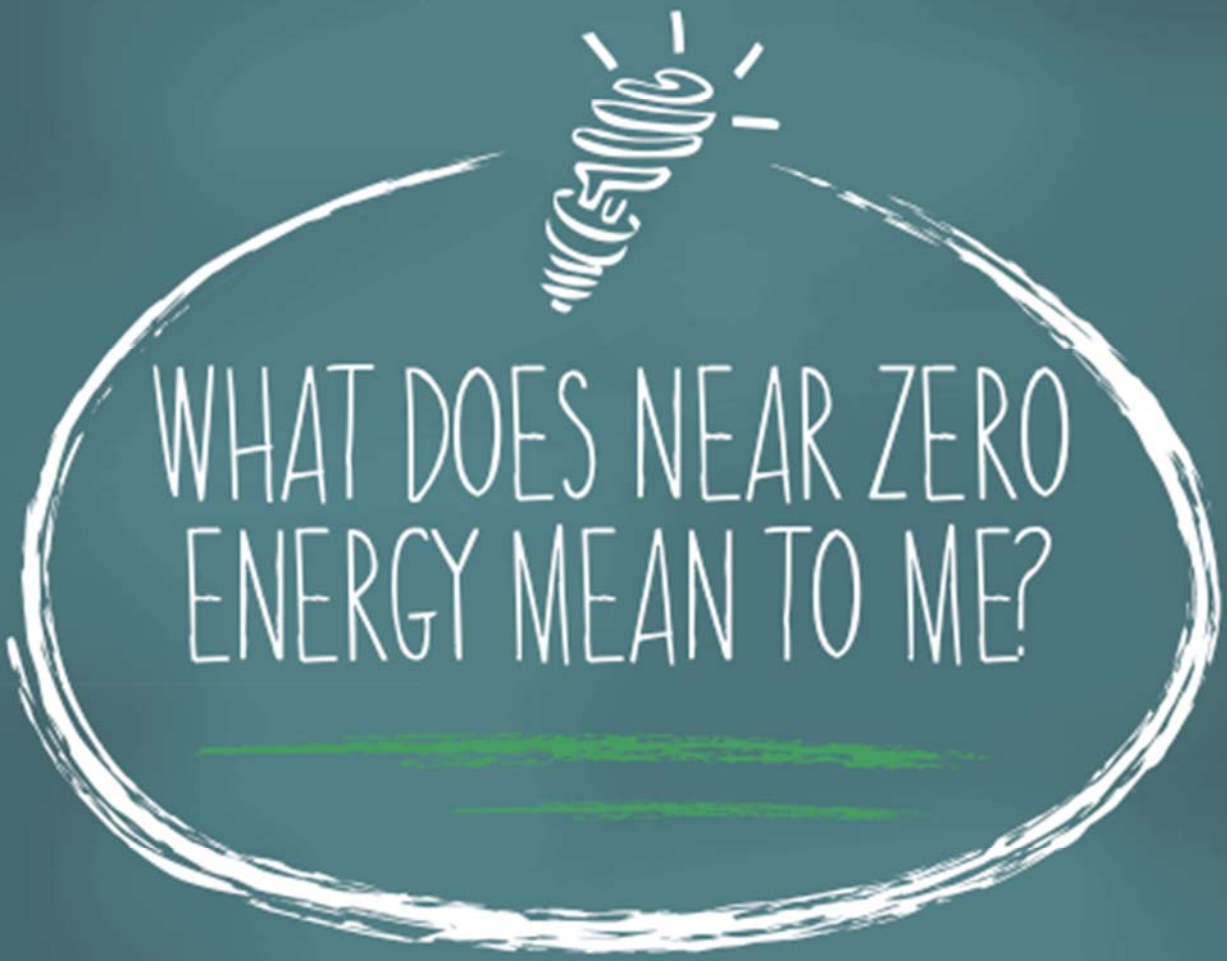
This course contains 6 Units

U1 U2 U3 U4 U5 U6

CERTIFICATE IN

Introduction to Low Energy Building Construction



Trainers Manual

Co-funded by the Intelligent Energy Europe Programme of the European Union

QualiBuild
Upskill • Train • Improve

Further information

More details on BUILD UP Skills QualiBuild can be found at www.qualibuild.ie

Note: Any mention of commercial names and products are for purposes of illustration only and does not mean that this manual endorses any of the products or services so referred to.

Co-funded by the Intelligent Energy Europe Programme of the European Union

Summary

At a national policy level, Ireland has committed to reducing its total energy consumption by 20% by the year 2020. With energy use in buildings accounting for over 31% of total final energy consumption in Ireland this is an obvious sector to target as a pathway to meeting 2020 targets. Building regulations and standards have been amended significantly over the past 10 years, establishing a new approach to construction and renovation to prescribed energy performance standards. These standards will evolve towards a near zero energy framework for buildings by 2020, necessitating the integration of renewable energy systems to achieve the set energy and carbon performance levels.

A National Energy Retrofit Programme (NERP) was introduced in 2011, setting out a target of 1 million buildings to be retrofitted by 2020. The prevailing economic conditions in Ireland resulted in an unprecedented fall in commercial and residential construction projects and consequently, the employment opportunities in the sector. The Build Up Skills – Ireland (BUSI) report, August 2012, found that there are still 70,000 building construction workers in the building sector and that the residential sector accounted for 68% of the value of building construction output in 2011. The report also highlights that there is a knowledge gap rather than a skills gap in the building sector when it comes to the successful implementation of low energy buildings.

In order to narrow the knowledge gap, the Foundation in Energy Skills (FES) course is designed to introduce building construction workers, BCWs, to low energy building techniques and key energy terminology.

The intention of this course is to encourage construction workers to build high quality low energy buildings. Factors that should be discussed and directly relate to ‘Quality’ are:

- Energy Efficiency
- Workmanship
- Comfort
- Environment

Table of Contents

Course Overview

The course is delivered over 3 days inclusive of a demonstration day. An alternative delivery model consists of 4 evening sessions and a demonstration day, which will generally be on a Saturday.

The three days are divided into six units with two units being covered each day, (this is equivalent to one unit per evening session). Each Unit of the course is equivalent to a session, which is approximately 3.5 hours in duration (equivalent to an evening session or a half day of training).

Figure 1 below gives a breakdown of each unit and the topics to be covered during the course.

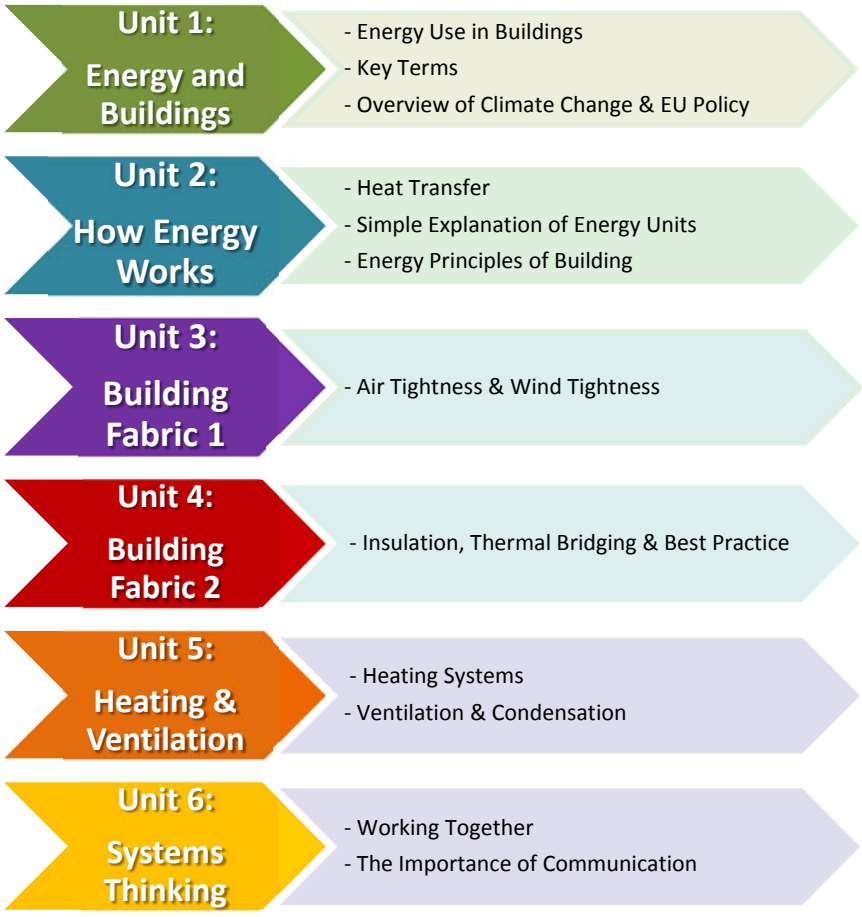


Figure 1: Breakdown of the 6 units and course topics

Homework assignments will be introduced at the end of Unit 2 and Unit 4 where the homework content will be discussed. These should be handed in at the beginning of Unit 3 and Unit 5 respectively for assessment.

In order to link the course with the following six learning outcomes, each Unit addresses a number of specific topics.

Learning Outcomes:

There are 6 'Learning Outcomes' (LOs) with associated weightings, which are described below. The LOs form the foundation of this course and the associated accreditation. Each LO is assigned a percentage weighting to indicate where emphasis should be placed in the delivery of the course. The associated content, assessments, homework and exercises should follow a similar weighting criteria and logic.

The following weightings highlights the importance of each of the 'Learning Outcomes';

1. List and describe the key policy and legislative drivers, relevant to construction workers, behind the move to low energy buildings	**5%**
2. Explain the key energy terms and measurement units associated with low energy buildings.	**10%**
3. List and describe the key principles of low energy techniques for, new-build and renovation works, including insulation, air-tightness, ventilation etc.	**30%**
4. Identify best practice relevant to low energy/near zero energy construction methods and details.	**25%**
5. Communicate the need to engage with other crafts to meet specific design demands.	**20%**
6. Describe the challenges of low energy quality building projects and how to apply specific solutions	**10%**

Tips for Using the Trainers Manual

It will be very helpful if trainers are familiar with the principal parts of the Learners Handbook before starting to deliver the course, as all students will be expected to have read this document prior to the commencement of the course.

Purpose of the Trainers Manual

The Training Manual (TM) is a guide to help the instructor to deliver the Foundation in Energy Skills (FES) course. The TM will summarise the methodology to be used by the instructor for each unit. The intention of the manual is not to be over prescriptive so that there is flexibility for the trainers to employ their own pedagogical approaches and concentrate on areas they feel needs greater attention. The objective is to achieve the learning outcomes outlined for the course.

The Training Manual will outline the objectives for each unit, clearly demonstrate what is required of the trainers, listing resources required and timings for delivery. The TM provides directions for the students as how to complete the activities and direction to the trainers regarding assessment. It will provide a breakdown of assessments, exercises and various activities to be completed by the students. Due to the varied experiences and having mixed trades participating, students will interact and respond differently to the information delivered, therefore some exercises may take longer or shorter than the recommended times allocated.

The course is broken up into a number of ‘activities’ designed to engage students in learning. Activities include a PowerPoint presentation, video presentation, demonstrations, assessments, discussion and exercises that can be either individual or group work. These will be discussed in greater detail below.

Activities may be assessed for certification purposes. Students can be assessed individually or as part of a group. In group assessment there is an individual assessment component so students cannot ‘opt out’ of the exercise. Students must be informed prior to any assessment activity that they are going to be assessed.

Format of training materials

The course is constructed so that there is a combination of PowerPoint presentations, group and individual activities and exercises, homework and demonstration.

The programme coordinator will provide a resource pack to the trainer, which will have all PowerPoints, worksheets, poster sheets, materials, and markers etc. included.

For each Unit, a summary will be presented on a PowerPoint slide, which will provide an overview of the content within that unit. This will also include a set of instructions for the students clarifying what will be presented and what is expected of them.

All worksheets and relevant materials should be handed out to the students as outlined in the trainer’s manual. All worksheets are labelled and should be handed out at each activity or exercise. These can consist of individual worksheets, group activity sheets,

posters or homework sheets. These sheets will be collected for assessment purposes at the end of each activity or exercise.

Activities

As mentioned, the delivery of the course consists of a series of activities. Icons have been developed for the Training Manual to assist the trainer quickly identify the purpose of the activity.

The PowerPoint presentations will use these icons to aid the trainer and student to visually prompt what is required of them. Below is an explanation of some of the more commonly used icons which denote a type of activity.

