Lothian NHS Board

NHS Lothian Headquarters
Waverley Court
4 East Market Street
Edinburgh
EH8 8BG
www.nhslothian.scot

Date 09 Octoberber 2026
Your Ref
Our Ref 11689

Enquiries to Richard Mutch
Extension 35687
Direct Line 0131 465 5687
loth.freedomofinformation@nhs.scot
richard.mutch@nhs.scot

Dear

ENVIRONMENTAL INFORMATION – CLADDING

I write in response to your request for information in relation to cladding.

Question:

1. Is the installed cladding system the Alucobond BM system as was specified in the planning application?
2. What is the specification for the core of the ACM panels in this system - i.e. is it the fire-resistant type?
3. Can you forward me a copy of the fire test certificate for the installed system? This would require to be submitted to building control by the architect or fire engineer in order to obtain a building warrant. A copy of this certificate should also have been included in the O&M Manual delivered to the Board at handover.
4. Can you advise what the insulation system specification is and can you confirm that it is low risk as required by the Technical Standards?
5. Why was it deemed necessary to change the spacing of the cavity barriers from 20m to 10m if the installed ACM system was fully compliant with the contract requirements?
6. Did the project managers Mott McDonald raise any concerns with you regarding issues with the external cladding as part of their remit to carry out due diligence during the construction phase of the contract?

Answer:

1.	There are various cladding and Render systems across the façade with the key items attached, but yes Alcubond Plus is what is installed and in the O&Ms.
2.	See the document 'Aluminium Composite Material Scope of Works' attached which confirms that the product is fire resistant. The product Spec for Zone A is attached.
3.	The attached building control completion certificate should satisfy the request that the fire test certificate is satisfactory.
4.	The specification is listed within the NBS Specification from HLM Architects HLM-SP-H43
5.	The Warrington Fire report attached from expert Andrew McCracken confirms the rationale and was re-confirmed by a review from Astute Fire. Multiplex came forward following a review to confirm that these works are recommended to be added to the facade.

6.	All of the systems installed at RHCYP & DCN went through full RDD as per the PA, the only reference to Cavity Barriers that EQUANS can find or were copied on specifically was during the RDD of the Fire Strategy of which Mott McDonald are included. The Status B comments added at this stage are in the WSP Report (noting this is not the final version as it's at a point of RDD).
Provided by EQUANS	

Please note that NHS Lothian has a policy of not releasing the names and details of staff (and non-staff) below a senior level. This is considered exempt under Regulation 11 of the EIRs – personal data.

I hope the information provided helps with your request.

If you are unhappy with our response to your request, you do have the right to request us to review it. Your request should be made within 40 working days of receipt of this letter, and we will reply within 20 working days of receipt. If our decision is unchanged following a review and you remain dissatisfied with this, you then have the right to make a formal complaint to the Scottish Information Commissioner within 6 months of receipt of our review response. You can do this by using the Scottish Information Commissioner's Office online appeals service at www.itspublicknowledge.info/Appeal. If you remain dissatisfied with the Commissioner's response you then have the option to appeal to the Court of Session on a point of law.

If you require a review of our decision to be carried out, please write to the FOI Reviewer at the email address at the head of this letter. The review will be undertaken by a Reviewer who was not involved in the original decision-making process.

FOI responses (subject to redaction of personal information) may appear on NHS Lothian's Freedom of Information website at: https://org.nhslothian.scot/FOI/Pages/default.aspx

Yours sincerely

ALISON MACDONALD
Executive Director, Nursing
Cc: Chief Executive
Enc.

·EDINBVRGH·

THE CITY OF EDINBURGH COUNCIL

Planning & Building Standards
Services For Communities

NOTICE OF ACCEPTANCE OF COMPLETION CERTIFICATE

Building (Scotland) Act 2003
Acceptance under Section 18 of a Completion Certificate

Acceptance
This document confirms acceptance of the completion certificate submitted by the relevant person: Brookfield Multiplex Construction Europe Ltd, FAO Liane Edwards-Scott, RHSC & DCN Project Office, Little France Crescent, Edinburgh, EH16 4TJ

Duly authorised Agent (if any)

