new mexico architecture

January-February 1981 $1.00

Solar—an Energy Source
—second in a series—

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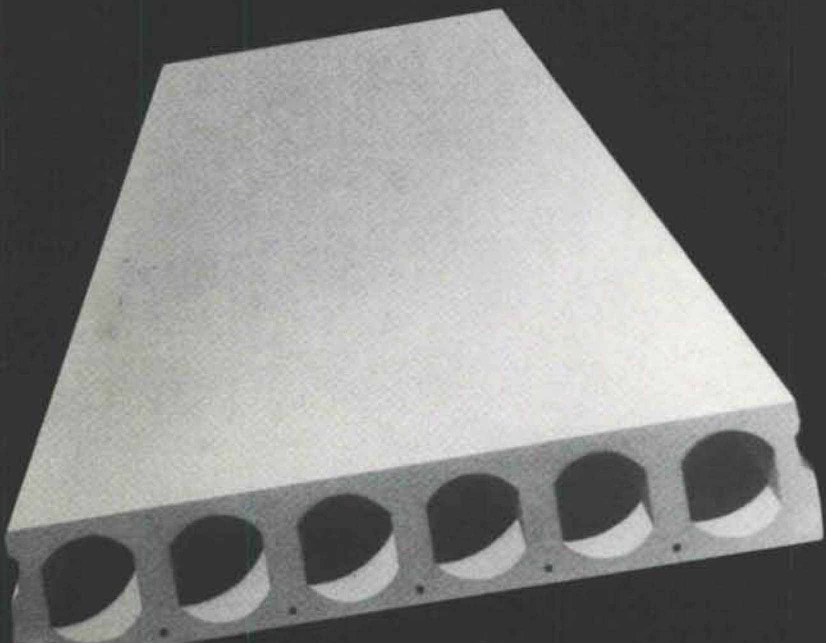
The right product for your next project.



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With Dy-Core, there's no storing, forming, placing and finishing of the concrete floor slab. The patented extrusion process utilized in its manufacture assures a level surface for each Dy-Core member. The use of precast Dy-Core structural slabs will result in lower total construction costs for your next project.

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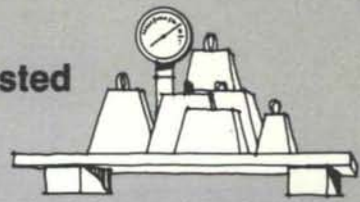

Dy-Core is a fully tested product. Design tables are provided for your use. Competent engineers are available to provide assistance to you during the design phase of any project. You can save and profit by using Dy-Core because it is truly the economical way to build in today's market.

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Dy-Core speeds construction. Dy-Core was literally made for modern building techniques. Inclement weather need not stall the progress of construction. Since the slabs arrive at the jobsite completely finished, they are "weatherproof" and can be erected immediately. Upon completion of erection, a working surface is then available for use by the other trades.

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Dy-Core makes possible a reduction in design time and total building costs because of its simplicity and by maintaining complete product uniformity. The most modern precast concrete plant, and the use of the latest quality control techniques during its manufacture, assures the uniformity of each Dy-Core slab. And uniformity is the key to any modern systems approach to buildi

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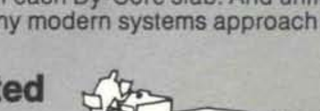

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Restrained Assembly Ratings—2, 3, and 4 Hr.
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Dy-Core offers special advantages to the owner of a building:

- Lower insurance rates—smaller premiums
- Greater personal safety in the event of fire
- Less lost time in restoration of structure and return to business

You can economically provide the built-in fire safety that concrete construction offers through the use of Dy-Core slabs.

nma

• *vol. 23 no. 1* •

• *jan.-feb. 1981* • *new mexico architecture*

This is the second in the **Solar—an Energy Source** series. More is yet too come.

The cover photograph for this issue is the Department of Energy's Central Receiver Test Facility (CRTF) at Sandia National Laboratories. The facility is used for testing components for future solar-powered electrical generating plants. The CRTF has a field of 222 heliostat arrays (foreground), each containing 25 four-foot-square mirror facets, which concentrate the sun's rays on solar receivers (boilers) mounted on the 200-foot-high tower. Water circulated through a boiler, for example, is converted to steam by the high-intensity solar radiation. The steam can be used to drive a turbogenerator for the production of electricity.

This important series will continue within the May/June, 1981 issue.

□ □ □ □

The March/April **NMA** will contain the **AIA** and **ASID** rosters. Also, it will feature the New Mexico Society of Architects, 1980 **Design Awards.** *JPC*

□ □ □ □

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The **NMA** staff wishes to thank those members who have contributed to its growth.

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(Cover: CRTF—see Editor's Column—a Sandia Laboratories photograph)

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TELECONFERENCING. TURN YOUR PHONE INTO A CONFERENCE ROOM.

COMPUTER SIMULATION OF ENERGY CONSERVING BUILDINGS

By Thomas T. Shishman

Thomas T. Shishman

Thomas T. Shishman is a Vice President of CM Construction/Managers, Inc., and the Manager of the Albuquerque Office of Bickle/CM, Inc., the energy division of The CRS Group, Inc. Mr. Shishman earned a Bachelor of Science degree in Mechanical Engineering from the University of Notre Dame. He also holds Master of Science degrees in Mechanical Engineering and Nuclear Engineering, as well as a Master of Business Administration from the University of New Mexico. He is a long-time resident of New Mexico, having been employed as a Technical Staff Member at Sandia Laboratories and as the Director of The University of New Mexico's Energy Institute. His interest in the subject of computer applications in the design of energy conserving buildings is the direct result of Bickle/CM's active role in the shortening of the time period required to apply the impressive results of New Mexico's many research institutions to the private A/E community.

Energy-conscious design is the only economical way to successfully integrate energy conservation and construction. Retrofitting and energy management projects merely compensate for the deficiencies of old designs that reflect the bargain energy used to be. Now that energy is expensive, the basic principles of conservation must be built **into** design. The consideration of energy-saving alternatives throughout the design process is the key to the successful design of energy-conscious buildings for the 1980's.

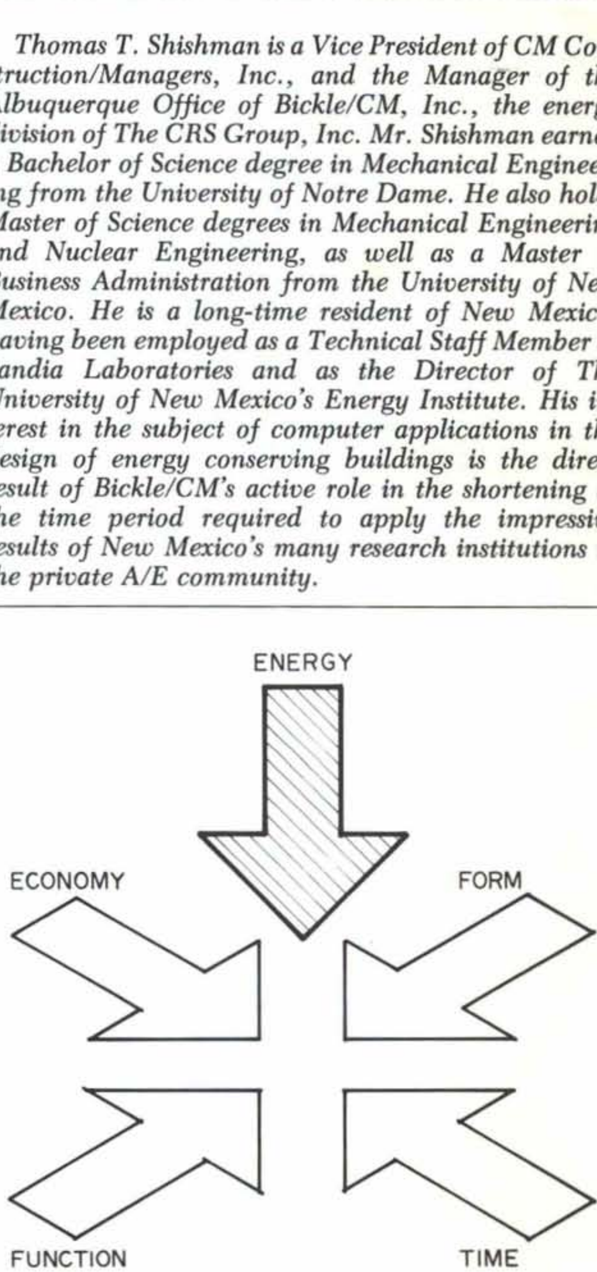
Architects and engineers are expert at balancing the fundamental design determinants of function, form, economy, and time. It is our experience that today's design team is faced with a new challenge—introducing and incorporating a fifth design constraint, ENERGY, into the traditional design process. There is true need for specific types of computerized design tools.

