TENOS

FIRE SAFETY ENGINEERING CONSULTANTS

REPORT INTO A FIRE ON 30 JULY 2004 AT CLIFTON COMPREHENSIVE SCHOOL ROTHERHAM

Report for

Kingspan Building Products
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1 INTRODUCTION

1.1 A fire occurred at Clifton Comprehensive School, Middle Lane, Clifton, Rotherham at approximately 1930 hours on Friday 30th July 2004. On Thursday 5th August 2004, Kingspan Limited instructed Tenos Ltd to examine the structure to determine the behaviour of any Kingspan products. M Dennett of Tenos Ltd and M Harris of Kingspan Ltd visited the building on Friday 6th August 2004 together with Mr Keith Walker of Balfour Beatty (the main contractors).

1.2 On 22nd September 2004, M Dennett of Tenos Ltd undertook interviews at Rotherham Fire Station. The people interviewed were: Station Officer M Mockett (officer in charge of the incident), Firefighter J Shuttleworth (fire attack team) and Assistant Divisional Officer P Salter (fire investigation officer).

1.3 The information contained within this report is based on an interpretation of the physical evidence examined at the scene on Thursday 5th August 2004 and on the information supplied by the fire service personnel who attended the fire.

2 BRIEF DESCRIPTION OF THE BUILDING

2.1 The building comprised the first phase of a development at the school. At the date of the fire the building was detached and, although it had been handed over by the builders and a significant quantity of equipment had been installed (computers, laboratory equipment etc.) the building had not been brought into use by the school.

2.2 The building was a steel framed structure with brick, stone and blockwork walls and concrete floors. The roof was constructed of Kingspan insulated roofing sheets, 1m x 5m and 80mm thick (roof incline approximately 15^{o} to the horizontal).

2.3 Because of the configuration of the roof, the Kingspan insulated roofing sheets had been cut diagonally across several sheets. The joint between the sheets had been sealed using a waterproof strip fixed to the roof by use of an adhesive. The name of the adhesive was not known. This was not a Kingspan product.

2.4 In addition to the main roof there were two areas of flat roofing on which were installed small air-conditioning units. Accommodation was provided on two floors and the building measured approximately 84m x 19m on plan with the eves being approximately 7.3m high and the apex of the roof approximately 9.8m high. The outline of the building is shown on the drawing at Annex 1. As it is not known how the contractor identified the different elevations they have been identified on the drawing as ‘North’, ‘South’, ‘East’ and ‘West’.

2.5 Of particular interest was the area where the fire occurred. In addition to the general floor areas, a passageway had been constructed in the roof space. This passageway linked the two flat roof areas indicated ‘A’ and ‘B’ on the drawing at Annex 1. A drawing of the cross section of the building and this passageway is shown at Annex 2. A door was fitted to each end of the passageway and both doors were fitted with a stay that kept them open once opened fully.

2.6 It is understood that the passageway had been constructed to provide an escape corridor between the two flat roofs. At the date of the fire the only way up to these flat roofs was by external ladder however, it is understood that when a future phase was completed the roof areas would be accessed from internal staircases. The only item on the floor of the passageway was at the end adjacent to roof B. This was a GRP water tank (1500mm x 900mm x 900mm) produced by Decca Plastics. This tank was not involved in the fire.

2.7 The floor of the passageway was of concrete slab construction. Blockwork walls, that formed the corridors on the ground and first floors, had been carried to 1370mm above the concrete slab of the passageway thereby forming the lower walls of the passageway. The upper walls of the passageway consisted of partitioning between the top of the blockwork walls and the underside of the Kingspan insulated roofing sheets. The partitioning was constructed using a Knauf 70mm stud partition system.

