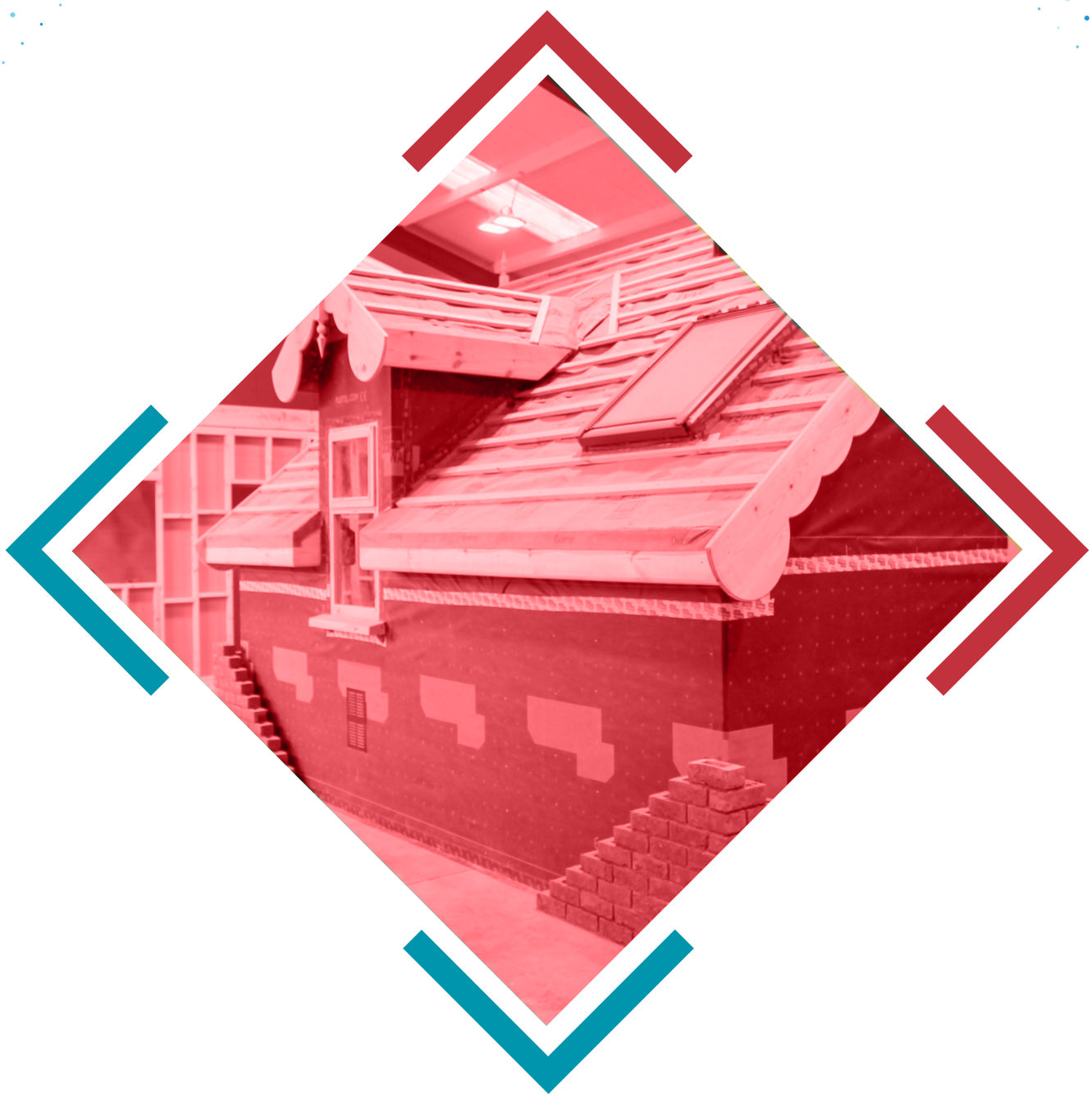
NZEB



NATIONAL SKILLS SPECIFICATION
NEARLY ZERO ENERGY BUILDING
ELECTRICAL

Version 1.4 | 11.10.2018


NZEB

Foreword for the

National Skills Specification for Nearly Zero Energy Buildings,

Waterford and Wexford Educational Training Board (WWETB)

by

Mr. Damien English, T.D.

Minister for State - Housing and Urban Renewal.

As a Government we are committed to responding to climate change through our policies and legislation. The implementation of Nearly Zero Energy Buildings (NZEB) is a key action for the built environment in contributing to Ireland's Low Carbon Transition and Mitigation Plan. This requires a change in how we live. In Ireland, approximately 40% of total energy produced is used in the building sector. Whilst we are a small country we can play a leadership role and one significant area we are doing this in is NZEB.

