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An Irish Building Environmental Assessment Method

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ABSTRACT: This paper presents a building environmental assessment methodology developed for application in new commercial buildings in Ireland. In an attempt to address issues of specific national interest the development of the methodology considered the recent introduction of the EU Energy Performance of Buildings Directive, a vibrant economy in which the building industry accounts for 23% of GDP, the highest in the European Union, increasing concerns over national environmental performance and a projected shortfall in meeting its Kyoto commitments.

The development of the methodology was supported by a steering committee representative of a wide spectrum of professional, public and industrial representatives and reflects the interests and concerns of all contributions. In particular and in an attempt to innovate where other similar international schemes have not, credit categories have been developed to reward projects that address and integrate the principals of passive and microclimatic design. Daylight access and protection, solar access and protection and wind and shelter are addressed. In addition, a separate credit category has been added to reward innovation as part of the procurement and design process.

Keywords: environmental assessment, whole building performance, passive design

1. INTRODUCTION

The increasing application of and support for sustainable strategies in building design is part of a growing awareness by professionals, institutions and governments alike that building construction, use, demolition and the consequential consumption of natural resources is having a direct impact on the quality of our environment and that our relationship with the world's ecology requires action and reappraisal. In support, the environmental assessment of new and existing buildings and the evaluation systems employed, has been successfully introduced in a number of countries around the world as a method of promoting sustainable design [1] with a view to lessening the impact of buildings and construction on the world's ecology.

Building environmental assessment tools have been developed by several countries as a means of pursuing sustainable development and encouraging more ambitious performance objectives in the built environment. They allow for the clear identification of key performance issues to be addressed in environmental projects and provide a verifiable set of criteria against which environmental design can be evaluated. As countries seek to curb harmful emissions and increasing consummation of raw materials, the introduction of building environmental assessment tools has been recognised as a valid method of reducing the negative environmental impact of buildings and the building industry, promoting innovation and transforming market practices [2, 3]. This strategy, of assigning comparative merit to individual buildings, has been adopted as a means of using the competitively inherent in the commercial market place as a vehicle for market transformation and the introduction of better practice in environmental design [4].

Environmental assessment systems also provide important and additional coverage of a wider range of environmental and building performance related issues beyond a minimum energy performance as this is generally addressed by national legislation or similar or, in the case of the EU, through application of directives such as the Energy Performance of Buildings Directive (EPBD).

2. THE NATIONAL CONTEXT

The design and construction of the built environment, unlike other major economic contributors and labour sectors, is uniquely informed by its immediate circumstance and locality [5]. National efforts to control potentially harmful environmental impacts predominantly group into the following:

- the intervention of environmental agencies or appropriate ministries,
- environmental assessment methods,
- national development plans
- energy taxes,
- protectionist legislation.

While there is diffusion in terms of approach between countries with parallel or adjacent economies, most continue to address their environmental concerns on a domestic basis.

In 2006, the Irish economy was among the most successful in Europe and its economy continues to grow at an average of 4-5% each year, largely driven by investment in the construction sector and infrastructure projects. Ireland's economic recovery and subsequent growth present a unique circumstance in which to launch an environmental assessment method. In 2005, the Irish construction sector was estimated to have accounted for 20% of Gross Domestic Product or 23% of Gross National Product [6]. Domestic construction remains the key driver of output in the construction industry at about 62%, on average 70,000 houses per year (over a ten year period), although the rate is decreasing with a modest increase in commercial activity. The continuing prosperity of the construction industry has resulted in a market where the level of consumer demand negates the ability of the public to insist on high standards of construction. Ireland's housing stock is among the least efficient in northern Europe [7].

In such an environment it is unlikely that a voluntary scheme such as the one described here would experience widespread uptake. However, the introduction of the EPBD has raised awareness of a broader range of environmental issues beyond energy among designers and highlighted a deficiency in their current design skills and knowledge. In this context such a scheme has an opportunity to stimulate innovation and advance, through the application of assessments and supported by training through professional education, the implementation of more environmentally strategic building design.

Existing environmental assessment methods have been successful in markets that are significantly different in scale and organisation to the Irish model. The United Kingdom's BREEAM is possibly the most suited to operation in Ireland due to the similarities in respective construction industries. However, as a privately run enterprise it may experience difficulty in implementation in the less regulated Irish economic market. There is a precedent for the voluntary application of an environmental management scheme in Ireland in the success of the Repak [8] waste packaging initiative though the difficulty in enforcing this scheme would suggest that some legislative support may facilitate the implementation of building environmental assessment.

