forms or shapes optimize the orientation of specific building elements. Mass, and to some extent colour, affect the dynamics of heat-energy utilization.

Windows offer very little resistance to heat flow. Improving the thermal resistance characteristics of windows is achieved mainly by the use of multiple glazing. A double window with an air space of one half inch has twice the thermal resistance of a single window. Windows in general, it has been found out after experiments in Canada, transfer about five times as much energy as an equivalent area of typical insulated wall construction. It is therefore, important in design that the amount, type and location of glazing be carefully considered. Since windows admit solar energy, both in winter and in summer, those facing south are in the most desirable location. They will receive the greatest amount of solar energy during the heating season and they can be shaded most effictively in the summertime.

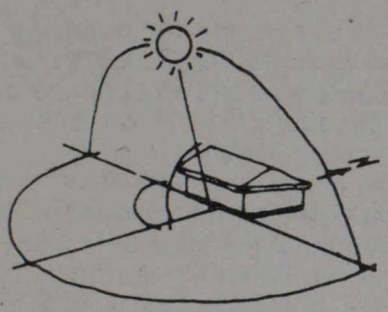
A south-facing window is exposed to direct radiation from about 9 a.m. to 3 p.m. in summer. Its peak gain occurs at about noon. This gain is only about half that of an east-or-west-facing window because the sun is so high in the sky at midday; therefore, most of the radiation is reflected by the window. In winter the heat-gain picture is completely different. The sun rises later in the morning and remains lower in the sky throughout the day; consequently, a south-facing window gains the most solar heat.

Over the last 10 to 15 years there has been considerable development of techniques for detailed analysis of energy exchanges in buildings. This has involved the application of computers in calculation and simulation of the total building energy system. At present, sets of programs are available which can be used to evaluate the energy utilization consequences at various design stages as well as for modelling existing buildings to determine the optimum operating schedules for conservation.

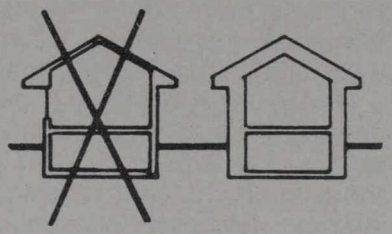
The Department of Public Works of Canada, using such techniques, has analysed a number of existing buildings and prepared a new operating schedule which has resulted in a substantial saving in energy. It is also applying these techniques to the assessment and development of new building designs.

Up to now, first-cost has been the main criteria used by designers. There has not been a great need to evaluate energy consumption consequences of design decisions. This is changing rather quickly. Designers will have to be able to estimate energy consumption

Many applications of solar heating are under way in Canada. Like Gananoque House at Larry's Landing, R.R.3, Gananoque, Ontario, owned by Mr. Larry South. It is a four-bedroom, two-storey house with a usable floor area of 2,200 sq ft, The system, consisting of 230 ft of collector surface mounted on the south side of the roof, uses water as a heat transport medium and 4,000 lb of paraffin wax as a heat of fusion storage unit. Auxiliary heat requirement is provided by a large stone fireplace which has water circulating in the stainless steel clad tubing that surrounds the flue. This hot water is directed to the heat of fusion storage where it will be used again for space heating.



**Some of the more energy-conserving forms or shapes (of houses) optimise the orientation of specific building elements. Mass and, to some extent colour, effect the dynamics of heat-energy utilization.**



The Hoffman House, another solar heated building, was built in 1968 by Eric W. Hoffman in Surrey, British Columbia. In addition to house heating, a swimming pool solar heater was added in 1974. The house is located at the 49th degree north latitude. The floor area of the house is 2,700 sq. ft. It uses a flat plate type solar collector 460 sq. ft. in area. It has two vertical cylindrical uninsulated water tanks totalling 800 gallons which are held within an insulated basement room. The house is heated by air that has circulated by gravity convection through the tank room. The system is claimed to provide 50 per cent of the space heating and domestic hot water needs. Auxiliary heaters are electric baseboard units.

John Hix, Architect, and Frank Hooper, Engineer, University of Toronto, are designing a solar heated house in Mississauga, Ontario. A two storey, single-family residence of 2,400 square feet resembling a modified "A" frame building, it will exhibit more than 800 square feet of collector surface and host a 70,000 gallon water storage unit.

Another project to demonstrate the feasibility of solar heating, sponsored by the National Research Council, is Housing for the Quebec Indian Communities. It entails construction of three prototype houses incorporating features such as solar-heating systems, wind-power systems and composting toilets. The three houses feature three different types of solar-heating systems. One is an air-heating system with forced circulation; another an air-heating system with natural circulation; and the last a circulation; and the last a passive "solar" wall.

Prince Edward is another experiment in autonomous living and biologically-balanced rearing of