Up-Skilling Architects and Building Services Engineers in the Use of Higher Level Evaluation Tools for Energy Efficient Design of Buildings

Ian C Ward and Martin Brocklesby

Building Energy analysis Unit, School of Architecture, University of Sheffield, Sheffield, UK.

ABSTRACT: It is well recognised that many architectural and engineering design practices rely heavily on experience to design buildings. However with an increasing amount of legislation and a tightening of building regulations such an approach does not necessarily lend itself to producing energy efficient buildings. This paper explains a project funded by the European Regional Development Fund through the Learning Skills Council to up-skill both architects and building services engineers in the use of higher level evaluation tools. The delivery mechanisms for this project involved producing case studies, fact sheets, seminars and in house personalised training.

Keywords: energy, training, software

1. BACKGROUND

The built environment consumes a large proportion of the UK's delivered energy [1] (approximately 50%) as seen in Figure 1 and is responsible for much of the avoidable carbon-based emissions – a key reason why many Government policies and initiatives are focused upon this sector. Within a building the energy usage is again about 50% as is shown in Figure 2.

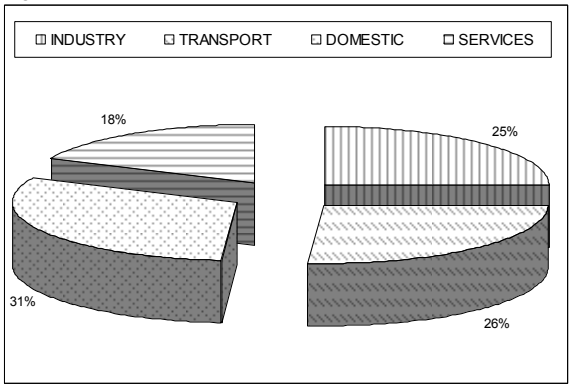


Figure 1: Sector breakdown in energy use

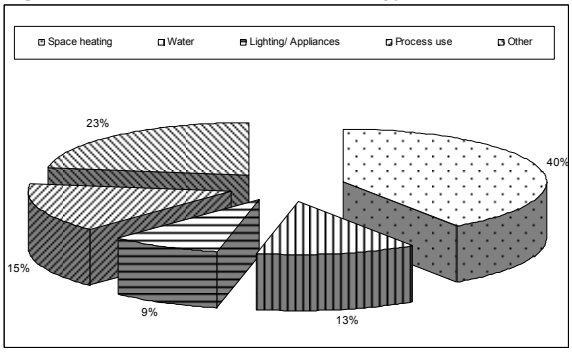


Figure 2: Breakdown in Energy Usage by Buildings

Over the last ten years there has been an increase in legislation with respect to energy efficient building design. Coupled with this increase has been a growing awareness of the impacts of global warming. Both these have placed added pressures on designers of buildings to make sure that their designs are as energy efficient as possible. In line with increased legislation has been the growing improvements in the computer simulation of buildings which gives designers added tools to investigate the likely performance of their designs. However the implementation of these "advanced" computer simulation packages has mostly been seen in the larger consulting organisations with little impact in smaller companies. At the 2004 annual general meeting of the Scottish Energy Systems Group, Professor Clarke [2] indicated that in the region of 30% of new design contracts in the UK had energy efficiency as part of their design brief, but only 6% of those designs used "advanced" simulation packages. He further indicated that if this 6% were to increase to 14% then the UK projected energy gap could be met by the improvements in the designs of these buildings. This demonstrates quite clearly that by using building simulation to develop the most energy efficient design, significant improvements can be made in performance and reductions in carbon emissions achieved.

2. THE SOUTH YORKSHIRE PERSPECTIVE

South Yorkshire's industry suffered a great deal during the 1970' and 80's due to the closure of steel plants, the coal industry and related industries. A report produced by Sheffield City Council [3] indicated that in this period about 75% of the jobs in South Yorkshire were lost. As a result of this re-structuring

of the industrial base South Yorkshire has about 75% of the average European Gross Domestic Product and has therefore been declared an Objective 1 Region by the European Union. This has resulted in a strong investment programme in education through the Learning Skills Council. This training is aimed at improving the skills base at all levels from the trades to post graduate education.