From the establishment and implementation of BREEAM in the UK many similar tools and assessment methods were developed including LEED in the United States, CASBEE in Japan, Green Globes in Canada and the US, Green Star in Australia, HQE in France and the GBTool internationally. Many of these tools share a common methodology but differ in measurement scales and identified criteria. Each system has also evolved along its own path, in the industry and economic climate of its place of origin, adapting the assessment tools to different typologies as the method of evaluation becomes increasingly sophisticated.

For the purpose of this research three of the most widely used/developed tools have been chosen to compare and contrast. These were BREEAM, LEED and GBTool. In the case of the former two they are environmental assessment tools that have been well documented and applied to a range of building project typologies. Research has been completed that not only focuses on the tools themselves but on the wider impact they have on building design, the design process and the building industry. All three tools have significantly evolved over their life span and the buildings that have been certified under the BREEAM and LEED systems have been in use and occupied for a period that makes analysis of their effectiveness in achieving an environmentally responsible built environment possible. GBTool differs to the other two in that it is not a building specific method in itself but does provide a good framework around which such a system might be developed.

3. ASSESSMENT METHOD DEVELOPMENT

Building environmental assessment methods include both global criteria, such as pollution and climate change, and local/national criteria and as a result a successful rating tool should address both [1]. The requirements of an environmental assessment method for the Republic of Ireland are nationally and regionally specific and include social, economic and geographical issues.

The environmental design criteria employeed in the assessment methods reviewed shared many attributes and all used benchmarking against set standards as a basic framework. These are assigned a specific and declared credit value within the assessment method, a method of calculating and communicating the determined performance of a building and criteria that are identifiable as purely environmental. These form the larger part of assessment methods and refer to aspects of the design that have direct meaning or effect on the surrounding environment or in the use of resources.

The primary function of environmental assessment methods, as demonstrated by existing research and operable methods, can be subdivided into primary and secondary functions. Primary functions are those explicitly stated by assessment documentation as the fundamental goals of such methods while secondary functions are those opportunities and benefits implicitly accrued through the successful implementation of an environmental assessment method.

In addition to a review of existing tools in a national context it was decided to also identify criteria that were not currently considered within either BREEAM or LEED that might either be specific to national conditions or may extend the innovative dimension of a resulting methodology.

Additionally, a steering committee was established to support and advice the research undertaken and consisted of representatives of govenmental bodies, institutions, professional associations, organisations with large property portfolios etc. Credibility of the scheme and it acceptance by members of the industry, while limiting in some respects, are important in the acceptance and support of the implementation of such a scheme. The Irish steering committee consisted of the following partners:

Industry Steering Committee Partners

- UCD Energy Research Group (co-ordinators)

- Irish Environmental Protection Agency
- Construction Industry Federation
- Office of Public Works

Industry Steering Committee Participants
- The Royal Institute of Architects in Ireland (RIAI)
- Sustainable Energy Ireland
- Department of Environment, Heritage and Local Government
- Fingal County Council
- South Dublin County Council
- Society of Chartered Surveyors
- National Irish Centre for Energy Rating
- Irish Estates (Management) Ltd.
- Ulster Bank
- Gardiner and Theobald, International Project and Cost Management

4. ASSESSEMENT SYSTEM

The following criteria will be assessed against relative standards and the performance awarded as appropriate through a defined system of credits and weightings. There are a number of criteria that include an ascending or culumulative level of credits. These are awarded to categories that can be objectively defined in terms of relative performance.

