Enhancing building energy efficiency with accountable system of building regulations compliance

Eymard Ahern*[a], Api Desai[a], Carlos Jimenez-Bescos[a]

[a] *Department of Engineering and Built Environment, Anglia Ruskin University, Chelmsford, UK*

[*]*Corresponding author's mail:* eymard.ahern@pgr.anglia.ac.uk

Abstract

This paper reports a study of how a Building Control system of accountability can improve compliance and enhance building energy efficiency in new buildings. Research to date has presented many non- compliance issues with Part L of the Building Regulations in the dealing either with design or construction. Based on a literature review, the paper notes as to how some European countries such as Ireland have set out to improve Building Regulations compliance by ensuring that certificates of compliance are provided by each member of the design team to certify the design is compliant, in conjunction with building contractors' and building certifiers' certifying that the construction is compliant. Although comprehensive in its nature, this approach in turn, puts additional professional accountability on each member of the design team, the building contractor, the sub-contractors' and certifiers' in terms of accurately identifying non-compliance, rectifying the problem and certifying compliance. By exploring and understanding the nature of this additional professional accountability, the paper sets out the problems with a system of accountability faced by certifiers' and other building professionals involved in the certification process.

Keywords: Building Control; Building Regulations; compliance; energy efficiency;

1. Introduction

Energy efficiencies in newly constructed buildings will limit greenhouse gas emissions through continuous improvements in Part L of the Building Regulations, but improvements in the regulations will only be effective if both design and construction in the building process are compliant with the Building Regulations. Examining the case of Ireland, this paper sets out to examine their system of compliance with accountability from building designers', building contractors' and building certifiers' involved in the entire building process that has gone a step further in improvement of energy efficiencies through improved Building Regulations compliance.

2. Problem identification and basic principle

Achieving compliance has ever been challenging for constructors and professionals in the construction industry as recent studies show a mismatch between expected and actual performance gap of low energy buildings [9]. In a drive to forward energy efficiencies and achieve compliance, many EU countries have reviewed their compliance systems. It is apparent that non-compliance can be found in either design or construction, or both, and can often be caused by the Building Control system itself. Building control systems with unsatisfactory levels of compliance could be developed to improve building energy efficiencies.

3. Methodology

In evaluating the system of compliance in Ireland, the enactment of the Building Control (Amendment) Regulations 2014 ensure that buildings or works specified under the regulations have to be certified by a registered architect, registered building surveyor or chartered engineer [18]. Building contractors' and certifiers' are also required to certify compliance with the Building Regulations. This Building Control system of accountability was designed to ensure compliance throughout the building process from both design and construction perspectives and was examined to determine how Building Regulations compliance has improved from the introduction of new certifier roles, certifiers' insurance and litigation risk, Building Control Authorities' compliance framework, Part L compliance and the innovative system of accountability designed to ensure compliance.

4. Building Control System in Ireland

The new Building Control system of certifying compliance with Part L of the Building Regulations as outlined in Fig.1 provided three new certifier roles, being the assigned certifier, design certifier and ancillary certifier. The design certifier is responsible for certifying the design of the building or works is compliant, while the ancillary certifiers' are responsible for certifying the construction of the building or works are compliant and the assigned certifier is responsible for coordinating the inspection plan with certificates from the design certifier, ancillary certifiers', building contractor, various sub-contractors' and specialist contractors'. The legislative changes created additional work and responsibilities on certifiers', but the system ensures buildings and works are certified to be both design and construction compliant with the Building Regulations.

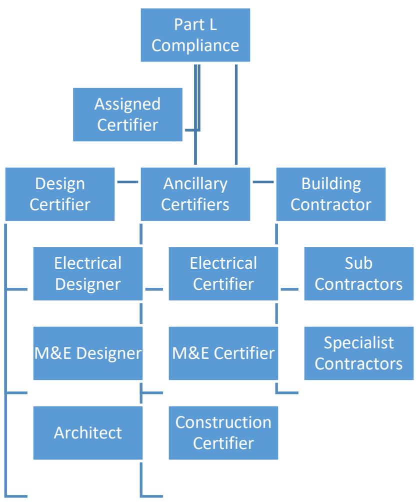

Fig. 1: Ireland's Part L Compliance System

One major implication of the change for Part L specifically relates to owner occupation, as the regulations specifically state that the owner cannot occupy the building until it is certified to be fully compliant with Building Regulations. Therefore, if the building fails to meet Part L compliance at project completion, it will have consequences for those involved in energy efficiency certification, such as the building contractor, subcontractors', architectural ancillary certifier and the M&E ancillary certifier, as the building cannot be occupied by the building owner and may ultimately result in civil litigation against those responsible for Part L compliance.

