**INSOTV1**

**Title:** Assess the age, nature and characteristics of older and traditional buildings

**Overview**

This standard is about assessing the age, nature and characteristics of older and traditional buildings.

It sets out the skills, knowledge and understanding for you to assess their heritage values and significance, construction, condition, and heating and ventilation performance, and the implications of these for the introduction of energy efficiency measures.

This standard is suitable for those working in the retrofit sector with responsibility for assessing older and traditional buildings for the installation of energy efficiency measures.

**Performance criteria**

1. establish the age of buildings and the implications for the introduction of energy efficiency measures
2. assess the heritage values and significance of older and traditional buildings

**P3**. apply conservation principles to older and traditional buildings

**P4.** assess the construction of older and traditional buildings, their performance and the materials used

**P5.** assess the types of heating and ventilation systems in older and traditional buildings and the implications these have on the introduction of energy efficiency measures

**P6**. identify common building issues and defects, and assess their implications for energy efficiency measures

**P7**. Assess when further analysis or investigation is required and refer to a specialist

**Knowledge and understanding**

**P1 BUILDING AGE AND IMPLICATIONS**

1. sources of information to help establish the age of older and traditional buildings including:

* the building
* owner/occupier
* building plans and documents
* historic maps
* historic environment records and listed building records
* conservation area appraisals

1. the architectural styles and characteristics of buildings from the following periods:

* Medieval
* Pre-Georgian
* Georgian
* Victorian
* Edwardian

1. how U-values for building elements can be calculated and why the age building parts may impact on the default U-values used in core energy modelling methodologies
2. the relevance of building age in relation to the difference in performance characteristics between traditional and modern materials and construction methods

**P2 HERITAGE VALUES AND SIGNIFICANCE**

1. how the following heritage values are used to assess and describe the significance of buildings:

* evidential
* historical
* aesthetic
* communal

1. why and how statements of significance and heritage impact assessments are prepared and used
2. the range of current legislation and sources of official guidance relevant to built heritage relating to:

* listed buildings
* scheduled monuments
* conservation areas and tree preservation orders
* directions withdrawing permitted development rights
* exemptions relating to ecclesiastical buildings
* local listing

1. the necessity and context of applying a whole building approach
2. the key factors to consider when taking a whole building approach to the installation of energy efficiency measures including:

* occupant or owner requirements, behaviours and well-being, financial and human resources
* local context, including location, orientation, elevation, exposure, access, planning and site constraints
* exposure to existing and future natural hazards, including extreme weather events, wind driven rain, flooding and overheating
* exposure to harmful materials such as asbestos and radon
* the increased risk and cost of unintended consequences
* building use and occupancy patterns
* building fabric and potential reactions between materials
* building condition and hygrothermal performance
* impacts of moisture, humidity and water
* heritage values and significance
* building services, including user understanding of controls
* existing energy efficiency measures and climate change adaptations
* local options for heat and energy supply
* wider context and opportunities for enhancements including environmental, cultural, community and economic

1. reasons for taking a whole building approach to the installation of energy efficiency measures including ensuring that measures are:

* building specific – no ‘one size fits all’ approach
* suitable and proportionate
* planned and phased
* well-integrated, properly coordinated and installed in the right sequence
* effective and sustainable
* specified once uncertainties are highlighted and resolved
* designed to manage the risks of unintended consequences

**P3 APPLY CONSERVATION PRINCIPLES**

1. the following principles of conservation:

* authenticity
* integrity
* maintenance
* like-for-like repair
* minimum intervention
* restoration
* re-treatability
* reversibility

1. how the principles of conservation are applied to older and traditional buildings in relation to the introduction of energy efficiency measures

**P4 CONSTRUCTION AND MATERIALS**

**K13.** the types of construction of older and traditional buildings, the materials used and how they differ from modern construction and materials

**K14.** how to identify local and regional variations of traditional buildings and materials

**K15**. how the performance of traditionally constructed buildings differs to modern construction particularly in relation to:

* thermal mass
* moisture transport mechanisms: diffusion, convection, capillary suction and gravity, and how these affect hygrothermal performance
* relevant material properties such as hygroscopicity and vapour permeability
* ability of materials to buffer moisture and temperature
* condensation and dew-point
* vapour pressure
* absolute and relative humidity
* ventilation and air movement

**K16**. the effect of the geographical location, climate, aspect, orientation and the differing exposure of individual elevations on the way older and traditional buildings perform

**K17**. the interaction of traditional and modern materials and the consequences of using incompatible and poorly designed energy efficiency measures with particular reference to:

* thermal mass
* thermal bridging
* moisture movement
* air tightness of the fabric
* ventilation and air movement
* indoor air quality (IAQ) and indoor environmental quality (IEQ)
* climate change and the ability of buildings and their occupants to manage natural hazards including extreme weather events, wind driven rain, flooding, and overheating
* heritage value and significance

**P5 HEATING AND VENTILATION**

**K18**. the types and condition of water and space heating systems and the implications these have on the introduction of energy efficiency measures including:

* hard water and soft water impacts
* gas heating systems
* oil systems
* micro-renewable systems
* electric systems
* solid fuel
* hybrid systems
* combined heat and power (CHP)
* district heating systems

**K19.** the types and condition of controlled ventilation and the implications these have on the introduction of energy efficiency measures including:

* background and trickle vents
* centralised and decentralised mechanical extract ventilation (MEV) and mechanical ventilation with heat recovery (MVHR)
* passive stack ventilation
* permanent openings and ventilation grilles
* purge ventilation
* positive input ventilation

**K20.** the sources of uncontrolled air infiltration and the implications these have on the introduction of energy efficiency measures

**K21.** the way of establishing and measuring the level of airtightness of older or traditional buildings including smoke tests, blower door tests and infrared thermography

**P6 BUILDING DEFECTS**

**K22**. how to identify the common building issues and defects, and their causes including:

* moisture, including driving rain, rising and penetrating damp, internal moisture vapour, inadequate or damaged drainage systems, elevated external ground levels
* effect of moisture on the thermal resistance of building fabric, particularly external walls
* time needed to allow for walls to dry out after repairs
* inadequate or defective ventilation
* structural defects and structural movement
* condition of exterior building fabric
* defects with existing energy efficiency measures
* cavity wall issues, including early cavity walls, blocked cavities, wall-tie failure, hard to treat cavities
* asbestos, radon and other harmful materials
* alterations or extensions to the building, its materials or finishes

**K23**. the implications of common building issues and defects for the introduction of energy efficiency measures

**K24**. how building materials degrade and deteriorate over time with particular reference to:

* inherent material defects
* physical processes, including shrinkage, expansion, erosion
* chemical processes, including corrosion, salt crystallisation
* fungal attack and insect infestation
* excess loading

**K25**. how alterations to the original construction affect the performance of buildings with particular reference to thermal performance, hygrothermal performance, overheating and thermal comfort

**P7. SPECIALIST ANALYSIS OR INVESTIGATION**

**K26**. when there is insufficient knowledge or evidence present to make recommendations on the introduction of energy efficiency measures to older or traditional buildings

**K27**. the range of specialists that may be needed when considering the introduction of energy efficiency measures to older and traditional buildings including:

* fire consultant
* heritage consultant
* local authority planning or built heritage conservation officer
* building surveyor
* structural engineer
* independent damp and timber consultant
* building services consultant
* conservator
* archaeologist
* ecologist

**K28**. the types of further analysis and investigation available including:

* fire assessment
* assessment of significance and heritage impact assessment
* building condition survey
* keyhole investigation
* opening up
* testing, monitoring and remote sensing, including airtightness testing, infrared thermography and in situ U-value monitoring
* moisture management evaluation
* moisture risk assessment
* building services assessment
* archaeological investigation
* ecological assessment
* overheating assessment

**K29**. when and how to refer to specialists

**INSOTV2**

**Title: Evaluate the options for introducing energy efficiency measures to older and traditional buildings**

**Overview**

This standard is about evaluating the options for the introduction of energy efficiency measures to older and traditional buildings.

It sets out the skills, knowledge and understanding for you to evaluate the options for energy efficiency measures based on an understanding of building performance, the implications of building condition and use, current legal and regulatory requirements, and risks.

This standard is suitable for those working in the retrofit sector with responsibility for evaluating options for energy efficiency measures in older and traditional buildings.

