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HAWAII ARCHITECT

March, 1981

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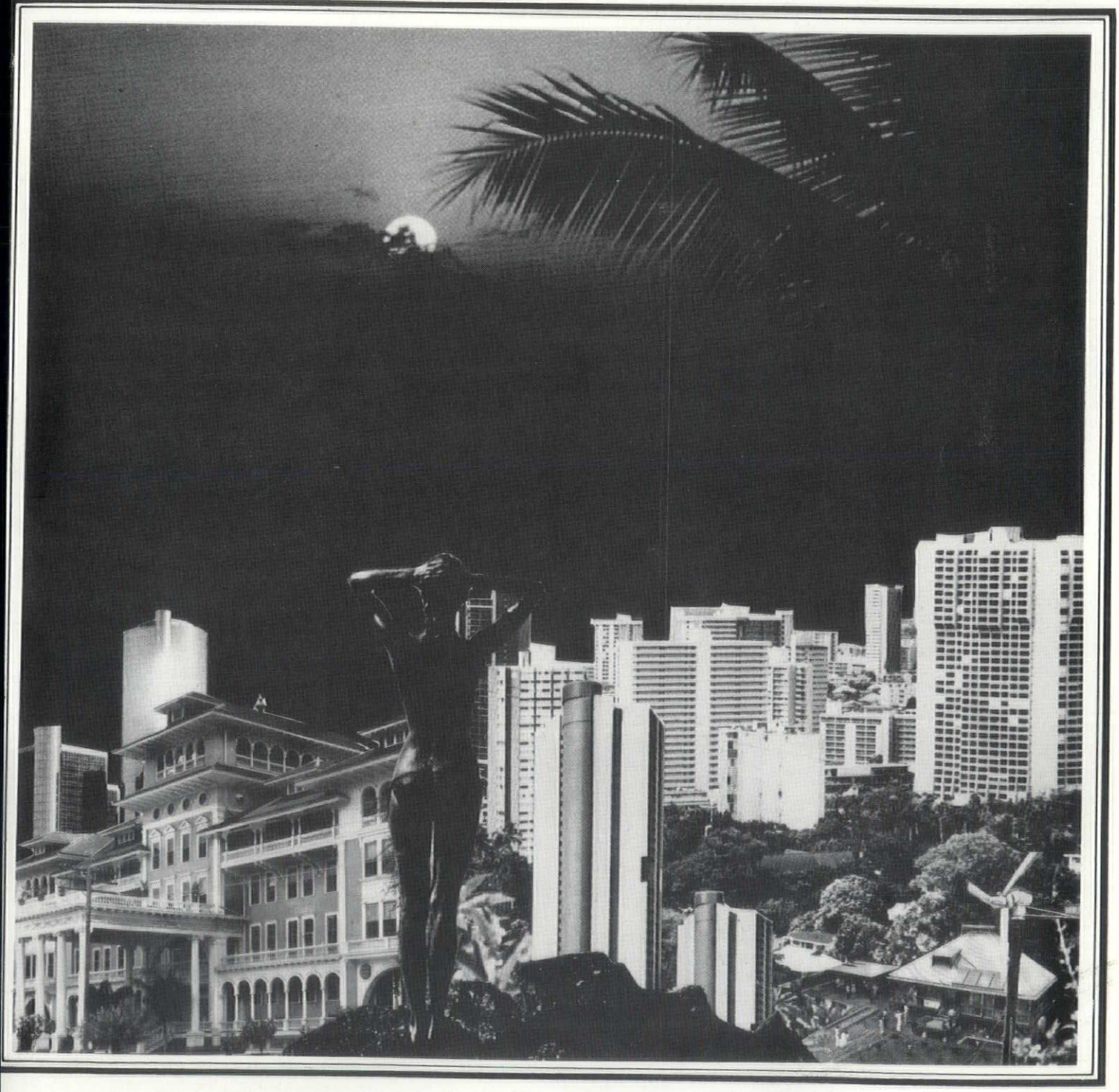

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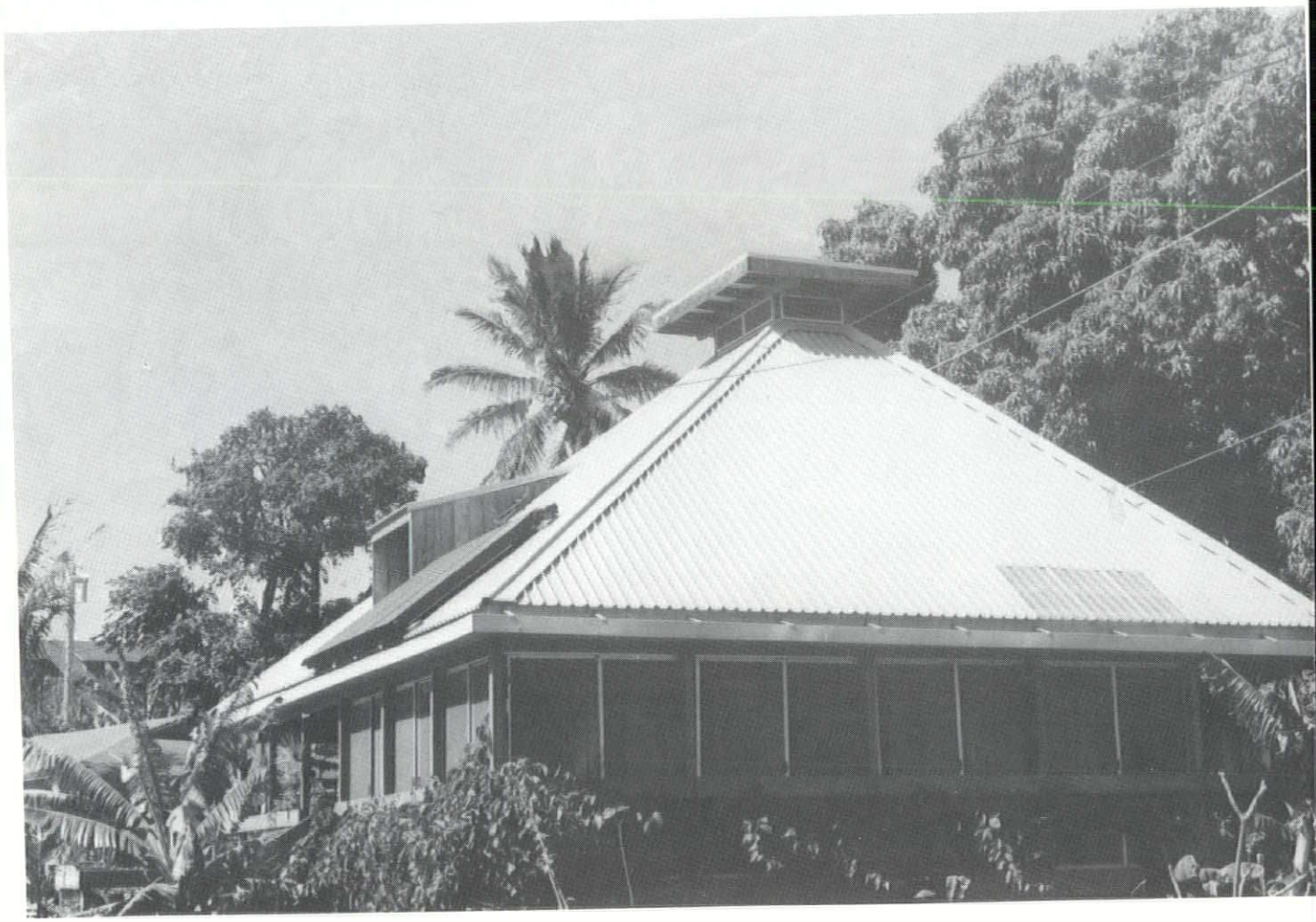

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HAWAII ARCHITECT

Volume 10, No. 3 **MARCH, 1981**

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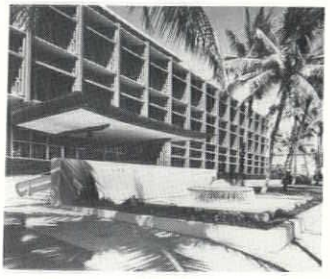
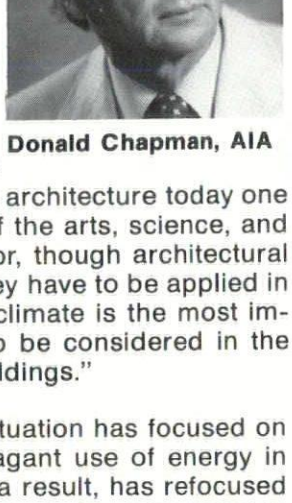
Contents:



Grassroots '81

by DONALD D. CHAPMAN, AIA
President, Hawaii Society/AIA


Donald Chapman, AIA

Indian architect C.P. Kukreja states the following in his book, *Tropical Architecture:* "The twentieth century has brought new dimensions to our living conditions and environment, through successive industrial and scientific revolutions. The invention of various "comfort gadgets," like air-conditioning, and the use of new materials and building techniques have altered our approach to the design of buildings. To practice architecture today one must have an understanding of the arts, science, and the technology of our times. For, though architectural principles may be universal, they have to be applied in a particular environment, and climate is the most important environmental factor to be considered in the design and construction of buildings."

The world's critical energy situation has focused on the design profession's extravagant use of energy in many of their projects, and as a result, has refocused attention toward more efficient designs using nature's elements singularly and in conjunction with contemporary technology. I believe that the unique climatic conditions of our islands give us a "built-in" advantage over most areas of the world, but to be fully utilized, will take some relearning on our part.

One of the most enjoyable and rewarding aspects of serving as your president is the exposure I have to other architects serving their chapters in a similar position. Along with the pleasure of making new friends, it is also comforting to find that they and their Excoms wrestle with similar problems of budgets, dues increases, membership drives, politics in and out of the chapter, program attendance, committee effectiveness, and the rest. This interchange of information and fellowship occurs for Hawaii delegates primarily at the Northwest Regional Convention and at Grassroots. This year, instead of the three separately zoned meetings normally held across the country, Grassroots 1981 was held in Washington, D.C., with presidents and presidents-elect from across the country meeting as a body.

Opening session officially began Wednesday evening, January 28; however, Francis Oda and I spent most of the day with the four members of Hawaii's Congressional delegation making a brief presentation of the Institute's goals for the 1980s. We were both most impressed by their interest, knowledge, and concern for the built environment.

All four have since received copies of the AIA's policy positions on housing and urban development, energy efficiency in buildings, professional liability legislation, and federal building design and A/E selection.

Our first full day started off with a colorful presentation by Texas Congressman Jack Brooks, author of the "Brooks Bill" that calls for the selection of architects by ability. He was followed by Vermont's Robert Stafford, who stated he will continue to push for the Public Buildings Act of 1980 that would require a design competition for all federal projects both large and small. Another interesting speaker was Maryland's Senator Charles Mathias Jr., who discussed product liability reforms with regard to our insurance premium problems.

