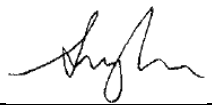
Indicative hoarding fire experiment

Prepared for: London Fire Brigade

21 May 2014

Client report number 292366

Prepared on behalf of BRE Fire and Security by

Name	Dr Sung-Han Koo	Phil Clark	Louise Jackman
Position	Research Manager	Senior Consultant	Principal Consultant
Signature			

Approved on behalf of BRE Fire and Security by

Name	Martin Shipp
Position	Technical Director
Date	21 May 2014
Signature	

BRE Fire and Security
BRE Global
Bucknalls Lane
Watford
Herts
WD25 9XX
Customer Services: 0333 3218811
F + 44 (0) 1923 664994
E enquiries@breglobal.com
www.breglobal.com

Introduction

BRE Global has been in discussions and correspondence with London Fire Brigade regarding a project intended to examine the fire safety issues for occupants and fire fighters as a result of hoarding. BRE Global was commissioned by London Fire Brigade, following acceptance of BRE Proposal 292366 on 27th February 2014, to undertake a demonstration fire experiment to assist with an appraisal of fire risks and the effectiveness of a typical sprinkler in a room containing hoarding materials.

A planning meeting was held at the London Fire Brigade Headquarter on 10th April 2014, attended by:

Mark Andrews and Bob Selby – London Fire Brigade

Steve Mills – National Fire Sprinkler Network

Andy Kelleher – Triangle Fire Systems

Louise Jackman and Sung-Han Koo – BRE Global

Representatives from CFOA, housing associations and other interested parties were invited by London Fire Brigade to observe the demonstration fire experiment and to provide observed hoarding experience.

Project objective

The aim of this demonstration fire was to provide an initial indication of whether or not a sprinkler system is likely to be effective in controlling (or suppressing) a fire in a room involving typical “hoarding” materials.

Methodology

BRE Global provided a 4 m x 4 m x 2.5 m (high) rig constructed of timber frame and plasterboard with a single door opening.

The experimental arrangements were discussed and agreed with the London Fire Brigade and their representative interested parties prior to the fire demonstration.

Contents

The experimental rig was filled with hoarding materials as shown in Figure 1. The contents comprised “household” material sourced by London Fire Brigade and included tables, chairs, cardboard boxes, clothing, papers, books, plastic bags of clean household waste, as well as a TV set.

The hoarding material was provided by London Fire Brigade and installed by them to a level defined in the Clutter Index, i.e. nominally Clutter Index 6 bedroom as shown in Figure 2 and also described in:

http://www.science.smith.edu/departments/PSYCH/rfrost/Hoarding_Images.htm (link provided to BRE Global by the client on 12th September 2013).

The contents of the rooms were not weighed but were video recorded by BRE Global as each item was introduced. The camera was installed next to the door at about 2 m height.

Figure 1 Hoarding material in the experimental rig

Figure 2 Level of hoarding material of Clutter Index 6

Set up and instrumentation

Figure 3 shows the layout of the room and the location of video cameras, thermocouples and sprinklers installed. Four video cameras were installed for the demonstration fire. Camera 1 was installed next to the door at a lower height, around 30 cm from floor. CCTV cameras 2 and 3 were installed at the bottom wall in Figure 3, one observing the side wall sprinkler and the other one observing towards the TV, the ignition source. Camera 4 was installed near the centre of the room under a table looking towards the ignition source. Two thermocouples were installed; one at the ceiling height near the door to the room to measure hot layer gas temperature exiting the compartment and the other adjacent to the side wall sprinkler head to measure the temperature at sprinkler activation.

Two domestic sprinkler heads were fitted in the room. An automatic 68 °C side wall sprinkler head was fitted on the right hand side wall in Figure 3. A sidewall sprinkler was selected as it was considered to represent a practical installation arrangement for a sprinkler in hoarding premises. A second sprinkler head was installed on the ceiling near to the centre of the room but this was fitted with a valve (held closed) so that it could be manually activated in the event that the side wall sprinkler was not effective in suppressing the fire.

