BUILDING ENERGY STANDARDS – TOOL FOR CERTIFICATION (BESTCERT) – PILOT METHODOLOGIES INVESTIGATED

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ABSTRACT

This paper describes progress on the BESTCert project on pilot methodologies for certifying the energy performance of building in accordance with the European Energy Performance of Buildings Directive (EPBD). The objectives and framework of the project are described and an account given of the overarching methodology that has been developed. Each partner in the project has applied the methodology in the context of their country's implementation programme. The methodology allows a wide range of software packages and tools to be used and these have been applied to a number of buildings to calculate asset ratings and benchmarks and to illustrate how a certificate might be produced. The project is due to finish in December 2005 when the final report will compare and contrast the tools developed for each country and make recommendations for the certification of the energy performance of buildings.

KEYWORDS

Energy, performance, certification, benchmarks, calculations, methodologies.

PROJECT OBJECTIVES

The project objective is to investigate pilot methodologies for certifying the energy performance of buildings in accordance with the European Energy Performance of Buildings Directive (EPBD) which is due to come into force in January 2006. The energy performance is to be calculated for standardised use of the building, the Asset Rating. Furthermore, article 7 requires reference values, such as current legal standards and benchmarks, in order to make it possible for consumers to compare and assess the energy performance of the building. The project will demonstrate how these calculations can be used to generate a certificate in accordance with appropriate CEN standards and the emerging national tools. Dissemination of these several pilot tools will be predominantly through a web site and workshops coordinated with emerging national programmes.

PROJECT PARTNERS

Building Research Establishment (BRE), UK – project coordinator
Centre Scientifique et Technique du Batiment (CSTB), France
Association pour la Recherche et le Development des Methodes et Processus Industriels (ARMINES-CENERG), France
Consiglio Nazionale delle Ricerche (CNR), Italy
Cenergia Energy Consultants (Cenergia)
National University of Ireland, Dublin (NUID/UCD)

PROGRESS TO DATE

The project schedule is shown in annex 1. Phases 1 and 2 are complete and have produced an overarching methodology within which the partners are developing a wide range of certification tools. In phase 3 the several pilot tools have been used to demonstrate how a certificate could be produced. All the partners have gathered data on educational buildings and at least one other type, mostly offices. In particular, extensive occupancy-related data were collected in order to draw up standardised schedules as required by article 2.
The tools are made up of a user interface, a calculation engine and a report generator. As the certification process is still being evolved by the member states it has been necessary to maintain as much flexibility in the tools as possible. The user interfaces are capable of being used with a number of calculation engines, while a wide range of calculation methods have been considered ranging from simple spreadsheet based energy balances to full dynamic simulation. Some simple report generators has been developed for phase 3, but as national governments have yet to decide what will be required for the certificate, these demonstrate how a certificate could be produced in accordance with draft prEN 15217.

PILOT TOOLS

In the UK, Italy and Ireland the pilot tool has been based on the Design Builder interface with the Energy Plus simulation software. Further details can be obtained from the respective web sites www.designbuilder.co.uk and www.eere.energy.gov/buildings/energyplus The Design builder interface allows a detailed model of a building to be created as illustrated below for a UK primary school:

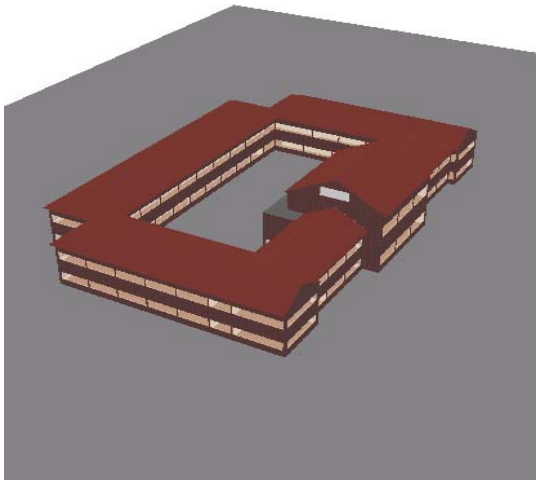

Figure 1: Model of UK primary school

The model can be interrogated at different levels such as by activity i.e. classroom, staff room, circulation etc as illustrated below:

