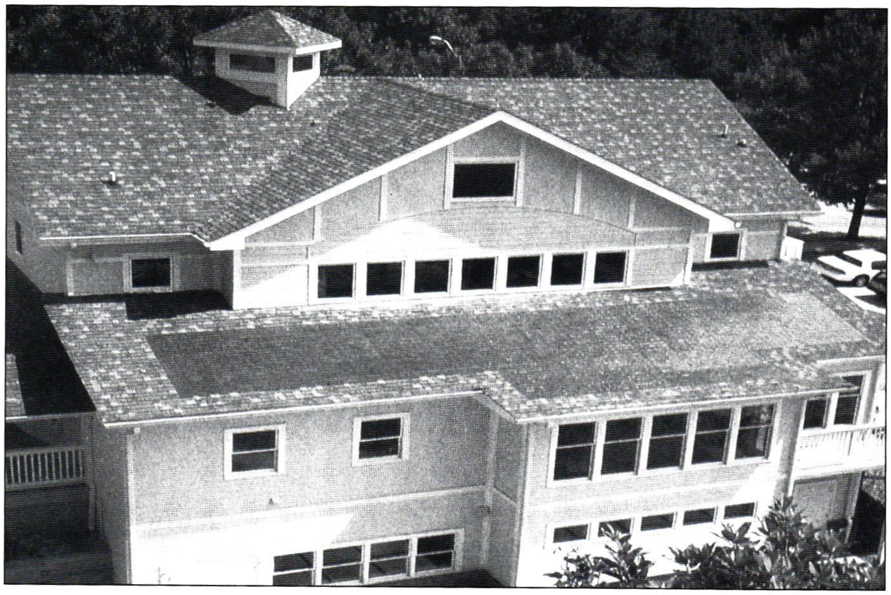


Photo courtesy of UNI-SOLAR, Inc.

Energy-efficient principles have been put into practice at the Southface Energy and Resource Center in Atlanta, with a roof-integrated photovoltaic system, a light-colored roof and plenty of ventilation.

Choices We Can Live With

Design and construction professionals are in a better position if they can select energy-saving features that are well suited to their project, site and market. This may help avoid the imposition of mandatory energy code requirements that may be more difficult and expensive to implement and less suited to project needs.

We look forward to working with design and building professionals during the coming year in our search for better building alternatives. Our preliminary analysis of commonly recommended energy-saving features suggests that many are cost effective, can improve project marketability, and may solve a variety of additional problems while contributing to energy savings and comfort. The grant and model home will provide design guidelines and a real-world demonstration of energy and resource efficient features that meet today's needs without compromising the future.

Nick H. Huddleston, AIA, is an architect in private practice and the project manager for the "Energy Guidelines" grant.

Building homes for resource efficiency

Going Green in Hawaii

by Alan Ewell

After the oil embargo of 1974, a wave of interest in energy efficiency swept the country. Solar water heaters appeared on rooftops, "superinsulation" became a builder's buzzword and cars began to shrink. There was great hope that the United States could become energy independent.

Since that time, much progress has been made, but much growth has also taken place. As we near the turn of the century, the United States is, for the first time, dependent on foreign sources for over 50 percent of its energy needs. In Hawaii that figure is over 90 percent, the highest of any state.

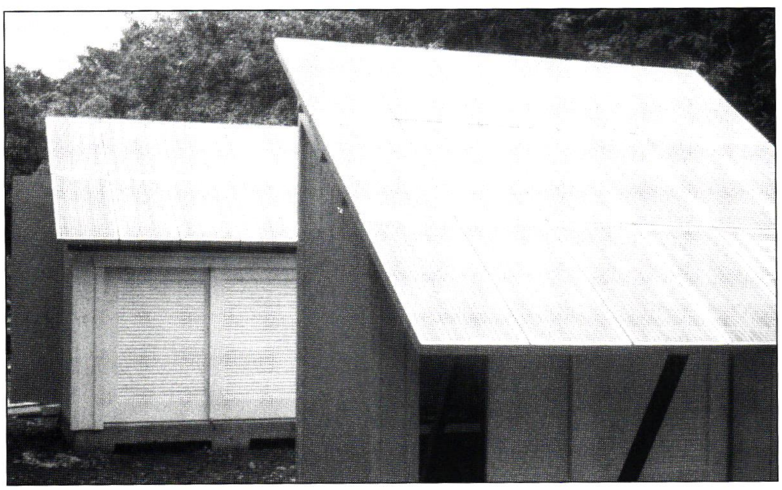


Photo by Stephen Meder

Stand-alone photovoltaic systems developed by Hawaiian Electric Light Company on the Big Island provide a good example of local companies' commitment to developing energy-efficient systems and practices.