The decade of the 1970's witnessed the development and application of a variety of energy analysis computer programs. A large number of computerized analysis methods for solar heating and cooling applications were also introduced during the late 1970's.

The problem is that most of the computer models available were developed by a particular organization to solve a specific problem(s). Also, a significant number of the codes are proprietary, some are inadequately documented for general usage, some are very difficult to obtain, and essentially all are difficult to input, are costly to run, and are highly subject to user interpretation of output results. However, several are extremely useful design tools at both the programming (analysis) and design (synthesis) phases of a project.

Ideally, energy considerations should be addressed with the Owner, even before the A/E Team is selected. If energy is introduced as a design determinant only at the end of the programming phase, the potential benefit of energy-conscious design concepts will have diminished significantly.

During conceptual design, the design team can effectively utilize a series of very simple, synthesis-oriented computer programs. The objective of these programs is not to analyze energy consumption, but to identify the major design variables which influence



ENERGY DISRUPTS TRADITIONAL DESIGN

energy consumption. It is helpful to assess the sensitivity of the final design to these variables, and to evaluate the interaction of various key parameters. During early schematic design, progressively more complex computer models are desirable; large energy analysis and simulation programs are normally utilized during the latter stages of schematic design and design development.

The following computer programs evaluate the effectiveness of energy conservation alternatives. They are coordinated with energy conscious design methodology, and range from simple statistical reference data sources to comprehensive simulations.

In explaining each program, it's helpful to discuss:

- Problem that led to the program's development
- Solution offered by program,
- Input required, and
- Output format.

Major Computer Program: EBUDG

Problem: Architect/Engineer design teams frequently spend tremendous amounts of time and effort looking at areas of conservation and alternative energy sources that are not appropriate to a particular project.

Solution: EBUDG provides direction to the design process by establishing a reasonable "energy budget" for the building and identifying major energy end uses. After the building type and climatic zones are outlined, EBUDG breaks down the types of energy use to show us which areas the design team should concentrate effort on to realize the most effect. For example, some buildings in Houston use 50 % of their energy demand for air conditioning—so cooling techniques are a logical focus for the design team.

Input: General climate zone; area by usage type (E.G. 10,000 square feet of office space, 50,000 square feet of warehouse, etc.); number of occupants anticipated.

Output: Two bar charts. One shows the 20th percentile, mean, and 80th percentile range of an energy budget for a typical building, modeled from our input. The scale is in units of BTU's/square foot/year.

The other chart shows a breakdown of energy usage by type. It depicts what percentage of total energy consumed will go for the various end uses such as lighting, cooling and equipment operation.

Major Computer Program: WONDER-2

Problem: It is often difficult to determine the relative importance of internal loads (such as people and equipment), compared to external loads placed on the building.

Solution: Designed to be run in series with EBUDG, WONDER-2 analyzes how various components in a building contribute to overall energy consumption. WONDER-2 also introduces the concept of time into the evaluation.

By performing a simple hour-by-hour energy balance, or "mix", for the building, the program shows relative time relationships between various load components as well as average overall energy use. If, through EBUDG, we determine that cooling is a prime end use, WONDER-2 will show us what percentage of the cooling load comes from the glass, the walls, the ceilings, infiltration, etc. And we'll see how peak load air conditioning relates volume-wise and time-wise to other end uses, such as lighting. Designers can use WONDER-2 many times during conceptual design to understand the building's performance as a dynamic system.

Input: Hourly weather data, either for a typical day, typical season, or typical year, and the best possible description of the building. If the building's geometry and orientation are known, they can be used as input; if not, the program has default values for typical buildings.

Output: Rainbow plots, pie charts, or linear graphs showing the temporal relationship between internal and external loads. Because the input for WONDER-2 consists of hourly profiles, the precision of the program can be increased simply by using auxiliary programs to generate more and better hourly readouts for the different elements of the building. Key design alternatives can also be evaluated through the auxiliary programs.

Auxiliary Computer Program: COMPGLZ

Problem: Glazing questions tend to be extremely complex. They affect so many energy issues—solar gain, heating and cooling load, natural lighting. Also, there is a basic economic issue involved in the life cycle value of double-glazed glass.

Solution: The design team defines three or four windows designs and picks several different glass types; COMPGLZ determines the annual BYU's/sq. ft./yr. consumption rate associated with each glass type, for each orientation.

Input: Glass type; the material properties of the glass (thickness, index of refraction, normal vector); overhang/fin geometry; and hourly weather data, including solar radiation.

Output: A figure representing the cooling load, the net number of BTU's/sq. ft./yr., produced by each glazing option. This figure is then compared to the load of standard building wall, as a point of reference. The program predicts beam and diffuse radiation and conduction gains and losses on an hour-by-hour basis through use of an empirical model.

Auxiliary Computer Program: LUMEN II

Problem: Lighting typically turns out to be the most important energy use in commercial scale buildings, so we need to place particular emphasis on high efficiency systems that make maximum use of natural lighting.

Solution: LUMEN II analyzes artificial lighting schemes based on the predicted number of occupants and the availability of natural lighting.

Input: Description of the proposed auxiliary lighting system, the lighting fixtures, lamp type, room geometry.

Output: A "map" of the lighting levels which shows the specified area's light distribution, both from a side and an overhead view. The girds are figured in **light candles**, as if a light meter were read at one-foot intervals and lines were drawn to connect all the 30-light candle readings, etc.

Auxiliary Computer Program: EFFUFAC

Problem: There are many walls that actually use more energy when more insulation is added to them. In a cold climate, for instance, a south-facing wall acts as a solar collector; insulation only detracts from the wall's collecting efficiency and increases the heating load. Also, in buildings with very high internal loads, such as manufacturing plants, some of the process heat must be vented.

Solution: EFFUFAC takes into account the internal heat load generation and external absorbed solar radiation on an **average annual basis**, so the long term heat gains and losses are understood.

Input: Description of the building's wall construction, including the material properties (both physical and thermal); site orientation, latitude and longitude; shading information; local hourly weather data.

Output: Three sets of figures describing 1) the instantaneous heat flux on an hourly basis, 2) the integrated net heat transfer over a specified period of time, and 3) the Effective U-factor for the buildings.

Auxiliary Computer Program: ECONZER

Problem: There is frequently a need to evaluate the long term effectiveness of various economizer cycles and heat recovery schemes.

Solution: ECONZER is a simple and inexpensive program to use and describes the annual energy savings associated with, for example, the selection of an economy control on an air conditioning unit for a particular climate and a particular combination of internal loads.