Presentation

PowerPoint slides to be presented or class given formal instruction and information. These presentations may include some class/group discussions.

Plus, Minus, Interesting (PMI)

Pluses, **M**inuses and **I**nteresting things (or **I**mplications), PMI associated with a topic. This icon represents a brainstorming activity that encourages students in a discussion to look at an idea from more than one view point. It allows them to think broadly about an issue, make informed decisions and work as individuals, in pairs or as members of groups.

Think Pair Share (TPS)

Think-Pair-Share, TPS is where the individual students share their thoughts/ideas with the group. A group worksheet will be completed for this activity at this point or discussion held within the group. This type of activity first asks the students to consider a question on their own, and then provides an opportunity for students to discuss it in pairs or small groups, and finally with the whole class.

Teamwork

The teamwork graphic indicates that at this point the group should work together to produce a single piece of work, which could include a poster, presentation or some other task as directed by the trainer.

Group Report

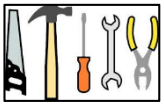
Presentation graphic indicates that the group leader must present the findings of the group to the class and respond to Q & A from the floor or findings recorded on a flipchart by the trainer.

Assessment

This icon indicates that there will be an assessment. The assessment may evaluate a group exercise, multi-choice or short answer type questions which will be distributed to the students. Generally, assignments will be submitted to the instructor immediately after completion. As this is a HETAC accredited course the trainer must retain all completed worksheets and assignments to demonstrate to external examiners that there was assessment carried out in line with the criteria set out below. To aid supporting documentation photographs of posters and presentations should also be taken.

Videos

Video icon indicates that a video should be shown and students asked to take notes which will lead on to other activities



Demonstration

The demonstration icon indicates that the instructor must bring the group to a practical demonstration site or workshop, or show them in a practical manner a key concept as part of the underlying theory.

Dots and squares

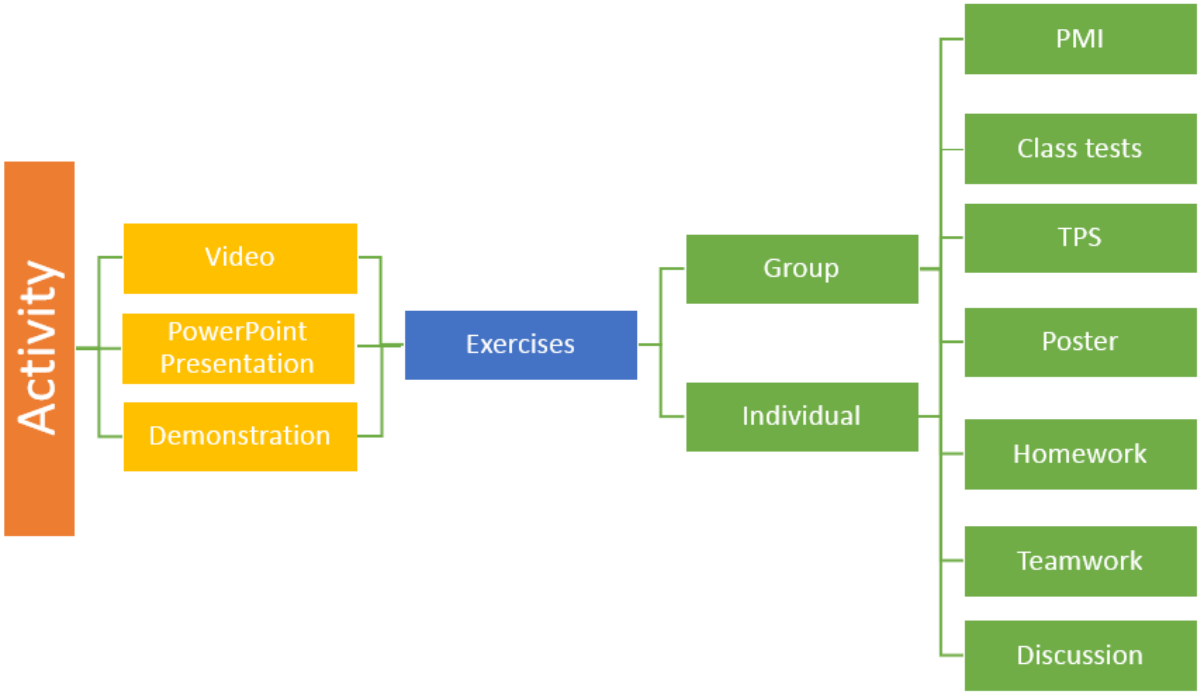
- In a list of bullet points this type of bullet indicates information

- In a list of bullet points this type of bullet indicates a suggested action by the trainer or student.

Structure of Activities

'Video', 'PowerPoint presentation' and 'Demonstrations' are considered 'Activities' and from these activities are a series of exercises. These exercises may be individual or group based. Whether group or individual a number of 'tasks' must be completed. The diagram below shows that these tasks can be PMI, TPS, Poster work, homework, teamwork or a class discussion.

The diagram below demonstrates how an 'Activity' relates to 'Tasks'.



Assessment Schedule

The following table gives an overview of the assessment schedule. There are marks allocated for homework, group work and individual exercises.

Assessment Schedule			
Description/Type	*Outcome/s Assessed*	*% of Total*	*Timing of Assessment*
Pre survey questionnaire	6	2.5	Pre start
Assessment 1 – Homework 1	1	5	End of Unit 2
Assessment 2 – MCQ 1	2	5	During Unit 2
Assessment 3 – Homework 2	3, 4	5	End of Unit 2
Assessment 4 – Worksheet 6	1, 3, 4, 5	10	During Unit 3
Assessment 5 – Sketch detail	3, 4,6	15	During Unit 4
Assessment 6 – Homework 3	3, 4	5	End of Unit 4
Assessment 7 – Homework 4	3, 4	5	End of Unit 4
Assessment 8 – Poster Design	3, 4, 5	15	During Unit 5
Assessment 9 – MCQ 2	1, 3, 4	10	End of Unit 5
Assessment 10 – Worksheets 12, 13, 14	3, 4, 5	15	During Unit 6
Assessment 11 – Worksheet 15	6	5	During Unit 6
Post survey questionnaire	6	2.5	After Unit 6
		100	

Group Activity Observation Checklist

A similar table to the one illustrated below will be provided in softcopy format so that an instructor can modify to suit the groups and input scores etc. It allows for the instructor to mark group activities, so that each group can be assessed and the contribution each group member provides can also be assessed. A group score is only as good as its weakest member(s) so students must be encouraged to take part and actively participate.

Group Activity Observation Checklist

Each individual/group observation is scored on a sliding scale 0 -5. 0 = Lowest , 5 = Highest

	Observation	Group 1				Group 2				Group 3				Group 4				Group 5			
	Student Name	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith	J. Smith
Individual	Makes a valuable contribution to the task	5	2	4	1	2	3	3	2	2	5	4					4		3		
	Uses technical terminology appropriately	4	3	4	1	3	3	3	2	3	5	2					3		3		
	Supports/encourages other members of the group	2	3	5	1	2	2	3	1	3	4	2					4		4		
	Displays appropriate communication skills	3	2	4	1	4	3	4	1	4	5	2					3		3		
	Total individual mark	14	10	17	4	11	11	13	6	12	19	10	0	0	0	0	14	0	13	0	
Group	Technical accuracy of presentation	4				3				5				3				4			
	Evidence of group thinking in final product	3				2				5				3				4			
	Presentation of final product	4				2				4				4				5			
	Group average mark	11				7				14				10				13			

	Learner	Total
Group 1	J. Smith	25
	J. Smith	21
	J. Smith	28
	J. Smith	15
Group 2	J. Smith	18
	J. Smith	18
	J. Smith	20
	J. Smith	13
Group 3	J. Smith	26
	J. Smith	33
	J. Smith	24
	J. Smith	0
Group 4	J. Smith	10
	J. Smith	10
	J. Smith	10
	J. Smith	24
Group 5	J. Smith	13
	J. Smith	26
	J. Smith	13
	J. Smith	13

Assessment Criteria for Group Exercise

You will be marked for this group exercise on the following basis

Individually:

Your level of contribution to the group task

Your ability to communicate an understanding of technical terms relevant to the task

Your ability to work well within a group to complete a task, respecting and encouraging others

As a group:

The technical accuracy of your group presentation

Evidence of group contribution to the final presentation

Quality of presentation of group work

Your total score will be a combination of your individual and group marks

Introductions

This section will include the explanation of the house-keeping requirements, the organisation of the roles of the students and the introductions of the students to the trainer and each other using an ice breaker approach. Although this is part of Unit 1 it does not form part of the course content, therefore is treated separately.

Overview of Delivery

No more than 45 minutes should be spent explaining fire exits, H & S etc. and 'Introductions'. This allows a buffer for students attending late or any queries relating to the course. The key objective of this section is to form the groups and for students to communicate with one another.

Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
5	Introductions	Presentation 1 Intro TPS + introduce group member	10 minutes 35 minutes	Presentation 1 Coloured name tags Notebook & pens	

House keeping

Before commencing delivery of this course the following items should be addressed at all new premises. This will apply to the demonstration day also:

1. Fire exits and assembly points etc. should be outlined.
2. Health and safety requirements should be outlined if appropriate
3. At the beginning of each Group Activity the class should be divided into groups, with no more than 4 people per group. Each group should ideally have a mixture of trades and skills, as being able to learn from and communicate with other trades is part of the required learning outcomes of the course. As far as possible groups should be made up of people who are not already well known to each other.
4. Ideally, a **coloured sticker** should be distributed to individuals to distinguish the various trades or skillsets.
5. Seats and tables should be organised in such a way as to allow for ease of communication and to encourage group participation, so that no one person is placed in a leading position.

Pre- and Post-survey questionnaire

The pre-survey questionnaire must be completed by students prior to starting this course. On completion of the course a post-survey questionnaire must be completed. There is 5% available for completing these tasks. These surveys must be completed online through the QualiBuild website @ www.qualibuild.ie . If students don't have access to computers, hardcopies may be provided by the course facilitator.

Sign-in sheet:

A sign-in sheet must be completed by the students at the start of, or during each Unit. This course requires 100% attendance before a certificate or a statement of results will be issued.

Preparing Students for Group Work

1. As part of the introductions, an ice-breaker is used as described in the next sections.
2. The trainer should make sure everyone is clear in relation to the activities. If required, the group leader should be encouraged to obtain clarification.
3. It should be made clear at the very start that the presentations, whether on whiteboard/flipchart or poster, will be photographed and may be used for assessment purposes.

The Group Leader:

The outline of the role of the group leader should be shared with all students.

- This should be done in the trainer's own words and with consideration of the readiness of the students for group work.
- Students may not be used to this format and should be gently introduced to this form of engagement.

The group leader is not expected to take the role of the trainer, but should assist with completing the following tasks and act on behalf of the group:

- Organising the recording of any notes during the discussion with a view to formalising responses for discussion. Another member of the group can be asked to be the note-taker.
- Developing an agreed response to each question or issue insofar as that is possible which should be recorded clearly and legibly on any worksheets provided. If agreement cannot be reached the different views should be recorded.
    - The responses to the questions posed in the activity should be presented as a team and any queries raised by the group should be clarified by the team.

Introductions and Ice-breaker

The purpose of the ice-breaker is to introduce the students to each other and to the trainer and to commence the process of communication. One ice-breaker suggestion is set out below but the trainer may prefer to use another with which he or she is familiar. However, whatever ice-breaker is chosen it should be appropriate to the group involved and not ask too much of them or any individual group member.

Suggested ice-breaker

Each student within each group is asked to introduce one other person to the whole class.

This activity is a way of getting the students to relax a little, to get them communicating with each other, to give everyone a flavour of the make-up of the class and to get an insight as early as possible into any issues that might exist .

This activity also envisages that the various trades work together and therefore requires good communication skills, both listening and speaking. In order for this exercise to be effective the group must work together and listen to each group member, then each individual must introduce another member of the group to the rest of the class.

This, or whatever form of ice-breaker is used, should at a minimum involve each student in giving -

1. Their name
2. Where they are from
3. Background and Trade
4. How long they are in the building game
5. Their best job ever
6. What they hope to get out of the course
7. Any concerns or issues they may have about taking part in the course

If the suggested ice-breaker is used the trainer should:

- Inform the students that they are required to introduce themselves to their own group and then that each group member will have to introduce another group member to the full class.
- Present the following PowerPoint slide – Introduce someone to the students
- Keep the slide visible until the end of the introductions
- Inform the class that each group is to decide who will be introducing whom (suggest that students introduce the person to their left) before introductions start.
- Inform the groups that each student will have 1 minute to introduce themselves to the rest of the group.
- Ask that each member of the group introduce themselves in turn within the group.
- Then go around the class and ask each group member to introduce their designated member from that group giving them 1 minute for the introduction.
- Ensure that everyone has introduced a person and that everyone has been introduced to the class.

