



**Energy Training for Building Construction Workers for Low Energy Buildings**

**BUILD Up Skills QualiBuild**

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- Outline Document**

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## 1 Executive Summary

This document sets out a brief outline for the QualiBuild programme intended for a pilot scheme implementation for Ireland in October 2014. It outlines a way of thinking about the challenges—of climate-change policies, the recent changes to the Building Control Regulations, best practice methods and energy efficiency in the construction of buildings.

The QualiBuild programme is focused on the implementation of the Build Up Skills Ireland Roadmap (<http://ireland.buildupskills.eu/en/national-project>). QualiBuild is co-funded under the EU Intelligent Energy for Europe programme as part of the Build Up Skills Initiative.

The poor image associated with the construction industry in Ireland has led to the recent legislation in Building Control (amendments) Regulations (BC(A)R) which will apply to most building works (including new houses, housing and apartments, house extensions over 40m<sup>2</sup>, schools, factories, offices, shops, hospitals and other government investment projects) from 1st March 2014.

This legislation has placed an emphasis on best practice for general operatives, craft apprentices and craft workers, (collectively referred to building construction workers in this document) professionals and clients.

A key component of this project is to develop a programme to provide information to building construction workers and develop low energy quality buildings (QualiBuild). This will create an opportunity to focus on an improved attitude to how carry out construction and develop higher expectations (ie what is acceptable work). As identified in the BUSI National Roadmap, the construction sector will benefit from focusing on changes being made to improve quality control and raise awareness on the benefits of low-energy buildings. This presents an opportunity to focus on quality and efficiency of new construction and retrofitting practices and challenge the way building construction workers work, process and understand the end goal.

It will also include a specific tasks focused on improving communications and engagement between professionals (architects, engineers etc.), builders, craft workers and clients.

This document outlines the main objectives of QualiBuild.

- Transfer knowledge and information on specific elements in construction build.
- Increasing awareness of best practice with all aspects of the building trade
- Provide a basic understanding of EU policy driven directives
- Emphasise the legal requirements within the Irish Building Regulations.
- Aims to support and advise Building Construction Workers on improving building techniques, awareness and skills in quality building.
- Provide an on-going process via a website for assistance and support.

In brief, it is intended to provide know how and practical information for Building Construction Workers with the intention of improving their skills and awareness of energy efficiency and best practice procedures.

It will also aim to promote the process of Systems Thinking which is defined as the collaboration and consideration of all trades and their workmanship on the entire build leading to a complete quality build.

**KEYWORDS**

*Quality Build, Systems Thinking, Attention to Detailing, Continuous Air-Tightness, Controlled Ventilation, Comfort Levels.*

## 2 Introduction

The Aim of the Foundation Energy Skills (FES) programme is to promote quality build and raise awareness within the construction sector of energy efficiency and Systems Thinking with the emphasis on:

- Quality Build
- Systems Thinking
- Attention to Detailing
- Continuous Air-Tightness
- Controlled Ventilation
- Comfort Levels

This document seeks to define the Foundation Energy Skills programme in terms of:

- Defining the programme learning outcome(s) which the learner/participant should achieve having completed the programme.
- Defining the modules which should be completed to make up that programme of learning
- Defining the learning outcome(s) which the learner/participant should achieve having completed each module
- Defining the assessment methodology which will be used to test that those learning outcomes have been achieved.
- Developing the module content to reflect the learning outcomes to be achieved.

### 2.1 Policies and Regulations

As a direct result of the Kyoto Agreement in 1997 various acts and regulations have been formulated and implemented.

- European Performance Building Directive (EPBD) in 2002, adopted by Ireland in 2006.
- National Climate Change Strategy (2007) introduced a National Energy Efficiency Action Plan with binding targets for 2020 and addressed energy efficiency and overall energy policy for Ireland.
- European Performance Building Directive (EPBD) Recast in 2010 benchmarked the minimum energy performance requirements for 'nearly zero' energy in 2020 and the use of renewable sources. Deep retrofitting of buildings will also have to comply with new legislation.
- The Irish Building Control Regulations 1997 with amendments (2008 - 2014) - Technical Guidance Documents (TGD) in particular Parts F and L and to a lesser extent parts D and J.