In response, there has been renewed interest in reducing our energy use, but today that concern also includes mandates to protect the environment, improve comfort and rebuild our communities.

Mainland Cities Go Green

Building professionals across the nation are searching for more cost-effective, resource-efficient ways to construct homes. Pioneering and highly successful Green Builder programs have rapidly ignited interest in resource-efficient design and construction. For example, every home in the Denver Parade of Homes last year was built "green." Government programs including the Energy Star home program and the Building America project now reach millions of homeowners. Eighteen states have Home Energy Rating Systems tied to financial incentives for buyers of energy-efficient homes, and that number is growing.

The HABiT Program

Now there is an exciting opportunity for Hawaii's builders, developers, government agencies and energy providers to join this nationwide effort to re-engineer homes for resource efficiency. The Hawaii Advanced Building Technology Program (HABiT) was created to encourage cost-effective, environmentally responsible residential design and construction. The program and related grant projects have received over $400,000 in funding from the U.S. Environmental Protection Agency, U.S. Department of Energy, The Hawaii Department of Business, Economic Development and Tourism, the Hawaii Department of Health, the City and County of Honolulu, and the American Institute of Architects.

Along with training and technical support, information is the cornerstone of the HABiT approach (the "i" in HABiT). To convey that information, the group has recently published the *Guide to Resource-Efficient Building in Hawaii*. The guide is organized around objectives of energy efficiency, water quality and conservation, superior indoor air quality, resource-efficient building materials, effective construction waste management and environmentally-sensitive pest control. The guide is available through the Honolulu Chapter AIA, the Building Industry Association of Hawaii, and the DBEDT Energy Conservation Branch.

The HABiT Guide will be used to train building professionals in a series of Advanced Building Technology Workshops beginning this month in all Hawaii counties. Featured speakers will include nationally-recognized resource-efficiency experts Steve Loken from the Center for Resourceful Building Technology in Missoula, Montana; and Joel Schurke from the Cunningham Group in Minneapolis.

From Theory to Practice

Beginning this summer, teams of trained architects, builders and developers will begin work on a series of demonstration homes that will showcase the environmental objectives of the program. Commitments are in place for HABiT homes on Kauai, Maui and the Big Island.

On Oahu, the program has concluded a preliminary partnership agreement with the CARB group, one of four national Building America teams. CARB has agreed to commit $250,000 in funding for research, design and evaluation and up to $50,000 in donated materials to a joint demonstration home project. The program is currently seeking a developer partner to build the Oahu home and other local sponsors to provide matching funds and in-kind donations. The project will benefit from the CARB group's experience with the Building America Program and should receive national as well as local recognition.

Marketing Green Homes

One of the key components of successful green building programs has been creating tools that help home buyers identify resource-efficient homes and provide a means for green builders to differentiate themselves in the marketplace. HABiT, working with Realtors and mortgage lenders, will create a Home-Efficiency Rating System designed to quantify resource-efficient features of homes.

Based on these ratings, home buyers will qualify for financial incentives which may include free appraisals, lower points and closing costs, or higher debt-to-earnings ratios. Builders will be able to point with pride to homes certified by an independent rating program as superior in design and construction.

Our homes have a major impact on the state's economy, yet Hawaii has been slow to assess the impact of our communities on our environmental and economic resources. HABiT offers the opportunity for Hawaii's architects, builders and developers to work together to define innovative solutions to reduce construction costs, increase comfort and energy efficiency of homes, and improve the quality of life in our communities.

Alan Ewell is project manager for the Hawaii Advanced Building Technology Program. He is an architect and builder with 20 years of experience in energy-efficient residential construction. For more information about HABiT projects, publications and workshops, call 945-3853.

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Project Profile:

KAPOLEI POLICE STATION

The establishment of a major regional government complex in Kapolei is a part of the master plan for Oahu's Second City. The Kapolei Police Station currently under construction is a major component of that plan and is intended to serve the growing communities of Leeward and Central Oahu. When completed, approximately 250 police officers and civilian personnel will be assigned to the station.

