

# INDOOR THERMAL STRESS IN ANTARCTICA

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ARMY PERSONNEL RESEARCH ESTABLISHMENT

## INTRODUCTION

It has been argued that life in Antarctica is associated with little or no cold stress. This was based on man spending only 9-15 % of his time outdoors<sup>1,2</sup>, whilst experiencing indoor air temperatures similar to those in temperate climates<sup>3</sup>. An indoor temperature of 15°C +/- 2°C has been described as acceptable and satisfactory<sup>4</sup> while at Australian Antarctic stations, air temperatures of 18°C were recorded, suggesting little cold stress<sup>3</sup>.

The British Antarctic Surveys' southern most base, Halley Bay, is located 1280 kms from the South Pole on a floating ice shelf 175 metres thick. The base was constructed of Armcø steel tubing inside which was found the living and working accommodation. Originally built on the surface the base gradually became submerged as snow accumulated around it. In 1978 it was buried to a depth of 10 metres. Entrance and egress was via vertical shafts which were extended regularly as more snow accumulated. The temperatures described above applied to stations constructed on terra firma where the indoor thermal environment had no effect on the life expectancy of the base construction. However at Halley Bay, surrounded by ice, strict control of the indoor temperature was essential to prolong the useful life of the structure and prevent subsidence.

The aim of this study was to examine the indoor thermal environment at Halley Bay.

## METHOD

A biometeorological record was compiled from the daily synoptic observations made by the scientists. Indoor temperatures were recorded using a Comark Electronic Thermometer and Cu-Ni thermocouples. The thermocouples were enclosed in clear plastic tubes, open at each end, to dampen the effects of air movement. These were attached to a wooden pole 208 cm long and positioned at 2.5 cm, 30.5 cm, 61.0 cm, 91.4 cm, 122.0 cm, 152.4 cm, 183.0 cm and 203.2 cm above floor level. Measurements were made at 39 work stations on 24 occasions between Mar - Dec 1978. A thermograph, temperature range +5°C to -40°C, was positioned in a commonly traversed Armcø corridor linking the dormitory and living block, near the latrine.

## RESULTS

The outside temperatures ranged from +2.7°C to -47.7°C with a maximum monthly mean of -5.2°C and a minimum monthly mean of -28.7°C. The annual mean wind speed was 15.9 knots. It was observed that as the wind speed increased so did the temperature and vice versa. The sun set in mid April rising again in August giving 2 months total darkness and 2 months twilight.

The mean office temperature was 11.9°C (maximum 24.9°C and minimum -8.8°C). The mean workshop temperature was 4.1°C (maximum 22.0°C and minimum -24.4°C; both in the generator shed). The mean internal corridor temperature was 6.0°C (maximum 19.2°C and minimum -17.1°C). The Armcø corridor temperatures (ie. those corridors linking the buildings under the ice) were; mean of -3.4°C with a minimum of -23.3°C and maximum of 9.5°C. The mean temperature in the washroom was 15.5°C with a maximum of 34.7°C and a minimum of -6.5°C while the drying room had a mean of 14.6°C (maximum 35.1°C and minimum -6.1°C). The minimum temperature in the latrine was -21.1°C and in the toilet -9.6°C; fortunately gastro-enteritis was not a problem. On each test occasion a minimum temperature sub-zero was recorded in the workshops, corridors, Armcø corridors, washroom and drying room. The coldest temperatures were invariably at the lowest levels although stratification was in evidence. The results from the thermograph were; 100 % of the time was spent sub-zero; 53.2 % of the time was below -10°C; 6.6% of the time below -20°C and 1.6 % of the time below -25°C. A large thermal gradient existed across the complex both vertically, due to stratification, and horizontally. A man working indoors might walk from the surgery, with a mean temperature of 15.7°C, towards the kitchen and experience a temperature fluctuation of 47.3°C; leave and walk to the garage with a range of 44.4°C move on to the toilet and experience a range of 49.3°C.

## CONCLUSIONS

Scientists in **Antarctica** are exposed to little cold stress while living and **working at** bases constructed on terra firma. However where man lives a troglodytic **existence** submerged **beneath** the surface of a floating ice shelf, **constraints on** the internal thermal **environment** are **necessary**. In **these** circumstances it must be concluded **that** scientists at Halley Bay do **not** live and work in temperate surroundings but **are** exposed daily, indoors, to **marked cold stress**.

## REFERENCES

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