Existing housing stock in the UK and the thermal insulation challenge: case of granite traditional constructions in the United Kingdom.

BENNADJI, A., SCOTT, J. and TAYLOR, B.

2009

Existing housing stock in the UK and the Thermal insulation challenge

Case of granite traditional constructions in the United Kingdom

Bennadji Amar, Scott Jonathan and Taylor Bruce

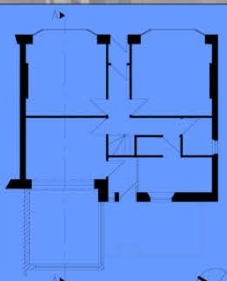
Scott Sutherland School of Architecture and Built Environment, Faculty of Design and Technology, The Robert Gordon University, Aberdeen, UK

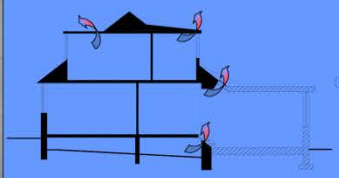
ABSTRACT: *The increase in energy price has sparked a debate in the UK as to what would be the best way to address this problem. Various political parties and civil societies are also concerned and various responses to the crisis are being suggested and debated. The British Prime Minister; after a long debate about waiving the tax related to the cost of energy; gave a straightforward and radical answer. It was suggested that the existing building stock should be improved to reach a certain standard. The goal is to reduce the energy consumption which will ensure a reduction in the running cost of household and commercial assets in the UK. The government initiative was to make grants available to dwellings that shows a lack of energy efficiency this includes the increase of insulation of the buildings' envelop as well as renewable energy generator and end use equipments.*

The CO_2 emissions per capita and the reduction of the national dependency on finite fossil fuel resources are achievable via major refurbishment programmes of both owners occupied and rented properties. Many of the easy measures have been done, leaving only the major areas that need addressing. These areas are complex and expensive therefore home owners and private landlords are deterred from addressing them. Incremental improvements are no longer cost or physically effective, however; therefore a holistic and integrated approach to buildings' refurbishment is required. The aim of this research is to present the different possible scenarios of refurbishment based on the most popular building typologies in the UK, focusing on typical case studies in Aberdeen as exemplars.

Keywords: CO_2 emission, energy saving, existing housing stock, thermal insulation

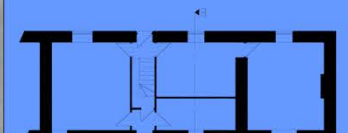
Above: View of house 2 Below: Locations of cold spots in fabric caused by alterations and changes in building regulations



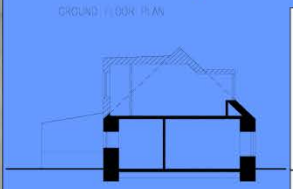


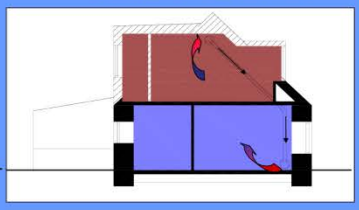
Case Study One: Semi-detached dwelling house, suburban, 1930'S.

Originally this granite dwelling had four family rooms downstairs, two upstairs home. This has undergone significant adaptation during the intervening period due to changing demographic, technology and fashion. Significant alterations have been conducted to include space additions to the roof and most recently to the rear of the building. Technologically, there has been a change to the heating and an increase in the electrical appliances within the building. With these changes over different periods, it is anticipated that improvements to the building/additions are not consistent throughout the building. For example, the building fabric in different locations will vary and without a thorough building survey, it is unlikely that any one u-value is known or accurate, for a variety of reasons. This will lead, in practice, to 'cold spots' in many existing buildings. Likely locations for these 'cold spots' are the joints between each additions. An easy solution would be to insulate the exterior of these buildings. For granite wall buildings in Aberdeen the city planning authorities rule out the use of external insulation – granite forms the cultural identity of the character of Aberdeen, therefore the easy option for Granite buildings (simply putting insulation on the exterior) is simply not an option, and this is the same for most of the older, historic buildings in Urban and Rural settings.



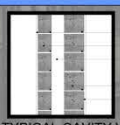
Above: View of house 2 Below: Proposed Solution (not adopted)





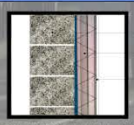
Case Study Two: Semi-detached rural house, late 18th century.

Originally a home with an attached workspace, this rural dwelling has undergone several changes throughout a long lifespan. Large, solid granite walls prevent significant alteration or upgrading of the building fabric on the lower storey, with a conservatory the only physical space added at this level. The roof space, in this instance, is where the house has been developed. There is very little insulation and no large windows in the ground floor, conversely the upper storey has large south facing glazing and an insulated envelope (built in the early 1980's). Initial post occupancy study highlights the significant increase in temperature in the upper storey, while the lower ground floor remains cooler (in the homeowners' opinion). In this instance, the change in the pattern of use of the building is problematic – daytime activity is in the lower storey, which is cold therefore the heating in the building remains 'on' even on moderately warm summer days. In the evenings, with the upper storey on the same heating loop and benefiting from passive gains, is where significant heat build up occurs. This could be used or perhaps stored, but in this instance it is not, with the preference to release the heat by opening a window. With the ventilation at night, the sequence begins again as no heat is stored overnight and the lower storey remains 'cold' to the home user (especially in the early morning).

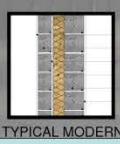


TYPICAL CAVITY WALL DETAIL PRE '60's

TYPICAL TIMBER FRAME WALL DETAIL



GRANITE WALL DETAIL WITH RIGID INSULATION



TYPICAL MODERN CAVITY WALL DETAIL

TYPICAL MODERN T / F WALL DETAIL

GRANITE WALL DETAIL WITH BLOWN INSULATION

DISCUSSION

The two cases addressed in this paper are very limited comparing the wide range of housing typologies in the UK. Nevertheless, they represent a specific, existing and older construction type which is prevalent throughout the UK. Despite the close similarity between the two construction types presented in this paper, one of them required a reconfiguration of its internal space distribution and the other still requires further investigation on how its insulation can be achieved with respect to the integrity of the interior design. The failure of the cavity fill insulation in the first case was fortunately discovered at an early stage otherwise the lath structure could be rotted and an entire costly refurbishment operation would have been required.

On the other hand the rejected alternative solution, despite its acceptable technical standard, the soul of the internal spaces was not appreciated by the owner; therefore the solution should be technical and maintain the originalities of the existing housing stock. The limited availability of qualified and experienced labour will constitute another challenge, and guidance on how to deal with the large numbers of housing typologies that the UK contains should be issued to various agencies involved in informing the future labour force. This process will take more than two decades to be solved and a scientific study with a focus on a better control of energy consumption and CO2 emission should be conducted. The proposed research will also garner understanding of the social and psychological impacts of the potential radical restructuring of British housing estates. Other type of buildings, such as large office buildings, benefit from integrated information systems that assist architects and designers to achieve better energy conservation, the housing area does not benefit from such integrated systems and a parallel development still needs to be achieved, the skills and technology based on academic research.

CONCLUSION

The first case study shows building constructions for which there is not yet a robust way of upgrading insulation and therefore further research is required to widen the range of dwellings that can be successfully and safely upgraded. The need for whole systems approach for refurbishment or extension of a dwelling is illustrated by the second case study. All the issues with existing houses in Aberdeen and current methods or practices are not adequate. Hence, there is a need for further research to explore or evaluate the best methods for building insulations.