Details of completion certificate
Date of completion certificate submission: 13 March 2019
Address of building to which the completion certificate applies:
211 Old Dalkeith Road/, 2 Little France Crescent, Edinburgh, EH16 4TJ

Details of building warrant (see note 1)
Reference number: 14/04220/STAGEA granted on 8 December 2014

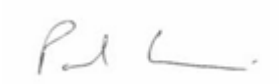
Details of amendment(s)
Reference number: 14/04220/STAGEB granted on 28 January 2015
14/04220/STAGEC granted on 5 March 2015
14/04220/STAGED granted on 24 August 2015
14/04220/STAGEE granted on 12 November 2015
14/04220/STAGEG granted on 15 March 2016
14/04220/STAGEU granted on 23 June 2016
14/04220/STAGET granted on 23 June 2016
14/04220/STAGEW granted on 23 June 2016
14/04220/STAGEX granted on 23 June 2016
14/04220/STAGEV granted on 23 June 2016
14/04220/STAGEY granted on 23 June 2016
14/04220/STAGEH granted on 30 June 2016
14/04220/STAGAA granted on 10 February 2017
14/04220/STAGEZ granted on 10 February 2017
14/04220/STAGEJ granted on 10 February 2017
14/04220/STAGER granted on 22 February 2017
14/04220/STAGES granted on 22 February 2017
14/04220/STAGEK granted on 27 February 2017
14/04220/STAGEF granted on 2 October 2017
14/04220/STAGEQ granted on 2 October 2017
14/04220/STAGEP granted on 2 October 2017
14/04220/STAGEM granted on 2 October 2017
14/04220/STAGEN granted on 2 October 2017
14/04220/STAGEL granted on 2 October 2017
14/04220/STAGEA/Z granted on 21 August 2018
14/04220/STAGEA/Y granted on 14 March 2019

Continuing requirements imposed by this acceptance

There are no requirements in this case.

Declaration
We confirm as verifiers, so far as we are able to ascertain after making reasonable enquiry, that we are satisfied the work which is the subject of the above completion certificate has now been completed in accordance with that certificate and the warrant (and any amendments) detailed above.

Signed



PAUL LAWRENCE
Executive Director of Place
For and on behalf of
The City of Edinburgh Council Dated 14 March 2019

FORM M

Notes

1. The building warrant details should be provided unless the completion certificate was submitted without a building warrant having been obtained.

2. For work of construction or conversion, this acceptance permits the occupation or use of the building.

WARNING

The acceptance of a completion certificate is no guarantee of standard of workmanship.

This acceptance is an important document that may be requested during property transactions, and should be kept securely.

Brookfield Multiplex Construction Europe Ltd
FAO Liane Edwards-Scott,
RHSC & DCN Project Office,
Little France Crescent,
Edinburgh,
EH16 4TJ

Date 14 March 2019

Your Ref

Our Ref 14/04220/STAGEA

Dear Sir(s)/Madam

NOTICE OF ACCEPTANCE OF COMPLETION CERTIFICATE
211 Old Dalkeith Road/, 2 Little France Crescent, Edinburgh, EH16 4TJ

I refer to the "Completion Certificate - Submission" dated 13 March 2019 in relation to the above property and have pleasure in now enclosing the appropriate "Notice of Acceptance of Completion Certificate" in this regard.

In addition, please find enclosed the relevant Certificate which enabled the Department to accept the electrical installation as demonstrating compliance with the relevant requirements of the Building Standards. This document has been scanned and retained on record with this Department.

Please note, if you are acting as an agent on behalf of the "relevant person" (usually your client), then these documents should be sent to them as a priority to enable retention in their records relating to their property.

Should you have any queries relating to the above, please ask for Jackie Tullis on 0131 529 4469.