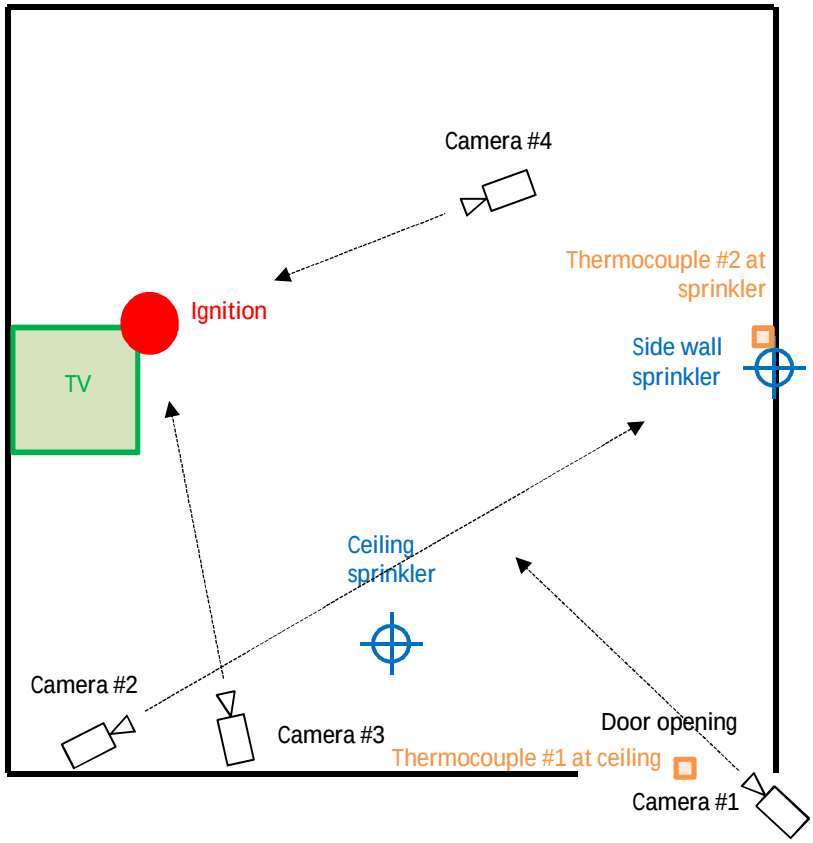


Figure 3 Layout of experiment room instrumentation

Ignition

The ignition source and its location were agreed with the London Fire Brigade. It consisted of a stainless steel wire coiled around a small piece of low density fibreboard wetted with a small amount of Heptane. It was placed near the TV set. Power was applied to the coil using a low voltage power supply which initiated heating in the coil.

Figure 4 Experiment observers

Results

As shown in Figure 4, observers were able to monitor the demonstration via video footage taken by two CCTV cameras in real-time.

The heated coil cause smouldering to occur where it was in contact with the low density fibre board and as the voltage continued to be applied, the heating caused the low density fibre board and heptane to transition to flaming. Once the primary ignition was achieved the fire quickly spread to other items in the vicinity.

The recorded data is provided below.

Figure 5 shows temperature data measured at the ceiling and at a point adjacent to the side wall sprinkler head. From ignition to around 400 seconds, there was no temperature rise measured. During this period a small amount of smoke was observed floating in a thin layer near the top of the room and gradually spilling out from the room. It was noted that while smoke was produced in the early smouldering stage of the ignition, it did not have sufficient momentum to overcome the warm layer at the ceiling and as a consequence the optical smoke detector did not operate, despite smoke clearly being present. At about 464 seconds (7 minutes 44 seconds) from ignition, the optical smoke detector activated and the measured temperature at the sprinkler head and at the ceiling level rose significantly. At 494 seconds, some 30 seconds from smoke detector activation, the side wall sprinkler operated. The temperatures measured at the sprinkler head and at the ceiling were 131.3 °C and 162.4 °C respectively.

The sprinkler was initially operated with a flow of 53 litre/min which corresponds to 3.3 mm/min. At 734 seconds (4 minutes after sprinkler operation) the flow was increased to 57 litre/min which corresponds to 3.6 mm/min.

The operating sprinkler significantly reduced the temperature in the room. Steam and smoke were observed spilling out of the room throughout this period.

At 1,130 seconds from ignition (approximately 10 minutes after sprinkler operation), it was agreed that the sprinkler would be temporarily turned off, to represent a 10 minute duration of available water. As shown in Figure 5, the temperature rose gradually. Consequently, the sprinkler was turned on again 2.5 minutes later, when the temperature decreased to the previous level. While the sprinkler was off much of the cool smoky steam cleared from the room; the gradual increase in the ceiling temperature indicated the potential for further fire development within the room.

To observe the spray characteristics from two operating sprinklers (which shared the water supply), at 1,394 seconds (15 minutes after sprinkler operation), the second sprinkler was manually operated and the total flow was increased to 105 litre/min which corresponds to 7 mm/min.

At about 1,544 seconds (17.5 minutes after sprinkler operation) the sprinklers were turned off. As shown in the figure, the temperature rose slightly. The remaining fire was manually extinguished.