2.8 The Knauf partition system consisted of metal studding fixed to the top of the blockwork wall. The top of the vertical studding terminated in an inverted ‘U’ channel that ran the full length of the roof. Fire resisting board, approximately 25mm thick, had been installed between the top of the inverted ‘U’ channel and the underside of the Kingspan roofing sheets. The Kingspan roofing sheets had not been cut into and the insulation in the sheets passed over the top of the Knauf partition system. Each side of the Knauf partition system had been clad with fire resisting board, approximately 15mm thick.

2.9 At the junction of the passageway wall and the outer wall to the flat roof A (marked ‘X’ on the drawing at Annex 1), the blockwork walls, that formed the lower walls of the passageway and the partitioning that formed the upper walls of the passageway terminated at a structural steel column that supported a steel principal rafter. There was a 200mm gap between the structural steel column and the outer wall adjacent to the flat roof. The effect of this gap was that the whole of the eastern roof void in the centre section of the building and the passageway in the roof void formed a single compartment.

2.10 The roof void was separated from the classrooms on the first floor by a suspended ceiling (panels fixed on a grid).

2.11 A 10 zone fire detection and alarm system was installed throughout the building, including the passageway. It is understood that the system operated satisfactorily and that the fire brigade were called via a central collecting station.

3 THE FIRE

3.1 South Yorkshire Fire Service received an emergency call at 1937 hours on Friday 30th July 2004 to a fire at Clifton Comprehensive School, Middle Lane, Clifton, Rotherham. At 1938 hours one pump Rotherham and one pump Mexborough booked mobile to the incident (the second pump Rotherham was engaged on an earlier call).

3.2 On arrival at the incident at 1947 hours Station Officer Mockett could see smoke and flames issuing from the roof in the centre of the building. It was not clear to him whether the fire was in the building or confined to the roof. Firefighters broke through a security fence and then through doors at the centre of the building (see Photograph 1 at Annex 3). As entry was gained to the building, Stn O Mockett was informed that there was scaffolding at the rear of the premises that gave access to the flat roof to the north end of the building (see Photograph 2 & 3 at Annex 3). The scaffolding had fixed ladders from the first level to the roof. A further ladder was pitched against the wall of the building adjacent to the scaffolding.

3.3 Stn O Mockett instructed Sub Officer Calledon to access the roof via the scaffolding and requested the attendance of an aerial ladder platform (ALP). Stn O Mockett entered the building at ground floor level, traversed the corridor to the north end of the building and climbed the internal staircase to the first floor. He described “significant” smoke in the first floor corridor but light smoke in the rooms off the corridor. When he reached the staircase at the south end of the building Sub O Calledon informed him via his radio that the fire was in the roof space.

3.4 On gaining access to the roof Stn O Mockett saw that the door to the roof space was secured in the open position (Sub O Calledon confirmed that this door was in the held open position when he gained access to the roof) and smoke was issuing through the doorway. Smoke could also be seen issuing from the apex of the roof. There were no flames issuing through the doorway or from the roof. On looking into the passageway that had been constructed in the roof space, Stn O Mockett saw thick smoke at high level and flames on the underside of the apex of the roof (he subsequently determined that the flames on the underside of the apex of the roof were from burning light fittings and cabling). He could see that the door at the opposite end of the passageway was in the fully open position.

3.5 Stn O Mockett ordered the ALP to set up at the front of the school (the elevation opposite the scaffolding) and ordered two Firefighters in BA up the scaffolding to the flat roof. The two Firefighters took a line of hose from the ALP cage and entered the passageway (hose - 45mm lay flat, branch - ACRON Marauder 4508). At 2014 hours Stn O Mockett sent a message “Fire in roof, two BA. one jet in use”.

3.6 Firefighter J Shuttleworth and his colleague entered the passageway and used a jet/spray to extinguish the fire in the apex of the roof and also some burning debris on the floor on the left of the corridor near roof A. After all visible flame had been extinguished they continued along the passageway to ensure that nothing was burning behind the water tank. They found the area clear of fire and exited the door at the far end of the passageway. This door, like the other door to the passageway, was secured in the open position before the arrival of the fire service.