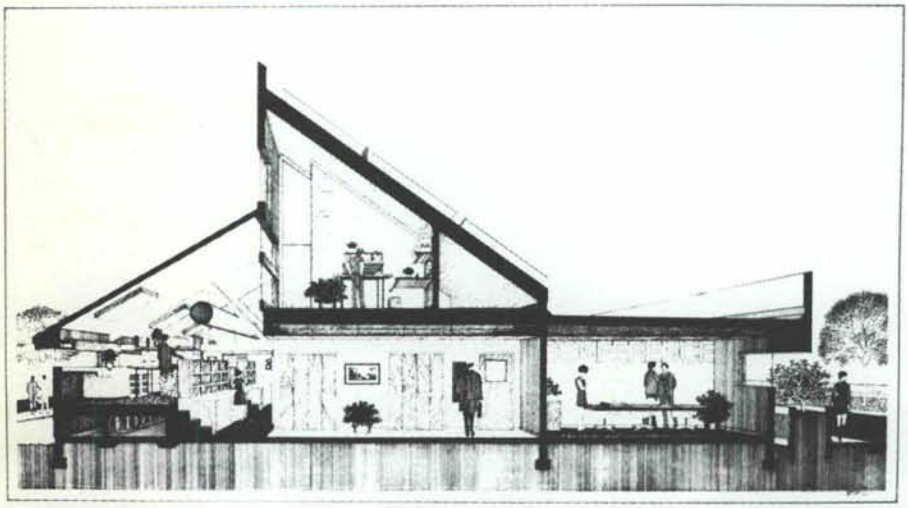
Input: Hour-by-hour weather data and hour-by-hour internal load data.

Output: A figure summarizing the average yearly BTU savings which would result from a scheme's implementation.

The auxiliary programs described thus far have dealt with individual components. The efforts up to this point have been **synthesis**-oriented, that is, working toward a cohesive energy network. The next two programs are **analysis**-oriented. We evaluate the interaction between the energy saving components and determine the total effectiveness of the entire energy system. *T.T.S.*

SUNSTRUCTURE OFFICE BUILDING
Albuquerque, NM

Architect:
The Burns/Peters Group



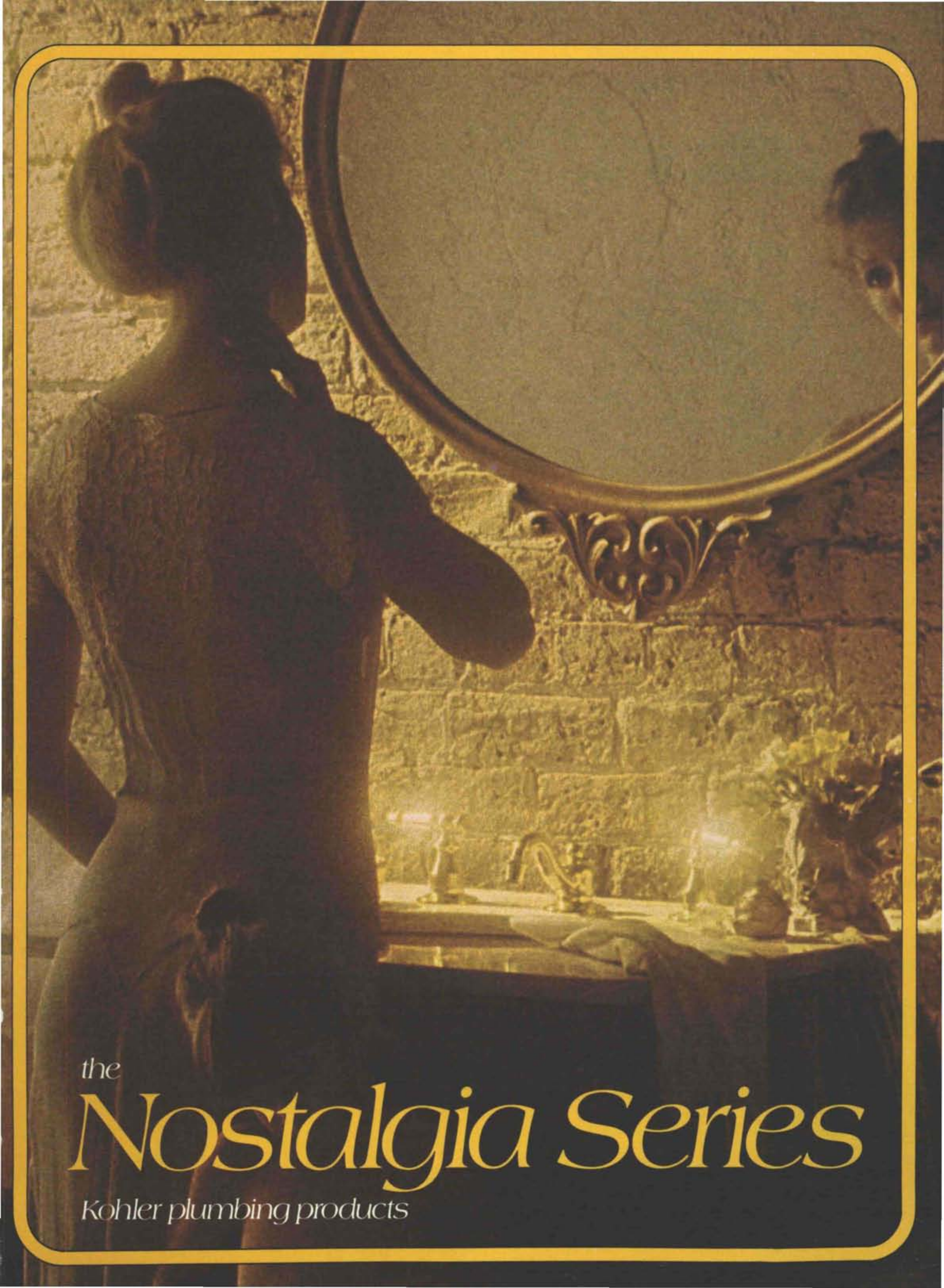
The Sunstructure Office Building, built by The Burns/Peters Group for themselves and other tenants was designed to be energy efficient in many ways. Not only is the majority of the heating provided by the sun, but energy conserving features have been used throughout.

The main feature of the building, both architecturally and in the area of energy are the tracking azimuth collectors mounted on the sloping roof. These provide hot water to a storage tank which in turn circulates through a heat exchanger providing heat for the six fan-coil units. The storage tank also provides a source for the thermosiphon coil for domestic hot water. A back-up gas fired boiler and an electric water heater are also provided. It was estimated that 80% of the typical fuel usage was saved during the winter of 1979-80.

The windows throughout the building have been minimized and those on the south are shaded from the summer sun by an overhang. The glassed-in entry way is also recessed for sun and weather protection. There are no windows on the east or west facades where shading is ineffective.

The entire building is well insulated, with double-glazed windows and thick fiberglass batts on walls and roof. Additional energy savings are realized through the use of six evaporative coolers, used instead of traditional refrigerated cooling. Natural ventilation is also possible with operable windows used during the spring and fall.