Overview of Delivery – Unit 1

UNIT 1 – Energy and Buildings					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
2	Energy use in Buildings (O'Brien's)	Exercise 1 - PMI Exercise 2 - TPS	20 minutes 20 minutes	Video 1 *Worksheet 1 [20 sets]* *Worksheet 2 [5 sets]*	
	Tea break		20 minutes		
5	Low Energy Terminology	Presentation 1.1 Exercise 3 - TPS Exercise 4 – Group Poster	15 minutes 20 minutes 30 minutes	Presentation 1 *Worksheet 3 [5 sets]* *Worksheet 4 [5 sets]*	
	Energy use in Buildings	Presentation 1.2	15 minutes	Presentation 1	
1	Climate Change and EU Policies	Presentation 1.3	20 minutes	Presentation 1	
1	Homework 1	Presentation 1.4 Assessment 1	5 minutes	*Presentation 1* *Homework Sheet 1* Link to Prezi/resources	5
			210		

Overview of Delivery - Unit 2

UNIT 2 – How Energy Works					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
5	Heat Transfer	Presentation 2.1 Demonstration 1.1 Teamwork 1 Presentation 2.2 Presentation 2.3	5 minutes 15 minutes 25 minutes 15 minutes 30 minutes	Presentation 2 Demonstration Pack Soft ball Presentation 2 Presentation 2	
	Tea break		20 minutes		
	Building materials	Exercise 5 – PMI and group discussion	20 minutes	*Materials pack* *Tables 1 and 2*	
	Properties of Insulation	Presentation 2.4	20 minutes	*Presentation 2*	
	Heat Transfer	Demonstration 1.2	10 minutes	***see footnote*	
2		Assessment 2 – MCQ 1	30 minutes	*Worksheet 5 [20 sets]*	5
	Energy Principles of Building	Presentation 2.5	15 minutes	*Presentation 2*	
3, 4	Issue Homework 2	Presentation 2.6 for Assessment 3	5 minutes	*Presentation 2* *Homework Sheet 2*	5
			210		
**	*After demonstration issue QualiBuild cups [20sets] to participants*				

Overview of Delivery - Unit 3:

UNIT 3 – Building Fabric 1					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
	Homework collection	Homework 1 Homework 2	10 minutes		
1, 3, 4, 5	Air Tightness and Insulation	Presentation 3.1 Presentation 3.2 Assessment 4 – Sketch and record findings Presentation 3.3	20 minutes 20 minutes 20 minutes 30 minutes 10 minutes	Presentation 3 Presentation 3 *Worksheet 6 [10 sets]* Whiteboard/flipchart Presentation 3 Airtightness tapes pack Airtightness barriers pack	10
	Tea Break		20 minutes		
3, 4	Demonstration lab	Demonstration 2 testing	60 minutes 20 minutes	Airtightness Unit Smoke gun/pen Fan test/unit Thermal imaging camera	
			210		

Overview of Delivery - Unit 4:

UNIT 4 – Building Fabric 2					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
	Demonstration Model and cutaways	Presentation 4.1 Demonstration 3.1 Demonstration 3.2	45 minutes 25 minutes	Presentation 4 Construction wall/model Cut away models Insulation pack Building materials pack	
	Tea Break		20 minutes		
3, 4, 5,6	Thermal Bridging and Best Practice	Presentation 4.2 Exercise 6 – TPS Presentation 4.3 Assessment 5 – Sketch Presentation 4.4	30 minutes 30 minutes 10 minutes 30 minutes 10 minutes	Presentation 4 *Sections /acetates [5 Pack]* *Worksheet 7 [5 sets]* Presentation 4 *Worksheet 8 [20 sets]* Presentation 4	15
3, 4	Issue Homework 3 Homework 4	Presentation 4.5 for Assessment 6 Assessment 7	10 minutes	Presentation 4 *Homework Sheet 3* *Homework sheet 4*	5 5
			210		

Overview of Delivery - Unit 5:

UNIT 5 – Heating and Ventilation					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
	Homework collection	Homework 3 Homework 4	20 minutes		
	Heating Systems	Presentation 5.1 with discussion	30 minutes	Presentation 5	
3, 4, 5	Ventilation and Condensation	Exercise 7 – PMI Presentation 5.2	30 minutes	*Worksheet 9 [20 sets]* Presentation 5	
	Tea Break		20 minutes		
1, 3, 4	Ventilation and Condensation	Exercise 8 - TPS Assessment 8 – Poster and Report Presentation 5.3 Assessment 9 – MQ 2	30 minutes 30 minutes 30 minutes 10 minutes 20 minutes	*Worksheet 10 [5 sets]* *A1 Poster [5 sets]* Presentation 5 *Worksheet 11 [20 sets]*	15 10
			210		

Overview of Delivery - Unit 6:

UNIT 6 – Systems Thinking					
Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
3, 4, 5	Working Together	Presentation 6.1 Exercise 9 PMI Assessment 10 – TPS Group PMI	10 minutes 20 minutes 40 minutes 30 minutes	Presentation 6 Video 2 *Worksheet 12 [20 sets]* *Worksheet 13 [5 sets]* *Worksheet 14 [5 sets]*	10
	Tea Break		20 minutes		
6	Communication	Presentation 6.2 Video 3 Exercise 10 - TPS discussion Presentation 6.3 Assessment 11	5 minutes 5 minutes 20 minutes 5 minutes 15 minutes	Presentation 6 Video 3 Presentation 6 *Worksheet 15 [20 sets]*	5
5	Table Quiz	Table Quiz	30 minutes	Table Quiz pack	
	Course completion	Thank you, photos etc.	10 minutes	** see footnote	
			210		
**	If available issue CPD attendance certificates [20 number] and USB stick to participants				

Delivery Plan for Unit 1: "Energy and Buildings."

This Unit deals with introducing the group to low energy terminology, energy use in sectors and buildings, as well as EU policies and legislation leading to Irish policies and legislation and in particular the Building Control Act and the Building Regulations and how these affect building construction workers.

Topics to be covered:

- **Topic 1** – Energy Use in Buildings
- **Topic 2** – Energy Use in Buildings – Low Energy Terminology
- **Topic 3** – Climate Change & EU Policy

Order of Delivery – Unit 1	
Video 1	The O'Brien family home
Exercise 1	PMI for the O'Brien home
Exercise 2	Group TPS on issues in the O'Brien home
Presentation 1.2	Introduction to Low Energy Terminology
Exercise 3	TPS activity on low energy terms
Exercise 4	Group Work (Poster)
Presentation 1.3	Energy Use in Buildings
Presentation 1.4	Energy Policies and Building Regulations
Presentation 1.5 for Assessment 1	Homework sheet 1

Delivery Instructions

The objective of this section is to ease the students into the programme. It uses an animated video to highlight issues and problems experienced by the O'Brien family in their home, which is a typical family dwelling built in 2005. The first segment of Video 1 has narrative with the family explaining the issues. The second Part, which has no narrative, shows a typical day in the life of the O'Brien family living in their home. The students will be required to fill in a sheet that picks out the 'Issues' with the O'Brien family home and then share their thoughts through a TPS exercise.

This is followed by a presentation showing 5 main energy related topics, the group will be able to examine the issues with the O'Brien family home again in greater detail, which will enable them to create a poster showing their understanding of the issues.

Video 1 - The O'Brien family home: (20 minutes)

Video 1.1 shows the O'Briens in their family home. They explain the issues and problems they are experiencing such as condensation, odours, poor heating system and similar issues.

- Hand out Worksheet 1 and explain they will be required to complete this sheet at the end of seeing both segments of the Video.
- Suggest they make notes in their notebooks, but not essential
- Play Video 1.1, which has the narrative
- Pause the video at the end of part 1
- Have a brief discussion about the video and what the obvious issues are.

Exercise 1 - PMI:

This is an individual exercise where learners are tasked with creating a numbered list to describe the 'Issues' that lead to energy being wasted in the O'Brien home.

- Play Video 1.2, which doesn't have the narrative and explain they now must fill out Worksheet 1
- Complete Worksheet 1

Exercise 2: Group TPS on issues in the O'Brien home (20 minutes)

The objective of this exercise is to get students to reflect on the bigger picture of 'energy in buildings'. Consideration of how the issues in the O'Brien home lead to energy being wasted. This should lead to an appreciation and understanding of the relationship of energy use to how the building is constructed and the nature of the services installed.

The trainer should -

- Ask the class to divide into 5 groups of 4 (they should stay in these groups for the remainder of Unit 1)
- Ask each group to nominate a group leader.
- Remind the class of the limited role of the group leader

Use the following as guidance for the Group TPS activity:

- Worksheet 2 should be handed out to each group.
- The students should be asked to share their Worksheets 1 from Exercise 1 with the rest of the group as a Think/Pair/Share exercise
- The group members should be asked to discuss the lists and create one agreed list of Issues on Worksheet 2 for the group.
- The trainer should walk around the room to direct the groups if necessary, to collate information and possibly to prompt discussion between group members on certain issues.
- Worksheet 2 should be collected at the end of the exercise

Presentation 1.1 - Introduction to Low Energy Terminology: (15 Minutes)

A short presentation introduces some 'Low Energy Terminology' that will be frequently used throughout the course and in particular terms related to how energy impacts on climate change etc.

The following terms should be introduced by way of Presentation 1 provided, so that Exercise 3 can be completed.

1. Climate Change
2. NZEB
3. Air Leakage
4. Thermal Bridging
5. Interstitial Condensation

While presenting the slides, the students should be prompted to use the information to explore how these issues affect the building, end-users and the environment.

During the presentation highlight what '**Effect**' these have on:

- The Building
- Its Occupants
- The Environment
- Building Comfort levels

Exercise 3 - TPS activity on low energy terms: (30 minutes)

On completion of the group list from Exercise 2, the group members should be asked to choose 6 of the issues for further development and to record these on Worksheet 3. They should also discuss and list the causes of the 6 issues and the effect they have on the building, occupants and environment. They should consider the 5 concepts/terms shown in presentation 1 during these discussions.

- Worksheet 3 should be handed out to each group.
- The students should be asked to:
  - Consider the 5 new terms previously presented, look at the O'Brien home again and review the group list of issues.
  - Choose 6 of the issues from their group's list and record them on Worksheet 3.
  - Collectively discuss the causes and effects of the 6 chosen issues
  - Identify and list the causes of these 6 issues on Worksheet 3
  - Identify and list what effect these causes have on the building, occupants, comfort and environment on Worksheet 3.

- The trainer should walk around the class and prompt the groups with the following questions if required:
  - What issues exist?
  - What caused these issues
  - How are the causes and the issues linked?
  - How these issues affect the building and homeowner?

Some examples of cause and effects are listed in the Worksheet 3 sample below for Exercise 3.

Issues	**Causes**	**Effect**
1. 2. 3. 4. 5. 6.	Poor ventilation Infiltration Poor Insulation Inefficient heating systems Workmanship Design	Building Occupants Environment Comfort levels

Exercise 4 - Design a poster and class presentation: (30 minutes)

Exercise 4 is designed to incorporate the conclusions of the previous exercise (issues, causes, effects) into a group activity which consist of the design of a poster which leads to a Q & A session.

- A2 sized poster should be handed out to the groups
- The groups should be asked to:
  - Choose one of the issues to create a poster collectively
  - Create a poster that shares the suggestions from their group list and helps to describe the Issues, Causes and Effects.
  - Design an A2 size poster similar to Worksheet 4
  - Hang the poster on the wall/board

Presentation 1.2 - Energy Use in Buildings: (15 minutes)

The slides provided should be presented to the class in a concise way.

- The slides presentation which is divided into 4 parts should be shown.

1. Energy use in sectors
2. Energy use in buildings,
3. Effects of energy use
4. Comfort levels

The 4 parts should be explained using the slides provided, using the following instructions as guidance:

1. Energy use in sectors

It is important to make the students aware of where energy usage/waste occurs within different sectors, so that they have an understanding of the bigger picture and of how energy use in buildings contributes significantly to the overall consumption in Ireland.

2. Energy use in buildings

The percentage of energy used within the residential and non-residential buildings should be highlighted, which should be followed by asking the following question of the class: Where is this energy being used?