A survey of over 500 Yorkshire Humber design Practices carried out by the Building Energy Analysis Unit in 2003 indicated that over 65% of Practices felt that they were ill equipped to deal with the growing demands being placed on them with respect to energy and environmental issues. A comment from one practice summed up the general responses:
"*We feel that the UK Government has neglected the growing need of practices to be skilled in energy and environmental issues and we feel very exposed on a significant new project which demands knowledge which we do not have in house*".

3. UP-SKILLING OF DESIGN PROFESSIONALS

During most of the 1990's BEAU ran one of the four UK offices of the Energy Design Advice Scheme – a UK Government funded project to offer strategic energy and environmental design advice to those involved in procuring or designing buildings. The final report on this project [(2)] indicated that by providing face to face advice coupled with introducing Practices to simulation packages that in the region of £17m of annual energy savings were obtained from over 1400 projects. This equated to a return on Government investment of £30 for every £1 spent on the project. This project clearly demonstrated that face to face training sessions focused around real design projects was a successful way of up-skilling design staff.

4. THE PROJECT

The European Social Fund (ESF) which was created in 1957 is the European Union's main tool for the development of human resources and the improvement of the workings of the labour market. It supports measures to prevent and combat unemployment and to develop human resources. The ESF aims to promote a high level of employment, equality between men and women, sustainable development and economic and social cohesion. The key aim of the Fund is to provide supporting finance for implementing the National Action Plans for Employment [(5)].
Given the above mentioned commercial climate in South Yorkshire, BEAU applied to the Learning Skills Council for a grant to offer bespoke up-skilling training to the construction industry on energy and environmental design.
The objectives of this project were to:

1. To foster the development of in-house simulation capability within design practises
2. To provide latest information on policy changes or new technologies

Specifically:

- Engage with built environment professionals
- Identify weaknesses in current practices
- Evaluate tools in 'live' settings
- Identify the changes required to support integration of energy tools into design processes
- Up-skill personnel in practises.
- Dissemination of latest Information on energy and environmental issues
- Applications software training
- Establishment of partnerships
- Seminars/ workshops on modelling topics
- Seminars/ workshops on new topics relevant to the building design industry

5. DELIVERY OF PROJECT

The project was delivered by two main mechanisms:– one to one training in small groups at the company or at the project offices, and via more general presentations such as seminars or smaller workshops. Flexibility was considered to be a key element in ensuring that training was provided. As far as possible the training was provided in the manner best suited to the company. Another important element of the project delivery was the "learning" factor – rather than simply start with a methodology and deliver a "set menu" the project changes direction in response to the requirement of the companies. This was particularly true of the seminar program. An initial seminar was held early in the project focused on building simulation software. This seemed to be generally well received, but feedback suggested that more information was required about more basic environmental impact issues. It had been thought initially that this level of training was already covered by providers such as the Building Research Establishment, however this seemed not to be the case. The seminar program was therefore extended and the focus shifted to provide a module examining sustainable design issues in a more general way, although retaining a small focus on building simulation software.

The software training was provided on a company specific level, so the length of time spent with each company varied widely. In many cases teaching had to be fitted in around the individual architects, all of whom were also carrying out work for the companies involved. Architectural practices tend to be very small and goal focused so, although many were interested in the services on offer, finding the time for individuals to partake of the training was in many cases problematic.

The seminars were delivered in two parts – the initial single seminar covering building simulation and the second part covering sustainable design. The second part was split into four modules each delivered over a three hour 'breakfast meeting'. To allow maximum flexibility, each module was designed to be self contained as far as possible, while linking up to create a

coherent whole. Fact sheets were provided to all attendees providing guidance on each of the topics covered. As often as possible the seminars used active rather than passive techniques – Q & A sessions, sustainable design 'games' and demonstrations of software in use.