The Building Control (Amendment) Regulations 2014 have caused concern among certifiers about increased litigation risk because full compliance has to be certified. If there is a dispute, the Building Control (Amendment) Regulations 2014 may lead to civil liability and multi-party problems [17].

A design certifier or assigned certifier may resolve a dispute in arbitration with the building owner, but cannot bring in a third party ancillary certifier to the arbitration procedure. The assigned certifier may have to instigate legal proceedings separately against the ancillary certifier responsible for non-compliance and this remains a worrying scenario for assigned certifiers who may be subject to a civil action for ancillary certifier errors.

Certifiers' must take out professional indemnity insurance for a period of six years after certifying buildings or works to offset the risk of litigation from latent defects. The Construction Industry Federation has a register of registered building contractors, but there is no mandatory legislation that building contractors have to be on the register and there is no mandatory requirement for building contractors to provide latent defects insurance. Contractors' latent defects insurance would reduce the risk of litigation on certifiers' when construction companies are liquidated or bankrupt after project completion.

The design certifier has responsibility for overall design compliance, but design compliance can be problematic in the renovation of existing buildings or protected structures. In some cases, protected buildings cannot be modified, and the Building Regulations are compromised. The grey area of Building Regulations compliance associated with the renovation of protected structures and old buildings will pose a dilemma for the design certifier where total building regulation compliance can be impossible. The assigned certifier has responsibility for confirming overall compliance and must employ ancillary certifiers for areas he is not competent to confirm competence, as he must use "reasonable skill, care and diligence" to confirm compliance [7]. However, the regulations provide no format or legislation to certify compliance, leaving certifiers to their own methodologies in certifying compliance and thus leaving them open to litigation.

Energy efficient construction such as earth ships, straw bale and cob buildings are problematic for certifiers as the regulations require registered professionals to design and certify construction works including all the materials, products, systems and methods. Certifiers' are unlikely to design or certify man made buildings without product accredited certified materials. If a client wants to construct his own straw bale home, one option available to him is to opt out of the regulatory certification procedure. However, most banking institutions require a certificate of compliance from a registered construction professional at completion, even if the client wants to opt out of the regulatory process.

The Building Control (Amendment) Regulations 2014 increased costs of professional fees, but amended regulations introduced in 2015 allowed owners of domestic extensions and new dwellings to opt out of the statutory certification requirements if they could demonstrate by other means, such as demonstrating themselves that they could comply with the

Building Regulations. This meant certificates from the building contractor and registered professionals were not mandatory in the construction of a new single dwelling, on a single unit development, or a domestic development [8]. Professional bodies indicated that they did not agree with allowing people to opt out of the statutory certification process as it would be a retrograde step creating a two tier market of properties and were not in agreement with the opt-out regulations [19]. It is estimated that regulatory changes may have added 10% to the cost of constructing a three-bedroom semi-detached house in Ireland [14]. Therefore, the new system of compliance increased costs of professional fees and the resultant cost of construction.

The Building Control Authorities have a checklist framework designed to ensure design and construction compliance in new dwellings, material alterations and extensions to existing dwellings, and buildings other than dwellings. The assigned certifier must provide information showing compliance as outlined in Fig. 2 below.

Part L Building Regulations Compliance Documentation
New Dwellings
Energy Calculations. Energy Consumption & CO_2 Emissions
Renewable Energy Sources. Minimum level of Contribution
Limiting Heat Loss. Acceptable U Values in building fabric.
Air Infiltration & Thermal Bridging details
Air Pressure Testing Max. Air permeability of $7m^3(h.m^2)$
Space Heating & Hot Water Supply System Controls
Material Alterations and Extensions to Existing Dwellings
Minimum acceptable U Values in building fabric
Continuity of insulation and thermal bridge limiting
Limiting cold air infiltration. Reduced unintentional air paths.
Buildings other than Dwellings
Primary energy consumption and CO_2 emissions
Limiting heat loss and maximizing building fabric heat gains
Energy efficient space, water heating services and controls
Design limiting need for cooling. Energy efficient air-conditioning or mech. ventilation system sized and controlled
Limit the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air
Measures to limit heat gains by chilled water and refrigerant vessels, pipes and ducts to air conditioning systems
Energy efficient artificial lighting systems and controls (other than emergency lighting display or specialist process lighting)

