

1979:2

This newsletter contains mainly information on new projects sponsored by the Swedish Council for Building Research, and is intended to improve communication between researchers. Further information can be obtained from the Council or from the responsible researcher.

Swedish Building Research News

New projects

Radon in Swedish buildings

Radon is a decay product arising from radium (^{226}Ra). Trace amounts of uranium are always present in matter, and will especially in certain minerals used in building constructions continuously produce radium, thus acting as a billion year constant source of radon, a radioactive and chemically inactive gas. It is formed in the building materials and moves to the surface by diffusion thus entering the atmosphere inside the building. Radon is instable and has an average lifetime of 3.8 days. Its decay products are called the radon progenies, still radioactive and with strong tendency to combine with any particles always present in the air. These progenies enter man's lungs and are caught by the tissues. Giving rise to alphasradiation they may cause cancer in the lungs.

Some building materials have focused special attention due to their highly elevated radioactivity. Most concern is paid to aerated concrete based alum shale. The shale has been mined at places with high uranium and radium contents during the period 1930-1975, and is thus built into many Swedish homes. Activities may vary in the interval 500-2 500 Becquerel/kg ($\sim 15-60$ picocurie/g) in this material.

Other sources of radon are the ground on which the houses stand and ground water. The contribution of these sources depends on the local circumstances and may in some areas be significant.

Estimates have been made as to how many houses are having serious problems with radon. Estimates point at thousands to tenth of thousands of homes, where remedial action must be considered. Estimates have also been made as to how many additional cases of lung cancer related to radon to-day's situation may induce, figures mentioned are 200-1 100 per year in Sweden. The majority of the cases are induced in more normal houses than in the limited group mentioned above.

As a gas radon can be ventilated away. This technique can be used to reduce radon if sources are of normal elevation. If sources are highly elevated the turn-over rate of air will be more than twice an hour causing draughts and high energy consumption. Ventilation may thus be used up to a certain point and should be combined with other technical measures.

Many Swedish homes use ventilation techniques based on natural draught that is highly uncontrolled using the thermic power of the air. The turn-over rate of air may be as low as 0.1 per hour. As a mean of lowering energy costs the authorities have lowered the recommended turn-over from 0.7 to 0.5 per hour. Tightening of windows and other measures taken by the inhabitants have certainly increased the number of homes with insufficient ventilation.

Swedish authorities have paid much attention to the radon problems, resulting in 1978 in enforced research and investigation activities financed by the Swedish Council for Building Research and described below.

1. The basic knowledge of risk evaluation of radon has come from the mining industry. Consequently, results are not easily transformed to circumstances in Swedish housing. The amount and spreading of especially radioactive building materials is unknown to a large extent. - Finally ventilation standard is unknown and assumed to be low in many houses. Although some Swedish houses have been identified to be rather radon-contaminated, the total knowledge of radon stands on a weak basis. Therefore, the Council initiated in 1978 a project with a view of planning a total programme where research activities should be enforced. This plan will be presented in the summer of 1979.
2. In Swedish homes having elevated levels of radon either from building materials or from the ground, steps should be taken to reduce the activity. In a joint project between research institutions and building industries different techniques are used and the results will be evaluated. The techniques are basically a) a more efficient ventilation b) use of diffusion resistant films in order to seal wall surfaces and c) elimination of certain ac-

tive materials. The project started in January 1979 and will be reported towards the end of the year.

3. Electrofilter may effectively reduce the concentration of the radon progenies. In a current project this technique is being evaluated in the laboratory.

Jan Werner, Swedish Water and Air Pollution Research Institute, P O Box 21060, S-100 31 Stockholm

Dialogues with a computer provide more efficient planning of district heating systems

When planning the layout of a district heating network for a complete built-up area or parts of such an area, manual calculations have been most commonly used until now. In addition to the fact that these demand a considerable amount of time they restrict the planner's opportunities of carrying out a variety of calculations concerning system designs for different environments. In order to make such calculations, in terms of work in-put, in a more economical way, computers must be used.

One project, the findings of which are expected to be of considerable value to planners of district heating systems will start in July this year at the Department of Heat and Power Engineering at the Lund Institute of Technology. The Council has approved a grant of Skr 176 000 and Sydkraft AB will contribute a further Skr 50 000. The project is also expected to provide new approaches to the comparison of the efficiency of different district heating systems and provide ideas about how this can be increased in existing systems.

An interactive graphical computer programme will be developed for the layout of district heating networks. This programme will allow the planner to analyze the technical and economic consequences of different layout alternatives.

The model is not intended to provide a "total optimization" of networks but instead to permit the user to hold a continuous dialogue with the computer, maps and networks being fed into it enabling the operator to come up with increasingly improved solutions. In this way use is made of the operator's own knowledge and experience while freeing him from the time-consuming work involved in making calculations. The model supplements, but does not replace, the streaming models that are currently available in a number of places.

The project first involves a study of problems concerning technical, economic and physical planning and the graphical problems involved with the feed in and out of maps and network outlines. This study will be followed by the development of a computer model and a simple data base which will be tested on a suitable object. An evaluation of the whole project is expected to be carried out in the autumn of 1980.

