APPROVED DOCUMENT B – will it stop early collapse of combustible sandwich panels?

A view by Dr Gordon Cooke, International Fire Safety Consultant, Visiting Professor, Department of Civil Engineering, City University, London

THE revisions to the 1992 edition of Approved Document B which have recently been through the public consultation process include a new item which deals with insulated sandwich panels used as walls or ceilings. The guidance states:

Insulating sandwich panels

6.1.6 The following guidance applies to wall and ceiling panels made by bonding a thermoplastic foam core to metal, grp, or other facings skins, where the mechanical strength of the panel is largely dependent on the core and its bond to the skins. If heated in a fire the thermoplastics in common use may melt so that the strength of the panel is rapidly lost.

6.1.7 Panels of the sort described in 6.1.6 should not be used as suspended ceilings other than in refrigerated rooms in Purpose Group 6 or 7 buildings.

When you consider the definitions of thermoplastic and Purpose Groups 6 and 7 the guidance is in effect stating that sandwich panels made by bonding a foamed polystyrene core to the facings may only be used as ceilings in refrigerated rooms in industrial and storage buildings. This recognises the hazard to life, especially to fire-fighters, of foamed polystyrene (expanded or extruded) which among other things melts, forms flaming droplets (a mechanism for further fire spread) and produces large amounts of smoke and toxic products of combustion. It also recognises the current practice of using foamed polystyrene in applications such as freezer rooms where the very high levels of thermal insulation needed can only be met economically with foamed polystyrene.

So far so good. But have the problems associated with sandwich panels been fully addressed?

Consider the background. Apart from the large financial loss and business interruption which was being caused by an increasing number of fires in buildings containing sandwich panels with combustible cores, the danger of unexpected early collapse of combustible lightweight insulated sandwich panels was focused following the fire in 1993 in the Sun Valley Poultry Ltd. chicken processing building said to contain 930m^3 of polystyrene foam and 490m^3 polyurethane foam according to the chief fire officer, Mr D. O'Dwyer. The hazard of sandwich panels had however been recognised in 1969 in the Annual Report of the director of the Borehamwood Fire Research Station, and in a BRE Information Paper (IP4/87) in 1987 in which I pointed out the hazard of falling panel facings. Following the Sun Valley fire, the Home Office Fire Research and Development Group (FRDG) sponsored some research into the fire safety of lightweight insulated sandwich panels, and a summary is available (Fire Safety of Sandwich Panels, Research Report No.76, FRDG, Home Office, 1997).

The proposed guidance in the Approved Document will not guard against a recurrence of the Sun Valley fire scenario. The reason is that the adhesive normally used for bonding metal facings to the core material has a low softening point, usually not much above 150°C. This softening point is reached early in a developing fire and the panel then loses its flexural strength and may, when used as a ceiling, delaminate and fall down. The hazard of collapsing facings and core material can be avoided by providing horizontal restraint to the ends of the upper and lower facings so that catenary forces are developed when the panel loses its flexural strength and begins to sag. To transmit the catenary force in the facings it is necessary to use a mechanical fastening system which does not fail in tension in the early stages of fire development when the catenary force is at its maximum value.

The problem of early collapse of bonded lightweight sandwich panels not only applies to core materials of foamed polystyrene but others as well. Foamed polyurethane, foamed polyisocyanurate, and non-combustible rockwool are often used as the core material in sandwich panels in a variety of buildings, including food processing and storage rooms which are not operating at the very low temperatures, e.g. minus 18°C, experienced in freezers. Phenolic foam and foamed glass are sometimes used as core materials in similar applications. If combustible cored panels are not to add significantly to the fire load of the building and also contribute to the production of smoke and toxic gases early in a fire, it is of the utmost importance that they are not allowed to collapse early in a fire. I have shown by calculation elsewhere (Building Engineer, July 1997, pp14-29) that the fire load of these panels can easily exceed 30 per cent of the fire load of the contents of the building. Most fire safety engineers and scientists will agree that most combustible foamed plastic materials have poor reaction to fire properties and have the potential to produce large amounts of heat and dense smoke, depending on the insulation and

integrity of the panel facings.

The pro-plastics lobby may say that smoke is not an issue because the smoke produced by decomposition of the panel core can safely escape to the outside air. A risk assessment may, in some cases, show that plastic foam cored panels can be used in the external wall or roof situation without causing an unacceptable risk to life or property, but when used as internal partitions and ceilings the smoke will, if we accept the manufacturers' hypothesis, unfortunately invade the rest of the building making the job of fire-fighting more difficult and dangerous and adding to the fire loss by smoke and heat damage. This criticism of course would not apply to panels with non-combustible cores such as rock wool. This emphasises the absolute necessity of ensuring that bonded sandwich panels do not delaminate and collapse unexpectedly early in a fire. This problem is not addressed in the Approved Document B life safety guidance. It is of course difficult to draft acceptable guidance in the face of strong commercial pressure to retain the status quo. The lack of sufficient staff in the fire section of the DETR Building Regulations Division does not help when it comes to the difficult job of obtaining a consensus view on a wide range of important fire topics and drafting guidance documents.

I am a member of the DETR Fire Advisory Panel which advises BRAC which in turn advises the Secretary of State for England and Wales on the making of building regulations and official guidance. I am also a member of the working group currently preparing the LPC code of practice for fire safety in the food and drink industry. This code deals with food processing and storage buildings and is intended to apply to new buildings and refurbished buildings where it is practical and cost effective to carry out the refurbishment. It relies on a property risk assessment approach and quite properly leaves Approved Document B to cover life safety aspects. In both arenas I have tried to focus the attention of co-members on the structural problems associated with bonded sandwich panels, especially when used as ceilings, and offered rational fire engineering solutions. It remains to be seen if the various guidance documents, when they eventually emerge, will adequately deal with this aspect.

The Approved Document B guidance ought to require that bonded sandwich panels used as ceilings in **any** building should have their ends adequately restrained to prevent collapse. In the case of panels with combustible cores the guidance should emphasise the importance of retaining good fire integrity at panel joints so that the core material is starved of oxygen and its contribution to the fire is delayed for as long as possible.

It is interesting to note that the proposed CEN standards for fire resistance do not cover bonded sandwich panels used as non-load bearing internal walls or ceilings which rely on suspension techniques for their stability and integrity. Although this article focuses on sandwich panel ceilings it should be noted that suspension techniques may be necessary where a wall panel is considerably higher than the height of the panel subjected to the fire resistance test, the latter usually being three metres in a fire resistance test. As already mentioned suspension techniques may be the only way of preventing a bonded sandwich panel from collapsing early in fire, irrespective of the height or span of the panels.

The fourth draft of a guidance document for the preparation of standards describing the methodology involved in extending the application of fire resistance test results on individual elements has been prepared for Ad Hoc 20 of CEN TC127. It does not at present give guidance on ceilings and internal walls which rely on suspension techniques, but it is to be hoped that this omission will be corrected in due course.

However, even if the European and British fire resistance test standards dealt adequately with bonded sandwich panels which relied on suspension techniques for their stability and integrity there would be many buildings where fire resistance was not a requirement but where early collapse could nonetheless occur, providing a hazard to fire-fighters. Surely this situation must be prevented by a redraft of the Approved Document B guidance.