In addition to conforming with the urban design plan and guidelines established for the City of Kapolei, a major goal of the design was to create a "Hawaiian style" building that would welcome the surrounding neighborhood and be responsive to the needs of the community.

Architecturally, emphasis was placed on creating an entrance sequence which would orient a visitor easily and comfortably. Double-pitched clay tile roofs, wide overhangs and walkways, deep, inset window openings, precast art panels and murals, and native Hawaiian landscaping help to reinforce the Hawaiian sense of place.

The station is a two-phase project, with the first phase consisting of an approximately 51,000 square-foot regional police station, including departments for Narcotics/Vice Division, Receiving, Regional Patrol, Juvenile Services Division, and Criminal Investigation (C.I.D.). The station consists of three levels: one below-grade basement level housing the holding cell block, and two above-grade levels of administrative and public spaces. Separate ancillary structures include a clean/detail building (for searching confiscated vehicles), a fuel station and a covered trash enclosure.

The configuration also allows for the future construction of a 14,000 square-foot Phase II addition which will provide office and storage space for the Finance and Records Division.

The construction of the building basement level below the first floor is concrete, and construction of the two upper levels above the first floor is structural steel. Structural steel is also used on the separate secondary structures.

The decision to use steel as the major framing material was made early in the design process. The advantages of using structural steel over other systems included ease of construction, relatively quick erec-

Rendering by Carter Black

The Kapolei Police Station is a part of the City and County of Honolulu's commitment to develop the "Second City."

tion time, flexibility for both architectural and structural design, and lighter overall structure weight.

The use of concrete above the ground floor was ruled out as it would have created "bulkier" columns and added additional weight to the overall structure. The added weight would have translated into greater seismic forces which would have to have been addressed.

The slenderness of the steel wide flange columns and the absence of any internal first floor shear walls allowed for a greater flexibility of the building's space plan. Lateral forces above the first floor are resisted by steel ordinary moment-resisting frames (OMRF) which were modeled using the RISA 2-Dimensional Structural Analysis computer program.

A major feature of the building is a two-story entry atrium which required that the structure be exposed to view. Special structural consideration was given to this area as the roof truss is cross braced with slender tube steel web members connected to the top and bottom chord with custom-designed slotted gusset plates. Connections are to be welded and ground smooth versus bolted. The finished product will be a smooth and clean structural element with a light-weight, lace-like appearance.

The exterior walls above the first floor are framed with cold formed metal framing clad with exterior sheathing board. A textured exterior wall finish will be applied as the final finish. Like the decision to use structural steel, the cold formed metal framing allowed for flexibility in the design of the exterior wall. Window size and placement could be easily modified as the design progressed. In addition, the exterior wall plane was able to be articulated with deep window recesses, pilasters, bulkheads and soffits.

The structural floor systems consist of grade slabs, precast prestressed concrete planks (either 14" tritees or 3-1/2" thick solid planks at the first floor level) and concrete topping over 16 gauge metal decking (at the second floor). The use of precast elements enabled greater span lengths, and the use of concrete over metal decking allowed a lighter structure versus concrete columns and beams.

The double pitched roof was also easily achieved with the use of structural steel. Roof trusses and bent steel wide flange beams were utilized to create this element found on many Hawaiian structures.

The use of steel for the Kapolei Police Station has proven to be an effective material of choice in framing the structure of the building. Its versatility has provided the required flexibility driven by the users' needs without compromising the strength and integrity required for the project.

by Emile C. Alano, AIA, Associate, Architects Hawaii Ltd.

KAPOLEI POLICE STATION

Credits:

