Focus on Energy Conservation
A Project List

ULI the Urban Land Institute

DISCLAIMER

FOCUS ON ENERGY CONSERVATION

A PROJECT LIST

PREPARED FOR

U.S. DEPARTMENT OF ENERGY

By

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INTRODUCTION

The Urban Land Institute - ULI - has prepared the following list of outstanding energy conserving projects for the U.S. Department of Energy. As requested by the Department, the list includes descriptions of land developments and individual buildings suggested by members of ULI and by other sources. The projects have been selected to exemplify the major energy saving techniques in use today, with emphasis on those strategies most significant for people engaged in the business of land development.

To make the list a useful reference for developers and public officials, ULI has attempted to cover energy conservation in the broadest sense -- from overall site planning down to the functioning of individual building components. We have avoided focusing too closely on the myriad types of hardware available -- energy-saving equipment of all sizes and types -- and tried to provide examples of the basic considerations important to energy-conscious planning and design. Details on some heating, ventilation and air conditioning systems are provided in order to acquaint readers with major innovations in the field. We have tried to make these descriptions comprehensible to the diverse audience involved in land development.

DISTRIBUTING THE PROJECT LIST

The importance of disseminating the information contained in the project list to members of the land development industry is now clear. The list has grown to over 40 projects with more information arriving in the mail daily. ULI feels that the project list should be distributed to developers for three major reasons:

- The list covers a wide range of examples of energy conservation; it provides a good overview of current thought, techniques and mechanical equipment in the field.
- Development practitioners are not presently knowledgeable about examples of energy conservation. While over 650 ULI members informed us of their opinions on various aspects of energy conservation, only 80 suggested particular energy conserving projects. Most of the members who did suggest projects mentioned either a development with which they were closely involved or one in their geographic area. Distribution of the project list would alert some developers to the existence of energy conserving development techniques and would broaden the localized knowledge of others by providing information on projects around the country.
- An excellent way to persuade developers to incorporate energy conservation into their daily practice is to show examples of projects which are already designed to save energy. Concrete examples are more convincing than abstract descriptions of energy conservation methods. In addition, each project in this list includes a contact for more information so that developers can follow up on techniques they may wish to apply to their own practices.

ORIGIN OF THE PROJECT LIST

The 1973 Arab oil embargo and the energy crisis which followed alarmed North Americans used to the comfortable, carefree style of life made possible by cheap energy. The importance of conserving energy became obvious to everyone who drove a car, heated a home or bought plastic toys and other petroleum-based products. But energy conservation is particularly important to people involved in land development and building construction. Building systems consume over one-third of the energy used in the country as a whole*, so energy savings in both building construction and operation will have a substantial impact. Energy conservation need not be costly. Through good site planning and building design, energy consumption in buildings can be reduced by as much as 40 percent without increasing initial construction cost. We can no longer afford to pass up such opportunities for saving natural resources and dollars.

As a first step in learning more about developments in the field of energy conservation as they relate to land development, ULI began preparation of this project list. Specifically, ULI hoped to accomplish the following:

- Learn to what extent members of the land development community are aware of energy conservation techniques.

  ULI requested its members to suggest outstanding examples of energy conservation. By turning to its own members, ULI would begin to learn how much people in the land development field know about energy conservation. It could then provide journal articles, handbooks, or other material to fill gaps in general knowledge. As mentioned above, members' knowledge was generally confined to their own geographic areas.

- Obtain a fresh insight on energy conservation from the perspective of land development.

  ULI membership would provide a new source of information not normally tapped by the Department of Energy or other Federal agencies. ULI felt that a number of interesting projects would come to light under the relatively broad category of land development; these projects could add to the documentation already available on projects using solar energy and other technological advances.

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* Source: Energy Conservation in Building Design, The American Institute of Architects, 1974, p.3.

- Include projects not suggested by ULI members which would interest members of the development community.

ULI reviewed some of the engineering, architectural and historic preservation literature and also consulted various experts in the field of energy conservation. Suggestions from these sources which would be informative for developers were also included in the project list.

TYPES OF PROJECTS

ULI has included projects in the list ranging from energy conservation endeavors at the large-scale, land use planning level down to specific operating methods for individual buildings, and from an emphasis on design to an emphasis on technology. They range from solemn corporate headquarters designed to impress the viewer (American Center) to homey examples where an energy-conscious life-style is promoted (The Village in Davis, California and the David Wright House). They range from well-known, test-case examples of energy conservation which have been written up extensively in architectural and engineering journals (GSA's Norris Cotton Office Building, Manchester, New Hampshire), to examples which have not been publicized (Opus 2, Bedford Mews, and the Atlanta Office Building).

The project list is divided into three categories:

I. Energy Conservation at the Site Scale

This section focuses on projects where energy conservation is a factor in the overall planning of the site. Energy conservation is considered a major determinant of building orientation, drainage system design, road patterns, etc.

It is interesting to note that relatively few examples came to light of energy conservation in the planning of large-scale residential communities. Among the projects of this type which are included in the list are Mission Viejo, California, and Opus 2, Minnetonka, Minnesota. Two others still on the drawing boards are not included in the project list but should be mentioned. The office of the State Architect of California is currently designing a model energy-conserving neighborhood. The Living Systems firm of Winters, California (responsible for preparing energy guidelines for Davis, California) is designing a 20-acre residential development near Fresno, California, called Dinuba Energy Efficient Development. The design of energy-efficient communities is a promising new area in energy conservation; it places energy conservation as a guiding first principle in land development, rather than as an afterthought to be addressed by selecting appropriate hardware.

The limited number of large-scale residential examples can probably be attributed to the fact that relatively few large-scale projects have been built in recent years, due to the myriad difficulties inherent in this project type and to the general economic slowdown which inhibited investment in major land developments.

In addition, the building industry's response to consumer demands for energy conservation has been mainly in terms of improved insulation, thermal windows and other building materials with better energy conservation performance. The emphasis has been on building materials rather than on site planning. The explanation is that after the 1973 oil embargo, the issues which began to strike home were escalating heating bills for individual homes and offices. People began to ask how they could improve the energy performance of their existing homes and work places. In response, builders and developers began to investigate ways to improve the energy record of the new buildings which they would either have to operate themselves or would have to sell to energy-conscious buyers. Suddenly, the energy consumption of individual buildings became a major issue -- an issue that cheap energy had obviated previously.

II. Energy Conservation in Individual Buildings

Projects included in this section conserve energy through one or more of the following methods:

- Conceptualizing the building.

  In these projects, energy conservation is accomplished through the design process. The siting of the building vis-a-vis sun and wind is important; the size of the building is considered carefully; or an energy budget may be determined at the pre-design phase. These are all cases where energy conservation is inherent in the total design of the building. Examples include the David Wright House, the Union Savings branch offices, and Heery & Heery Associates' design for an Atlanta office building.

- Hardware

  Project examples in this category focus on new types of equipment, including advances in heating, ventilation and air conditioning equipment, and solar collection devices. Examples are the American Center and the Ontario Hydro Building. These office towers look like many of the International Style towers of the late 1950's, but they have far superior energy performance records due to advanced insulation and HVAC systems.

- Material and Operating Costs

  Projects focusing on material and operating costs either employ "life cycle costing" in a formalized manner or simply take material costs into account in a common sense fashion, without detailed cost comparisons. Examples are the Atlanta Office Building, where reflective glass was chosen over polished aluminum because less energy is required to produce glass; the Carnegie Mellon Science Hall project where the emphasis was on re-use and repiping of existing equipment and where a short payback period justified carrying out the project; and Summit Walk, where savings both in construction materials and in operating costs are key selling points.

III. Brief Notes on Additional Energy Conserving Projects

This section of the project list is a "grab bag" of short descriptions of projects which are in the planning stages, projects on which we have limited information, and projects in which energy conservation is a minor factor.

COMMENTS

A review of all the projects in the list leads to two main observations:

1. A common form for energy analysis can be developed.

In examining a large number of projects, one begins to see certain techniques or methods repeat themselves. Certain projects use energy budgeting; others focus on the insulation value of materials used; and still others concentrate on orientation of buildings in relation to the sun. Certain factors, highlighted in one project, may be downplayed in another. It is evident that there is no prescribed way of incorporating energy conservation into the planning of a development. However, the groups of common energy considerations can provide the makings of a generalized approach to energy analysis.

The following factors, drawn from various examples in the project list, should probably be included in any development's design for reduced energy consumption:

- Site conditions- take advantage of natural sunscreens, windbreaks, and drainage systems.

- Siting and orientation of buildings - to save energy in a northern climate, for example, a building should be oriented to the south to take advantage of winter sun, and it should be protected to the north where heat loss is greatest.

- Size and shape of buildings - the "necessary" size of a building can be reduced through efficient design and more intensive use of space. It is known that a building's shape greatly influences energy consumption -- a tall building uses a great deal of energy for cooling; buildings with courtyards require less heating.

- Energy requirements or budget for the project - setting an energy budget (in kilowatt-hours or BTU's per square foot) at the pre-design phase assures that energy consumption is considered throughout the design and construction of the project. Setting an energy budget should become as routine as setting a dollar budget.

- Evaluation of building materials in terms of their thermal characteristics and in terms of the energy required to produce them - certain products, aluminum for example, consume enormous amounts of energy in their production. This factor, along with the insulation value of materials, should be considered when choosing construction materials.

- Location, size, shape and materials to be used in windows - it is important to weigh energy saved through use of natural lighting against energy lost in the form of heat loss through windows. Double glazing and shutters which can be closed at night to prevent heat loss can aid greatly in energy conservation. Since windows have a major influence on heat loss and gain, the appropriate amount and location of windows must be designed to suit the particular site and the particular climatic area of the country.

- Ventilation - in many buildings today, air conditioning must be turned on in winter to fight heat build-up. Operable sash windows would obviate this waste of energy. Natural ventialtion should be provided wherever possible.

- Heating and air conditioning choices - heat recovery systems are now available which use waste heat from lights, people and equipment to provide space heating. Today it is possible to choose energy-conserving heating and air conditioning methods.

- Lighting levels and fixtures - many buildings, particularly office and commercial structures, are lit to an intensity which is almost uncomfortable. Lower lighting intensities and task-oriented lighting fixtures can save energy and increase comfort.

2. The Demands of local conditions cannot be ignored.

While the analysis used to insure energy conservation in each project may eventually be more uniform, individual buildings and developments will continue to vary greatly. It will always be important to consider the topology and climatic conditions of the individual site. This focus on local conditions is in fact the result of the same forces that produced vernacular architecture.

The New York brownstone was a response to high land costs and the resultant need for a compact housing form which would be comfortable during cold winters and extremely hot summers. The Cape Cod house, with its small windows and unpainted clapboard exterior, responded to the windy, salty seacoast climate. While vernacular architecture was once considered insignificant and "un-modern", it has re-emerged as an improtant part of architectural practice. It also represents a key ingredient in energy conservation -- accommodation to local conditions. This element of returning to the basics of evaluating a site on its merits and in the context of local geography is a crucial element in successful energy-conserving projects.

The overall method for dealing with energy conservation should one day be transferable from one part of the country, just as so many types of equipment are transferable, but the final form of the development will be influenced by local conditions.

A NOTE ON FORMAT

In each project write-up includes the following sections:

- Summary -- provided only for lengthy write-ups
- Project Information -- names of developer, architect, engineer and other factual details
- Introduction -- general description of the project
- Energy Conservation -- describes energy conserving features
- Costs -- included when information available

The names of a person to contact for more information is provided either in the Summary or in the Project Information section of most write-ups.

DEFINITION OF TERMS USED IN PROJECT DESCRIPTIONS

U value	A measure of heat loss through one sq. ft. of window or other surface for each degree F. of temperature difference between indoor air and outdoor air. The heat loss measure is expressed in Btu.
R value	A measure of resistance to heat flow, indicating the insulation value of a particular material.
Degree day	Average difference over 24 hours between the mean temperature and 65°. The number of degree days in a heating season indicates the severity of the winter in a particular area.
HVAC	Heating, ventilation, and air conditioning
Heat-of light system	A system which captures heat thrown off by light fixtures and uses it to heat spaces or to heat domestic hot water.
Heat recovery system	Captures waste heat from machinery and equipment in a building and recycles this waste heat for use in space heating or domestic hot water heating.
Passive solar systems	Building systems which store solar energy where the sun's rays hit the building walls and floor. Passive systems are designed to shield the structure from excessive summer heat while capturing and storing solar warmth during winter months. Passive solar design can be incorporated into new buildings but cannot be added to existing structures.
Active solar systems	Mechanical equipment is used to collect and move solar heated air. Equipment includes solar collectors, fans and pumps.
Heat sink	A body of water, earth, brick, etc., which stores heat.
Load-shedding device	An instrument which reduces the energy load or consumption of machinery at peak periods. This device might shut off certain freezers, fans, and other equipment in a building for a short period when total energy demand is highest.
Power-storage	A system which stores energy produced at off-peak times for use during peak demand periods.

<u>Heat pump</u> A refrigeration machine which can be used for both heating and cooling. Like the refrigeration system in a standard air conditioner, the heat pump contains a compressor, an evaporator and a condenser. But the operating cycle can be reversed to reclaim heat rejected from the condenser for other uses.

ASHRAE Standard <u>90 - 75</u> Standards for energy performance in new buildings published by the American Society of Heating, Refrigeration Air Conditioning Engineers. These standards are widely referred to in new construction and also are a component of some state energy regulations. Available from ASHRAE Circulation Sales Department, 345 E. 47th St., New York, N. Y. 10022.

I. ENERGY CONSERVATION AT THE SITE SCALE

Projects included in this section exemplify important factors in energy conservation beyond the use of improved construction materials. In grouping these projects together, we have attempted to highlight energy conservation as a major consideration in overall planning of a site. Energy conscious developments involve proper building orientation, consideration of prevailing winds, topography of the site, natural drainage patterns, possibilities for centralized heating systems to serve several buildings, among other factors.

Projects included in this section include examples of energy conservation in site layouts for planned communities (Mission Viejo and Opus 2), energy conservation in site planning and in operating methods of residential developments (The Village), community energy or heating systems (Integrated Community Energy System and Carnegie-Mellon Retrofit). In addition there are a number of mixed-use office and retail projects which demonstrate use of energy conscious construction and building siting techniques in developments covering at least a city block. (Hydro Place, Citibank Corporation).

SUMMARY

Opus 2
Planned Community
Intersection of Highway 18 and Crosstown 62

Contact: Mr. J. Robert Snyder, P.E.
Chief Mechanical Engineer
Rauenhorst Corporation
7900 Xerxes Ave. So.
Minneapolis, Minnesota 55431
(612) 830-4459

ENERGY CONSERVING FEATURES:

- A community which provides work places, homes, recreation and cultural facilities minimizes the need to travel long distances by car.
- Traffic system with one-way primary road for vehicular traffic and secondary roads for pedestrians, bicycles, etc., encourages people to walk and bicycle rather than use cars.
- Natural terrain is preserved, allowing for the cooling effect of ponds and existing stands of trees.
- Natural runoff system
- Orientation of buildings to complement the environment
- Data 100 office and plant facility on site was designed with energy-savings in mind. (Off-peak electricity storage, north-south orientation, extra insulation).

PROJECT INFORMATION

Name:	Opus 2 Planned Community Intersection of Highway 18 and Crosstown 62 Minnetonka, Minnesota
Type:	Planned Community: Office, Residential and Industrial
Developer:	Rauenhorst Corporation 7900 Xerxes Ave. So. Minneapolis, Mn. 55431 (612) 830-4444 Mr. J. Robert Snyder, P.E.
Architect:	Same (John Albers) (612) 830-4464
Engineer:	Same (J. Robert Snyder, P.E.) (612) 830-4459
Project Management:	Same (Ron Ryan, P.E.) (612) 830-4455

Completion date: Development of Opus 2 began in the winter of 1973. Completion of the business center is planned for 1979, the retail support areas by 1981, and the residential areas by 1984. Data 100's corporate headquarters on the site were completed in December 1975.

INTRODUCTION:

Opus 2 is a planned development which combines residential, commercial, and business facilities into a living-working community. The focal point of the community is to be a 300,000 sq. ft. multi-purpose service center with shops, a community theater, dining facilities and medical and police services.

The site is planned as follows:

	Acres
Residential (multi-family)	58.23
Retail support	30.00
Business park	220.00
Open space (including ponds)	75.00
Primary streets and secondary pedestrian pathway	65.00
Total:	±448.00

To date (Jan. 1978), the business part is 60% developed and the streets and roadways are 96% complete. The concept of providing a complete working and living environment which can provide jobs, recreation, housing, shopping, medical and cultural facilities is in itself energy-conserving. People do not need to travel far to meet their daily needs, and the amount of cars, gasoline and roads required is therefore lessened.

Construction of a major office and plant facility for the Data 100 Company provided the basis for developing Opus 2. Rauenhorst Corporation was asked to locate a site for the company. In the process of acquiring 25 acres for Data 100, Rauenhorst decided to purchase the adjoining 400 acres to implement the Opus 2 concept. So the basic ingredient of a major employment center was there from the start.

ENERGY CONSERVATION ON THE SITE

Energy conservation in overall site planning is evident in three techniques listed below. These planning techniques were not carried out solely to achieve energy conservation, but rather, in Rauenhorst's words, to enhance the "livability" of the land. The fact that these techniques also conserve energy made this project an excellent demonstration of the fact that certain concepts inherent in sound, well-thought-out site planning also contribute to energy conservation.

- Engineering to avoid traffic congestion

The unique road system consists of counter-rotating thoroughfares for routing traffic in and out of Opus*, and a secondary roadway connecting all businesses, neighborhoods, and recreational areas. The one-way primary road is a merge-and-diverge pattern of extended loops, figure eights and bridges, designed without intersections, traffic lights or stop signs. Traffic confrontation is thus eliminated.

Pedestrian traffic, bicycles and electric vehicles travel on a secondary road which passes under busy thoroughfares. The roadway also provides a right-of-way for utilities, so that repair work does not disrupt the main roads.

The division into primary and secondary roads encourages people to walk and ride bicycles. They have a pleasant roadway to themselves, and it is in fact more convenient not to use a car than to use one -- this is certainly a back-to-basics, energy-saving approach.

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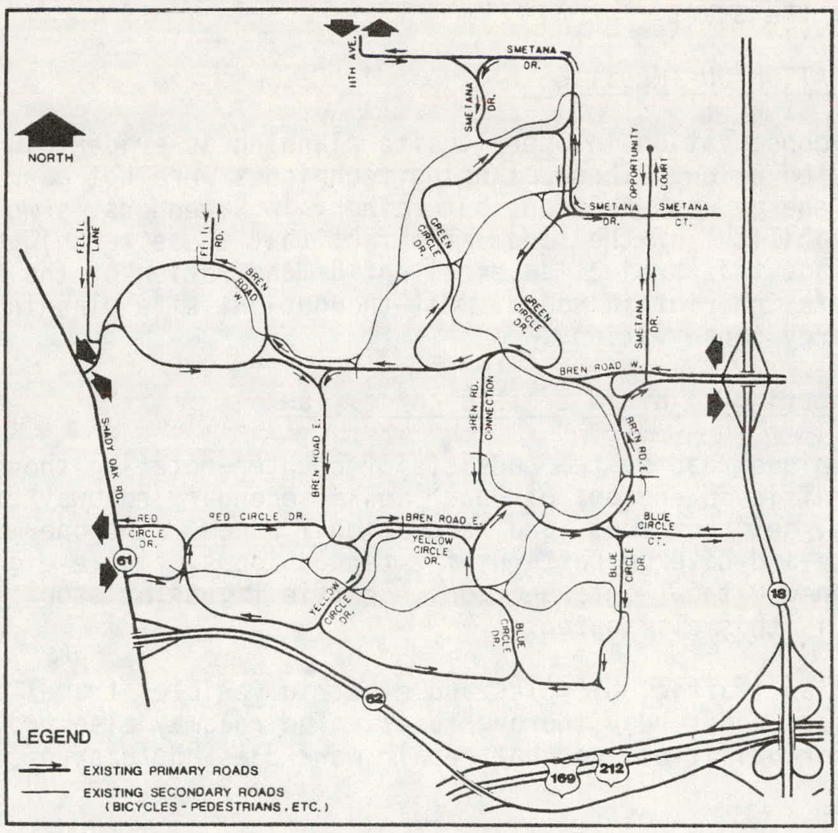
*See Circulation Plan

Opus 2 circulation plan



- <u>Preserving the natural terrain</u>

Open space - ponds, grassland and wooded areas - weave the site into a cohesive pattern. Within that setting, buildings are positioned to complement the environment, maximizing opportunities for energy conservation and blending in with the site. Energy is conserved at the construction stage since enormous amounts of site work to "level the hills to fill the swamps" are not required. Working within the natural terrain also provides an opportunity to take advantage of shading provided by existing trees and the cooling effect provided by existing ponds.

- <u>Providing a natural runoff system</u>

There are five interconnected ponds on the site. Runoff from roads and ditches percolates through the soil into the ponding system. The ponds serve a flood control function and provide a habitat for geese and other wildlife. The natural runoff system obviates the need for constructing a storm sewer system, and the ponds also serve to cool the air in summer.