3. Effects of energy use

The following slides summarise how energy is used in buildings under the 3 main users:

- Space heating
- Water heating
- Lighting

The combination of space heating, water heating and lighting lead to the majority of energy losses and gains. The main contributors should be highlighted using the pictorial slides.

4. Comfort levels

The levels of thermal comfort can be affected by the following factors: metabolic rate, clothing insulation, air temperature, radiant temperature, air speed and humidity, however it should be noted that other factors affect comfort but are not related to heat transfer. These include smells, noise, pollution and allergies

Presentation 1.3 – Climate Change and EU Policies: (15 minutes)

This presentation introduces the students to energy related polices and legislation and should also be presented as an introduction for the Homework 1 assignment.

It may be difficult to keep students' attention during this topic so it is suggested that the description are kept short and that interaction from the class is encouraged.

- Presentation 1.3 should now be shown

The slides are divided into 2 parts - the first part is a brief introduction to the relevant EU Policies and Legislation starting with the Kyoto Agreement

The second part explains how EU policies have led to the Irish Policies and Irish Legislation and to the12 TGDs A to M. For the purpose of this course emphasis will be placed on NEEAP 3, TGD Part L (2008, 2011), Part F (2009) and Code of Practice for inspecting and certifying buildings and works (2014) and lesser so on Part J (2014) and Part D (2013).

Assessment 1 - Homework 1: (10 minutes)

Students are to be given Homework sheet 1. This is to be completed using the 'Learners Handbook' as a resource. For those that are comfortable using online resources, a Prezi presentation is also provided on the QualiBuild website under additional resources.

- Presentation 1.3 should now be shown
- Hand out Homework sheets 1 to each student.

Note: Homework sheet 1 will be issued for completion at home. Completed worksheets should be collected at the start of Unit 3 for individual assessment purposes.

Resources for Unit 1

Hand-outs

- Worksheet 1 - Individual PMI [20 sets]
- Worksheet 2 - TPS Group [5 sets]
- Worksheet 3 - TPS Group [5 sets]
- Worksheet 4 - A1 Group Poster [5 sets]
- Homework 1 Sheet [20 sets]
- FES Learners Handbook [20 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations

- Resource 1: PowerPoint 1 → "Presentation 1"
- Resource 2: Video 1 "Introduction to the O'Brien family etc."

Course Materials

- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Coloured stickers/ name tags [20 sets]

Assessments

- Homework sheet 1

Delivery Plan for Unit 2: "How Energy Works."

This unit is designed to introduce students to the concepts of 'Heat transfer' and 'Energy Principles for Buildings'. Heat transfer examines the basics of how heat transfers and explains the terms 'conduction, convection and radiation'. This leads on to a discussion of the properties of the materials used in the building and an introduction to their U-values.

Then, the principles of how buildings should be constructed to provide low energy quality buildings, in particular, air and wind tightness, continuous insulation, thermal bridging and controlled ventilation is examined.

Topics to be covered

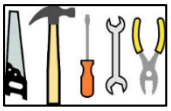
- **Topic 1** – Heat Transfer
- **Topic 2** – Explaining Energy Units
- **Topic 2** – Energy Principles in Buildings

Order of Delivery – Unit 2	
Presentation 2.1	Introduction to demonstration
Demonstration 1 (Part 1)	Heat loss and transfer (coffee cups)
Teamwork 1	Principles of heat movement (convection, conduction and radiation)
Presentation 2.2	Principles of heat transfer
Presentation 2.3	Energy units - Summary of conductivity, resistance and transmittance.
Exercise 5	PMI on insulation materials with class discussion
Presentation 2.4	Properties of Insulation and Compliance
Demonstration 1 (Part 2)	Heat loss and transfer (coffee cups)
Assessment 2	MCQ on heat transfer
Presentation 2.5	Energy principles in buildings
Presentation 2.6 for Assessment 3	Homework 2 - Read units 3 and 4

Delivery Instructions

Presentation 2.1 - Coffee cups: (5 minutes)

The demonstration described below is introduced by way of a number of slides. It outlines the approach to be used in this demonstration.



Demonstration 1 .1 - Coffee cups: (15 minutes)

This demonstration should be set up at the start of the session. At the end of Section 5, heat loss values should be measured using a thermometer to summarise the modes of heat transfer and the importance of insulation and air tightness.

With the aid of a slide, the trainer should explain to the students how the trainer will be carrying out the demonstration and emphasise the importance of reducing heat loss using insulation and air tightness.

The trainer should carry out the following demonstration for the class by -

- Getting three paper coffee cups
- Cup 1 - Wrapping outer edge of cup with Sheepswool insulation and placing this cup on a piece of PUR insulation
- Cup 2 - Wrapping outer edge of cup with Sheepswool insulation and placing this cup on a piece of PUR insulation
- Cup 3 – Leaving this as is.
- Filling the cups with hot water from a flask and placing equal volumes in each cup. Care should be taken to make sure the water is as hot as it can be.
- Measuring the temperatures of water in each cup using a thermometer and recording these on a flipchart.
- Placing PUR insulation on the lid of Cup 1 and Cup 2 and leaving Cup 3 uninsulated
- Placing Cup 1 into a sealed plastic bag. This is to demonstrate the effects of air-tightness.
- Leaving the cups aside for the duration of the session on a tray away from the room.
- Referring to Demonstration 2 at the end of this section for the results and conclusion.

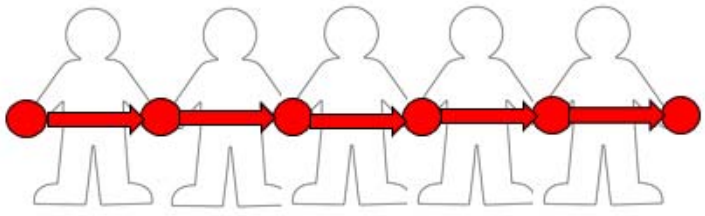
Teamwork 1- Principles of heat movement: (25 minutes)

This is an exercise to demonstrate the principles of conduction, convection and radiation. Ten students should be nominated to carry out a demonstration on how heat is transported. This may give the opportunity to get the quieter and less involved students to participate more. The soft ball supplied should be used.

- The students should be asked to stand up in front of the class.

To demonstrate conduction

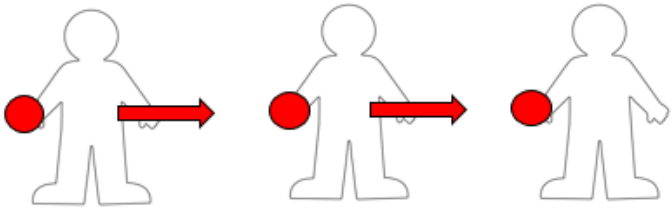
- The students should be asked to line up shoulder to shoulder with feet touching.
- The ball should be handed to the first person in the line and the ball passed by them to the next person without losing contact, who passes it to the next person and so on until it reaches the last person. Students should be asked to make sure that they keep their shoulders and feet touching those of the students beside them.



The students represent tightly packed molecules and the ball represents heat energy passing from molecule to molecule. Therefore heat is transferred through a solid object or material steadily.

To demonstrate convection

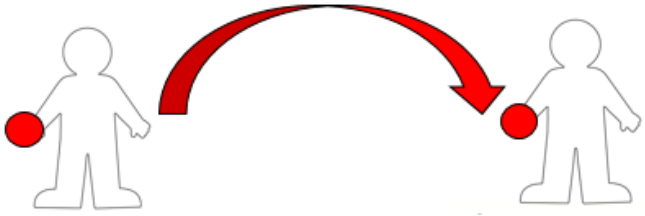
- After the conduction demonstration every second person in the line should be asked to sit down so that there is a gap between each student.
- Again the ball should be handed to the first person in the line and the ball passed but not thrown by them to the next person, who passes it to the next person and so on until it reaches the last person.



This demonstrates that there is space between the molecules and that this represents a gas or a liquid i.e. molecules are free to move and are not as tightly packed together as in the case of materials which conduct heat.

To demonstrate radiation

- All students should be asked to sit down except the 2 at either end of the line
- The 2 students are asked to go to opposite corners of the room.
- One student should be asked should be asked to throw the ball to the other. The other must catch the ball perhaps with a vessel.



This demonstrates that heat energy can travel through space or air without the need for molecules at an even faster rate. No physical material is required as heat can travel through a vacuum via radiation.

- The final two students can now be asked to sit down.

- The slides should now be shown to summarise the demonstration.

Presentation 2.2 - Heat Transfer: (10 minutes)

Each slide should be shown in sequence, as each slide deals with a different but related topic as follows:

Day to day use of boiling water in a pan is a good example of heat transfer. It shows Conduction, Convection and Radiation.

No longer than 10 minutes should be spent discussing the following questions or similar with the class.

- The students should be asked if they can suggest where conduction, convection and radiation occur in other day to day activities. (hot poker, hairdryer, weather/sun)
- The students should be asked if they can relate these to heat transfer within a building.
- The slide should be used to show how heat transfer relates to a building and to address the following questions -
  - What can cause convection in a building?
  - Do these flows differ in summer and winter time?

Presentation 2.3 – Energy Units: (20 minutes)

This presentation is to inform the students briefly on the thermal properties of materials in particular – λ, R and U-values and will be followed by a slide showing a working example of how important the thickness of the insulation is to the thermal performance of the building envelope.

This should include an explanation of the symbols commonly used to denote them such as Watts and Kelvin and how the R-value is calculated by dividing the thickness of a material (in metres) by its conductivity (λ).

It will be important for the students to be aware of these concepts in order for them to be able to progress to an understanding of the concept of U-values.

By using the slides:

- Basic energy units will be explained with a single slide.
- Heat transfer will be examined, by explaining the principles of thermal conductivity and thermal resistance.
- The students should then be introduced to Thermal Transmittance - How much heat is lost from a particular building material

U-values

The students should be informed that a simple calculation will be used to demonstrate how the U-value is dependent on the thickness of insulation material. It should be pointed out that this is only a demonstration and if they want to carry out a U-value calculation they should refer to TGD Part L in Appendices A for direction.

- The following should be shown using the slide provided for Exercise 5. Each calculation will be shown step by step.
- The steps should follow this order:
  - In calculation 1 - The first material: a concrete block (100mm thick) and a second material: Phenolic insulation (60mm thick) should be considered.
  - The calculations should be demonstrated
  - In calculation 2 - the first material: a concrete block (100mm thick) and a second material: Phenolic insulation (120mm thick) should be examined.
  - The calculations should be demonstrated
- Compare. The students should be informed that the only difference between the 2 calculations is that the thickness of the insulation has increased.

The following slides will show the results of both calculations and explain the difference in U-values for each.

N.B. These examples do not take RSi or RSe in to account. An explanation must be given that if a U-value calculation is being carried in practice they must be included. In this example it is designed to show that if the insulation levels are doubled then the U-values are effectively halved. Refer students to TGD Part L for examples of properly calculated U-values using upper and lower values and so on.

This example also highlights some of the terminology and units associated with U-value calculations.

U value Calculation 1			
Material/Surface	Thickness m	Thermal Conductivity W/mK	Thermal Resistance m^2K/W
	D	k or λ	R=d/λ
R_1 Concrete Block	0.10	1.33	0.08
R_2 Phenolic	0.06	0.02	3.00
R_{total} Total Resistance			**3.08** m^2K/W
		U-value = 1/R_{total}	**0.32 W/m^2K**

U value Calculation 2			
Material/Surface	Thickness m	Thermal Conductivity W/mK	Thermal Resistance m^2K/W
	D	k or λ	R=d/λ
R_1 Concrete Block	0.10	1.33	0.08
R_2 Phenolic	0.12	0.02	6.00
R_{total} Total Resistance			6.08 m^2K/W
		U-value = 1/R_{total}	**0.16 W/m^2K**

- It should now be pointed out to the students that they have seen how the thickness of the material significantly affects the U-value of a system, the thermal properties of various materials can be investigated in more detail.

Exercise 5 - Building materials: (20 minutes)

This is an activity whereby each student gets a chance to handle various building materials and explore the thermal properties of each.

The trainer should:

- Hand out a selection of building materials to each group to examine and discuss. Each sample will be labelled with a stated thickness (d) and lambda (λ) value.
- Ask the students to look at the thermal properties of each material.

- Walk around the room to encourage discussion of the properties of the materials and should ask the students if they are familiar with the products or similar ones.
- Prompt each group to determine whether the material is a good conductor or insulator.