Having advanced our performance standards for new dwellings over the last 10 years for which we have received international recognition, we are now addressing the significant challenge to improve existing dwellings by introducing a minimum standard for major renovations i.e. cost optimal level. To turn these high performance standards into reality on site we need a highly skilled construction workforce with a good understanding of the principles of energy efficiency, and the roles and responsibilities of interacting trades.

The delivery of our housing and climate action targets is dependent on having a properly trained workforce with the right skills and training in place. Thanks to Waterford and Wexford Education and Training Board (WWETB), in partnership with key stakeholders, a programme to deliver Nearly Zero Energy Building Construction skills to existing tradespersons and professionals in the construction sector has been developed. Key stakeholders in this highly collaborative initiative have included the Department of Education and Skills, Department of Housing, Planning and Local Government, the Department of Communication, Climate Action and Environment, the Sustainable Energy Authority of Ireland , SOLAS, the National Standards Authority of Ireland, the Irish Green Building Council, the Construction Industry Federation, Connect Trade Union, Limerick Institute of Technology, Carlow Institute of Technology and Waterford Institute of Technology.

These courses come at a time when skills are becoming an important resource in Ireland's ability to deliver housing. There will be a significant demand for these NZEB skills, given that all new buildings in Europe must be NZEB by the 31st Dec 2020. In Ireland, all new buildings which start construction in 2019 are required to meet the NZEB standards as set down in Part L of the Building Regulations. This is also a key measure in Ireland's Climate Action Plan and is identified in Action 50 of the plan to skill-up current contractors/other industry players in deep retrofit, NZEB and new technology installations.

Ireland is committed to Climate Action and is showing international leadership in the area of new Nearly Zero Energy Buildings. The United Nations Economic Commission for Europe are supportive of the development of this programme and Ireland looks forward to cooperation with the UNECE on this programme and in other areas related to the sharing of information in the development of Nearly Zero Energy Buildings at an international level.

This collaboration with UNECE will enable Ireland to show leadership internationally in addressing climate change and to share the lessons and skills we are learning with both the developed and developing world. This initiative will support Ireland's contribution to the UN Sustainable Development Goals by training people and supporting a skilled workforce.

I wish Waterford and Wexford Education and Training Board well with this first of its kind initiative and look forward to meeting the craft workers who avail of this training across all of the trades covered. This will make a valuable contribution to the delivery of sustainable and quality housing in Ireland. It is a key action for the Built Environment in contributing to Ireland's role in addressing Climate Change and supports the implementation of Action 50 of the Climate Action Plan to Skill-up current contractors/other industry players in deep retrofit, NZEB and new technology installations. To those who are taking part in this training, I wish you all well and I'm sure it will be of great benefit to you in your future careers in the construction industry.

Damien English, T.D.
Minister for State,
Department of Housing and Urban Renewal

Foreword for the

National Skills Specification for Nearly Zero Energy Buildings,

Waterford and Wexford Educational Training Board (WWETB)

by

Mr. John Halligan, T.D

Minister of State for Training, Skills, Innovation, Research and Development

The National Skills Strategy set a clear direction for lifelong skills development and for a workforce that is flexible, adaptable and capable of dealing with the challenges and opportunities posed by the major forces influencing the world of work. The challenge of tackling climate change, growing the use of renewable energy and improving the energy efficiency of homes, businesses and public services are having a significant influence in workplaces and working lives across sectors and regions.

Thanks to a highly collaborative project led by WWETB and supported by a broad range of stakeholders including; the Department of Education and Skills, Department of Housing, Planning and Local Government, the Department of Communication, Climate Action and Environment, the Sustainable Energy Authority of Ireland, SOLAS, the National Standards Authority of Ireland, the Irish Green Building Council, the Construction Industry Federation, Connect Trade Union, Limerick Institute of Technology, Carlow Institute of Technology and Waterford Institute of Technology, the first NZEB skills specifications have been produced - one of the first internationally for crafts persons in the construction sector. These courses come at a time when skills are becoming an important resource in Ireland's ability to deliver housing.

Not only will there be interest in these NZEB skills specifications nationally, I understand there is also international interest and many other countries wish to learn from Ireland's experience in this area. The United Nations Economic Commission for Europe (UNECE) is committed to working with the relevant authorities and stakeholders to develop an International Centre of Excellence in High Performing Buildings in Wexford. This national skills specification will form a cornerstone of that collaborative project at both a national and international level."

Education and training institutions have a long track record of working with the construction industry, both in training those entering the sector at the start of their working lives and, increasingly, in supporting skills development within the construction workforce. As the sector adapts to meet the challenges and the significant opportunities of providing high performing homes and buildings and improving the energy performance of our existing building stock, the education and training sector are there to support them. The development of this programme also supports Ireland's Climate Action targets and is key measure in Action 50 of the Climate Action Plan. Consistency in training delivery and the framing of training standards will underpin our success in this area.