- New commercial TGD part L is due in 2016.
- The Building Control (amendments) Regulations (BC(A)R) requiring the builder to demonstrate competency and compliance with Building Regulations.

## 2.2 Role of the Building Construction Workers

The collaboration between trades is required in order to ensure that the key requirements for low energy buildings, such as air-tightness and ventilation, are implemented.

The building construction worker can be defined as the team member who ultimately undertakes the works under the direction of the construction management team.

The building construction worker will work in a manner as outlined by agreed method of works or best practice information.

The building construction worker should be aware of the regulations and rules, building regulations requirements and the need to provide low energy buildings.

The building construction workers should also be aware of the critical interfaces on any project with the aim to reducing energy losses.

It should be remembered that the construction profession is directly responsible for ensuring that buildings:

- Provide acceptable thermal comfort for occupants
- Use minimum amounts of fuel and energy
- Are adequately and efficiently lit
- Provide good indoor air quality, and
- Are properly operated and maintained.

**'Systems thinking' should be considered at all levels**

## 3 Programme learning outcomes

### 3.1 Description of Course

Upon completion of the programme the learner will be able to:

- List the key policy and legislative drivers behind the move to low energy buildings
- Explain the key energy terms and units associated with low energy buildings
- List and describe the key principles of low energy techniques for, new-build and renovation works.
- List and describe-the key principles of air tight healthy buildings
- Appreciate the need to engage with other crafts to meet specific design demands
- List the challenges of low energy building projects and how to apply specific solutions

Upon the completion of training, building construction workers should be able to answer the following questions:

- What is low energy in the context of buildings?
- Where do the building details go wrong? And what is Best Practice to prevent this occurring?
- How to apply the building techniques for low energy quality construction? And how to deliver healthy comfortable buildings.
- How their own work affects the work of other trades and vice versa? Systems Thinking
- Attendees need to become more reflective about the consequence of their actions and how they contribute to the success of the project.

### 3.2 Indicative Content

The aim is to create understanding of the building techniques requirements, Building Regulations and Best Practice standards for new and retrofitting projects. This will be combined with the assessment of key building components (insulation, ventilation, heating etc) and System Thinking with the launch of an interactive website facility.

The indicative content of the programme will cover the following:

1. Describe the key EU policy and legislative drivers behind the move to low energy buildings. Understand why these directives were implemented.
2. Introduction to the terminology and accepted definitions in the energy sector. Overview of Thermal Conductivity ( $\lambda$ ), Thermal Resistance (R-value) and Thermal Transmittance (u-values). Initial group discussions to determine the level of understanding of low energy within the construction sector
3. Consider buildings as a collaborative system – ‘Systems Thinking’.

4. Review of the energy principles and the law of thermodynamics. Consider the modes of heat transfer (ie conduction, convection, radiation) and why and where they occur in buildings. Benefits of thermal mass and solar gain. Illustrative examples of the effects of heat transfer.
5. Principles of insulating materials, where and how they should be correctly installed and the importance of continuous insulation. The principles of structural air tightness including the effect of air infiltration on the building energy performance and occupant comfort levels. Designing for and maintaining air tightness in a building. Discuss suitable materials for air tight construction. Explain common air leakage paths in buildings, integrating services and using service cavities. Discuss wind tightness. Air tightness standards and measurement. Illustrative examples of the effects of air infiltration including thermal images. Fabric and air infiltration heat loss in buildings.
6. The principles of thermal bridging, definition and identification. Effect of thermal bridging on heat loss and the movement of moisture. Repetitive thermal bridging and thermal bridging due to penetrations in the building fabric. Illustrative examples of the effects of thermal bridging including thermal images.
7. Building ventilation design and maintenance. Natural and mechanical ventilation. Airborne pollutants and their sources in buildings. Controlled ventilation to alleviate condensation and air pollutants. Illustrative examples of ventilation systems.
8. Heating Systems overview. Why use certain types of heating systems. Renewable and new technologies. Understand implications of incorrect installations and medium/long term investments to improve energy efficiency.
9. Energy use in buildings. Factors affecting energy use for space and hot water heating. Solar and thermal mass on energy. Energy use for pumps, fans and lighting. Air quality and Thermal Comfort levels.
10. Communication between all those involved. Learn to ask. Clearly explain to homeowners on how to use and maintain equipment. Clarification of language. Understanding issues of running costs and maintenance.