Once the groups have discussed the materials.

- Tables 1 and 2 should be handed out to each group.
- The groups should be prompted to discuss the materials and insulations shown in Table 1 and 2 and asked to compare the thermal properties of the materials in both sheets and how these will affect the building performance.

Presentation 2.4 - Properties of Insulation: (20 minutes)

This is a short presentation on the thermal properties of insulation and how the thermal resistance changes with the thickness of an insulation material. It also highlights that materials must be fit for purpose and used according to manufacturer's recommendations.

In the next slide – Materials,

- The slide should be presented to illustrate the thermal properties of the following materials by using the graph:
  Aerogel, Phenolic, Cellulose, Sheepswool and Hemp block
- The students should be asked to note the difference in thermal resistance for different materials at a thickness of 100mm.
- The trainer should also note at this stage that not all materials suit the construction type of the building e.g. using PUR insulation to insulate the walls of a period home that has lime mortar or loose rubble construction. Product similar to Calsitherm Climate Board should be used.
- Trainer should stress the importance of Insulation but that air-tightness is also very important, which they will see later units and in the demonstration day.

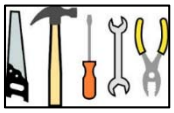
This will be explained at the end of this Unit and in more detail in Unit 3 and Unit 4.

<u>Compliance with TGD Part L</u>

Using the slide – Compliance.

- The students should be informed that the Building Regulations require certain minimum standards regarding the heat-loss from buildings and the current U-values for a dwelling should be shown.
- The following should be highlighted during this short presentation:

- That understanding the thermal properties of the materials, i.e. thermal conductivity and U-values is essential to construct low energy building.
- That not only is the type of insulation important but also the thickness plays an important role in providing high thermal rating.



Demonstration 1.2 - Coffee Cup Results: (10 minutes)

The intention of this demonstration is to show how heat loss through the envelope can be delayed if it is insulated continuously and can be further improved if air tightness is also created.

Continuing on from demonstration 1:

- The cups should be brought back and the temperatures of the water in each cup measured with the thermometer.
- These temperatures should be recorded next to the original ones on the flipchart and calculate the temperature drop.

It should transpire that the insulated Cup 2 will have a higher temperature than the uninsulated Cup 3.

The demonstration should conclude that the insulation layer of the cup slows down the rate of heat loss in a way similar to that in which the insulation layer in a building slows down the building's heat loss.

Cup 1 should have a marginally higher temperature than Cup 2.

This is due to the effect of air tightness.

- The students should be directed to the summary slide which will recap these principles of energy and lead on to their application in the context of buildings.

Assessment 2 - MCQ 1 (30 minutes)

Multiple-choice questions (MCQs) based on heat transfer. Learner's handbook can be reference to answer the 10 MCQs.

Presentation 2.5 - Energy Principles of Buildings (15 minutes)

Building Physics in fifteen minutes:

This presentation will explain the laws of heat transfer and then compare clothing with the building envelope.

- The slide - Laws of Energy Transfer – should be presented.

The 4 relevant slides should play out a story in 15 minutes. It should be kept simple to set the students up for the next Units. It has been divided into 3 parts for ease of demonstration:

1. Insulation
2. Wind and air-tightness
3. Vapour barriers

To set the scene:

- The 4 slides should be presented while telling the story and using the animations on the slides.

The Story

This may be told by the trainer in a way which suits their own teaching style. However, the key elements of the story should be retained.

As it is Ireland we have many weathers with wind, sun, and rain, even horizontal rain.

1. Insulation

Imagine walking up a hill in wintertime in Ireland wearing a thick woolly jumper. You are warm and cosy. You need to make sure it has no holes though!

Question: Why should there be no holes in the woolly jumper?

Answer: Holes in a jumper allows the cold air to make contact with body, allowing it to cool down or lose heat. Not as effective as a continuous layer.

Question: How does this compare with a badly insulated building?

Answer: A partially insulated house (holey jumper), or an uninsulated house for that matter (no jumper), will allow heat to escape to the atmosphere, and therefore a need to supply more heat to maintain correct temperature or freeze?

Question: What if you have an old timber door with no draught sealing or a single glazed, timber framed window?

Answer: similar to a holey jumper, or a thread bare jumper, the door allows heat to escape and cold air to penetrate.

Comment: keeping warm either in a jumper or a house is most efficient with insulation that has no break in it, i.e. Continuous Insulation

Now the rain starts and the woolly jumper gets wet. You can't keep warm. The jumper is damp and you begin to freeze.

Question: What happens the woolly jumper?

Answer: A damp woolly jumper loses its effectiveness as water increases the rate of heat loss through increased conduction.

Question: How does this compare with damp insulation in a house?

Answer: Similarly, damp insulation material cannot retain the warmth in a house. Again there is increased conductivity and increased heat loss. Use vapour barriers to stop insulation absorbing moisture.

2. Wind and Air tightness

A breeze starts to blow, so imagine if your jumper is too loose and lets the cold breeze through; you won't want to wear that jumper too often!!

Question: Why do you get cold when a breeze blows through your jumper?

Answer: Air voids and gaps in the material

Explanation: Jumpers are made from cotton or sheep's wool which both have the same insulating properties, but it is the air voids or gaps in the material, not the material itself, which provides insulation. Increased air speeds allows the cold air to penetrate the insulation material.

To continue with the story; it is starting to get very windy so you put on a rain coat. It is a lot warmer now, as the thin raincoat stops the wind.

Question: What is the equivalent of this raincoat for the house?

Answer: A wind-tight barrier on the external envelope of the building. A hole in your raincoat will let the cold in. The same logic applies to your home.

3. Vapour Barriers

The wind starts to die down and the sun comes out. Climbing up that hill starts to make you sweat.

Question: Why this is so?

Answer: The thin raincoat and woolly jumper prevent the water vapour from your body and excess heat to escape to the outside.

Question: If you had a "Gore-Tex" raincoat instead of the thin raincoat, you wouldn't sweat as much, why?

Answer: Goretex allows moisture to escape and lets your body breathe.

Imagine a building acting in the same way.

Question: How should the water vapour that arises in a building be dealt with?

Answer: While it may be acceptable for a person to sweat inside their raincoat, when it comes to a building steps need to be taken to control and remove the water vapour which arises. This can be done in a variety of ways which will be discussed later in the course.

So…..

Question: What else is needed in a building?

Answer: Controlled Ventilation.

And that's how air tightness, insulation and controlled ventilation work for you and your woolly jumper and similarly for a house!!

Assessment 3 - Homework 2: (5 minutes)

Students are to study Units 3 and 4 at home for the next class. Five short answers are to be completed on 5 topics: Air tightness, wind tightness, continuous insulation, breathability and thermal bridging. Homework sheet 2 is to be handed out.

- Presentation 2.6 should now be shown
- Hand out Homework sheets 1 to each student.

Note: Homework sheet 1 will be issued for completion at home. Completed worksheets should be collected at the start of Unit 3 for individual assessment purposes.

Resources for Unit 2

Hand-outs:

- Tables 1 and 2 [5 sets]
- Worksheet 5 [20 sets]
- Homework sheet 2 [20 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations:

Resource 1: PowerPoint 1 → "Presentation 2"

Course Materials:

- **Soft/foam ball** [1 set]
- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Demonstration pack: [1 set]
  - 3 paper coffee cups
  - Sheep's wool insulation
  - PUR insulation
  - Elastic bands
  - Clear plastic bag
  - Boiling water (from a flask)
  - Thermometer
- Insulation sample pack [1 set]
- Building materials sample pack [1 set]
- Learners handbook (already issued)

Assessments

Assessment 2 – Multi-choice Questions 1

Assessment 3 – Homework sheet 2

Delivery Plan for Unit 3: "Building Fabric 1."

The aim of this unit is to develop the importance of 'wind –tightness', 'air-tightness' and 'continuous insulation' in reducing heat loss from a building. The focus is on attention to detailing, installation of different types of insulation, choice of tapes and membranes which lead to the control of air infiltration, heat loss and on quality of work. The presentation leads on from the Unit 2 by continuing with the principles of air-tightness and continuous insulation and is followed by an exercise to determine "What the problem is? Why the problem occurred? and How to solve the problem?". A practical demonstration will then be given at an air tightness demonstration unit by yourself or other trainers.

Topics to be covered:

- **Topic 1** – Air-tightness and Insulation
- **Topic 2** – Demo 2

Order of Delivery – Unit 3	
Homework	Collect homework 1 & 2
Presentation 3.1	Principles of 5 Topics - Air-tightness, thermal bridging and continuous insulation etc.
Presentation 3.2	Importance of 5 Topics
Assessment 4	TPS (paired exercise) Record Findings
Presentation 3.3	Solutions to previous exercise
Demonstration 2	Demo Lab / workshop

Delivery Instructions

This activity involves a presentation on the principles of air tightness, continuous insulation and thermal bridging. It will summarise the previous unit and lead the students into the demonstration part of the course. It will give the students a good grounding before moving on to aspects of detailing. Understanding these topics should enable the students to complete exercise 6, which involves solving problems which can arise on site.

Presentation 3 .1 – Principles, Recap from Unit 2: (15 minutes)

This presentation sets out the basic concepts and principles of conserving energy in buildings:

1. Wind-Tightness,
2. Air-Tightness,
3. Continuous Insulation,
4. Breathability of Materials
5. Thermal Bridging.

- The trainer should introduce the 5 topics listed above using the presentation provided
- Explain what each topic is and why it is important to conserving energy in a building
- Students should be asked to consider the story “walking up that hill” and apply the same thinking and concepts to a building.
- Each slide should be worked through in sequence.
- Allow time for some discussion and ask students to recall the story of the woolly jumper and walking up a hill in various weather conditions

The trainer should make sure that the students are aware that reducing air leakage/draughts and heat loss will greatly improve the energy performance of a building, reducing running costs and increasing comfort levels. The technical aspects will be looked at in further detail in Unit 3.

- Summarise the section by a question answer session
- Trainer can use the following questions as a guideline

Air/wind Tightness

Question: What is air leakage /tightness?

Answer: Air-tightness is a really important part of ensuring an energy efficient building and is part of the design and construction stages and a lot of time and effort should be devoted to making sure a building is air/wind tight. If a building is not air-tight it can be considered to be leaky. Air-leakage is what happens when you don’t have an air-tight building. This attention to detail will reduce heat loss and save the building owner money on energy bills and also reduces carbon emissions.

Continuous Insulation

Question: Why provide continuous insulation?

Answer: Failure to achieve continuous insulation will give rise to heat loss and thermal bridging, which in turn will create problems with condensation, mould growth and low comfort.

Breathability

Question: What is Breathability?

Answer: Different insulating materials have varying capacities to absorb and release moisture or let water vapour pass through them. This is known as Vapour Resistance or Breathability ***(μ).*** As mentioned previously materials must be fit for purpose so as not to interfere or hinder moisture movement.

Thermal Bridging

Question: What is thermal bridging and what are the issues associated with poor insulation detailing?

Answer: (discussed already)

Issues that thermal bridging might cause are condensation, mould growth etc.

Remember heat will always travel towards a cold spot and take the path of least resistance. Thermal/cold bridges offer little resistance and are colder than surrounding fabric. When hot moist air meets the cold surface the moisture condensates out. Condensation causes the mould growth, interstitial condensation, and weakness in insulation materials and so on. To control moisture in a building one must consider ventilation.

Controlled Ventilation

Question: What is controlled ventilation and air infiltration?

Answer: Controlled provision of air vs draughts and leaks

Question: Why ventilate?

Answer: To remove moisture, smells, Carbon Monoxide, provide fresh air etc. for health and prevent condensation/mould.

Presentation 3.2 – Importance of 5 Topics (20 minutes)

This presentation looks at how to achieve the following 5 details:

1. Wind-Tightness,
2. Air-Tightness,
3. Continuous Insulation,
4. Thermal Breaks
5. Breathability of Materials

- The trainer should present the 5 topics with the presentation provided by referring to the issues which arise and what causes them.
- Each presentation should be worked through in sequence.

- It is important that the students stay engaged with these topics. The trainer may wish to encourage controlled class discussion and ask individuals specific questions on each topic to maintain their participation.

Notes:

Topic 1: Wind Tightness

The scene should be set by the trainer with a statement similar to the following.

Ireland not only has a lot of rainfall but encounters wind, a lot of wind, so we need to protect our buildings in the same way as we protect our bodies.

- The cut away sections in the slides should be used to demonstrate where the weak spots are and why there *are* weak spots.