Under the heading, "Ask not what your AIA can do for you, but what can I do for the AIA," I would like a round of applause for our own Elmer Botsai. President Randy Vosbeck spoke of the Institute's seriously declining financial position over the past several years, their agonizing on how to broach the membership with a dues increase, and of Elmer's dramatic floor speech saying in effect, "To hell with a $10 increase, make it $35," its passage resulting in an again healthy Institute. Elmer, good stuff!

Energy. I know I must be sounding like a broken record, however, if you haven't spent some time recently with your brother and sister architects on the mainland, or haven't kept abreast of what is happening in the schools of architecture, you're in for a surprise. The Institute is also moving full steam head to develop energy educational programs for the profession to keep the energy crisis from becoming a design crisis.

The Energy Professional Development Program is one of the first survival courses coming on stream, designed to teach yourself the skills required to implement BEPS. It was stated that designers can and should be able to use 40 percent less energy over designs of only five years ago. Seems to me a real opportunity to bring back regional architecture. This program will be presented over an extended time frame with advancement through four levels: (1) Basic Information; (2) Foundation for Architects; (3) Level of Knowledge Expected of Practicing Architects; and (4) For Architects Specializing in Energy on a Consulting Basis.

I'm told Will Rogers once said, "We Americans think we're pretty good, when we want to build a house we cut down a few trees, when we want to build a fire we dig a little coal; when these things run out, we'll see how good we really are." Keep up your design, ethical and educational standards and you should have no problem saying to the mirror, "Babe, you're good." H

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A Path To Our Future

by WILL BEATON AND JAMES N. REINHARDT, AIA

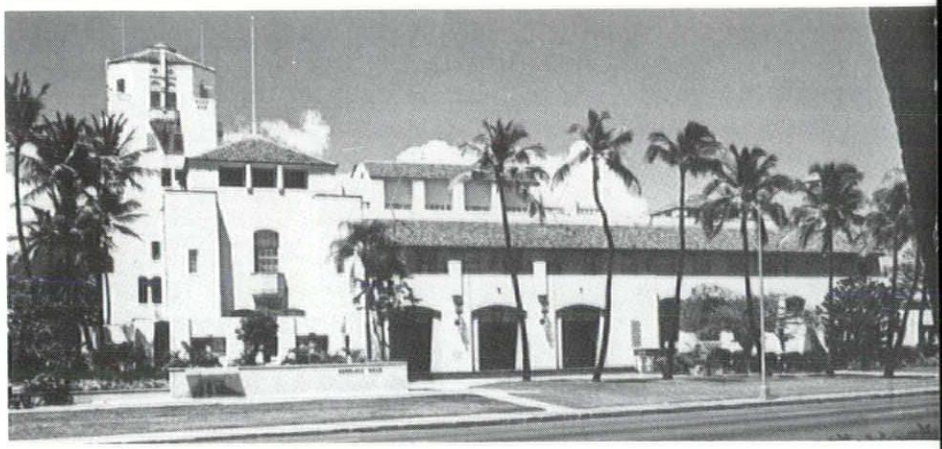
The question central to this issue and to this article is "What is a Hawaiian architecture? Or — *"Is* there a Hawaiian architecture?" Many definitions and descriptions have been offered in this issue by design professionals and citizens concerned with the future development of our islands and involved to varying degrees in the past and present architecture we live with today.

Little, if any, of today's architecture could be labeled truly Hawaiian. There are many buildings and urban environments both new and old which exhibit characteristics that are pleasing, perhaps tropical, and if not indigenous to Hawaii, are commonly defined as Hawaiian because they feel good and respond sensitively to the surroundings, the climate, and our images of the "good life" in Hawaii.

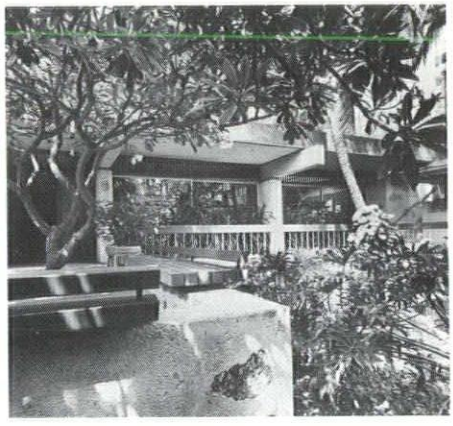
These buildings, mostly residential, represent an enduring and valuable reminder of Hawaii's past, and of the values and lifestyles that existed, and help to define and shape the architecture most of us so lovingly admire (and wish for) today.

This Hawaiian architecture can and should be utilized in defining and developing Hawaii's future architecture, especially its residential architecture. However, it has not provided the answers or the clues to our future direction in commercial and high-rise (C/HR) development.

Much of the C/HR architecture has been the result of poor, insensitive, or no planning. It has been pushed, pulled, and kicked by various economic interests. It has been designed as if it were to sit and "fit" in downtown Los Angeles, Houston, St. Louis, or Chicago, rather than specifically in Honolulu or the other developing urban areas of the islands. This is not to imply that our city is bad or that all of Hawaii's C/HR buildings are distasteful and insensitive. We have many notable examples of fine architecture to be proud of: aesthetically pleasing, highly functional, well-planned, and well-designed buildings. We still have a very comfortable, clean, and pleasing environment to live in.



Honolulu Hale, 1927. An image of Hawaiian architecture of the past. Good thermal mass and open interior court.



Outrigger Canoe Club, 1964. Hawaii's environment utilized and enjoyed.

We do not, however, yet have a C/HR vernacular that is truly "Hawaiian"; one that is sensitive to Hawaii's varied cultures, lifestyles, and climates. Can we or should we ever hope to establish a commercial and high-rise architecture distinctly Hawaiian? If so, *why* and *how?*

Our answer to the first question is not only that we can and should hope for it, but that we must strive for it.

Why? First, because of Hawaii's history, heritage, and pride — Hawaii is a special place and remains a paradise of the Pacific. We must not participate in its devaluation to "paradise lost." We must cooperatively and creatively define and develop new ways for our architecture to become truly Hawaiian in spirit. We must sensitively consider and respond to our communities, cultures, and human needs to develop an architecture that will not only help to define more suitable and functional urban forms, but also inject more vitality, richness, and diversity into our lives.

The second reason is the most urgent and compelling: ENERGY! Energy has been frequently and accurately defined as one of our state's (and nation's) most pressing problems. Hawaii has and will continue to have a petroleum-based economy for decades, even if we become the leader in alternate energy sources. But rather than view the problems of energy with disgust or dismay, the architects and entire building industry of Hawaii must accept it as our greatest opportunity and challenge.

Jim Reinhardt, AIA, and Will Beaton are with the CJS Group, Architects, Ltd. Reinhardt is a past Hawaii Society/AIA president and former editor of Hawaii Architect. Beaton leads the energy conservation efforts at CJS Group.

R. Randal Vosbeck, AIA president, recently said in the AIA Journal:

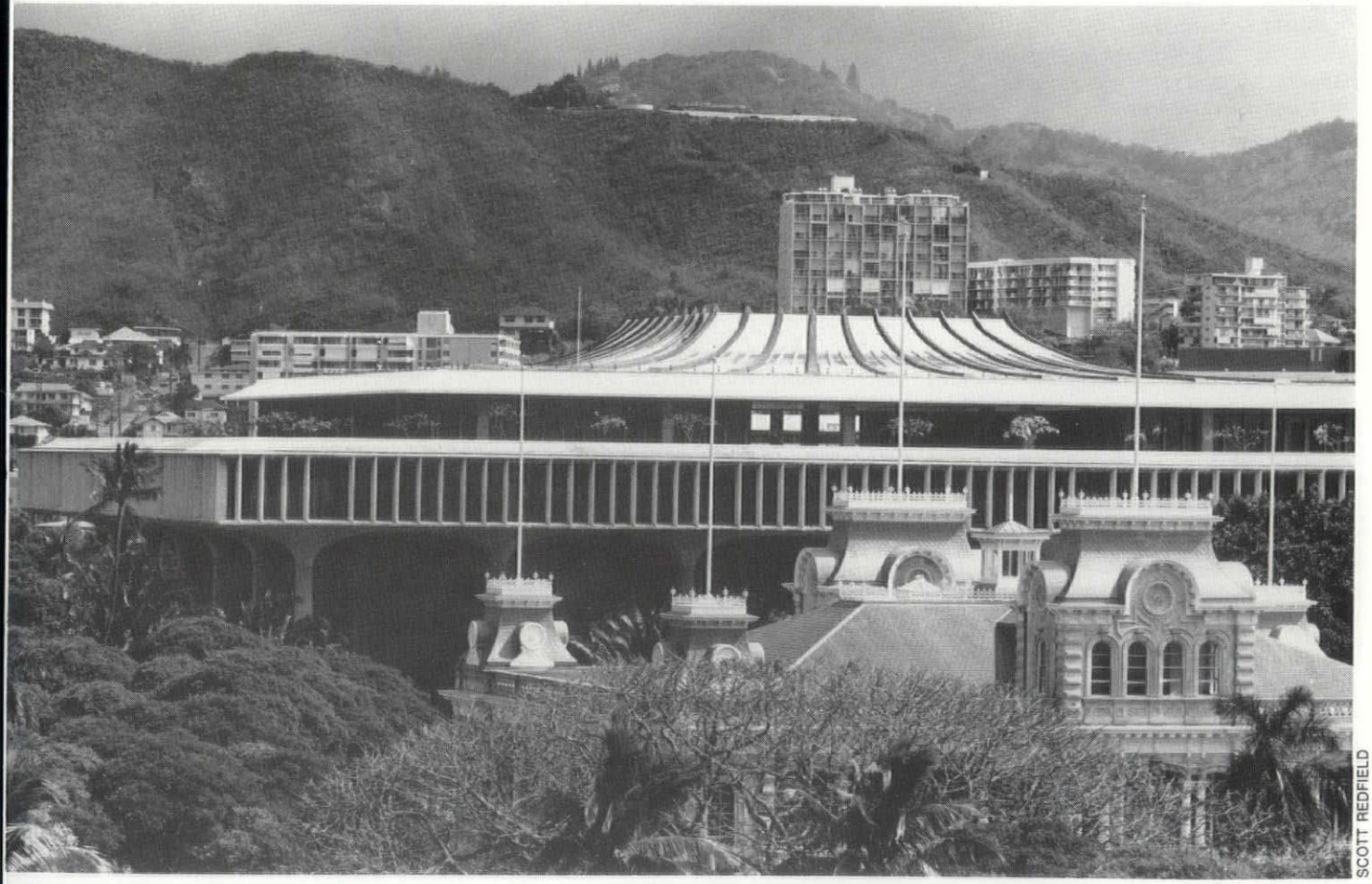
"Potentially, it (the energy crisis) can create a new design vocabulary and is far more revolutionary than anything that has happened since the Renaissance. By infusing the design process with energy consciousness, architects will pay more attention to bulk and mass and shape, to fenestration, orientation and daylighting — all those things we should do intuitively, but have been ignoring . . . it really has the potential for changing the whole character of the built environment, for changing entire cityscapes."[1]

We must answer together, as a profession and an industry, *how* we are to create this new Hawaiian architecture. The ideas that follow are certainly not exhaustive or absolute and are intended instead to act as catalysts for thought and action.