**Performance criteria**

1. identify the range of energy efficiency measures relevant to older and traditional buildings
2. evaluate the implications of existing building issues, condition and defects, and how the repairs and enabling works required affect the choice of energy efficiency measures
3. evaluate the implications of current and future occupancy and occupant behaviour on the selection of proposed energy efficiency measures
4. evaluate the implications of the relevant legal and regulatory requirements
5. evaluate the risks associated with the selected energy efficiency measures and how to mitigate them
6. evaluate the suitability and use of different building performance modelling and evaluation techniques
7. evaluate the options for the introduction of energy efficiency measures to older and traditional buildings

**Knowledge and understanding**

**P1. RANGE OF ENERGY EFFICIENCY MEASURES**

1. the range of energy efficiency measures for building fabric including building maintenance and repair, airtightness, ventilation and insulation
2. the range of energy efficiency measures for building services
3. the suitability of materials and construction techniques for older and traditional buildings with particular regard to:

* moisture open versus moisture closed materials and their capillarity, hygroscopicity and vapour permeability
* air gaps and thermal bypass
* air and vapour control layers

1. how and why it is important to concentrate on the interfaces between corners, junctions and edges of building elements, and between the building fabric, building services and the occupants
2. the interactions and effects of energy efficiency measures in combination with each other including:

* measures that are independent and do not interact
* measures which interact or may connect and require construction detailing
* measures which interact and require complementary specification and/or upgrade
* measures that are not appropriate together and should not be combined
* relationship between insulation and airtightness

**P2. BUILDING ISSUES, CONDITION AND DEFECTS**

K6. how building issues, defects, enabling works and the repairs required affect the choice of energy efficiency measures

K7. the effect of moisture on the energy performance of traditional materials and construction

**P3. OCCUPANT BEHAVIOUR**

K8. factors that influence occupant behaviour in relation to energy use including:

* social factors including age and health
* economic factors
* geographical and location factors
* psychological factors such as perception of comfort and comfort taking
* type of building, building use, changes of use and occupancy pattern
* type of systems and system controls, including heating, cooling, ventilation systems
* tenure types and impact on maintenance
* occupant perceptions of controlled and uncontrolled ventilation
* occupant interaction with building systems and controls
* indoor environmental quality
* external environmental quality

K9. the different methods of heat transfer – convection, conduction, radiation – in relation to the thermal comfort of occupants

K10. how levels of energy use vary between traditional buildings due to occupant behaviour

K11. the ways occupant behaviour impacts on moisture and humidity levels including:

* producing moisture and carbon dioxide through respiration
* producing moisture through activities such as cooking, bathing and drying clothes
* heating patterns and level of heat
* blocking intended ventilation routes

**P4. LEGAL AND REGULATORY REQUIREMENTS**

K12. the ways in which energy efficiency measures can change the appearance and character of traditional buildings and impact their significance

K13. the content and role of the following types of relevant legislation, regulations, standards and guidance, and how they treat the requirements for energy efficiency measures for traditional and protected buildings:

* planning and heritage protection
* national building regulations
* energy efficiency standards
* wildlife protection
* gas and combustion flues and vents
* party wall legislation
* British Standards and Publicly Available Specifications
* fire safety

K14. the requirements of planning and heritage consents for energy efficiency measures on traditional and protected buildings

K15. when compliance with the technical requirements of the relevant national building regulations is required and when exemptions and special considerations apply

K16. when an application for approval to a building control or other regulatory body is required for energy efficiency measures

K17. how to obtain the necessary relevant legal and regulatory permissions including:

* sources of information to identify protected buildings
* application processes, documentation and timescales
* getting pre-application advice
* resolving potential conflicts between planning and heritage consents and national building regulations approval
* consequences of not gaining permission if required

**P5. RISKS**

K18. the technical risks associated with energy efficiency measures and enabling works including:

* thermal bridges
* incorrect ventilation
* thermal bypass
* condensation
* interstitial condensation
* impact of extensions and alterations to the structure, fabric and finishes
* moisture movement
* impact on existing and proposed building services
* disturbance of hazardous materials
* material incompatibility
* timing of works including duration, time of year and disruption to occupants

K19. the potential unintended consequences of using poorly specified or unsuitable interventions or energy improvement measures including:

* harm to heritage values and significance
* harm to indoor environmental quality and occupant health from condensation, moulds and spores, and inadequate ventilation
* interstitial condensation and the impact on building fabric of rot, mould growth and decay
* impact of moisture on structural components such as walls, floor and roof timbers
* structural issues arising from the introduction of energy efficiency measures, such as solar panels
* performance gap and failure to achieve predicted carbon and financial savings
* reduced access to services
* under or over performance of building services
* impact on fire safety
* poor interaction with other energy efficiency measures
* poor resilience to the impacts of current and future natural hazards including extreme weather events, wind driven rain, flooding and overheating
* impaired financial value
* increased maintenance liability

K20. how and when to mitigate the risks including:

* adopt whole building approach
* concentrate on the interfaces
* risk management
* good communication between project managers, energy assessors, building control bodies, planning and conservation officers, building professionals, installers, and people who use and manage the building
* setting objectives and developing an improvement plan
* qualifications, knowledge and skills of the professional team
* vocational competence of installers and requisite certification schemes
* good design detailing
* planning
  + quality control during construction
  + testing and commissioning
  + handover advice to occupants
  + ongoing monitoring and evaluation
  + future maintenance of the building and energy efficiency measures
* seeking specialist advice when needed

**P6. BUILDING PERFORMANCE MODELLING AND EVALUATION TECHNIQUES**

K21. the development, use and limitations of energy modelling and evaluation tools for older and traditional buildings

K22. the impact of using input assumptions, default recommendations and U-values on the energy efficiency rating and recommended energy efficiency measures

K23. U-values, their sources and how they are calculated

K24 how and why Psi-values are used

K25. in what circumstances calculated or in–situ measured U-values should be used and the issues to be aware of, including the documentary evidence required

K26. how to estimate the financial cost and payback of proposed energy efficiency measures for buildings

K27. the range of thermal and moisture models, how they compare, their uses and limitations

K28. how and why hygrothermal modelling is used

K29. the range of calculations, testing and investigation techniques for assessing thermal and moisture risks, including:

* assessing the risk of surface and interstitial condensation
* calculation of overall heat gains
* assessment of ventilation
* calculation of the whole building ventilation rate
* heat transfer coefficient
* assessing the airtightness and air leakage paths of a building envelope by fan pressurisation testing
* infrared thermography to show variation in surface temperature in elements or the building envelope as an indicator of condition and to identify heat loss, heat gain, moisture, voids, defects, different materials
* monitoring internal relative humidity and indoor air quality using sensors and loggers
* overheating risk assessment
* psi value calculations

**P7. EVALUATE THE OPTIONS**

K30. when and how proposed energy efficiency measures need to be adapted due to existing building structure, detailing and services, the heritage values and significance of buildings or technical risks

K31. when and how adaptations are required to existing building detailing and services, and when energy efficiency measures cannot be recommended due to these factors

K32. key concepts and how they apply to evaluating the options for the introduction of energy efficiency and ventilation measures including:

* fabric first approach and the potential risks for traditional buildings
* risk based approach
* whole lifecycle analysis
* embodied carbon
* sustainability and carbon footprint of materials

**INSOTV3**

**Title: Advise on energy efficiency measures in older and traditional buildings**

**Overview**

This standard is about selecting energy efficiency measures based on your understanding of older and traditional buildings.

It sets out the skills, knowledge and understanding for you to provide advice on the introduction of the measures and make recommendations based on a whole building approach.

This standard is suitable for those working in the retrofit sector with responsibility for advising on energy efficiency measures in older and traditional buildings.

**Performance criteria**

1. make recommendations and provide advice on introducing energy efficiency measures
2. review a range of information sources and refine the proposed energy efficiency measures for the client or other interested parties
3. prepare reports and plans, including recommendations on the introduction of energy efficiency measures
4. provide advice on the introduction of energy efficiency measures for the client or other interested parties
5. explain the implications of the relevant legal and regulatory requirements for introduction of the energy efficiency measures to the client or other interested parties
6. provide a rationale for the recommended energy efficiency measures
7. explain the requirements for the delivery of energy efficiency measures in a retrofit project to the client or other interested parties

**Knowledge and understanding**

**P1. MAKE RECOMMENDATIONS AND GIVE ADVICE**

K1. the principles to follow in the whole building approach including:

* understanding the whole building approach
* understanding the building and its context
* understanding the safety of the occupant of the building
* engaging building users, owners and managers
* reducing demand on energy using systems
* avoiding waste
* increasing efficiency
* improving controls
* using lower carbon energy supplies
* avoiding complication
* managing the risks of unintended consequences
* reviewing outcomes

K2. when and how performance gaps occur when reductions in fuel use, fuel cost and carbon dioxide emissions are not as large as intended or predicted including:

* incorrect assumptions about the thermal performance of existing buildings
* inaccuracies in the data and models used to predict energy performance
* inadequate design and specification of improvements
* poor installation, integration and commissioning of improvements
* ineffective or confusing control systems and poor management
* ineffective handover
* changes in building occupancy or patterns of use following installation of energy efficiency measures
* occupant behaviour, comfort taking and the rebound effect
* poor maintenance of a building and building services

K3. the reasons for improving the energy efficiency of a traditional building including:

* reductions in energy use
* reductions in energy costs and alleviation of fuel poverty
* reductions in emissions associated with energy use
* improvement in internal comfort
* improvements in indoor air quality
* elimination of condensation, damp and mould
* reducing the risk of overheating
* improvement in energy rating
* meeting a performance standard
* improving the usefulness or sustainability of the building, protecting its embodied carbon
* protecting the building against decay or deterioration
* improving the management of moisture within the building
* improving resilience against flood risk and other current or future climate risks
* protection or enhancement of architectural heritage
* integration of energy efficiency measures with other improvements, such as building fit-out for new tenants

K4. how and why it is necessary to establish the intended outcomes

**P2. REVIEW AND REFINE PROPOSED ENERGY EFFICIENCY MEASURES**

K5. sources of information relating to specific buildings including:

* energy performance certificates
* condition surveys
* reports and surveys on energy performance and moisture risk
* measured surveys
* site visit
* communication with owner and occupants
* heat loss survey
* information on significance and heritage value
* planning history

K6. what factors to consider when reviewing the recommendations for energy efficiency measures including:

* an understanding of the building and its context
* the range of options available and suitable for the building
* the effectiveness and value for money of measures to improve energy performance
* the repairs and enabling works needed prior to installation of the measures
* occupant behaviour
* maintenance requirements post-installation

K7. how to use a range of information sources to undertake a risk assessment for the proposed energy efficiency measures

K8. how to undertake an assessment of significance and heritage impact, and prepare a heritage impact statement for traditional and protected buildings

K9. when and why further information sources, testing and investigations should be used

**P3. PREPARE REPORTS AND PLANS**

K10. why and how to prioritise energy efficiency measures in a staged approach

K11. factors to consider in relation to sequencing when installing energy efficiency measures in a staged approach including:

* quick wins focusing on low cost, low risk measures and changes to occupant behaviour and building management
* recommended energy efficiency measures
* advice on the order of their implementation
* advice on critical interactions between measures
* need for preparatory work, including building repairs and moving services
* measures which are best installed together
* how the installation of some measures may preclude the later installation of other measures or make subsequent installation more difficult
* any risks introduced pending the installation of measures to be included at a later stage and their potential mitigation

K12. how the present and future impacts of climate change, and the need for climate change adaptation and resilience can affect the options for the introduction of energy performance measures

K13. common repairs and enabling works required before installing energy efficiency measures

K14. common occasional, regular or cyclical maintenance tasks which help to maximise the thermal performance of the building

K15. the role and benefits of maintenance checklists and plans

**P4. LEGAL AND REGULATORY REQUIREMENTS**

K16. how and when it is necessary to obtain legal and regulatory permissions relating to planning and heritage protection, and the national building regulations

**P5. RATIONALE FOR RECOMMENDATIONS**

K17. how and why it is necessary to be able to provide a rationale for the recommended selection of energy efficiency measures

K18. factors to explain when providing a rationale for the recommended energy efficiency measures including:

* when and why proposed energy efficiency measures have been selected that do not meet or exceed targets set by regulations and standards, including national building regulations
* when and why certain energy efficiency measures have or have not been selected
* when and why specific design, installation or operational features are used to minimise the impact of the chosen energy efficiency measures on the building
* sources of further guidance for the consumer

**P6. REQUIREMENTS FOR THE DELIVERY OF ENERGY EFFICIENCY MEASURES**

K19. how and why it is important to explain what is required to deliver the installation of the energy efficiency measures including:

* the packaging and sequencing of measures
* any repairs, enabling works or adaptations needed
* any legal or regulatory permissions needed
* protection works required to the building and its features
* site issues, access and temporary works
* fire safety and health and safety issues, including risk assessments
* ensuring work is undertaken in accordance with the design and specification
* level of disruption to the occupant
* timelines
* time of year
* occupant communications strategy

K20. how and why it is important to explain the roles and responsibilities in a retrofit project including:

* range of roles, including retrofit assessor, retrofit coordinator, retrofit designer, retrofit evaluator, main contractor, retrofit installer
* qualifications, knowledge and skills of the professional team
* vocational competence of installers and requisite certification schemes

K21. how and why it is important to explain the following common stages in a retrofit project to the building owner or occupier:

* preliminary considerations
* project inception
* building assessment
* significance assessment
* improvement option evaluation
* agreement of intended outcomes
* medium-term improvement plan
* design and specification
* statutory approvals
* pre-installation building inspection
* repairs, enabling works, installation and quality control
* test, commission and handover
* evaluation, ongoing monitoring and fine-tuning
* future maintenance of the building and energy efficiency measures

K22. how and why it is important to explain the soft landings strategy to ensure problems from the transition from construction to occupation are minimised and that operational performance is optimised