Topic 2: Air Tightness

Air Tightness should be continuous around the envelope of the building as any gap or “breech” will allow for draughts and draw the heat out of the building. Attention should be drawn to certain areas of breach.

Topic 3: Continuous Insulation

Insulation should be continuous around the envelope of the building as any gap or “breech” will draw the heat out of the building.

Topic 4: Thermal Bridging

Students should be asked to consider Rule of Thumb 1:2:

´Always ensure the weakest part of a structure has at least half the insulating properties of the strongest part, or there may be a risk of thermal bridging‘

Topic 5: Breathability

This should be briefly referred to at the end of the presentation. The fact that different insulating materials have varying capacities to absorb and release moisture or let water vapour pass through them should be highlighted.

The following should also be pointed out:

The breathability property of insulation can be particularly significant when it is installed

Assessment 4 - Worksheet 6: (20 minutes)

This paired exercise will be submitted for assessment purposes.

It is designed to get the students to discuss and understand why air tightness, insulation and thermal bridging problems occur within buildings. To highlight the importance of the above 5 photographic details provided, all the examples used are located at junctions.

Remind the students to consider the principles discussed in the previous Units and use this information for discussion within each group. Each member of the group will have the opportunity to explain one part of the worksheet to the class.

- The class should be divided into pairs, preferably different trades.
- The introductory slide should be shown
- Worksheet 6 should be handed out and one construction detail given to each paired group.

The paired groups should be:

- asked to look at their detail on the worksheet 6 and discuss the topic
- told that each member will be asked to provide a one-minute summary of either where, why, what or how to the class and that they should decide who will be presenting which part of the worksheet
- asked to consider air tightness, continuous insulation, breathability and thermal bridging during their discussions
- asked as a group to record any comments which highlight air leakage, heat loss, thermal paths, positioning of air tightness tapes, insulation etc. on worksheet 6

The trainer should walk around the class and prompt the students to ask themselves the following questions:

1. Where does air leakage or thermal bridging occur?
2. Why does air leakage or thermal bridging happen?
3. What problems occur as a result?
4. How can air leakage or thermal bridging be solved?
5. What insulations or tapes may be suitable?

Record Findings: (30 minutes)

After the students have completed Worksheet 6, each member of the group should provide a summary of two of the following: where, why, what or how?

- The trainer should move around the class to each pair and ask each member to summarise their findings under the 4 headings - Where, Why, What and How.
- Each heading in turn should be considered starting with Where…..
- Each person should be given one minute to answer, therefore 2 minutes per group.
- The findings with regard to each detail should be recorded on a flipchart/whiteboard.
- The previous 5 questions should be used as prompts by the trainer if needed to help the students in finding the answers.
- This process should be continued with each group in turn.
- Groups should be allowed to provide additional comments to all the details if they can at the end of the process (if time permits)

Assessment 4

- At the end of this session worksheets 6 should be collected for assessment

Presentation 3.3 - Summary (10 minutes)

On collection of worksheets 6, the issues highlighted should be summarised with the information provided on the Presentation 3 slides. A sample answer is provided for each of the 5 details making up worksheet 6. Slides make reference to the ACDs.

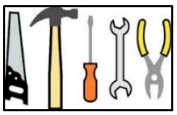
A single slide is included to highlight compliance with TGD part L, use of ACDs and impact on BER. So the following are addressed:

- Control Heat Loss
- Air Tightness
- Correct Insulation

this leads to:

- Best Practice
- Compliance

- Allow for a short Q & A session if time permits.



Demonstration 2 - (Workshop/ Demo site): (90 minutes)

At this point the class should be directed to the demonstration facility and briefly advised as to what they are going to see and what is expected of them. It will be important to organise the group so that everyone can hear and see the delivery and participate in Q & A.

Air Tightness

The demonstration unit is an air-tightness unit with parts of the construction open to view. The unit is used to demonstrate common air leakage points and the carrying out of an air pressure test. Internally a variety of tapes and membranes will have been applied to the openings, walls and roof areas demonstrating key parts of the construction that require particular attention.

The instructor (this may be an in-house trainer) should explain how to apply these tapes and systems and why they are installed.

- Some breaks should be incorporated into the air tightness layer to demonstrate air leakage. These should be capable of being remedied and a re-test should be carried out if time permits.
- The fan should be used to pressurise/depressurise the unit.
- A smoke gun test should be used to show points of air leakage

Care should be taken that the following are clearly demonstrated and discussed where appropriate:

1. Correct choice of tapes and membranes
2. Installation of relevant tapes and membranes
3. Intrusions in air-tight layer
4. Service cavity and grommets/seals
5. Air-tightness using a permeability test unit/fan
6. How air-tightness is measured on-site
   a. Blower door kit
   b. Reading @ 50 Pascal,
7. Smoke gun/ pencil
8. IR thermal imaging camera (if available)
9. Air-leakage paths
10. Thermal bridging

Resources for Unit 3:

Hand-outs:

- Worksheet 6 – paired TPS [10 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations:

- Resource 1: PowerPoint 3 → "Presentation 3"

Course Materials

- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Learners handbook (already issued)
- Demonstration unit/lab
- Blower door fan with manometer or Aircon Unit
- IR thermal imaging camera (if available)
- Smoke gun/pen
- Samples of air-tightness membranes [1 sets]
- Samples of air-tightness tapes [1 sets]

Assessments:

- Assessment 4 - Paired TPS on airtightness and insulation topic assessed using group assessment matrix.

Delivery Plan for Unit 4: "Building Fabric 2."

This section will carry out an investigation into best practice approaches regarding where and how insulation and air tightness tapes and membranes should be installed and how to achieve compliance with building regulations in particular Part L. The understanding of the principles outlined previously in Unit 4 is reinforced through a group exercise in Exercise 6.

Topics to be covered:

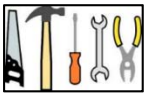
- **Topic 1** – Thermal bridging and Best Practice

Order of Delivery - Unit 4	
Presentation 4.1	Introduction
Demonstration 3	Workshop demonstration
Presentation 4.2	The 'best' and the 'Ugly'
Exercise 6	TPS (acetate pack)
Presentation 4.3	Solution to acetates
Assessment 5	Individual assessment (sketch)
Presentation 4.4	Compliance and ACDs
Assessment 6 – Homework 3	Homework sheet
Assessment 7 – Homework 4	Five short questions

Delivery Instructions

Presentation 4.1 - Introduction: (5 minutes)

This presentation is an introduction to Unit 4.



Demonstration 3 - Insulation and Thermal Bridging: (70 minutes)

This section allows the students to investigate how insulation should be installed correctly to minimise thermal bridging. They are directed towards best practice installation methods and made aware of how various construction materials work differently depending on their make-up, which insulations are not suitable and why.

The class should be directed to the demonstration site and briefly advised as to what they are going to see and what is expected of them. It will be important to organise the group so that everyone can hear and see the delivery and participate in Q & A.

Inform the students:

- that they will be directed towards a construction model/wall which displays various insulations and materials within different construction types

This model/wall will display common construction details such as concrete cavity walls, timber frame and solid wall construction and show how the tapes and membranes are applied to provide air tightness. It is important that the students understand how and why certain insulations, tapes and membranes are applied for each construction type.

- The students should be directed towards the cut away models. Time should be spent explaining certain details, highlighting elements which reinforce the concept of continuous insulation and air tight envelopes. Encourage any questions from the students.

The cutaway models will demonstrate how best practice is applied to detailing. This is aimed at reducing thermal bridging but also at developing a best practice approach to detailing, good workmanship and exceeding minimum compliance.

- Samples of insulations should be provided to the students. If time is limited then these can be introduced earlier.

It is important that the following are explained to the students:

- Where and how to install these products correctly, i.e. fit for purpose
- The importance of retaining continuous insulation throughout the envelope of the building (thermal breaks and insulation without gaps).
- The general properties of the materials, i.e. thermal performance, U-values and breathability properties.

Thermal Bridging and Best Practice

This section will investigate best practice approaches to and the installation of air tightness tapes and membranes and how to achieve compliance with building regulations, in particular Part L.

On completion of the demonstration activities, the class will discuss best practice approaches by looking at examples of “The best” the “Norm” and “The ugly” using a presentation. This will lead to a group exercise, combining all the learnings from Unit 3 and Unit 4 with emphasis on best practice methods.

Presentation 4.2 - Best Practice: (30 minutes)

This presentation should summarise the critical aspects of continuous insulation and thermal bridging and consider these when applying Best Practice methods. A series of slides demonstrating roof, wall, window and floor details are included.

- Present the series of slides, “ The Best, the Norm and the Ugly”
- Encourage some Q&A after each detail and relate back to previous exercise and what they have seen in the workshop demonstrations
- Encourage students to take notes as it may help in next exercise (acetates)
- .The trainer should address the following in his presentation of the slides:
  - The importance of continuous insulation and air tightness
  - Installation of insulation and air-tight membranes
  - Importance of detailing
  - Thermal bridging routes – gaps in insulation and at junctions
  - Use of correct type of insulation and air tightness tapes/membranes
  - Performance of insulations – thermal and breathability properties
  - Advantages of service cavities
- During the presentation the students should be asked whether they have seen some of these practices on site, whether best, norm or ugly?

Exercise 6 - TPS Group Work (Acetates): (30 minutes)

This exercise is to combine all the learning from Units 3 and 4 with an emphasis on best practice methods. Each group should be provided with 4 sectional details and a selection of acetates with individual details of insulations, tapes and membranes.

As part of this exercise,

- The class should be divided into 5 new groups of 4.
- Each group should nominate a group leader to present the groups choices/findings.
- A pack of sectional details and acetates should be handed out to each group.

Each pack contains four sets of sectional details, each one illustrating a different build type. A number of acetate sheets, each containing a different element of an insulation/air tight envelope is included. These acetates may be overlaid on the sectional detail with the objective of selecting the correct order of installation required to provide continuous insulation/air tight envelope.

- When handing out the acetate packs, hand out 4 no. Worksheet 7 (one for each sectional detail) to each group.
- Students should be asked:
  - To look at the building fabric of each sectional detail, discuss within the group and assess how to install insulation and air tightness products to best practice standards, taking into account continuous insulation, thermal bridging and air tightness.
  - In each group to record their reasons for choosing the acetates and provide any other relevant information as they see fit on worksheet 7.
  - To look at the sectional details one by one and assign the appropriate acetates to each detail sheet. Students may add as many acetates as they wish in order to build up to an overall design picture.
- The trainer should walk around the class and prompt questions if need be, so that some of the following points should come out in the discussion namely:
  - Continuous Insulation
  - Air Tightness
  - Thermal Bridging
  - Attention to Detailing
  - Best Practice
  - Quality
- To ensure all the students get involved with this exercise questions may be directed to individual group members if required.

Presentation 4.3 - Summarise main points: (10 minutes)

On completion of the sectional details/acetates and Worksheet 7 the trainer should summarise the 4 details using the slides provided.

- Show solutions to the acetates on slides provided
- The acetates and worksheets 7 should be collected at the end of Unit 4
- A photograph of the acetates and worksheets 7 should be taken.

Assessment 5 - Individual sketching exercise: (30 minutes)

To reinforce the concepts and details of the various constructions types explored in Exercise 6, the students will be required to draw/sketch on to a sectional detail for a particular construction type as outlined in Worksheet 8. This is an open book individual assignment.

- Distribute worksheet 8 and a sectional detail of a house built in 1970. One per student.
- Instruct students to use
  - Blue marker to draw a line indicating the wind barrier
  - Yellow marker to indicate the insulation layer
  - Red marker to indicate the air barrier

A list of insulation materials will be listed alongside the sketch. The student is to match an insulation material to an appropriate building element. Some insulation materials may be used in more than one location.

- Ask the students to draw a line/arrow from and insulation material to an appropriate and suitable location on the sketch
- The choice of insulation must be suitable and fit for purpose

.

Presentation 4.4 - Compliance and ACDs: (10 minutes)

Compliance

There are certian checks that can be put in place to help to achieve compliance with Part L of the current building regulations. How can this be achieved?

- The checklist slide should be presented and some brief information provided for each item on the list.
  - U-values
  - Performance of Materials
  - Correct Installation
  - Correct Detailing
  - Best Practice Workmanship
  - Continuous Insulation and Air Tightness

Acceptable Construction Details ACDs

The students should have already investigated ACDs in the homework exercise for Section 3. This is one slide directing them to the website - Acceptable Construction Details, ACDs, are required to improve the energy performance rating to a minimum standard. However, Best Practice details should be the target and will provide an even better outcome.