### 3.3 Reading Material

- Pre-learning and post-learning material
- To include links to websites and specific printed material
- Link to moodle on registration

## 4 Programme Learning Units

### 4.1 Course Content:

The following sections define the learning units which are proposed, their indicative content and potential requirements for delivery within the QualiBuild programme. The content will be delivered at a suitable learning level with the aid of graphical and visual presentations and images.

#### 4.1.1 Definitions and Terminology:

This unit will focus on agreeing the key definitions which are most appropriate for use and explain why some definitions are used.

Potential for some group work/cross trade discussion on the use of terminology and understanding of energy efficiency at the start of the training programme.

#### 4.1.2 Regulations and Rules:

Focussing, briefly, on the key policies and drivers leading to the present Irish Regulations for low energy buildings; ie Kyoto Agreement, EPBD and Irish Building Control. This will highlight the implications for the lack of compliance and emphasise the inter-relationship between the various pieces of legislation and develop responsibilities and expectations of the building construction workers.

This will be delivered with diagrams and graphs to explain the legislation in simple format explaining EU policies and Irish Building Regulations and why they are needed. There will be use of multi-media content to make the subject material be more interactive. The focus will be on how the building construction worker can assist in meeting (and beyond) the various standards.

#### 4.1.3 Buildings as a System:

The concept of 'systems thinking' and quality building is to be introduced into the programme at an early stage. These will set the scene and be a reference point throughout the programme. This unit will focus on the relationship between fabric, air tightness, ventilation, heat supply and renewable energy. In particular emphasis will be on inter-relationship between various trades and crafts.

The content is to be delivered through a range of classroom discussions between mixed groups and involve case study/what if analysis.

Integrating this 'systems thinking' approach may also be achieved through the development of Systems Thinking quizzes within the relevant units.

#### 4.1.4 Energy Principles:

The key units of energy need to be defined clearly and carefully to ensure that the future aspects of the programme are delivered in a straight forward manner. This will focus on defining

- Thermodynamics – heat transfer
- Power, Energy and their units

- Thermal mass and Solar Gain
- Insulation, R and U-Values - Materials/products and systems
- Air-Tightness – workmanship and materials
- Ventilation – Mechanical and natural
- Thermal bridging – details and understanding
- Energy performance standards and methods: BER, Passiv House, BREEAM, LEED
- Primary energy and use

#### 4.1.5 Air Tightness and Building Fabric:

Debunking the myths that exists e.g. My Granny never got sick and she lived etc.

- Principles of applying insulation in new build and retrofit situations.
- Insulation methods and types of materials with their relative properties and appropriate use.
- Samples and examples of insulation materials and associated components.
- The principles of structural air tightness including the effect of air infiltration on the building energy performance and occupant comfort.
- Designing for and maintaining air tightness in a building.
- Examples of common air leakage paths in buildings.
- Wind tightness.
- Air tightness standards and measurement.
- Samples of materials suitable for air tight construction.
- Integrating services and use of service cavities.

#### 4.1.6 Thermal Bridging:

- Thermal bridging – definition and examples.
- Effect of thermal bridging on heat loss
- Causes of condensation with a focus on quality construction methods
- Repetitive thermal bridging and thermal bridging due to penetrations in the building fabric.
- How to avoid Thermal Bridges through best construction practice on site
- Sample of junctions etc. and how to eliminate thermal bridging.
- Thermal images.

#### 4.1.7 Ventilation and Condensation:

- Why install ventilation systems in buildings.
- Regulations for ventilation
- Importance of control
- Building ventilation design and maintenance
- Airborne pollutants and their sources in buildings.