Fig. 2: Framework for BCA's in Part L compliance [4]

The Building Control Authority will require proof of compliance with documentation provided by the assigned certifier that can be uploaded electronically to the Building Control Management System (BCMS), but uploading documentation to the BCMS can be slow, causing additional time consuming work for assigned certifiers. The assigned certifier issues a certificate of compliance on completion and must be approved by the Building Control Authority before the building or works are opened, occupied or used [4]. Therefore, the building or works have to be certified to be both design and construction compliant with the Building Regulations before handover to the building owner.

5. Part L Compliance

Research found how some low energy buildings are between 35th and 82nd percentile for carbon emissions [16], but the expected and actual energy performance of a building can be difficult to achieve as the built environment is complex with a degree of variables that causes difficulties in representing energy in-use [6]. Building Regulation compliance in the UK is dependent on building design standards and in evaluating compliance with the Conservation of Fuel and Power, the "anecdotal evidence suggests that workmanship on UK construction sites is poor, that buildings lose more heat in practice than in theory" [11]. Non-compliance with Part L of the Building Regulations were found in the construction of 376 newly constructed dwellings in the South East of England as shown in Fig. 3 where the degree of "compliance revealed was poor, at a level of 35%, accompanied by 43% 'grey compliance' and 21% 'grey non-compliance' due to failure to present sufficient evidence of achieving required CO_2 emissions reductions" [15]. Further research found that compliance was reported in only four of thirteen building energy case studies, of which nine buildings were located in the UK [5]. Therefore, research suggests that Part L compliance is problematic.

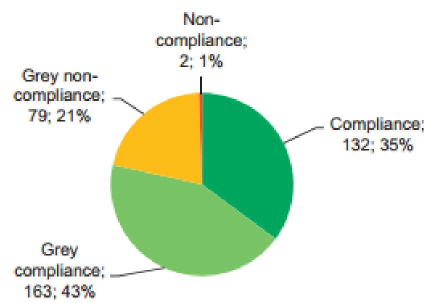

Fig. 3: Levels of compliance with Part L1A 2006 [15]

The design team has responsibility to achieve Part L design compliance in new buildings and the entire workforce involved in the construction process have responsibility for achieving actual performance, but research suggests that "there is still a significant gap between actual performance and design intents" [2]. Energy efficient design of a building is assessed as being compliant through energy compliance software such as SAP or SBEM in the UK, but software limitations and assumptions, complex design, design change, substandard materials and equipment, uncertain specifications and poor design team collaboration can all provide parameters for non-compliance. However, a system of compliance with accountability from each member of the design team, the building contractor, the sub-contractors' and building regulation certifiers' can improve standards primarily due to better supervision and inspection with greater responsibility and accountability from all the main parties involved in the construction process [10].

Non-compliance can be found from thermal bridging, U Values and air permeability as they all contribute to heat loss [13], but the calculation of building fabric U Values, g-Solar values, window sizes and orientation, airtightness, heating system, lighting, renewable energy, thermal bridging, etc. should all form the basis for finalizing design with the design team. Non-compliance can be caused from poor collaboration between the design team, as design of energy efficient buildings requires an integrated approach between engineers and architects from the beginning [1]. Consequently, an integrated design approach can ensure design compliance with continuous energy assessment of design with changes throughout the construction process and providing an updated schedule of documentary evidence to ensure compliance.

Non-compliance with Part L of the Building Regulations can be caused from construction methods that are not in accordance with the compliant design. It is important that documentary evidence shows compliance is achieved from production of material and equipment certificates supplied by the main contractor and sub-contractors', as the non-production of certificates can alter the energy software assessment to adopt default values that may eventually result in non-compliance. Modifications in design throughout the construction process without updated calculations in continuous energy assessment can also lead to non-compliance. Therefore, non-compliance can be avoided with competent certifiers continuously updating the energy assessment, documentary evidence through material and equipment certificates, construction certificates, reports and photographs throughout the design change process.

