NEW SNOW AND ICE RESEARCH LABORATORY IN CANADA

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New low-temperature laboratories consisting of two rooms designed to give the necessary controlled low-temperature environment were put into operation in July 1954 by the Division of Building Research of the National Research Council of Canada. One room is to be used primarily for experiments related to cold weather building research and the second for experiments on snow and ice. The rooms operate over the temperature range +40° F. to −50° F. (+4·4° C. to −45·56° C.) controlled to ±0·5° F. (0·27° C.).

The need for a cold room in which research studies on snow and ice could be carried out under controlled conditions was recognized from the inception of the Building Research Division in 1947. Since that time every possible opportunity has been taken to obtain advice on the design and construction of such a room. The advice of Dr. M. R. de Quervain, Director of the Swiss Federal Snow and Avalanche Research Institute at the Weissfluhjoch, Davos, Switzerland, and of members of the staff of the Snow, Ice and Permafrost Research Establishment of the United States of America proved to be most useful and is gratefully acknowledged.

A brief description of the rooms and associated refrigeration equipment and the nature of the work planned for the snow and ice cold room follows. A more detailed description of the construction of the rooms and of the refrigeration system will be published at a later date.

Construction of Snow and Ice Cold Room

After many months of detailed planning, the actual construction of the rooms began in November 1953. The snow and ice cold room is a box 22 ft. 7 in. by 18 ft. 11 in. by 11 ft. 9 in. (6·9×5·8×3·6 m.) completely enclosed in a sheet-copper vapour seal and resting on sleepers 2 in. (5 cm.) off the concrete basement floor. The walls, floor and ceiling of the room are wood frame, 10 in. (25 cm.) thick containing 8 in. (20 cm.) of glass wool insulation. Entrance into the room is through a door 3 ft. 6 in. by 6 ft. 6 in. (1·1×2·0 m.) ("A" Fig. 1, p. 637), into an airlock 6 ft. by 4 ft. 5 in. by 9 ft. 6 in. (1·81×1·3×2·9 m.) and then through a second door ("B" Fig. 1) into the room proper. The inside dimensions of the cold room are 21 ft. by 17 ft. 4 in. by 9 ft. 6 in. (6·4×5·3×2·9 m.). A floor area of 4 ft. by 17 ft. 4 in. (1·2×5·3 m.) is taken up by the diffusers against the back wall and 7 ft. 10 in. by 5 ft. 2 in. (2·4×1·6 m.) by the airlock. A false ceiling of perforated asbestos board reduces the floor-to-ceiling height to 8 ft. 9 in. (2·7 m.).

No permanent service connexions were brought into the cold room except those required for the refrigeration equipment and room lighting. Three service panels each consisting of twelve 2 in. (25 cm.) diameter capped entrances arranged in three rows of four were installed at "C", "D" and "E" (Fig. 2, p. 634). Any services such as electrical connexions required from outside the room during the operation of an experiment can be brought through one of the 2 in. diameter ports. At "F" is located a window 18 in. by 24 in. (0·45×0·6 m.) consisting of four spaced sheets of glass sealed in place for visual observation into the cold room.

Ventilation is provided for the room at the rate of 30 cu. ft. (0·84 cu. m.) per minute through a cooling coil and duct serving each of the two diffuser units (Fig. 2). Air flow is induced by the action of the fan in the diffuser unit, and precooling and dehumidifying of the entering air are accomplished by the small cooling coil.

Mechanical Equipment

The refrigeration load for both rooms is carried by three identical sets of two-stage, 30-horse-power, direct-expansion compressors employing monochlorodifluoromethane (Freon 22) as refrigerant. One unit is permanently connected to diffuser 1 in the snow and ice cold room, the second unit to diffuser 4 in the other cold room and the third unit can be connected to either diffuser 2 in the snow and ice cold room or diffuser 3 in the second cold room as required. This arrangement offers the possibility of increased capacity for rapid "pull down" of a room (two compressors working on one room), allows continuous operation of the cold rooms when one set of diffuser coils must be defrosted, and gives good measure of protection in the event of mechanical failure of one of the units. Each unit has enough capacity to carry the estimated maximum "holding" load.

Each compressor, when in use, operates continuously. After the air is cooled by the evaporator coils in the diffuser, it is reheated to provide the room temperature desired by electrical heaters. The capacity of the compressors can be varied by manual unloading of cylinders to match approximately the heat load of the room and thus keep the reheating to a minimum. The electrical heaters, in each diffuser unit, used for reheating the air have a maximum output of 12 kilowatts.