I would like to congratulate Waterford and Wexford Education and Training Board and their partners in the development of this training programme which is being delivered at a critical time to meet Ireland's housing needs and climate action challenge.

Mr. John Halligan, T.D

Minister of State for Training, Skills, Innovation, Research and Development

ELECTRICAL

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1. INTRODUCTION

On behalf of Waterford and Wexford Education and Training Board (WWETB), I am very pleased that we are playing our part in enhancing the skill-set of the national construction workforce in relation to Nearly Zero Energy Buildings (NZEB). WWETB Training Services have a proud and well-recognised tradition of being to the fore nationally in training craft apprentices and Wexford County Council has been exemplary in developing high performance energy efficient housing. It was from this initial partnership that the momentum for NZEB Skills Training emerged and this was heightened by the national imperative to develop National Skills Training response to meet the upcoming challenges. In addition, the WWETB Strategy Statement 2018-2022 prioritises collaborations and innovative training developments such as NZEB.

Minister for State for Housing and Urban Renewal, Mr. Damien English, T.D., in his foreword to this document has listed the wide range of participants who worked together with WWETB to produce the first National NZEB Skills Specifications in Ireland and we cannot thank them enough for their commitment and enthusiasm for the project. In addition, I wish to thank SOLAS who financially supported us, and without whose help this project could not have progressed to this stage. I would like to, also, acknowledge the Department of Education and Skills for their on-going support of WWETB. We are very proud to have played a leadership role in this development and we will now proceed to ensure the widest possible access to this learning is available to upskill the construction industry in NZEB. It is very gratifying that the United Nations Economic Commission for Europe (UNECE) have shown such interest in the project and we will continue to work with them in the potential development of a National Centre of Excellence in High Performance Buildings in Co. Wexford

These developed documents have now been converted to the curriculum to meet the requirement of the NZEB Skills Specifications and the process will continue to develop and adapt appropriate training programmes and manuals. This will enable training to commence at the WWETB National NZEB Training Centre in Enniscorthy. It is our hope that these National Skills Specifications and subsequent training programmes will ensure that the construction industry is well prepared to meet the legislative requirement whereby 31st of December 2020 all new buildings must meet the Nearly Zero Energy Building standard.

The National Skill Specifications have been developed in the following areas: NZEB Fundamentals, NZEB for Electricians, Bricklayers, Plasterers, Carpenters, Plumbers, and Site Supervisors, This broad range of training opportunities will enable all involved in the construction industry to continue to be at the cutting edge in supporting Ireland's Low Carbon Transition and Mitigation Plan. We, in WWETB, look forward to working with the construction industry and all our other partners in this area to ensure the provision of these most relevant training opportunities in NZEB available anywhere globally.

Kevin Lewis
Chief Executive
Waterford and Wexford Education and Training Board (WWETB)

2. NZEB PRINCIPLES, BUILDING REGULATIONS & PRODUCT STANDARDS

Understand the Principles relevant to NZEB, Building Regulations and Product Standards.

2.1 NZEB PRINCIPLES

KNOWLEDGE

- Define the acronym NZEB.
- Outline the EPBD and EED drivers relevant to building regulations and NZEB
- Describe the principles of NZEB and cost optimisation as they pertain to new dwellings.
- List some of the key exemptions that pertain to the requirement to meet NZEB.
- Define the timeframe deadlines that all new dwellings are to comply with the NZEB standard.
- Outline the current number of NZEB dwellings in Ireland and why it is important to reach certain targets for NZEB construction.
- Explain what is meant by the terminology 'Primary Energy' and 'Delivered Energy'.
- Define the maximum level of primary energy consumption required to achieve NZEB.
- Describe the key renewable energy technologies most relevant to NZEB in Ireland.
- Define what proportion of the regulated energy loads of dwellings must be met by renewable energy sources.
- Describe the key information that should be provided to the dwelling owner so that the building can be operated in such a manner as to use no more fuel and energy than is necessary.
- Explain the importance to building occupants in achieving adequate levels of ventilation, lighting and thermal comfort.
- Describe the key roles of adequate ventilation in meeting the fresh air needs for the occupants of the building, as well as preventing excessive levels of relative humidity and the associated risks of mould and condensation.
- Explain the importance of continuing professional development (CPD) in relation to the NZEB standard.

2.2 BUILDING REGULATIONS

KNOWLEDGE

- Describe the suite of Building Regulations Technical Guidance Documents (TGDs) in Ireland.
- Describe the Building Control Assessment Regulations (BCAR).
- List the Building Regulation and relevance to NZEB compliance for new dwellings.