The 6,000 SF building has three separate levels. The base level of the Burns/Peters offices has a reception area, production and drafting area, offices and a conference room. Additional offices are provided between trusses on a raised platform, and the loft area under the collectors is used as a design studio. The sloping ceiling and two story spaces give an open feeling to the office space within.



the

Nostalgia Series

Kohler plumbing products

Caxton lavatory

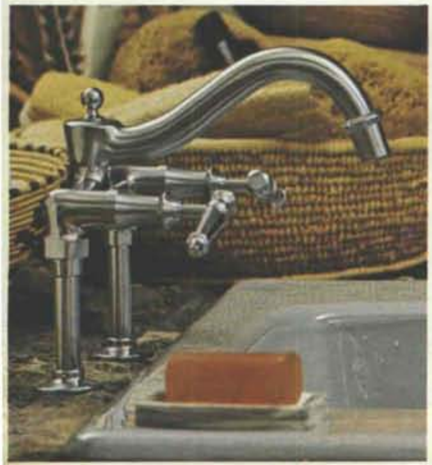
For installation under marble, tile, woo
or any countertop... to recreate th
old-fashioned charm of yesterday'
washbasin

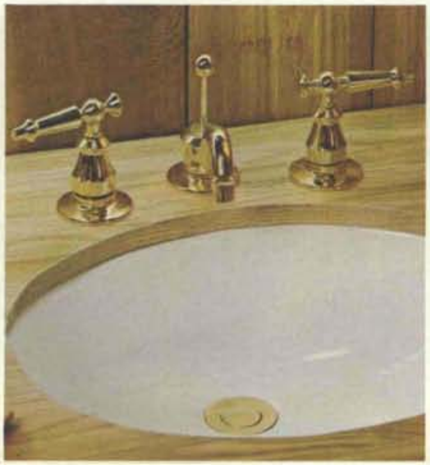
Sculptured in vitreous china. Offered i
two sizes, 17" x 14" and 19" x 15." Pic
tured: Caxton K-2210 17" x 14" lavator
in Country Grey, a high-fashioned Kohle
color that complements nostalgic decors
Also available in 10 other Kohler color
and white. "Antique" Water-Guard fauce
in polished chrome

"Antique" faucets

Distinctive elegance for everyday living. The perfect complement for the nostalgic bath or powder room. And equally at home in a variety of other decorating schemes—Victorian, the Roaring '20's, contemporary, eclectic, art nouveau. "Antique" faucets are designed for new construction as well as for remodeling. Imaginatively styled and quality crafted, they are offered in brushed or polished chrome or 24 carat gold finishes to complement Kohler's Birthday Bath, Caxton and Chablis lavatories and Vintage toilet. The perfect accent for Kohler's more contemporary bathroom products as well.

Lavatory faucets and City Club showerheads in the "Antique" line offer Water-Guard water-saving flow control, designed to help you save water, energy and money. "Antique" Rite-Temp bath/shower control features a vitreous china dial plate plus a pressure balanced mixin valve designed to maintain your desired water temperature regardless of sudden pressure changes in the available water supply.






IN A WORLD OF THE ORDINARY,
KOHLER PRESENTS THE EXTRAORDINARY
The "Antique" look. A nostalgic glimpse of the past. Prepared for you by Kohler Co., innovators of the Bold Look in plumbing products.
Here are fixtures and faucets designed to let you make a very personal statement about your lifestyle. An elegant rolled-rim bathtub with feet. A recreated turn-of-the-century pull-chain toilet. A continentally-styled pedestal lavatory. Antique-style faucets and fittings. And a rimless lavatory for under-the-counter installations.
Today the past is popular. Yesterday's quality and craftsmanship are back in demand. Past elegance once again blends with present comfort, charm and convenience. Clearly the time is right for the nostalgia series of Kohler plumbing products.

the Vintage

The pull-chain toilet is back! Complete with elevated tank and solid oak seat. Truly a return to nostalgia!

Kohler calls it the Vintage. And it's a blend of classic Victorian styling and contemporary colors and craftsmanship.

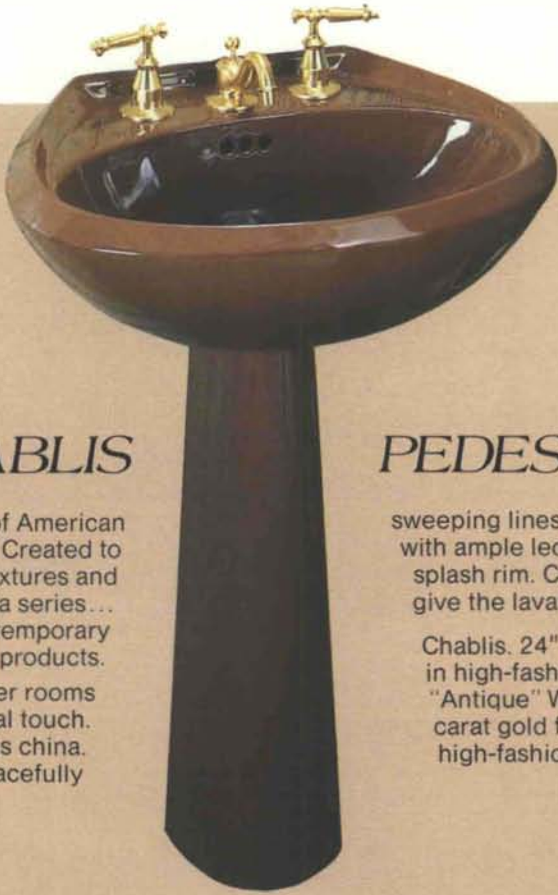
The Vintage is totally compatible with contemporary plumbing systems, and ideal for remodeling. The bowl offers positive, thorough flushing action. The tank features Kohler's "Insuliner" lining to help prevent condensation. Piping, pull-chain and seat hinges are high-quality brass in polished chrome or polished 24 carat gold finishes. Solid oak seat and cover have a moisture-sealed finish. Available in Parchment, Country Grey, Swiss Chocolate, Black Black, Expresso and White.

Birthday Bath

Here's old-fashioned comfort charmingly recreated for you... by Kohler. A nostalgic blend of yesterday and today... of long ago and now.

The Birthday Bath. It's the focal point of any bathroom, nostalgic or contemporary. A bath that's long, deep and comfortable. With smooth rolled trim. High sloping back. Lustrous enamel interior bonded to durable cast iron. Six feet long and 37½" wide for roomy, stretch-out bathing.

Pictured above in white. Also available in Black Black, Parchment and Antique Red. With "Antique" faucets, exposed piping and classic ball-and-claw feet in brushed or polished chrome or 24 carat gold finishes.



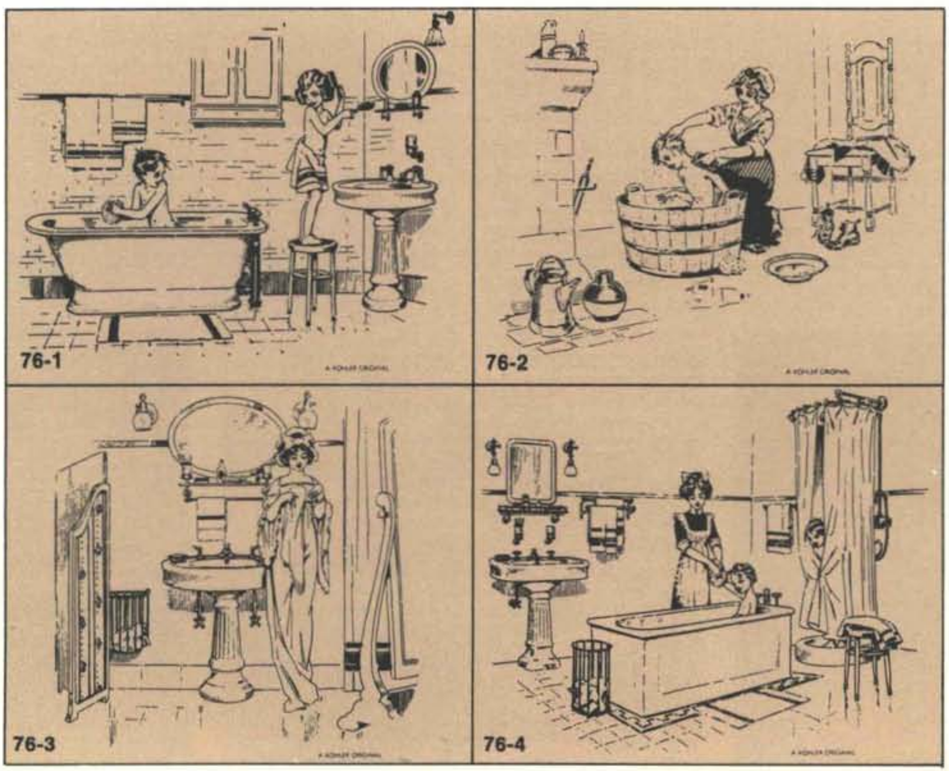
KOHLER CHABLIS PEDESTAL LAVATORY

An exceptional melding of American design and European styling. Created to coordinate beautifully with fixtures and faucets in Kohler's nostalgia series... and with the full line of contemporary Kohler plumbing products.