3.7 Firefighter Shuttleworth reported that there was no fire or smoke issuing from the roof at the south end of the passageway and that there was no access to the flat roof from the ground. Firefighter Shuttleworth and his colleague returned through the passageway and removed their BA sets.

3.8 While firefighter Shuttleworth and his colleague were fighting the fire, Stn O Mockett noticed wisps of smoke from the edge of the roof adjacent to and opposite the access door but as the flames in the passageway were extinguished the smoke died down.

3.9 When the residual smoke had cleared from the passageway Stn O Mockett had some of the fire resisting board of the Knauf partition system removed and some of the external skin of the roof removed to check that the fire had been completely extinguished. He could find no residual fire and no smouldering in the insulation between the two skins of the roof. He found some discoloured insulation around the perimeter of the roof near the door that had been used for access (see Photographs 4, 5, 6 & 7 at Annex 3). He also found some discoloured insulation in the apex of the roof near the door that had been used for access (see Photograph 8 at Annex 3). He considered that these areas of discoloured insulation were as a result of charring while the fire was burning in the passageway but had self extinguished when the flames in the passageway had been extinguished.

4 THE INVESTIGATIONS

4.1 When Stn O Mockett was satisfied that all residual fire had been extinguished he started to investigate the cause of the fire. He identified the point of origin as being near an open drum a few metres into the passageway. He was unable to identify the substance so at 2045 hours he requested the attendance of a fire investigation officer.

4.2 Assistant Divisional Officer P Salter was mobilised as fire investigation officer and arrived on site at 2105 hours. ADO Salter examined the scene and reported that the substance at the point of origin looked like a liquid that had partially solidified. He described the debris as "crispy black" on top and "pink bubble-gum colour" on the underside. When lifted, the whole of the debris came away from the floor as a flexible solid. He also reported that the debris had a "solvent" smell. ADO Salter was of the opinion that the liquid had been spilled from the open drum but there were no markings on the drum to indicate its contents.

4.3 ADO Salter contacted the school caretaker and a representative from Balfour Beatty (he did not obtain the name of either person). The caretaker said that at 1600 - 1630 hours that day someone from Balfour Beatty had handed him a set of keys and said that the building was his. All construction workers had left the site at this time. The caretaker had not been into the building or even looked around the outside. He said he was not aware of the scaffolding at the rear of the building (this is surprising when the scaffolding was visible from the existing school building). ADO Salter then asked the representative from Balfour Beatty what the debris was likely to be and was informed that it was probably roof sealant. ADO Salter recorded the cause of fire as "Unknown" on the FDR 1 but did not complete a detailed fire investigation report.

4.4 Neither Stn O Mockett nor ADO Salter considered that the Kingspan insulated roofing sheets had anything to do with the cause of this fire or contributed to the way in which the fire spread.

4.5 At the date of the investigation on Friday 6th August 2004 all debris had been removed with the exception of an empty drum (thought to be the drum examined by ADO Salter). Mr Keith Walker of Balfour Beatty indicated that he was not able to provide any information on the fire.

4.6 An examination of the whole of the passageway on Friday 6th August revealed that there were no sources of ignition at low level. The only potential source of ignition within the passageway was electrical wiring to luminous discharge tube lighting at high level. The wiring for the lighting installation was routed through metal conduit except for short lengths where the wiring connected to individual lighting units. The conduit entered the passageway near the foot of the door giving access to roof 'A', travelled up the side of the door and along the apex of the roof. There was no evidence of a fault within the electrical system and even if there had have been a fault it could not have ignited something on the concrete floor of the passageway.

4.7 Interpretation of the physical evidence established that the seat of the fire was on top of the concrete slab floor of the passageway, approximately 3.5m from the door that gave access from the flat roof (marked 'Y', on the drawing at Annex 1) and against the left hand wall when looking into the passageway from the door (the eastern wall). At the time when the fire started and throughout the time that it was burning both of the doors that gave access to the two flat roof areas were open to their fullest extent (see the pattern of burning on the upper hinge corner of the door on Photographs 2, 3 & 4 at Annex 3).