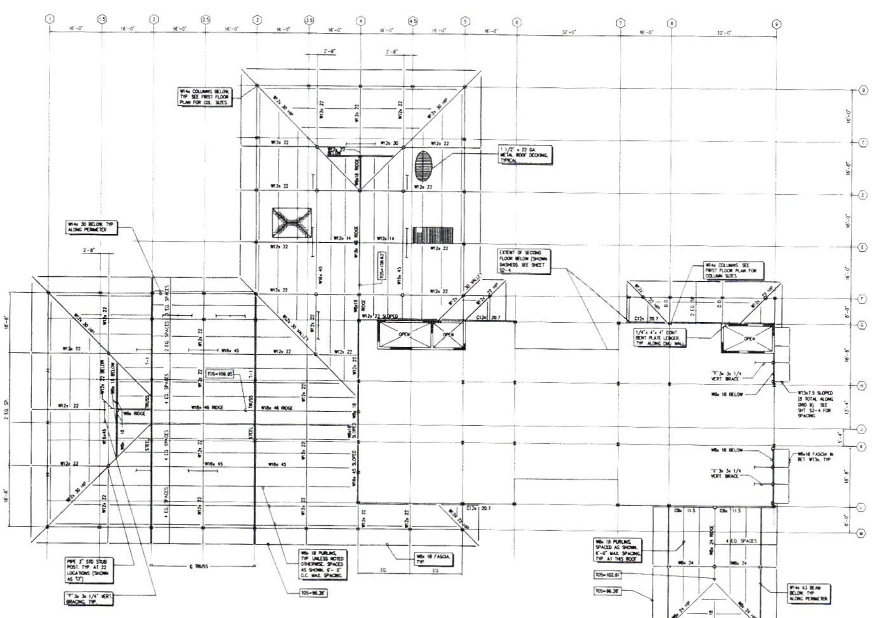
Client/Developer
City & County of Honolulu
Mayor Jeremy Harris
Department of Design and Construction

Architect
Architects Hawaii Ltd.

Structural Engineer
SSFM Engineers, Inc.

Structural Steel
S & M Welding Co., Ltd.

General Contractor
Okada Trucking Co., Ltd.



LOW ROOF PLAN

From garbage to greenbacks

Recycling Construction Waste

by Gail Suzuki-Jones, Assoc. AIA

It is estimated that the demolition of a typical single family home generates four pounds of construction and demolition (C & D) waste per square foot. An average 1,500 square foot home therefore generates approximately three tons of waste.

The annual statewide estimate for C & D waste was recently estimated to be 600,000 tons. On Oahu, roughly 34 percent of the waste stream is C & D material. These statistics explain why both the State and the City and County of Honolulu have targeted C & D material for diversion from landfill disposal.

On May 1, 1998, the City and County imposed a restriction on the amount of C & D waste that can be disposed of at Waimanalo Gulch, the county's only Municipal Solid Waste (MSW) landfill. No more than 10 percent of the load's volume can contain C & D material.

The legal alternatives to the MSW landfill are disposal at Island Demo, the C & D transfer station and recycling facility in Mapunapuna; or disposal at the PVT Land Company facility in Nanakuli, Oahu's only C & D landfill. (Maui is the only other island with a C & D landfill.) In addition to the MSW landfill restriction, tipping fees have continued to increase.

Increased tipping fees and a lack of disposal sites have led to illegal dumping, which poses a threat to environmental and human health. State officials estimate there are at least 20 illegal dumps on Oahu's Leeward coast alone.

Materials from a recent warehouse demolition project at Hickam Air Force Base were recycled.

Don't dump, recycle

Contractors and waste haulers have been exploring ways to reduce the amount of waste dumped at landfills and gain the economic benefits of recycling. Recycling materials such as aluminum and steel can produce revenues to help offset the hauling costs of other materials. Coordination with subcontractors and haulers can result in a program that will keep recyclables and trash separate.

Local companies have demonstrated the economic and environmental value of recycling and reusing C & D material. As examples, last year Island Demo diverted 5,331 tons of C & D from landfills by segregating and recycling C & D debris. Transcend, a demolition, excavating and hauling company on Oahu, recycled 45,000 tons of concrete, 2,300 tons of scrap ferrous material and 300 tons of aluminum.

Government and industry-sponsored workshops in 1998 offered in-depth training and successful case studies to promote recycling and reuse of C & D materials. For copies of documents from the workshops, call the Clean Hawaii Center at 587-3802. The Hawaii Materials Exchange provides a means for reusing unwanted material. Contact www.himex.org for information.

With the limited land area of an island state, conserving landfill capacity is becoming more critical. More contractors, subcontractors and other companies are seeing the value of recycling and reusing C & D materials. In these tough economic times, using C & D waste as a source of revenue has tremendous potential.

Gail Suzuki-Jones is materials exchange specialist with the Clean Hawaii Center, Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism. She is co-chair of the AIA Energy and Environment Committee.

Ocean Pointe commits to steel framing

Steel as a Selling Point

by John White

Kenneth Choate (center) explains how a steel-framed home is constructed to a group of Ocean Pointe home buyers.