- Describe in outline the TGDs; “fire safety” as defined in Part B, “Site preparation and resistance to moisture” (Part C), “proper materials and workmanship” (Part D), “sound” (Part E), “heat producing appliances” (Part J) and “access and use” (Part M) of the Building Regulations.
- Describe the principles of “conservation of fuel and energy” (Part L) and “nearly zero energy buildings” as defined in TGD Part L – dwellings, of the Building Regulations in relation to meeting the NZEB standard.
- Describe the key principles of and requirements for “ventilation” as defined in TGD Part F of the Building Regulations in relation to meeting the NZEB standard.
- Differentiate between the need to meet the NZEB standard and the need to ensure compliance with other key performance standards of buildings, most especially fire, ventilation, moisture ingress and durability of materials.
- Describe how the building standards required for building energy performance and carbon emissions will continue to improve in the future.
- Describe the key information presented in the Acceptable Construction Details (ACDs) including key areas that are most relevant to the role of electrician.
- Understand how to keep up-to-date with changes and amendments to relevant Building Regulations and Irish policies.
- Describe in outline the software tool Dwelling Energy Assessment Procedure (DEAP).
- Explain the relevance of DEAP for verifying compliance with Building Regulations and NZEB standards for new dwellings.
- Describe the difference between regulated and unregulated loads in DEAP.
- Define the acronyms ‘BER’, ‘EPC’, ‘CPC’ and ‘RER’.
- Describe what minimum BER would be required to achieve NZEB standards for a dwelling.
- Outline the differences in building NZEB to a B3 rated dwelling in relation to energy savings, comfort, Co2 emissions and cost optimisation using relevant case studies.
- List the key units used to define the energy efficiency of buildings including kWh/m2/year and kgCo2/m2/year.

2.3 PRODUCT STANDARDS

KNOWLEDGE

- List the key NSAI standards and certification schemes that are relevant to NZEB construction.
- Describe what is included in NSAI’s ‘Construction Products Regulation’ (CPR).
- Define the acronym ‘CE’ (which stands for “Conformité Européene” or “European Conformity”).
- Describe the relevance of CE marking for construction products as mandated by the Construction Products Regulation (CPR).
- Describe the key information presented on both a CE label and in the associated Declaration of Performance.
- Describe the key information presented on energy labels for pumps, fans and lighting including performance classes and performance indicators.

- Describe web-based resources where supporting information can be found on efficiencies of key elements of highly efficient NZEB buildings (such as technical products, controls, pumps and fans).
- Describe the Ecodesign Directive (which requires manufacturers to decrease the energy consumption of their products by establishing minimum energy efficiency standards.

3. BUILDING PHYSICS

Understand Building Physics – Key energy terms and units

KNOWLEDGE

- Describe the different means by which heat flows in a building
- Describe the terms “U-value” and “R-value”, including their units, and explain their practical relevance with regards to the energy efficiency of dwellings and achieving NZEB.
- Perform a simplified U-value calculation for a wall, floor or roof assembly.
- Describe the consequences of poorly insulated dwellings.
- Describe the term “thermal conductivity”, including its units, and explain its practical relevance with regards to the energy efficiency of dwellings and achieving NZEB.
- Describe the term “Psi-value” (or ψ-value), including its units, and explain its practical relevance with regards to the energy efficiency of dwellings.
- Describe the consequences of having poor thermal bridge detailing in dwellings.
- Describe the process by which insulation reduces heat loss from buildings, pipes, vessels and ducts.
- Describe the term “air-permeability”, including its units, and explain its practical relevance with regards to the energy efficiency of dwellings.
- Describe the consequences of having high air permeability in dwellings.
- Describe key terms commonly used in relation to moisture movement in buildings including “breathability”, “vapour control” and “airtightness”.
- Describe the effects of temperature reduction on the relative humidity of air and the associated risk of creating conditions for mould and condensation.
- Describe the potential adverse effects arising from penetrations in the building envelope considering both thermal and moisture movement.
- Describe the terminology “surface condensation” and how insulating certain elements can increase the condensation risk at uninsulated elements.
- Describe the terminology “interstitial condensation” and the principle of making materials more vapour permeable as you move towards the external surface.
- Explain the importance of minimising heat loss through the building envelope.
- Describe what is meant by “solar radiation” and outline its relevance for energy efficient buildings in relation to solar gain, risk of overheating and renewable energy production.
- Describe the benefit of maximising heat gains in buildings through the windows whilst ensuring that buildings do not overheat.

- Describe HLC (Heat Loss Coefficient).
- Outline where to find information on real U-value requirements for insulation using case studies.
- Describe the key factors that affect occupant comfort in a building, including temperature, relative humidity, air speed and indoor air quality.