Lennart Thörnqvist, Department of Heat and Power Engineering, Lund Institute of Technology, P O Box 725, S-220 07 Lund 7

Local authority energy planning

Models for the evaluation of multi-technology systems

When designing systems for the provision of energy, many factors must be taken into consideration. Among these are the availability of primary energy sources, the magnitude and character of energy consumption, the structure of development as well as particular economic and political factors. To determine the complicated relationships between these factors a system-oriented analysis of energy provision is required.

The Swedish Council for Building Research has approved a grant of Skr 518 000 to the Department of Electric Power Systems Engineering at the Royal Institute of Technology in Stockholm, to carry out an analysis of multi-technology systems in energy planning. A computer-based macro-system model will be developed which will include the following micro-models:

- new technology and techniques for energy systems
- the development and characteristics of energy loading
- societal developments - energy requirements
- energy systems and the structure of development

Research will concentrate on two main areas:

- the evaluation of the control complex and energy savings
- the provision of energy in future energy systems

The findings will be primarily used as aids for local authority energy planning with regard to the evaluation of the technical, economic and social aspects of energy systems.

Professor Janis Bubenko, Department of Electric Power Systems Engineering, Royal Institute of Technology, Fack, S-100 44 Stockholm

Heat pumps utilizing surface earth heat

Heat pumps utilizing surface earth heat can be operational throughout the year and have shown advantageous energy properties even during cold winter periods. Heat pumps systems of this type are still in the development stage in Sweden. Experience of these systems has shown that the dimensioning of earth heat exchangers is of considerable importance for the economics of these systems. A better understanding of the way in which geohydrological factors e.g groundwater levels and movements, affect energy and power outputs, will mean that dimensioning can be carried out more economically.

A project with the objective of increasing the knowledge in this field has been financed by the Council (totalling Skr 1 180 000 as a grant and Skr 200 000 as a loan). By carrying out measurements in a newly built housing area, attempts will be made to find out whether groundwater levels and movements affect the energy and power output of heat pump systems.

It is proposed that 24 homes are to be built as semi-detached and detached houses. Half of the houses will be supplied with water-borne electric heat, the other half will be provided with surface earth heat pumps and water-borne heat.

Measurements of earth heating systems utilizing groundwater have not been made previously. The measurements will provide data for calculations concerning the dimensioning of earth heating systems with regard to groundwater and in terms of e.g. the degree of utilization, the density of the installation, the restoration of groundwater levels etc. It is the intention that the measurements will show whether dimensioning can be based on other principles than those currently used.

The project is being carried out jointly by Orsa Companie AB and two departments at the Chalmers University of Technology in Gothenburg - the Department of Geology and the Department of Heat Power Technology. Further information about the project can be obtained from Chalmers University of Technology, Department of Geology or the Department of Heat Power Technology, S-412 96 Göteborg.

Tests of various energy systems in a block planned for energy conservation

A model for a block planned for energy conservation at Eslöv in the south of Sweden has been presented in a preliminary study (Report R16:1979, in Swedish). It proposed tight-knit, small-scale varied development with integrated social facilities. The street area is to be glazed over and will serve as a combined service, energy and social zone.

In the second phase of this research project for which the Council has approved a grant of Skr 535 000 it is primarily the intention to study and evaluate different alternatives for the construction of the energy system. Since the model for Eslöv assumes the integration of different types of development such as schools, institutions, shops and homes and a variety of energy components, many opportunities are provided for the organisation of the total energy system.

The heat storage unit, located underneath the glazed-over street, is the section that is the most difficult to evaluate. In order to design this, the relationships between the storage unit and the ground must be studied as well as the buildings and the street area. In addition, heat pumps, solar collectors, air exchange and insulation systems must be designed and analyzed.

On the construction side, a study will be made of the construction of the glazed unit, sanitary units and the street itself.

Kjell Norbäck at Sydkraft AB is responsible for the energy section and Peter Broberg, Landskronagruppen for the construction section.

Storage of heat by Gunnar Wettermark

A review of methods and possibilities for the storage of heat has been presented by the Department of Physical Chemistry at the Royal Institute of Technology, Stockholm under the direction of Professor Gunnar Wettermark (Document D2:1979).

The report provides a broad, comprehensive presentation of possible storage methods. It deals, amongst others, with

- the role of heat storage in different energy systems
- the storage of heat in passive and active solar heating systems
- the storage of sensible heat
- the storage of latent heat - phase conversion
- thermochemical reactions

The report concludes with a review of the American R & D programme on heat storage.

The report can be ordered from Svensk Byggtjänst, P O Box 7853, S-103 99 Stockholm
Price: Skr 45

New Publications

Growth and Transformation of Cities

The Proceedings of the 1978 Stockholm Symposium on Growth and Transformation of Cities are now published by the Council. The objective of the symposium was to compare the physical growth of Stockholm during the past hundred years with that of other big cities.

In the Proceedings four experts on urban research deal with the growth of Stockholm from different aspects and provide an up-to-date survey of the development of modern Stockholm.

A number of leading urban research specialists from Scandinavia, United Kingdom, the United States and other countries present various problems connected with urban growth in various countries during the past hundred years in articles such as Architecture and civic design in nineteenth-century Paris, The growth and transformation of Scottish towns, Environmental control and planning in European capitals 1850 - 1914: London, Paris and Berlin, The European city in the year 2000.

The book can be ordered from the Swedish Council for Building Research, Information Unit, Sankt Göransgatan 66, S-112 30 Stockholm, Sweden. The price is Skr 95 and orders must be accompanied by cheque.