Steel framing has become a desirable feature in the marketing of new homes, according to local developers, and the Ocean Pointe development by Haseko provides a good example. The 4,850 homes planned for the Ewa site will be constructed with steel framing, and the developers want customers to know about it.

Every month, Kenneth Choate, executive vice president of Haseko Construction, Inc., takes customers on a tour of the job site. "Our buyers are making a major investment in a product that's largely a mystery to them. They don't understand the building process and have a lot of questions," Choate said.

Most consumers are receptive to the idea of steel framing but have never seen how a steel framed building is put together, he said.

"We show them steel members, the fastening and anchoring devices and how we assemble them. We tell them why it's engineered a certain way, why bolts need to be placed in certain areas. We try to convey a sense of the structural engineering that's behind a steel-framed home."

Choate said the Ocean Pointe developers decided to use steel because it is resistant to termites, fungus, dry rot and fires, galvanized so it won't rust, and considered environmentally friendly because it is recyclable. These features are explained to the tour participants.

Shifting from wood to steel framing requires special training. "The tools are completely different; instead of using a nail gun, you use a screw gun," said Choate. But after an initial period of adjustment, the builders have found that they can build faster with steel in part because they can panelize different items, according to Choate.

The steel is shipped to Hawaii as rolls of sheet metal. Once delivered, the material is made into studs, joists and track material by cold forming.

According to Choate, the response to the tours has been excellent. Customers leave with a sense that the builders take pride in their work and enjoy showing owners what goes into the construction of their homes, he said.

Award of Excellence

Single Family Residential

Jeffrey Nishi & Associates/Architects

The Dragon House

Photos by Augie Salbosa

The roof eaves and trellises provide shade and shelter over the structurally expressive concrete columns.

Credits

Client:
Anonymous

Architects:
Jeffrey Nishi & Associates/Architects
Norman Lacayo

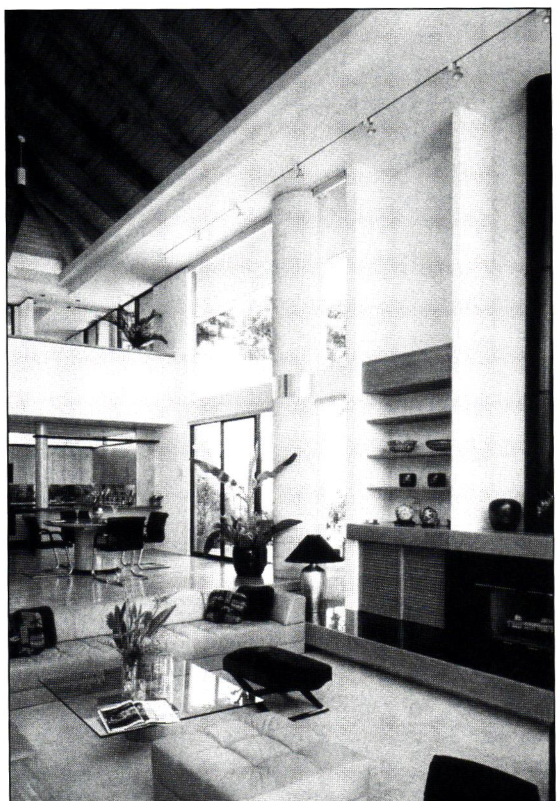
Contractor:
Design Build Inc.

Consultants:
Civil: DHC Hawaii Corp.
Structural: JAI/Adams Allison Inc.
Electrical: Yuki Matsumoto and Assoc.
Landscape: Walters Kimura Motoda Inc.
Interiors: Lacayo Interiors

Jury's Comments:

"All good projects require good clients."

A requirement of this project was to design a residence to be used as the main family house for 100 years. The interior rooms share common spaces to create a spacious atmosphere and to maintain view lines through adjacent spaces. Strong consideration was given toward a dramatic view from the site. The home is appropriate to the space, site and Hawaii's climate.



Rooms were designed to blend into each other to create a feeling of spaciousness.

Pacific Rim
SPECIFICATION STANDARDS
Special Section: Cladding
Published by the Honolulu Chapter, Construction Specifications Institute

EXTERIOR INSULATION AND FINISH SYSTEMS

By Justin M. Koizumi, CCS

Exterior Insulation and Finish Systems (EIFS) are multi-layered exterior wall cladding consisting of a reinforced, aggregated, resin modified coating applied to rigid insulation which is adhered or mechanically attached to a base substrate. The aggregated coating has an outward finish appearance of portland cement plaster or stucco and is also referred to as "synthetic plaster."