ENERGY CONSERVATION IN THE DATA 100 BUILDING

Within the Opus 2 project, the headquarters for Data 100, completed in December 1975, represent an experiment in off-peak electricity storage carried out jointly by Northern States Power Co. and Rauenhorst Corporation. The system, involving two 40,000 gallon insulated water tanks buried in the building's parking lot, was installed in Data 100's 36,000 sq. ft. all-electric office building. Off-peak electric power is used to generate hot water during the heating season and cold water during the cooling season for use during higher demand daytime hours. The boiler and chiller do not operate during the day. In intermediate seasons, one tank stores hot water and one stores cold. The air cooled chiller works at full capacity during the cool night hours, resulting in lower power input per ton of cooling. Water is carried to the HVAC system from the storage tanks in insulated pipes.

This project was the first commercial application of off-peak electricity storage in the Midwest. Mr. Robert Snyder of Rauenhorst Corporation, indicated recently, however, that the installation of the two huge tanks was not commercially justifiable. The costs in this case could only be justified as an experiment. Any future system might use less storage to reduce, rather than eliminate, boiler and chiller operation at peak periods.

Other energy-saving elements in the building are:

- Building orientation with primary exposures to the north and south.

- Insulation and glass in accordance with proposed Minnesota energy code, though the code was not in effect at the time of building construction.

- Walls: 4" brick, 8" concrete block, 1½" fiberglass foil-faced batt insulation, and roof with 3½" rigid insulation.

- Exterior shading built into the building to minimize solar heat gain.

COSTS

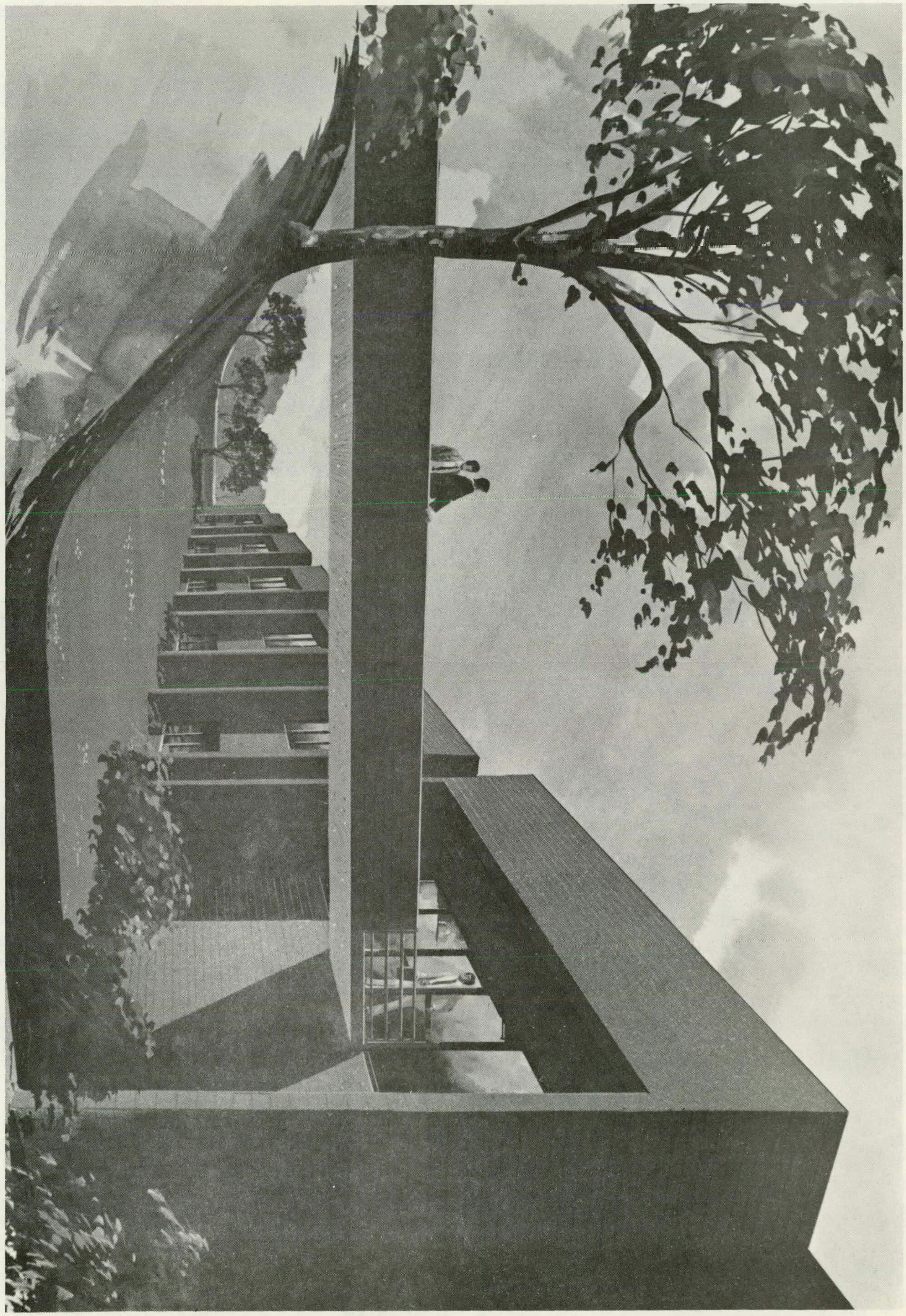
For the entire project, the price per acre of the various types of land use is as follows:

1.	Residential (multiple family)	$21,000
2.	Retail support	50,000
3.	Business park	64,000

It is impossible to break out costs attributable to energy conservation, since most of the energy savings are the results of good site planning.

Energy conservation costs are available for the Data 100 building:

- Additional mechanical system cost: $1.67 per sq. ft.



SUMMARY

	Hydro Place 700 University Avenue Toronto, Ontario M5G 1X6
Contact:	Mr. M. C. Wallis Ontario Hydro Hydro Place (address above)
More details:	Brochures available from Ontario Hydro; articles in Canadian Architect, April, 1976.
Energy conserving features:	- Double glazed reflective glass with U value of masonry - Heavy insulation - 2.7 watts per sq. ft. for lighting - Heat pump system captures heat from lights, people and equipment. There is no heating plant in the building - Underground storage of heated and chilled water - Computerized HVAC controls - Use of electricity at off-peak hours - 30% reduction in size of HVAC equipment

PROJECT INFORMATION

Name:	Hydro Place 700 University Avenue Toronto Ontario M5G 1X6 Canada Mr. M. C. Wallis, Energy Conservation Supervisor
Type:	Mixed Use: Office building (headquarters of Ontario Hydro) and commercial space
Developer and Architect:	Canada Crescent Corporation
Structural Engineering:	D. Law Consultants, Ltd.
Mechanical Engineering:	Tamblyn, Mitchell & Partners
Electrical Engineering:	H. Lapas & Co., Ltd.
Completion Date:	1975

INTRODUCTION

The 1.3 million sq. ft. headquarters for Ontario Hydro contains 18 office floors, and upper and lower concourses with shops and restaurants. Under a lease-purchase agreement, Canada Crescent Corporation has assumed responsibilities of design, construction, and operation of the project for 30 years (beginning in 1975), at which time Hydro will purchase it for $1. Annual rental is $4.84 per sq. ft. (1975 figure), exclusive of taxes, maintenance and land.

The building has what is thought to be the world's largest continuously post-tensioned concrete floor slabs. This type of construction reduces floor thickness, thus saving height on every floor, or at least two stories of usable space in the 20-story building. The construction also allows for an open floor plan.

ENERGY CONSERVATION

The Ontario Hydro project is a landmark example of energy conservation, and therefore much has been written about it. Brochures are available from Ontario Hydro itself and there are two articles on the project in The Canadian Architect, April 1976.

The energy-conserving features of this development are well worth noting. It contains no furnace or heating plant, but relies on recovery of heat from lights, people and machinery. Energy consumption is less than 54,000 BTUs per sq. ft. per year. On the average, a well-designed building similar in size uses 120,000 BTUs. Major features are outlined briefly below. More details are provided in the brochure available from Hydro.

- Glass. Double- glazed reflective glass achieves thermal efficiency. Glass at Hydro Place is equivalent in insulation value to normal masonry walls. One of the two thickness of glass is coated to reflect 80% of the solar heat outward.

- Insulation. Although the mirrored glass surface looks like an unbroken expanse from the outside, it is actually mirrored glass separated by spandrels covered with reflective glass. Spandrel sections are backed by 2" of glass wool which insulates the wall heating ducts. Behind the concrete panels at the rear of the building is a 1" layer of urethane insulation and a layer of reflecting foil. While there is no structural concrete wall, concrete panels are backed by 4" of rock wool protected by a vapor barrier and interior wallboard.

- Lighting. The lighting load has been reduced about 33% - 2.7 watts per sq. ft. yield 100 foot-candles of illumination whereas 4 watts are usually required. Lighting is not task-oriented, however.

- Heat pump. A heat pump system captures heat from lights, people and equipment in the core area for restribution to the perimeter in winter. The system greatly reduces energy costs by storing and using heat usually expelled into the atmosphere.

- Storage reservoir. An underground storage reservoir with 1.6 million gallons of water stores heated and chilled water as needed.

- Computerized controls. A central computerized system optimizes operation of all mechanical and electrical equipment.

- Off peak power. The heating and air conditioning system uses chilled and warm water produced at night, thus reducing energy requirements at periods of high demand.

- Smaller HVAC equipment. Because of the building's efficiency, heating, ventilation, and air conditioning equipment is 30% smaller than in comparable buildings, allowing for more usable space.

COSTS

Estimated construction costs of the project of $44,700,000 include materials, labor, overhead, design fees, and interim financing. Savings in energy consumption per year are estimated at 20 million kilowatt hours, enough to supply 2,500 average size homes.

PROJECT INFORMATION

Name:	Mid-Island Shopping Plaza Broadway Hicksville, New York
Type:	Shopping Center Renovation
Developer:	Mid-Island Shopping Plaza Co. Broadway Hicksville, New York
Architect:	Franklin Frank, Executive Partner Werfel & Berg, Architects & Engineers New York, New York Mr. Lawrence Werfel
Completion Date:	1978

INTRODUCTION

At 1.5 million square feet of building area with over 120 tenants, Mid-Island Plaza is one of the largest regional shopping centers. The center is located on 70 acres and has a market area of two million people, with more than 400,000 within five miles of the plaza. The plaza's renovation follows a 10 courtyard design scheme with the theme of "international islands."

ENERGY CONSERVATION

The renovation has provided an opportunity to incorporate energy-conservation considerations. Only materials with high insulation values are used in the interior. The floor is natural wood with carpeting, both materials which minimize heat loss. Upper clerestories permit natural light to enter and minimize the need for heating and for artificial lighting. A solar system is part of the renovation plan. The solar system is designed to use 370 3x9 foot copper collectors, totalling 10,000 square feet, mounted on a 2,000 foot long roof. In the summer the solar collectors provide shading, to reduce the amount of high summer sunlight coming in through the mall's upper windows.

COSTS

In January, 1972 gas and electric bills for the 1.5 million square foot center were $4,851. In January 1976, they were $12,274. This tripling of cost was a major influence behind the decision to incorporate solar heating. Insulation of the solar system was estimated to cost $400,000, with a payback period of 16 years.

The solar system, along with other energy-saving factors in the renovation design, are estimated to reduce BTU's consumed by heating from 108,00 BTU/gross square foot per year to 43,000 BTU/gross square foot/year.

SUMMARY

Integrated Community Energy System (ICES)
Trenton, New Jersey

Contact:

Mr. John Clark
Director of Planning & Development
City of Trenton, New Jersey

Energy conserving features:

- Co-generation plant saves energy through recovery of waste heat
- Co-generation plant serves 18 existing and 9 proposed developments, eliminating individual building heating systems
- Individual buildings do not require staff to maintain boilers
- Space normally taken up by heating systems in each building becomes useable space
- Heat produced costs less than that of conventional systems
- Saves over 10,000 barrels of oil annually compared to conventional systems
- Plant power generation capacity can be expanded

PROJECT INFORMATION

Name:	Integrated Community Energy System (ICES) Trenton, New Jersey
Type:	An "Energy Community" - many buildings served by one co-generation plant
Owner & Operator:	Public Service Electric & Gas Company Newark, New Jersey
Developer:	City of Trenton, New Jersey (609) 989-3586 Contact: John Clarke, Director of Planning & Development (in cooperation with Public Service Electric & Gas Co.)
Architect:	Richard G. Steen & Partners New York, New York
Engineer:	R.G. Vanderweil, Inc. Boston, MA
Completion Date:	Construction to begin in Sept., 1978; completion by June, 1981

INTRODUCTION

The City of Trenton is planning construction of an Integrated Community Energy System to serve 18 existing buildings and 9 proposed developments (including a Civic Center) in the downtown redevelopment area. The existing buildings total 1,885,000 square feet, and the proposed buildings would add 1,252,000 square feet to be served by the energy plant. City officials regard construction of the plant as a major incentive to downtown development, due to the savings in operating costs estimated for each development served by the plant.

The demonstration plant will serve as an information center, with a viewing area for pedestrians and a display explaining the functioning of the plant. The complex will include not only the co-generation plant, but also three office buildings and a parking garage.

ENERGY CONSERVATION

Energy conservation is inherent in the functioning of a co-generation plant, since it involves recapture of waste heat. The Trenton plant will contain a small electrical generator which is also equipped to recapture waste heat produced in the process of generating power. The heat will be converted to high pressure steam, which will then be distributed to surrounding buildings. Steam will both heat and cool the 18 existing and 9 proposed buildings and produce domestic hot water.

The system will be powered by four oil-fueled combustion turbines, and a fifth can be added later. Each of the turbines can be replaced by more powerful ones, so that the system could eventually supply power to the entire downtown.

Fuel consumption will be reduced due to improved efficiency. A conventional plant averages a fuel efficiency of 30 to 35 percent; the proposed plant should have a 63 percent useful energy output.

Individual buildings hooked into the system will save money because staff to operate boilers in each building will not be needed, space normally devoted to heating equipment will be spared, and the cost of the heating itself will be lower from the co-generation plant than from conventional methods.

COSTS

Total construction cost of the system should be $11,138,000, with the cost of the central Integrated Community Energy System (ICES) plant estimated at $6,655,100. The Department of Energy has funded phase one of the feasibility study.

In their interim report, the demonstration team estimated the ICES system would save over 10,000 barrels of oil a year in comparison with a conventional system. They estimate additional savings of 4,224 tons of coal annually, equivalent to 28,000 barrels of oil.

When amortization of capital costs is subtracted from the dollar value of annual fuel savings, the annual dollar savings are roughly $40,000. The $40,000 annual savings figure represents the savings of the ICES system in comparison with a conventional system, beyond what is considered zero point average profitability for a utility system.

SUMMARY

California State Office Project
"Site One"
Sacramento, California

Contact:

Sym Van der Ryn, California State Architect
Peter Calthorpe, Chief Designer
Office of the State Architect
Box 1079
Sacramento, California 95814
(916) 445-2163

Energy conserving features:

- heat absorbent concrete structure
- "flushing" out building with cool, night air
- 660-ton rock heat sink in central courtyard
- trellis projections on south wall, shades on the east and west
- two watts per square foot lighting system
- central courtyard provides preheating and cooling for the ventilation system

PROJECT INFORMATION

Name: California State Office Project
"Site One"
Sacramento, California

Type: Office Complex with Central Courtyard

Developer & Architect: Office of the State Architect
Box 1079
Sacramento, California 95814
(916) 445 - 2163
Sym Van der Ryn, State Architect
Peter Calthorpe, Chief Designer

Completion Date: Design now complete

INTRODUCTION

The "Site One" California state office project, along with two other planned office buildings, promises to be an outstanding example of energy conservation and human comfort in architecture.

The Site One project is a four-story city block site near the capital in Sacramento. The large site permitted design of a low-rise structure surrounding a huge skylit court. The courtyard is a key element in eliminating some mechanical air conditioning requirements - it is designed to take advantage of the sharp night-time drop in Sacramento temperatures. The building's full HVAC capacity is to be used in only the most extreme heat, since 80 percent of the cooling requirements are met by using cool, night air.

ENERGY CONSERVATION

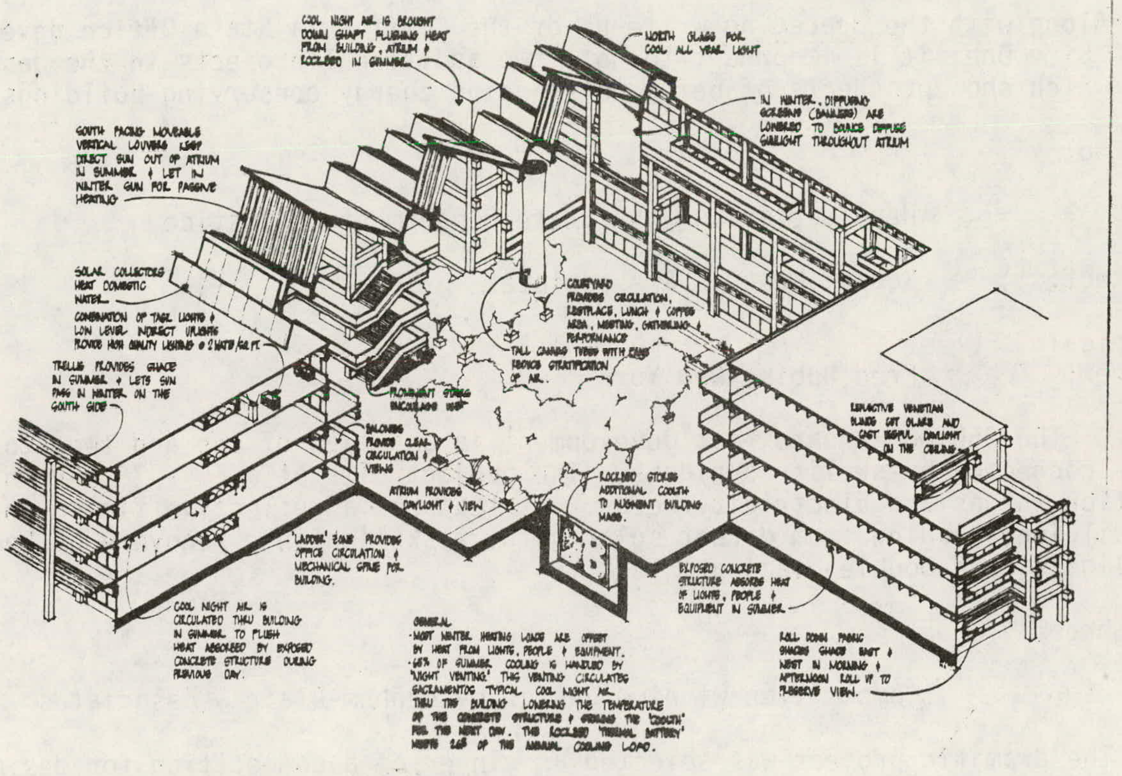
The major energy design problem for large buildings in Sacramento is cooling. Four techniques were used to conserve energy required for cooling:

- The concrete structure provides the thermal mass to absorb heat given off by lights and people during the day. Auxiliary thermal mass is provided by a 660-ton rock bed sunk in the courtyard, which is connected to the HVAC system. As the outside temperature drops below that of the warm thermal mass, the building is flushed out with cool night air.

- The building is shaded by trellis projections on the south side and cloth shades which can be drawn at will on the east and west sides.

- A more efficient lighting system saves energy. Low level ceiling lights combined with task lighting average 2 watts per square foot. Natural daylinght is used as much as possible. Venetian blinds are provided on clerestory windows to cut glare.

- A large central courtyard is a gathering place, and also provides light and preheating and cooling for building ventilation.



California State Office Project, "Site One"
Drawing reproduced from <u>AIA Journal</u>, 12/1977 p. 51

PROJECT INFORMATION

Name: California State Office Projects: Sites 2 and 3
Sacramento, California

Developer & Owner: Office of the State Architect
Box 1079
Sacramento, California 95814
(916) 445-2163
Sym Van der Ryn - State Architect

BRIEF NOTES

Along with the preceding write-up of the California State Office development - Site One, it is important to note two additional projects in the design phase which show prospects of being outstanding energy-conserving buildings.

Site Two:

Headquarters of the State Department of Justice

Architect: Robert Marquis & Associates

Mechanical Engineer: Fred Dubin, New York

The 350,000 square foot development is a series of one and two story spaces connected by skylit corridors. The project aims at a 65 - 75 percent reduction in gas and electricity needs. It features a reflective finish on the building, shading from direct solar gain, task lighting, recovery of heat from lights, and double glazing.

Site Three:

Competition winning design by Benham-Blair & Associates

The dramatic project was selected as winner of a competition for design of an energy conscious state office complex out of 41 entries. It is an earth-covered building where the surface is a park. The major above ground element is, a huge solar collector at one end of the site which will provide energy to cool the building. Consultants claim 50 percent energy savings over similar conventional projects, but the design is still being refined and it is too soon to calculate its energy efficiency.

SUMMARY

Citibank Corporation
Lexington Ave at 53rd
New York, N.Y.

Contact: Mr. Robert Dexter
Vice President for Facilities Management
Citibank Corporation

Energy conserving features:

-- Cold water for air conditioning shared with adjacent building

-- Uses double glazed, reflective glass

-- Reflective aluminum used on exterior

-- Energy saving heating and ventilation system

-- Heat recovery for domestic hot water and some space heating

-- Lighting at 1.9 watts/square foot instead of 4 watts

-- Computer controlled heating, air conditioning and lighting

-- Building exterior is 46% glass

PROJECT INFORMATION

Name: Citibank Corporation
Lexington Ave. at 53rd Street
New York, N. Y.