Chablis. Ideal for powder rooms remodeled with that special touch. Sculptured in gleaming vitreous china. Gently rounded corners and gracefully sweeping lines encompass a large basin with ample ledges and functional anti-splash rim. Concealed wall fasteners give the lavatory additional stability.

Chablis. 24" x 19" x 33" high. Pictured in high-fashion Swiss Chocolate with "Antique" Water-Guard faucets in 24 carat gold finish. Available in Kohler's high-fashion and full-line colors.

KOHLER NOSTALGIA PRINTS



An original idea for your bath or powder room...charming, turn of the century artwork from early Kohler Co. catalogs... beautifully reproduced, enlarged and printed in brown on high-quality beige stock. 11" x 14." Ideal for framing.

Single print, $1.5
Set of 4, $5.00. S
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Please allow six weeks for delivery.

KOHLER

Architect's Office · Studio
Cerrillos, New Mexico

Architect:	**Richard Grenfell, AIA**
Solar Consultant:	**Herman Barkmann, P.E.**

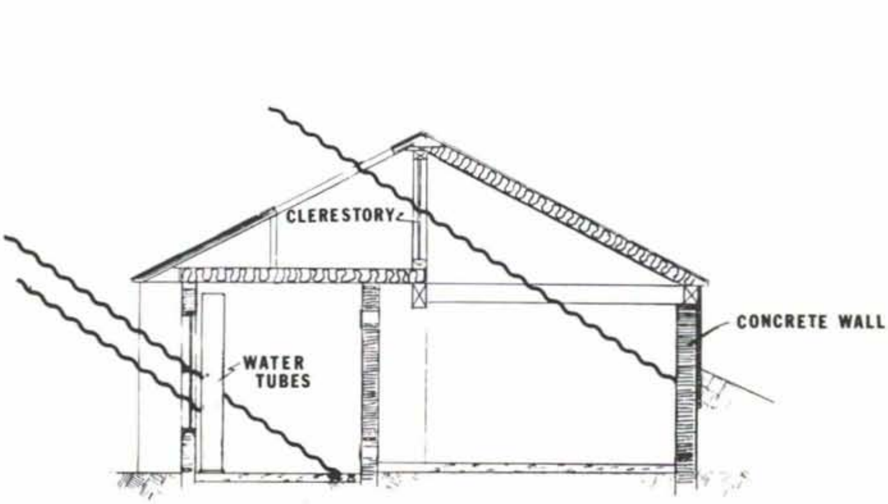
When an architect is his own client, he can be most demanding. Richard Grenfell, AIA, wanted to design his building for maximum passive energy use, and yet maintain an aesthetic appearance. The result was a highly efficient building.

The schematic of the building indicates how the solar energy is gathered, stored, and distributed. Along virtually the whole south side, acting as an entry, is located a solar gallery. The south wall is fully glazed, and immediately behind the glazing are located 14-12 inch diameter Kalwall water tubes. The water is capable of storing the energy gathered with a minimum of temperature rise. High and low transfer registers are located in the wall separating the gallery from the office area. The floor of the gallery is brick-paved for better heat retention. Above the gallery on the south wall of the office is located a large clerestory which allows direct solar gain onto a 12 inch thick filled concrete slump block wall—the back wall of the office area.

The energy gathering and storing water tubes in the gallery are aesthetically quite pleasing, and it is interesting to watch the focal line of the sun's rays move around the back side of the translucent tubes.

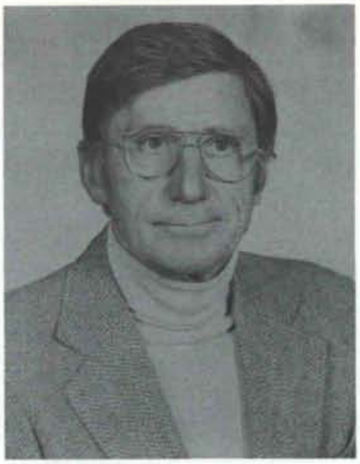
The lighting on the back, dark stained office wall has proven to be quite effective and pleasing. Auxiliary heating is accomplished by judicious use of electric resistance baseboard and floor dropin heaters.

The design has proven to be quite successful. The overall design is quite attractively subdued without the use of vast expanses of glass. In the first year of use it was necessary to turn on the auxiliary heat only three days; and one day in March it was necssary to open the windows to remove some excess solar energy.



THE NATIONAL LABS AND THE A/E PROFESSION

by Herman Barkmann, P.E.



Herman G. Barkman, P.E.

Herman G. Barkmann, P.E., holds a BS in Mechanical Engineering, from the University of Kansas. He came to New Mexico in 1948 with Black & Veatch Consulting Engineers and became a staff member at LASL in 1950, working first in weapon design and then for ten years in the reactor division. In 1965 he went into private practice as a consulting mechanical engineer in Santa Fe, responsible for design of heating, ventilating and air conditioning systems. Barkmann Engineering, in addition to regular mechanical design, has evaluated many projects for use of solar energy. Mr. Barkmann is a member of ACEC Energy Committee, ISES, NMSE, ASHRAE: Committee on Solar Utilization, Chairman. Subcommittee on Passive Solar Heating, Chairman. Standard Committee 104P, and was member of HUD Cycle IV Technical Review Committee.

We in New Mexico have for the last thirty plus years been aware of Sandia Laboratory and Los Alamos Scientific Laboratory. Up until just recently, however, our knowledge of them has been in respect to nuclear weaponry and nuclear reactors, and some other activities usually highly secret and associated with government work.

Some few years ago, however, both laboratories directed their activities toward broader fields, associated generally with alternative energy sources. Los Alamos even became associated with a number of universities in the area in a coordinated field of scientific endeavor.

The effort by both laboratories has increased through these past years, probably most visibly in the fields of solar energy, but also in other non-nuclear energy fields. Let us look in a broad way at some of the work which has been done at these neighboring facilities and which may affect the Architectural Engineering field.

SANDIA LABORATORY, Albuquerque

Solar Energy: In general Sandia Laboratory has devoted its efforts to research and development on large scale and high temperature applications. These projects, some of which are delineated below, undoubtedly will have great impact on our profession in the future, but are to a great extent to embryonic for current applications.

1. **Total Energy Program:** This is a concept that provides both low grade (low temperature thermal) and high grade (electrical and mechanical) energy needs of selected applications. For example energy collected by solar collectors could operate a thermodynamic power conversion while the waste heat from power generation could be used for process, heating, or air conditioning. The maximum use of energy collected can thus add considerably to the economics of a solar system. Future applications could be for shopping centers, manufacturing plants, etc. Sandia is currently managing and monitoring two large scale experiments; an army barracks complex, and a large knitwear factory.

