tenos

Report into fire at car dealer, Brussels October 2014

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for:
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THE INDEPENDENT FIRE SAFETY ENGINEERING CONSULTANTS

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Important information

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1 Introduction

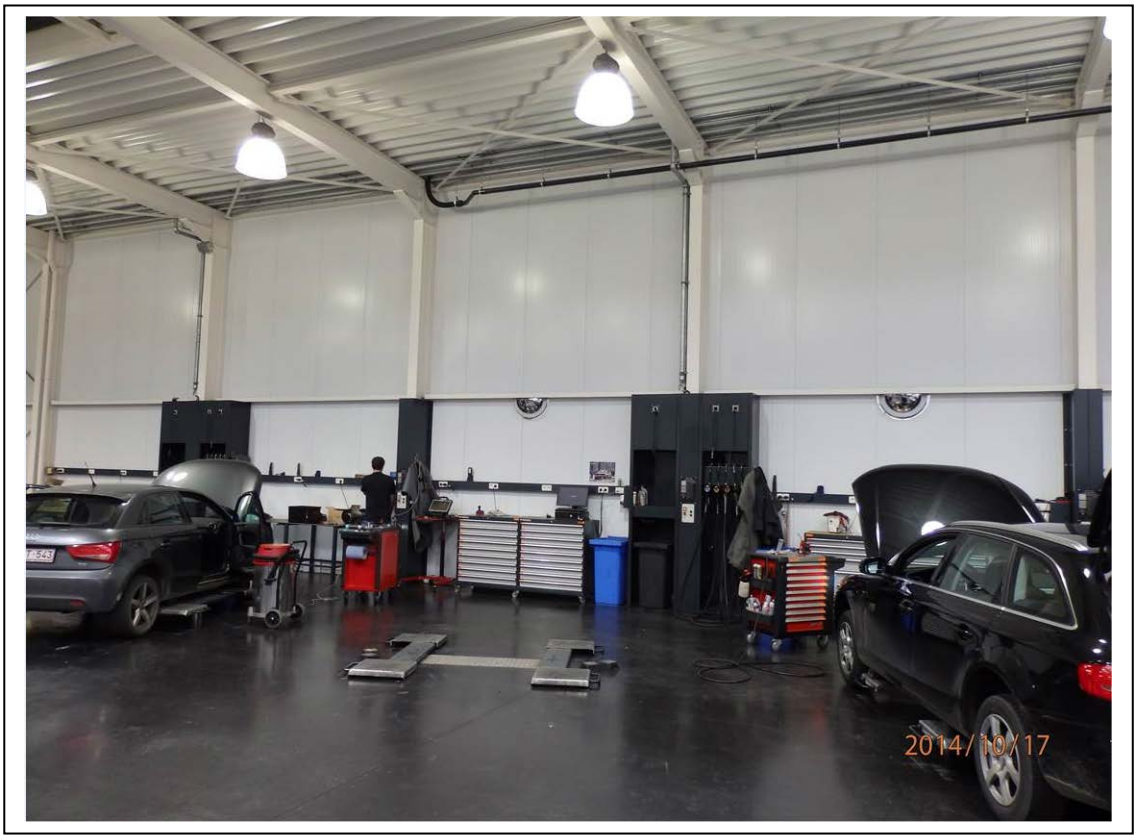
1.1 The fire occurred in the external compound of a large Audi dealership. It was a deliberately set fire.

1.2 Figure 1 shows the aftermath of the fire and is a photograph taken (by others) shortly after the fire event. The car in the foreground is understood to be an Audi Q3 with other cars being of at least a similar overall dimension and construction type.

Figure 1 – Aftermath of the fire

1.3 Figure 2 shows a photograph taken from the inside of the premises after the fire showing the inside of the external wall at the fire location and demonstrating that the fire had not penetrated into the interior of the premises.

Figure 2 – View of the inside of the fire-exposed external wall after the fire



1.4 Kingspan Ltd instructed Tenos Ltd to examine the site and to carry out an assessment and report of the fire exposure to which the Kingspan panels had been subjected.

1.5 Mostyn Bullock of Tenos Ltd visited the building on Wednesday 5th November 2014 in the company of Evert Kraaima of Kingspan to perform an inspection of the fire affected area on the site.

1.6 On the date of the inspection the site had been cleared of the fire damaged vehicles apart from one vehicle that had been moved to a location on site away from the external façade of the building.