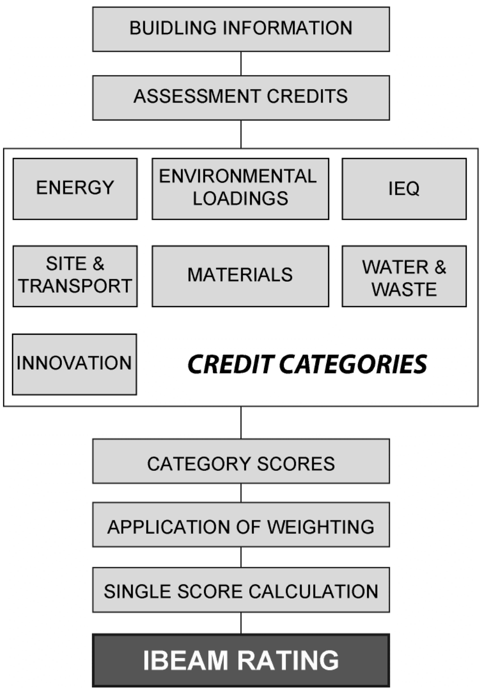

Figure 1. Irish Building Environmental Assessment Method Scheme Structure

Part of the recommended calculation system for this proposed assessment method is the application of a weighting to the individual category prior to the final rating. This system allows for a simple division of credits at the stage of information input and for the comparative importance of category in terms of environmental impact and national policy priority to be applied later. The weighting of each main category can be defined relative to their importance to a national context. They can also be modified to respond to changing circumstances in industry to emphasise or otherwise one or more credit categories or sub categories in line with international and/or national policy priorities without having to carry out major changes to the basic method itself.

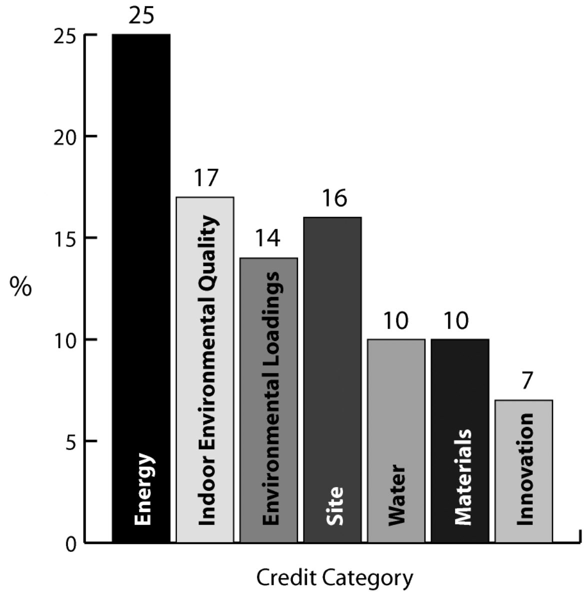

Figure 2. Credit category weightings

4.1 Energy

The energy category represents the single largest credit group (25% of the total credits available) due to its relative importance to national policy. Recognising the role buildings play in a European context, the European Union has introduced the Energy Performance Building Directive, introduced into legislation in Ireland in 2006. Although the Building Energy Rating is compulsory it has been included in this credit as a baseline aspiration and as a standard above which best practice design and construction may be evaluated.

The credit is divided into three main subcategories:

- Energy consumption
- Energy control
- Building management

Additional credits are awarded for the generation of on-site renewable electricity. Credits are awarded cumulatively on the basis of between 40% and 80% of electricity generated on-site.

4.2 Indoor Environmental Quality (IEQ)

Indoor environmental quality, for the purposes of this research and assessment method, was defined as the standard of air quality, thermal comfort, visual environment and acoustics present in a confined or enclosed occupied area. This credit has been developed on the basis that buildings with a high standard of indoor environment can safeguard and be conducive to occupant well-being and health. The link between polluted interiors and health conditions is an important one as people are living longer and spend up to 90% of their time indoors [9]. Hazards present can derive from the buildings components, its finishes (paints, varnishes etc.), the buildings services or systems, other building occupants or functions carried out within. The following areas related to indoor environmental quality have been included in this credit category:

- Thermal comfort and its control.
- Indoor air quality and ventilation.
- Acoustics and noise.
- Daylight, lighting and glare control.
- Building generated pollutants, fumes and odours.
- Control of humidity.

Although some areas of this credit are difficult to objectify, the costs of low quality environments for building occupants can be accounted for in higher levels of ill-health and absentisim [10]. The measures included do not guarantee a high standard of indoor environmental quality as building practice in maintenance policy and occupant behaviour may still have a negative effect [11].

In other systems reviewed there was a clear bias towards assessing and awarding credits to either building systems or those issues that can be objectified by means of standards, supporting research, etc. Credits can most easily be awarded to such categories as objective criteria can be defined. However, there remain issues that have a direct and sometimes significant impact on a buildings performance but are less easy to objectify. Specifically, credits are awarded to measures that will introduce architecturally derived design contributions such as passive thermal, daylight, natural ventilation, etc. These are specific to the elements of a building design most influenced by architectural decisions. The design team are required to provide the assessor with a study of the proposed passive strategy along with the relevant calculations and assessments to demonstrate their effectivness. The design team will also be required to provide a schedule of the areas that qualify as passive zones as a percentage of the total net useable floor area.