Yours faithfully

Customer Services Assistant

Customer Services Assistant, Customer Services Team, Services for Communities
G3 Waverley Court, 4 East Market Street, Edinburgh EH8 8BG
Tel 0131 529 7826 and select option 2 Fax 0131 529 6208

INVESTORS IN PEOPLE CUSTOMER SERVICE EXCELLENCE

Issue of
Notice of Acceptance of Completion Certificate
Letter to Owner to Be Sent

The reference number of this building warrant is - 14/04220/STAGEA

Please print either

COCOWN - “Notify Owner Accept Cert of Comp” for a single owner, or
COCOWNMULTI - “Notify Multi Owners Accept Cert of Comp” for multiple owners

to:-

Lothian NHS Board
Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG

Charles Henshaw & Sons

Technical submission No: - CHSL-SZ-SL-TS-300-037 rev 00

ACM rainscreen data

1. Elevation layout and panel colour locations
2. BBA certification
3. Technical data sheet for ALUCOBOND Plus cladding panels

A
Seafoam Green 604
ALUCOBOND

B
Grey Metallic
ALUCOBOND

C
Anthracite Grey 105
ALUCOBOND

D
Silver Metallic 500
ALUCOBOND

E
Grey Blue Metallic 603
ALUCOBOND

F
Indiana Copper 704
ALUCOBOND

G
Gold Metallic 601
ALUCOBOND

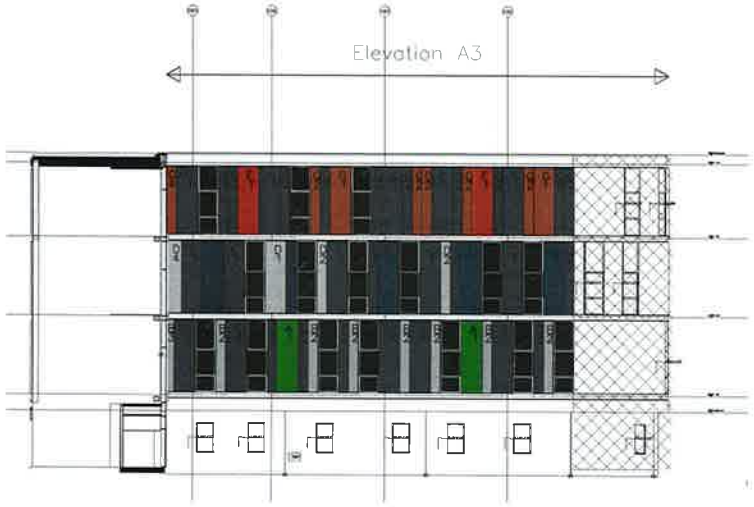
NOTES:-
MATERIAL:- 4mm Thk. Alucobond
FINISH- VARIES - SEE TABLE

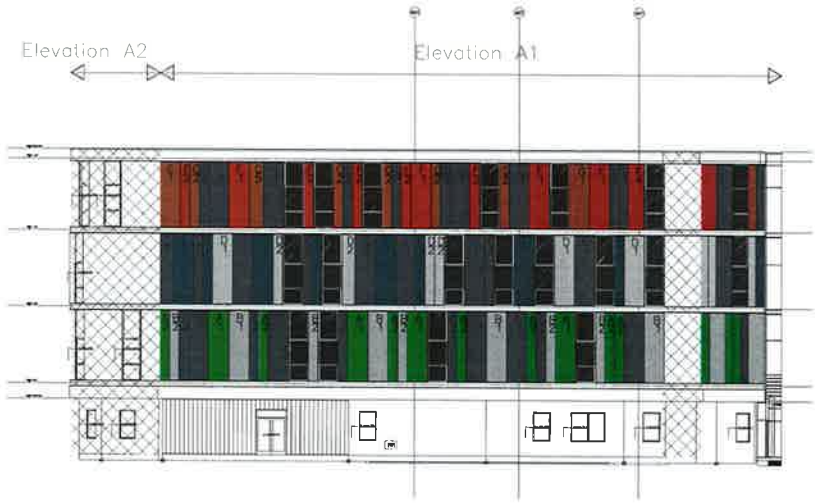
ALL FIXINGS (BY CLIENT)

ALL DIMENSIONS ARE THEORETICAL AND SHOULD BE CHECKED AND VERIFIED PRIOR TO INSTRUCTION TO MANUFACTURE

ISOLATION TAPE BY FIXER REQUIRED BETWEEN DISSIMILAR MATERIALS







AS - BUILT

Rev	Date	Alteration

Cad Ref :- RSCH - EDINBURGH A1

BOOTH MUIRIE LTD.
Architectural Cladding Systems
www.boothmuirie.co.uk

A EUROCLAD COMPANY

Client	Charles Henshaw + Sons Ltd
Project	RSCH - EDINBURGH
System	BML200
Title	Elevation Details