1.7 It was stated by staff at the dealership that the fire was deliberately started during out of business hours and that this had been recorded by the CCTV security system. The CCTV recording was not available to view at the time of the visit.

1.8 The dealership staff stated that a total of six cars had been destroyed by fire in the incident and that these cares had been parked as a pair and group of four. The staff stated that the CCTV footage had shown that one of each adjacent pair of cars had a window smashed and ignited material thrown inside.

1.9 An attempt was made to speak to the fire-fighters who were attendant at the incident but no one was available at the fire station for comment on the date of the site inspection.

2 Brief description of the building

2.1 The building is of steel frame construction clad with 1m wide by 100mm thick Kingspan PIR cored sandwich panels and provides single storey showroom and workshop accommodation and an internal mezzanine floor for additional vehicles and back of house accommodation.

2.2 On the side of the building that was subject to the fire event, the overall length of the external façade is approximately 80m and has a height of approximately 7m.

3 Chronology of the fire event

3.1 As the CCTV recording is not currently available and it has not been possible to interview the fire brigade, a chronology of the fire event cannot be accurately established. However, from what can be seen from the photographic evidence, it is clear that the majority of the vehicles involved in the fire were effectively completely consumed in terms of their component combustible materials. The fact that alloy components with significant mass (e.g. wheels and radiators) have melted indicates that fire temperatures well in excess of 650ºC were reached for a sustained period.

3.2 Due to the finite amount of time that would have elapsed between ignition, discovery and call to the fire service, mobilisation time, the distance of the local fire station from the site (approximately 10km) and deployment time when arriving at the fire scene, it can be reasonably hypothesised that the vehicles would have been effectively alight for at least 15 minutes before fire brigade intervention.

4 Analysis

4.1 From the location of fire residue on the parking area paving it was possible to assess with a reasonable degree of accuracy the location of the six cars along the length of the façade.

4.2 Photographs and residue from the fire on the parking area block paving indicate that the vehicles would have been parked such that the rear wheels were up against the kerb of the raised pavement area with a width of approximately 1m when measured from the building façade.

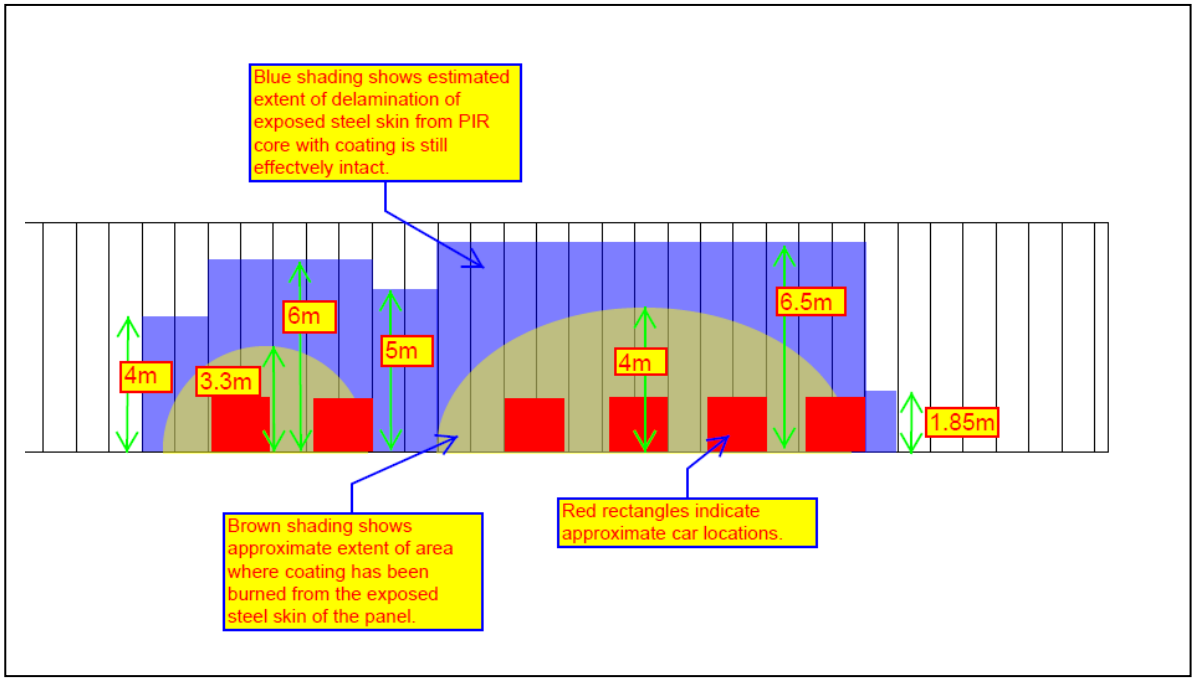
4.3 It is assumed that each of the cars was of the same geometry of an Audi Q3 as follows (from published data):