#### 4.1.8 Heating Systems:

- The selection of heating systems,
- why buildings use multiple heating systems,
- heating system retrofitting challenges,
- Why install renewable systems, Why review holistic approach,
- Discuss new emerging systems
- Promote efficiency and installation techniques (ie insulate piping)

#### 4.1.9 Energy use in buildings:

- Factors affecting energy use for space and hot water heating.
- Energy use for pumps, fans and lighting.
- Matching the supply and demand of user.
- Cross trade consideration is needed along with links to air-tightness and communication transfer.
- Indoor air quality
- Thermal Comfort levels

#### 4.1.10 Low Energy Language:

- Issues with communication between trades and professions should be discussed in group sessions.
- Consider what the client wants and does this comply with building regulations.
- Information from Designer/Architect/Engineer should be clear and should be understood. If you don't understand ask.
- Does the Specification/drawings clearly show required information?
- Confirm what the Building Control Officer/Supervisor requires for compliance.
- The final session should focus on the development of a common understanding of different languages and 'lingo' used across/along the construction chain
- Should also provide participants with some questions which they can ask if they don't understand with what is being asked of them

Remember **KEYWORDS**

**Quality Build, Systems Thinking, Attention to Detailing, Continuous Air-Tightness, Controlled Ventilation, Comfort Levels.**

In brief, it is intended to provide know how and practical information for building construction workers with the intention of improving their skills and awareness of energy efficiency and best practice procedures.

## 4.2 Scope of Works

This programme will

- educate learners about the principles of low energy building and how these principles are applied on-site for new build and retrofit scenarios
- be focused on illustrating how low energy buildings can be achieved in practice
- be of an appropriate duration to ensure maximum participation is balanced against covering appropriate level and scope of content
- involve group discussion/exercises/activities to maximise cross-trade/craft knowledge transfer
- not provide detailed installation instructions for products, systems or technologies
- not lead to a qualification which allows successful learners to register on specific schemes for product/system/technology installation e.g. National Retrofitting support schemes
- result in a qualification and award under the National Framework of Qualifications

## 4.3 Target Audience

The target audience for the programme is:

Level 5

- General Operatives: those building construction workers who have no specific craft qualification but contribute to the construction industry e.g. labourers, glaziers, steel fixers etc
- Craft Apprentices: apprentices who have started their apprenticeship and typically are at Stage 4 or later in their apprenticeship
- Craft Workers: those who have completed their apprenticeship and may or may not have a period of post apprenticeship work experience completed.

Level 6

- Craft Operatives: those who have completed their apprenticeship with experience in the workplace: such as carpenters, plumbers, electricians etc

There should be no distinction made between those who are unemployed or employed initially. However, it should be noted that the priority in the short term is to roll out the training to those who are currently employed in the sector.

## 4.4 Entry Requirements

The target audience indicates that the entry requirements will have to be at a level which does not exclude general operatives from engaging in the programme. It is proposed that an entry requirement of Level 5 on the National Framework of Qualifications (NFQ) is appropriate to consider. i.e., the same level as the existing craft qualification in Ireland. Registration of Operatives.

Level 6 on the National Framework of Qualifications (NFQ) is appropriate to consider. i.e., the same level as the existing craft qualification in Ireland. Registration of Crafts Operatives.

Those who have a relevant award at Level 6/7/8 in engineering, architecture, construction studies etc. should be excluded from taking the programme as the primary focus is on building construction workers and crafts.

#### 4.5 Assessment

- Assessment will be completed through a series of question banks/progress reports at the end of each topic. This could include multiple choices, descriptive, selective and other question types. Consideration should be given to the following aspects also
- Participants be required to submit a minimum of 5 questions/queries they have about low energy building before the programme
- Participants to complete an on-line case study in addition to the question banks
- Assessment to be done after the training and not during it
- Marks to be given for attendance ~ 20%
- Inclusion of practical assessments will be very difficult given time, health and safety and resources restrictions.