4.8 The fire burned fiercely with flames impinging on the left hand blockwork wall and the partition above. Flame and hot smoke travelled down the passageway at high level in both directions.

4.9 The following photographs at Annex 3 show the progressive damage in the passageway from the south door to the seat of fire.

a) Photograph 9 shows the extreme southern end of the passageway (up to the first steel principal rafter). The steelwork is undamaged. There is some delamination of the inner skin of the roofing sheets but they have not distorted. Plastic components of the fire alarm have melted.

b) Photograph 10 is a close up of the melted plastic components of the fire alarm.

c) Photograph 11 is looking towards the seat of fire from the south entrance to the passageway. In the foreground is the GRP water tank Smoke staining is visible to the walls and roof of the passageway and the spray pattern from fire hoses directed from the north door.

d) Photograph 12 shows the roof section adjacent to the GRP water tank. The steelwork is undamaged. There is some delamination of the inner skin of the roofing sheets but they have not distorted. Plastic and glass components of the light fittings have shattered/melted. The lighting supports have been displaced.

e) Photograph 13 shows the next section of roof (between the first and second steel principal rafters). The steelwork is undamaged. There is some delamination and distortion of the inner skin of the roofing sheets but the insulation has not been exposed. Plastic and glass components of the fire alarm and light fittings have shattered/melted.

f) Photographs 14 & 15 show the section of roof under which was the seat of the fire (between the second steel principal rafter and the north door). The substantial steel purlins were severely deformed and the internal faces of eight Kingspan roofing sheets in the immediate area of the fire had delaminated and deformed, exposing the insulation. Plastic and glass components of the fire alarm and light fittings had been destroyed.

g) Photographs 16, 17, 18 & 19 are close up views of the distortion and delamination of the Kingspan roofing sheets in the immediate area of the fire.

h) Photograph 20 shows the area where the fire started, the empty drum and the holes made in the Knauf partition system. The 200mm gap between the structural steel column and the outer wall adjacent to the flat roof is to the right of the doorway shown in Photograph 20.

i) Photographs 21 & 22 show the top of the 200mm gap between the structural steel column and the outer wall.

j) Photograph 23 shows the view of the eastern roof void above the first floor from the hole in the east Knauf partition (to the right of the door in Photograph 20). The Kingspan roofing sheets had delaminated and deformed, exposing the insulation.

k) Photographs 24, 25 & 26 show the view of the western roof void above the first floor from the hole in the west Knauf partition (to the left of the door in Photograph 20). There was slight heat and smoke damage to the underside of the roofing sheets that was consistent with heat and smoke migration between the top of the vertical studding and the underside of the Kingspan roofing sheets. There was no indication of any heat and smoke migration through the insulation of the roofing sheets.

5 OPINION

5.1 Within the UK, a description of a cause of fire includes four factors:

- source of ignition;
- material or item first ignited;
- material or item mainly responsible for development of the fire; and
- defect, act or omission causing ignition.

5.2 From all the available information it is thought that the most likely cause of this fire was children who accessed the roof via the scaffolding and accidentally or purposely ignited the roof sealant with a naked flame. The roof sealant was both the material first ignited; and the material mainly responsible for development of the fire.

5.3 The deformation of the purlins immediately above the seat of the fire shows that this was a very hot fire. As noted above, the internal faces of eight Kingspan roofing sheets in the immediate area of the fire had delaminated and deformed, exposing the insulation. In spite of the substantial quantity of insulation exposed, there was no evidence that the insulation contributed to the spread of this fire; although it is probable that, while the fire was burning, the insulation charred and some smoke would have been produced.

