EPIC
ENGINEERED PANELS IN CONSTRUCTION

Insulated panels for external roof and wall cladding

A guide to fire safety, specification and installation

Foreword

Insulated panels are used extensively for the external roof and wall cladding of buildings in most construction sectors. They are selected for their thermal and energy saving properties and their construction and installation benefits. Insulated panels are single piece factory engineered units comprising two metal faces and a fully insulating core. The core is with few exceptions either polyurethane/polyisocyanurate or mineral fibre.

The performance in fire of insulated panels has only recently been analysed in depth. In particular studies have highlighted the differences in design, materials and method of fixing between external roof and wall panels and other sandwich type panels designed specifically for internal applications.

External roof and wall panels are uniquely designed for the external envelope and are securely fixed to the main building structure. They perform totally differently in fire compared to free standing internal systems. This is born out by large scale tests and real fire scenarios. Studies have also shown that rarely have external roof and wall panels been involved in the initial stages of a fire, only becoming involved as a result of a fully developed fire.

The Guide has been prepared to provide comprehensive information on the fire performance, specification and installation of external roof and wall panels.

New fire classifications

New European harmonised fire tests and classifications were agreed in 2001. These will be gradually adopted in England, Wales and Northern Ireland and in Scotland from 2002 replacing the current BS 476 requirements. There will be a transition period before the substitution of the relevant parts of BS 476 by the harmonised classes.

The Guide describes the new European classifications and illustrates their relationship to the current requirements.

Download EPIC information from the website
This guide to Fire Safety, Specification and Installation, together with other guides, can readily be downloaded from the EPIC website at www.epic.uk.com

New thermal performance requirements

In addition to the requirements for fire performance, specifiers and designers must also take into account the new thermal transmission and airtightness regulations for the external roof and wall systems of buildings [Amendment to Building Regulations: Approved Document L2: 2002 [1]]; and in Scotland the new thermal transmission requirements in the 6th Amendment to the Technical Standards Part D.

The Guide illustrates that the latest junction details, which have been designed to meet these Regulations, can readily be combined with good fire engineering practice.

The guide

The guide is effectively divided into two parts.

Sections 1 to 8 review the history of insulated panels; their performance in fire; and the regulatory requirements for external cladding and roofing in England, Wales and Northern Ireland and also in Scotland. Additional fire precautions that may be desirable to minimise property damage and business interruption are also covered together with an overview of fire safety engineering techniques and how they may be applied to assess the impact of materials used in the external building envelope.

In the second part, Sections 10 to 13 consider the practical issues affecting panel specification, design and installation from a fire performance viewpoint. Checklists have also been added to assist designers and installers, including recommended information sheets for inclusion in the CDM health and safety file.

A substantial number of major fires can be attributed to the poor management of fire safety both during construction and maintenance operations and as part of the day-to-day operation of the building. An additional Appendix provides guidance on the fire safety procedures that are appropriate where construction work is involved or is carried out in the proximity of insulated panels. This Appendix refers equally to all forms of roof and wall cladding and not specifically to insulated panels.

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General information and regulatory requirements

Practical design issues

Introduction

This guide is designed to give a clear understanding of how insulated panels work as the external envelope of a modern building by combining the requirements for fire performance with thermal performance.

1.1 Insulated panels

The guide covers the installation and fire performance of insulating panels used to clad the roofs and external walls of buildings. These have variously been called sandwich panels, composite panels, insulated panels, factory-engineered panels etc. The term insulated panel has been used throughout the guide as their primary function is as an energy saving construction element.

Nevertheless, it is the 'sandwich nature', in which two metal facings are bonded either side of a core insulating material, which gives the panels their excellent strength and mechanical properties and improves their fire performance.

1.2 External cladding

The term 'external' is emphasised throughout. This is to separate clearly external and internal systems and applications. Lack of differentiation between the two types of panel over the last decade has lead to some confusion regarding the very different performance in practice, particularly their fire performance.

External insulated panels have been specifically designed to fabricate the external envelope of buildings. They are required to absorb the considerable forces – wind, snow, static loads etc – to which the roofs and walls of buildings are subject and to transmit those forces to the supporting structure. They are also required to be weather tight and control energy loss through air tightness at the joints. As a result the method of fixing needs to be strong and the joint design robust and effective.

Internal sandwich panels on the other hand are generally structurally weaker systems designed for ease of installation / demountability and to satisfy the thermal insulation and hygiene demands of the cold store and food processing industries. There have been a number of high profile fires involving this internal type of system and the potential weaknesses and corrective design solutions are well documented.