Type: Office Tower plus Retail and Restaurant space

Management: Robert H. Dexter
Vice President for Facilities Management
Citibank Corporation

Electrical
Mechanical
Engineers: Joseph Loring & Associates

Completion
Date: 1977

INTRODUCTION

Citibank's 48 story building in downtown Manhattan is the third tallest skyscraper in the city. It contains 1.8 million gross square feet, including 1.1 million of useable square feet in the office tower, and 400,000 square feet of office, retail and restaurant space in the low rise building and two basement levels. At the top of the building is a metal gridwork, originally scheduled to hold half an acre of glass in what was planned to be the city's largest solar project. The solar energy project was scrapped when it was learned that redesigning the development for increased energy efficiency would make the cost of the solar system prohibitive. Final cost figures indicated that after building redesign, the solar energy project would save a maximum of $3000 per year but would cost at least $1.7 million to install.

ENERGY CONSERVATION

The redesign cut down the amount of glass in the project to 46%. The glass is double-glazed and reflective. Light reflective aluminum spandrels reduce heat gain; the walls are lined with 2 inches of insulation rather than the one inch typical of such projects.

Along with an energy conserving exterior, the development includes a carefully designed HVAC and lighting system which keep energy consumption at 100,000 BTU/sq. ft./yr. The energy saving devices have been used before, but it is unusual to find them combined in one project:

-- Heating/cooling through two-pipe, non-changeover induction system. (This system saves energy and also reduced initial costs).

-- Interior ventilation by variable air volume system with fans that throttle down if full cooling is not needed.

-- Instead of throwing away heat via cooling towers, it is used to temper ventilation air and pre-heat domestic hot water.

-- Lighting will use 1.9 watts/square foot as compared with the usual 4 watts, thus reducing electricity consumption and cooling needs. Task lighting (small lights above desks) was used instead of strong overhead lighting.

-- Lighting and the HVAC system are computer controlled in sectors.

-- A four feet square tunnel drilled beneath the street connects the new building to Citibank headquarters. It is used for a mail car but also serves to shuttle cold water between the buildings enabling either building's air conditioning system to cool <u>both</u> buildings during low demand periods.

The solar system which was not used was an innovative project developed by M.I.T. The solar system would have been part of a giant humidifier that would use a chemical (triethylene glycol) to extract water from New York air, the chemical would absorb the moisture and eliminate the cost of chilling air below the comfort level in order to get water out by condensation. The solar energy would heat the chemical to remove moisture, enabling it to be used again.

<u>COSTS</u>

Not available

NOTE: The HVAC system is described in more detail in <u>Buildings</u> magazine, Nov, 1976, p. 104.

SUMMARY

Woodroffe Demonstration Housing Project
Woodroffe Avenue and Baseline Roads
Ottawa, Ontario, Canada

Contact: Central Mortgage and Housing Corporation (CMHC)
National Office
Ottawa Ontario K1A 0P7
Judy Connolly, Policy Development Division
(613) 746-4611

ENERGY CONSERVING FEATURES

- Recommended use of district heating -- central plant for the 400-acre project.
- Flexibility in use of different fuels to power the plant.
- Consideration of life cycle costs and costs in terms of barrels of oil consumed.

PROJECT INFORMATION

Name:	Woodroffe Demonstration Housing Project Woodroffe Avenue and Baseline Roads Ottawa, Ontario, Canada
Type:	Residential
Developer:	Central Mortgage & Housing Corporation (CMHC) National Office Ottawa, Ontario K1A 0P7
Contact:	Judy Connolly, Policy Development Division (613) 746-4611
Consulting Engineers:	Brais, Frigon, Hanley & Associates in consort with Shawnigan Engineers, Ltd. Montreal, P.Q.
Completion date:	Construction to start 1978

INTRODUCTION

The Woodroffe Demonstration Housing Project is located on a 400-acre site with a total planned population of 12,000. The development comprises 17 precincts and a town center; it contains schools, commercial and employment centers, and 3,140 housing units of various types.

Innovative energy conservation methods are important to the project. A study was conducted to identify a heating system for the project which would conserve energy and permit shifts to lower cost energy sources in the future.

ENERGY CONSERVATION

Three methods of providing space heating and domestic hot water were studied:

1. Individual heating systems for all houses and structures in the project.

2. Cluster heating systems -- a small heating plant in the basement area heats a group of structures.

3. District heating system -- a single heating plant and distribution system for the entire project.

Precinct heating -- providing one plant for each of the 17 precincts in the project -- was also reviewed and deemed unsatisfactory. Of the three systems, district heating is recommended as compatible with the widest range of possible future energy sources. It is most adaptable to retrofit work, whereas other systems would require major alterations to enable use of alternative energy sources.

Consultants found use of community refuse as a source of energy to be economically unattractive, because of the community's small size. Solar energy is considered a possible future energy source.

COSTS

The capital cost for installing district heating is estimated at $12.7 million, compared with individual heating at $4.2 million and cluster heating at $9.9 million. However, life cycle costs at a 10% discount, expressed as a cost per million BTU of heat consumed are:

District heating	$8.23
Individual "	10.00
Cluster "	10.79

District heating is also more attractive in terms of Barrels of Oil Equivalent (6.3 million BTU per barrel). Individual heating systems require 112,000 barrels per year; a district heating system uses 39,000 barrels less, and a cluster system uses 23,000 barrels less than individual heating systems.

PROJECT INFORMATION

Name of Development:	Eastland Mall 5471 Central Ave. Charlotte, N. C. 28212
Type:	Commercial - shopping center
Developer:	Eastland, Ltd. 1824 Wachovia Center Charlotte, N. C. 28285 (704) 374-1711
Contact:	Mr. Howard M. Phillips, Jr.
Architect:	Little and Associates 4000 Park Rd. Charlotte, N. C. 28209 (704) 525-6350
Engineer:	Harvey Capell 212 Rodborough Rd. Columbia, S. C. 29210 (803) 781-3884
Completion Date:	July 30, 1975

ENERGY CONSERVATION

This 450,000 sq. ft. shopping center is located on a 23 acre site in Charlotte. Electrical energy is conserved through use of an IBM System 7 computer which reduces peak demand through load shedding. Savings are estimated at 8% of utility costs and will be even greater if the utility company shifts to peak time billing for electricity.

Developers are pleased with the system's performance and are considering expanding it in other developments to other controllable energy loads. In the future, they would use a less expensive micro-processor rather than a computer.

Construction costs for the project were $23/sq. ft., of which $.05 per sq. ft. was attributable to the electrical energy saving device.

This shopping center is included simply as an example of the hundreds of companies with substantial monthly utility bills which have installed computer utility management systems. Emory University, Atlanta, Ga., Gulf Life Tower, Jacksonville, Fla.; Sara Lee Kitchens, Deerfield, Illinois; and One Financial Plaza, Hartford, Conn. are among many other examples.

SUMMARY

Hizashi Condominium Residences

Contact: Mr. Robert Medearis
HCC, Inc.
431 Burgess Drive
Menlo Park, Ca. 94025
(415) 327-6883

Energy conserving features

- Passive solar design
- Double glazed, bronze pane windows
- Heavy insulation
- Water and electricity saving appliances
- 320 sq. ft. solar collector system providing hot water & heating
- 1000 w photo-voltaic cells generating electricity for solar pumps and common areas.

PROJECT INFORMATION

Name	Hizashi 629 Lytton Ave. Palo Alto, California 94301
Type:	Condominium Residential
Developer and Project Management:	HCC, Inc. R. W. Medeares, President 431 Burgess Drive Menlo Park, Ca. 94025 (415) 327-6883
Architect:	Moyer Associates; Mr. Ken Abler 512 Waverly St. Palo Alto, Ca. 94301 (413) 321-3705
Completion date:	Completed in 1977 and is sold out

INTRODUCTION

Hizashi is a 10 unit, three-story solar-heated condominium. This residential development has 10 covered car spaces and a fully developed solar, hydronic, closed loop solar system extracting both heat and electricity from the sun. The site is 14,062.5 sq. ft. with the total site being developed. The square footage of the building is broken down as follows:

a. Residential units: 11,303
b. Community space: 825
c. Open parking garage: 6,758
d. Total covered area: 18,886

Hizashi's developers emphasize a "holistic" approach to housing design, indicating their attempt to recognize man's physical and mental health needs along with the impact of the housing development on the environment and other people. Promotional literature on the projects emphasizes as a major selling point of the units the fact that they have been thoughtfully designed to create a setting conducive to man's overall well-being while minimizing negative environmental effects.

Features relating to personal comfort and well-being are:

-- Full spectrum lighting (light having the same spectrum as the sun)
-- Natural materials (wood, ceramic tiles, natural fiber drapes...)
-- Cleaner air (heat from the solar energy system is cleaner than that of standard furnaces)
-- Negative air ion generator in each condominium (allegedly provides a more natural balance of air ions)
-- Quiet (acoustically) insulated plumbing, noise stop boards in floors, acoustic sealants at

perimeters of jointed materials...)

ENERGY CONSERVATION

Hizashi development is supposedly the first condominium project with both solar heating panels and photo-voltaic cells.* A number of design factors minimize energy consumption:

Building design

The project is designed for passive solar heating. Exposed areas are protected. In addition, energy conservation is inherent in condominium design: While single family homes lose heat through exterior surface area which is large compared to floor area, condominiums are more efficient. Shared exterior walls, floors and ceilings minimize heat loss and use less materials for construction.

Construction Materials

R-19 fiberglass insulation is used in the ceiling; R-13 in side walls and R-11 in all interior walls. Windows are double-pane and bronze-glazed; construction is double-stud with 2" of lightweight concrete wrapping the structure. Units have heat-circulating fireplaces which recirculate more of the heat into the room than up the chimney.

Appliances and Electricity

Only appliances and lighting fixtures which use less electricity than normal have been installed. Water-saver toilets and shower heads are also used. A total solar flat plate system of 320 sq. ft. of collector area and 1000W of photo-voltaic cells are installed. The photo-voltaic cells generate electrical energy to run the solar pumps and light portions of the common areas.

Solar Heat and Natural Gas

Homes are heated by solar energy supplemented by natural gas. Solar energy heats buildings and generates hot water for domestic use. A decrease in use of natural gas of 24% - 35% over conventional heating is anticipated.

*Photo-voltaic cells convert solar energy into electricity.

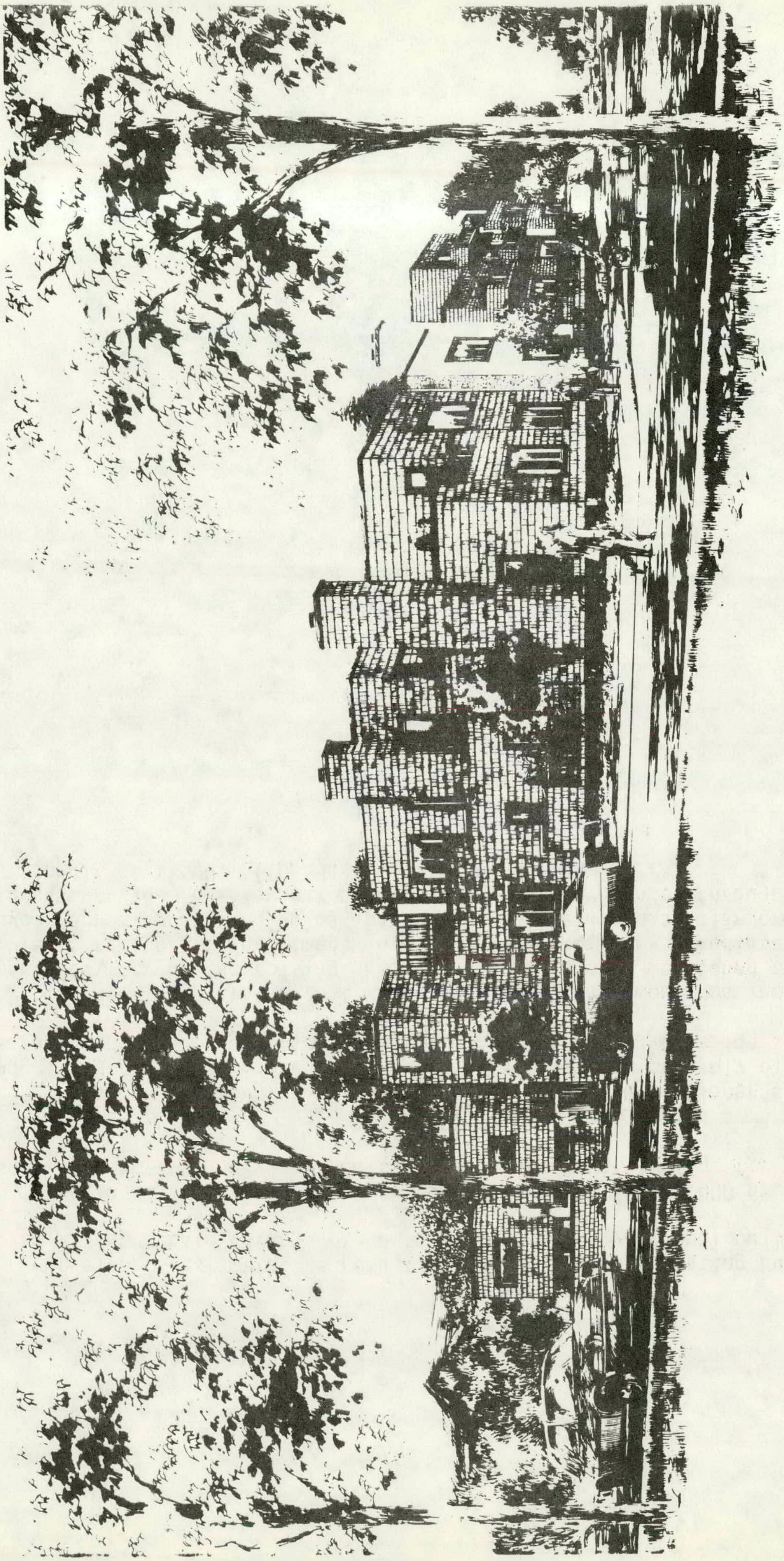
COSTS

Developers estimate the result of the insulating, heating and solar features will generate savings of up to 75% over a conventional building.

The total selling price of the development is $1,136,000 or $60 per sq. ft. with the individual units selling at about $100/sq. ft. Developers cost is $51/sq. ft.

Inclusion of energy-saving devices increased the developer's cost by roughly $3.50/sq. ft. The actual solar plate portion probably did not increase costs; the major increase is attributed to passive design aspects.

The developer states that the energy-conserving measures increased the marketability of the housing greatly. The developer mentioned that he was able to recoup his investment in energy-saving devices immediately through improved market appeal and sales and through the California solar credit. California provides a solar tax credit; the developer passed through to each buyer a credit of $1500. (The Hart Bill - No. 1558).



SUMMARY

Bedford Mews Townhouse Development

Contact: Mr. Lee Harris Pomeroy AIA
Pomeroy, Lebduska Associates p.c.
17th floor, The Plaza
2 West 59 St.
New York, New York 10019
(212) 838-6170

Energy-conserving features

- -- Project meets New York State Energy Guidelines (equal or exceed ASHRAE 90-75 criteria)
- -- On-site solid waste disposal
- -- On-site wells
- -- Solar system for heating and hot water available to individual units.
- -- Electricity taken off-peak electric rates and stored for use during peak hours.
- -- Solar heated pool and clubhouse. Pool is also used as energy storage facility
- -- Natural materials used in construction
- -- Cross-ventilation minimizes mechanical cooling

PROJECT INFORMATION

Name: Bedford Mews
Harris Rd.
Bedford, N. Y.

Type: Multi-Family Residential Complex, Clubhouse and Pool

Developer: D.W.S. Holdings, Inc. (an affiliate of Louis Dreyfus Corp)
24 Richmond Hill Ave.
Stamford, Conn. 06901
(203) 357-8444

Architect: Pomeroy, Lebduska Associates, p.c.
The Plaza, 17th Floor
2 W. 59th St.
New York, N. Y. 10019
(212) 838-6170

Engineer: George Langer
114 E. 32nd St.
New York, N. Y. 10016
(212) 689-9393

Solar Design: Ecosol, Ltd.
17th Floor, The Plaza
2 W. 59th St.
New York, N. Y. 10019

Completion Date: Construction starts March 15, 1978
First phase: July 1978
Total completion planned March 1980

INTRODUCTION

Bedford Mews, winner of an Owens-Corning Energy Conservation Award for 1977, is a 160-unit townhouse project being built in a 13-acre former dump yard. It is the first townhouse project and the first to include subsidized units, in the rural area of Bedford. Ten percent of the units will be subsidized rental housing for the elderly(acquired and operated by a non-profit housing corporation). The project is comprised of:

16 one-bedroom apartments for the elderly
28 one-bedroom simplex units
78 two-bedroom simplex units
28 three-bedroom simplex units
10 two-bedroom duplex units
Swimming pool and 2 level solar heated clubhouse

Twenty-eight of the condominiums will be offered for sale with individual energy recovery systems which combine solar collection with a water-to-water heat pump and reduced rate, off-peak electric service. Six of the twenty-eight units are funded under a Cycle II, $40,000 HUD demonstration grant.

The solar heated clubhouse lounge and meeting rooms, sauna and service facilities and a greenhouse area in the clubhouse are available to residents for growing plants for use in private gardens. It serves to humidify the clubhouse in the winter heating season and adds oxygen to the environment.

ENERGY CONSERVATION

Overall Design

Some of the major aspects of the energy-conscious design employed in Bedford Mews follow:

1. Solid waste disposal is done on site with subsurface discharge of effluent into highly absorptive sand and gravel.

2. Potable water is provided by on-site wells.

3. Energy usage is minimized through conservation in construction, planning and the use of an advanced solar system for heating and hot water which together with cooling is provided by a compact individually packaged Energy Recovery System. 28 condominium units will be offered with these solar systems.

4. Purchasers of condominiums will be able to purchase optional Energy Recovery Systems which take energy at night (at half rates) and store it for use during more expensive peak load periods. These can be combined with solar systems or utilized separately.

5. The solar heated pool and clubhouse provide the Condominium Association with additional energy savings. Solar collectors are mounted on a southerly exposed arbor. The pool doubles as an energy storage facility and heat sink used in combination with the water-to-water heat pump.

A variety of design concepts contribute to energy-efficiency within the individual dwelling:

1. Units are clustered, utilizing party walls and floors which minimize surfaces exposed to the weather. In the semi-rural Bedford area such dense planning is innovative and a direct response to new energy concerns.

2. Grouping around courtyards and selected landscaping is designed to reduce wind exposure and velocity.

3. An extensive pedestrian-oriented walkway system connects to limited car access and suburban bus stop on the adjoining road.

4. Basic construction materials and exterior surfaces are wood. Energy-expensive building products and synthetic materials are avoided.

5. All white, well-insulated, buildings reduce cooling loads during summer peak energy periods.

6. Buildings are designed with carefully placed insulated glass areas which allow natural light and ventilation, reducing power usage.

7. Styrofoam insulation 1" thick is provided beneath all concrete slabs on the ground.

8. Every dwelling unit has carefully located opposite window exposures. This allows natural (cross) ventilation during mild weather. Emphasis on mechanical cooling is substantially reduced during Spring and Fall seasons.

9. Reduced-rate, off-peak energy is fully employed with solar units and separately. This allows voluntary and automatic energy savings for consumers and the utility company.

Clubhouse and Pool

The basic system employed in the Clubhouse Building uses the swimming pool itself as a heat source during many months. A Greenhouse within the Clubhouse has a natural solar function and humidity control, which adds comfort, energy savings and oxygen to the building environment.

A ducted fireplace doubles as an energy conservation vehicle by utilizing outside air to feed the combustion process. This reduces infiltration losses from windows and doors. The central fireplace will be fitted with grating made of water pipes that circulate and extract heat from the fireplace which is delivered to the storage tank. A description of the energy recovery system was provided by the architect:

> "Dwelling units and Clubhouse employ a completely <u>packaged energy recovery system</u>. When water in the solar system is hot enough, a pump circulates it to an air handler and then to storage. When the tank temperature is below the required heating range, the heat pump extracts the heat from the storage tank. If a prolonged period occurs where no solar input is made and the tank temperature drops to 50°F the oversized domestic hot water heater turns on during off-peak hours to provide heat during the night and for part of the next day. The tank is sized to limit the off-peak input so that water temperature will be low enough to permit efficient collection during cold weather. Additional controls allow only partial off-peak operation if proper tank temperatures are reached.
>
> This basic system employed in the Clubhouse Building enables us to utilize the swimming pool itself as a heat source during many months. In the Spring and Fall, if cooling is required heat can be rejected into the pool to heat it for extended use. In summer the collectors will be used to warm the pool for morning and evening use.

COSTS

The solar/off-peak system compares favorably with convential heating:

Residential Units (averaging 1200 sq. ft.)	
conventional electric heating and hot water	$767.30/yr.
solar/off-peak	331.00/yr.
annual savings for average unit	$436.30/yr.
Clubhouse (3000 sq. ft.)	
conventional heat and hot water	$4,200.00/yr.
solar/off-peak	2,300.00/yr.
annual savings	$1,900.00/yr.