When the coils in the diffuser operating have accumulated a large amount of ice, this unit is shut down after the cooling load has been transferred to the second diffuser in the room. The ice on the coils can then be rapidly removed by electrical heaters without affecting temperature conditions in the room.

Fig. 3 is a view of the mechanical equipment room in which the compressors are located. The location of this room in relation to the two cold rooms is shown in Fig. 1. A 1-horsepower refrigeration unit is used to keep the temperature of the airlock close to the temperature of the room.

Air Circulation Inside Snow and Ice Cold Room

In order to achieve the close control of temperature desired in the working space of the room, a high rate of air change was necessary. In normal cold room construction this results in large, localized drafts which are uncomfortable at low temperatures. In the D.B.R. snow and ice cold room, the air, which has passed through the cooling coils and been reheated to provide the control temperature, goes from the diffuser into the space between the main ceiling and false ceiling of the room. The air is forced through perforations in the asbestos board ceiling and gives uniform distribution throughout the room at a velocity which is acceptable even at low temperatures. (The rate of air change can be altered by changing the speed of the three-speed motor driving the air circulating fan.)

At maximum fan speed the variation in temperature throughout the room is not more than $\pm 1°$ F. (0·5° C.) while the control operates to $\pm \frac{1}{4}°$ F.

Area Layout

Inside the cold room the layout in the working space has been kept flexible. At present a lathe and band saw for preparing ice samples for strength tests are located at "H" and "I" respectively (Fig. 1). Bench space, which is movable, is provided at "J" along the front wall. In order to give the maximum free area, bench space will be increased or decreased with the demand. A table is located at "K" to be used in conjunction with the lathe and band saw for preparing ice specimens. On the table at "J" is mounted a small testing machine of 2000 kg. capacity.

Outside the cold room is an air conditioned working space whose layout is shown in Fig. 1. This space is used as a general working area for various tasks, including setting up experiments to be carried out in the cold room, storing instruments, constructing apparatus, and locating apparatus associated with experiments in progress in the cold room. A small low-temperature cabinet is located in this room ("G" Fig. 1) in which small-scale experiments can be carried out.

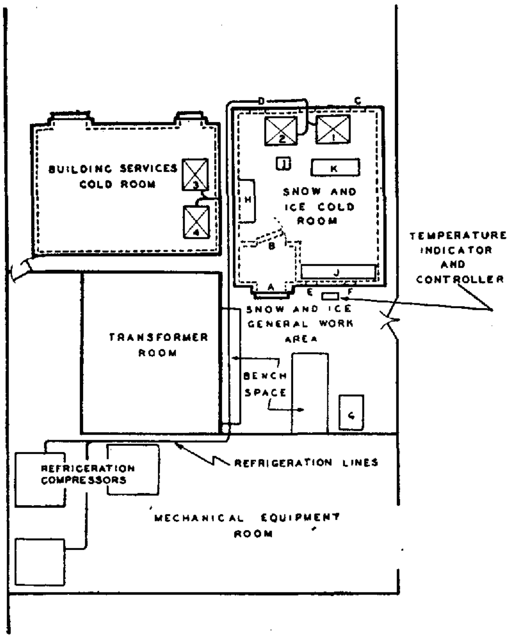

Fig. 1. General layout of cold rooms and associated refrigeration equipment

WORK TO BE CARRIED OUT IN THE IMMEDIATE FUTURE

The initial program to be undertaken within the cold room will be modest because of the shortage of staff. Work has begun on measuring the ultimate strengths of ice in tension and compression and the influence of temperature and rate of loading. This will be followed by studies on the elastic and plastic behaviour of ice. This work is to form the foundation for an approach to the problems of determining the bearing strengths of ice sheets, the loads which can develop against structures from static ice, and the loads which can be exerted against structures by flowing ice.

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A GLACIER WATER-SPOUT IN SPITSBERGEN

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ON 14 July 1953 some members of the Oxford University West Spitsbergen Expedition saw a glacier water-spout near the foot of the Von Postbreen, Tempelfjorden. Its spouting lasted only a few seconds. On closer investigation the source was seen to be at a point where a small melt stream crossed a closed crack in the ice and had developed a glacier mill at the crossing. The spout repeated itself several times whilst the party watched, and it was photographed.

The point where it occurred was about 2 km. from each side of the glacier, and some 6 km. from the snout. The height was about 200 m. above sea level. There was no medial moraine, the nearest moraine being the lateral moraine 2 km. away. The glacier surface at this point was level, being situated between the two steeper parts of the Von Postbreen, as indicated in the longitudinal profile, Fig. 1 (p. 639).