This Drawing is Copyright, it must not be Copied, used disclosed to third parties without our written permission, it remains our property

Scale 1:50@A1 Date February 2016 Rev

Job No RSCH Drg No CHSL-SZ-SL-EL-251-001

ALUCOBOND®

Technical Data Sheet
ALUCOBOND® plus

Panel Thickness		***Standards***	***Units***	**3 mm**	**4 mm**
Thickness of Aluminium Layers			[mm]	0.50	
Weight			[kg/m²]	5.9	7.6
Technical Properties					
Section Modulus	W	DIN 53293	[cm³/m]	1.25	1.75
Rigidity (Poisson's ratio μ = 0,3)	E·I	DIN 53293	[kNcm²/m]	1250	2400
Alloy /		EN 573-3		EN AW-5005A (AlMg1),	
Temper of Cover Sheets		EN 515		H22 / H42	
Modulus of Elasticity		EN 1999 1-1	[N/mm²]	70'000	
Tensile Strength of Aluminium		EN 485-2	[N/mm²]	R_m	
0.2% Proof Stress		EN 485-2	[N/mm²]	$R_{p0,2}$	
Elongation		EN 485-2	[%]	A_{50}	
Linear Thermal Expansion		EN 1999 1-1		2,4 mm / m at 100°C temperature difference	
Core					
Mineral filled polymer					
Surface				Coil Coating	
Lacquering				Fluorocarbon based (e.g. PVdF)	
Gloss (initial value)		EN 13523-2	[%]	30 – 80	
Pencil Hardness		EN 13523-4		HB - F	
Acoustical Properties					
Sound Absorption Factor	α_s	ISO 354		0.05	
Sound Transmission	R_w	ASTM E90	[dB]	STC: 30	OITC: 24
Thermal Properties					
Thermal Resistance	R	ASTM C518	[m²K/W]	0.007	0.009
Temperature Resistance			[°C]	-50 to +80	
Fire Classification		acc. to EN 13501-1: Class B-s1,d0			

3A Composites GmbH
Alusingenplatz 1
78224 Singen, Germany
www.alucobond.com
issued by CAT 11/2010

3A Composites GmbH
Alusingenplatz 1
78224 Singen
Germany
Tel: 00 49 7731 80 3500 Fax: 00 49 7731 80 3510
e-mail: info.eu@alucobond.com
website: www.alucobond.com

BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
05/4214
Product Sheet 1

3A COMPOSITES CLADDING SYSTEMS

ALUCOBOND CLADDING SYSTEMS

This Agrément Certificate Product Sheet[1] relates to ALUCOBOND Cladding Systems, comprising aluminium sheet composite panels attached to an aluminium sub-frame, used as a drained and back-ventilated rain screen cladding system to provide a decorative and protective façade over external concrete, masonry, steel and timber frame walls of new and existing buildings.

(1) Hereinafter referred to as 'Certificate'.



CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Strength and stability — the cladding systems can resist the surface loadings normally encountered in the UK and transfer the design loads to the substrate wall structure (see section 6).

Behaviour in relation to fire — the cladding panels have various reaction-to-fire classifications (see section 7).

Air and water penetration — provided all joints between panels are adequately baffled, the cladding systems will minimise water entering the cavity. Any water collecting in the cavity due to rain and condensation will be removed by drainage and ventilation (see section 8).

Durability — the cladding systems have acceptable durability and can be expected to have a service life of in excess of 30 years (see section 10).