1 Solar Gain Artificial Light Savings

2 Natural Light Double Glazed

3 Sun Control

4 Natural Ventilation

5 Private Court

6 Energy Storage (In-Ground Solar and Off-Peak Power Source)

7 Roof = R-21

8 Walls = R-17

9 Under Slab Insulation

10 Tightly Clustered Dwellings (Reduce Heat Loss and Gain)

11 Solar Collectors

12 Share Common Wall

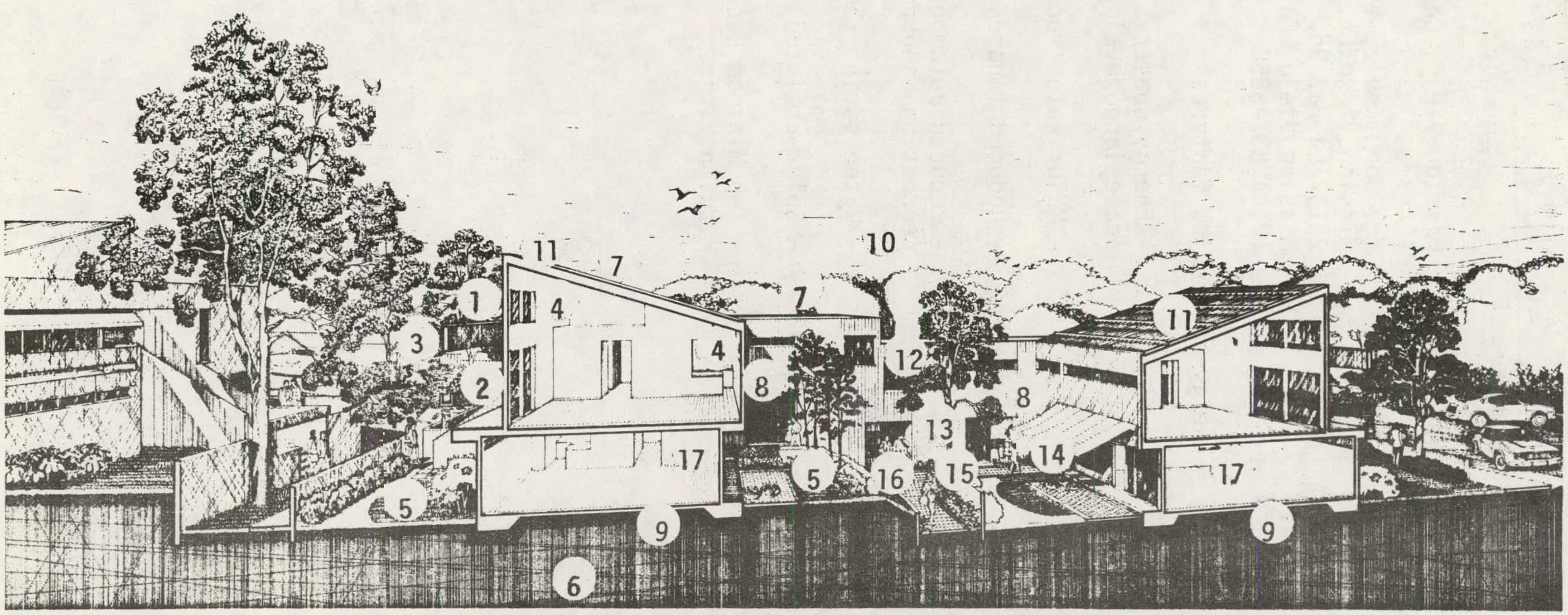
13 Siding Renewable Material

14 Sun Control Shades

15 Courtyards Low Level Lighting System

16 Pedestrian Underpass

17 Pre-Engineered Energy Recovery System



SUMMARY

Mission Viejo, California

Contact: Mr. Don Schulz, Vice President
Mission Viejo Co.
26137 La Paz Rd.
Mission Viejo, Calif. 92675
(714) 837-6050

Energy-conserving features

- Energy conservation taken into account in large-scale land development planning

- Major water reclamation project

- Reduced landscape watering

- Reduced automobile usage through provision of local recreation, shopping and transportation facilities

- Water saving showers and toilets in homes

- Solar-assisted gas hot water heaters in seven homes

- Two Minimum Energy Dwellings built and studied in Mission Viejo.

PROJECT INFORMATION

Name: Mission Viejo, California

Type: Residential Community

Developer: Mission Viejo Company
26137 La Paz Road
Mission Viejo, California 92675
(714) 837-6050

Completion Date: Ultimate population of 30,000 families by 1990; now has 10,000 families

INTRODUCTION

Mission Viejo presents a unique opportunity for energy-conscious planning and development, since it is a 10,000 acre community being developed entirely by one company. The community is in Orange County, south of Los Angeles. The current population is 10,000 families, and it is expected to reach 30,000 families by 1990.

ENERGY CONSERVATION

Energy conservation measures undertaken at such a large scale are dramatic in comparison to what can be undertaken at the individual building scale. Examples at Mission Viejo include:

- Mission Viejo Company and the Santa Margarita Water District are cooperating in a water reclamation program. Water reclamation appeared feasible in light of a study which cited rapidly rising costs of importing water to Southern California.

  The project involves construction of a 1,000,000 gallon per day water reclamation plant as a first stage of an ultimate 9,000,000 gallon per day plant. The project will save 10,000 acre-feet out of the 23,000 acre-feet of water the community will ultimately require per year. This reduction translates directly into a 37% reduction in energy needed to pump the water.

- In 1976, Mission Viejo cooperated with the University of California at Irvine to come up with a reduced landscape watering plan. Residents, the county, and the Mission Viejo Company support an irrigation program which saves 1,000 acre-feet of water per year. Again, savings in water translate into energy saved in pumping the water to Southern California.

- Mission Viejo has tried to cut automobile usage by providing a recreational lake and a major recreational facility within the community. Neighborhood shopping centers reduce car usage by providing a variety of stores near people's homes. Park and ride bus stations and commuter car pools also provide alternatives to the car.

A number of energy-conserving features have been incorporated within individual houses as well:

- Water-saving showerheads and toilets have been installed in all new homes since 1976.

- Seven demonstration homes are being built with solar-assisted gas water heaters.

- Two identical Minimum Energy Dwellings (MED) were built in 1976 in Mission Viejo. The dwellings were a cooperative venture by Mission Viejo Company, Southern California Gas Company, and the U. S. Department of Energy. House features include: R-19 wall insulation, double-entry doors, slab insulation and solar assisted water and space heating and cooling. A recent study of the homes indicates that they are twice as efficient as ordinary houses. Air leakage, even in these houses, however, points up the importance of sealing duct work, air handlers, and the furnace if they are outside the conditioned area.

COSTS

Not available.

SUMMARY

The Village
2417 Bucklebury Rd.
Davis, California 95616

Contact: Judy Corbett
2417 Bucklebury Rd.
Davis, California 95616
(916) 756-5941

Energy conserving features:

- 8% coverage of site by roads versus 25% typical for residential subdivisions
- Bike paths and greenbelts
- Agricultural land and food-producing plants incorporated into development
- Recycling systems
- Passive and active solar home designs available

PROJECT INFORMATION

Name:	The Village 2417 Bucklebury Rd. Davis, California 95616
Type:	Mixed Use: Residential, Commercial, Park and Agricultural Land
Developer:	Michael and Judy Corbett 2417 Bucklebury Rd. Davis, California 95626 (916) 756-5941
Architect:	Michael Corbett/John Hofacre 2310 Portage Bay Ave. #10 Davis, California 95616 (916) 758-8505
Engineer:	Fred Kendall 545 Rutgers Dr. Davis, California 95616
Completion Date:	Two of Five Phases completed, Phase Three in progress Final completion date - 1981

INTRODUCTION

The Village is a 70 acre subdivision designed both for the development of a sense of community and for conservation of energy and natural resources. Construction of the project began in the fall of 1975; as of February 1977, 60 private homes, 10 apartment units, an apricot orchard, greenbelt and bike paths have been constructed. The entire project, when completed in 1981, will be comprised of 196 homes, 72 apartment units, 12 acres of agricultural land, a playfield, mini-playgrounds and greenbelts and bike paths. A commercial center now being developed will include a co-op store, a small restaurant and an inn.

A number of space heating options are offered for residential units:

Solar tempered home

Double panel glass, southern exposure, use of high mass materials to absorb night-time breezes and keep houses cool during the day, 3½" of R-11 insulation in walls, 6" batts with 4" blown insulation in ceilings. Cost differential over standard construction: $1100 per 1500 sq. ft. home.

Solar Clerestory Home

As above, but with additional clerestory window
Cost differential over standard construction: $1600 per 1500 sq. ft. home

Solar Wall Home

Same as solar tempered but with water filled columns lining south facing glass wall
Cost differential over standard construction: $3000 per 1500 sq. ft. home

Solar Skylight

Same as solar wall home but with skylights
Cost differential over standard construction: $4100 per 1500 sq. ft. home

Active System

Same design as Solar Skylight but with active water and space heating solar system
Cost differential over standard construction: $7000 per 1500 sq. ft. home

The developers found that although cost of the solar devices are passed on to buyers, the project is still extremely marketable. The City of Davis is in the forefront of energy conservation and there are many citizens of Davis who are "environmental activists." So the Village project appeals to a well-defined market in Davis. The developers also note that sales have never been a problem in Davis subdivisions.

ENERGY CONSERVATION

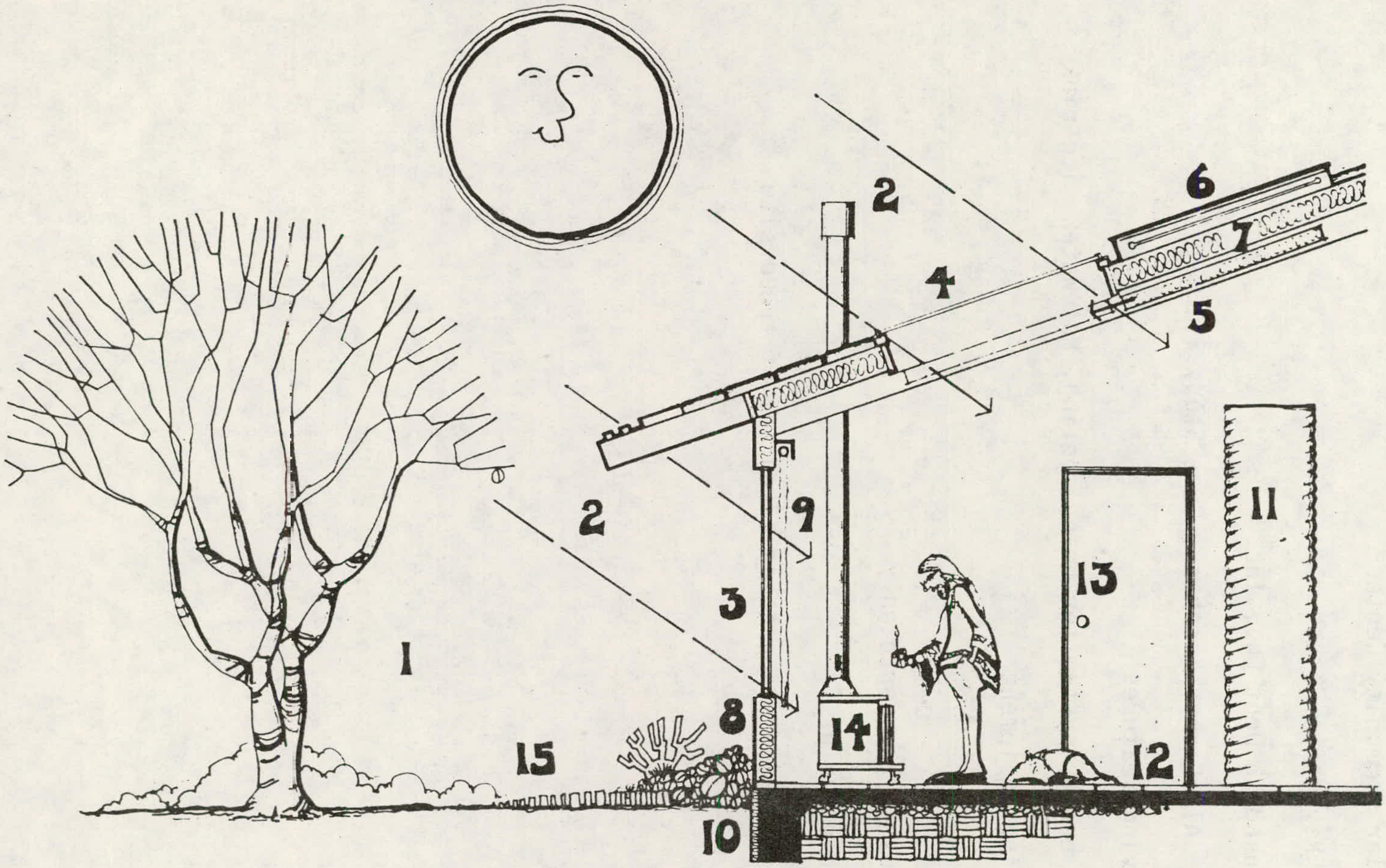
In addition to the solar home options described above, a number of energy-conserving features mark the overall planning of the project:

1. North-South orientation of all lots
2. Long, non-connecting cul-de-sacs. Less pavement conserves on building materials and leaves land available for other uses. Roadways account for 8% of the land acreage versus roughly 25% in standard subdivisions.
3. Bike paths lessen use of the automobile.

4. Natrual drainage system - all run-off water is reabsorbed into the ground through a natural drainage system. The creeks which are part of the drainage system also add visual appeal to the greenbelt area.
5. Narrow roads (20 - 25 feet versus a standard 44 ft. road width). Narrow roads minimize the amount of heat-absorbing asphalt. Houses are set back only 15 feet from the roadway.
6. Extensive use of greenbelts and common areas.
7. Incorporation of agricultural land and food-producing trees. An apricot orchard already exists and an almond orchard is being planted. Many more food producing plants are being planted in greenbelts and residents have plans for extensive vegetable gardens. Developers hope that 50% of the development will remain in food production.
8. Recycling systems. Compostables are picked up weekly from each home and are composted into fertilizer in giant bins.
9. Passive and active solar systems (see introductory section)
10. Indoor and outdoor clotheslines to replace dryers.
11. Tile roofs - chosen for high insulation value and durability.
12. Air conditioning needs almost eliminated. Minimal use of asphalt assures a cooler environment. Houses are well ventilated, light in color, windows are shaded, and high mass materials keep houses cool during the day.

COSTS

The developer states single family homes prices ranging between $33,000 and $100,000/unit. Additional costs for various solar options are listed in the introductory paragraphs describing those options.



1 [illegible]RTHERN [illegible]ENTATION 2 SOUTH SUN PASSIVE HEAT GAIN. 3 DOUBLE PANE (INSULATED) GLASS 4 SKYLIGHT 5 SHUTTER ([illegible]) 6 ACTIVE SOLAR HOT WATER HEATING 7 R-19 TO R-30 INSULATION 8 R-11 TO R-19 INSULATION 9 INSULATING CURTAINS 10 SLAB INSULATION 11 MASS THERMAL STORAGE (WATER) 12 THERMAL MASS CONCRETE OR TILE FLOORS 13 INTERLOCKING DOOR WEATHER STRIPPING 14 WOODBURNING RADIANT METAL FIREPLACE 15 SOLAR RIGHTS LOW VEGETATION AND DECIDUOUS TREES

Energy Conserving Design Elements

SUMMARY

Shenandoah Solar Community Center

Contact: Mr. Ray Moore

Shenandoah Dent Co., Inc.

More Details: AIA Energy Notebook, Case Study #18

Energy conserving features

- Solar energy system for heat, cooling, hot water, ice rink resurfacing equipment
- Earth berms
- Windows to the north only
- Roof U value of 1
- Building orientation takes advantage of treed site

PROJECT INFORMATION

Name: Shenandoah Solar Community Center
Shenandoah, Georgia (25 miles southwest of Atlanta)

Type: Community Facility

Developer: Shenandoah Development Company, Inc.
P.O. Box 1157
Shenandoah, Ga. 30265

Architect: Taylor & Collum, Architects
Atlanta, Ga.

Structural: Boston Cook, Inc.

Solar Design: Dr. J. Richard Williams
Georgia Institute of Technology

Completion Date: Opened May, 1977

INTRODUCTION

The entire new town of Shenandoah was planned with energy conservation in mond both because development began in 1973, the oil crisis year, and because Georgia itself has few energy resources. Shenandoah's developers have emphasized clustering of housing, food stores, industries, auto service centers in order to reduce the energy and natural resources consumed for pipes, pacing and other materials. The majority of housing in Shenandoah is attached; a solar subdivision possibly with a central solar system, is being developed; a knitwear factory is being built to use solar collectors for heating, cooling and hot water. This energy-conscious setting is certainly appropriate for the Shenandoah Community Center, an outstanding example of energy conservation in building design.

The 59,000 sq. ft. community center is located on a 9-acre site and includes an ice rink, auditorium/gymnasium, meeting and game rooms and offices. An ERDA grant provided funds for design of the solar and energy conservation features. The solar system provides space heating and cooling, hot water, heating for the outdoor pool and resurfacing requirements of the ice rink. The system is augmented by natural gas.

ENERGY CONSERVATION

In addition to the solar energy system mentioned above, other energy conservation features are:

- Building orientation: The north facade contains the only glass. Major building facades face north and south and woodland shelters provide protection from wind on the west and north.

- Building form: The square shape minimizes perimeter area and therefore reduces heat loss and gain.

- Building surface: Air conditioning is the significant heating and ventilation system determinant, because of the great amount of heat generated from lights, people, and equipment. By designing the building primarily "underground" (i.e., with 20 foot earth berms at the sides) with no additional insulation for the perimeter walls, the exterior temperature remains in the 55 - 60° range.

- Roof: The polished aluminum roof, with a U value of 1, is crucial to the energy systems: (1) it reflects additional insulation to the solar collectors for summer air conditioning needs and (2) the reflectors reduce energy demand for air conditioning by reducing solar heat gain through the roof.

- Lighting: Mercury vapor lights with dimmer controls minimize energy consumption.

COSTS

The estimated utility cost for the original building design was $118,000/year. The estimated utility costs for the solar design is $38,000/year reflecting a savings of $80,000 annually (based on 1977 fuel prices).

The total cost of the solar designed building is $726,000 - producing a payback period of 11 years (1977 fuel prices).

CONSTRUCTION

Basic Project	$1,269,431
Solar system	726,000
	$2,995,431

OPERATING

	$/Yr
Electricity	33,695
Natural gas (without solar)	10,160
Natural gas (with solar)	3,420

The above is based on a far more detailed review of the project in the AIA Energy Notebook, Case Study #18, available from the American Institute of Architects, 1735 New York Ave., N. W., Washington, D. C. 20006. In addition to the case studies, the notebook contains articles, an annotated bibliography and regular news items of professional opportunities for federal and related work in the energy and design field.

SUMMARY

Carnegie-Mellon University Science Hall Retrofit
Pittsburgh, PA

Contact: Mr. Warren L. Custer, President
H.F. Lenz Co.
Consulting Engineers
Lyter Drive
Johnstown, PA 15905
(814) 255-5821

Energy Conserving Features:

- Recovery of waste heat instituted
- Repiping and reuse of existing equipment, including conversion of an air conditioning machine into a heating machine
- Reduction of air leakage
- Cascade refrigeration-heating system using waste heat from Science Building to heat entire five building complex
- Cooling tower water use reduced
- Lower water temperature from 160^{o} - 200^{o} down to 100^{o}
- New controls installed

PROJECT INFORMATION

Name: Energy Audit & Retrofit of Carnegie-Mellon University's Science Hall
Pittsburgh, PA

Type: Retrofit of Campus Science Building

Engineers: H.F. Lenz Co.
Consulting Engineers
Lyter Drive
Johnstown, PA 15905
Mr. Warren L. Custer, President
(814) 255-5821

Completion Date: 1975-1976

INTRODUCTION

This project won a 1977 Owens-Corning Fiberglass Corporation Energy Conservation Award. It is an outstanding example of the dramatic savings possible through retrofitting existing energy-wasters.

The Science Hall is part of a five building complex on Carnegie-Mellon's Pittsburgh campus. It is eight stories high, contains 335,588 gross square feet, and is one of the largest computer facilities in the United States. The Lenz Company studied the functioning of the building, pinpointed the largest sources of waste, and suggested changes. The building, which contains 18% of the usable building area of the campus, consumed an excessive 33% of all the steam and 44% of the electricity on the campus.

ENERGY CONSERVATION

The major sources of energy waste were identified as:

-- Air systems operated completely on outside air, with no recovery of the enormous amount of heat generated by equipment, lighting, etc.

-- Air systems were grossly oversized for the actual use required.

-- Reheat systems in the building were extremely large users of energy.

-- Excessively large quantities of electricity were used to operate the cooling system year round.

The Lenz Co. proposed the following changes which the University carried out:

-- Air recovery was instituted, so that the building would no longer use 100% outside air for heating and cooling and would no longer require costly preheating of this air. The potential for warm air recovery was great, because the scientific equipment pumps and fans generated great amounts of heat in the interior portions of the building. This heat could be recycled to the perimeter. Recovery of air necessitated separating exhaust air from lab experiments from all other exhaust. Existing fume hoods were reconnected to do this job.

-- Air leakage was reduced. The simple job of sealing up outside air damper leakage saved 46,000 BTU's per net sq. ft. in winter, and 15,100 BTUs per net sq. ft. in summer. New, smaller, better fitting dampers were installed in the building.

-- A dramatic cascade refrigeration-heating system was instituted. The system involves using waste heat from the computer center and other rooms in the Science Building to heat not only the perimeter of the Science Building, but also the other four buildings in the complex.