- One slide of the Acceptable Construction Details – ACDs should be presented.
- The trainer should point out that better design details are available and should be considered in order to achieve Best Practice.
- The ACDs on the TGD website should be mentioned.

http:/www.environ.ie/en/TG

- The final slide which is a summary of Unit 4 should be presented
- Time should be allowed for a short Q & A session

Assessment 6 - Homework 3: (5 minutes)

This homework exercise is in 3 parts based on Units 2, 3 and 4.

Part 1 generally look at a chosen house recording construction, type of materials used and detailing

Part 2 look at 2 existing details and investigate wind/air tightness, insulation thermal bridging etc. by creating a sketch

Part 3 look at how to improve these 3 details.

Assessment 7 - Homework 4: (5 minutes)

Students are to study Units 5 and 6 at home for the next class. Answer five short answer questions based on these units.

Resources for Unit 4

Hand-outs

- Worksheet 7 packs (4 details) – Group TPS [5 packs]
- Worksheet 8 – PMI [20 sets]
- Homework sheet 3 [20 sets]
- Homework sheet 4 [20 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations:

- Resource 1: PowerPoint 4 → "Presentation 4"

Course Materials

- Acetate Packs [5 sets]
- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Learners handbook (already issued)
- Construction models/walls
- Cutaway models and materials
- Camera/ phone with camera

Assessments:

- Assessment 5 - Individual assessment on sketch exercise
- Assessment 6 (Homework sheet 3) – individually assessed.
- Assessment 7 (Homework sheet 4) – individually assessed

Delivery Plan for Unit 5: “Heating and Ventilation.”

The previous units have emphasised the importance of ensuring that the envelope of the building is air tight and completely insulated and this should always be the first line of defence in reducing energy or heat loss. Once the building is airtight, then maximising the efficiency of the installed heating and ventilation systems is the next step in the process of achieving energy efficient buildings. This Unit briefly investigates the topics around heating and ventilation and address any important factors or issues which may arise within air tight buildings.

It should be stressed that this unit is not a detailed account of how heating or ventilation systems work, but is a demonstration of the importance of energy efficiency, carbon emissions and healthy buildings.

This second section will look at why ventilation is important, how to provide ventilation and the effects on the building and end-user if ventilation is not provided. The issues of condensation, mould growth, unhealthy buildings and possible structural damage are also discussed.

Topics to be covered:

- **Topic 1** – Heating Systems
- **Topic 2** – Ventilation and Condensation

Order of Delivery – Unit 5	
Presentation 5.1	Heating systems
Presentation 5.2	Ventilation and Condensation Exercise 7 – PMI on ventilation
Assessment 8	Exercise 8 - TPS on ventilation – TPS Poster - Poster design and presentation
Presentation 5.3	Ventilation Compliance
Assessment 9	MCQ 2

Delivery Instructions – Heating and Ventilation:

Presentation 5.1 – Heating (50 minutes)

This presentation sets the scene regarding how heating has changed over the years. A single slide – Heating over the Years – should be presented

A brief overview of how heating sources have changed over time, from open fires to renewable energy heating systems should be given. These heating systems have moved towards using more efficient fuels and renewable sources and the building performance energy ratings reflect this change of fuel and systems over the years.

- Students should be asked why they think the changes have occurred - policies, costs, technology changes, consumer demands and health considerations being amongst them.
- The trainer might wish to point out that it is being suggested that A and B BER's will be required after 2020 as the EU commission has introduced a policy that all buildings should be NZEB by 2020. It is expected that Ireland will provide its guidelines on NZEB this next year.

Though the efficiency and effectiveness of air-tight and insulation layers are important, it is equally important to consider how efficiently heat is produced and distributed within the building.

The first part of the presentation covers:

1. How heating a dwelling has changed over the years
2. Brief look at conventional and renewable systems
3. Importance of insulating storage vessels, pipe and ductwork
4. Emitters
5. Controls
6. Compliance and TGDs L, J and BCAR

The presentation is intended to be interactive so Q & A should be encouraged after each slide. The slides address heating types, storage and distribution, emitters and controls and the effects on the end-user.

The trainer should point out that:

- The energy efficiency and the sizing of the boiler/stove is important to regulate energy use.
- The choice of heating source should suit the buildings use, in other words be fit for purpose.

- The insulation of the storage vessel plays a huge part in reducing heat loss.
- Understanding that pipes should be insulated as well as the building envelope is important.
- Reducing the lengths of pipe work (if possible) can also reduce heat loss
- The trainer should again point out that many houses have radiators installed and these can easily be replaced with energy efficient alternatives without significant alterations to the heating system.
- The trainer should also note that changing or upgrading emitters is often carried out by altering the controls to reduce energy usage/waste and improve comfort levels within the building. The various measures which can be taken such as those below should be identified:
    - Controls to the heating system
    - Controls to the emitters
    - Controls to the temperature of each room
    - Controls by the end-user for the automatic/manual control of the timer.
- Provide ways in which the end-user could improve the energy efficiency through knowing how to use the system, annual maintenance, using the system correctly, insulation of pipes, installation of effective controls

The following are some suggested questions for class discussion:

- How can the heating system improve the energy efficiency of the building?
- Compare the conventional fuels with renewables and ask in particular the heating specialists on their approach to choice or preference and why?
- The energy use in the DHW supply can be high and maintaining enough hot water storage by reducing heat loss is important especially in dwellings. Why is this so?
- How can energy efficiency be improved by choosing the correct heat source, storage, emitters and controls?

- The trainer should ensure that the following considerations emerge in the class discussions
    - Control heat loss
    - Energy efficiency
    - Best Practice
    - Communication

Ventilation and Condensation:

This section is of great importance to air-tight buildings and may be highlighted with the phrase -

"Build tight, Ventilate right".

This section will look at why ventilation is important, how to provide ventilation and the effects on the building and end-user if ventilation is not provided. The issues of condensation, mould growth, unhealthy buildings and possible structural damage are also discussed.

Exercise 7 – PMI (30 minutes)

This is the individual component of the exercise where the student will take notes on the slides presented.

- Hand out Worksheet 9 to each individual
- Present the slides as per Presentation 5.2
- Inform them that they will be put into groups for the next part of the exercise

Presentation 5.2 - Ventilation and Condensation:

This set of slides will briefly look at the history of ventilation from unwanted air infiltration to using controlled ventilation in buildings, whether by natural or mechanical mean. They look at why we ventilation and the methods of ventilation.

- The trainer should explain the following to the class:
  - Historically in Ireland, windows were opened to remove excess smells and smoke (from the fire and cooking). However, although this was common in the past, these homes had little insulation with single glazed windows and airtightness was non-existent. The houses relied on air infiltration for fresh air intake providing **healthy but cold homes.**
  - With the increase in costs, EU Directives and Building Regulations, buildings need to reduce energy usage. The fundamental principle of low energy building is to build air-tight constructions, thereby minimising the transfer of heat energy through the external envelope. However, fresh air is still required!! Therefore **controlled ventilation** is required to provide healthy, energy-efficient homes.
  - As we build more airtight and thermally efficient homes the need for ventilation increases. Without a dedicated ventilation solution to remove moisture and pollutants from our buildings whilst supplying fresh air, there would be little opportunity for pollutants to escape. This would seriously affect the health and comfort levels of the end-users.
- Advise the students that worksheet 9 should be used to take notes on the presentation and that there will be a poster and presentation to be completed.

This presentation will cover the important points which will be discussed in the next activity. It is envisaged that the main points about ventilation, condensation, comfort, health and compliance will be discussed between the students. The principles of controlled ventilation has also been covered in Unit 2 (Infiltration vs. Controlled Ventilation etc.)

Importance of Ventilation

This part will be used for individual and group assessment purposes. The previous presentations have provided information for this exercise, where the students should consider the importance of ventilation and the consequences of not ventilating correctly. Students will have to refer to the video on the O'Brien home, Unit 2, the practical demonstration, the notes from Presentation 5.2 and the learner's handbook to complete this exercise properly. It has 2 components to it:

1. Worksheet 10 (TPS)
2. Poster design and Presentation (A1 poster sheet)

Exercise 8 – TPS (30 minutes)

This is the group exercise were the groups will come together and share their notes from Worksheet 9. There are 5 topics within Worksheet 10 and each group will be given 1 topic to work on. Give them time to familiarise themselves with the questions attached. Each topic will have a number of pointers listed, which should provide direction for the students. See notes below for further information on the topics.

- The class should be divided into 5 <u>new</u> groups of 4
- Each group should be asked to select a group leader
- Assign one of the 5 topics, listed below, to each group
    1. How to ventilate
    2. Ventilation and surface condensation
    3. Ventilation and interstitial condensation
    4. Ventilation and health
    5. Ventilation and comfort
- Hand out Worksheet 10 to the 5 groups (1 per group)
- Inform the students that they will have to produce a poster after this so should keep this in mind
- Inform the students this is a group exercise and that they will be marked as individuals and as a group
- The students should share their notes from Worksheet 9
- The students should work in a group and refer to the slides and their Learners Handbooks, also remind them to think back to the video on the O'Brien's home and recall issues on ventilation and condensation. Notes may be taken during their discussion to assist with the development of a poster which should be presented to the class.

Assessment 8 – Poster design and Presentation:

When the groups have finished discussing and writing down their notes.

- An A1 sized poster sheet should be handed out. Each group to name of group at the top of the poster.
- The students should be asked to complete a poster on the A1 sheet on their assigned topic.
- The students should be informed that the poster should include at least one drawing/sketch representing a key piece of information and list 5 points if possible which are ready to be presented to the class.
- Each group should be asked to discuss their designated topic by using the Learners Handbook and other resources.
- The trainer should walk around the room to make sure there is engagement from all students.

On completion of the posters,

- The posters should be hung on the wall for all to see.
- The group leader should present the poster to the class in a **maximum of 4 - 5 minutes** outlining its main points and the reason for choosing the sketch.
- The presentation should be followed by a Q & A and discussion
- Collect Worksheet 9 and 10 (individual and group) and posters for assessment purposes

The 5 topics will show the following:

1. **How to Ventilate**
   - Which ventilation is required?
     - Background, purge and extract
   - What ventilation is required in?
     - Roof space
     - Living space
     - Bathrooms etc.
   - Type of ventilation systems
     - Natural – holes in the wall, trickle vents, DCVs, Passive stack
     - Mechanical – with heat recovery, PIV

2. **Ventilation and Surface condensation**
   - What is it?
   - Why and how does it form?
   - Who does it affect?
   - How do you eliminate it?
   - What problems does it cause?

3. **Ventilation and Interstitial condensation**
   - What is it?
   - Why and how does it form?
   - Who does it affect?
   - How do you eliminate it?
   - What problems does it cause?

4. **Ventilation and Health**
   - Reasons why it impacts health?
   - Pollutants?
   - Wellbeing?
   - How ventilation has changed over time
   - Mould within the fabric and on the surface?

5. **Ventilation and Comfort**
   - Fresh air requirements (regulations)
   - Temperature?
   - How do you control it?
   - Air quality?
   - Smells/odours
   - Humidity
   - Draughts/infiltration?

Compliance

Presentation 5.3 (10 minutes)

Requirements on ventilation and condensation are laid out in the TGD part F and is available on the website www.environ.ie/en/TGD.

This document is only mentioned in brief during this course. However certain topics which are outlined below are of importance and should be brought to the attention of the students.

Means of ventilation. F 1

Adequate means of ventilation shall be provided for people in buildings. This shall be achieved by

a) Limiting the moisture content of the air within the building so that it does not contribute to condensation and mould growth, and

b) Limiting the concentration of harmful pollutants in the air within the building.

Condensation in roofs. F 2

Adequate provision shall be made to prevent excessive condensation in a roof or in a roof void above an insulated ceiling.

Assessment 9 - MCQ 2: (20 minutes)

Worksheet 11 – 10 Multi-choice Questions

Resources for Unit 5

Hand-outs

- Worksheet 9 – individual [20 sets]
- Worksheet 10 – Group TPS [5 sets]
- A1 poster [5 sets]
- A3 size sheet (rough work) [5 sets]
- Worksheet 11 – Individual [20 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations:

- Resource 1: PowerPoint 5 → "Presentation 5"

Course Materials:

- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Camera/ phone with camera

Assessments:

- Assessment 8 – (TPS, Poster and Presentation) – Group assessment using Group Assessment Matrix
- Assessment 9 (MCQ) – Multi-choice question sheet to be completed in class by students.

