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Publisher's version / Version de l'éditeur:

<https://doi.org/10.4224/40000586>

Building Research Note, 1977-07

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ISSN 0701-5232

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BUILDING RESEARCH NOTE

ANALYZED

AN UPDATE OF THE FEDERAL SOLAR HEATING PROGRAM

by

J.R. Sasaki

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JUL 27 1977

NATIONAL RESEARCH COUNCIL

Division of Building Research, National Research Council of Canada

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Ottawa, July 1977

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AN UPDATE OF THE FEDERAL SOLAR HEATING PROGRAM*

J.R. Sasaki

In 1976-77, a feasibility study of solar heating in Canada was completed, and the following new activities were initiated: construction of 14 solar-heated demonstration homes, 7 research and development contracts, 4 monitoring contracts and the establishment of an independent solar-collector test facility. The 1977-78 program, with a budget of \$2,100,000, will support construction of solar-heated multi-unit residential buildings, monitoring of non-residential solar-heated buildings, and additional research and development of solar heating systems and components. Work on the durability of solar heating components, and on large in-ground heat storage tanks will also be undertaken.

PROGRAM AIMS

The aims of the Solar Heating Research and Development Program of the National Research Council are to:

- (i) determine the feasibility of various ways of utilizing solar heating in Canada;
- (ii) develop simplified design methods and a data base for the rational design of solar heating systems;
- (iii) support construction of solar heating demonstration projects, to stimulate public interest and to obtain quantitative data on the performance of solar heating systems in Canada;
- (iv) assist Canadian equipment manufacturers to develop durable, cost-effective solar heating hardware.

FEASIBILITY AND DESIGN METHODS

In pursuit of the first aim, a feasibility study on solar heating in Canada was undertaken by the University of Waterloo. The results of this study are now available.⁽¹⁾ Another result of this study was the development of a design method for sizing solar heating systems, entitled the WATSUN program.⁽²⁾ Work is continuing at Waterloo on the development of simpler methods for sizing solar heating systems for residences.⁽³⁾ Development of a solar-heating system design method for more complex buildings, e.g., air-conditioned office buildings, will be undertaken in the current year by the Federal Department of Public Works.

* Prepared for presentation at the Third Annual Meeting of the Solar Energy Society of Canada, Edmonton, August 1977.

SOLAR DATA BASE

The development of a solar data base is being undertaken by the Atmospheric Environment Service of Environment Canada. Their intent is to prepare weather and solar radiation data for the major urban centres in a format that can be used by building heating engineers. To this end, they are developing a method for inferring insolation for regions with no measured radiation data, and a reliable method for translating insolation data on horizontal surfaces into insolation data on inclined surfaces. This latter work is being conducted jointly with Professor J.E. Hay of the University of British Columbia.

DEMONSTRATIONS

In 1976-77, support was provided for the installation of solar space-heating systems in 14 single-family detached homes (Table I). Single-family homes were chosen for demonstration in the first year of the program because it was thought that this would stimulate the greatest interest in the construction industry and the general public. In the current year, both solar service-water and space-heating systems will be demonstrated in multi-unit residential buildings, which are now recognized to be a more appropriate application for solar energy.

MONITORING

Contracts were let in 1976-77 to monitor the performance of solar heating systems on four houses (Table II). Two of the houses were constructed under the Canadian Urban Demonstration Program (now discontinued); the other two were constructed with private funds.

In addition to letting monitoring contracts on the 14 solar demonstration houses, contracts will be let in the current year to prepare monitoring systems for non-residential solar-heated buildings, e.g., schools, office buildings and commercial buildings. Monitoring systems will also be installed in a home in Ottawa with a simple liquid-heating solar system and in a 29-unit Senior Citizen Home being constructed by the Ontario Housing Corporation. The latter building will feature a solar heating system intended to supply all the space-heating needs by utilizing a seasonal heat storage unit.

The aims of the monitoring program are to determine the solar contribution to the heating needs of the buildings and to provide technical data for validating the worth of solar system design methods.