First and foremost a united team effort on many levels in the building design process is vital. These team efforts must involve more then rhetoric. Without planned, patient, and executed action we will accomplish very little or it will be very slow in coming. We are already years behind. Active cooperation, communication, and interaction between all members of the building industry must occur, including clients, developers, contractors, Realtors, regulatory agencies, product manufacturers, researchers, the university, the design team including the engineers and architects, all associated professional organizations and unions, building and architectural journals, and last but not least our politicians and communities. This is the primary and perhaps most important *HOW* of them all!

Within the Hawaii Society/AIA there is a vital need for organizing an active and extensive system for intercommunication of new ideas concerning Hawaii's specific prob-

Continued on Page 8



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State Capitol, 1978, and Iolani Palace, 1882; restoration, 1978. Both buildings controlled by energy management systems to minimize energy loss.

A Path To Our Future

Continued from Page 7

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Board of Water Supply Bldg., 1958. Notice the effective sunscreen system of the makai elevation.

Hale Manoa, 1963. Proper orientation with effective horizontal and vertical shading.

lems and solutions (including an emphasis on continuing education). The sharing of new ideas and developing technology, of identifying practical, proven ideas in a cooperative framework does not have to co-opt the competitive spirit between firms — creativity will continue to render unique, diverse and interesting design solutions.

As a profession, we are alone in our reluctance to share the fruits of our individual experiments, successes, and failures. Imagine if doctors and scientists were as reluctant to share their research as we are! The fields of science and medicine would be where the field of energy technology is today!

Within individual offices and firms there must be a commitment to the team approach in energy conscious design. The team must work closely together from the first day. An essential part of teamwork within the office is frequent and open communication of new ideas to stimulate growth and knowledge among the entire design team and staff. The energy conscious design firm must become as serious about energy savings in design as they are about structural integrity. A special consultant or energy engineer must be included on the team. This may or may not be the mechanical/electrical engineers depending upon their personal understanding of "architectural" energy analysis.

Each design decision, especially the earliest ones, has an effect on the ultimate energy performance of the building. It is essential that the architect and the team understand the effects of those design decisions on energy performance. Some effects are obvious, but many critical ones are more subtle and complex and require in-depth computer analyses. Such services must be accounted for in the initial fee proposal and contract.

It is the architect's responsibility as a professional to demand satisfactory energy performance in each building design just as he demands structural integrity — and appropriate fees must be charged to ensure such performance. This issue must be addressed frankly and openly with each potential client if we hope ever to solve the problems before us.

The second *how* in the development of a Hawaiian architecture involves the development of responsible, realistic, and appropriate criteria, or standards for Hawaii. Preferably, these standards would be voluntary rather than mandatory — the "carrot" rather than the "stick." The final outcome of this question may well rest on the architects' shoulders and their ability to be concerned and responsible; not only to get involved with the process of criteria development but also execute that criteria effectively in each design.

This situation may soon be influenced as much by client demand as it is by incentive and/or mandate. If we in the profession do not take the lead, legislative mandate will force action. This has already happened in California.

On the local level it is essential that we accept our opportunity to get involved as a professional community to help establish appropriate standards. Currently, Article 8 of the UBC is the only regulation on the books governing energy performance. It will continue to grow via revisions and additions as a result of input from both the private sector and government review agencies, especially the state Department of Energy.

UBC's Article B may be the state's only mandatory standards

Continued on Page 11

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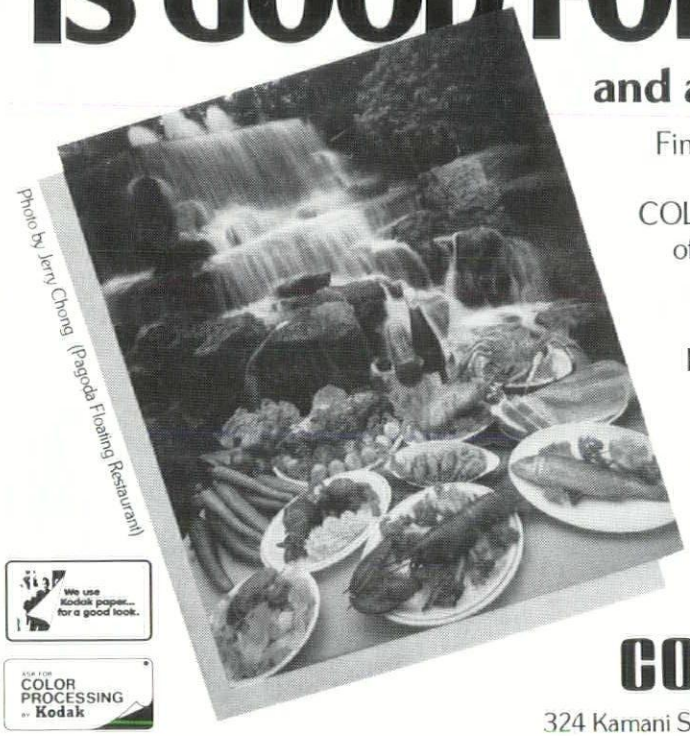

Photo by Jerry Chong (Pagoda Floating Restaurant)

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A Path To Our Future

Continued from Page 8

imposed unless the long-awaited national Building Energy Performance Standards (BEPS) pass their final hearings this spring and make it through Congress. If BEPS is passed without major revisions in the "energy source weighting factors" then Hawaii's architects will be at a great disadvantage because of the poor rating allowed "all-electric" buildings.

BEPS is but one more reminder that local architects must get involved in order to define and protect our local interests, as well as identify and solve our unique design problems. It is even foreseeable in the future that architects may have to accept legal liability for the energy performance of their designs, which emphasizes the necessity for our concerned involvement.

The third ingredient involves knowledge, which we classify in two categories: design considerations and economic considerations. Knowledge involves the understanding of the multitude of design concepts and cost management systems associated with energy conscious design as applied to Hawaii's and each project's specific conditions and climate.

These concepts may well be influenced or dictated by the standards previously discussed, or they may be design elements which are utilized creatively to achieve such standards.

This is where uniqueness enters into the design process and where shared ideas (knowledge) are utilized by each design team to create sensitive, efficient, and diverse Hawaiian architecture.

Design considerations occur at all scales — urban and architectural. A few examples include:

1—A 24-hour mixed-use area where residences and offices share the same block (a concept used to influence traffic flow, commuting and parking, scale and density, building occupancy and utilization, and the rest.)

2—Proper shading on all glass exposed to solar radiation. This can reduce interior heat gain by 90 percent and is the most effective protection we can provide (far more effective and less obtrusive than reflective glass).

3—Maximum utilization of natural daylighting wherever possible and appropriate, by means of courtyards, skylights and shaded exterior windows.

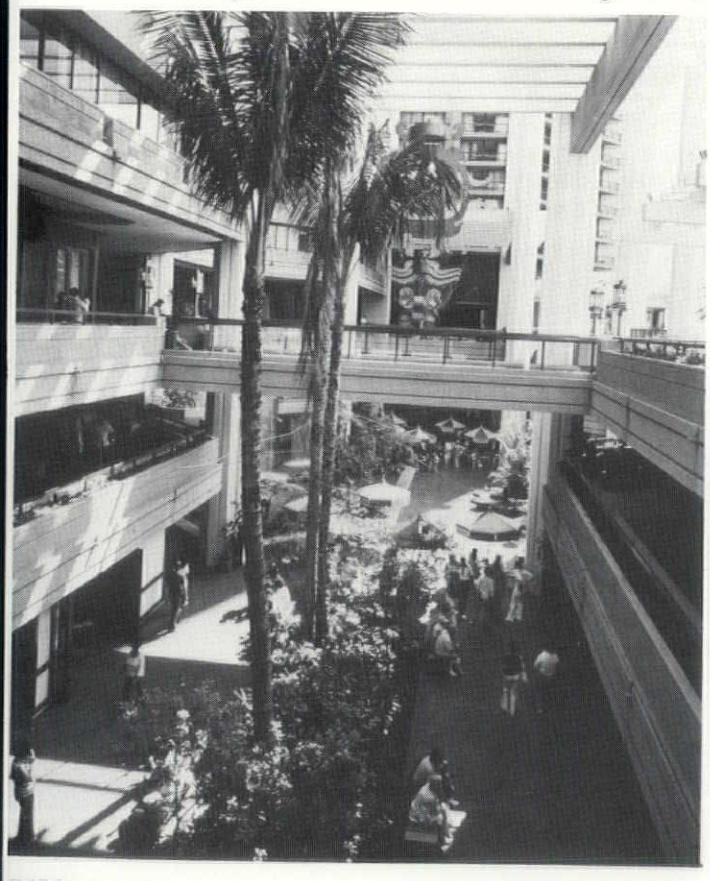
4—Utilization of energy management systems to provide hourly, zoned control of all mechanical, electrical, and lighting systems.

5—Careful and studied use of natural ventilation where appropriate. (It is possible in high-rise office buildings — we just haven't identified the solution yet).

6—Detailed energy programming during the initial schematic phase to satisfy both the clients' needs and the energy performance criteria. Energy programming defines the energy demands of each department, space, or job. This program then translates into energy-zoning and space efficiency.

Economic considerations involve cost management, the means of ensuring that the functional components of the project perform at the highest degree of efficiency at the most economical investment cost without forfeiting quality. This too involves computer cost control and use of life-cycle costing and where appropriate, value engineering. Life-cycle costing defines the total costs of

Continued on Page 12



Left: Hemmeter Center, 1979; below: Garden Court Office Bldg., 1969, both featuring use of interior courtyards.

A Path to Our Future

Continued from Page 11

ownership. In addition to the initial cost of the building and equipment, it includes costs of operation, maintenance, and replacement.

This is essential if clients are to receive the most building for their investment dollar, and it must be employed at all stages of design and development.

Number four involves the definition of human comfort in Hawaii's climate. This is a key question when examining the requirements for mechanical systems necessary to provide that defined level of comfort and also when examining the potential for using the natural elements for the same purpose. It is important that we clearly define our threshold between comfort and discomfort, and whether we are willing or capable today of accepting infrequent conditions of "discomfort."