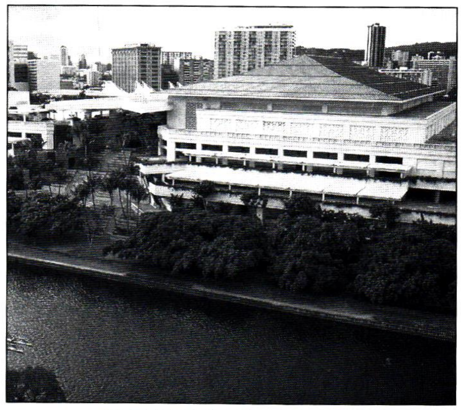
The aggregated coating is put together in two coats. The base coat is commonly reinforced with a fiberglass mesh and the top coat or finish coat, which is the aggregated component, is a colored decorative finish coating. The original coatings consisted of all acrylic and acrylic-modified portland cements. Today, manufacturers have further modified the acrylic technology or have added forms of silicone to the acrylic formulations to achieve further enhancements.

EIFS was originally developed in West Germany in the 1950s for masonry on commercial buildings. In the 1960s, it was used for the European modular home market. By the 1970s this product found its way into the North American marketplace. Today, EIFS accounts for 23 percent of the U.S. commercial exterior wall market and 2 percent of the residential wall market.

Basic Types - Traditional

Currently, the EIFS Industry Members Association, Inc., which represents manufacturers, suppliers, applicators and contractors involved with EIFS, recognizes two basic forms of EIFS — polymer modified or PM systems and polymer based or PB systems.

The systems are differentiated by their "base coating" thickness. PM systems may be 1/4" to 3/8" in thickness while PB systems are typically 1/16" minimum in thickness. Finish coats are typically 1/16" in thickness. PM systems being thicker, more rigid and less flexible are referred to as "hard coat" systems, while PB systems being thinner, less rigid and more flexible are referred to as "soft coat" systems.


Hawaii Convention Center photo by Olivier Koning

Basic Types - Direct Applied

A variation on the traditional systems has become prevalent in Hawaii and U.S. southern states. It is called the "direct applied" system, in which the base and finish coats are applied directly to a base sheathing applied to metal stud framing. "Direct-applied" does not include applications of the coatings directly to concrete and masonry.

Types of sheathing which have been used include plywood, OSB (oriented strand board), exterior gypsum sheathing, cement board, and gypsum sheathing with a silicone treated core. Not all of these sheathings are approved by manufacturers and should be verified for their approval under project conditions of use.

Rigid Insulation Base

Rigid insulation, which forms the other half of an EIFS assembly, may be extruded polystyrene, expanded polystyrene or polyisocyanurate. The polystyrene insulations form the bulk of the EIFS market. Traditionally, the thicker PM coatings are applied over mechanically attached lath (fiberglass or wire mesh) and mechanically attached extruded polystyrene to its base substrate. The stiffer extruded polystyrene provides a more compatible substrate for the more rigid PM systems and needs mechanical fasteners. The more flexible PB systems can be adhered directly to the less rigid, expanded polystyrene which in turn can be adhesively attached to its base substrate. Typically, manufacturers do not allow use of insulation panels with a thickness of less than 3/4"; therefore, cut profiles in thicker boards should not be less than 3/4" in thickness.

Base and Finish Coatings

Base coatings may be all acrylic or acrylic-modified cements. Many base coatings have fiber as an added reinforcement. Where heavier profiled textures are required, cementitious base coats are used. Where the base coat comes closer to the 1/4" thickness, it starts to take on the characteristics of a PM rather than a PB system.

There are basically four types of finish coats. They may be all acrylic, elastomeric, the new altered acrylic technology, or the siliconized acrylic coatings. The finish coats are typically aggregated with calcium carbonate, marble or quartz silica. Some can contain ferrous elements which can be sensitive in environments that can corrode (rust) these materials, but this can be minimized through proper selection.

Coatings and Their Modifications

Traditional EIFS coatings are all acrylic or acrylic-modified cements. Elastomeric coatings are touted as more water-resistant, while improving elasticity; however, for some dirt pick-up increases. The most current innovations are two types which include a further refinement in the basic acrylic technology or the addition of silicone to the basic acrylic formulation. These new coatings are said to decrease the amount of dirt pick-up, and in the case of the silicone modified products, to assist in the drying process by shedding water more readily.