4. BUILDING FABRIC

Understand Building Fabric – Continuous Insulation, Thermal Bridging, Air

Permeability, Windows and Doors.

4.1 CONTINUOUS INSULATION

KNOWLEDGE

- Describe the three principle means of reducing heat loss from buildings, namely through increased insulation, and reduced thermal bridging and limiting air permeability.
- Describe the importance of creating a continuously insulated thermal envelope in order to reduce heat loss through the building fabric.
- List the minimum backstop NZEB U-values required for different elements of the building envelope.
- Identify the insulation layer(s) in the acceptable construction details (ACDs) for the external envelope (roof, wall and windows/doors).
- Describe the best practice procedures regarding placement of electrical installations in the insulation layer with special emphasis on fire safety and thermal retention. Consider all types and positions of the insulation layers in a case study scenario.
- Describe the risks associated with poor services workmanship relating to continuity of the insulation layer and reducing the number and size of penetrations.
- Identify best practice materials and products for use in insulating services
- Describe how recessed lighting in ceilings can be installed without compromising the continuity of the insulation layer.
- Describe how service penetrations will affect the effectiveness of the insulation layer for typical roof, wall and floor assemblies for both masonry and timber frame construction commonly used in Ireland, using case studies.

KNOW HOW & SKILLS

- Install necessary electrical services without compromising the effectiveness and continuity of the insulation layer.
- Ensure careful routing of electrical services in order to facilitate subsequent placement of continuous insulation by the insulation installer.
- Describe the potential fire hazards of installing electrical services in highly insulated zones.

COMPETENCE & RESPONSIBILITY

- Describe the importance of not reducing the effectiveness of installed insulation through removal or damage.
- Describe what procedure should be followed when products which do not comply with those specified for the building are provided for use.
- Carry out the repair and / or reinstatement of insulation where it has been damaged or removed to accommodate electrical services.
- Describe a scenario whereby remedial assistance from others might be required in order to ensure the continuity of the insulation.
- Describe new insulation products recently available in the marketplace and how they can be used in the area of services on dwelling construction projects.

4.2 THERMAL BRIDGING

KNOWLEDGE

- Describe the term “thermal bridges” .
- Describe the practical relevance of thermal bridging with respect to energy efficiency and NZEB compliance for dwellings.
- Describe where thermal bridging typically occur in dwellings for both masonry and timber frame construction (non-repetitive and repetitive).
- Identify the location of a typical thermal bridge in the acceptable construction details (ACDs) for the external envelope.
- Describe the importance of not creating thermal bridges though the removal or damage of insulation.
- Describe the most commonly used interventions to prevent or reduce thermal bridging.
- Describe the thermal bridge effect of penetrating the insulation layer with electrical services.
- Describe the potential adverse health impacts to occupants of the building of thermal bridging with respect to risk of mould and condensation.
- Describe the potential adverse structural impacts to the dwelling of thermal bridging with respect to risk of mould and condensation.

KNOW HOW & SKILLS

- Avoid creating thermal bridges through alternative routing or placement of electrical services.
- Ensure minimisation of thermal bridging in the insulation layer through avoidance where feasible of penetrating highly conductive materials such as steel conduits or metal straps.
- Carry out the appropriate repair of the insulation layer where it has been damaged or partially removed to accommodate electrical services without compromising the continuous insulation.

COMPETENCE & RESPONSIBILITY

- Describe a scenario whereby assistance might be required from other experienced insulation applicators on the building site in order to mitigate the thermal bridge effects of an electrical installation.

4.3 AIR PERMEABILITY

KNOWLEDGE

- Define the maximum level of air-permeability allowed in Part L of the Building Regulation and NZEB, including its units.
- Define the level of air permeability below which mechanical ventilation is required, including its units.
- Describe the multiplicity of benefits that airtightness brings to dwellings.
- Describe how the air permeability of a dwelling has a significant influence on the extent of heat loss.
- Explain the importance of providing adequate ventilation to a dwelling when there is an increased level of airtightness.
- Describe the key concept of “unbroken continuity” as it relates to the formation of a highly airtight building.
- Identify the airtightness layer in the acceptable construction details (ACDs) for the external envelope.
- Describe the best practice techniques and types of materials that can be used to retain the airtight layer for mechanical and electrical ducts and conduits.
- Explain the importance of minimising the number and size of holes in the airtight layer.
- Describe how mechanical and electrical ducts and conduits which penetrate the envelope may adversely affect the air permeability of the project.
- Describe the benefits of creating a ‘service cavity’ in relation to the airtightness of a building.
- Explain the importance of not reducing the effectiveness of the installed airtightness and vapour control layer through removal or damage.