2. **Central Receiver Solar Thermal Program:** This program is aimed at developing solar electrical power generation. The central receiver concept is one wherein many acres of tracking reflectors (heliostats) focus solar radiation into a single receiver mounted high atop a tower. In the receiver super-heated high pressure steam is generated to drive a turbine/generator. A pilot plant is now under construction involving industry, local government, and a team of utility companies. For support of this power generation effort Sandia is operating the Central Receiver Test Facility, CRTF, at a location south of Albuquerque. Various types of heliostats and receivers are tested at this facility which has a testing capability up to 5 megawatts thermal. This program has little current input (no pun) to our profession, but is directed to the future generation of electricity, a matter of great importance.

3. **Photovoltaic Systems Definition Project:** Photovoltaics, the direct conversion of solar radiation to electricity is being pursued along two paths. One is to identify promising applications and configurations for power generation, and to establish component and subsystems requirements within practical economic limits. The second effort is aimed at concentrator systems for photovoltaic cells. By increasing the solar illumination the output power and operating temperatures are increased. The intent of this work is to replace expensive solar-cell area with less expensive concentrator area, thereby decreasing the overall cost of photovoltaic generation of electricity. This application of solar energy has great promise to our profes-

sion, as it holds out the hope of local power generation. The great problems have been those of economics. The work done here at Sandia may get us over some of these hurdles.

4. **Vertical Axis Wind Turbine:** Although not always recognized as solar power, windmills are dependent on varying solar heat absorption by the earth to initiate wind currents. The vertical axis wind turbines is another attempt to provide local power generation at lower cost. The vertical configuration allows elimination of yaw and pitch control; allows location of the transmission and generator at ground level, all of which mean substantially lower weight. Lower weight of course should mean lower costs.

5. **Solar Irrigation:** One project in which Sandia is involved could be of interest to some engineers, but probably not to architects is one of solar irrigation. One system has been in operation in New Mexico since 1977, and a larger one is being planned for Arizona. The New Mexico system consists of a solar collector array, thermal storage tank, solar engine, irrigation pump, water storage pond, instrumentation and controls, located on less than four acres. The solar engine, an organic Rankine-cycle turbine, supplies 25 shaft horsepower to the pump, which delivers 2600/Lmin of water from a 30-m-deep well. The importance of this application can be appreciated when it is realized that there are 160,000 irrigation wells in the southwest powered by natural gas.

6. **Solar Support Projects:** A diverse group of projects to which Sandia is applying its diverse technical skills could have great impact on the work of architects and engineers involved in the design process. These projects are:

A. Solar Monitoring Station: A compact portable station capable of collecting total and direct insolation, temperature, wind velocity and direction, and other climatic variables.

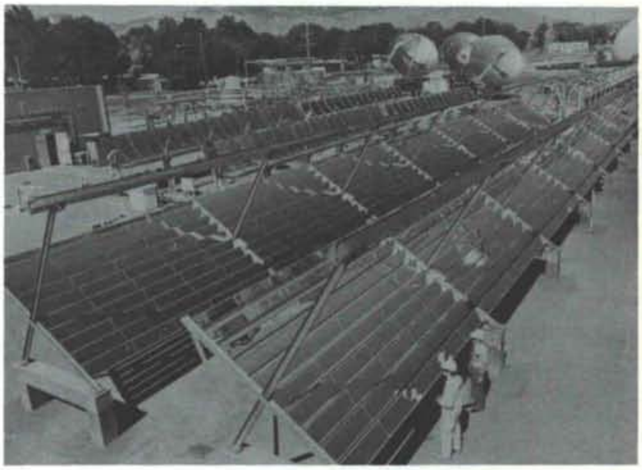
B. Standard Meterological Year Derivation: Here statistical methods will be utilized to develop a method for generating a standard year with respect to six meteorological variables, and to generate a standard year and compare it with available meteorological data.

C. Solar Heating and Cooling Technical Supports: The objective of this work is to furnish the R&D branch of DOE's Division of Solar Technology with systems analysis support.

D. Solar Technology Transfer-Southwest: The purpose of this project is to augment technical projects and speed up the generation of a solar energy industry. Objectives are to (1) identify organizations and persons able to accelerate commercial development and (2) supply selected technology in forms best suited to rapid transfer of a commercial capability, and (3) to feed back information to the Department of Solar Technology program management of suggested changes in program emphasis.

GeoEnergy Technology: Sandia Laboratory is active in developing and improving methods in several fields of GeoEnergy. As these activities are directed primarily in the production of fuels, or processes required for energy production, they are not directly related to the A/E design profession, and will only be briefly mentioned.

Coal	**Oil and Gas**
In situ Coal Gasification	Enhanced Oil Recovery
Coal Mine Subsidence	Enhanced Gas Recovery
Mining Technology	Drilling Technology
	Offshore Technology
Synthetic Fuels	**Geothermal Energy**
Oil Shales	Drilling/Well Completion
Coal Liquefaction	Magma Energy Research



Midtemperature Solar Systems Test Facility at Sandia Laboratories is the nation's first solar total-energy facility to produce and use both electrical and thermal energy. It has demonstrated the "total-energy" concept by efficiently using 63 percent of the collected solar energy to generate electricity and then use the remaining thermal energy to air condition a 12,000-square-foot office building. Sandia, a Department of Energy research and development laboratory, is investigating and developing solar total-energy for onsite power systems for such applications as industrial plants, shopping centers and housing complexes.

LOS ALAMOS SCIENTIFIC LABORATORY

Solar Energy: As opposed to Sandia Laboratory the research and development work at LASL has been aimed at the field of solar energy applications for near time use, directed at the building market. This work is of immediate interest and benefit to the architectural/engineering design profession, and it is hoped that the information gained can be disseminated. Possibly a brief overview of some of the various projects can allow our profession a glimpse of what is available at LASL, and spark a desire to look deeper.

1. Active Solar Systems

Collector Development: One of the first projects in solar in which LASL became involved was the development of a liquid collector. This collector was a "pillow" type in which virtually the entire absorber plate is a wetted surface. The collector was unique in that it was designed to become a structural part of the roof as well as an energy collecting device. This could simplify and lighten the overall roof assembly. The

production of the collector was accomplished by a farm-out plan to industry, and 8000 square feet of the collector were installed at the National Security and Resources Study Center at Los Alamos.

Nambe Community Center: In association with local architect Allen McNown LASL developed an air collector rock storage system for the heating system of a new community center at Nambe Pueblo located twenty miles north of Santa Fe. A continuing program of monitoring actual performance of the system is being followed.

National Security and Resources Study Center: This new 59,100 square foot building adjacent to the LASL administration building was designed by the LASL staff. The main features consist of the 8,000 square foot flat plate collector array, cooling tower, two air conditioning systems (a standard lithium bromide absorption chiller and a specially designed turbine-powered Rankine-cycle compression unit), a hot storage and cold storage, and complete instrumentation for monitoring the performance of the building's solar features. Continual evaluation and upgrading of the solar systems are taking place.

Mobile/Modular Home Unit: In association with Burns/Peters Group Architects, LASL designed a mobile home incorporating an active air heating system into a home of 1056 square feet. Panels are located on the side of the home at a 60° angle, and possibly the most unique feature is the thermal storage system using 1536 pint jars of water. This project also was completely instrumented and undergoes monitoring of its performance.

Active System Computer Simulation and Validation: Considerable work has been done in developing system simulation codes. These codes are most valuable for simulating and validating the various systems under study. A possible potential benefit is that of a software package which could be developed for certain mini-computers.