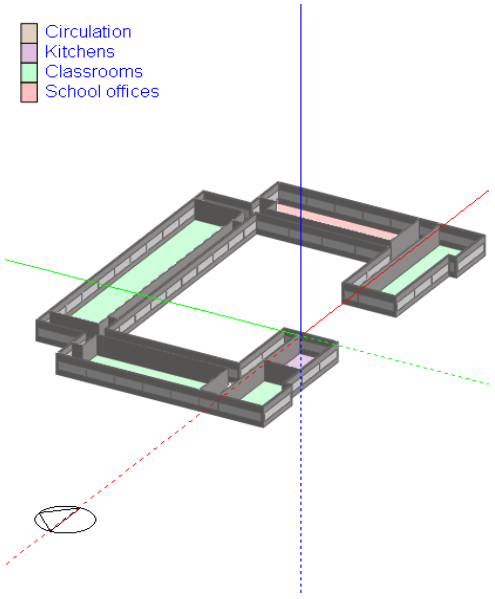

Figure 2: Activity areas in school

Standardised occupancy schedules have been drawn up for schools in each of the partner countries. Also construction templates have been created which comply with current legal standards which are used in the calculation of reference values as required by article 7. Benchmark values are created by using templates for typical and good practice constructions. Databases of default values for the performance of building services and auxiliary power have also been drawn up.

By using different input data the model is used to calculate an asset rating, a reference value based on current legal standards, referred to as a notional building, and typical and good practice benchmarks as illustrated below.

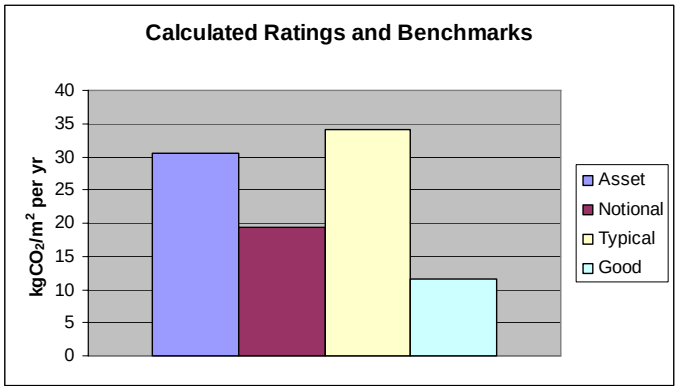

Figure 3: Calculated Ratings and Benchmarks

A similar approach has been adopted in France but using different software packages. Centre d'Energetique has adapted the COMFIE programme, while at CSTB the Method DPE has been applied. In Denmark, Cenergia working with the Danish Building Research Institute, has used an excel spreadsheet tool. Each of these methods is capable of calculations similar to those illustrated above.

PRODUCING A CERTIFICATE

Phase 3 of the project headed "Develop Certification Tool" was intended to be a report generator to produce the certificate. However, national governments have yet to decide what is to appear on the certificate. The best guidance we have is the draft European standard prEN 15217 which is currently out for consultation. This proposes comparing the performance of a building against an A to G scale. The BESTCert project illustrates how the calculations illustrated above can be used to create the scale and asses the performance of the building in accordance with annex B of the draft standard.

The draft standard defines the A to G scale according to the value of a classification parameter C which is calculated from:

EP, the energy performance indicator, which is taken to be the asset rating based on CO_2 emissions

R_r Energy performance regulation reference/benchmark. This corresponds to the limit value that should be expected on new buildings in conformity with national Energy Performance Regulations in 2006. In the UK this will be the performance of a notional building complying with the building regulations.

R_s Building Stock reference benchmark. This corresponds to the value that should be expected to be reached by approximately 50% of the national or regional building stock in 2006. This corresponds to the typical benchmark used in the UK except that existing benchmarks are often based on relatively old data.