This decision dramatically effects our peak-energy-load demands. It is an extremely controversial subject that must be more thoroughly researched and addressed by the local professional design community.

Our last idea regarding how we achieve a new Hawaiian architecture involves the challenge we have been offered. It involves vision by all involved, an expanded and creative vision into the future. It involves, more simply stated, a new way of looking at things to solve our problems. It involves creative research into new building materials and components for glazing, lighting, shading, natural ventilation, cooling, and building skins.

It involves some bold and daring "experiments" in design and construction to break new ground so we can all move ahead.

It requires courage, insight, and faith. Perhaps most importantly, though, we must begin to define the mind, the body, and the spirit of this new Hawaiian architecture so that once again we may all take pride and pleasure in its existence.

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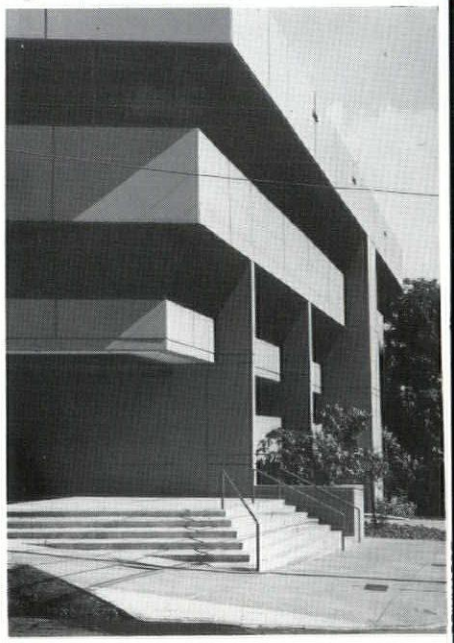
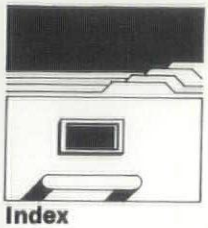


Above: 1441 Kapiolani Bldg., 1958, shaded by a system of operable louvers. Below: School Street Office Bldg., 1980, featuring effective shading and thermal mass.



Index

The Real Issues: An Interview with Elmer Botsai

by WILL BEATON AND JAMES N. REINHARDT, AIA

(The following excerpts and ideas are taken from a conversation with Elmer Botsai, dean of the School of Architecture, University of Hawaii at Manoa. Although most of the statements are not direct quotes, we have tried to capture the essence of his responses as accurately and colorfully as they were presented.)

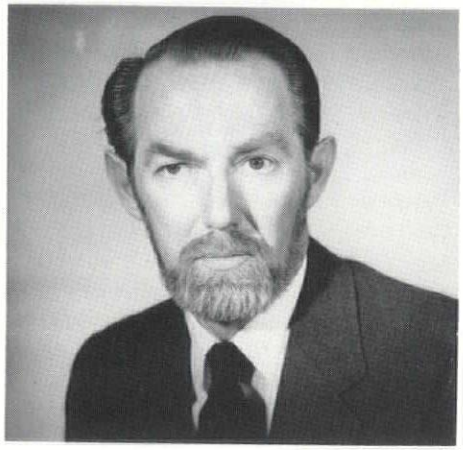
Hawaii Architect: Is there an identifiable Hawaiian architecture today?

Botsai: No, there certainly is no Hawaiian vernacular, for we haven't been around long enough to establish a style as has been the case in Europe and Asia. There are perhaps residential characteristics that are called "Hawaiian" but they are more the result of migrations than of a specially developed Hawaiian architecture.

As for commercial and high-rise development, there isn't yet a U.S. commercial vernacular, and certainly not a Hawaiian one. There are many reasons for this. Foremost is that it takes *time,* generation upon generation of developed, shared ideas, and we haven't had that here. Secondly is that urban growth and the bulk of development has only occurred recently in relation to Hawaii's history of 200-plus years and much of that development has been influenced by modern economics and mainland migrations — thus destroying any pure "regionalism" that may have existed before that surge. But other parts of the world have lost their vernacular too, and were also affected by the international movement.

If one is to examine "style" it must be in regards to housing, but "the weakest point of Hawaii's building industry is the housing — I think the housing stock smells." Why? "If you look at the price of land and housing in this state, it's got to be the lowest use return on the invested dollar in the U.S., if not the world."

H.A.: Why has there been such a lack of development adapting to and taking advantage of the local



climate — or "climatic architecture"?

Botsai: This question must again be answered in relation to the residential sector. First of all, Hawaiians are outdoors people and historically lived in simple dwellings whose foremost purpose was to provide protection from the elements. Migrations occurred from all parts of the Pacific, Asia, and the U.S.

The cultural heritage from which the new housing sprung was one of low housing standards and not a rich housing heritage. Much of what transpired were tracts of housing totally foreign to this climate — one most notably being the transplanted southern California suburban tract. But many of the buyers were willing, even desiring, to accept this status quo.

Other situations which have influenced or demonstrated this lack of sensitivity have been the exhorbitant cost of land, the lack of appropriate building materials suited to this climate and the buyers' acceptance of what is being provided.

"There will be no change until the buyers become educated and get wise to the fact that they are being shortchanged. The construction industry has also accepted these limitations and not searched out new solutions to these specific local problems."

H.A.: What are your views concerning energy efficiency in design?

Botsai: "Apart from the fact that all housing in Hawaii should be naturally ventilated and not air conditioned, I can't make a case for energy conservation in housing except for looking at the total energy required to produce and deliver appropriate building materials.

"Energy" is not in short supply — only petroleum. Unfortunately, that affects our local situation more than on the mainland since they have coal, hydro and other sources more readily available to supplant oil-base power.

"I hate to say this but the response to the energy shortage seems to be a typical kneejerk, unstructured reaction. The people of the U.S. are impatient and want answers *now!* What is important, however, is whether the right questions are being asked. I think not."

Energy efficiency must be balanced against other design considerations, i.e. structure, life safety and privacy/security. These conditions are more influential in high-rise construction, especially residential. "I don't believe in sacrificing fundamental life safety considerations for energy efficiency. More people are killed in residential fires each year than any other cause, except for autos. We also cannot forget about the potential effects of tsunamis, earthquakes, and the rare but devastating hurricane that can occur here."

Energy efficiency is affected, however, by certain fundamental design considerations that too

Continued on Page 14

Hawaiian Architecture

Continued from Page 13

often are not considered a priority. Most important among these include orientation of the building; its relationship to site, landscaping, and other structures; solar shading and the placement and size of windows and other penetrations in the skin.

"These *are* important and should be major considerations in the design of every building. However, high-rise buildings are a different ballgame altogether and I'm not sure I could solve all the difficult conflicts between life safety, privacy, and energy efficiency."

The new technology, however, is still to be scrutinized. Some concepts, such as solar cooling have still not proven efficient or cost effective. Other technologies, which are already developed for other purposes have not been offered to us in new forms and should be explored, such as microwave hot water heaters.

Again, the problem is asking the right questions, and the profession is not seeking the proper answers — we still are too affected by the vogue and are not adequately involved with research. The AIA research is good but too little and will not/cannot identify or answer Hawaii's particular problems. Therefore, those answers must come from the local professionals and the university.

We are trying to ask the right questions and teach the students (and hopefully professionals) to ask those very questions."

H.A.: Are Hawaii's architects sensitive to "Hawaii" and its unique characteristics?

Botsai: They certainly are not insensitive — not most anyway! Most or many seem concerned but don't have the answers and don't have the time to look for the answers to solve all the problems we are facing. I certainly do not feel this is wholly the fault of the professional. "First of all I don't know the answers and I believe they are beyond the grasp of a single generation.

"If we are trying to define "Hawaiian architecture" and energy efficient architecture, we can look to the past but I don't think we'll find the answers. What is intrinsically Hawaiian about C.W. Dickey? Is a double-pitched roof any more "Hawaiian" than a single pitch? It certainly is a beautiful form, but somewhat arbitrary and capricious."

A typical description of "Hawaiian architecture" is predictable: Open plan, low eaves, pitched roofs with overhangs, oriented to the wind, with generous lanais. But these images of old are not going to solve today's problems, especially in high-rise construction.

"We must begin to demand adequate fees . . ."

Land is less available and very costly; construction costs are skyrocketing and lifestyles are changing.

"We need to learn to share our new ideas as we begin to experiment: for the transfer of knowledge is essential for the growth of such an architecture and the profession. Law and medicine have an extensive and sophisticated structure for communication and sharing, but the architectural profession does not — and the professional journals too often emphasize the wrong things or aren't sensitive to Hawaii's problems. This is something that we must solve here in Hawaii."

In addition the "market" must reorient itself and put its money where it really counts.

"The bankers, the developers, the Realtors don't argue about the price of land, the price of money, the price of streets and utilities, the processing costs, and the rest, but they do argue about building costs with their cries for 'economic feasibility.' They want 'social responsibility' but at no extra cost.

"The dollars are going to the wrong places. Their priorities are wrong and until they change, the architect will seldom be able to provide buildings that are worthy of our community and our people. It's our buildings which last and should not be the target of constant and indiscriminate budget slashing — we all suffer as a result.

"We've got to put the squeeze on the government to set up a stable loan market."

Related to this is the problem of the architect having inadequate time to find new answers to the "right" questions — and this requires time for research and design. Too often the developer or client won't allow adequate design time.

"We must begin to demand adequate fees to find the answers. We are 'professionals' and must accept the responsibility to pursue and apply appropriate new ideas. We must also represent ourselves as responsible professionals. This is where we've brought the problems on ourselves. If we'd charge what we're worth, clients wouldn't quibble. Fixed fees are crazy — percentage fees too.

"We aren't selling products — we're selling opinions and time. Seldom do clients haggle over fees or opinions with lawyers or doctors, but we are constantly faced with the dictates of others' opinions and demands. We've got to find an acceptable compromise if we're ever going to being to solve our real problems."

H.A.: What is your image of a future "Hawaiian" vernacular and how do we get there?

Botsai: "I don't really know how to predict what it will become, but we do need to search. I believe we

must accept Honolulu as an urban city — and a successful one. There's no blight, it has a strong neighborhood structure, and a healthy, alive downtown core which is not being killed by suburban shopping centers.

"Initially the answers will arise at the residential level, because experimentation is more common and acceptable since the budget is larger relative to the invested dollars. But this alone will not translate into a modern 'Hawaiiana,' applicable to commercial development as well.

"We must look forward. I don't want a future that looks backwards. We must find new forms — both urban and architectural that fit our unique circumstances. I strongly believe it must be a series of criteria — *not* styles. If we work from criteria we will have excitement and diversity rather than sterility and redundance that results from the dictates of 'style.' Architects should remain concerned with their personal styles, but augment this individualism by utilizing the standards of the new criteria.