DOE Collector-R&D Support: LASL has been designated the support laboratory for collector R&D. As a result of this the lab has been active in awarding and monitoring contracts for DOE. Up through the first part of 1979 over 200 collector element contracts had been awarded. LASL also is active in testing and evaluating collectors. Recently they have been active in evaluating several evacuated tube collectors. A new program being initiated which could be of great interest is that of solar pond dynamics.

2. Passive Solar Systems:

Ghost Ranch Project: In 1973 a group of adobe structures were built at Ghost Ranch employing a variety of passive solar heating concepts. LASL has monitored the performance and operation of these buildings since their construction.

Passive Test Cells: There have been eight test rooms in operation where numerous concepts of passive heating have been tested and evaluated. These test programs have been invaluable for validation of computer simulation programs. A sampling of tests performed during 1978-79 is shown below.

1. 12" Kalwall water tubes, black chrome coated
2. 15.5" concrete block, black chrome coated
3. 19" Kalwall watertubes, flat black
4. Convective loop, flat black, single glaze
5. Window box, mas #6,E#11
6. Direct Gain
7. Bead Wall operating 15.5" concrete block
8. Bead Wall open 15.5" concrete block
9. $CaCl_2$, Phase change plus water tube
10. Direct gain: 3M windows; Cyro-Acrylite
11. 15.5 concrete block: SUNTEK solar membrane Dow Corning film, 3M film
12. Roof Aperture

Natural Interzone Convective Thermal Energy Transport: Testing was performed on small models to determine if proper sizing and location of doorways would induce natural transfer of energy from the south rooms to other rooms of a passive solar heated structure. If successful the expensive installation of ducts, distribution fans, etc. could be omitted.

Monitoring of Passive Solar Heated Buildings: LASL has designed a passively heated modular home utilizing a roof pond system. The system has four rows of double glazed apertures arranged in a sawtooth pattern with aluminium reflectors to enhance the energy collectors. The performance of this house has been carefully monitored and analyzed.

LASL has been monitoring some fifteen passively heated buildings during the 1978, 1979 heating seasons. Most of these were residences in north central New Mexico, but one was in Princeton, New Jersey. The data from these test programs are being processed and will appear in a report prepared by Sandia.

Theoretical Modeling and Computer Simulation of Passive Solar Heated Buildings: Much work has been done on both the development of a computer simulation program PASOLE, and then from the computer program simplified methods of predicting passive storage wall behavior have been developed.

One method - Monthly/Solar Load Ratio - requires the knowledge of the solar radiation on a horizontal square foot for each month, and the heating degree days for each month. The building heat loss coefficient is then calculated and empirically determined correlations are used to find the yearly heating fraction by means of a pocket calculator. A simpler method - Load/Collector Ratio - requires the calculation of the heat loss cofficient, exclusive of the south wall, as well as the area of the collector south wall. The load collector ratio has been tabulated for solar heating fraction for some 220 cities. One merely needs to pick a city and obtain the solar fraction by interpolation.

A simplified method has also been devised for predicting the behavior of Direct-Gain structures. This method derived from PASOLE/SUNSPOT thermal network computer codes involves the use of a correlation between monthly solar heating fractions and monthly solar-load ratios.

PASOLE - Passive Solar Simulation Program: A passive simulation computer program employing FORTRAN and disseminated to those requesting it. A

second version has been rewritten in HP-BASIC and is operational on the HP-9845.

SUNSPOT: A thermal network code based on PASOLE has been developed for direct gain systems.

DOE Sponsored Passive Design Handbook: For the past two years a great effort was expended in the preparation of a Passive Solar Design Handbook. Its form will be in two volumes. Volume 1 authored by Bruce Anderson should be available in early summer, and is concerned with passive concepts. Volume 11 authored by Doug Balcomb is out at this time, and is concerned with design methods. Both volumes have undergone reviews by several interested parties, and are still being reviewed.

3. Hybrid Passive-Active Designs;

Although at times there appears to be a great chasm between passive solar design advocates, (the passivists being much more the active), it is realized that the two systems can work together. A properly designed structure can employ passive concepts to offset much of the required heating demand, and then an active system can make up the major part of the remaining load. This is of course a very wise path as it greatly decreases the investment required for the expensive active solar heating components. Not only can passive and active solar design be incorporated in parallel paths, active components can augment passive components. For instance, forced air flow over water walls, Trombe walls, or water tubes. LASL has been evaluating several mixes of hybrid systems for their effectiveness, as well as monitoring the performance of several structures. One combination found to be economically attractive consists of a passive solar heating contribution, a domestic hot water heating system, and a small active heating system achieved by extending the size of the hot water system.

Conservation and Solar Energy in Building Design:

It has long been stated that the most economic application for solar heating of a structure starts with energy conservation in all features. There has been, however, little attempt to allocate a finite amount of resources between conservation measures and solar equipment. LASL has developed a method using local cost estimates, and local weather data whereby one can establish a design to minimize annual auxiliary building heat. This same procedure can then be extended to identify the point of minimum life cycle costs, assuming future fuel costs, financing, etc. A paper presenting this procedure is to be presented at the annual meeting of the American Section International Solar Energy Society in Phoenix, Arizona, in June. A paper has also been submitted to Solar Age Magazine.

Conservation:

While LASL has been little involved in conservation measures other than alternative energy sources which affect the building professions, the effect of the computer program DOE-2 may be felt to great extent by the design profession very soon.

1. DOE-2: This is a computer program for analyzing building energy consumption and developed by the federal government and is the primary evaluation tool designated by DOE as the Standard Evaluation Technique in the upcoming Building Energy Performance Standards (BEPS). As the law now is written all buildings using conventional HVAC systems shall have their design energy consumption evaluated by a DOE-2 computer run. Solar Buildings shall be evaluated by either TRNSYSS or DEROB but it is obvious that for the majority of buildings designed by our joint professions, computer evalution shall be by DOE-2.

DOE-2 is a building energy analysis computer program. Its objectives are (a) to be used by architects and engineers in the design of new buildings and to explore the potential of various retrofit options, as well as a research tool in energy analysis, (b) to be used as the standard against which energy performance is to be evaluated. The program has the capability of comparing some twenty different HVAC for energy consumption, and DOE-2.1 will have the capability of complete active solar input and interaction with other systems.

LASL involvement has been primarily threefold:

1. Writing of the documentation, both reference and program manuals.
2. Administering of the verification program. Several buildings with real energy consumption records have had their records compared with program results.
3. Development of the active solar simulation and modification to passive.

2. Building Energy Conservation: The laboratory is involved in two efforts which should be of interest to architects/engineers.

Two building modification proposals have been submitted to the Solar Federal Building Program. One building, the Occupational Health Laboratory, has a heating load that consists in great part of ventilation load. A system is being proposed for this building that is an active liquid system providing hot water through heating coils to reduce the load of the existing gas fired boiler. This building was selected as being typical of DOE facilities having high ventilation requirements. The project could provide the proof-of-concept necessary to promote widespread implementation of retrofit solar systems in the wide variety of laboratory and industrial buildings where ventilation rates are high.

The other building is the building housing the Bradbury Science Hall and Museum. This building, of masonry construction, includes two inner courtyards, and is arranged to maximize visual access to the exterior environs. It is proposed that a roofmounted system of clerestory windows and reflectors be constructed to enclose one of the courtyards to provide 26% of the total space heating requirements of the building. This will provide an atrium that will thermally buffer a portion of the building and will preheat outside air required for ventilation. This project will serve as a working exhibit in itself demonstrating

available passive solar technology. In addition it will allow year round use of this courtyard which in the past has been closed during the winter. It is hoped that these buildings will be monitored, and that the results of these solar retrofits will be made available to the design community.