5.1 Operation of in-house training

Following the same format as the Scottish Energy Systems Group we provided in-house training which we named "*Supported Technology Training*" (STT). The aim of STT was to allow practitioners to gain risk-free access to simulation in the context of live projects and normal work practices. This allows them to identify the financial and human resource barriers to routine tool deployment as well as affording valuable training in the new technologies.
A typical example of an STD includes:

- the deployment of software within an architectural practice to allow early design stage assessment of energy and environmental issues;
- the deployment of compatible thermal and lighting modelling programs within an engineering consultancy;

5.2 The following scenario elaborates an STT

An architectural Practise, has won a new contract which requires a detail understanding of the daylight penetration throughout the building. The Practise has identified that they do not have the expertise to carry out the requirements and request help from BEAU. A trainer from BEAU is seconded for a period of time to demonstrate the various software packages available and provided that the Practise purchase the software (if not free) then the BEAU trainer will up-skill a member (or members) of the Practise in the use and evaluation of the software.

5.3 Some Results of In-house Training

The two projects outlined below were awarded to architectural practises in the South Yorkshire sub-region and both expressed concern that they did not have the skills to evaluate the energy and environmental performance. In both cases the staff were trained in the use of readily available software which allowed them to make design decisions early on in the concept stage of design. The projects are outlined below.

Study 1

One of the main considerations in this project was the penetration of sunlight as the building was designed to be naturally ventilated and overheating potential was highlighted as a possible drawback to the building meeting the design specification. The staff from the practise were trained in the use of a software package ECOTECT (which they subsequently purchased) and the design of the windows was optimised as shown in Figure 3.

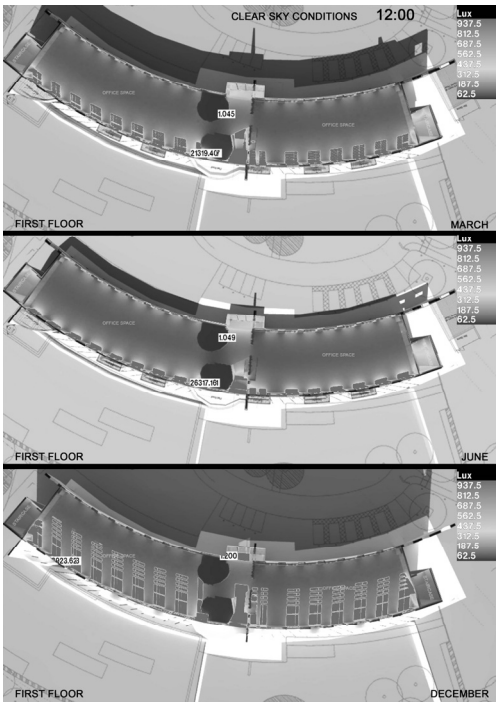


Figure 3: Radiance simulation of sunlight penetration

Study 2

In this study concern was expressed on the use of thermal mass to minimise the temperature fluctuations in the building. One reason this was important was the fact that air conditioning loads had to be minimised. In this case an educational programme was set up within the practise to train them in the issues surrounding the use of thermal mass and the calculations were carried out using the LT- for Europe public domain programme. Figures 4 shows the design of the building and Figure 5 shows the results of the analysis.

Figure 4: The building

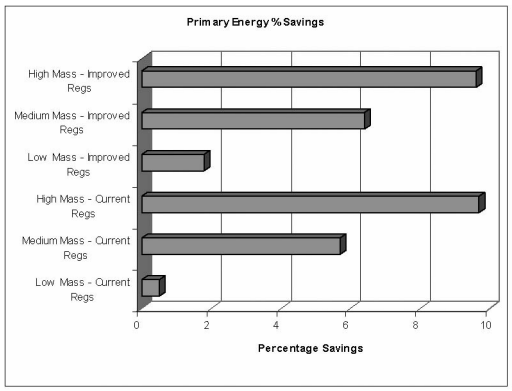


Figure 5: Results of the analysis

In both cases the main benefits were that the staff members in the practises were up-skilled to a level above their initial competence level without making them feel that they were out of their depth. This process has also installed a desire by these people to learn more. The main benefits of this type of training is that staff feel more confident with technical issues at a level they are confident with and gives then a mechanism whereby they can receive more training as the complexity of the projects increases. It has also been stated that by having these skills that they are in a better position to win more complex contracts which for the sub-region is ensuring that jobs are secured and often increased – this is in line with the objectives of the EU Objective 1 programme.