This credit category is not common to other existing environmental assessment methods but is recommended for inclusion in the IBEAM system. It is an architecturally driven agenda, something often missed or overlooked in existing environmental assessment schemes and is based on the philosophy that if the architectural form of a building can be optimised then supplemental and potentially polluting systems can be minimised or even eliminated. It has been shown to encourage the use of natural ventilation, increase access to daylight, allow for self-regulation of temperature by the buildings occupants and promotes the construction of shallow floor plates that can be of benefit to other sustainable measures [12]. Ireland's mild, temperate climate is well suited to passive design and as climate or seasonal extremes are rarely present this type of design strategy can be used in a range of locations and typologies.

It may also prove supportive to designers employing adaptive comfort criteria in the control of the indoor environment.

4.3 Environmental Loadings

The function of Credit 3 is to address those issues of pollution creation and waste production that are not included in any other area of the assessment. This credit presents a dual function in terms of the end user it targets. The majority of items are focused on the building or development itself, its materials, services and functions. However some items address the process of construction and the contractor's duty to minimise the environmental impact of a development. Construction pollution can be difficult to define and may have a low cost impact on a project, making it less of a priority for the client. Other elements of this credit include the minimisation of refrigerants and toxic or environmentally harmful emissions. The measures covered in this section include the following subjects:

- Use of refrigerants within any HVAC system.
- Light pollution.
- Construction derived pollution and waste creation.
- Flood risk assessment and preventative strategies.
- Minimisation of NO_x emissions.

4.4 Site & Transport

The function of the Site and Transport category is to evaluate the specific ecological needs of the locality and implement design strategies that will best meet those needs. The credit covers issues of landscape, vegetation and wildlife and areas such as the impact of construction on the site and methods of transportation for the building users. The credit seeks to encourage the use of brown field sites that are by their nature more sustainable than a green field development. The aim of a development project must be to cause minimal or no damage to the ecology surrounding it and to seize any opportunity available to improve that ecology. This credit includes measures for the upgrade and/or control of the following:

- The use of brown field sites over and above the use of green field sites.
- Provision of open space through encouraging the minimisation of the building's footprint.
- Provision of an ecology report and a management plan for the building's surroundings, landscape and ecology.
- Provision of facilities for cyclists and users of any wholly or partly renewable-powered form of transport.
- Proximity to public transport links that will decrease to building occupiers reliance on private transport i.e. cars.

In addition, credits can be awarded to projects that can demonstrate that they have:

- Avoided causing the overshadowing of neighbouring buildings.
- Avoided enhancing disturbing wind effects on neighbouring buildings and surrounding public and pedestrian areas.
- Respected the potential of solar applications of neighbouring buildings.
- Avoided contributing to a noisy environment surrounding the project.

These additional credits are in support of innovations introduced in credit category 2: Indoor Environmental Quality (IEQ).

4.5 Water

The creation of potable water involves significant treatment and resource input (land, labour, energy, etc) and therefore the minimisation of use is desirable. Building and landscape design and services can make a significant contribution to water conservation and the minimisation of potable water usage.

The water credit is sub-categorized into water usage, water metering, and waste water. The first and second refer to water consumption and management within the building or development while the last consists of measures that are predominantly of benefit to the water quality in the greater community.

There are three main methods for reducing water consumption- system optimization (i.e., efficient water systems design, leak detection, and repair); water conservation measures; and water reuse/recycling systems. Each of these strategies has been included as a measure to achieve, individually or collectively, a significant reduction in water usage.

This credit includes measures for the upgrade and/or control of the following:

- Water efficient fixtures and fittings.
- Provision for proximity detection shut off to areas of high water use.
- Provision for the quick detection of leakage.
- Alternative water supply for irrigation or landscaping purposes and the treatment of any re-usable water on site.

4.6 Materials

This credit encourages a higher standard of sustainability in construction elements and materials. Often the benefits of sustainable products are reaped predominantly by the community at large rather than an individual client. Responsibly sourced construction supplies can reduce resource consumption and minimize pollution by lessening the environmental impact of extraction, manufacture and/or transport. The use of these materials means less energy consumption, less natural resource depletion and pollution, and is generally less harmful for both the environment and its occupants.