RESEARCH AND DEVELOPMENT

The seven research and development studies initiated in 1976-77 are listed in Table III. The intent in this part of the program was to develop information that would be useful to both building system designers and potential manufacturers of solar heating components and systems. In 1977-78 there will be continuing support for some of these projects that were started in the previous year. New research and development work will be initiated on: durability studies, selective

coatings, chemical-change and latent heat storage units, and advanced collector designs.

The establishment of an independent solar collector test facility was supported in 1976-77 (Item 8 in Table III) in anticipation of the need for such a facility by a growing collector manufacturing industry.

FEDERAL GOVERNMENT ACTIVITIES

Other Federal government departments will be involved in solar heating activities in the current year, in addition to the activities of the Atmospheric Environment Service and the Department of Public Works already mentioned. Agriculture Canada will be initiating work on the agricultural applications of solar heat. Central Mortgage and Housing Corporation will continue its study of the Mini-Utility Concept, that is, the use of a large, central solar-collection and heat-storage system serving the space-heating needs of clusters of residential buildings. The Department of Public Works and the National Research Council will be concerned with the possibility of utilizing solar heating systems in Federal buildings.

The Division of Building Research of the National Research Council will be concentrating on the following areas: development of test methods and standards for solar heating components; durability of solar heating components; and performance of large in-ground heat storage units. Preparation of a handbook describing construction features and costs of Canadian solar-heated buildings and a study of existing solar-heated buildings related to maintenance and component deterioration, will also be undertaken. A major undertaking will be the preparation and/or dissemination of reports resulting from the current research, development, demonstration and monitoring contracts.

One activity outside the solar program being undertaken jointly by the Division and the Housing and Urban Development Association of Canada (HUDAC), is the construction of four similar houses in Ottawa; one built to 1975 residential standards and the other three with additional energy-conservation features. All four houses will be electrically heated, but one will incorporate a supplementary solar air-heating system and another will have an air-to-air heat pump. The effectiveness of the energy-conserving features and of the solar-heating and heat-pump systems will be studied in detail.

INFORMATION ON FUNDING PROGRAMS

The Solar Heating Research and Development Program of the National Research Council is just one of the activities supporting solar heating development in Canada. Work to be funded under this program is announced in the Research and Development Bulletin of the Department of Supply and Services, Ottawa. Those wishing to keep informed of the research and development funds being made available should have their names placed on the mailing list of the DSS R&D Bulletin.

An industrial support program that may be applicable to manufacturers of solar-heating hardware is the new Enterprise

Development Program of the Department of Industry, Trade and Commerce. Information regarding this program can be obtained from the regional offices of the Department

Some of the provinces are currently establishing programs in support of renewable energy development, including solar heating. Provincial energy ministries can provide details on the programs in their respective provinces.

This paper is a contribution from the Division of Building Research of the National Research Council of Canada and is published with the approval of the Director of the Division.

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- (1) Hollands, K.G.T. and Orgill, J.F., Potential for solar heating in Canada. Waterloo Research Institute, University of Waterloo, February 1977, \$3.50, 102 pages.
- (2) Orgill, J.F. and Hollands, K.G.T, User's Manual - WATSUN - A solar heating simulation and economic evaluation program. Waterloo Research Institute, University of Waterloo, May 1977.
- (3) Hollands, K.G.T. and Orgill, J.F., Continuation study of the potential for solar heating of buildings in Canada. Waterloo Research Institute, University of Waterloo, May 1977.

