

FIRE SERVICES EXAMINATIONS BOARD

STUDY NOTE

EXAMINATION	STATION OFFICERS' EXAMINATION
PAPER	OPERATIONS
SUBJECT	FIREFIGHTING AND RESCUE INCIDENTS
ITEM	SANDWICH PANELS
STUDY NOTE No.	3105

INTRODUCTION TO THE STUDY NOTE

This study note has been prepared as the basis of study in connection with the qualifying examinations for promotion.

Candidates will be expected to demonstrate knowledge of the information contained in the study note and understand how it should be applied:

The 'References' made at the end of the Study Note are included for information only and candidates will not be expected to study these as part of the bibliography.

FIRES INVOLVING SANDWICH PANELS

1. Introduction

It is generally recognised that fires in buildings containing insulating core panels, commonly referred to as 'sandwich panels', present a special problem to the safety of fire crews dealing with them.

This study note is an introduction to the use of these panels and the precautions that should be considered when fighting fires in existing buildings that may contain them.

2. The Use of Sandwich Panels

Sandwich panels are building elements, which comprise of an insulating core within an outer skin.

They are used for both the outer envelope of lightweight buildings, or to create partitions within a building.

The most common use of insulating core panels when used for internal structures, is to provide an enclosure in which a chilled or sub-zero environment can be generated for the production, preservation, storage and distribution of perishable foodstuffs.

Here the outer skins are often coated to provide a food safe surface that can be frequently washed down with water sprays.

This type of construction is also used in many other applications, particularly where the maintenance of a hygienic environment is essential.

A second hand market also exists for the panels and accordingly they could be found almost anywhere.

The panels can and are used to recreate the interior layout of existing buildings.

The partition ceilings formed by the use of such panels may create large undivided roof voids, which are sometimes used to house machinery and plant such as ventilation equipment.

3. The Construction of Sandwich Panels

These panels typically consist of an inner core sandwiched between, and bonded to, a membrane such as facing sheets of galvanized steel, often with a PVC facing for hygiene purposes. The panels are then formed into a structure by jointing systems, usually designed to provide an insulating and hygienic performance. The panel structure can be free standing, but is usually attached to the building structure by lightweight fixings and hangers.

The most common forms of insulation in present use are:

(a) Expanded Polystyrene

A thermoplastic material made from the styrene monomer expanded to form a cellular structure; typically pure white in colour, it softens and melts on heating often before ignition.

(b) Extruded Polystyrene

Extruded polystyrene foam is typically blue in colour.

(c) Polyurethane

A thermosetting material made by mixing two components, typically yellowish/brownish/pinkish in colour, which will char on heating and could undergo flaming combustion if sufficiently heated.

(d) Mineral Fibre (MRf).

A non-combustible fibrous material.

There are other types of filling that appear to be less common such as polyisocyanurate and phenolic composite foams. Glass fibre is also used as an insulation material.

The generic term 'sandwich panel' is mostly used to refer to those composite panels, which are assembled in a factory although those that are assembled or finished on site may have very similar characteristics and which, may typically be one metre wide and may be over ten metres long.

The cores are generally 50mm to 200mm thick.

4. Fire Behaviour of Core Materials and Systems

The behaviour of these panel systems, when involved in fire differs in important respects from other construction systems. The nature of this behaviour and the implications for firefighters must be taken into account at the earliest opportunity.

(a) Core Materials

Irrespective of the type of core material, the majority of panels (unless provided with appropriate mechanical fixings between the facings) will when exposed to the high temperatures of a developed fire, tend to delaminate between the facings and core material. This is due to a combination of expansion of the membrane and softening of the bond-line.

In addition, the degradation of polymeric materials can be expected when subjected to radiated/conducted heat from a fire. This is likely to result in fire-spread within the panel and in the production of large quantities of smoke, before delamination has occurred. The delamination of polymeric-cored panels can also add to rapid fire-spread and lead **to flashover** conditions.

(b) Fixing Systems

Once it is involved, either directly or indirectly in a fire, it can be anticipated that the panel will have lost most of its **structural integrity**. The stability of the system will then depend on the residual structural strength of the non-exposed facing, the joint between panels and the fixing system. If the ceilings of these systems are being used to carry loads such as refrigeration or air-conditioning plant the hazard caused by the collapse of the panel system will be further exacerbated.

Most jointing or fixing, elements for these systems have an extremely limited structural integrity performance in fire conditions. If the fire starts to heat up the support fixings or structure to which they are attached, then there is a real chance of total collapse of the panel system.

(c) General

The nature of these panel systems means that fire can spread behind the panels, hidden from view. The panels and fixing systems are, therefore, susceptible to the effect of fire from a number of directions, by means of conduction, convection and radiated heat.

