

CIOB CARBON ACTION 2050

RE-USE OF BUILDINGS

1. Introduction

Decisions on whether to re-use buildings or replace with new ones will very often be flawed because not enough is known about the energy performance and sustainability of either new or existing buildings.

The majority of construction activity concerns what we do to existing buildings and not in the construction of new ones (1). There are also various estimates of how many of today's buildings will exist in 2050 with a figure of between 70% and 85% commonly quoted. That means a necessity to focus on what we do with our current building stock in terms of its use, re-use, management, retrofit and refurbishment.

2. Feasibility and the need for a well-informed approach

As buildings are such valuable assets, mistakes can be costly. Consideration for refurbishment and new uses is made via feasibility studies and options appraisals. These take account of potential viable uses, the investment needed and on-going costs in use. This can then allow a comparison between re use of an existing building with the construction of a new one. Whilst there can be a fair degree of accuracy in costing the initial work, the costs in use are much more difficult to accurately calculate and will increasingly see energy costs as a significant proportion that will increase in size over the life of the building. Without a much more informed approach to costs in use any analysis that compares re-use with new construction will be flawed (2).

3. Understanding real energy performance

Unfortunately the assessment of energy performance is an unreliable process whether the building in question is traditionally built or whether it is new. Without reliable data, feasibility studies are flawed potentially leading to poor decisions.

One case study by the London Better Buildings Partnership of two modern office buildings in the City of London highlight that a building designed to an energy rating 'E' was 66% more energy efficient than a similar building designed to an

energy rating of 'C' (3). Another study from the same partnership involving an analysis of two million square metres of office space undertaken between 2011 and 2012 found that they all have a similar performance regardless of their energy rating. Click for more information:

[\(http://www.betterbuildingspartnership.co.uk/](http://www.betterbuildingspartnership.co.uk/)

Energy efficiency of domestic new construction is also unpredictable. For example, research by Leeds Metropolitan University has highlighted serious concerns about the reliability of energy efficiency in newly constructed homes (4. Construction Manager May 2012, p 20-22).

Traditional buildings were once regarded as 'carbon villains' by the Energy Savings Trust (5), but analysis of energy costs provides the opposite view. A 2007 study of Courts Service buildings (ref 6) see traditional buildings being the most energy efficient.

Studies of individual elements of buildings have also provided results which are different to those that are commonly understood. Analysis of actual U Values of traditionally built walls compared with theoretical values contained in energy performance software highlight that that about three quarters of walls could be providing better energy performance than predicted and on many occasions by a marked degree. As walls on average relate to just over a third of total heat loss, such a discrepancy between actual and assumed U Values have a significant impact on the result of an energy assessment process. This skews any analysis on the overall performance of a building and could lead to flawed decisions concerning proposed energy efficiency measures or indeed lead to proposals for replacement of a building (7).

Box sash timber windows are another example. These were considered to be inefficient and replacement with UPVC double glazed windows is common practice. However, a study has shown that repairing and draught proofing an existing window and applying secondary glazing can provide a U Value which is at least as good as a standard UPVC double glazed window (8). This is also more cost effective as the RICS have predicted the pay back for a UPVC window could be over 120 years (9) which is perhaps four times longer than the UPVC window will last by conservative estimates.

One major influence over energy performance is the maintenance and operation of buildings. Comfort levels are much higher than they were 50 years ago (10), different occupiers will demand varying levels of comfort, and evidence suggests that when buildings have been thermally improved, there may be a tendency to 'take back' the increased energy savings by occupants being able to 'afford' to increase energy use.

4. Building maintenance to provide energy efficiency and sustainability

The maintenance of buildings can have a profound effect on energy performance. Building services and equipment has an obvious connect with this, but it also relevant to building fabric. Damp walls for example could be over 30% less energy efficient than a comparative dry wall (11) and some manufacturers of liquid water repellents for use on masonry are now claiming that they are an energy efficiency measure (ref 12 Francois Samuel) as their main selling point.

This all points towards maintenance and repair being the primary energy saving measure. It means that basic maintenance such as clearing overflowing gutters that discharge water on to walls is necessary to save energy.

5. Understanding the analysis and judgements required for sustainability

With such unpredictability in almost all areas of activity it is not surprising that there is so much discrepancy between planned and assumed with reality. However, if there is a concerted focus on learning from what really happens, there is a much greater chance of making better decisions in the future.

The Sustainable Traditional Buildings Alliance (STBA) have highlighted many of these issues and have promoted a risk management approach to retrofit based on the best available understanding of a buildings performance (ref 13).

A risk management approach to retrofit involves making decisions on re-use that best suits the sustainability of the building. This can mean prioritising measures that are known to work and will not damage the existing building fabric and the health of occupants. For example, solar panels provided they are installed properly will not damage the structure of a building. It also means great care taken towards measures whose use is not always well understood and which could pose potential risks in some situations. One example is internal wall insulation for use with traditional buildings where the STBA have highlighted that there aren't any systems that have been tested in real life situations.