KNOW HOW & SKILLS

- Identify the airtight layer and its constituent parts on construction drawings.
- Identify the airtight layer, its constituent parts and its routing on building assemblies and junctions.
- Carry out optimal routing or placement of electrical services in order to avoid compromising the airtightness and vapour control layer.
- Carry out adequate separation of electrical penetrations through the external envelope so that each of them can be individually sealed to the airtightness layer.
- Define the qualities required of materials used in order to create a permanent airtight seal around electrical penetrations of the external envelope.
- Carry out the application of appropriate materials including tapes, membranes, grommets and caulks in order to create permanent airtight seals around external envelope penetrations.
- Carry out the correct air-sealing of electrical penetrations such that the measures applied will not be compromised by the later installation of second-fix materials such as plaster-board and wood finishes.

COMPETENCE & RESPONSIBILITY

- Explain the importance of enquiring from the site supervisor as to the airtightness strategy being used for the project and the relevance this might have for electricians.
- Explain the importance of taking responsibility to report to the site supervisor where unavoidable air leaks have been created as a result of electricians work.
- Explain the importance of sequencing of works on the building site with respect to achieving high levels of airtightness.
- Carry out the repair to damage caused to the continuity of the airtightness layer by electrical penetrations.
- Describe a scenario whereby assistance might be required from other experienced airtightness applicators on the building site in order to mitigate the adverse effects on airtightness of an electrical penetration.
- Outline how an airtightness test is conducted and typical fault areas relevant to electrical installations.

4.4 WINDOWS & DOORS

KNOWLEDGE

- Describe the energy efficiency and comfort related function of windows, highlighting their role in relation to thermal protection, solar gains and ventilation.
- Describe the risks for continuity of insulation as well as air-sealing in drilling holes through window frames for the purposes of accommodating electrical services.

KNOW HOW & SKILLS

- Carry out the installation of cabling for intruder alarms and other window and door-mounted electrical services without compromising their performance.

5. BUILDING SERVICES

Understand Building Services – Space heating and Domestic Hot Water, Controlled Ventilation, Lighting, ICT and Smart Technology.

5.1 SPACE HEATING & DOMESTIC HOT WATER

KNOWLEDGE

- Explain why space heating and domestic hot water provision is typically one of the highest sources of carbon emissions from a dwelling.
- Define the controls required to shut down the heating system when there is no demand for either space or water heating from that source.
- Explain why all hot water storage vessels, pipes and ducts associated with the provision of heating and hot water should be fully insulated.
- Describe the significant energy losses from poorly insulated heating and DHW pipes and explain why up to 50% of these losses cannot be used as free “passive” heat gains.
- Describe why water pipes and storage vessels in unheated areas need to be insulated, for the purpose of avoiding condensation as well as protection against freezing.
- Describe the benefits of clustering of rooms which use DHW in an effort to keep pipe-runs short which minimises heat losses.
- Describe the compatibility of certain heating emitters with relevant space heating source.
- Define the controls and equipment required to regulate space heating on the basis of room temperature.
- Identify the optimum position to locate room thermostats.
- Define the controls and equipment required to regulate heat input to stored hot water on the basis of stored water temperature.
- Define the controls and equipment required to provide separate and independent automatic time control of space heating and hot water.
- Describe why the use of direct resistance electrical heating is highly inefficient in terms of primary energy and should generally be avoided.
- Describe the different kinds of electrical heat pumps that can be used for space heating and hot water generation, including air to water, geothermal and hydrothermal.
- Explain how the use of heat pumps and combined heat and power (CHP) can both make a positive contribution towards the renewable energy requirements for NZEB.
- Define the operating temperatures that different heat generators operate at, comparing the difference between higher temperature and lower temperature heat pumps. (e.g. Oil/gas boilers and low temperatures e.g. heat pumps).
- Describe the correct method for installing electricity and other utility meter boxes.

KNOW HOW & SKILLS

- Read and interpret electrical drawings relating to applications commonly used to maximise the energy performance of an NZEB dwelling.
- Select appropriate sensors to control heat input on the basis of temperature within the heated space (for example by the use of room thermostats, thermostatic radiator valves, or other equivalent forms of sensing device).
- Describe how to provide independent temperature control in larger dwellings for separate zones that normally operate at different temperatures (for example living and sleeping zones).
- Describe how to provide independent temperature control in larger dwellings that have different heating regimes (for example, zones that differ in relation to either internal heat gains or solar gains).
- Installation of a heating and DHW time and temperature control system.
- Installation of a room thermostat which regulates the operation of the heating system.
- Installation of a suitable system to prevent the risk of legionella in the hot water system.
- Installation of electrical provisions required for heat pump space heating and hot water systems.
- Installation of an appropriate electrical connection to flow control or other equivalent devices to ensure boiler switch off when thermostatic radiator valves (TRV's) are fitted.
- Understand the impact of heat pump installation on overall electrical loads of dwelling.
- Understand the impact of biomass installation on overall electrical loads of dwelling.
- Describe how controls on buffer tanks are installed and the benefits.
- Describe the controls required for manifolds.
- Describe how to install, regulate and position radiators and underfloor heating controls.
- Understand the differences in radiators versus underfloor heating controls
- Describe different scenarios of the integration of PV/HP/Ventilation.