Whilst it is recognised that the potential for problems in fires involving mineral fibre cores is less than those for the polymeric materials, the potential hazards caused by the collapse of the system, and hidden fire-spread, are common to all panels irrespective of the type of core.

5. The Hazards for Firefighters

Research indicates that the additional hazards to the life safety of firefighters dealing with fires in buildings constructed or separated using sandwich panels can be categorised as:

- (a) The rapidity of fire spread;
- (b) Rapid collapse of internal structures; and
- (c) Smoke inhalation.

6. Rapidity of Fire Spread

The danger to the general public or to workers in factories containing sandwich panels may not be any greater than from other combustibles on the premises, however there is an unusual risk to firefighters who may have to enter such buildings when a fire is in progress and developing.

A fire in a building containing sandwich panels can spread rapidly and grow due to:

- (a) The properties of the combustible material of the core;
- (b) The lack of cavity barriers to prevent the fire from travelling along the inner core of the panel unnoticed;
- (c) Large undivided voids such as in roofs; and
- (d) The metal facing of the panel preventing the penetration of water to extinguish the burning central core.

This rapid spread of fire can change the circumstances in the building with such speed that firefighters inside may be unaware of what is happening around them.

Although sandwich panels may be present as part of the external cladding of a building, it is fires involving sandwich panels used as internal partitions that generally result in rapidly developing fires in hidden cavities. Such fires are amongst the most difficult to extinguish.

7. Rapid Collapse of Internal Structures

Many of the buildings using this kind of partition are of large volume with high roofs that are difficult to ventilate.

The effects of a fire can cause panels, even those with non-combustible cores, to delaminate, ie the other skin or skins separates from the central core, and as a consequence the structural integrity of the panel is compromised.

In addition, the effects of a fire can cause the failure of the joints between the panels with similar consequences. It should be noted that it is at present an accepted practice for roofs to merely rest on the walls, relying on the weight of plant to provide the inertia. A suitable analogy may be that of a "house of cards".

In either or both of these circumstances the structural failure of internal walls and ceilings can lead to the rapid collapse of the building, jeopardising the safety of firefighters through injury from falling debris or the resultant fire spread cutting off their lines of retreat.

8. Smoke Inhalation

The materials used in the central core of sandwich panels can generate unusually large quantities of acrid smoke. The hazards from this are not only to firefighters in close proximity or inside the building but also to those much further away who would normally be considered to be in safe locations.

The difficulty of cutting through this type of panel to ventilate the smoke and fumes exacerbates the situation.

9. Firefighting

Fires involving sandwich panels present a special problem to the crews attending. The special problem relates primarily to the speed of development and spread of a fire and the general build-up of dangerous conditions.

This means that the Officer in charge must react more quickly, must be more responsive to new information and evidence of changing conditions, and needs to consider operational priorities of crew safety.

Considerations will need to be:

- (a) Are teams to be committed internally? If so, why?
- (b) Will it be necessary to withdraw teams or call for more resources earlier, possibly before the real need is apparent?

In attending such a fire the Officer in Charge should pay particular regard to:

- (a) Recognising that sandwich panels are present and the hazard they present.
- (b) Issues for Dynamic Risk Assessment.
- (c) Obtaining information from the site manager etc.
- (d) Communicating the hazard information to crews.
- (e) The maintenance of the health and safety of crews and the possible deployment of safety officers.
- (f) The possible need of further resources and that they may be needed at an early stage.
- (g) Predicting imminent collapse.
- (h) Considering the possible need to change firefighting tactics from offensive to defensive.
- (i) Difficulties of ventilation.
- (j) The environmental issues.
- (k) The availability of special equipment to cut through the panels and the use of special techniques to aid ventilation etc.

10. Operational Planning

In addition to the general brigade policy regarding preplanning, regard should be had for the special hazards presented by buildings containing sandwich boards.

Operational plans should be adapted to include:

- (a) Increasing the number of pumps on the PDA due to the potential for rapid fire spread: past experience indicates that incidents will require significant resources over extended periods, thereby presenting serious demands on brigade resources in terms of personnel, appliances and equipment.
- (b) Measures to account for environmental issues should they arise: these need to pre-empt the potential implications of large quantities of smoke and run-off water leaving the site boundary.
- (c) The location of special equipment that may be required and personnel trained in its use: particular attention needs to be concentrated on the difficulties of gaining access, eg to roof voids, due to their height.
- (d) Interagency co-operation.

10. Training

Fire crews who are likely to encounter buildings containing sandwich panels should be fully informed of the hazards that they pose.

The training should include:

- (a) Information on 'sandwich panels'.
- (b) How they behave in fire.
- (c) The special hazards they present.
- (d) How to recognise imminent collapse and other hazards that are likely to occur.
- (e) How to recognise the signs and labels from industry schemes that are used to mark sites using 'sandwich panels'.
- (f) Environmental dangers.

References

Dear Chief fire Officer Letter 15/1999