A second project is the proposed reworking of fourteen buildings to improve their energy consumption through improved control techniques and various other retrofit efforts including some solar. Here again it is hoped that sufficient monitoring will be done to determine the real effects of the modifications on energy consumption. This could be a great opportunity to verify DOE, and help substantiate BEPS.

Heat Pipe

One item which could be considered fallout from past development under the nuclear rocket program is the heat pipe. This device, which the author was instrumental in having applied in the building industry, is now beginning to see considerable use in heat recovery. The heat pipe, which could be thought of as a super-conductor, is incorporated in air to air heat exchangers, so that incoming fresh ventilation air can be either heated or cooled by the outgoing exhaust air.

Geothermal:

This field, as at Sandia, is of little immediate interest to the architect/engineer design profession. In the future, however, it is expected that its importance will be great. Los Alamos is directing its effort at the hot dry rock energy source. This source, such as granite, is everywhere at some depth below the earth's surface. In this process water is forced down to the rock where it is heated then returned to the surface. The water can be heated to provide steam for electrical generation, or it can be heated to a temperature compatible with that of space heating. LASL developments are directed at both uses. In fact plans are underway to initate space heating in some existing buildings using geothermal heat from sites near the Valle Grande. They have also done considerable work in development of drilling and logging techniques. Several test holes have been drilled and tests performed in the area west of the Valle Grande.

I have tried to present a broad picture of projects ongoing at both laboratories. It has not been within my scope in either time or space to give detailed information or tests results. We have two sources of very valuable information at these laboratories and we should use these sources. Hopefully readers will want to look deeper.

I wish to express appreciation to some of my sources of information. Robert Stromberg at Sandia Corporation, and David Friewald, Fred Schilling, Doug Balcomb, and Bruce Hunn, all of LASL. *H.B.*

BOOK REVIEW

Lloyd C. and June-Marie F. Engelbrecht. *Henry C. Trost: Architect of the Southwest.* El Paso Public Library Association: El Paso, Texas, 1980, 150 pages, 87 illustrations, $27.00.

Review by Spencer Wilson

On June 19, 1919 the Val Verde Hotel opened for business in Socorro, New Mexico. The little town had once been the center of a booming mining industry but by the end of World War I was already in decline as people and business moved to other, more lucrative places. Why, then, open a new hotel with appropriate ceremonies and honored guests—except that among the honored guests was Henry C. Trost?

The Val Verde Hotel was the result of a vision of Missouri investors and operators who recognized the need for a convenient and comfortable stopping place for the growing number of tourists to New Mexico. They came by rail and road—a couple of dozen cars and trucks a day passed through Socorro in 1920! Facilities were needed and the Val Verde was built to handle that traffic.

The hotel was designed by the firm of Trost and Trost and is, today, a reminder of the considerable number of Trost designed commercial and residential buildings in the southwest. The Trost influence reached into Arizona, New Mexico, and Texas, and yet, today, little is known of their work and many of the buildings are gone.

Now, the Engelbrechts have gone a long way to put the Trosts into a well-deserved place among the architects of the United States. Lloyd and June-Marie spent the last fifteen years researching and writing about this family of architects. The Trost firm left an indelible mark on the southwest, as seen in the surviving buildings. This work is a must for anyone interested in the architectural history of the southwest from the 1880's through the early 1930's and for any collector of southwestern history.

Trost's work was influenced by Louis Sullivan and Frank Lloyd Wright and included the Mission Revival, a California import to the "arid America" of the southwest. Unfortunately many of his best examples have fallen to the wrecking ball of the mis-guided work of urban renewal and the economic pressure of "progress". The Franciscan Hotel in Albuquerque, New Mexico is a classic case in point.

The works of Trost live on, however, even in the Val Verde—now a collection of offices and small shops. The research goes on too. The small mining and cattle town of Magdalena, New Mexico, was the sight of planned and constructed Trost buildings. It is unfortunate that the present book, excellent as it is, does not include a complete listing of Trost buildings. Apparently such an addition is possible from the records in the El Paso Public Library but lack of money prevented the authors from doing it.

The Englebrechts have put together a masterful study on a very important, and long neglected, architect. The book itself is handsome to behold with excellent reproductions. *S.W.*

NEW MEXICO GLASS SHOW
Second Annual Show to be held in Albuquerque

The New Mexico Glass Show will present fine glass art by New Mexico Artists at its second annual show March 14th to 28th, 1981, on the first floor of the main Albuquerque Library.

At least five thousand people are expected to view works representing all aspects of the glass medium—stained, blown, etched, fused, bevelled and cloisonne. In addition to these works, glass artists will be available throughout the show to answer any questions and provide information about glass as an art medium.

Last year seventy-five works by thirty-two glass artists were displayed on the Mezzanine of the La Fonda Hotel, Santa Fe, for a nine day show. This year's show will run for fourteen days. The main branch of the Albuquerque Public Library, located at 501 Copper NW, was chosen because of its central location, its abundant natural light and large display area. The area where the glass will be displayed has two walls of floor to ceiling window glass.

In conjunction with the Second Annual New Mexico Glass Show, Otto Rigan, author of *New Glass* and *Up From the Earth* has agreed to give a lecture and slide show about contemporary art glass in America. This lecture will be held in the Library Auditorium at 2:00 P.M., March 14th. Both the glass show and lecture are free to the public.

This exhibition is being juried by two extablished New Mexico Glass Artists and a fine crafts gallery manager: Jenny Langston, blown glass artist and a prize winner in last year's show, from La Cienega; Maurice Loriaux, internationally known glass designer from Santa Fe; and Kay Zink, manager of Running Ridge Gallery, Santa Fe. Jurying is done as a means of assuring a high quality show.

The New Mexico Glass Show is sponsored by the Glass Community as part of a continuing effort to educate the public about glass and to encourage and support glass art in New Mexico.

Three New Mexicans Honored by AIA

Van Dorn Hooker, AIA, Dr. Bainbridge Bunting and Dr. Myra Ellen Jenkins received awards at the fall 1980 meeting of the Western Mountain Region, American Institute of Architects. The region encompasses Arizona, New Mexico, Colorado, Nevada, Utah and Wyoming.

Van Dorn Hooker, University of New Mexico Architect was presented with the Silver Medal, the highest honor conferred upon members by the Western Mountain Region, for his work at UNM. The award was for his efforts in preserving the old while maintaining a harmony with new architecture during a period of major growth at the University.

Awards of Distinction were given to UNM Professor Emeritus Bainbridge Bunting, who founded the curriculum of art and architectural history at the University and to Dr. Myra Ellen Jenkins. Dr. Jenkins received the award in recognition for her years of service as State Historian and for her efforts in helping frame legislation establishing the New Mexico Register of Cultural Properties.

Annual Meeting of the Historical Society of New Mexico

The annual meeting and conference of the Historical Society of New Mexico will be held in conjunction with the Texas State Historical Association in El Paso, Texas, March 5-7, 1981.

An outstanding program has been arranged. A total of 21 sessions have been scheduled featuring papers of interest to both New

Continued on page 18

(Annual Meeting continued from page 17)
Mexico and Texas historians. It is expected that some 30 book dealers and publishers will be on hand to display their products.

As usual the Historical Society of New Mexico has issued a poster in recognition of the occasion. The 1981 poster is the third in a continuing series. Each poster features a historic photograph of New Mexico. For full information, please contact NMA editor, John Conron, P.O. Box 935, Santa Fe, NM 87501.

new mexico architecture **nma**

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