A more thoughtful approach to refurbishment would also make re use more sustainable. For example matching a use with what the building can passively achieve, or which could be achieved with minimum measures that avoid increased use of energy. If environmental conditions of internal spaces were known before space use decisions were made this could, in some situations, obviate the need for air conditioning or mechanical ventilation systems. This

would require a proper analysis of the building, including the monitoring of its environment and intelligently modelling what conditions could be created with different retrofit measures. The latter can be achieved to varying degrees of accuracy dependant on the building type.

6. Making carbon conscious decisions.

The foregoing discussion looks at decisions relating to the performance and suitability of re-using buildings compared to replacing them with new buildings. Re using buildings must also consider the carbon produced from the initial work involved in adapting and retrofitting an existing building compared to carbon produced in the construction of a replacement building, known as capital carbon. The analysis must also properly consider the carbon produced in the use of buildings, known as operational carbon. Whilst studies have indicated that re using existing buildings is more carbon efficient than replacement with new (14) it is important to consider carbon efficient practices in retrofit and refurbishment works. The attributes of retaining existing windows has already been described, which reduces capital carbon that would result from replacement windows. When you consider the amount of energy required to produce other elements and components, it emphasises the advantage of re-use over a replacement building and also the need to re-use existing materials. The manufacture of one tonne of bricks requires a lot of energy and is claimed to be equivalent to about 100 litres of petrol, but the re-use of bricks is only feasible when walls have been constructed in lime mortar. The potential for re-use of materials and components should be considered at the outset.

7. Conclusion

This paper highlights some of the most important issues to be considered, with more information being available from the web site sources and references. Common approaches are not necessarily the best ones and clearly there needs to be a much better understanding of all these issues within industry and also by clients. It is important to understand that there aren't any standard solutions, but there is a standard approach based on looking beyond common assessment methods and going back to basics by properly analysing the design, construction and real performance of buildings based on studies of what performance is being achieved. This paper has highlighted some of the studies which have taken place and unfortunately there are far too few of them. More analysis is needed.

In the meantime practitioners must take the risk analysis approach and follow decision making with a focus on prioritising what we know and understand against what is unpredictable and carries potential risks.

Whilst it is inevitable that decisions on re- use or building replacement will be based upon inadequate knowledge on building performance, it is safe to say that normally re-using an existing building will be more carbon efficient.

By John Edwards FCIQB, March 2013

Further information and guidance

1. Buildings under refurbishment and retrofit, March 2011, CIOB Carbon Action 2050.com
2. Buildings in operation and maintenance, March 2011, CIOB Carbon Action 2050.com

References

1. HOWARD, N., Sustainable Construction – The Data, Centre for Sustainable Construction 2000, Table 1.
<http://projects.bre.co.uk/sustainable/SusConstructionData.pdf>
2. BORDASS W., Flying Blind: Things you wanted to know about energy in commercial buildings but were afraid to ask:
[http://www.ukace.org/publications/link here](http://www.ukace.org/publications/link%20here)
3. The London Better Buildings Partnership
<http://www.betterbuildingspartnership.co.uk/>
4. Construction Manager May 2012, p 20-22
5. Retrofit Buildings.com for Energy Efficiency
<http://retrofitbuildings.com/featured-articles/90-carbon-villains-very-misleading.html>
6. BRE, Cutting down on carbon, improving the energy efficiency of historic buildings (BRE), 2007:
<http://www.helm.org.uk/404.htm?aspxerrorpath=/upload/pdf/BRE-seminar.pdf>
7. Society for the Protection of Ancient Buildings Energy Efficiency Research:
<http://www.spab.org.uk/advice/energy-efficiency/>
8. Historic Scotland, Technical Paper 1, 2010: Thermal Performance of Traditional Windows: <http://www.historic-scotland.gov.uk/gcu-technical-thermal-efficiency-traditional-windows.pdf>
9. Royal Institution of Chartered Surveyors, BCIS energy efficiency of a sample property 2008: <http://www.docstoc.com/docs/21819538/Energy-Performance-Certificate---Sample-Property-Priced-Schedule-of>
10. Historic Scotland, Technical Paper 14, 2011: Keeping Warm in a Cooler House: <http://www.historic-scotland.gov.uk/technicalpaper14.pdf>
11. Building Conservation Directory 2012:
<http://www.buildingconservation.com/articles/solid-wall-construction/solid-wall-construction.htm>

12. Cold and Damp Seal: <http://www.coldanddampseal.co.uk/>
13. MAY N., and RYE C., Responsible Retrofit of Traditional Buildings, Sustainable Traditional Buildings Alliance (SBTA), 2012: <http://retrofitbuildings.com/images/pdfs/stba%20responsible%20retrofit.pdf>
14. New Tricks for Bricks 2008: <http://www.bshf.org/published-information/publication.cfm?thePubID=3DE7278E-15C5-F4C0-99E86A547EB36D44>