For the school illustrated above the calculated values are:

EP (Asset Rating)	30.3 kg CO_2/m^2 per year
R_r (notional building)	16.6 kg CO_2/m^2 per year
R_s (calculated typical)	34.4 kg CO_2/m^2 per year

The full classification procedure is given in annex B of the draft standard. In this case EP/ R_r = 1.82 and EP/ R_s = 0.88. As the energy performance of the building, EP, is between the energy performance regulation reference R_r and the building stock reference R_s (here taken as the calculated typical), the appropriate formula for C is:

$$C = 1 + \frac{(EP - R_r)}{(R_s - R_r)}$$

Therefore C = 1.77 equivalent to D rating. A mock up below illustrates how this may be indicated on the certificate.

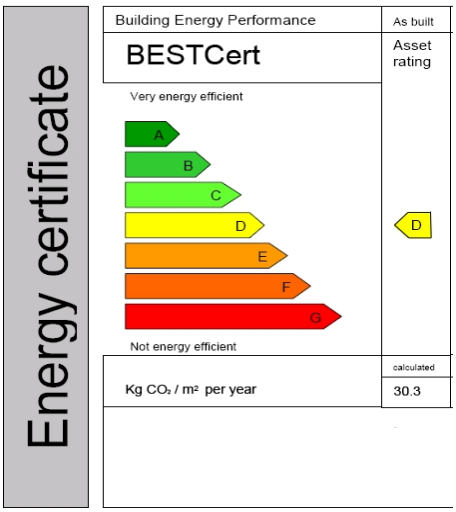

Figure 4. Illustration of Certificate

Feedback on prEN 15217

As the draft standard is out for consultation it is worth providing some feedback on the proposed classification procedure. In the example above the building stock reference value, R_r, has been calculated. However, the implication in prEN 15217 is that it should be based on the building stock in 2006, an approach which appears to find favour in a number of countries. While it is not possible to give details in this short paper, the extensive calculations performed for the BESTCert project show that the calculated values, irrespective of which tools are used, can differ significantly (by 30%) from the actual energy consumption in a building. There are many reasons for these differences, such as not knowing the actual internal temperatures and how they vary and the air change rate. Furthermore, accurate modeling, while possible, requires detailed knowledge of the building and the way it is operated, which can not usually be justified on time and cost grounds. The consequence of combining the reference value R_r based on building stock data with calculated values for EP and R_r is that the value of C, used to classify the building, can be distorted, depending on the extent to which the model calculations do not fully represent the actual building. Usually the model calculations underestimate the energy consumption either through not accounting for miscellaneous energy using equipment or inadequate knowledge of how the building is used and operated. However, as all the calculated values are affected in the same way, ratios based on these values, and hence C, are insensitive to this discrepancy. It is therefore recommended that the certification process be based on all calculated values as illustrated above.

CONCLUSIONS AND FUTURE DEVELOPMENTS

During the course of the project the final version of the Energy Performance of Buildings Directive was published and also various working groups have reported on new CEN standards, in particular CEN/TC 89/WG4/N249. This proposes an energy balance method for calculating the energy performance of a building, although dynamic simulation methods are allowed. National governments are now in the process of implementing the directive in accordance with the several CEN standards. In the UK a National Calculation Tool (NCT) is being developed based on the standard. Clearly these developments will influence how the BESTCert pilot methodologies evolve and how they are disseminated. Software vendors such as Design Builder are being invited to adapt their interfaces to the NCT. This means that the standardised occupancy schedules, construction templates and default databases developed for BESTCert all remain valid. The generation of a certificate from the calculated values for asset rating, notional building and typical benchmark is relatively straightforward as the project has illustrated.

For phase 4 of the project a large number of candidate buildings have been identified as possible case studies. Phase 5, dissemination, will need to be carried out in collaboration with the national programmes to ensure that there are no conflicting messages.

ANNEX 1: PROJECT SCHEDULE

The project is organised into 5 phases as shown below. For reporting purposes the original headings have been retained.

Phase/Duration (in months)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Establish Energy Standards																								
2. Building specific benchmarks																								
3. Develop Certification Tool																								
4. Test and compare experiences & case studies																								
5. Dissemination																								
Proj. meetings	x											x			x						x			
Deliverables						PR						Pr + 1			2			PR + 3			4			FR + 5

PR = Progress report
FR = Final report

Deliverables:

1. Energy standards for two building types
2. Building specific benchmarks for two building types
3. Certification tool
4. Case studies
5. Certification tool