"We must commit ourselves to creating buildings which enhance our surrounding. We're still too concerned with producing 'publishable buildings' to the detriment of our environment. An example would be several of the new glass buildings which don't enhance their environment. They are too individualistic and are rude neighbors."

Architects must also utilize their skills as urban designers in designing to fit each setting. This is particularly critical in multi-family housing, large housing tracts, and new urban development.

"We must fully realize the limitations of our resources and take full advantage of each and every opportunity offered us. I am really tired of laws and regulations that restrict our good judgment, but if we architects continue to be irresponsible, we will continue to feel the burdens of new laws."

This does not have to be our fate. We have the knowledge, the skills, the concern, and the spirit to develop an exciting, diverse, livable, humane Hawaiian architecture if we choose to accept the challenge together. HA

Commentary

Panoply of Definitions:

Looking at Tropical Architecture through Many Eyes

A tropical building would invite me to enjoy its shade and protective overhang even as a passerby. Should I wish to enter, I would be greeted by shaded courts, plants, and trickling water surrounded by spaces bathed in filtered sunlight. As I push a window, it would actually open and tree-cooled breezes would refresh me. The building would not loom or glint or give me an icy stare; it would just smile.

Smiling tropical buildings are rare and endangered for, like the nene and palila, they have been eliminated in the name of progress. They also seem to reproduce very slowly. That is not to say that they are not being husbanded by eminent architects such as Val Ossipoff whose Pacific Club, C. Brewer offices in Hilo, and numerous residences smile at me graciously.

If we are to encourage the significant growth of tropical architecture, however, we have to look at the very foundations of our life-style and laws. We require an efficient working day that is often contrary to climate and relies on conditioning. Our need for safety makes illegal the natural ventilation of modern high-rises. We need quick transit and multi-laned freeways. We have a high concentration of people doing business in a high-rise downtown. These are a few characteristics of our society endangering our tropical life-style as much as our tropical buildings.

Are we willing to change? If we do change, our architecture will surely follow.

Francis S. Oda
Group 70, Inc.

The ultimate in a modern tropical home is still off in the future. Under ideal conditions, it would have electronically-controlled vertical wall panels that would open at various angles according to the velocity of the trades. (But not too open. You don't want to blow out the fire pit in the middle of the living room while cooking the pupus.) These panels would close when the first drop of rain touches them.

Don't ignore color. Adventurous homeowners could select one of the dominant Hawaii colors (such as the various reds in volcanic activity) and then blend them in pastel shades from wall to wall. Of course, please call in a color consultant.

Jerry Tune
Sunday Home Section
Star-Bulletin & Advertiser

Passive lighting and cooling are architectural applications of solar energy. Rather than use energy to provide light or to cool the inside of a building, the structure should be so designed as to make maximum use of shade and of sunlight. Cooling is a more important consideration than lighting because much more energy is used in air conditioning. Some researchers in the University of Hawaii at Manoa Architecture Department have been developing formulae for analyzing a building's thermal performance. Passive solar applications are natural solar applications for Hawaii and other tropical areas; they should be pursued further.

Mary Troy,
Hawaii Natural Energy Institute

A good tropical building should allow the people who live in it to take full advantage of the advantages of living in Hawaii. It should open and shut easily and as fully as possible to the wind and sun. It should require minimum maintenance and housekeeping. Good Hawaiian landscaping should be able to take care of itself until the grower feels like gardening, whether on the ground or lanai. If it has all these advantages, the shape it must take should certainly be beautiful tropical architecture.

Marilyn Bornhorst
City Councilwoman

Tropical architecture is simply an architecture suitable for the tropics. The definition is simple; its achievement not quite so.

What's different about the tropics from other climes? Just that — the climate. The terrain and building materials can be virtually the same, the clients can be the same, but the climate, if you recognize it, is different. If you air condition, you don't recognize the climate; you create your own. And so out of necessity — economics and land availability — you crowd commercial buildings, make them multi-storied, and then, for comfort must air condition them.

Then, when talking about tropical architecture one must be talk

Continued on Page 2

Continued from Page 16

ing about domestic architecture. (This, like any generalization, is of course not true.) Ed Stone's U.S. Embassy in India comes to mind as a chef-d'oeuvre of modern tropical architecture. Whether it's air-conditioned or not, I don't know.

Now then, if you limit your talk to domestic architecture you probably conjure up custom, expensive residences which are naturally the exception and not the rule. Everyone knows what the exceptions are like — open, free-flowing homes, with well-ventilated louvers oriented to the spacious gardens (and views) about them. So let's not talk about them. Let's talk about the "rule."

But before we do that, let's touch on some indigenous examples. An indigenous house, you must think, will be the answer. The Samoan *fole* is a fine example of tropical architecture. A series of relatively closely spaced posts arranged roughly in a circle or a rectangle with semi-circular ends, "walls" between the posts made of woven palm fronds which fold horizontally so that when folded there are no walls at all. All this covered with a rising thatched roof resting on the posts. With ownership of worldly goods and security not a problem, what an ideal tropical structure!

Take another example — the Hawaiian *hale*. A hut of thatched walls, thatched roof, a single low opening serving as the entrance, and the only source of air. How stifling it must have been!

So, indigenous examples don't help us. Custom houses, the exceptions, don't help us. So let's turn to the everyday house, the rule. A few years ago standard walls were ¾-inch thick, which, were it not for the belly band around their middle, would buckle under the weight of the roof.

Windows — double-hung, requiring frames to house the two sash and the counter balancing weights such that they ended up roughly six inches square in horizontal section with most of the six inches projecting on the exterior of the ¾-inch wall. This window is an expensive bit of millwork so you didn't find many of them per room. Moreover, being double-hung they could open halfway only at best.

The floor plan was invariably bad; the living room, dining room, and kitchen lined up one behind the other with two bedrooms and the between bath lining up and paralleling them. Orientation made no difference. There was little cross ventilation. Doesn't sound like the house that would have evolved in response to tropical conditions. Yet that was the house, and hundreds of them were built, with some still standing in areas like Kaimuki and Kalihi.

The point of all this is, I guess, that you can't define tropical architecture. The best description of what a tropical house must have, I think, was made by a visiting architect from Ceylon who said that the house must have a roof which acts as an umbrella which will shed the rain when it rains and will shade the house when it's sunny. Too often do we forget this simple counsel.

Vladimir Ossipoff, FAIA
Ossipoff, Snyder, Rowland & Goetz

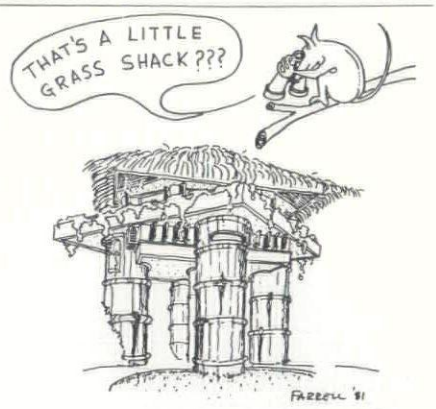
Tropical architecture is, in short, a roof in a garden.

Hans Riecke
Hans Riecke Architects Associates

If indeed we shape our buildings and they shape us, then we who live in the tropics certainly should be allowed by the structures we live in to enjoy a tropical lifestyle with whatever beneficent effects such a style may engender. Although there have long been happy examples of attractively adaptive architecture here, too often we have by our buildings been "bent out of shape."

Perhaps our need now to conserve energy will lead to a more universal, varied but truly Hawaiian style of architecture, to buildings and homes designed for the unique characteristics of our enviable climate and environs — whether at the shore, in a valley, on a mountain, in bustling downtown or a changing old neighborhood. Necessity can mother beyond invention abundant creativity which could beguilingly help shape not just our lives, but our Hawaiian future.

Jean King
Lieutenant Governor



Joe Farrell
Architects Hawaii, Inc.

"Tropical architecture" implies a recognizably characteristic way of treating structural requirements within a specific geographical area, but the tropics are so notable for their lack of any limiting demands that the style, if such it be, varies as much with its longitude as with its latitude. Here it has earned a window-dressing connotation of tikis and tree ferns rather than sound rational analysis — just add pineapple to the recipe and call it Hawaiian.

Aunty Nature has been too easy on us, giving us a land where architecture might well be considered redundant, where all we really need for shelter is an umbrella. Other perceived needs are of our own making and choice; they aren't tropically topical. We've created or imported them from other lands, along with their inadequate solutions. They aren't Aunty Nature's; they're anti-nature.

The growing human imbalance in this ecosphere can't be swept under a lauhala mat for a cosmetic return to the old days of a fancied Polynesian idyll. This is tropical non-architecture, a chimera . . . or is that spelled *shibai*? All together now — let's hear it: Alooooooooo-HA!

William D. Merrill,
FAIA-ME

Nostalgia may cause some people to desire building designs that could make better use of our natural climate. Many will point to the "good old days" when there wasn't a means to improve on our wonderful climate. The population densities and people's expectations of the future in Honolulu are

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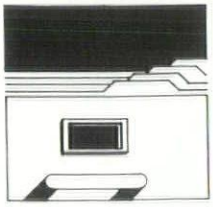


Index

Designing with Less Energy

by THOMAS CREIGHTON, FAIA-ME

One of the most difficult architectural decisions to make in Hawaii is how to design. It's easy enough to follow mainland precepts: discover the program of needs (how much space is necessary for the obvious requirements, how much for non-essential but desirable wants and how much will be left over, if any, for frivolities but good notions), see how all of this fits the site, cut and twist the program until it works well (perhaps brilliantly) in the space available, and then project it into elevations that reflect the current, fashionable mode.

These translations of the program into architecture may be simple and ingenuous, as so many of our new condominiums are; they may be tinged with modernist cliches, as are so many of the buildings on the University campus; or they may, in this day and age, contain partially concealed historic allusions. That is, they could be contemporary, or modern, or post-modern. Those seem to be the "styles" that are followed today, and if anyone is to be admired in Hawaii, one certainly can't be out of step with current practice.

Once in a while, though, an architect here breaks the mold. The program is considered not a rigid statement of required needs, but a spark to stimulate the imagination: demands are fixed, of course, but in a way that starts the mind working instead of stultifying it. Perhaps space is needed for living — but in what way? As one does in Dubuque, Iowa, or in a way appropriate to our peculiar climate and particular winds and views? Maybe there is a call for a work area. What sort of work, under what conditions? Pleasant, uncluttered, calm, in the way most indoor labor in this balmy atmosphere has always been accomplished — or tight, hurried, constricted, as so many of the daily stint areas on the mainland are designed?

A great deal of the translation of the program, as it turns out, will affect the appearance of the building. A house or an apartment will be turned to catch the almost constant breezes, and will be open to the view that is almost always there. An office building will allow the clean fresh air that we still have here into the building (being careful, of course, that notes and papers remain fixed in their place), and will allow most daylight work to be done in the good abundant light that nature obligingly provides.