1.3 Historical development of insulated panels

1.3.1. Early insulated cladding systems

The initial lightweight cladding systems that evolved in the 1950's and are still used for some applications, are constructed from a number of separate elements as a site-assembled system.

Built-up or site-assembled systems comprise an external profiled weather sheet, internal lining, spacers, fixings and an insulation layer of low-density glass-fibre quilt (9-12kg/m^3) Fig. 1.

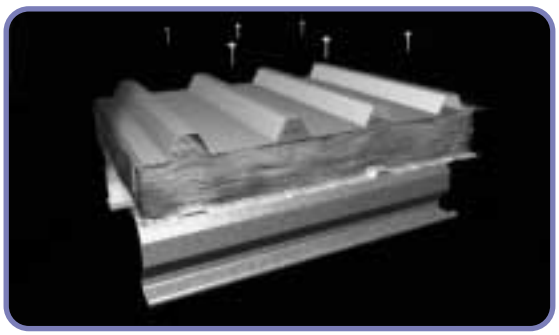

Figure 1. Site assembled built-up systems

Latterly higher density mineral fibre [MF] quilt (25kg/m^3) has been increasingly used especially with standing seam roof constructions to produce improved performance specifications. High density MF bats of up to 150kg/m^3 have been used for wall applications requiring a high degree of fire resistance.

In the mid 1980's site-assembled constructions made up approximately 90% of all metal cladding systems.

Fire performance – site assembled systems.

These systems have generally been regarded with minimal concern due to the relatively low organic content (limited combustibility) of the core insulants. However fire stopping in multi-storey applications can be of importance and is a specific requirement of Building Regulations.

1.3.2. Advent of insulated panel systems

Insulated panels have been used as the external roof and walls of buildings in increasing volumes since the early 1980's although their history in use dates back to the late 1960's.

Insulated panels are factory engineered and produced one-piece cladding panels consisting of two metal faces positioned either side of an insulating core which completely fills the space between. The facings are fully bonded to the core so that the panel acts compositely when under load. [Fig. 2].

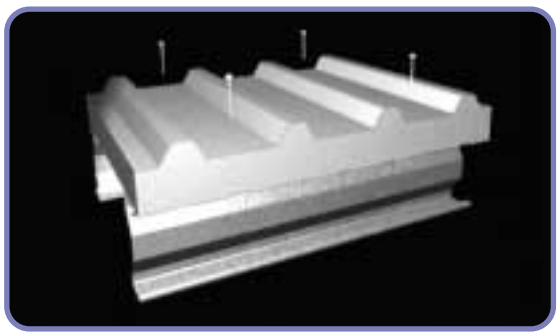

Figure 2. Factory engineered insulation panels

Facings used for insulated panels are predominantly of steel although aluminium can also be used for specific applications. The insulating core is bonded to the facings either auto-adhesively (urethanes) or by a conventional adhesive bond (mineral fibre and polystyrene). Initially all external panels were manufactured with rigid urethane insulating cores [PUR] whereas internal panels, following a separate parallel development, used polystyrene [PS]. The thickness of external panels at this time was 25-30mm compared to the 40-80mm typical of current urethane cored production.

PIR (polyisocyanurate) which is a variation of rigid urethane [section 9] was introduced in the early 1970's offering improved fire performance. These two forms of rigid urethane [PUR & PIR] still account for over 90% of insulated panels used externally and have followed parallel development paths and modifications in design to improve their fire performance.

Mineral fibre cored panels were introduced in the 1990's for applications where enhanced fire performance was required. In 2000, MF panels accounted for about 8% of the external insulated panel market.

Other core materials (polystyrene, phenolic foam and cellular glass) have been used from time to time in the production of insulated panels but their use has largely been restricted to internal applications. Polystyrene has been incorporated in some architectural wall panels but volumes with this insulation are very low. PUR and MF have now largely replaced this core material for external applications.

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1.4 History of fire performance – insulated panels

Insulated panels, the majority with rigid urethane cores, have been use for over 30 years with an exemplary record (in fire terms) as the external roof and wall cladding of buildings.

Analysis of the collated information indicates:

There are no recorded incidents where external insulated panels have caused or have been involved in the initial stages of a fire.

External roof and wall insulated panels have only become involved when an already established internal fire has reached a fully developed stage;

- During the development stage any involvement of the fire load from external insulated panels is gradual and does not provide an immediate and total contribution to the fire development.
- Due to the method of external fixing and engineered joint designs, insulated panels forming the external envelope retain their structural integrity until the structural support is compromised or fails.

Correctly engineered insulated panel systems with rigid urethane or mineral wool cores and designed for the external envelopes of buildings have performed well and should not be a major cause for concern in fires.

