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The potential and need for energy saving in standard family detached and semi-detached wooden houses in arctic Greenland

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ABSTRACT

The paper gives an account of the potential and need for energy saving in standard family detached and semi-detached wooden houses in Greenland. It is based on studies of house construction compared with Building Regulation requirements and the spread of buildings over time. In the climatic conditions of Greenland, there is considerable potential for energy saving in houses due to their construction, shape and condition. To estimate the total potential for energy saving and thus reducing CO_2 emissions, we carried out a detailed investigation of three typical standard semi-detached family houses (type 18D). Temperature, relative humidity and air tightness were measured, and thermal bridges were determined from drawings, visual inspection, and by using a thermal camera. The findings show a current energy consumption of up to 383 kWh/(m^2 a) for heating, poor air tightness, a large number of thermal bridges, and high indoor temperatures. We demonstrate a potential for a reduction in CO_2 emission by a factor of 10. Finally, the paper describes a practical way of reducing thermal bridges significantly, increasing air tightness, upgrading insulation and adding mechanical ventilation to approximately half of the housing stock without changing the architectural expression or having to relocate the occupants during the renovation.

1. Introduction

This paper gives an estimation of the potential for energy savings, and thus reductions in CO_2 emissions, in detached and semi-detached family houses in Greenland based on calculations, measurements, and studies of the construction of the houses compared with Building Regulation requirements and the spread of buildings over time.

Studies of the literature show that very little has been published on energy savings in buildings in the arctic climate and the implication on the environment. A performed study by Tobiasson [1] describes the needs and research necessary for buildings and utilities in very cold regions. The article by Norling [2] is based on studies of the project carried out in 2005 of a new Low-energy house in Greenland where the target was to build low-energy building fulfilling the requirement of Greenlandic Building Regulation 2006. The publication by Vladykova [3] deals with building renovation and briefly outlines the possibility of energy savings in a wooden house in Sarfannguit, Greenland. The national Statistic gives information's on the average energy consumption for heating in detached and semi-detached houses in cold climate countries. Greenland's Statistics [4] shows that an average household with an average floor area of 65.5 m^2 uses 416 kWh/(m^2 a) for heating and Norway's Statistics [5] shows 181 kWh/(m^2 a) with an average floor area of 119 m^2 and Canada's Statistics [6] has heating consumption of 231 kWh/(m^2 a) with an average floor area of 134 m^2 for detached, semi-detached and row houses.

The contribution of this article lies in its outline of a systematic method of energy renovation and a remarkable reduction of CO_2 using standardised packages for the renovation of more than half of the housing stock in Greenland. The method is significant in the number of houses it applies to and in the way it adds the air tightness and the vapour barrier from the outside - a method which gives a better technical solution and interferes very little with the interior, making it unnecessary to relocate the occupants. The solution is expected to be broadly accepted since it preserves the architectural expression of the houses. The originality of the work is based on the combination of a study of the Building Regulations over time, the reuse of packages solutions based on the methods of house construction and implementation in Greenland, common knowledge and findings from the investigation of three standard wooden houses.

Energy savings and reductions in CO_2 emissions are important for the climate, and Greenland is actively working on a reduction of CO_2 emissions by 8% (from 1990 level) over the period 2008–2012 [7]. Although the price of oil is relatively low for the end–consumer at present, oil is a limited natural source. Greenland has to prepare

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