5.4 From the physical evidence of the limited spread of heat and smoke to the roof void to the west of the passageway, it is clear that the general construction of the passageway and the Knauf partition system worked effectively as fire resisting barriers. There was only limited spread of heat and smoke between the top of the Knauf partition and the underside of the Kingspan roofing sheets. There was no evidence of heat or smoke spread through the insulation of the Kingspan roofing sheets.

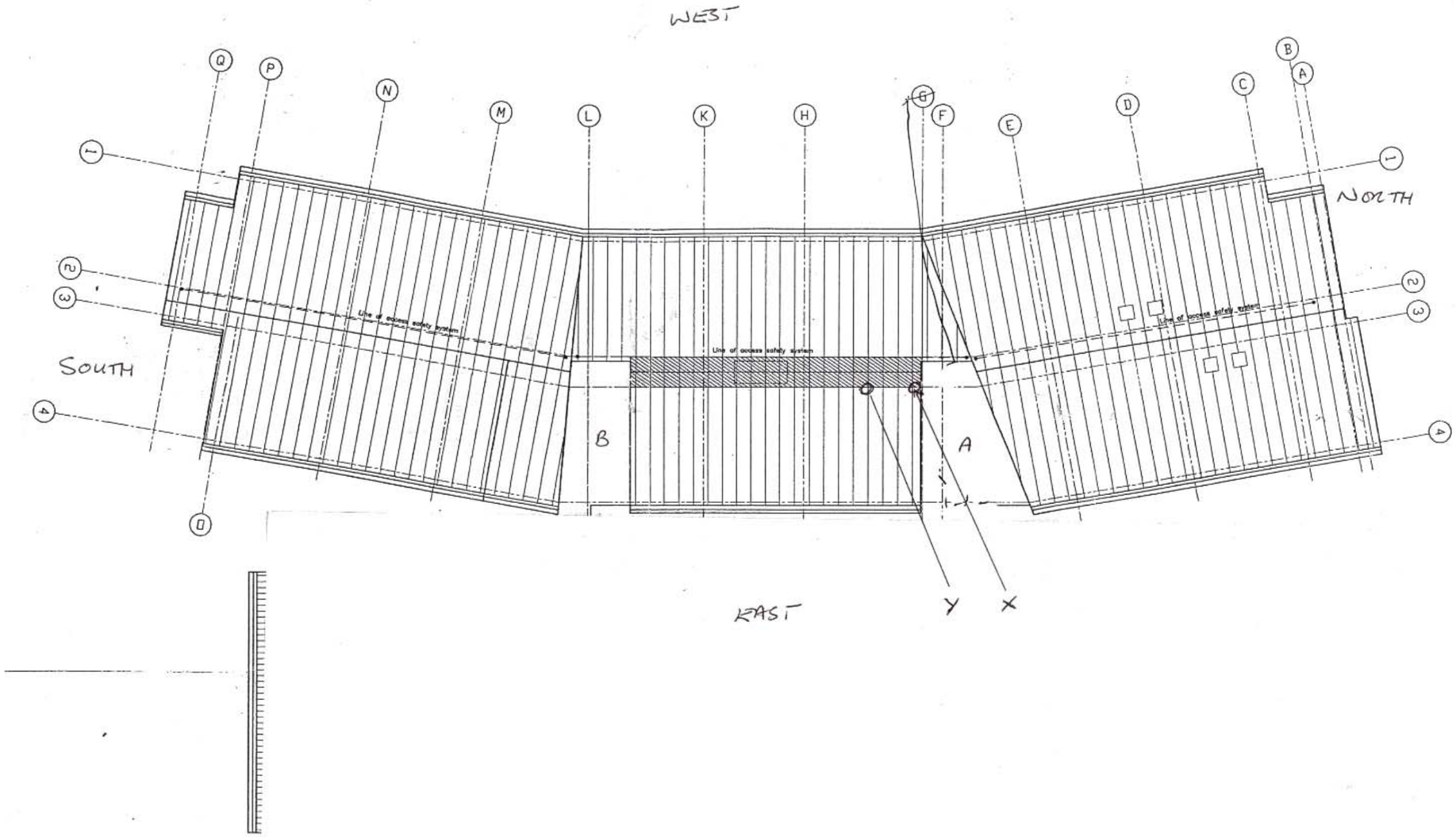
5.5 The pattern of heat damage and smoke spread to the roof void to the east of the passageway shows that this was due entirely to the 200mm gap between the structural steel column and the outer wall. There was no evidence of heat or smoke spread through the insulation of the Kingspan roofing sheets.