Substrates

Traditional EIFS assemblies with coatings over a rigid insulation offer the most stable of the EIFS systems. The rigid insulation protects the underlying structure from thermal changes and cushions movements in the structure, thereby preventing potential cracking.

Direct applied systems are applied to the base substrate and are therefore highly dependent on the mechanics of the base substrate. Direct applied systems have been very successful but require more attention to the physics affecting each selected system.

Performance - Fire

The coating portion has an ASTM E 84, surface burning characteristic with a flame spread of 5 maximum and smoke developed of 10 maximum. Rigid insulation has a flame spread of 25 or less. However, its smoke developed goes as high as 450. In addition to ASTM E 84, EIFS systems should pass UBC 17-6, the Full Scale Multi-Story Test, ASTM E 119, and the modified ASTM E 108 test. The fire tests, which are usually acceptable to authorities, confirm that EIFS systems when used as an exterior cladding do not adversely affect the fire safety of the building.

Performance - Impact Resistance

EIFS systems can be reinforced against high impact. Manufacturers typically use alkalai-resistant fiberglass mesh in different weights that range from around a low of 4.5 oz/sy to a high of about 20 oz/sy. ASTM D 2794 (EIMA 101.86) and ASTM D 1037 are standardized impact tests.

The lightest-weight meshes are used for formability around highly complex architectural details. The heavy-weight meshes are used where high impact loads are anticipated. EIMA 101.86 classifies standard, medium, high and ultra-high impact loads, which range from 25 ft-lbs to 150 ft-lbs or more. There is no standardization of meshes between manufacturers, and a combination of meshes may be required.

Performance - Wind

Wind performance is dependent upon bond strength to the substrate and substrate performance. It is not uncommon in hurricane or typhoon areas to encounter wind loads up to 200 psf or more. Manufacturers' publications indicate that bond strengths up to 180 psf and greater can be achieved in accordance with ASTM E 330, including for direct applied systems.

Performance - Water Intrusion

EIFS is most sensitive at the joints which is also true for all wall cladding systems. The original EIFS systems are called "barrier" systems as they are designed to prevent water from intruding into the system. Redundancy is often provided with the addition of building paper or some other moisture barrier (in sheathed systems).

Currently, manufacturers are touting "drainage" systems. These systems are designed to let intrusive water to escape out the system either by channels grooved into the insulation or adding a drainage mat behind the rigid insulation.

Whether using a "barrier" or "drainage" system, proper joint design is critical. Low modulus elastomeric sealants are typically recommended at "backwrapped" rigid insulation or sheathing to minimize potential delamination by pull-off of the coatings due to sealant movement at the joints.

PB systems are generally considered monolithic and require joints only where the base structure require them, such as at openings and where other types of movement may occur. Manufacturers may limit how monolithic walls may be. One publishes a 75 feet maximum limit. PM systems being more rigid tend to perform very similarly to traditional portland cement plaster systems and control joints are required every 150 square feet.

Direct applied systems are dependent upon the thermal expansion and other movement qualities of the base substrate used and control joints should be located in accordance with the physics of that substrate.

Whether EIFS is distinguished by its method of overall assembly, its method of coating assembly or how it prevents water intrusion, the systems have had a long history of success. While no system is without its sensitivities, proper understanding of the physics impacting it and resulting proper design and installation will go a long way to ensuring the continued success of this type of wall cladding material.

CAST STONE: THE DRY-CAST METHOD

by Peter Morocco

History

The use of stone as an architectural detail can be traced back to early known history. The aesthetics and strength of stone make it a fine material to work with in many applications. Stone is the dominant construction material in many architectural marvels of the world — the pyramids of Egypt and Central America, and the grand castles of Europe and Asia.

Cast stone is also referred to as "simulated stone." Its first use dates as far back as 1138. The first extensive use of cast stone was in London in the 1900s. In America, cast stone was popularized in the 1920s. Many of the earlier applications of cast stone were carved details from large blocks cast at the job site. Instead of carving and/or shipping large blocks from a quarry, it was faster and more economical to make blocks of stone and detail them to the exact specifications at the installation site.

Dry-cast Stone

The dry-cast method is a mix of limestone sand, portland cement (typically white Type II) and as little water as possible so that the mix is dry or zero slump (meaning just enough water to activate the cement). The mix is then tamped into a mold by ramming it with a pneumatic hammer. Color may also be added to the mix.