Sustainable materials for selection in the building process should include some or all of the following attributes:

- Be made from renewable rather than non-renewable raw materials
- Be made from recyclable or bio degradable material.
- Be made from recycled or salvaged material
- Employ a manufacturing and transport process that is resource efficient.
- Be durable, long-lasting and, where appropriate, available in standard sizes to reduce construction waste.
- Be non-toxic, non-carcinogenic and not require any accompanying materials in installation that are toxic or carcinogenic (i.e. sealants etc.).

The promotion and use of sustainable materials in the construction industry in Ireland would greatly benefit from the compilation of a comprehensive products and supplies directory, one that evaluates the resource cost, the impact of manufacture, the transport costs and the eventual chemical make-up of individual elements and materials. Further research is required.

Interestingly, the development of this category of credits was the most contentiously debated among the steering committee partners due to potential economic repercussions. However, any perceived lack of enforcement found in these credits was due to a lack of specific and authorative information that could be used as a basis for reward or penalty.

4.7 Innovation

The objective of this credit category is to reward projects that can demonstrate they have taken additional steps to address environmental concerns and that go beyond the very best of practice. These are projects that embrace innovation in both the design process as well as in the construction and operation of the building and its surroundings. Credits can be awarded to projects that employ innovation design processes such as charettes, integrated or holistic design or similar. Projects that consider and employ innovative architecture and/or ground breaking technologies will also be awarded credits.

Success in this category is likely to be for exceptional projects and those who exceed current standards of green building through new design and construction strategies will be awarded the maximum possible rating.

5. RATING SCORING

Table 1 outlines the range of credit scores to be used in awarding awards. All scheme scorings are shown out of 100 but it should be noted that the maximum points in LEED is 69.

In comparison to BREEAM it can be seen that IBEAM aims to reward only good and very good projects and so has set the minimum score to a higher level. These are similar to LEED but IBEAM also includes a Grade 1+ category for exceptional projects.

When reviewing the BREEAM scheme it was noticed that a very large number of projects are assessed each year and that only modest advances in environmental design are awarded while in LEED, despite the large number of projects currently in review, very few have been fully assessed and awarded certificates.

IBEAM aims to undertake a sufficient number of assessments to ensure financial viability and independency while adhering to a relatively high standard to ensure credibility within the industry.

Table 1: Grade scores for the IBEAM, BREEAM and LEED environmental assessment schemes.

IBEAM	Pts	**BREEAM**	Pts	**LEED**	Pts*
Grade 4	40	Pass	25	Certified	37 – 46
Grade 3	50	Good	40	Silver	47 – 55
Grade 2	60	Very good	55	Gold	56 – 73
Grade 1	75	Excellent	70	Platinum	74 – 100
Grade 1+	85				

* Points for LEED have been normalised to a total out of 100 for comparative purposes.

5. CONCLUSION

The objective of this project was to examine the potential benefits of environmental assessment to the development and promotion of sustainable building design in Ireland. To assess the current situation the following reviews were undertaken:

- The evolution of environmental assessment as an acknowledged strategy to promote sustainable development within construction markets.
- The fundamental function of assessment methods, the role that they play within the construction sector and who assessments most benefit.
- The opportunities or barriers presented by Ireland's current environmental legislation and policies.

It was concluded that Ireland's construction industry was likely to benefit from the introduction of an environmental assessment method but due to a range of nationally specific issues existing assessment methods imported from other countries may experience difficulty in implementation. To develop an assessment method for the Irish market a comprehensive comparative study of the foremost existing building environmental assessment methods already in operation in other countries was undertaken to identify trends and commonalities amongst them. The scope, general framework and relative success of each assessment method were reviewed and the individual criteria classified suitable for evaluation were contrasted. The shared principles connecting the nominated methods provided a preliminary framework for the development of a generic building environmental assessment method.

An Industry Steering Committee was formed to contribute to the research as representative of the national construction sector with the intention of amending the generic outline of an assessment method to meet Irish requirements. The Industry Steering Committee advised on the basic scope and the specific content of the method. The participants also advised on implementation strategies that would most efficiently lead to the adoption of a building environmental assessment method into the Irish market.

The findings of the above research were then collated and a suggested framework and content for such an assessment in conjunction with a series of recommended implementation strategies was proposed with specific reference to Ireland. The final stage of the research, yet to be undertaken, is a trail period of application to real projects to fine-tune the credit system and to fully develop the implementation system to be used in a full assessment method roll-out.

6. ACKNOWLEDGEMENT

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