The BBA has awarded this Certificate to the company named above for the systems described herein. These systems have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 24 July 2013

Originally certificated on 24 March 2005

Brian Chamberlain
Head of Approvals — Engineering

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA
tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk
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Regulations

In the opinion of the BBA, the ALUCOBOND Cladding Systems, if installed, used and maintained in accordance with this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	A1	**Loading**
Comment:		The systems are acceptable for use and can be designed to adequately transfer the design loads from the cladding to the substrate wall structure as set out in sections 4.3 and 6.1 to 6.11 of this Certificate.
Requirement:	B4(1)	**External fire spread**
Comment:		The panels are capable of achieving Class 0 requirements. See sections 7.1 to 7.8 of this Certificate.
Requirement:	C2(b)	**Resistance to moisture**
Comment:		The systems will meet this requirement. See sections 8.1 to 8.4 of this Certificate.
Regulation:	7	**Materials and workmanship**
Comment:		The systems are acceptable. See sections 10.1 and 10.4 and the *Installation* part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	**Fitness and durability of materials and workmanship**
Comment:		The systems are acceptable. See sections 9.1 to 9.3, 10.1 and 10.4 and the *Installation* part of this Certificate.
Regulation:	9	**Building standards applicable to construction**
Standard:	1.1(a)(b)	Structure
Comment:		The systems are acceptable with reference to clauses 1.1.1[1][2]. See sections 4.4 and 6.1 to 6.11 of this Certificate.
Standard:	2.4	Cavities
Comment:		The panels when used in conjunction with fire-resistant materials, can meet this Standard, with reference to clauses 2.4.1[1][2], 2.4.2[1][2], 2.4.5[1], 2.4.7[1][2] and 2.4.9[2]. See sections 4.3 and 7.8 of this Certificate.
Standard:	2.6	Spread to neighbouring buildings
Comment:		The panels can contribute to a construction satisfying this Standard, with reference to clauses 2.6.4[1][2], 2.6.5[1], 2.6.6[1][2] and 2.6.7[2]. See sections 7.1 to 7.8 of this Certificate.
Standard:	2.7	Spread on external walls
Comment:		The panels can contribute to satisfying this Standard, with reference to clause 2.7.1[1][2]. See sections 7.1 and 7.8 of this Certificate.
Standard:	3.10	Precipitation
Comment:		The systems will contribute to meeting this Standard, with reference to clauses 3.10.1[1][2], 3.10.3[1][2], 3.10.5[1][2] and 3.10.6[1][2]. See sections 8.1 to 8.4 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The systems can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012

Regulation:	23	**Fitness of materials and workmanship**
Comment:		The systems are acceptable. See sections 10.1 and 10.4 and the *Installation* part of this Certificate.
Regulation:	28(b)	**Resistance to moisture and weather**
Comment:		The systems will contribute to meeting this Regulation. See sections 8.1 to 8.4 of this Certificate.
Regulation:	30	**Stability**
Comment:		The systems are acceptable as set out in sections 4.3 and 6.1 to 6.11 of this Certificate.
Regulation:	36	**External fire spread**
Comment:		The panels are capable of achieving Class 0 requirements. See sections 7.1 to 7.8 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 1 *Description* (1.2), and 3 *Delivery, storage and site handling* (3.5) of this Certificate.

Additional Information

NHBC Standards 2013

NHBC accepts the use of the ALUCOBOND Cladding Systems, provided they are installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 6.9 *Curtain walling and cladding.*

Technical Specification

1 Description

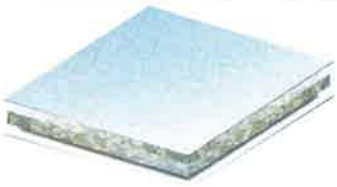
General

1.1 ALUCOBOND Cladding System comprises ALUCOBOND composite panels attached to an aluminium sub-frame secured to external walls.

Panels

1.2 The ALUCOBOND cladding panels are available in three grades and two styles (see Table 1) and consist of a core layer bonded either side to aluminium outer skins. The panels are available in various thicknesses and colours.

Table 1 ALUCOBOND composite panels

Characteristic	Panel type		
	Standard ALUCOBOND	ALUCOBOND plus	ALUCOBOND A2
			
Core	Low-density polyethylene (LDPE)	Thermo-plastically bonded aluminium hydroxide	Inorganic filler materials with thermoplastic binder
Length (mm)[1]	3200,4000	3200,4000	3200,4000
Width (mm)	1000,1250,1500[2]	1000,1250,1500[2]	1250,1500[3]
Thickness (mm)	3, 4 and 6	3 and 4	3 and 4
Density (kg·m^{-3})	900-940	1600-1800	1600-1800
Core colour	Black	Grey	Grey/white

(1) Lengths up to 8000 mm available on request.
(2) 1750 mm width available on request.
(3) 1650 mm width available on request.