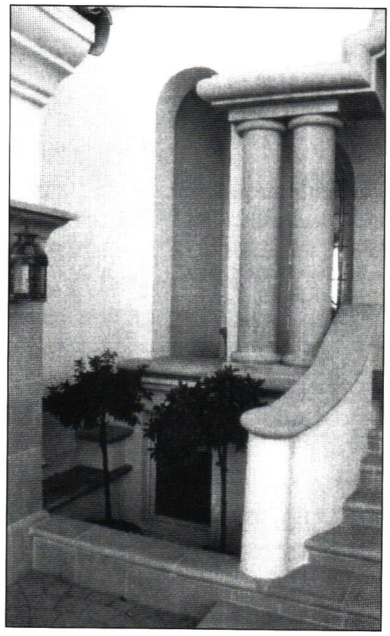


Photo courtesy of Sierra Stone

Dry-cast, like wet-cast, can be formed into slabs, tile, and ornamental profiled shapes and be applied with metal anchorage and/or mortared in place.

Differences Between Dry-cast and Wet-cast

Greater strength, density, and less porosity distinguish dry-cast from the wet-cast process. The more water in the mix, a higher percentage volume of water evaporates as it cures, creating a more open structure between each microscopic piece of sand and cement. A dry-cast product attempts to use only enough water to activate the chemical reaction and to attain a tighter-knit structure of sand and cement. Combining this feature with the physical hammering of pneumatic tools, dry-cast stone is typically denser and stronger than products cast by the wet process.

Dry-cast products generally have fewer defects after the molding process than wet-cast products. The final product has a fine grain surface free from any "bugholes" or voids left by water pockets. The texture is very similar to a limestone or sandstone which is usually acceptable as the final finish for these types of products. Wet-cast products will typically require acid etching, sandblasting or some other method for achieving an acceptable finish for the product. Color control is much greater in a dry-cast product because it uses very little water. Deep colors such as black are more readily achievable in the dry-cast process.

Range of Options

Today's market has a vast array of stone and simulated stone products. There are basically seven choices: cut stone, dry-cast stone, wet-cast stone, exterior insulation and finish systems (also known as synthetic plaster), GFRC (glass fiber reinforced concrete), FRP (fiberglass reinforced plastic) and ceramic tile. All present different price points and have various installation methods. Each has its place and purpose in the marketplace.

Cut stone is the most expensive and has the longest lead times. Considered a lost art, there are few craftsmen who can carve architectural details other than simple, square or flat shapes.

Dry-cast stone costs less than cut stone, but costs more than wet-cast products. Dry-cast products are typically used as-cast. Wet-cast products can be simple gray, as-cast concrete or have texture-altered finishes.

EIFS, GFRC and FRP are lighter than the cast stone and are less expensive to install. The savings in materials can sometimes be inconsequential, but the savings on the installation can be fairly substantial.

GFRC is concrete with fiberglass blown into a mold resulting in a thin shell concrete product. This reduces up to 60 percent of the concrete that would be used in a similar wet-cast product. The reduction in weight makes these products faster and cheaper to install.

FRP can be made to look like stone and is very durable. It too is a thin shell product. Boat hulls use this type of technology. Significantly lighter than GFRC, it is less expensive to install than GFRC and is still very strong structurally. However, manufacturers of FRP who use cheap resins will have fading and warping problems which are controllable in quality FRP products.

EIFS is often referred to as "synthetic plaster" as it is an alternative to portland cement plaster or stucco. It can be made to look like cast stone. EIFS is the least expensive of all the products in terms of materials and installation. It too is a very light product and can be made to look like ornamental stone when the profiles are not intricate. The finish is a soft coating that is most often placed over a rigid insulation. Being softer, it requires a fiberglass reinforcement when impact resistance is needed.

Within recent years, ceramic tile products have been manufactured to look like stone. While these products have been manufactured more for the flooring market, there is no reason why these products will not eventually find their way to the wall cladding market. Most of the products are in tile form with a finish and texture which resemble marble and granite. These products are not produced as yet in profiled units similar to ornamental stone units.

Today's market bears many simulated options and choices. The lighter weight versions are less demanding on the structural framing of a building, but the cast products come closest to retaining the original feel, look and durability of the original cut stone products.

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