Further information on the performance in fire of external insulated panels and the results from large scale fire tests are given in section 9.

1.5 Specification

Buildings are becoming increasingly complex. The range of materials and components are more extensive, with greater opportunity for architectural expression using modern materials such as insulated panels. Latest designs often require a greater degree of flexibility to accommodate change of layout, information technology, product and system changes etc. Speed of installation is of particular importance in many applications.

Insulated panels and systems are required to be multifunctional. They need to satisfy a variety of factors including speed of construction, cost, ease of installation as well as meeting the new energy efficiency regulations and other technical requirements including fire.

The building designer is faced with a number of specification considerations encompassing a wide range of practical, commercial, technical and aesthetic factors of which fire is but one. These choices can be classified under the headings of 'regulatory' or 'general design/construction'.

The weightings given to different design issues will be influenced by many factors and will vary according to statutory requirements and the objectives of the client and the designer. Most of the specification choices directly influence cost, construction speed, and the cost in life/energy performance of the building.

Fire safety and fire performance may be subject to regulatory requirements. Generally the current range of commercially available insulated panels with rigid urethane or mineral fibre cores, when correctly designed and installed, should meet the present building regulations requirements [Section 2].

Insulated panels are suitable for a wide range of building applications. However like all cladding systems rarely will a single product provide the best performance for all design requirements and it is necessary to consider the optimum balance of properties for the particular building. In fire safety terms a cladding system that is more than adequate for a typical single storey storage building may be unsuitable for a high rise hospital where evacuation is impractical and staff and patients will need to remain in the building during a fire.

Specification factors for insulated panels used for external roof and wall cladding.

Energy: Regulatory requirement – Building Regulations – Approved Document L2: 2002 edition
~ Energy performance of fabric [new insulation levels]
~ Energy control of fabric [new recommended levels for air tightness – England & Wales]

Cost

Aesthetics

Buildability

Speed of installation

Durability and life cycle

Weight

Fire: Reaction to fire
Fire resistance
[see sections 3 and 4]

Acoustics

Environmental

Health and safety

Specific requirements from client; insurance industry etc.

2 Statutory Requirements

In the United Kingdom fire safety in buildings is controlled under various statutory instruments. The main requirements arise from:

a) Building Regulations:
   (i) England and Wales – The Building Regulations 2000 [2]
   (ii) Scotland – The Building Standards (Scotland) Regulations 1990 (as amended) [3]
   (iii) Northern Ireland – The Building Regulations (Northern Ireland) 1994 [4]

b) Fire precautions Act 1971 (as amended)

c) Fire Precautions (Workplace) Regulations 1997 (as amended 1999)

d) Construction (Design and Management) Regulations 1994

2.1 Building regulations

The Building Regulations apply to the design and construction of new buildings and also to existing buildings if a material alteration or material change of use is being made. It is the building regulations that are likely to have the main impact on the required fire performance of external cladding systems.

England and Wales, Scotland and Northern Ireland each have their own building regulations and each country has its own set of guidance documents for fire safety. It is important to recognise that the guidance applicable in Scotland can be significantly different to that applicable in England and Wales or Northern Ireland. Guidance on the building regulations applicable in England and Wales and Northern Ireland is given in section 3 and Scotland in section 4.

2.2 Fire precautions legislation

The Fire Precautions Act and Fire Precautions (Workplace) Regulations are primarily intended to ensure that an acceptable level of safety is achieved during occupation of the building. Generally this legislation will not have a direct effect upon the design of the structure or the specification of external cladding systems.

The Fire Precautions Act contains a statutory bar that prevents additional structural measures being required if the building has been previously approved under building regulations. Therefore this act is likely to have little impact on the specification of the external cladding.

The Fire Precautions (Workplace) Regulations (FPW) require that a risk assessment be carried out to identify any potential fire hazards in a workplace and to evaluate the risks to employees. Employers are required to take steps to reduce any unacceptable risks. Construction materials complying with current building regulations would normally be acceptable but there may be circumstances where additional fire precautions are appropriate (e.g. during maintenance procedures).

2.3 Construction (Design and Management) Regulations

The Construction (Design and Management) Regulations 1994 (CDM) relate to all aspects of construction and affect all those concerned in the construction process. The CDM regulations impose specific obligations on designers to consider matters relating to safety during construction and subsequent maintenance of the completed building.

The FPW and CDM regulations require that any foreseeable risks associated with the construction and the continuing operation of a building are identified and effectively managed and controlled. Guidance on appropriate management procedures, which is appropriate to all types of building systems not just buildings with sandwich panels, is given in the appendix.