6 CONCLUSIONS

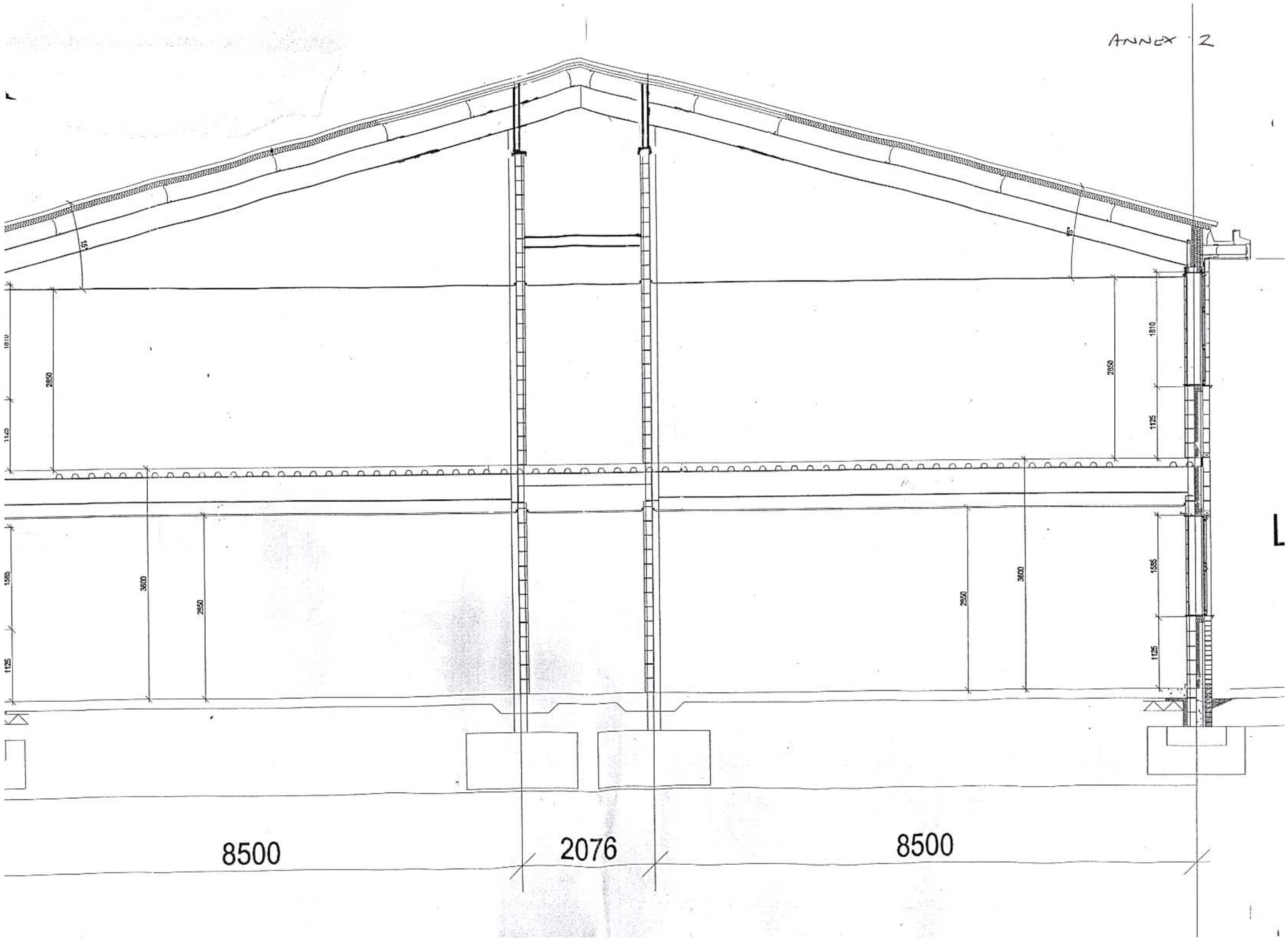
6.1 The Kingspan insulated roofing sheets did not contribute to the cause of this fire or to the way in which the fire and smoke spread from the passageway into the roof voids and thereby into the first floor of the building.