Integrated design analysis and building information modelling can lead to informed sustainable solutions at important stages of development, leaving the final stage of compliance achievable with a greater degree of certainty [3]. However, actual energy efficiency performance at completion is dependent on building contractors skill and competence to construct the design model as intended with competent certifiers' ensuring all elements of the design are compliant. Therefore, skillful contractors' and certifiers' knowledgeable and competent in energy efficient construction methods are essential to ensure construction quality. The other factor for the performance gap is user behavior, which is outside the scope of the certifier but will have an influence on energy use.

6. System of Compliance Findings and Discussion

In evaluating the accountable system of compliance in Ireland, it was found that certifiers' did not have to be independent. For example, certifiers' directly employed by construction companies can certify their own design and construction of buildings or works, which may ultimately result in a conflict of interest. Therefore, the system does not ensure independent certifiers' are the only persons permitted to certify compliance.

The building contractor, design certifier and assigned certifier enter into a contract with the building owner and agree to certify compliance, but the assigned certifier can rely on ancillary certifiers' to assist him in providing ancillary certificates of compliance. The difficulty with relying on ancillary certifiers' to certify compliance is that they normally have no contract with the building owner and only liable by civil suit in tort. If an ancillary certifier is responsible for non-compliance and the building owner takes proceedings against those responsible, it is possible that the design certifier and/or assigned certifier may also be subject to civil litigation as they have a contract with the building owner and the ancillary certifier may not. Therefore, the new legislation has increased the risk of litigation on both design certifier and assigned certifier.

The certificates outlined in Fig. 4 below are the evidence of accountability required to show compliance. The assigned certifier has responsibility for ancillary certifiers' as he certifies that all have exercised reasonable skill, care and diligence in certifying their work in the ancillary certificates [12]. In addition, he certifies to inspect the building or works, coordinates the inspection work of others and implements the inspection plan. The assigned certifier has to certify that the work of others is compliant with the Building Regulation from the certificates produced to him, but the degree of responsibility could be open to interpretation in a court of law. Therefore, it is important that the assigned certifier believes the ancillary certifiers' involved in the project are competent.

Form of Commencement Notice for Development	Owner
Form of 7 Day Notice	Owner
Design Certificate	Design Certifier
Notice of Assignment of Assigned Certifier	Owner
Undertaking by Assigned Certifier Form of Certificate of Compliance	Assigned Certifier
Notice of Assignment of Builder	Owner
Undertaking by Builder Form of Certificate of Compliance	Builder
Certificate of Compliance on Completion	Assigned Certifier & Builder
Form of 7 Day Notice Statutory Declaration	Owner & Commissioner of Oaths

Fig. 4: Documents in BCMS [12]

The Building Control (Amendment) Regulations 2014 allows certifiers' to certify buildings or works without mandatory qualified competence. Any chartered engineer named on the register of Section 7 of the Institution of Civil Engineers of Ireland (Charter Amendment) Act 1969 can act as design certifier or assigned certifier under the regulations. This effectively means that in theory, a computer engineer who believes himself to be competent could certify a building to be compliant. Therefore, the system does not ensure that qualified persons competent in the Building Regulations are the only persons permitted to certify buildings or works to be compliant with the Building Regulations.

7. Conclusions

Research has shown that Part L compliance has proved to be less than satisfactory. Improvements in the Building Regulations are only truly effective if the system of compliance is robust. The Building Control system in Ireland provides a system of accountability with the assigned certifier responsible for overall compliance, the design certifier responsible for design compliance, while the building contractor and ancillary certifiers are responsible for construction compliance. The system has improved compliance as building designers', building contractors' and building certifiers' are at risk of litigation from certification misrepresentation if the building is non-compliant. In the majority of projects in Ireland, the M&E Engineer takes on the role of ancillary certifier and certifies both design and construction of all electrical and mechanical services as he is the most competent person involved in the project to do so. Therefore, a system of compliance such as the system implemented in Ireland, with certification of combined design and construction by competent certifiers' is one way to enhance building energy efficiencies.

Abbreviations

BCA. Building Control Authority
BCMS. Building Control Management System
CCMA. County and Management Association
DECLG. Department of Energy, Community and Local Government
LAI. Local Authorities Ireland
SCSI. Society of Chartered Surveyors Ireland

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