COMPETENCE & RESPONSIBILITY

- Carry out the commissioning of electrically controlled heating and DHW equipment and systems including initial programming (time, temperature, and daily operational times) in accordance with a variety of prescribed scenarios. This should allow for different situations where you have e.g. HP + PV; SThermal + HP; PV + Boiler etc.
- Apply the competent use of measures used to minimise energy use for heating and DHW in a dwelling, including circulation pump speeds and time and temperature controls.

5.2 CONTROLLED VENTILATION

KNOWLEDGE

- Explain natural/background/mechanical ventilation.
- Describe the air permeability requirements of dwellings for different appropriate ventilation strategies to ensure compliance of Building Regulations and NZEB standards.
- Outline best practice scenarios governing the use of natural ventilation, including sizing and placement of background ventilators to achieve Building Regulation and NZEB compliance.
- Describe the different kinds of mechanical ventilation systems that can be used for different types of dwellings (continuous, intermittent, whole-house individual room, with and without heat recovery, demand controlled etc.).
- Explain why the importance of controlled ventilation increases with decreasing air permeability.
- Describe when and where fire dampers are required on ventilation ducts in dwellings.
- Identify appropriate locations for home-owner controls for mechanical ventilation systems.
- Describe the importance of ensuring low noise levels from mechanical ventilation systems in dwellings.

KNOW HOW & SKILLS

- Carry out the installation and commissioning of electrical controls for ventilation systems including, where used, on-off switches, boost controls for different ventilation rates and regulatory sensors such as humidity and CO2.
- Carry out the installation and commissioning of appropriate connections of whole-house ventilation systems to the fire alarm system to ensure system shut down in the event of a fire.
- ICarry out the installation and commissioning of electrically controlled fire dampers.

COMPETENCE & RESPONSIBILITY

- Apply the competent use of controls to minimise electricity use for mechanical ventilation in a dwelling.
- Apply the appropriate levels of ventilation for rooms in the house to ensure the comfort levels of the occupants are compliant with Building Regulations and NZEB standards.

5.3 LIGHTING, ICT & SMART TECHNOLOGY

KNOWLEDGE

- Explain why lighting constitutes significant regulated electrical loads in dwellings.
- Define the needs of lighting provision explained in the overall energy performance measurement in DEAP.
- Describe the energy labelling used for light bulbs.

- Describe the different types of lighting that can be used in dwellings with regards to energy efficiency in compliance with NZEB standards.
- Describe current and emerging smart technologies that can be used to remotely control building services in the home as they relate to energy efficiency, including heating and domestic hot water.
- Describe the various means by which internet and Wi-Fi can be provided throughout a dwelling.
- Describe the various means by which telephone, intruder alarm and satellite television can be provided throughout a dwelling.
- Define the electrical loads for typical ICT use in the home including internet modems, satellite boxes, alarm systems and others.
- Review a design of a lighting system for interior spaces considering appropriate lux levels, light colour, room geometry and orientation and availability of natural daylight.

KNOW HOW & SKILLS

- Describe lighting controls which can be used to reduce electrical energy including options such as zoning and dimming.
- Define occupancy sensors (including PIR) which can be used to reduce lighting loads in infrequently used spaces and identify appropriate placement of such sensors.
- Specify a low energy exterior lighting system including sensors to minimise electrical use.

COMPETENCE & RESPONSIBILITY

- Apply the competent use of commonly used smart technologies (including mobile 'apps') for the purposes of reducing energy use in a dwelling.
- Describe recent and emerging innovations in energy efficient lighting, ICT and smart home technologies.
- Keep up-to-date with emerging technologies.

6. RENEWABLE ENERGY, PHOTO-VOLTAICS, SMART METERING & ELECTRIC VEHICLES

Understand Renewable Energy, Photo-Voltaics, Smart Metering and Electric Vehicles relevant to NZEB:-

KNOWLEDGE

- Describe the importance of using renewable heating technologies and how they contribute to Building Regulation and NZEB compliance.
- Define the minimum level of energy provision required from renewable energy technologies to comply with NZEB requirements.
- Describe "renewable energy technologies" and cite examples of the different types of technologies that qualify as providing renewable energy.
- Define the limitations associated with energy output from relevant renewable

energy technologies in particular reference to micro wind.