-- Two air conditioners were repiped to operate in cascade fashion rather than in tandem, so they could meet load requirements - with less waste. They provide year-round heating and cooling with little or no assistance from the central campus plant.

-- One air conditioner was refitted with high pressure refrigerant to actually convert it to a heat machine. It can be converted to a cooling machine if needed.

-- Cooling tower water was repiped to be in use only when necessary, not full-time as before.

-- Water temperature re-heat was lowered from 160° - 200° F down to 100°.

-- New heating and ventilation controls were installed.

COSTS

Air System Retrofit	330,907
Retrofit of cooling system to serve five buildings	471,000
Conversion to Cascade	122,000
	$ 923,907

By contrast, individual plants for the four satellite buildings would have cost $660,250. The retrofit of the Science Building to serve all five buildings cost $471,000. This cost plus the $122,000 cost of the cascade system still leaves a $67,250 savings over individual plant construction.

Heating the whole complex uses 165,700 BTUs per net sq. ft. per year. This heat is now generated "free", except for the cost of the cascade system. When the plan is fully implemented, steam and electricity use will be lowered to 500,900 BTUs per sq. ft. per year, from 988,100 BTUs per sq. ft. for all five buildings.

Annual savings based on 1976 costs are $300,000 and the payback period is three years.

SUMMARY

Oakton Community College
Des Plaines, Illinois

Contact: Ms. Lois Kazakoff
Public Relations Coordinator
Perkins & Will
309 W. Jackson Boulevard
Chicago, Illinois 60606
(312) 427-9300

Energy Conserving Features

-- east-west orientation with minimum of windows north & south

-- thermally efficient building materials, low U factor for roof and walls

-- artificial lake for runoff water also cools the air in summer and warms it in winter

-- heat recovery HVAC system

-- buried heat storage tanks

-- operable windows

-- domestic hot water no hotter than 100° F

-- sheltered entrances with vestibules

-- low lighting levels

PROJECT INFORMATION

Name:	Oakton Community College Des Plaines, Illinois
Type:	Community College
Contact at the college:	Dr. Arthur Klein Director of Development Information Services Oakton Community College 7900 N. Nagel Road Morton Grove, IL 60053 (312) 967-5120
Developer:	Illinois Capital Development Board State of Illinois, State Office Building 401 S. Spring Street Springfield, Illinois 62706 (217) 782-2864
Architect:	Perkins & Will 309 W. Jackson Boulevard Chicago, Illinois 60606 (312) 427-9300
Contact:	Lois Kazakoff
Engineer:	Mechanical-Environmental Systems Design, Inc. 35 E. Wacker Drive Chicago, Illinois 60601 (312) 263-5759
Electrical & Structural Engineers:	Perkins & Will, Engineers, Inc. 309 W. Jackson Boulevard Chicago, Illinois 60606 (312) 427-9300
Completion Date:	June, 1979 Phase one ready for occupancy late 1978

INTRODUCTION

Oakton Community College is a two year vocational community college serving students from the north suburban area of the Chicago Metropolitan region. The college is a 214,413 gross s.f. single building facility on a 126 acre site along the Des Plaines River. It is designed for future expansion. The first phase of the college, now under construction, is for 1800 students (full time equivalent). The long, low building is oriented east-west and glass is limited on the north and south sides in order to permit the building to take advantage of natural heating and cooling.

The building is located on a 147 acre site, part of which is in the floodplain of the Des Plaines River. The building was therefore sited at the highest level of an open area, above the floodplain area. The open site made cutting trees almost unnecessary and helped maintain the beauty of the setting. An 8.5 acre retention pond, or artificial lake, balances the water displaced by the building, roads and parking lots.

ENERGY CONSERVATION

Energy conservation was a fundamental goal of the design. The building's shape, orientation and specially designed heat recovery HVAC system will allow for addition of solar panels in the future. Some of the building's main energy conservation features are:

- -- east-west orientation
- -- preservation of existing trees minimizes wind-chill effect
- -- minimum window area; all windows are double-glazed and most face east and west
- -- Red brick exterior and split face concrete block interior are thermally efficient building materials
- -- An artificial lake constructed for retention of runoff. Bodies of water store heat in winter and cool the air in summer
- -- heat by light: a heat recovery system uses heat from lights to load the pump which generates hot water for heating
- -- contains buried heat storage tanks
- -- roof U factors is .05, exceeding the ASHRAE 90 - 75 standard for thermal efficiency
- -- Masonry cavity walls have a U factor of .06, also exceeding the ASHRAE 90 - 75 standard. The heavy walls reduce the peak solar load
- -- operable windows for natural ventilation

-- fan rooms serve grouped spaces

-- sheltered entrances with vestibules to reduce heat loss

-- domestic hot water limited to 100^{o}F

-- relatively low lighting load

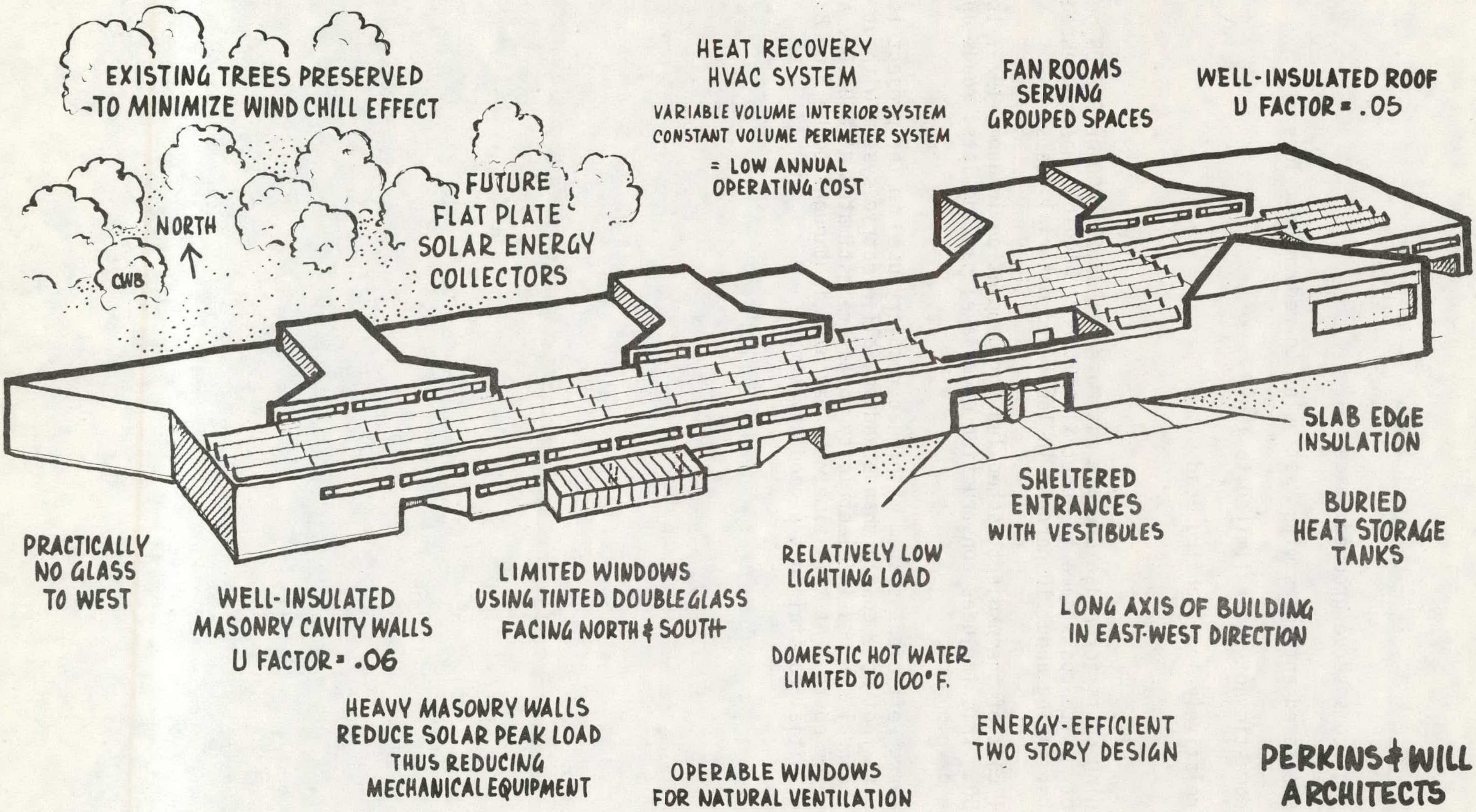
COSTS

Building costs for phase one are estimated at $9,237,000 or $43.08 per square foot. Site costs came to about $1,647,000. Bidding was sequenced over three years, saving about 10 percent in labor and material costs.

Total cost of the project, scheduled for completion in June, 1979, is $10,884,000. This includes construction of a lake, parking lots, roads and related site development.

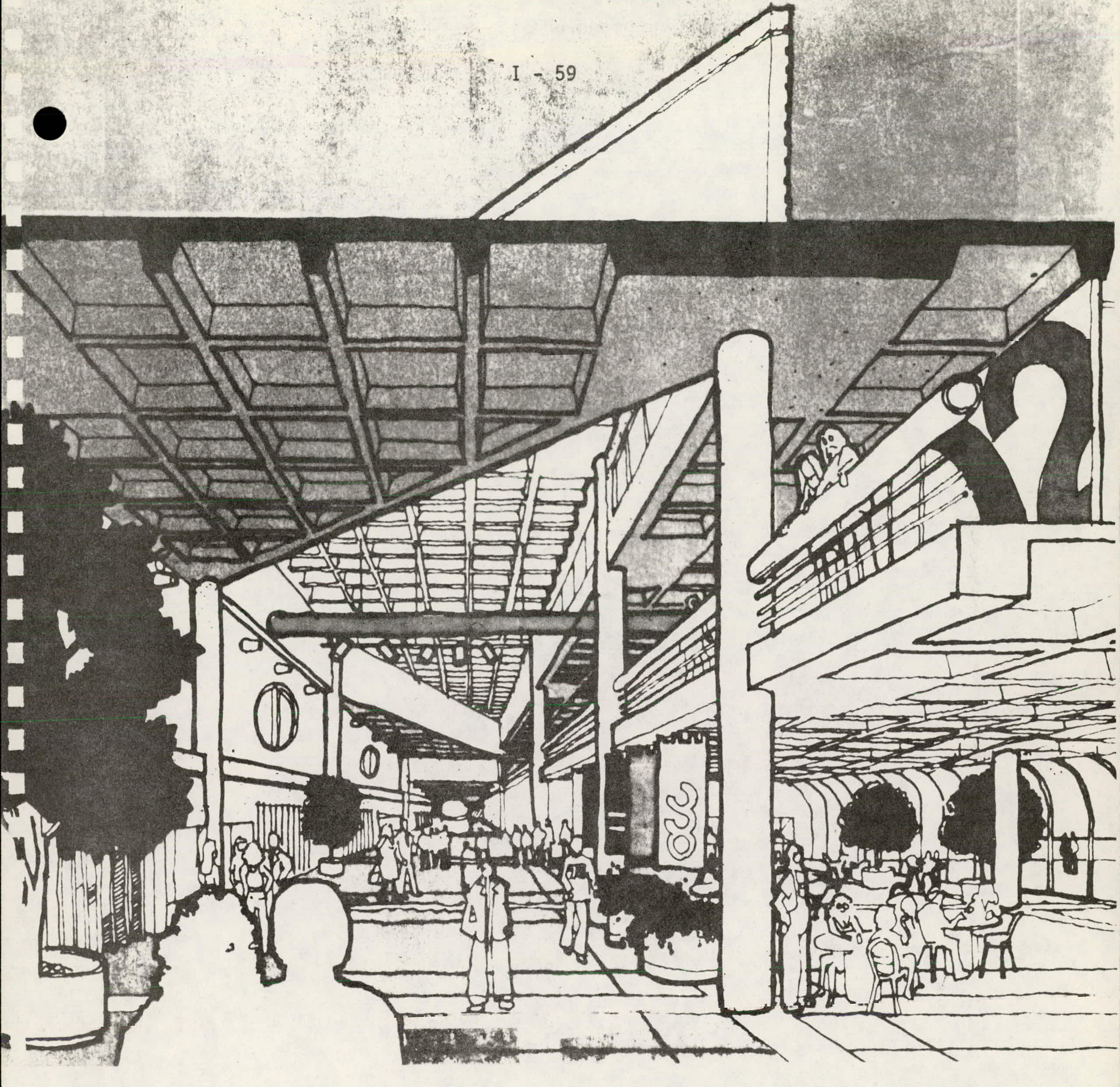
The energy-efficient system with heat recovery used in the project is about $2 per square foot more costly than standard, all electric system without heat recovery. Annual savings in electricity costs are estimated at $60,000, at present energy costs. At this time, the pay back is thought to be 7 or 8 years, making the initial capital cost a good investment.

DESIGN FOR ENERGY CONSERVATION



PERKINS & WILL
ARCHITECTS

OAKTON COMMUNITY COLLEGE – ILLINOIS CAPITAL DEVELOPMENT BOARD



Oakton Community College

New Campus
Des Plaines, Illinois

Perkins & Will

II. ENERGY CONSERVATION IN INDIVIDUAL BUILDINGS

Buildings included in this section demonstrate some of the major techniques for energy conservation in building design and construction. The focus is on new construction materials, innovations in heating and ventilation systems, and energy budgeting concepts used in individual buildings. The examples included here serve to acquaint the reader with the major technical developments in energy saving equipment and materials and also with some of the "classic" examples of energy conscious design such as the Norris Cotton Office Building and the David Wright House.

SUMMARY

Atlanta Office Building

Contact: Mr. Roger Alford, Jr., P.E.
Associate Vice President
Heery & Heery
880 West Peachtree St., N.W.
Atlanta, Georgia 30309
(404) 881-9880

Energy Conserving Features:

- -- energy budget prepared at pre-design phase
- -- close teamwork of architects and engineers throughout
- -- computer simulations of energy consequences of alternative building designs; simulations are repeated through the design process
- -- lighting, equipment and other energy demands established area by area in the building
- -- different treatment of east, west, north and south facades
- -- rectangular building sited on an east-west axis
- -- reflective spandrel glass
- -- window area is only 20% of surface
- -- solar collectors
- -- heat recovery system
- -- hot and cold water storage tanks
- -- functions demanding long hours of operation are grouped.

PROJECT INFORMATION

Name: Atlanta Office Building
(name and address confidential per wishes of corporate client)

Type: Corporate office building and commercial

Architect & Engineer: Heery & Heery
800 West Peachtree St., N. W.
Atlanta, Ga. 30309
(404) 881-9880
Mr. Roger Alford, Jr., P.E., Associate Vice President

Completion Date: late 1979 (project goes to bid in mid-1978)

INTRODUCTION

The Atlanta Office Building is a corporate headquarters high-rise office building. The building contains 12,000 sq. ft. of retail space, 42,000 sq. ft. of parking garage, and 702,000 sq. ft. of office and related space. It occupies approximately 10 acres in a redevelopment area on the northeastern edge of Atlanta's central business district. The building design exemplifies Heery & Heery's unique system of energy budgeting. It also demonstrates the advantages of a close partnership between architects and engineers from the pre-design through the final design phases -- a partnership that will be fundamental as energy-conscious design moves to the fore.

The estimated performance of the Atlanta Office Building is estimated at 39,800 BTU per sq. ft. per year with the solar system. Even without the solar system,energy-conscious design accounts for a 49,100 BTU/sq. ft./yr performance. Average consumption of Atlanta Office buildings is 94,350 BTU/sq. ft./yr. This performance has been estimated by hand calculators and by repeated computer simulations with various programs, TRACE, E-CUBE, AXCESS, and SS.

ENERGY CONSERVATION

The energy budgeting system is the key to the energy performance of the building. The Heery & Heery energy budget is a three-number objective specifically set for each project. It consists of:

1. BTUs/sq.ft. Total Annual Consumption
2. BTUs/sq.ft/ Hr. Peak Demand (Heating Cycle)
3. BTUs/sq. ft/ Hr. Peak Demand (Cooling Cycle)

These figures are set as maximums for the combination of all fuels and all uses of energy in the building, not just heating, air conditioning and lighting. The energy budgeting methodology and its results for the Atlanta Office building are summarized below:

- Energy data on 60 other Atlanta high and medium use buildings was obtained. Energy consumption of those buildings was compared with other buildings around the country. These comparisons helped set the goal for this building.

- An energy-conscious design idea checklist was prepared to aid the design team.

- Computer analyses compared various building components and their impact on energy demand. For example, 30 possible building shapes and sizes were tested. A rectangle, with an extended east-west axis, was selected as best meeting energy and programmatic criteria.

- Each functional area was analyzed for its lighting, machinery, and comfort requirements.

- Each wall was analyzed and treated differently. East and west walls are insulated against heat loss by placement of storage rooms, elevator shafts and fire stairs as buffers against those walls. The north wall has unshaded glass, but the south wall incorporates horizontal sun screens to protect against summer sun. Glass on the south wall is recessed for additional shading.

- Building skin options were evaluated. Reflective spandrel glass with insulation (U=.05), along with glazed reflective window glass on only 20% of the building were chosen. They proved to be energy-conserving in their production (unlike concrete block or polished aluminum, for example); they require low maintenance and they reflect the sun's rays.

- High traffic areas such as the entrances and cafeteria are grouped on one level to save on elevator energy.

- Functions with extended hours of use are grouped so that these areas can be lit and heated without operating the whole building.

- Solar collectors and an absorption chiller reduce outside energy purchases. 67,000 sq. ft. of roof will be devoted to solar collectors, reducing energy purchased by 10 - 25%.

- The building includes a 1500 gallon domestic water heater with solar heat exchange and an absorption chiller which uses solar heat for cooling the building.

- A conventional heating system is not needed, but a stand-by electric system is included.

- Hot and cold water storage tanks store energy on off-peak energy.

- Variable air volume system is used.

- Lighting is appropriate to each function. In addition, a new high pressure sodium light source is being designed to reduce the lighting load to 1 watt/sq. ft., the lowest of any of the office buildings reviewed for this project list.

COSTS

The basic energy design was accomplished at no additional cost since it was incorporated from the start as a goal of the project. Cost of the project was estimated at $39/sq. ft., excluding special equipment and the solar system. Inclusion of the solar system added $1,050,000 to the project cost.

SUMMARY

Deer Creek Lodge
Deer Creek State Park
Pickaway County and Fayette County, Ohio

Contact: Mr. Thomas W. Wilsley, AIA
PDT & Co. Architects
7434 Montgomery Rd.
Cincinnati, Ohio 45236
(513) 891-4605

Energy Conserving features:

- Walls and roof with R value of 19
- Bronze insulating glass for windows and skylights
- Load limiting equipment
- Heat pumps and heat recovery system
- Solar heating for domestic hot water, swimming pool and some space heating

PROJECT INFORMATION

Name:	Deer Creek Lodge Deer Creek State Park Pickaway County and Fayette County, Ohio
Type:	Lodge with sleeping rooms, restaurant, meeting rooms, etc.
Developer:	State of Ohio Department of Natural Resources Fountain Square Columbus, Ohio 43224 (614) 466-4633
Architect:	PDT & Co. Architects 7434 Montgomery Road Cincinnati, Ohio 45236 (513) 891-4605
Engineer:	Thomas W. Tilsley, AIA 24 North Jefferson Dayton, Ohio 45402 (513) 224-0861
Completion date:	June 1980

INTRODUCTION

The project consists of a one-story Lodge building with a basement, balcony, and two, two-story sleeping unit wings, containing 110 rooms. The Lodge building has meeting facilities to accommodate 400 - 500 people and dining facilities for 270.

The Lodge building also includes a Gift Shop, Game Room, indoor pool, housekeeping facilities and several lounges. The overall project also includes 25 cabins and site work (roads, parking lots, boat docks, new water storage tank, sewage lift station, etc.)

The Lodge building has approximately 93,050 sq. ft., with wings of sleeping rooms adding an additional 58,676 sq. ft., for a total of 151,726 sq. ft. The project is built within a State Park; however, the construction area around the Lodge and unit building (which includes parking areas) is approximately 21 acres.

ENERGY CONSERVATION

Energy conserving features consist of the following:

- Walls and roof were insulated for a minimum R value of 19.
- Exterior glazing (including skylights) is bronze insulating glass.
- Load limiting equipment is used with the kitchen equipment and boiler. At peak load times, certain machinery is shut down for short periods.
- Heat pumps (see section on Definition of Terms Used in Project Descriptions) and heat recovery are used in the heating system. Heat recovery is done through use of a heat wheel. Heat wheels are strategically placed to intercept exhaust hot air flows; they transfer the waste heat from the exhaust to air intake streams.
- A solar heating system provides heat for domestic hot water, the indoor swimming pool, and some of the compressor water for the heat pumps which supply building heat.
- Sliding glass doors are electrically controlled so that when the doors are opened, the heat pump is stopped.

COSTS

Total building costs are estimated at $11.5 million. Costs attributed to the solar system are approximately $400,000. Additional basement area to accommodate the storage tanks cost roughly $40,000. To achieve R-19 value for exterior walls and roof there is an additional 75¢/sq. ft. of wall area and 50¢/sq. ft. of roof area over normal construction costs.