At least that used to be true. It was true when architectural design was primarily a matter of fitting the requirements to the site and its peculiarities. But we've become sloppy and careless. Now we work backwards: the site is studied for its maximum use and requirements are fitted into the space indicated. If the balmy breezes blow in the wrong direction, or if the natural daylight isn't available, these difficulties can be solved by mechanical means. We have a great portfolio of modern techniques at our command: an artificial environment to substitute for nature's own; a mechanically lighted interior to take the place of that provided by the sun.

I've remarked before that the ability to use engineered means of shaping the climate to suit us marked the end of architecture as we had known it through the ages. It meant that an architect no longer had to study orientation, wind movements, the direction and intensity of the sun.

"Architecture," said Le Corbusier, "is made from sun and space." Again we are thrown back on them. The sun is as essential as it always was; space is needed to catch all the radiance we can.

Suddenly we realize that we have been completely careless of the way we use energy. It becomes something to be consumed sparingly; it is scarcer, and is becoming terribly high priced as natural resources dwindle. We study ways to conserve it, to spread its essential uses wisely instead of lavishly.

Many still are prodigal in its use, they point to nuclear fuel, which they tell us can be produced, gradually, less expensively than at present. But here in Hawaii we are fighting against the disposal of its wastes (still an unsolved problem) in the Pacific — along with most of our neighbor islands.

Suppose we forget, for the moment, the substitutes for oil and coal and begin again to design as we should, anyway, in Hawaii. Let's face the fact that energy is going to become increasingly difficult to obtain. Let's get ahead of the rest of America and find a design solution without it. Eventually, in Hawaii, we will have all kinds of alternatives that will in time be usable. But they'll always be expensive and will always have to be used economically.

No other place in the world has the advantages we have: the sun itself, shining most of the time; the wind, almost constant; the sea around us, with its geothermal changes; the volcanoes with their inexhaustible energy. They all offer us great design opportunities.

Why not develop an architecture of our own that makes full use of our peculiar characteristics? In the first place, let's think: why do we need energy in our buildings in Hawaii? Surely not for heating. Lighting can be minimal, depending on the orientation of a building. Air conditioning? We got along without it at all, until perhaps 1930.

Let's turn back the clock and, instead of depending on a manufactured environment, pretend that again we don't have it. It will be uncomfortable at first, on a wet, humid day with a sharp kona wind, and we'll wish we owned it, but

such days pass quickly and the sun and the trade winds come again.

Hot water? We need energy for that, and for the myriad gadgets that we've become used to around the house, particularly in the kitchen. Here's where Hawaii's substitutes will come in: solar energy, wind power, geothermal and other expedients. What design opportunities! A solar panel catchment itself can be a handsome adjunct to any house; they've already been used by smart architects in many ways, and the possibilities are endless. In addition, the broad expanse of glass on roof or walls for a building designed to catch as much sun as possible, can begin to supply the ingredients of an architecture of our own.

Suddenly, finally, an architecture of Hawaii begins to emerge. And a plan for Hawaii. No more tall buildings shutting off the natural elements from their neighbors. Protection of natural light and air around a new building should be a basic part of our zoning laws. We will have to begin again paying attention to the way a building is faced, to location of neighbors, to every opportunity to catch every bit possible of our valuable wind and sun and air.

Instead of Hawaii slavishly following mainland cliches so as not to be unwatchful of the latest trend, Hawaii could point the way in every respect, with a design of its own, moving toward a modern architecture, for the first time based on the qualities that are peculiarly Hawaiian. HA

Definitions

Continued from Page 21

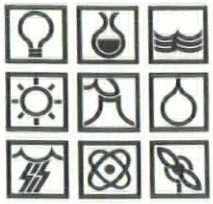
going to preclude returning to the "veranda" type designs of a simpler time.

The necessity to ameliorate the living and working space of the tens and hundreds of thousands of people in an urban setting will continue the space conditioning practice. Innovative designs may aid in the stabilization of the dramatically rising costs of providing a comfortable environment. But the only long term and significant relief from cartel manipulated energy pricing or cheap oil will be to produce local substitutes for imported oil, in abundance, to begin to slow down the hurtling rise in the cost of the style of life we have become very accustomed to.

John P. Keppeler II
John P. Keppeler II, Inc.
Energy Consultant

There is one major area of resistance to energy-conscious design, and that is a lack of awareness. This is particularly acute at the stage of project conception and design. The two factors critical to this initial phase of the project are developers and architects. They must accept and employ passive design techniques in new projects — and see results — in order for passive design to become an integral part of land development.

Richard Kawakami
Energy Administrator
Study of Energy-Conserving
Development Regulations
HA



Energy

Elements of Tropical Architecture

by CLIFF TERRY, AIA

A new resident of Hawaii frequently voices a familiar comment about the housing he finds as he looks for a home: "I expected to find tropical houses here in Hawaii, and all I see are the same ones I left in (Topeka, Toledo — or whichever city he comes from). Why can't I find a tropical house?" The answer is not complicated, but the question raises some points about the housing industry in Hawaii.

"The design and construction of human dwellings and settlements in a region are influenced, besides other factors, to a great extent by the climate and physical environment of the region. In constructing shelters for himself over the centuries, man has always taken into consideration these factors, sometimes consciously in a systematic way but more often unconsciously by following the traditional methods of planning and construction.

However, these traditional methods themselves are the result of generations of planning which have taken into consideration the local technology, materials, climatic factors, and social conditions. The tropical countries, with their varied climatic, physical and social environments, still retain and reflect these traditional features of planning in their buildings and towns to varying degrees."[1]

Before American society changed the forms of Hawaii's lifestyle, culture, and physical surroundings, tropical architecture in this traditional sense was found throughout the islands. The basic Hawaiian house was a response to the needs of a basic agricultural society. The surrounding countryside provided the building materials: timber, bamboo, and thatch.

The rhythm of life included time for building as much as cultivating or fishing. Everyone was a housebuilder to an extent; monetary transactions were minimal. Buildings were based on low investment and high maintenance.[2]

From the arrival of the first missionaries and whalers, this society began its transition to one virtually indistinguishable from a mainland one, except in relatively small areas where the traditional *ohana* survives.

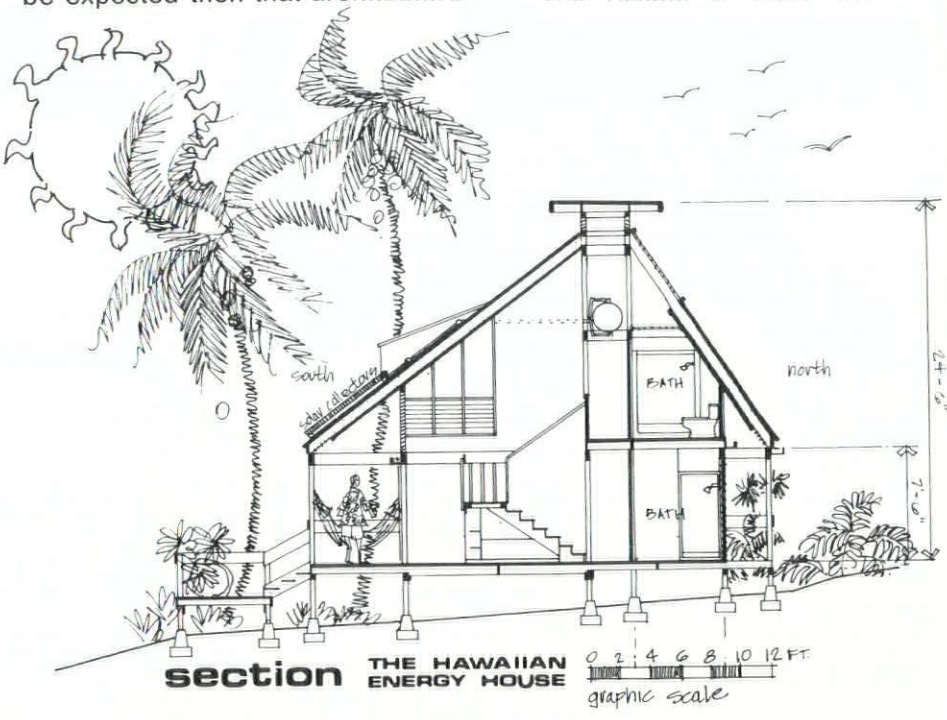
A contemporary lifestyle requires durable, comfortable and permanent furnishings and materials, and usually provides little time for maintenance or repair. (One can anticipate the reaction of a mortgage lender or real estate broker when presented with plans for a townhouse with thatch roof and bamboo walls.) Current attitudes toward material ownership as well as the unfortunately increasing need for security make it difficult to achieve a traditional level of openness in planning and design.

Also, as cheap electricity became widely available we could artificially produce an enclosed climate, and the traditional tropical features of buildings which responded to the climate of the site were no longer important. It is to be expected then that architecture as a response to social conditions and needs would change as those conditions and needs changed.

The constant element throughout this process of social change is the climate. One should expect to find tropical architecture, to the extent that climatic factors influence it, in tropical areas. Perhaps one of the reasons it is scarce in Hawaii is that this is not a truly tropical area for the most part.

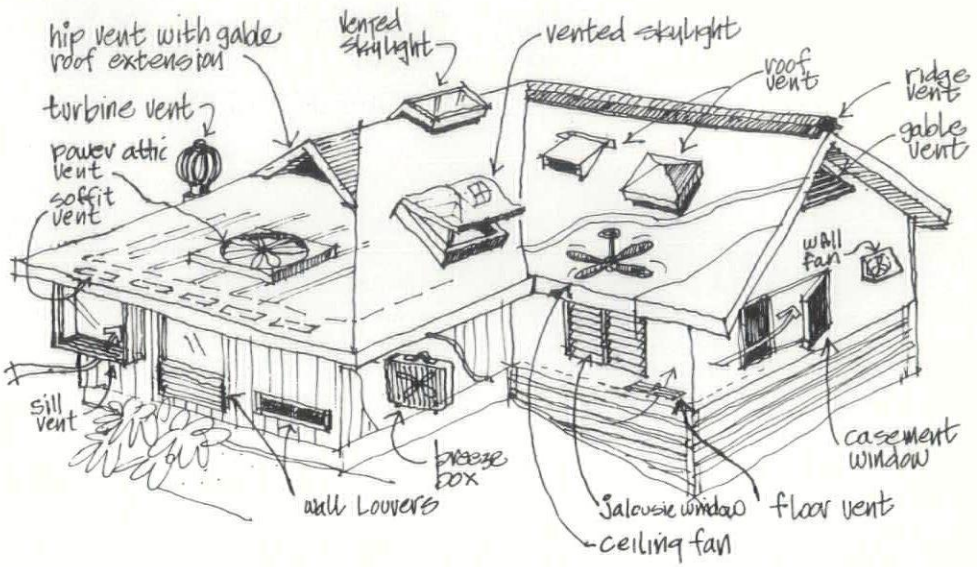
The large land masses of tropical Asia, Africa, and South America will have consistent weather patterns, depending on the seasons, due to the large distances over which conditions stabilize. Small low islands cannot influence their local climate and maintain a constant temperature depending on wind and water temperatures. Only larger high islanders develop the patterns of rising and falling air masses which cause cooling of the air, rainfall on windward sides, dryness on leeward sides, sea breezes, and the other climatic variations we experience here.