5.4 Seminars

The seminar programme was targeted at the specific needs of the practitioners'. An initial seminar on the benefits of simulation was presented and the attendees invited to state their specific requirements. From their responses we developed the following targeted range of seminars:
Sustainable techniques in Practice - effects of climate
Good building design – use of fabric
Building service systems – specifying energy efficient services
Material selection – sustainable building materials
Water resources and conservation
Renewable energy systems

5.5 Case studies

One way of promoting the value of the training being offered is to produce case studies of projects which have benefited from the interventions. In particular the case studies should relate to projects carried out within the sub region as this give added confidence that they are applicable to local designers.
It was established early on in the project that designers, although aware of many of the issues were not confident in their ability to implement environmental or energy design and felt that the available texts were either too long or did not give them sufficient information which was readily usable. For this reason a very extensive set of design fact sheets (over 100) were also produced and an example of one of them is shown in the Appendix. These can be viewed on the BEAU web pages [6].

6. EVALUATION OF THE PROJECT

In the objectives we were to interact with 24 companies and so far we have developed working relationships with over 30 companies. Our target of informing 100 individuals has been exceeded by a large margin. In line with most projects, those involved were asked for their responses with respect to value and suitability. A score of 5 related to high value while a score of 1 indicated significant deficiencies. Figure 6 shows the evaluation of the project by the companies who took part in the period 2004 -05. The relative high scores indicate that overall the project was valued by the companies and the advice/ method of delivery was appropriate to their needs.

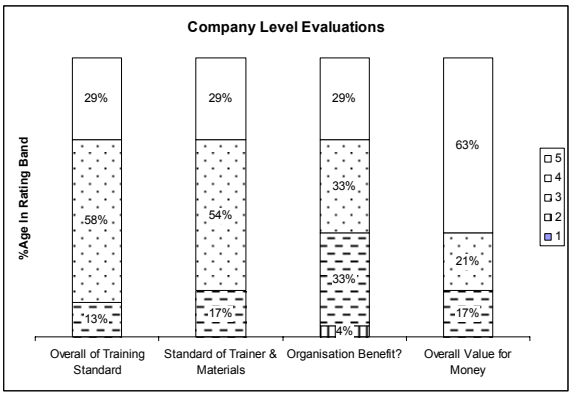


Figure 6: results of feedback form participating companies

7. CONCLUSIONS

This project has successfully up-skilled both Architectural and Building Services Engineering practices in the South Yorkshire sub region and has also provided a platform whereby a network of people who are interested in developing their skills in energy and environmental design can meet to share experiences. The project is continuing with funding from the EU through the European Regional Development Fund and is being extended to cover not only building designers but also construction companies, local authorities and building procurers.

ACKNOWLEDGEMENT

BEAU would like to thank the European Union through Regional Development Fund and Social Funds for the finances to carry out this work.

REFERENCES

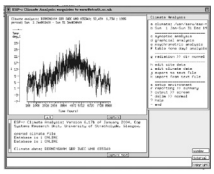
1. Energy White Paper, The Stationary Office,www.tso.co.uk/bookshop,

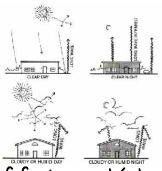
2. Presentation at the 2004 AGM of the Scottish Energy Systems Group, Strathclyde University, http://www.sesg.strath.ac.uk/
3. Strategic Planning Report to Council form Planning Department, Sheffield City Council, 2000
4. Energy Design Advice Scheme (EDAS): Operations and Achievements 1992-1998, Energy Technology Support Unit contract S/T1/00133/REP, Department of Trade and Industry
5. http://europa.eu.int/comm/employment_social/esf2000/glossary_en.ht ml
6. http://www.shef.ac.uk/beau

APPENDIX

An Example of one of the Data Fact Sheets given to all participants

CLIMATE DATA SOURCE





There are a wide range of factors which need to be taken into account— ambient temperatures, prevailing winds, sun light etc. Getting weather data can be difficult, but one relatively easy method of accessing a wide ranges of figures for the Uk and overseas is by using the ESP-r building simulation package. This package is offered free under an open source licence and has the ability to access a wide number of weather files. It should be noted that ESP-r is a complicated package and may not be suitable for those without a reasonable level of computing experience. Other packages are available that are easier to use, but require payment of a licence fee.