SUMMARY

American Center
American Motors Corporate Headquarters
Southfield, Michigan

Contact: Mr. William Allen
Cushman and Wakefield, Inc.
27777 Franklin Rd.
Southfield, Michigan
(313) 965-1890

Energy conserving features

- square plan
- double thickness, chrome reflective glass
- opaque mirror glass backed with R-4 insulation
- two-pipe fan-coil HVAC system
- heat recovery system
- computerized control of HVAC and lighting

PROJECT INFORMATION

Name:	American Center American Motors Corporation Headquarters Southfield, Michigan
Type:	Office Building and Contiguous Shopping Mall
Developer & Project Mgr.	Cushman and Wakefield, Inc. 27777 Franklin Rd. Southfield, Michigan (313) 965-1890 Mr. William Allen, Project Consultant
Architect:	Smith, Hinchman & Grylls Associates, Inc. Detroit, Michigan William Jarratt, Project Architect
HVAC Engineer	Environmental Systems Design, Inc.
Completion Date:	1975

INTRODUCTION

AMC wanted an all glass, impressive building befitting the corporate headquarters of a major automobile manufacturer; however, they were aware that heat gain and loss is a major problem in structures of this type. Architects and engineers handled the problem in two ways: they developed a window system which keeps heat loss to a minimum and they used a HVAC system which recovers heat from the building's core areas.

American Center is a 440,000 sq. ft., 25 story office tower, set on a 33-acre site. An additional 70,000 sq. ft. is contained in a two-story shopping mall contiguous with the tower. The top floors of the building are occupied by AMC while the lower 15 floors are rented.

The entire exterior of the building is chrome reflective glass. Even structural elements are sheathed in glass. The choice of a glass exterior made energy conservation critical in the building design.

ENERGY CONSERVATION

Building Surface

A square floor plan was chosen to minimize heat gain and loss. The exterior of the building includes two types of glass:

- Floor to ceiling windows are made up of two ¼-inch thick layers separated by ½-inch of air space. One surface is coated and acts as a one-way mirror to reflect 80% of the direct solar heat load, reducing heat gain by one-fifth. Windows are fixed glass.

- Double glass covering the beams is an opaque mirror backed by compressed mineral fiber insulation (R-4).

HVAC System

Interior and perimeter zones of the single duct system are treated separately. Interior areas require cooling even in winter, so air delivered there is a constant 55° F year round. Perimeter spaces are conditioned mainly by a two-pipe fan-coil system.

Heat Recovery

A fan-coil system is ideal because it makes direct use of the hot water generated by heat recovery machines.

Three centrifugal chillers in the basement can provide hot and cold water simultaneously. In the winter they operate as heat pumps, recovering heat from interior spaces and transferring it to perimeter fan-coil units. Recovered heat is enough to heat the building when it is occupied and equipment is working. Two electric boilers supply auxiliary heat at night and during harsh weather.

Computerized HVAC Management

A $350,000 computer system controls HVAC and lightening systems. It adjusts flourescent lighting when daylight is sufficient, it turns off two tubes of every four tube fluorescent fixture after closing hours. It "follows" the cleaning crew shutting off lights behind them. The system is a Johnson JC-80 computer system.

COSTS

Unavailable

Note: A detailed description of this project appears in a case study (advertisement) prepared by the Edison Electric Institute Conservation and Energy Management Division, 90 Park Avenue, New York, N. Y. 10016. The ad appears in the AIA Journal, 12/77, pp. 87-90.

PROJECT INFORMATION

Name:	Harris Corporation Corporate Headquarters Melbourne, Florida
Type:	Office building
Architect:	Joseph Amisano 741 Piedmont Ave., N. E. Atlanta, Ga. 30308 (404) 873-5882
Engineer:	Rosser, White, Hobbs, Davidson, McClellan, Kelly, Inc. 348 Peachtree St., N. W. Atlanta, Ga. 30308 (404) 688-5200
Project Mgr. Responsible for Energy Budgeting & Monitoring for Compliance:	Heery Associates, Inc. 880 W. Peachtree St., N. W. Atlanta, Ga. 30308 (404) 688-5200
Contact:	Mr. Roger Alford, Jr., P.E., Associate, Vice President
Completion date:	January 1, 1979

The project is a commercial Corporate Headquarters office building sited on 30 acres, of which approximately 15 acres are to be developed. The office building is a two-story structure, encompassing 75,470 gross sq. ft. An unusual feature of the project is a central utility building being constructed to service this building, with capacity to serve future buildings planned for the 30 acre site.

The cost is budgeted at $48 per sq. ft. Architects state that a 20 - 50% reduction in the amount of BTU/sq. ft. can be achieved over normal construction without any increase in first cost. This is achieved through use of Heery Associates energy budgeting system. (For details on the system, see write-up of the Atlanta Office Building, designed by Heery & Heery).

Energy budget criteria for the building are set at:

45,000 BTU/sq. ft. annual energy consumption
18 BTU/sq. ft/hr cooling season demand
16 BTU/sq. ft/hr heating season demand

SUMMARY

Government of Canada Building (North York)
4900 Yonge Street
Willowdale, Ontario M2N 6A6

Contact: Mr. Les Mondich
Public Relations & Information Services
Public Works, Canada
Sir Charles Tupper Building
Confederation Heights
Ottawa, Ontario K1A 0M2

More Details:

Extensive documentation of energy and dollar savings in the North York building is provided in an information packet on the building available from Public Works, Canada.

Energy-conserving features:

- lighting reduced to half that in typical building
- shutting down perimeter air supply at unoccupied periods
- variable air volume system for fans
- reduced ventilation
- thermal energy storage in 4 water tanks reduces need for heating by natural gas; it also provides a great saving in chiller and transformer capacity.
- reduced glass area
- blank panels to reduce heat gain on walls exposed to greatest amount of sunshine.
- space-saving HVAC system allows 91% rental factor
- two fan rooms on each floor rather than a central operation save on ducts and reduce complicated maintenance problems.

PROJECT INFORMATION

Name:	Government of Canada Building (North York) 4900 Yonge Street Willowdale, Ontario M2N 6A6
Type:	Government Office Building
Project Manager:	Public Works of Canada Ontario Region
Contact:	Mr. Les Mondich Public Relations & Information Services Public Works, Canada Sir Charles Tupper Building Confederation Heights Ottawa, Ontario, K1A 0M2 Canada
Architects:	Dubois & Associates Shore, Tilbe, Henschel, Irwin (associated architects and planners)
Mechanical Consultants:	Engineering Interface, Ltd.
Electrical Consultants:	The ECE Group (J. Chisvin & Associates, Ltd.
Completion Date:	1977

INTRODUCTION

In 1973, the Canadian Government produced "An Energy Policy for Canada", which placed strong emphasis on energy conservation. The government wished to set an example of energy conservation in its own buildings, and the North York building stands out as an example of innovation in energy conservation. At a cost of $33 per square foot, this building offers a strikingly pleasant working environment even when compared to far costlier buildings. The zig-zag facade offers more exterior wall than a square building, providing views for office workers; three atriums offer additional views. The design team focused on both energy conservation and safety, and the government claims that as a result the building is one of the safest high rise office buildings with one of the highest energy conserving capabilities in North America.

The building is 13 stories high, with two underground parking levels. Total area is 825,000 square feet, with an average of 53,500 square feet per floor, exclusive of space occupied by heating and elevator equipment.

ENERGY CONSERVATION

The North York building's energy budget is 19½ KW hours/square foot/year (66,6000 BTU/square foot/year), which is less than half the average of other Toronto office buildings with standard designs.

The building is described in detail in an information packet available from the Canadian Department of Public Works. The packet includes articles on the North York building in reference to 1) the initial costs of energy conserving devices (allaying fears that low energy consumption means high hardware costs); 2) figures on cash saved through energy conservation; 3) provision of more usable space in the building; 4) data control center; and 5) a life cycle cost summary. The following list therefore serves only to highlight the main energy-saving factors in the building. The first two items, the ceiling lighting and the use of thermal storage, are the most dramatically innovative. But the entire building is a showpiece of energy savings.

1. Lighting: Only half the usual number of ceiling fixtures are used. Installed energy is 2½ watts/square foot, compared with the ususal 4. Only the actual task work areas are lit to 75 foot candles. Task lighting has been incorporated into many buildings, but here it is done through an usual design innovation. Fixtures are designed so they can be plugged in at any location on the ceiling; lamps fit into 5' by 5' grid. In this way, rigidly installed fixutres do not prevent rearrangement of work areas.

   Estimated savings are attributed to less electricity used by the lighting itself and less pressure on HVAC system due to the heat generated by lights.

2. Thermal Storage: Surplus heat generated by lights, machines, and people is recovered and stored in four 75,000 gallon tanks in the basement. An ingenious movable plastic baffle in each tank separates supply and return water.

3. Glass is 29% of the wall area, compared to the usual 35%.

4. Blank panels are used on heavy solar exposures to reduce heat gain in summer.

5. Southeast and Southwest windows have more shading.

6. The HVAC system takes up a minimum amount of space, providing for an unusually high 91% occupancy rate. Minimizing HVAC area saved 57,000 square feet of rentable space.

7. Most offices are occupied only 2,000 hours per year, but many are heated and cooled for the full 8,760 hours/year. The North York building reduces this to 2,500 hours per year.

8. Two fan rooms on each floor rather than a central operation allow for segmental operation of the building. They also require less heavy piping and ducts over long distances. Maintenance costs for all 26 air handling stations are estimated to be less than for one central station. There are fewer, simpler controls at each station.

9. Variable air volume system saves 2 KW hours/sq. ft./year over constant air volume systems.

10. The amount of ventilation is reduced without reducing comfort.

11. An automatic control increases ventilation to the ground floor to balance air pressure on that floor with the outside and thus reduce winter cold air infiltration.

12. Most of the heating requirement is met through stored heat, with gas heating available as a back-up.

<u>COSTS</u>

-- Lighting: Savings of 1,000 KW for 670,000 square feet of office space have the added advantage of reducing the chiller requirement by 250 tons. Resultant savings are roughly $300,000 per year.

-- Thermal storage: Because of the storage system natural gas backup heat can be reduced. An estimated $8,650/year is saved in electric demand costs and $16,000/year is saved in heating costs.

-- Use of blank solar panels in areas of heavy sunshine is estimated to reduce the cost of air supply systems by $120,000.

-- Minimizing HVAC area saved 57,000 square feet of rentable space -- a dollar saving of $5,700,000 based on the present value of future rent assessed at $100/square foot.

-- Turning back fans (used to combat heat from lights) to 2500 hours/year saves 3 KW hours/square foot/year.

-- Reducing cleaners' lights to a far lower level than the lighting used by office workers saves 5 KW hours/square foot/year.

-- Shutting down air supply at the perimeter during unoccupied periods saves 3 KW hours/square foot/year.

-- Variable air flow volume reduces average air flow to two-thirds of that for constant flow, saving about 2 KW hours/square foot/year.

To give a rough idea of the significance of these individual savings of KW hours, the government of Canada estimates total energy savings of $19,000,000 over a 30 year life cycle based on present cost of 3 cents per KW hours (assuming energy escalates at the value of money).

SUMMARY

Union Savings Branch Offices
Mentor and Lorain, Ohio

Contact: Mr. Mike Busta
President
Union Savings
Cleveland, Ohio

More Details: See Buildings magazine, Nov. '77, p. 110

Energy Conserving Features

-- Rethinking a standardized building plan from the point of view energy conservation

-- Reduced window area

-- Thermal resistance factors of 12 for wall and roof

-- Night temperature setback

-- Entry vestibule with air lock

-- Low wattage, task oriented lighting

-- Low wattage lighting instead of spotlights for exterior buildings

PROJECT INFORMATION

Name:	Union Savings branch offices Mentor and Lorain, Ohio
Type:	Commercial
Owner & Developer:	Union Savings (Affiliate of Transohio Financial Corporation) Cleveland, Ohio Mr. Mike Busta, President
Completion Date:	1976

INTRODUCTION

The twin offices were designed to conserve energy and reduce utility costs and maintenance. They are 10% smaller and have 20% fewer windows than previous branch offices.

An isolated decision to build a smaller building would not be of major import. What is significant in this case is that a company which uses a standard design in a number of branch office buildings reviewed that standard design principally from the point of view of saving energy. Rethinking a standard design which may be repeated many times can result in substantial total savings in utility costs.

Construction costs were reduced by 20% over previous buildings, because of reduced size, increased amount of brick rather than windows, smaller heating and cooling plants. Money saved was put into improved insulation.

ENERGY CONSERVATION

A reduction in window area, mentioned above, reduces heat gain and loss, and permits use of a smaller heating and cooling plant. Other energy conserving factors are the following:

-- Two inch sized fiberglass is sandwiched into the brick and block exterior walls.

-- Two inch fiberglass under the floor at the building perimeter

-- Roof deck of urethane and tectum

-- Wall and roof thermal resistance (R) factors are at least 12

-- At night, temperature is set back

-- Entry vestibule has an airlock to reduce air infiltration by half. (In a building with high traffic, infiltration generally consumes 35% of heat energy).

-- Task-oriented lighting (lighting placed over work areas only)

-- Low wattage, high intensity lighting fixtures increase efficiency 100%

-- Exterior lighting is done by a few strategically located low-wattage fixtures, rather than by a flood light.

COSTS

Owners estimate first costs and operating costs are 30% less for these two buildings than for previous buildings. The installation of the night temperature setback system is expected to pay for itself in a year to a year and a half. The buildings are expected to save $2000 per year each on fuel costs.

SUMMARY

Air Terminal for Gainesville
Municipal Airport
Gainesville, Florida

Contact: Mr. Stephen Cadwallader
Cadwallader & Associates, Inc.
Consulting Engineers
3456 Southwest 42nd Ave.
Gainesville, Fla. 32608
(904) 376-0520

Energy-conserving features:

- Solar collectors to furnish 50% of heating, cooling, and hot water requirements
- Solar equipment functioning is prominently displayed
- Absorption air conditioning system
- Chilled water and hot water storage tanks
- Smaller air handling equipment required

PROJECT INFORMATION

Name:	Air Terminal for Gainesville Municipal Airport Gainesville, Florida
Type:	Air Terminal
Owner:	City of Gainesville P.O. Box 490 Gainesville, Fla. 32602 (904) 377-1717
Architect:	Moore, May & Harrington, Architects, Inc. 606 N.E. First Street Gainesville, Fla. 32601 (904) 372-0425
Engineer:	Cadwallader & Associates, Inc. Consulting Engineers 3456 S.W. 42nd Ave. Gainesville, Fla. 32608 (904) 376-0520 Mr. Stephen Cadwallader
Completion date:	May 20, 1978

INTRODUCTION

The Air Terminal Building is now under construction, incorporating public waiting areas, holding rooms, restaurants, baggage claim areas, and offices. Enclosed area totals 54,000 sq. ft. Approximately 29,000 sq. ft. will be air conditioned with the remaining areas to be ventilated and heated.

Great care has been taken in selection of materials and equipment to provide optimum control in energy expenditure. Requirements set forth in ASHRAE 90-75 are met. Concrete slab, masonry walls have a V value of .10. The bottom core roof panels have a V value of .07.

Solar collectors are not only an integral part of the mechanical system, but are also a focal point in the design. The south facade has a continuous band of collectors to display prominently the energy system used. A glass wall encloses the mechanical equipment room which is prominently located between the two entrances. The solar equipment and its operation is thus continuously displayed to passers by.

* See Chapter on Definition of Terms

ENERGY CONSERVATION

Conventional air conditioning systems use a compressor which runs on electricity. In this project the compressor is eliminated and the system is operated by heat, rather than electricity. The system is called an absorption air conditioner. The source of heat for the absorption air conditioner is the solar system; 180^o - 190^o water is generated in the roof collectors to run the absorption air conditioner.

Excess chilled water produced by the absorption air conditioner is stored in an insulated chilled water tank. Excess hot water generated by the solar system is stored in an insulated hot water tank. The storage system comes into play when the sun does not provide sufficient hot water to operate the mechanical systems dependent on it.

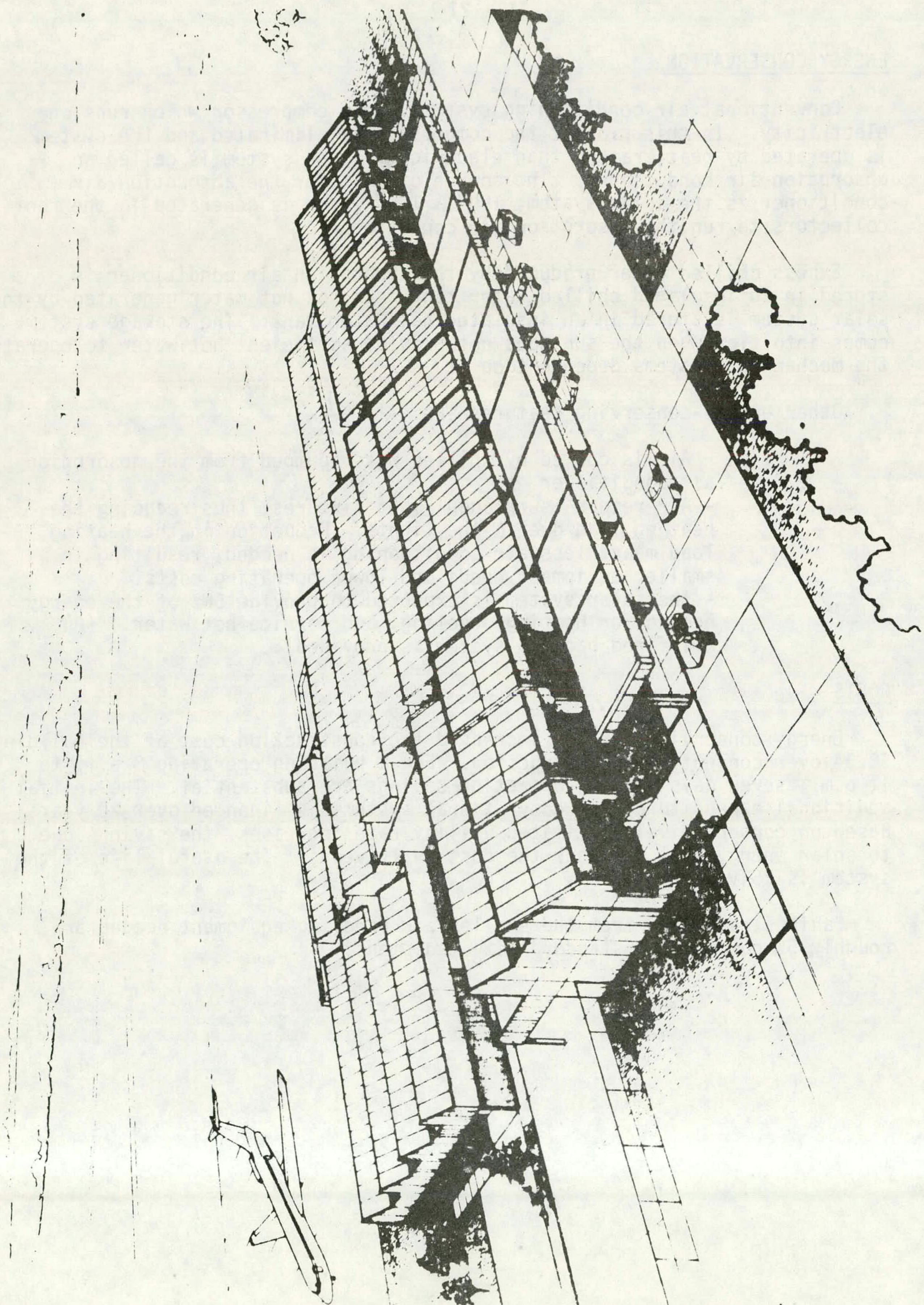
Other energy-conserving features are:

- Air is cooled by chilled water pumped from the absorption air conditioner
- Air return is through light fixtures, thus reducing the heating load due to the lights. Reduction in the heating load means less air conditioning is needed, resulting in smaller equipment needs and lower operating costs.
- The solar system is expected to provide 50% of the energy needed for heating, cooling, and service hot water. (An oil-fired back-up system is provided).

COSTS

Energy conserving devices increased the construction cost of the building $8.34 over conventional construction. For a building operating 8 a.m. to 11 p.m., seven days a week, operating savings are substantial. The initial additional expenditure over conventional systems is financed over 20 years. Based on conservatively estimated utility rate increases, the savings due to solar energy will pay back the cost in 15 years. The useful life of the system is 25 years.

Savings resulting from the smaller air handling equipment needed are roughly 5% compared to standard size equipment.



PROJECT DESCRIPTION

Name: Soil & Crop Sciences & Entomology Center
Texas A & M University
College Station, Texas 77843
(713) 845-6245

Type: University Facility

Architect: Omniplan Architects
1700 Republic National Bank Tower
Dallas, Texas 75201
(214) 742-1292

Completion Date: December, 1977

INTRODUCTION

This building is the first constructed at Texas A & M's new agriculture campus. Energy responsibility was one of the goals set at the start of the design process, and officials estimate a 45% reduction in operating energy used by this building in comparison with similar facilities built recently by the University. The 167,000 square foot building contains 85% Research & Teaching Laboratories, 10% Administration space, and 5% Classrooms. The building is constructed in two parts, connected by an enclosed arcade. The two portions of the building are of differing lengths and heights.

ENERGY CONSERVATION

Energy-conserving features are integral to the building's design:

- The two parts of the building shade each other from the sun
- Sun-control fins between the windows and spandrels above them shade the windows from summer sun
- Windows open to provide for natural ventilation
- The exterior surface of the building, which is most susceptible to heat gain and loss, is reduced by enclosing the space between the two parts of the building.
- The air conditioning system uses a maximum of outside air
- Roofs and walls are well-insulated
- Outside glass is insulated, and the arcade roof is made of reflective glass
- Natural light is available to most spaces

-- Lights next to windows can be switched on and off separately

-- A vent system relieves heat accumulation at the top of the arcade

COSTS

The construction costs were $51.26 per square foot. Energy conserving features did not add to costs.