The results of these wide va-



ventilating methods

Illustrations taken from Hawaii Home Energy Book, University Press 1978.



rieties in cultural and ethnic backgrounds and in site climate conditions make it unlikely that a uniform "tropical architecture" would (or should) be found among the houses in Hawaii. Yet satisfying the requirements of lifestyle and climate is a basic goal of traditional homebuilders, one which should be met in the houses we design in Hawaii. Not all of them do.

There are several basic elements of traditional tropical houses which should be reviewed and considered when any house is designed here, to see to what degree each of them applies to the problem at hand. The first element is a high pitched roof, which serves the purposes of encouraging rapid rainwater runoff, and creating high interior spaces for an upward flow of warm air.

Rainwater runoff is of less concern with modern building materials than it was with thatch, yet the moss-covered wood shakes which can be found on newer lower pitch windward roofs testify to the need to pay attention to this issue.

The upward flow of warm air is perhaps the most important single condition to achieve in a successful tropical house, since an adequate natural ventilation system can almost ensure a comfortable house in Hawaii while an inadequate system will ensure discomfort. The basic physical principle of warm air rising and being replaced by cool air below can easily be employed in our designs by introducing ventilation low on side walls and creating openings high in the ceiling spaces. The resulting chimney effect will create cooling air flow throughout a home even without the benefit of trade winds.

Side walls which can be opened will take advantage of the trades, which are a genuine asset to the designer in Hawaii. Too many of our houses have small windows in solid walls, generally located too high to permit a light air flow to cross our bodies, and too many designs ignore the requirements of cross ventilation through or between rooms.

Of course there are potential disadvantages to consider, such as noise, dust, excessive winds, and possible fire hazard, but in most cases these can be controlled through operable devices which control the air flow, such as louvers, sill vents, and sliding doors. Smoke detectors are a necessity in any home. The ability to close vents is also important when we consider that some houses in valleys only 10 minutes from Waikiki rely on fireplaces in the winter to control dampness and cold.

Sun control through overhangs or other devices is a simple but often neglected element. Many tract home designers and builders minimize the length of overhangs to save material or to limit distances between units to code minimums. The result frequently is an uncomfortably warm interior as the sun heats up east, south, and west walls, which transmit that heat to the residents inside.

Again, the particular site climate should dictate the length of overhang and degree of sun control required, with hot leeward areas needing more than cloudy windward areas.

The proper selection and use of building materials and colors is an important element. Masonry construction is frequently used in hot, arid climates for its thermal flywheel effect, which stores heat during the day, keeping it from the occupants, and releases it during the cool nights, warming the interiors. This flywheel effect is not as workable in Hawaii where the day/night temperature differential may be only 10 degrees instead of 80.

The principle remains the same, though, and dark-painted west walls of houses and apartments can render the interiors almost uninhabitable early in the evening and into the night. The use of large expanses of west-facing unprotected glass can turn an otherwise well-designed home into a solar cooker as the short-wave light radiation enters the room and the long-wave heat radiation builds up. Pulling the drapes to cut off the heat only substitutes semi-darkness at the expense of view and ventilation.

Although this discussion has focused mainly on houses, the same principles apply to multi-family buildings as well. Townhouse buildings can achieve the same or perhaps better vertical air circulation than single family residences, due to their generally being at least two stories in height. Single level apartments are more difficult, with only the upper floor units able to use pitched roofs, but cross ventilation is easily effected in all but double-loaded corridor buildings.

Sun control is a major element

Continued on Page 26

Elements

Continued from Page 25

to be considered in multi-family buildings. Site requirements usually dictate building orientation, so west-facing glass is common in apartments, but lanai overhangs and sun control devices can alleviate much of the solar heat problem.

Exterior fabric sunshades are

used, but are subject to deterioration from sun and wind. Rolling metal blinds can block all of the sun's heat, but block daylight and ventilation with them, and give a typhoon shelter appearance which may not be desirable. More elegant solutions could be devised, including wood shutters or bamboo shades.

There are also energy implications to these elements. A pie graph would show the greatest amount of residential energy goes to heat water, which of course can be provided by solar systems. Inventive solar installations can use collector panels as sunshades, thereby both using the sun's heat productively while preventing it from entering the building.

The greatest portion of the remaining energy use goes for appliance operation, which is not affected significantly by proper de-

Continued on Page 28

t McInerny, Royal Hawaiian Center . . .

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Elements

Continued from Page 26

sign except if the appliances include an air conditioner. There should be no need for mechanical devices to control climate in a properly designed residence in Hawaii except for particular site conditions or owner requirements.

What results from considering these elements is a set of principles which can be applied to our residential design projects to produce appropriate and acceptable tropical architecture, within the limits of climate and client dictates. Not tropical as a contrived postcard "style" but tropical as a natural development of the project conditions.

First, consider the site climate for amount and direction of wind, rainfall, and sunlight.

Second, design a building volume which, while satisfying the other program requirements, permits a free flow of air throughout.

Third, control the flow of air with adjustable sidewall openings.

Fourth, select materials and colors which absorb or reflect an appropriate amount of heat.

Fifth, cover the structure with a roof which shades the sidewalls adequately, extends wide enough to protect the openings from rain and sun penetration, and provides adequate ventilation high in the enclosed space.

If these principles are already being applied in your design work, you are probably producing the tropical architecture from which Hawaii should benefit. Your clients should be pleased with the results, and you probably will be also. HA

Footnotes

[1] Kukreja, C.P. *Tropical Architecture,* preface. McGraw Hill, New Delhi, 1978.
[2] Koenigsberger, O.H., et al. *Manual of Tropical Housing and Building,* p. xv. Longman Group, Ltd., London, 1973.
[3] Kukreja, p. 3

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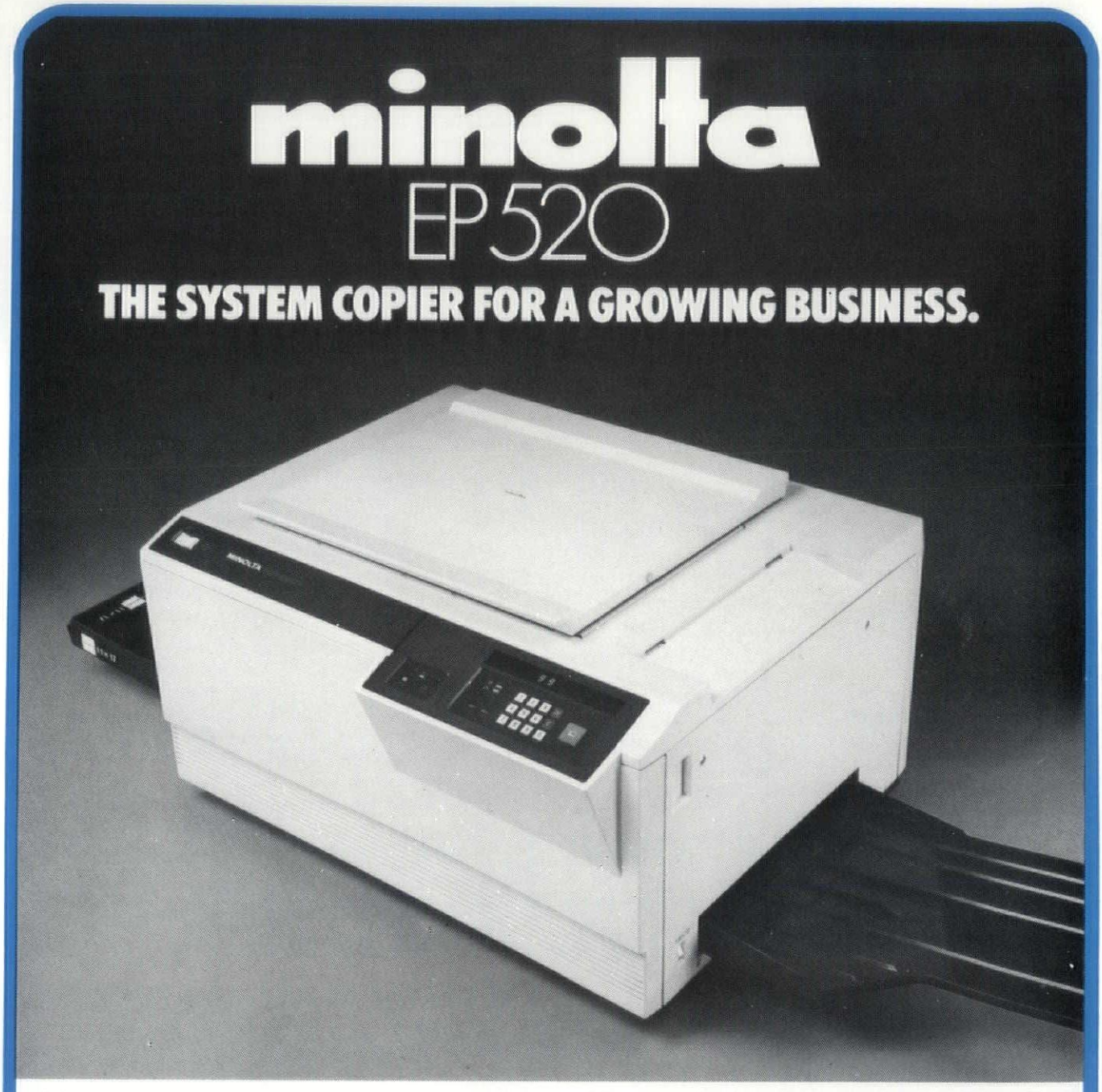

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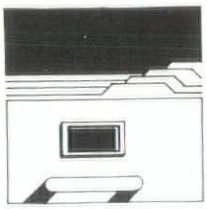


Index

Design for Daylighting

by DAVID LORD
Associate Professor of Architecture
University of Hawaii at Manoa

The architect of Hawaii who accepts and embraces daylight as an important design determinant will have the double reward of creating new and exciting building forms while saving significant amounts of electrical energy. Consider the following facts:

1—In Hawaii, the ambient light level is 100 times greater than is needed for efficient task performance inside buildings.

2—Most commercial buildings consume more than 50 percent of their energy for electric lighting, most of which is used during daylight hours.