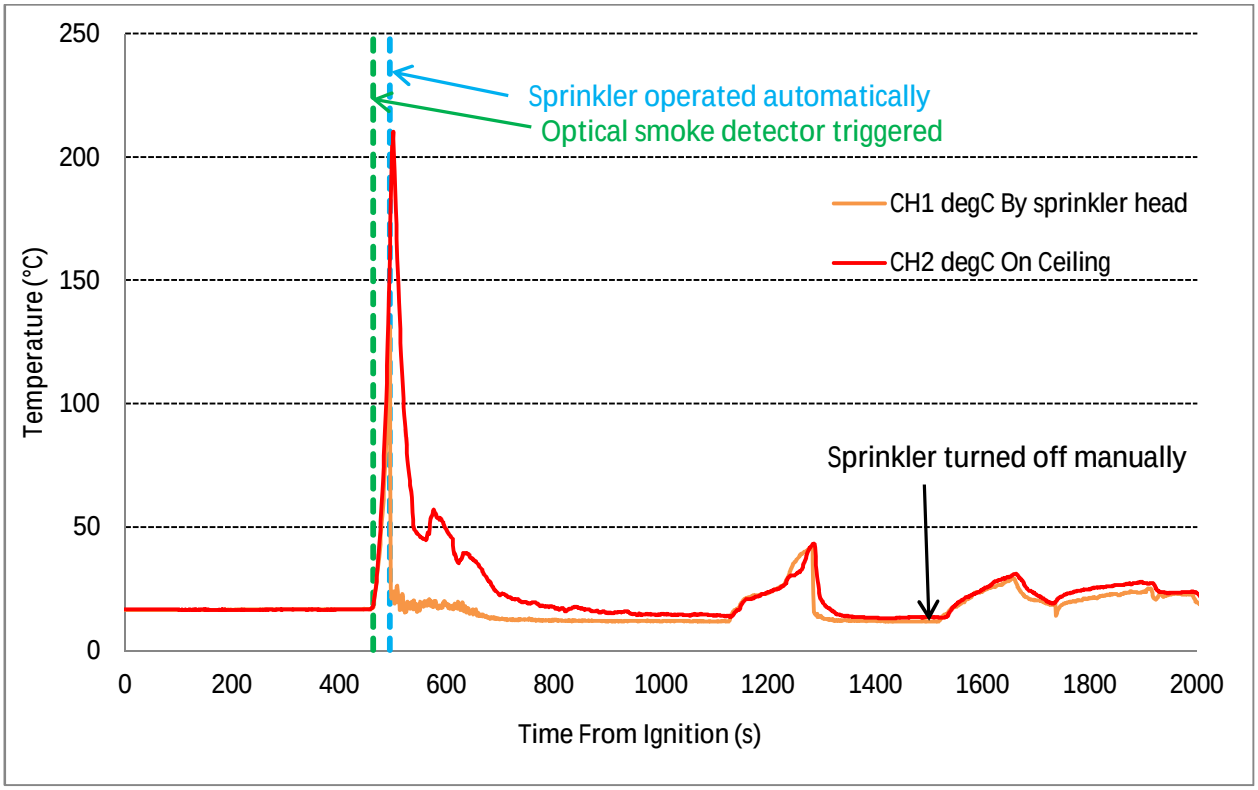


Figure 5 Temperature data measured at sprinkler head and ceiling

Table 1 shows photos taken by two cameras: Camera 1 installed at the door and Camera 4 installed below a table near to the centre of the room, at different stages of fire. At about 406 seconds (6 minutes 46 seconds) to 444 seconds (7 minutes 24 seconds) from ignition, a small flame was observed by both cameras. The flame grew rapidly and, by the time the smoke detector activated, the fire had spread to adjacent materials from the fire source, i.e. a TV. The flame then reached the ceiling and soon after the sprinkler operated. After the sprinkler operation, the flame size has significantly reduced producing lots of smoke.

Table 1 Photos taken from door camera and room camera at 5 different stages

Time from ignition	Door camera	Room camera
0 second Ignition		
406~444 seconds Flame visible from camera angle		
464 seconds Fire detector activated		
494 seconds Sprinkler activated		
514 seconds 10 seconds after sprinkler operation		

Figure 6 shows post-fire damage.

Although the flames were observed to impact the ceiling, the fire did not spread significantly beyond the ignition point before the sprinkler operation occurred.

Figure 6 Post-fire damage

Conclusions

The sprinkler duration and flow rates used in this experiment are considered to be “typical” for a domestic dwelling.

The demonstration fire experiment showed that a sprinkler system is likely to be effective in controlling and suppressing a fire in a room involving typical “hoarding” materials.

However, the fire did grow again when the water supply was stopped after 10 minutes. If sprinklers are to be used to protect properties with hoarding then the operational parameters for such a system may need to be more onerous than for “normal” domestic applications, i.e. may require a longer duration of water supply since the fire is very much shielded.

This experiment was limited to a single arrangement. A future project could consider:

- other “hoarding” arrangements, different packing heights, different packing density,
- other ignition locations and scenarios,

- other room types and sizes,
- other ventilation arrangements; closed door, cross flows,
- other sprinkler types, locations, arrangements and other suppression technologies,
- other sprinkler flow rates and durations,
- and further assessments based on temperature and smoke tenability.

The report is made on behalf of BRE Global and relates only to the observations and data cited in this report. It does not constitute an approval, certification or endorsement of the product. We have no responsibility for the design, materials, workmanship or performance of the product. As cited in our standard terms and conditions this report shall only be reproduced in its entirety.