SUMMARY

Norris Cotton Office Building
Manchester, N.H.

Contact: U.S. General Services Administration
Public Building Service
Office of Construction Management
Environment and Energy Branch
18th & F Streets, N.W.
Washington, D.C. 20405

Energy-conserving features:

-- landmark example which resulted in setting energy requirement of 55,000 BTU per square foot per year for U.S. General Services Administration

-- cubical shape

-- no windows on north facade

-- windows are 12% of east, west and south facades

-- well-insulated roof and walls

-- insulation on exterior of walls

-- solar collector system on roof

-- waste heat recovery

-- variety of mechanical systems tested

-- lower lighting levels

PROJECT DESCRIPTION

Name:	Norris Cotton Office Building Manchester, N.H.
Developer:	U. S. General Services Administration 18th & F Streets, N.W. Washington, D.C. 20405
Architect:	Nicholas Isaak & Andrew Isaak
Consulting Engineers & Energy Experts:	Dubin-Mindell-Bloome
Energy Performance Analysis:	National Bureau of Standards
Completion Date:	1976

INTRODUCTION

The Norris Cotton Office Building is a well-known example of energy conserving design; it has served in fact as a laboratory for innovative techinques and has influenced many designers since its completion. The building has been instrumental in familiarizing architects and engineers with the concept of BTU's/square foot as a measure of energy efficiency in buildings. Studies for the Manchester building helped GSA come up with the standard of 55,000 BTUs per square ft. per year which it now requires in all its buildings. The Manchester building itself does not meet this standard, however. Note in the write-ups of the Ontario Hydro building and the Government of Canada building in North York that the Canadian government also measures energy efficiency in its buildings. Canadian measurements are stated in killowat hours per square foot per year.

The Norris Cotton building is unusual in that each floor tests a different energy conservation concept, so the building is less efficient than it would be if one approach had been followed.

GSA is planning 27 energy-conserving buildings to be constructed in various parts of the country. Buildings will contain many of the features of the Norris Cotton building and will also use National Bureau of Standards analyses of the building's performance to improve upon many of those features. Examples of the buildings to be constructed are four planned for the Washington, D.C. area: two educational facilities for the Washington Technical Institute, the Lister Hill National Center for Biomedical Communications, and a student union building for Howard University.

The Norris Cotton building is cubical, minimizing surface areas, which are the greatest source of heat loss and gain. Window areas are smaller than standard and are located closer to the ceiling to let in as much natural light as possible.

ENERGY CONSERVATION

Much has been written on the Norris Cotton Office Building. The energy-conserving features listed below are summarized from information received from GSA and from detailed articles in the Washington Star (article by Howard Dutkin, April 23, 1977 p. E1) and in the AIA Journal (article by Marguerite Villecco, 12/77 p. 32).

-- No windows on the north wall

-- Windows are only 12% of the surface area of the south, west and east walls and are recessed to protect them from sun and wind

-- Each facade is treated separately - individually designed to meet sun and wind requirements

-- Roof and wall U values are .06; double glazed windows with shades have a U value of .55

-- Walls are insulated on the outside, thus allowing the walls to absorb interior heat and re-radiate that heat back into the interior

-- The solar roof system collector provides 20%-30% of the water heating, space heating and cooling loads on one floor

-- The building has two mechanical systems with variations on each floor (see AIA journal article cited above for a detailed description)

-- Waste heat from generators and other equipment is used to help heat the building at night and early morning and to supply domestic hot water

-- Since many office buildings consume half their energy with lighting systems, lighting levels were lowered significantly here. Offices use 2 watts per square foot, toilet and storage areas 1 watt, and parking .5 watts. Each floor has a different combination of lighting fixtures. The most popular lighting system involves a coffered ceiling with one cool white flourescent tube for each 5 foot office bay.

The building is experimental in the extreme and there are employee complaints. Walking from one floor to another can be jarring because of the different lighting systems; people find themselves a bit too cold in winter and too warm in summer; they complain of a "windowless" environment. These factors are not intrinsic to energy-conscious design and can be corrected in other buildings now that the state of the art has advanced greatly.

COSTS

Total construction cost was $9.32 million, including the solar collectors and their monitoring devices which cost $431,760.

SUMMARY

IBM Office Building
17600 Nine Mile Rd.
Southfield, Michigan

CONTACT: Mr. Charles Fleckenstein AIA
Gunnar Birkerts & Associates, Architects
292 Harmon St.
Birmingham, Michigan 48009
(313) 644-0604

More details: "By Reflected Light," Progressive Architecture, Sept., 1975

Energy conserving features

- Energy budget in BTU's/sq. ft./year established at preliminary design phase
- Exterior walls of metal panels
- Change in wall color from north and east facades to south and west facades
- Slanted double insulated windows
- Interior and exterior light reflectors on windows

PROJECT INFORMATION

Name:	IBM Office Building 17600 Nine Mile Rd. Southfield, Michigan 48075
Type:	Office Building
Architect:	Gunnar Birkerts & Associates 292 Harmon St. Birmingham, Michigan 48009 (313) 644-0604
Engineers	
Mechanical:	Joseph R. Loring & Assoc., Inc.
Structural:	Skilling, Helle, Christiansen, Robertson
Completion Date:	Spring, 1978

INTRODUCTION

Gunnar Birkerts' firm is becoming increasingly involved in the design of energy-conserving buildings. Birkerts is quoted in the AIA Journal (12/77, p. 48) where he emphasizes the importance of exterior building design for energy conservation: "I like that notion because you don't need enormous backup for it, enormous laboratories and whatnot. There is so much you can do based on logic alone." He feels that many architects are afraid to focus on energy-conserving design because they feel solar collection is the entire answer. The 14 story IBM building indicates how much can be done without embarking on solar system design. The firm now has under construction an underground library for the University of Michigan at Ann Arbor which is expected to use one-quarter of the BTU's per square foot per year of a typical office building.

ENERGY CONSERVATION

The design phase began with a determination of the building's energy requirements, using a computer program from the Trane Company. Building requirements were set to keep heating and cooling loads at 54,000 BTU/sq. ft./year. Energy and maintenance cost savings were estimated and balanced against first cost increases - a procedure now commonly known as life cycle costing.

The main energy conserving feature is the "skin" of the building. The building is square and the entrance is due north. The north and east sides are finished in gray (the building exterior is of metal panels) to absorb heat; the the south and west sides are finished in white to reflect heat.

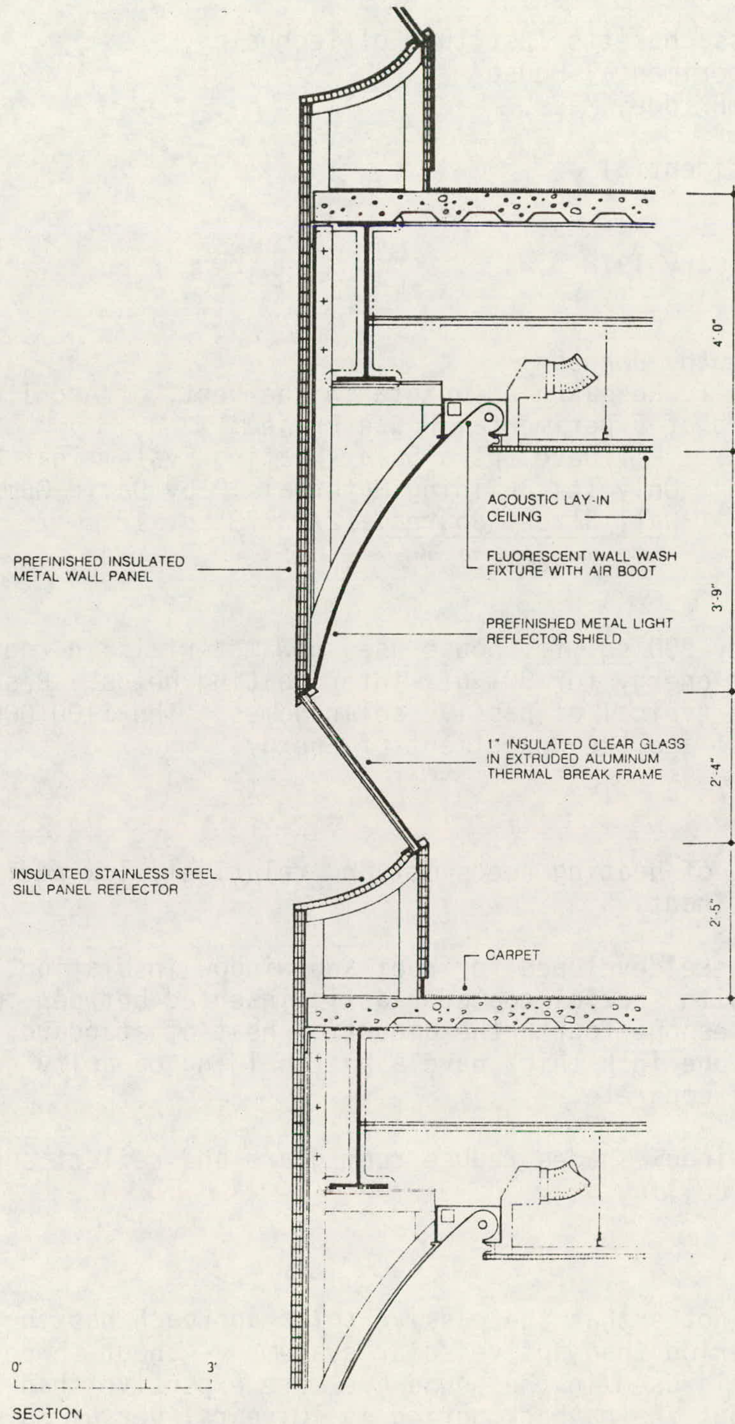
The windows are designed to reduce the peak solar load. The walls are 20% glass, while the actual aperture is 18%. This is accomplished by slanting the double insulated glass within the 24" wall thickness (see drawing).

This system reduces direct heat gain while permitting light to enter. Natural light is reflected up through the angled glass by use of a curved sill reflector which focuses light on a white matte reflector/diffuser inside the window. Interior light levels are kept around 50 foot candles, or under 2 watts per square foot.

COSTS

The exterior wall certainly increased initial costs, but by reducing the peak solar load by 40 percent, architects project a $21,000 savings per year in operating costs (comparison based on standard vertical window wall of 5'6" high). Engineers' calculations estimate a payback period for the wall premium of less than eight years.

NOTE: The above write-up is based on an article in Progressive Architecture, September 1975.



Drawing Reprinted from <u>Progressive Architecture</u> 9/75

PROJECT INFORMATION

Name: Massachusetts Institute of Technology
Experimental House
Cambridge, Mass.

Type: Residential

Completion Date: January 1978

Contact or Reference: Timothy Johnson
M.I.T. Research Associate in the Dept. of Architecture
Head of Experimental House Project
See: "MIT Develops a Solar-Heating System That Uses Only Its Building Materials," by David Gumpert, Wall Street Journal, 2/23/78, p. 12

INTRODUCTION

The single-story 900 sq. ft. house uses new materials in roof and window glass to utilize solar energy for 80% of winter heating needs. Researchers have overcome many problems typical of passive solar homes. The $100,000 project is jointly financed by MIT and the Department of Energy.

ENERGY CONSERVATIONS

High percentage of heating needs met and relatively low additional cost make this house significant.

New Materials were developed for roof and window insulation. A new type of window was developed with special coated plastic inserted between two sheets of glass. The window loses one-fourth the amount of heat of standard double-pane glass. Ceiling tiles one inch thick have a heat-holding capacity comparable to six to seven inches of concrete.

Thin mirrored window shades reduce room glare and reflect sunlight to heating panels on the ceiling.

COSTS

Johnson of MIT notes that the passive solar approach has the advantage of a much faster payback period than active solar systems -- about three times faster in this case. Materials used in the house are more expensive than those used in normal construction, but the payback period is 10 years, versus 30 with an oil heating system.

PROJECT INFORMATION

Name: David Wright House
Santa Fe, N.M.

Type: Private House

Architect: David Wright
Sea Ranch, California

Completion Date: 1974

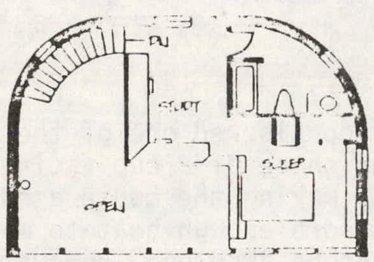
The David Wright House is considered one of the milestones of passive solar design. The plan is in the shape of a cup facing south. The complete south wall is fixed double glass, making the house a huge "solar scoop". The large glazed area is needed to absorb enough heat to maintain comfort into the night. This solar energy must be absorbed, however, or indoor air temperatures will rise too much during the sunny period of the day.

In the Wright house, the solar energy is absorbed and stored in a brick floor over 24 inches of adobe soil and in the 14 inch thick adobe walls, with their two inches of exterior polyurethane foam insulation. An adobe seat in front of the south - facing glass wall contains water filled, steel drums to add to heat storage capacity. These masses, called "heat sinks" radiate the heat slowly into the house.

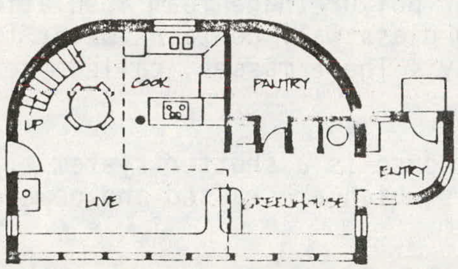
The control for the house is a shutter system of polyurethane foam panels hinged with cotton materials which are raised and powered manually. They prevent night heat loss.

Evidence of the quality of solar design in the Wright house is the fact that the house is kept warm through the winter with a fireplace providing the only auxiliary heating. Winters in Santa Fe are comparable to Detroit or Chicago with more than 6000 degree days per winter.

More Details: The house has been written up in the AIA Journal, 12/77, p. 39; The Journal of Architectural Education, 2/77, p. 18; and in the Washington Star of March 26, 1977, p. E-1 in an article by Harold Olin.



SECOND FLOOR PLAN



FLOOR PLAN

Plans of the David Wright House from Journal of Architectural Education 2/77

PROJECT INFORMATION

Name:	Summit Walk 100 Summit Walk Circle Marietta, Georgia 30067
Type:	Apartment Residential
Developer Management Enterprises, Inc. & Project Management:	#200 Prado West 5600 Roswell Rd., N.E. Atlanta, GA 30342 (404) 252-3690
Contact:	Mr. Edward Brinson, President
Architect:	Gary Coursey & Associates 4876 Lower Roswell Rd., S.E. Marietta, GA (404) 973-9090
Engineer:	Ross-Lee Consulting Engineers, Inc. 3020 Atlanta Rd., S.E. Smyrna, GA (404) 434-4461
Completion Date:	May 1978

INTRODUCTION

The 120 unit apartment complex consists of 12 two-story wood frame apartment buildings on 10 acres of land (density of 12 units/acre). There will be 32 "mini" one-bedroom efficiency units, 48 one-bedroom townhouse units, 40 two-bedroom flats and a resident manager's office.

The Summit Walk project is included as but one example of numerous housing developments now following the "Arkansas Plan." In 1975, two 1200 square feet homes were built to new energy-conserving standards in Benton, Arkansas. These homes averaged $10.75 per month for heating and cooling in 1975, at rates of 2¢ per KWH for cooling. The houses also cost less to build, due to a carefully worked-out type of post and beam construction which eliminated 41% of the conventional framing.

The two Benton, Arkansas homes, along with thirty-five other electrically heated and cooled homes built in Arkansas were constructed with target annual heating and cooling costs of under $10 per month. The homes were built to new energy construction standards issues by the Little Rock area office of HUD. Designed by a HUD construction analyst in cooperation with the Arkansas Power and Light Company; they were the result of 12 years of testing. Basically the homes require less materials and less time to build, so they represent a saving in energy used in producing materials, They also save on operating costs since they are extremely well-insulated and air tight, and they use as small a heat pump system as possible.

The Arkansas Plan has been used in many other states, as indicated by Georgia project summarized in this write-up. Another example is the new town of Maumelle, Arkansas, which is conducting seminars on the Arkansas Plan construction methods to encourage home builders to build energy-saving homes in the area.

A 1976 publication by the Owens-Corning Company reports that 200 builders in 41 states were planning to build 5,000 Arkansas Plan homes that year. The 1976 Owens-Corning booklet titled "Energy Saving Homes - The Arkansas Story" available from Owens-Corning Fiberglass Corporation, Fiberglass Tower, Toledo, Ohio 43659, provides detailed specifications and construction details for the Arkansas Plan home.

ENERGY CONSERVATION

Utilization of the Arkansas Plan is an important feature of the Summit Walk project and all new Management Enterprises Apartments. Some of its features compared to traditional residential construction are as follows:

	Normal Construction	Arkansas Plan
WALL	2" x 4" 16" o.c. with 3" fiber glass insulation R-13	2" x 6" 24" o.c. with 6" fiber glass insulation R-19
CEILING	3½" insulation R-11	12" insulation R-38
WINDOWS	Single Pane	Insulated Glass (Thermapane)
DOORS	Solid Core Wood doors	Urethane Core Doors with magnetic weatherstripping
VENTS	None	Ridge & Gable Vents

In addition:

All walks and floors are provided with a positive vapor barrier covering the entire surface and having a transmission rate not exceeding one perm.

Sill insulation is installed around complete perimeter.

1½" rigid urethane foam perimeter insulation is used with concrete slab floors.

Corner studs are set so one is flush to the outside sheathing and the other starting the connecting wall is at right angles 6" from and parallel to the sheathing so that the corner can be insulated. Similarly, where a partition meets an outside wall a single stud is used. Boxing around windows is simplified to permit a full 6" of insulation, instead of the normal 2".

All wiring is installed to permit correct placement of insulation. In walls, wiring is allowed to lie on the sill plate by cutting suitable notches in the base of wall studs. In the attic, wiring is attached to or through roof trusses at a point higher than 12" from the ceiling.

Window areas, which are minimized are aluminum framed, double glazed, and insulated with 3/6" air space between panes.

A continuous 3" soffit vent and continuous ridge vents exceed normal ventilating requirements.

All ducts are wrapped with 2" duct insulation to reduce heat gain and loss.

Heating and cooling equipment is centrally located in each apartment to minimize the distance heated and cooled air needs to travel.

Extensive testing and experience of other builders using the Arkansas Plan indicate a cost of 2 to 2½¢ per square foot for heating and air conditioning compared to 4½ to 6¢ per square foot with normal construction methods.

COSTS

The developer estimates costs per unit at $16,700 or $18.60/square foot. The incremental cost increase per square foot for the energy-saving factors is $1.11. The developer expects a three-year payback on the investment in energy-saving devices.

The energy-saving factors in the project result in reduced total shelter cost to the resident, but in initial leasing it is difficult to sell or translate the reduced cost to the prospective renter.

Initial projected rental rates are as follows:

mini-one bedroom efficiency (515 sq. ft.)-$185/unit month or $.36/sq. ft.

one bedroom townhouse (981 sq. ft.) - $250/unit/month or $.27/sq. ft.

two bedroom flat (1,127.5 sq. ft.) - $300/unit/month or $.27/sq. ft.

SUMMARY

NASA Technology Utilization House
Technology Utilization Office
Langley Research Center
NASA
Hampton, Va. 23665

CONTACT: Mr. John Samos
Technology Utilization & Applications Program Officer
Mail Stop 139A
Hampton, Va. 23665

More Details: The above write-up is based on a report entitled, Technical Support Package for Tech Brief (LAR-12134 NASA Technology Utilization House) available from the Technology Utilization Office of NASA's Langley Research Center. The report describes the house and contains names and addresses of the organizations from which NASA purchased services, materials, etc., used in the house. Some prices, effective prior to June 1976, are included for information.

PROJECT INFORMATION

Name: NASA Technology Utilization House
Technology Utilization Office
Langley Research Center
NASA (National Aeronautics & Space Administration)
Hampton, Va. 23665

Developer & Project Management: Technology Utilization Office
Mail Stop 139A
Langley Research Center
NASA
Hampton, Va. 23665

Architect: Forrest Coile & Associates
11721 Jefferson Ave.
Newport News, Va. 23606
(804) 595-7616

Engineer: Charles W. Moore Associates
Architects & Planners
Essex Ct. 06426
(203) 767-0101

INTRODUCTION

The Tech House was constructed to demonstrate to the building industry and the public the application of aerospace technology to housing in order to reduce monthly operating costs of living in a house. The Tech House is a 3-bedroom, 1500 square foot residence, located on approximately one-third of an acre. The house is located on Government property at the Langley Research Center. It contains an extensive amount of instrumentation for the purpose of gathering data, and it is difficult to establish the cost of construction. Approximate costs are $40/square foot. The house was completed on June 15, 1976, and was then open to the public for 13 months. In August 1977 a family moved into the house for a one-year test program. It was forecast in 1976 that the house could be built five years later for $45,000 (based on 1976 costs). To date over 400 copies of the drawings and specifications have been sold, an indication of development interest in the technology displayed in the test house.

ENERGY CONSERVATION

Before any system was included in the test house, it was verified that a payback to the homeowner would be realized within the lifetime of the system.