3—Even though fluorescent lighting is very efficient, north sky or indirect daylight is four times as efficient as fluoreseent in its ratio of useful light to heat. Daylight does not necessarily increase the heat gain in a building.

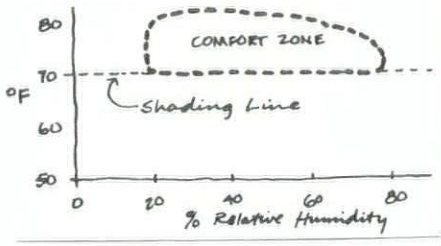
4—The technology already exists for introducing daylight deep into the interior of a building and controlling it around the perimeter.

There are two reasons for studying solar shading and daylighting in Hawaii: for thermal and visual comfort and for energy conservation. These reasons are explored in more detail below:

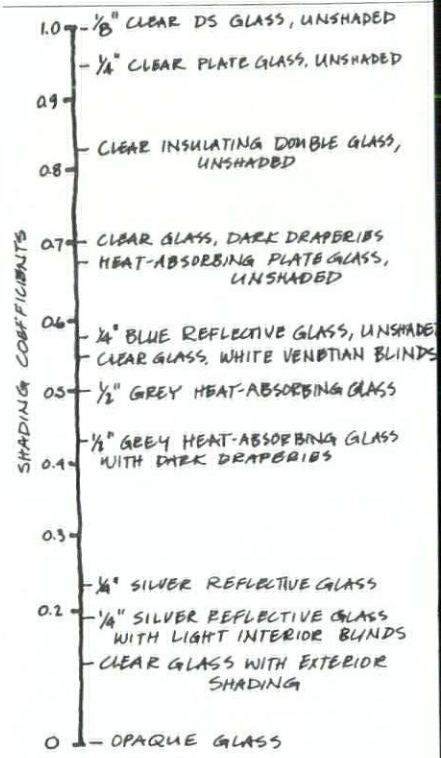
Thermal and Visual Comfort

In Hawaii's climate, thermal and visual comfort can be achieved through straightforward architectural means without resorting to mechanical and electrical systems. The environmental issues of light and heat are interwoven, since the provision of light results in an unwanted byproduct: heat. Reference to Victor Olgyay's bioclimatic chart reveals the parameters of thermal comfort.

When the air temperature climbs above 70 degrees Fahrenheit (which happens in Hawaii every day of the year), shading from the direct radiant heat of the sun is the easiest way to extend the limits of the thermal "comfort envelope." Many buildings which do not have solar shading and control devices use reflective or heat absorbing glass instead. This treated glass is not as efficient as shading in stopping heat gain to the spaces within.



It is interesting and informative

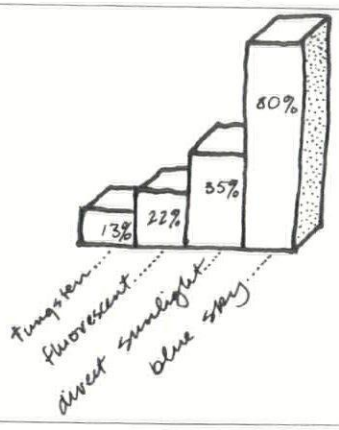


to compare the efficiency of various light sources expressed as a percentage ratio of light to heat:

Light Source	Percent Efficiency
incandescent	13
fluorescent	22
direct sunlight	35
blue sky	80

It can be seen that north sky day-

lighting is four times as efficient as fluorescent in providing light without concomitant heat gain to a space. This would be important for



thermal comfort in either a naturally ventilated or an air-conditioned room.

The primary purpose of most lighting systems is to enhance visual performance while providing visual comfort. It is generally accepted that effective sidelighting provides less veiling reflection, improved contrast and thus greater visibility than equivalent footcandles from most overhead lighting systems. Daylighting produces modelling effects which, if carefully controlled, are often pleasing and desirable.

Since the eye and brain evolved under daylight conditions, the color temperature is very pleasing and color rendering properties of daylight are excellent.

In tropical latitudes, the ambient light level is 100 times greater than is needed for efficient seeing or task performance inside buildings. Sky glare and direct beam lighting are highly undesirable for comfortable seeing environments. The problem in daylighting is therefore one of re-directing and diminishing ambient light so it can be delivered in a useful form to interior spaces. This process should have the combined effect of reducing heat gain

Continued on Page 32

Design for Daylighting

Continued from Page 31

to the interior and enhancing visual performance and comfort.

Energy Conservation

Shading of glass from direct sunlight will reduce heat gain to interiors by as much as 90 percent. If daylighting is to be a concern, tinted glass or mirrored glass are not wise choices to reduce heat gain. Not only do they not admit sufficient light but these treated glasses are not as effective in reducing solar heat gain to interiors as is the physical shading of the glass. While solar shading is necessary for comfort in any space, the energy conservation value of solar shading is greatest in those buildings which require air conditioning. As an example, in Honolulu 50 square feet of unshaded southeast-facing glass require one ton of air conditioning at 9 a.m. on January 21, just to compensate for direct solar gain to the space.

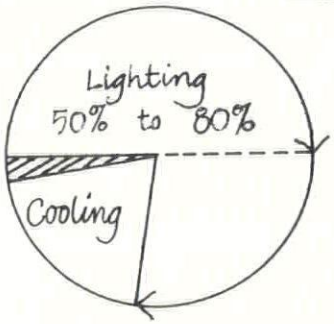
The energy conservation argument for using daylighting in commercial buildings is threefold:

1—Electrical energy savings. At 3 watts/square foot installed power with 2,500 hours-per-year of use there will be a consumption of 7.5 kilowatt hours (kwh)/square foot/year for lighting. Savings of 50 percent are realizable in the perimeter zones of most buildings with a well designed daylighted system incorporating on-off or dimmable controls. Thus, up to 4 kwh/square foot/year can be saved. Since electricity costs 7 cents per kwh, this has an economic value of about 30 cents/square foot/year. In large buildings these savings become significant in absolute dollar value.

2—Reduction in peak power and air conditioning costs. Charges for peak power demand may represent a significant fraction of a firm's total electric bill. Consider a typical all-electric office building in Honolulu in which 50 to 80 percen

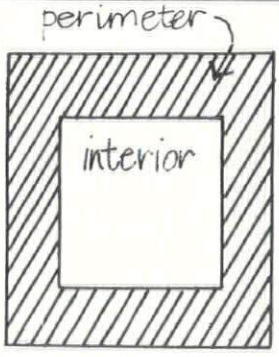
of energy consumption results from lighting. Assume that one-third of the usable floor space is in the perimeter zone next to windows. Thus, the maximum potential daylighting savings is one-third of the 50 to 80 percent or 15 to 25 percent of total energy. This maximum potential can be realized at peak conditions when ambient light levels, solar heat gain and electric power consumption are all at their greatest.

Under peak load conditions,



ELECTRICITY USE IN COMMERCIAL BUILDINGS

typical cooling loads are 5 to 10 watts/square foot. This is an air conditioning load of about one ton of cooling for every 350 to 700 square feet. Of this, about 3 watts/square foot represents lighting. With a net coefficient of performance of 2, the cooling power



requirement is then 2.5 to 5 watts/square foot.

Under peak load conditions if we turn the lights off in one-third of the

Continued on Page 34

Design for Daylighting

Continued from Page 33

building floor area in which daylighting is adequate, we have reduced the power consumption of the building by one-third times 3 watts/square foot or 1 watt/square foot average throughout the building. There is an additional savings of ½ watt/square foot average cooling power requirement for the building. This combination results in a net savings of 1½ watts/square foot or roughly 10 to 20 percent of building peak power.

The cost of new power plant construction is in the range of $2.00 per peak watt of installed power. In a new building, a 100 square foot office with lighting at 3 watts/square foot requires an investment by the utility of $600 in new generating capacity if the lighting and air conditioning is a contributor to utility system peaks.

3—Increased failure tolerance. The electrical supply in Hawaii is adequate; however there are at times citywide and regional power failures due to storm conditions and equipment failures. In a commercial building which does not depend entirely on electrical illumination, activities will be less subject to disruption during times of power failure.

Worker productivity is possible to quantify and has often been used in the argument for increased use of air conditioning. In fact, high lighting levels have been sold on the basis of increased worker productivity. Assume that an office worker with attributable indirect costs and overhead charges added to salary costs a company $40,000 per year. The worker occupies a 100 square foot space in the building, works 250 days, thus costs $160/day ($1.60/square foot/day or 2 cents/square foot/hour). Lighting, at 7 cents/kwh costs up to 60 cents/square foot/year. As a result, savings in productivity in a daylighted office due to the continuation of productive work for even *twenty minutes* during a blackout or power loss is equivalent in dollar value to an entire year's worth of energy savings! HA

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2—"Effective Daylighting in Buildings," by Stephen Selkowitz, *Lighting Design and Application*, February, March 1979.

3—*Mechanical and Electrical Equipment for Buildings*, 6th Edition, McGuiness, Stein & Reynolds, John Willey & Sons, New York, 1980.

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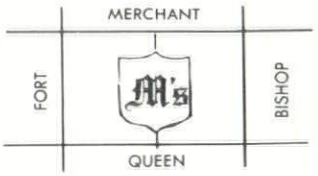

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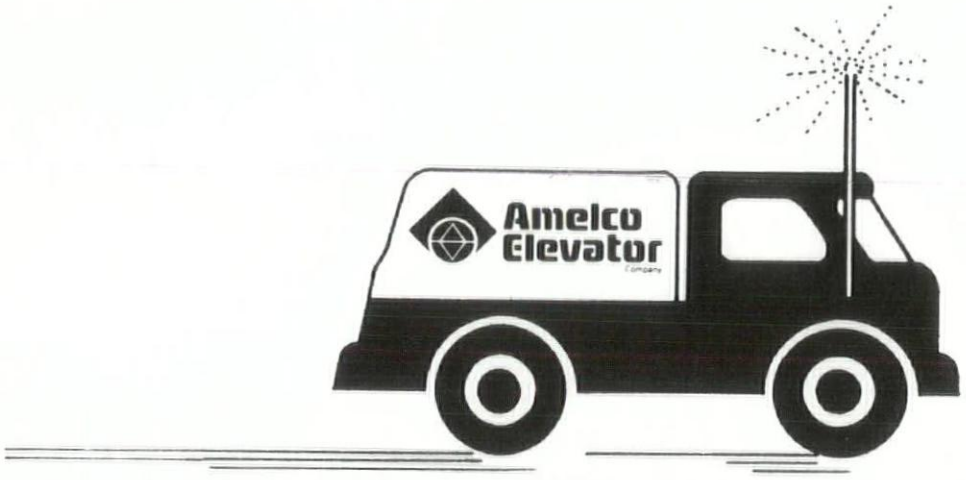

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