- Describe how a smart meter works concerning import and export of electrical energy from the home.
- Describe the portion of energy (CoP) above the electrical energy consumed by heat pumps which is allowed to be counted as “renewable energy”.
- Describe the rules governing whether certain boiler-types can be considered as contributing towards renewable energy.
- Describe commonly used options for meeting the renewable energy technologies for developments with multiple residential unit, such as centralised HPs and CHP unit.
- Describe how a photovoltaic panel (PV) generates electricity and contributes to achieving NZEB compliance.
- Describe how excess power from PV panels can be stored e.g boosting DHW tanks, batteries or other emerging technologies.
- Describe the role that small-scale combined heat and power (CPH) can play in meeting the renewable energy targets and achieving NZEB compliance.
- Explain the key data presented on energy labels for renewable energy generation technologies.
- Describe typical smart electrical appliances e.g. smart fridge and how they can be controlled by homeowner and/or energy provider.
- Describe the best practice installations required for the charging of electric vehicles.
- Describe the best practice installations required to store electricity generated through renewable technologies.

KNOW HOW & SKILLS

- How to install the cabling, inverter, controls and isolation switch required to connect both a photo-voltaic and micro wind turbine to the consumer unit in a dwelling.
- How to install the cabling, controls and isolation switch required to connect an electrical storage battery to both renewable energy generators as well as the consumer unit in a dwelling.
- How to install a smart meter as well as an in-house display unit which provides information on real-time electricity consumption and production in the home.
- How to install an external car-charging point for electrical vehicles.

COMPETENCE & RESPONSIBILITY

- Specify an appropriate solar thermal, solar photo-voltaic system and / or micro wind turbine which will meet the projected renewable energy production target in accordance with the BER prepared for the dwelling.
- Knowledge of emerging technologies in the smart metering, smart appliance, electricity storage and electrical vehicle sectors.

7. COMMUNICATION & USER INFORMATION

Demonstrate the required knowledge to facilitate high quality Communication and Best Practice User Information.

KNOWLEDGE

- Explain the importance of ensuring good communication between all members of the construction team to achieve NZEB compliant dwellings.
- Explain the importance of communicating closely with all other trades on the building site with regards to achieving a successful outcome in relation to airtightness. In particular, communication with those trades which regularly make penetrations through the airtight layer (including electricians and plumbers) is especially critical.
- Apply collaborative teamwork and systems thinking on-site with all trades.
- List key aspects that require excellent communication on-site, especially the strategies being used for airtightness, vapour control and thermal bridging to achieve NZEB compliant dwellings.
- Understand that discussions will be required with the site supervisor before works start to outline the airtightness strategy for the building.
- Understand the details specified in construction drawings with respect to thermal bridging, air tightness and window positioning and not to reduce their effectiveness.
- Outline what role the electrician will play in delivering the airtightness strategy, including recognising when specialist external expertise might be required.
- Outline the key sequences that must be followed in order to meet the airtightness targets and communicate these to the site supervisor and all relevant trades.
- Understand what envelope service penetrations will be required by discussing with the site supervisor and other relevant trades before works start.
- Describe the consequences of other trades adversely impacting the airtight and vapour control layer, consider plasterboard installers 'slabbers' and others pulling through cables/ducting.
- Understand where the electrician may be liable for failures, for example exceeding or failing to achieve specified airtightness targets.
- Outline the required information (products, agreements, materials) for the maintenance/operational information handbook which is handed over to the homeowner to ensure that the owner clearly understands how to maintain the building in an energy efficient manner.
- Describe the importance of installing and detailing specific products with regards to maintenance and replacing products and materials in the future.
- Understand how to operate the time and temperature controls for the heating and domestic hot water.
- Understand how to operate a mechanical ventilation system.
- Understand the various ICT and smart technology innovations used in dwellings.
- Explain how a PV and / or micro wind turbine system works, including seasonal variation in electricity production, and interpreting the kWh production display

on the control panel.

- Explain how a smart meter works in terms of importing and export electricity from the home and how to interpret the readings on the display.
- Explain how an electrical vehicle charger works.
- Explain how a whole-house energy storage battery works including how long it takes to charge and how much power it can store.
- Explain to the homeowner the contents of the maintenance/operational information which is handed over to the homeowner to ensure that the owner clearly understands how to operate and maintain the building in an energy efficient manner.
- Explain to the homeowner the importance of installing and detailing specific products with regards to maintenance and replacing products and materials in the future.
- Explain the importance of continuing professional development CPD, (continuous training) and association with relevant national quality assurance standards.
- Understand where CPD and future accredited training can be obtained in relation to the NZEB standards.

NOTES:

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