The major energy-saving systems, most of which are an outgrowth of NASA's aerospace technology, include:

1. Six-inch exterior walls containing Tripolymer (non-petroleum based) foam insulation (R-24.56), 8 inches of Tripolymer foam in the ceiling, and 6 inches gypsum foam under the floor.

2. Solar collectors are used to heat the house and the domestic hot water. The electrical energy requirements are expected to be reduced by two-thirds. The solar collectors, together with night-time radiators, two wells and a heat pump, supply major heating and cooling requirements.

3. Fireplace contains a heatolator, a water grate, and a glass screen to seal off the opening, and combustion air is provided from the outside by ducts.

4. Bath and washing machine water is recycled to flush the toilets. In addition, a water-conserving shower heads and water closets are used in the two bathrooms. Water savings of approximately 50 percent are expected.

5. Exterior retractable shutters provide energy savings when closed, preventing heat loss in winter and heat gain in summer.

SUMMARY

Sigurd Olson Environmental Studies Center
Northland College
Ashland, Wisconsin 54806
(715) 682-4531

Contact: Lois Kazakoff
Public Relations Coordinator
Perkins & Will
309 W. Jackson Blvd.
Chicago, Ill. 60606
(312) 427-9300

Energy conserving features:

- triangular design, with apex of triangle facing north
- windows to the south only
- earth berms
- wood construction
- open plan and sloping roof for air circulation
- windmill for electricity generation
- vines as a natural sunscreen
- provision for future solar collectors

PROJECT INFORMATION

Name: Sigurd Olson Environmental Studies Center
Northland College
Ashland, Wisconsin 54806
(715) 682-4531
Malcolm McLean, President

Architect: Perkins & Will
309 W. Jackson Blvd.
Chicago, Illinois 60606
(312) 427-9300
Contact: Lois Kazakoff

Type: College Facility

Completion Date: Unknown, building now in schematic design phase

INTRODUCTION

Northland College is a 750-student college located on a wooded property in a rural area near Lake Superior. The college requested a design that would express the college's concern for the environment, ecology and energy conservation. The proposed 5300 sq. ft. Environmental Studies building will contain a multi-purpose meeting room for 100, lobby-exhibition-reception area, office space and library.

This building is of particular interest in terms of energy conservation because it is to function as a teaching device. The college specifically requested a building that would teach energy awareness and the design therefore provides an image of environmental consciousness.

ENERGY CONSERVATION

The architects designed a low, triangular shaped wood building with earth berms on the northeast and northwest sides. South facing windows collect the sun's heat while the berms deflect wind and insulate against extremes of heat and cold. Earth is a good insulator because it absorbs heat slowly and then gradually re-radiates it. Below ground temperatures are fairly constant at 55^{o} F.

The building emphasizes passive solar design, but provision is made for addition of solar panels later when they prove to be economically feasible.

The triangular shape of the building is also aimed to protect against the cold. The triangle points north, so the north wall's surface is at a minimum. Thus heat loss to the north is minimized, while the southward facing glass wall permits sunlight to enter and be absorbed into the walls and floors of the building.

Vines planted in front of the south windows act as natural blinds against the high summer sun.

Other features include a windmill to generate electricity, an open floor plan to allow warm air to circulate and a sloping roof which creates a natural draw to circulate air.

COSTS

Not available

Note: Articles on Northland College are scheduled to appear in Institutional Management Magazine and Chicagoland Development magazine.

CHICAGO

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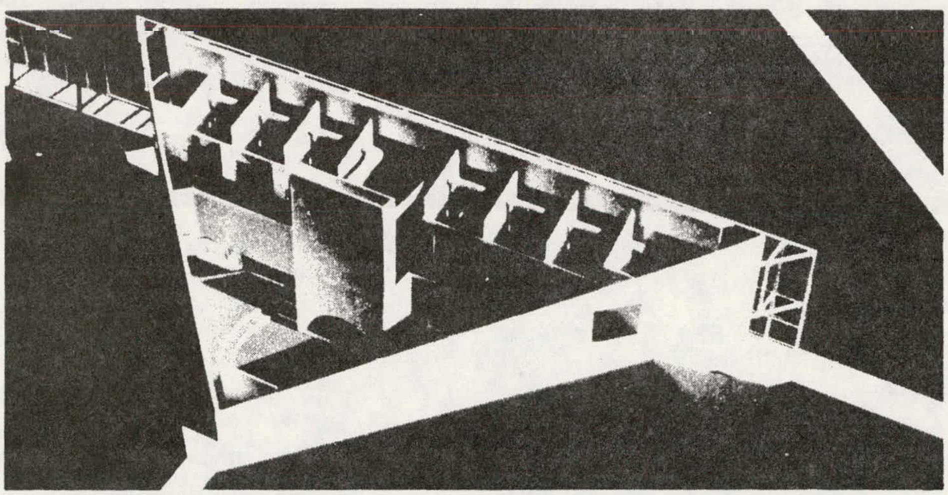
NEW PROJECTS 1978



SIGURD OLSON INSTITUTE FOR ENVIRONMENTAL STUDIES building will be a low, triangular-shaped wood structure with earth berms on two sides — demonstrating a good passive solar design. Designed by Perkins & Will, Chicago architects-engineers, for Northland College in Ashland WI, the proposed building will have a multi-purpose meeting room, lobby area, lounge and exhibition spaces, offices, project rooms and a library conference room on the floor above. P&W said the building illustrates the most current practical solar technology in a functional college facility designed to conserve energy and teach energy consciousness.

SUMMARY

Pako Photo Processing Plant
Minneapolis, Minn.

Contact: Mr. J. Robert Snyder, P.E.
Rauenhorst Corp.
Suite 2200, Northwestern Financial Center
7900 Xerxes Ave. South
Minneapolis, Minn. 55431
(612) 830-4444

Energy Conserving Features

- Heat recovery for heating perimeter areas
- Two heat recovery systems to provide hot water for photo processing
- Heat recovery from boiler room to heat warehouse.

PROJECT INFORMATION

Name: Pako Photo Processing Plant
Minneapolis, Minn.

Type: Industrial

Designer:

Developer: Rauenhorst Corporation
Suite 2200, Northwestern Financial Center
7900 Xerxes Avenue, South
Minneapolis, Minn. 55431
(612) 830-4444

Mr. J. Robert Snyder, P.E.
Chief Mechanical Engineer

Completion
Date: Spring 1978

ENERGY CONSERVATION

The Pako Photo Company is now building a new energy efficient building which meets the Minnesota Energy Code. The major energy-conserving features are four heat recovery systems:

1. Basic heating and air conditioning system utilizes waste heat from the central areas and circulates it to the perimeter. (Heating is an internal heat source water-to-air unitary heat pump system).

2. One of the largest energy requirements of photo processing is hot water. One system for energy savings is a shell and tube heat exchanger which extracts heat from waste/water to heat fresh water before it is sent to the plants water heaters.

Using December 1977 energy and demand rates, owners estimate the payback period for this system to be 6½ months.

3. A second energy-saving method for heating water is a heat reclaim system installed in the condenser water piping system of the air conditioning unit. This heat source is not available all year round.

Payback for this system is estimated to be less than four months.

4. A fairly simple energy recovery system is being incorporated into the building to heat the warehouse area with waste heat from the boiler room. The system saves 1375 hours of heat pump operation during the heating system in addition to the waste heat that would otherwise be exhausted from the boiler room to the outside. Controls were also added to introduce this heat to the condenser water system for storage in an underground tank for later use by the warehouse heat pumps.

Payback period is calculated at 2.1 years.

III. BRIEF NOTES ON ADDITIONAL ENERGY CONSERVING PROJECTS

This section includes brief write-ups on projects which are of interest for some particular energy-saving technique but which are not energy conserving in their overall design (Standard Oil of Chicago Building and Weyerhauser Company Plant). We have also included examples of projects developed in response to particular state programs (Oaks North Village and New Mexico Department of Agriculture Building), projects on which we have only a minimum of details (Housing Rehabilitation Project, New York), and projects which are in the early planning stages or have not yet been given the "go-ahead" (Bleyle Knitwear Plant and Great Lakes Naval Base).

PROJECT INFORMATION

Name: Housing Rehabilitation Project
519 E. 11th St.
New York, N. Y.

Renovated and owned by the residents

Architect for the energy-saving improvements: Travis L. Price, III

Completion date: 1976

The following notes are based on Allen Freeman's article in the AIA Journal, Feb. 1977.

The building, located on a block marked by burned-out and dilapidated buildings, was bought by the tenants. They began gutting and reconstructing with the aid of a municipal loan for $177,000. Tenants worked on the building 40 hours a week, of which 8 hours were unpaid "sweat equity".

Energy-conscious improvements included added insulation, storm windows, a solar collector which heats 85% of the domestic hot water, and even a windmill.

The windmill produces 2 KW of power per day; any surplus goes back into the Consolidated Edison system. The fact that the meter does actually reverse occasionally has been a source of contention between the residents and the utility company.

Costs for energy conservation materials are estimated as follows:

- Batt insulation, rigid insulation over studs, storm windows, weather stripping, and labor cost $11,000. This cost translates into $1.50 per month for each apartment but saved $14 in fuel monthly. *
- The solar hot water system cost $15,000, or $5.50 monthly per apartment, but saves $13.50 per month.*
- Windmill cost $4,000. It was built in the 1920's and was recently restored.

* Estimates assume a 7.5% mortgage rate, 30 year mortgage, and conservative fuel cost escalation.

PROJECT INFORMATION

Name:	Energy Conservation Project for Schenectady County Office Building 620 State Street Schenectady, New York 12301
Type:	Retrofit of county office buildings
Developer:	County of Schenectady (Richard Bliss, Schenectady County Engineer)
Architect:	Cullen Associates 108 Union Street Schenectady, New York 12305 (518) 372-4487
Completion Date:	November 1, 1978

This project involves a retrofit of a six-story county office building to reduce energy consumption due to high window heat losses and inadequate functioning of the heating and cooling system. The demonstration room in the building has already been renovated and the results have been monitored. The following changes are proposed for the entire building:

- 5' x 5' existing single pane windows will be replaced by units containing a 2.5 foot wide double glazed reflective window and a 2.5 foot wide blank insulated panel.

- Insulated panels will be placed on the walls inside the building, covering all exposed aluminum framing.

- Lighting levels will be varied according to the activities carried out in each part of the building.

- New air control valves will be installed.

COSTS

Improvements to the building described above would cost $7.92 per square foot of the 60,000 square foot building, or $472,400 in total. It is estimated that current annual energy costs would be cut by $49,784, at 1977 energy costs. New construction costs would be recovered in 6½ years, according to estimates made by the county engineer on a 10% annual escalation in energy costs.

PROJECT INFORMATION

Name:	Springfield City Hall Phase I of the Core Block Redevelopment Plan 76 East High St. Springfield, Ohio 45501
Type:	Government Office and Commercial
Developer:	City of Springfield, Ohio 117 S. Fountain Ave. Springfield, Ohio
Contact:	Mr. John R. Hickermell (513) 325-0511
Architect:	Kline-Meier Architects and Planners 4103 Old Mill Road Springfield, Ohio 45502 (513) 3234931
Engineer:	W. C. Koenig & Associates 358 East High St. Springfield, Ohio 45505 (513) 324-4298
Project Management:	Six Industries, Inc. 626 Railroad St. Springfield, Ohio 45501 (513) 325-7081
Completion Date:	Phase 1 - April 1979

Phase 1 of the 2 phase project includes the City Hall and Plaza (80,000 sq. ft) and a 45,300 sq. ft. parking garage. The construction cost is $52/sq. ft.

The project's energy-conserving features include:

- a heating system with variable air volume, recovery of heat from lights, and timed controls
- solar ban, double-pane, reflective bronze glass
- two tri-fuel boiler-burner units which permit switching to different fuels as supply and fuel costs vary. The boiler-burners function on #2 fuel oil, gas, or electricity
- open space layouts for 110 work stations in the City Hall building. Open space planning provides better air circulation.

The increased cost for the tri-fuel burners and stacks for vents was approximately $60,000. The necessity for a government building to be open during emergency situations easily justified the added cost.

PROJECT INFORMATION

Name:	Federal Home Loan Bank Board Building Washington, D. C.
Type:	Government Office Bldg.
Developer:	U. S. General Services Administration 18th and F Streets, N. W. Washington, D. C. 20405
Architects:	Max O. Urbahn Associates, Inc.
Engineers:	Lev Zetlin Associates (structural) Syska and Hennessy, Inc. (mechanical and electrical)
Completion Date:	1977

INTRODUCTION

As part of the development of the new Federal Home Loan Bank Board building, GSA was obligated to rehabilitate an adjacent 1842 cast-iron office structure. A plaza between the two buildings contains an ice skating rink, which is turned into a reflecting pool in the summer.

GSA was also obligated to aim for its energy guideline of 55,000 Btu/sq.ft./year. A computer simulation program used by the mechanical engineers estimates the building's annual consumption at 77,700 Btu/gross sq. ft./year. If corrections are made for 13-hr. operation, commercial lighting for the ground floor portion leased to stores and kitchen usage, the figure should drop to approximately 57,000.

ENERGY CONSERVATION

Major factors in energy consumption are:

- Masonry walls are insulated to a U value of .07.
- Double glazed glass is 35% of wall surface
- Venetian blinds to block sun
- Task oriented lighting at 2½ W per sq. ft. rather than the usual 4
- Three air systems rather than the usual two to increase efficiency
- A different system is used in each zone: exterior wall, perimeter, interior.
- Variable ventilation
- 105^{o} F. water is supplied to bathrooms by a single pipe
- automatic HVAC control system

PROJECT INFORMATION

Name:	Karen Terry House Santa Fe, New Mexico
Type:	Private Residence
Completion Date:	1975
Contact or Reference:	David Wright, Architect
Description:	Well-known solar design of an 864 sq. ft. lineal house. The house steps back into the hillside, exposing south-facing windows to the south.

ENERGY CONSERVATION:

- Successful passive solar design -- no auxiliary heating is necessary
- Double-glazed southern windows
- Heavy adobe walls with exterior foam insulation
- Water-filled drums buried in walls and floor to absorb heat
- Excellent cross-ventilation

PROJECT INFORMATION

Name:	Weyerhauser Company Boiler and Generator for the Log Sorting Yard Longview, Washington
Type:	Industrial equipment
Completion Date:	1977
Contact or Reference:	Combustion Power Company (fully-owned Weyerhauser subsidiary) 1346 Willow Road Menlo Park, California 94025
ENERGY CONSERVATION:	Bark and other debris collect in the log-sorting yard in the course of operations. In 1977, a new $32 million boiler and generator were developed to use the waste material. Former waste material (bark and wood) is burned and turned into electricity.

PROJECT INFORMATION

Name: Bleyle Knitwear Plant
Shenandoah, Ga.

Contact: Shenandoah Development, Inc.
P.O. Box 1157
Shenandoah, Ga.
Mr. Ray Moore, Senior Vice President

The Bleyle Knitting Mill will be the first factory to get its electric power and process steam, heating and cooling from solar energy. Five acres of solar collectors will be installed, with a back-up electric system. The building, containing extra insulation, has been constructed but the solar system is not yet in operation.

The Department of Energy has selected the plant as its second solar total energy experiment plant.

PROJECT INFORMATION

Name: Great Lakes Naval Base
Great Lakes, Illinois

Type: Retrofit Study for 22 Representative Buildings on the Base

Architect: Perkins & Will
309 W. Jackson Blvd.
Chicago, Illinois 60606
(312) 263-5759

Completion Date: Study completed June 1974

ENERGY CONSERVATION:

This study shows the potential for energy savings in older buildings. It is a large-scale retrofit analysis covering 22 buildings on the naval base. The architects reviewed 22 representative buildings ranging from 14,000 to 126,000 sq. ft. and from five to 70 years old. They included barracks, schools, offices and warehouses. Recommendations for energy conservation were to be practical and economically feasible. Architects made three types of recommendations:

- Methods to upgrade existing systems to maximum efficiency
- Modifications to upgrade performance
- New systems were suggested only if there were no alternatives

The study indicated that savings of $70,000 annually could be achieved through alterations to mechanical systems, resulting in a payback period of three years on the initial investment. An interesting conclusion of the study was that one to two-thirds of the total annual savings would result from implementation of a temperature setback system in buildings occupied only during part of the day.

PROJECT INFORMATION

Name:	Standard Oil Co. Chicago, Illinois
Type:	Retrofit of office building
Contact:	Edward Carmody, Building Manager
Heat Recovery Machinery:	The Trane Co. LaCrosse, Wisconsin
Completion Date:	1977-1978

ENERGY CONSERVATION

Two 1,260-ton heat recovery machines will be installed in this 80-story building. To date, heat produced by the building's refrigeration machines has been exhausted into the atmosphere. Hot water produced by the chillers has been sent to a cooling tower to eliminate excess heat. Excess heat from these two sources will now be added to the building's heat. In addition, excess heat generated by people, lights and equipment in the interior of the building will be re-circulated to the perimeter. The heat recovery system will operate in the tower two-thirds of the building.

The heat recovery system costs $1 million and is expected to save $250,000 per year.

PROJECT INFORMATION

Name: New Mexico Department of Agriculture
New Mexico State University
Las Cruces, N. M.

Type: Office and laboratory building

Completion Date: 1975

Contact or Reference: Bridgers and Paxton
Mechanical Engineers
c.f. AIA Journal article by Jeffrey Cook 12/77 pp. 41-42

ENERGY CONSERVATION

This project is notable as an example of building re-design in response to a state law. New Mexico adopted a policy that state buildings be designed for solar heating and cooling. This office and laboratory building was therefore adapted for solar heating through the addition of 6700 sq. ft. of solar collectors. The 25,000 sq. ft. building is one of the first large-scale solar applications.

Most new buildings incorporating active solar collection systems include passive solar considerations, such as building orientation, vis-a-vis the sun. However, since this building is a retrofit of an existing structure, no such passive solar considerations are evident. The building is an interesting combination of "pre-energy conscious" design with energy conscious technology.

PROJECT INFORMATION

Name: 6 Residential Units
Pennsylvania Power & Light Company
2 No. 9th Street
Allentown, Pennsylvania
(215) 821-5534

Contact: Mr. Bob Romancheck

Completion Date: 1977

ENERGY CONSERVATION

These six residential units of 2,000 sq. ft. each are of interest because they were developed as model homes by a utility company. They include styrofoam sheathing and 3½" fiberglass insulation in the walls, 12" insulation in the ceiling and triple-glazed windows. Solar panels for heating along with a heat pump are built into each home.

These energy-saving factors resulted in an incremental cost increase of $2/sq. ft. Mr. Romancheck notes that at present utility rates, a solar system is not cost-effective. He favors greater emphasis on improved insulation.

PROJECT INFORMATION

Name:	Oaks North Village Rancho Bernardo San Diego, California
Developer:	Oaks North Village, Ltd. 3510 Chapman Street San Diego, California 92110 (714) 223-7114
Architect:	Paul McKim, San Diego
Project Management:	Miramar Financial 3510 Chapman Street San Diego, California 92110 (714) 223-7114
Type:	Residential
Completion Date:	Phase 1 - June, 1978; Phase 2 - October, 1978

ENERGY CONSERVATION

This project is included as an example of a development response to a state law: California permits a 55% tax credit for the cost of solar heating. Oaks North Village contains 116 condominium units on six acres of land. The units are available with solar hot water units, and the developers state that the solar option has improved marketability of the project. Developers are able to offer an attractive option which saves on owners' operating expenses and the State Underwriters a portion of the initial capital cost.

IV. OTHER LISTS OF ENERGY CONSERVING PROJECTS

In addition to the projects listed in this report, other catalogues of energy-conserving projects are available, and we have tried not to duplicate material contained in those lists. Of particular note is the AIA Energy Notebook's excellent set of case studies. Twenty-two detailed descriptions of private homes, offices, and some institutional buildings are provided.*

Other projects lists are:

- Solar Heating and Cooling Demonstration Program, Descriptive Summaries of HUD Cycle 1, 2 and 3 Solar Residential Projects. Three volumes published by U.S. Department of Housing and Urban Development in cooperation with the Energy Research and Development Agency.
- Guide to Demonstrations of Energy Conservation, Solar Energy and Other New Technologies, Energy Research and Development Administration, 1977.
- National Program for Solar Heating and Cooling of Buildings, Project Data Summaries, Vol. 1 - Commercial and Residential Demonstrations, Energy Research and Development Administration, 1976.

There is substantial documentation of solar energy projects in the above lists, so we have tried to emphasize examples of other aspects of energy conservation.

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* AIA Energy Notebook is a subscription service from the American Institute of Architects, 1735 New York, Ave., N.W., Washington, D.C. 20006. Case studies include: (1) Shenandoah Solar Community Center, Georgia, (2) Terraset Elementary School, Reston, Va., (3) Markem Corporation Plant, Keene, N.H., (4) Junior High School, Parker, Colo., (5) Solar Office Building, Mead, Nebraska, (6) Fire Station, Dallas, Tx., (7) Maine Audubon Society, Orono, Maine, (8) Office Building Modification, Atlanta, Ga., (9) Residential Mental Health Facilities, El Paso, Tx., (10) Cherry Creek Office Building, Denver, Colo., (11) Armed Forces Reserve Center, Norwich, Conn., (12) Cary Arboretum Research Building, Millbrook, N.Y., (13) Municipal Animal Control Center, Albuquerque, N.M., (14) Sewell Elementary School, Aurora, Colo., (15) Albany High School, Albany, N.Y., and seven private homes.