Delivery Plan for Unit 6: "System Thinking."

This unit is designed to reinforce 'Systems Thinking' for the students and encourage communication between all trades. As this is the last Unit all the topics discussed in each of the previous sections should be brought together in the context of the need for communication and collaboration onsite. It is hoped that a common understanding and approach will emerge.

It is important for students to understand the following:

- how one trade's work impacts on another trade's work,
- the importance of working in a set sequence, paying attention to detail
- communicating effectively amongst themselves in order to achieve Low Energy Quality buildings

The final table quiz should be light hearted and entertaining with questions provided in the format of MC, and with short answers including the visual and audio.

Topics to be covered:

- **Topic 1** – Working Together
- **Topic 2 -** Communication

Order of Delivery – Unit 6	
Presentation 6.1	Introduce Video of Pat and Dan
Video 2	Video of Pat & Dan
Assessment 10	Worksheets from exercise 11, 12 and 13
	Exercise 11 - PMI on communication between Pat & Dan
	Exercise 12 - TPS activity on workmanship Summarise main points
	Exercise 13 - PMI - worksheet 14 Summarise main points
Presentation 6.2	System Thinking
Video 3	Pat & Dan system thinking
Exercise 14	Class discussion Record main points
Presentation 6.3	Compliance and Responsibility
Assessment 11	Individual – worksheet 15
Table quiz	
Conclusion	
Post survey questionnaire	

Delivery Instructions:

Working Together

The aim of this activity is to observe how construction workers work on site by looking at their workmanship, attention to detail and how they work alongside others on the site.

Two construction workers, Pat and Dan are introduced by way of video 2. Students should watch the video and make notes on how Pat and Dan work on the site. This will lead to group work and group discussion on the issues, causes and solutions to the problems. The results will be recorded by the trainer on a flipchart for class discussions.

Presentation 6.1 – Working together (10 minutes)

These are introduction slides for the next Unit.

- Present the slides on Working Together
- Ask the students to consider the following words. This graphic should be left on screen for reference during exercise 10 and while Video 2 is being played.

Workmanship Site Tidiness Attention to Detail Quality of Build Fit for Purpose	Sequence of Works Site Safety Skills/competence Knowledge Communications

Exercise 9 - PMI on Pat and Dan: (20 minutes)

The following exercise is based on Video 2 and Presentation 6.1. The students are to create a numbered list to describe any positive or negatives with the work that Pat and Dan have carried out on the O'Brien home**.** As part of this learning activity, Video 2 should be played, which re-introduces Larry O'Brien and Joe, but also introduces Pat and Dan the construction workers, working separately on site with no communication or attention to detail, leading to a series of mistakes and/or poor workmanship.

- The Individual PMI Worksheet 12 should be handed out to the individual students.
- The students should be asked to observe how Pat and Dan work on-site by filling out the worksheet 12 while watching video 2.

- Each student should be asked to try to list 5 Positive and 5 Negative features of how Pat and Dan work and make notes of any other important matters that they can identify.
- Play Video 2 of Pat and Dan working together. It highlights a lot of issues that may arise on a real site.
- This video will last about 5 minutes and should be played in full without any further explanation. The video can be played again if needed.

Assessment 10 – Working together:

The presentation, video and Worksheets 12 form the basis for this assessment along with the 2 associated activities:

1. TPS - Worksheet 13
2. Group PMI - Worksheet 14

TPS on Pat and Dan: (30 minutes)

On completion of worksheet 12, all the individual notes will be collated into one group list, whilst discussing the issues and recording them on Worksheet 13. The group will then decide which 2 issues they will investigate further.

- The students should be divided into 5 groups of 4. The trainer should make sure the groups differ from the previous Units to ensure a mix of trades and communication experiences.
- The students should then be asked to join their assigned groups.
- Each group should be asked to nominate a group leader

The group leader should not have presented previously. This is to ensure that different students have the opportunity to present their findings.

- Worksheet 13 should be handed out
- This a Think-Pair-Share group exercise therefore the students should be asked to combine their individual notes from Worksheet 12 into the Group Worksheet List 13.
- The students should be asked to discuss the Positives and Negatives which they have identified within the group. Students may add further to this list if they identify other issues during discussions.

Prepare a table on the whiteboard/flipchart to allow for 3 columns with headings: issues, causes and solutions. This table should be used to record the findings from all the groups for Assessment 10.

Summarise main points

Ask the groups to:

- Identify two poor situations, one relating to Pat's work and one relating to Dan's work. These should be presented to the class by the group leader.
- The responses should be recorded by the trainer on a whiteboard or flipchart for the class to see.
- The trainer should make sure that the majority of issues have been addressed as they may have to ask groups to address an issue which has not been picked up.
- Space should be left to the right of the issues lists as the causes and solutions will be added after Group PMI.

Group PMI for Issues and Causes: (40 minutes)

This PMI will require the students to look at how important workmanship and attention to detail are. To investigate how these issues have arisen each group should be asked to record the two chosen issues, discuss and record what they consider to be the causes and then record possible solutions.

After the class discussions in the TPS activity

- Hand out Worksheet 14 which includes 2 sheets A and B (for Pat and Dan)
- Each group should be asked to record the two agreed issues in the first column- headed - 1. Issue - on each worksheet for Pat and Dan.
- The students should be asked to discuss in more detail as a group the causes and solutions for each of these issues.
- The trainer may need to prompt and ask questions of the groups as he or she walks around the room if discussion seems to be slow or non-existent
- The students should be asked write down the causes and solutions of these issues on Worksheets 15 (A and B). This a Think-Pair-Share group exercise and all students should be in the discussion.
- Students should be informed that there may be more than one cause and solution, that sketches may be used and that they should refer to the resource Learners Handbook which may be useful.

The groups may have to be prompted to for the reasons for their choice and if there are reasons which may have caused the problems other than those which they have identified.

Summarise main points

Once the students have completed the causes and solutions in worksheet 15, each group should provide their answers to the class.

- The group leader should state the cause and provide the solutions.
- These should be recorded on the flipchart next to the issue and the cause.

- The trainer may prompt the group as to why they have decided on their choice and if there are other ways of solving the problem.

Low Energy Communication

The intention of this activity is to help the students to develop an awareness of how other trade's work on site and the importance of communication skills between all trades which leads to the concept of "Systems Thinking"

Presentation 6.2 - Systems Thinking: (5 minutes)

The slides introduce the concept of "systems thinking" and the "sequence of works" which should encourage trades to work in a way that will not cause unnecessary problems to another trade.

- The following terms should be introduced by the slides which summarise systems thinking
  - Listening and Talking - Communication
  - Consideration of all trades and their works
  - Working together
  - Complete Quality Build.

- The slides on the Sequence of Works should be presented outlining its stages – Investigation, Preparation, Construction and Completion - and how it affects the construction Worker.

This presentation identifies important steps during the construction of the building and although the individual construction worker may not be involved in all the steps, it is useful for him or her to understand the process of work so that they appreciate their role in it.

- It should be pointed out that all people on site have some role to play in achieving **quality of workmanship, competency and compliance.**

Video 3 - (Pat and Dan Part Deux): (5 minutes)

Following on from the presentation, Video 3 re-introduces Joe, Pat and Dan. The idea of this video is to show how Pat and Dan work on-site NOW. The video will show both trades working together with improved workmanship, management skills, attention to detail and communication.

Joe is able to sign off the build and certify compliance with a BER rating higher than the norm – the building achieving an A3 rating.

Exercise 10 – TPS Class discussion: (20 minutes)

Ask the students to:

- watch Video 3.
- look out for evidence of systems thinking and process of works in the video

  - The video will last about 5 minutes and should be played in full without any further explanation.

- Prompt the class discussion with some prepared questions

  Question: How did Pat and Dan carry out the process of works on site for investigation, preparation, construction and completion?

  Answer: By using the following:

  - Listening and Talking - Communication
  - Consideration of all trades and their works
  - Working together

Examples are listed below:

- Investigation/communication - BCW notices errors in the drawings and agrees with the Architect to solve the problem.
- Construction/consider all trades - BCW makes sure insulation is carried throughout, air tightness is provided, ventilation is provided.
- Completion/working together - Best practice - process of works is carried out.

Summarise main points

- Summarise the class discussion and emphasise that everyone on site has a bearing on the outcome of the quality of low energy buildings.

Presentation 6.3 - Compliance and Responsibility: (5 minutes)

- Using the slides, refer to the Building Control Act 2014 and the role of everyone on site especially the building construction worker. This should be linked with the Code of Practice and this in turn with key aspects of work on site.
  - Best Practice and Sequence of Works
  - Correct installation and detailing
  - Roles of responsibility
  - Compliance with Building Regulations and TGDs.

Assessment 11 - Worksheet 15: (10 minutes)

The previous slides and discussions should lead to the completion of a final worksheet 15.

To summarise the course it is intended to gather information from the students as to how they perceive low energy quality building now.

- Worksheets 15 should be handed out
- You should direct the learners to **Name and describe 5 things that you can contribute in your line of work to ensure low energy quality build**

The objective of this session is to make sure the individuals have recognised the importance of the six factors affecting quality build and how they all feed into low energy building.

- Collect Worksheets 15 before the table quiz.

Table Quiz: (30 minutes)

This activity will combine all the learnings from the 3 days into one final quiz. The important factors related to low energy quality building and systems thinking will be highlighted in the quiz but other light hearted questions will be added also.

There are 4 parts to the quiz: MCQs, short answers, visual and visual/audial.

- This should be a group activity, 5 groups of 4.
- The students should be asked to join their nominated groups for Unit 5.
- When they are in their groups the rules of the game should be explained
  - There will be 4 parts to the quiz.
  - Each answer is worth 1 point unless stated otherwise.
  - A time limit of 8 minutes is allocated for each sheet.
  - The students should be told that they cannot use their learner's handbook, TGDs, or mobile phone devices during the quiz.
- The first sheet should be handed out to each group
- The students should be asked to complete the 10 MC questions.
- Sheet 1 should be collected from each group
- On submission of sheet 1 marks should be allocated.
- Sheet 2 should be handed out, 10 questions asked to which short answers are required….
- The answers for parts 1 and 2 should be provided using slides.
- Sheet 3 which consists of pictures for which captions are required should be handed out. Students should answer by writing down who or what they see.
- Sheet 5 which includes a combination of short answers and listening to sounds should be handed out. The process of collection and marking should continue.
- The answers for parts 3 and 4 should be provided using PowerPoint slides.
- The answers for the last round should be provided and the overall winners announced.
- If there are prizes these should be presented now.

Final wrap-up and thank you: (10 minutes)

Using whatever approach he or she considers suitable, the trainer may wish to thank all the students and anyone else who has facilitated the course.

- The wrap-up should include some or all of the following –
  - A hope that they have gained something from the course
  - A wish that they will consider additional training in the future to keep their knowledge up to date
  - Encouragement to continue to visit the QualiBuild website for updates
  - Encouragement to use the Handbook from time to time as a starting point for guidance on questions which they may have.

Invite participants to contact any of the organisations involved in the project if they have any questions in the future.

Resources for Unit 6

Hand-outs

- Worksheet 13 – Individual PMI [20 sets]
- Worksheet 14- Group TPS [5 sets]
- Worksheet 15 – Group TPS [5 sets]
- Worksheet 16 – Individual [20 sets]
- A3 size sheet (rough work) [5 sets]
- TGDs – Part L (2008 & 2011), Part F, Part J, Code of Practice.[5 sets]

Presentations:

- Resource 1: PowerPoint 6 → "Presentation 6"
- Resource 2: Video 2 (Pat & Dan working, making a mess etc.)
- Resource 3: Video 3 (Pat & Dan working & communicating)

Course Material

- Coloured pens/markers [5 sets]
- Pens and notebooks [20 sets]
- Flipchart/whiteboard and markers/cleaners [1 set]
- Table quiz pack [5 sets]
- Table quiz presentation/audio
- Camera/ phone with camera

Assessments:

- Assessment 10 – (TPS, and Group PMI) – Group assessment using Group Assessment Matrix
- Assessment 11 – Short answer type questions individually assessed. The answer will be subjective in nature. Students must consider what they have learnt on the course and how they might apply it to their current role within the building industry or how it might apply to future work or projects.

Learning Outcome	Title of *Topic* being covered	Breakdown of activity	Breakdown of Timing	Resources/*hand-outs*	%
6	Post survey questionnaire	Completion of course	15 minutes	Post Survey sheet	2.5