TABLE I FUNDED SOLAR DEMONSTRATION HOUSES 1976-77

Location	Contractor	House Living Area (m ²)*	Collector Area (m ²)*	Storage Volume (m ³)*	Back-Up Heating
(1) Charlottetown, P.E.I. (Lewis Point Park)	Canadian-British Consultants Ltd. (Designer)	140 (New)	34 (liquid)	14 (water)	Oil (Hydronic)
(2) Halifax, N.S.	Mr. A. Penney (Owner)	140 (Existing)	56 (air)	15 (rock)	Oil (Hot air)
(3) St. John, N.B. (Belmont Development)	Mr. G.G. Murray (Owner)	110 (New)	38 (liquid)	11 (water)	Oil (Hot air)
(4) Fredericton, N.B.	A.D.I. Ltd. (Designer/Owner)	185 (Existing)	27 (air)	9 (rock)	Electric baseboard
(5) Laval, P.Q.	Fenco Consultants Ltd. (Designer)	120 (New)	44 (air)	7 (rock)	Electric baseboard
(6) Hudson, P.Q.	Mr. C.J.M. Ives (Designer/Owner)	250 (New)	37 (liquid)	7.5 (water)	Electric (Hot air)
(7) Ayer's Cliff, P.Q.	Direct Energy Associates (Designer/Owner)	100 (New)	42 (air)	11 (rock)	Electric (Hot air)
(8) Thunder Bay, Ont.	Proctor & Redfern Group (Designer)	140 (New)	37 (liquid)	6 (water)	Water/air heat pump (Hot air)
(9) Fort Garry, Man. (Waverley Heights)	W.L. Wardrop & Assoc. Ltd. (Designer)	165 (New)	38 (air)	6 (rock)	Gas (Hot air)
(10) White City, Sask.	Mr. J.R. Borden (Owner)	175 (New)	65 (air)	Latent heat storage unit	Air/air heat pump (Hot air)
(11) Calgary, Alta. (Silver-Springs)	Nu-West Development Corp. Ltd. (Owner)	105 (New)	33 (liquid)	13 (water)	Gas (Hot air)
(12) Calgary, Alta.	R.M. Hardy & Assoc. Ltd. (Designer)	110 (New)	12 (air) (Remotely located air-heating furnace)	9 (rock)	Gas (Hot air)
(13) Aldergrove, B.C. (Springfield Village)	Delmarco Management Ltd. (Owner)	- (New)	35 (liquid)	4.5 (water)	Air/air heat pump (Hot air)
(14) Victoria, B.C.	Mr. D.B. Thompson (Owner)	240 (New)	25 (liquid)	11 (water)	Water/air heat pumps (Hot air)

* 10.76 ft²/m²; 220.5 gallons/m³; 35.3 ft³/m³.

TABLE II MONITORING SOLAR HEATING CONTRACTS, 1976-77

1. D. Lorriman (Toronto) -
To monitor the solar heat contributed by a liquid-heating solar system with a water/air heat pump in a home, in Mississauga, Ontario.
2. Hooper and Angus Assoc. Ltd. (Toronto) -
To monitor the solar heat contributed by a liquid-heating solar system with a seasonal heat storage unit in a home, near King City, Ontario.
3. Domshy Industries Ltd. (Calgary) -
To monitor the solar heat contributed by an air-heating, remotely-located solar furnace attached to a home in Regina, Saskatchewan.
4. Professor B.P. Wisnicki, U.B.C. (Vancouver) -
To monitor the solar heat contributed by a passive, solar air-heating wall in a home in Naramata, B.C.

TABLE III R&D SOLAR HEATING CONTRACTS 1976-77

1. Mr. V. Ireton (Fredericton, N.B.) -
To study a developmental, retro-fit, solar service-water heating system in a home in Fredericton, N.B.
2. Acres Consulting Services Ltd. (Niagara Falls, Ontario) -
To study the feasibility of using the ground as a heat storage medium for solar heating systems.
3. Electrohome Ltd. (Kitchener, Ontario) -
To develop design information for packed-bed heat storage units for air-heating solar systems.
4. Solco Energy Systems Ltd. (Toronto, Ontario) -
To develop and evaluate prototype designs of liquid-heating solar collectors.
5. Electrohome Ltd. (Kitchener, Ontario) -
To develop and evaluate prototype designs of air-heating solar collectors.
6. Ontario Research Foundation (Toronto, Ontario) -
To study corrosion problems associated with solar heating components and systems.
7. Chemical Engineering Research Consultants (Toronto, Ontario) -
To study organic pigments for potential use in selectively absorbing paints.
8. Ontario Research Foundation (Toronto, Ontario) -
To construct a solar collector calorimetry facility for commercial testing of both air-heating and liquid-heating collectors.