- Height = 1.61m
- Length = 4.39m
- Width = 1.83m
- Distance between rear wheel and rear of car = 0.53m (approximately)

4.4 From the visual site inspection it was possible to assess the level of damage to the panels relative to the car locations in terms of the extent of delamination of the panel core from the exposed steel skin of the panel as well as the areas of the panels subjected to sufficient heat flux intensity to burn the coating from the panel.

4.5 The scaled schematic in Figure 3 shows the key dimensions estimated from the site inspection.

Figure 3 – key dimensions on the exposed elevation showing car locations and extent of panel damage



4.6 What was clear from the relative positions of the cars and the damage exhibited by the panels was that the panel damage was offset slightly to the left (north) indicating that the flame front may have been influenced slightly by a prevailing wind in a northerly direction. Further evidence of this is provided by the condition of the damaged car which remained on site at the time of the inspection and which appears to have been parked furthest to the right of the elevation. The south facing side of this vehicle exhibited areas of undamaged paintwork and glass.

4.7 The manner in which the fire was ignited (3 cars reportedly ignited in quick succession), together with the evident complete burn-out of the vehicles despite fire brigade attendance, indicates a significant likelihood that the vehicles would have been burning at peak intensity simultaneously.

4.8 Recent research on car park fires using modern vehicles[6.1] has demonstrated that, at peak intensity, a convective heat release rate of the order of approximately 4MW can be expected from a single car and that the period of peak heat release will be approximately 10 minutes. It is generally accepted that this convective heat release rate makes up about two thirds of the total heat release rate, therefore it can be estimated that the radiative heat emitted will be approximately 2MW from each car.

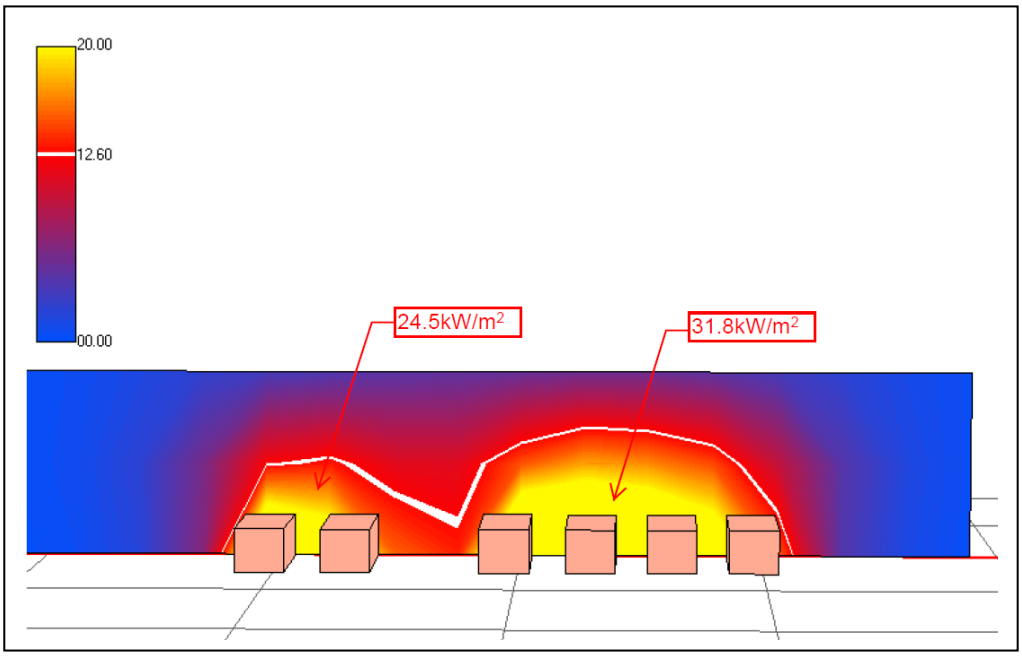
4.9 Assuming that the flame front of the car fire is described by the vertical and top surfaces describing the space occupied by the vehicle then the radiative heat flux intensity emitted from each car can be estimated as follows:

Estimated radiating surface area = (1.83x4.39)+(2x1.61x4.39)+(2x1.61x1.83) = 28.06m^2

Estimated heat flux intensity emitted from each car = 2000/28.06 = 71.3kW/m^2

4.10 An estimate of the heat flux intensity incident on the cladding can then be made using the TenRAD[6.3,6.4] model as shown in Figure 4. TenRAD is a 3-dimensional model that allows the radiative heat flux from a fire (or multiple fires) to be set up as a series of 'radiating panels' which can be set up at any angle relative to each other. TenRAD calculates by means of numerical integration the net received heat flux from these 'radiating panels' incident at the locations of interest. Locations of interest are set up as 'receiving surfaces' which can be oriented at any angle and distance relative from the 'radiating panels'. In this case the 'receiving surface' is the external façade of the building.

Figure 4 – TenRAD model showing estimate of radiative heat flux incident on cladding



4.11 Figure 5 shows a sample of the PIR core material removed from the cladding panel at the location of predicted peak incident radiative heat flux of 31.8kW/m^2. The photograph indicates that the PIR core had pyrolysed to a carbon char to a depth of about 40mm at this location.

Figure 5 – sample of PIR core removed from cladding panel at location of estimated peak incident radiative heat flux.

4.12 At locations remote from the area of peak incident radiative heat flus, the charring of the PIR core was significantly reduced, demonstrating that combustion had not been propagated by the PIR core material. Figure 6 shows an opened-up location where the panel had delaminated and just outside the area where the panel coating had been burned away. The photograph exhibits the breakdown of the bond interface between the PIR core with the steel skin but no significant charring of the PIR foam core itself.

Figure 6 – PIR core material at location exhibiting delamination but where panel coating is still intact

5 Conclusions

5.1 The analysis in this report ignores the potential impact of impingement of the fire plume (containing convective heat flux) on the cladding or possible direct sustained or transient flame impingement. This is because, without the CCTV record, it is not possible to determine the degree to which these effects were a dominant feature in this fire. Any such effects will have increased the net heat flux on the cladding. The proximity of the cars to the cladding (within 0.5m) was such that it is likely that there would have been at least transient fire plume and flame impingement on the cladding surface. The former is demonstrated by the deposition of soot on the cladding surface remote from areas where the heat flux intensity has burned away the coating.

5.2 Therefore the assessment of incident heat flux in this report can be considered to provide a conservatively low estimate of the peak heat flux intensity to which the cladding was subjected.

5.3 The following conclusions can be drawn:

- The PIR cored sandwich panels were subject to a fire likely to have lasted at least 15 minutes from ignition.
- It is likely that the cladding will have been subjected to peak incident radiative heat flux of at least 31.8kW/m^2 for a period of at least 10 minutes.
- The sandwich panels exposed to these conditions sustained damage in terms of delamination of the exposed steel skin of the panels away from the PIR core, removal of the paint coating and pyrolysis of the PIR core material to a depth of approximately 40mm.
- There was no evidence of fire propagation within the panels.

5.4 The behaviour of the Kingspan PIR cored sandwich panels in this fire was therefore commensurate with that observed in previous fire case studies[6.2].

5.5 Should the CCTV recording of the event be made available in the future, a detailed analysis of the recording may permit a more accurate timeline of events and exposure condition to be established and the report can be updated accordingly.

6 References

6.1 BD2552 – Fire spread in car parks. BRE. December 2010.

6.2 The Performance of Insurer Certified PIR (Polyisocyanurate) Core Steel Faced Sandwich Panels in Real Building Fire Situations. Mostyn J. Bullock BEng CEng FIFireE. Mark S. Harris BSc(Hons). Interflam 2013. Conference proceedings. Volume 2.

6.3 TenRAD v 2.0 - Software for Boundary Radiation Calculation. Tenos Ltd 2002

6.4 Building separation calculations revisited using advanced fire models. R Chitty and S Kumar. Fire Research Station, BRE. Interflam 2004

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