A.1 **ANNEX 1 – ROOF PLAN**

ANNEX 1


WEST
NORTH
SOUTH
EAST
Q
P
N
M
L
K
H
G
F
E
D
C
B
A
1
2
3
4
Line of access safety system
Line of access safety system
Line of access safety system
B
A
Y
X

A.2 **ANNEX 2 – TYPICAL SECTION**


ANNEX 2
1810
2850
1125
1595
3600
2850
1125
8500
2076
8500

A.3 ANNEX 3 – PHOTOGRAPHS



Photograph 1



Photograph 2



Photograph 3



Photograph 4



Photograph 5



Photograph 6



Photograph 7



Photograph 8



Photograph 9



Photograph 10



Photograph 11



Photograph 12



Photograph 13



Photograph 14



Photograph 15



Photograph 16



Photograph 17



Photograph 18



Photograph 19



Photograph 20



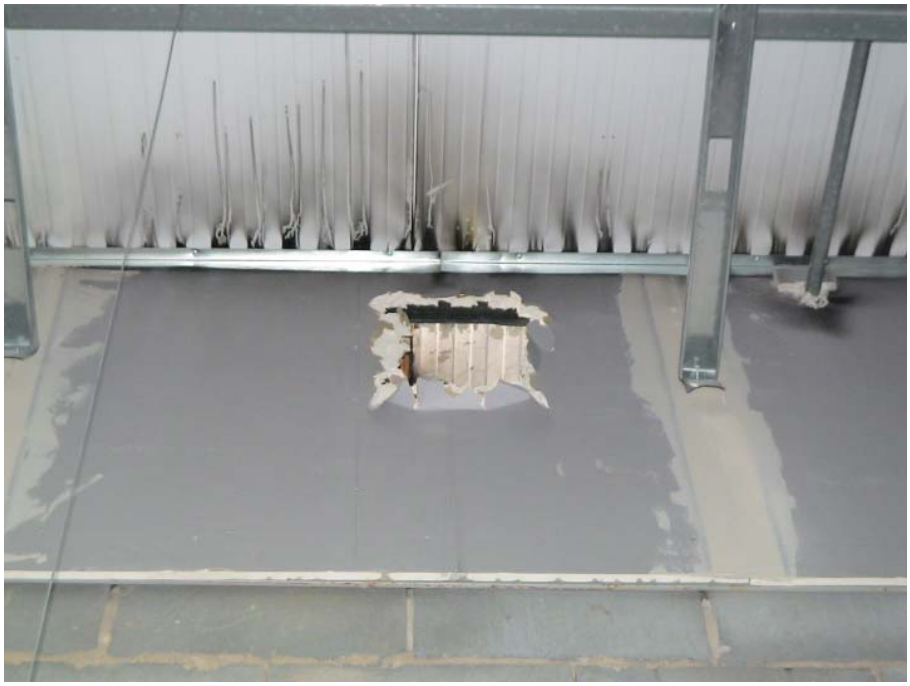
Photograph 21



Photograph 22



Photograph 23



Photograph 24



Photograph 25



Photograph 26