1.3 The panel outer skins consist 0.5 mm thick aluminium sheets manufactured from aluminium alloys EN AW-5005 or EN AW-3003, EN AW-3005, EN AW 3105 as per BS EN 485-2 : 2008 (bare anodised) or BS EN 1396 : 2007 (coated) with properties shown in Table 2. The external face of one or both sides of the skin may be plain, anodised (20 µm thick), primed (for post paint finish), or pre-painted with either 25 µm minimum coating of polyester paint, or PVDF (polyvinylidene fluoride) protective coating.

Table 2 Aluminium sheet properties

Property	Value
E modulus (E) (N·mm^{-2})	≥70,000
Tensile strength (R_m) (N·mm^{-2})	≥130
0.2% proof strength ($R_{p\,0.2}$) (N·mm^{-2})	≥90
Elongation at break (A_{50} mm) (%)	≥5

1.4 The panels may be used as flat panels or tray panels (ie folded flat panels produced in the factory by routing out the inner face and most of the core, down the length of a panel, and then bending to shape). Where necessary, the flat panels can be bent to form corner panels and trims for use around openings and installation perimeters. The panels can also be fabricated into bespoke shapes and profiles when required[1].

(1) Outside the scope of this Certificate.

1.5 Flat panels (Figure 1a) are riveted around the perimeter to the vertical support rails and cross-member bracing (see Figure 1a). The vertical support rails are bolted to the wall brackets and fixed to the substrate.

1.6 Fabricated cassette tray panels are either hung from (see Figure 1b) or mechanically-fixed (see Figure 1c) to vertical support rails using mounting bolts or rivets and fascia screws respectively.

1.7 The panels are strengthened at the fixing points; tray panels incorporate corner sheet plates riveted to the side corners of the panel, and also include a continuous vertical section riveted to the tray side. In addition, horizontal aluminium reinforcing profiles fastened with rivets along the top and bottom of the tray panels for lateral stability may be required (see section 6).

Support system

1.8 The panels are supported to the substrate via an aluminium sub-frame system comprising rail and wall brackets fixed to the substrate. The specifications of fasteners and support rails are given in Table 3.

Table 3 Fastener/rail system details

Type/system	Description
Flat panel	
Wall bracket	Specified on project basis by a suitably qualified and experienced individual
Vertical support rail and cross-member section	Minimum 1.6 mm thick aluminium alloy 6000 series T- or L-shaped profile (eg EN AW 6060 or EN AW 6063 to BS EN 573-3 : 2003) mill finish or powder-coated
Rail/bracket fixing	5 mm diameter shank blind rivet (aluminium) or self-drilling screw minimum 4.8 mm diameter stainless steel (grade 1.4301 material)
Sub-frame rivet (cross member to rail)	6 mm diameter head with 3 mm diameter shank; aluminium with stainless steel mandrel
Rivets (panel to rail/cross member)	11 mm, 14 mm or 16 mm head diameter with 5 mm diameter shank; aluminium body with stainless steel mandrel or aluminium pop rivet with steel mandrel which pops out on application
Tray panel (mounting)	
Wall bracket	Specified on project basis by a suitably qualified and experienced individual
Vertical support rail	Minimum 1.6 mm aluminium alloy (6000 series) U profile (eg EN AW 6060 or EN AW 6063 to BS EN 573-3 : 2003) mill finish or powder-coated
Corner sheet (reinforcement)	Minimum 2 mm thick aluminium alloy EN AW 5754
Rivets (corner sheet to panel)	11 mm, 14 mm or 16 mm head diameter with 5 mm diameter shank; aluminium body with stainless steel mandrel or aluminium pop rivet with steel mandrel which pops out on application
Bolt mountings	10 mm diameter stainless steel (grade 1.4301 material)
Tray panel (mechanically fastened)	
Wall bracket	Specified on project basis by a suitably qualified and experienced individual
Vertical support rail	Minimum 1.6 mm aluminium alloy (6000 series) U profile (eg EN AW 6060 or EN AW 6063 to BS EN 573-3 : 2003) mill finish or powder-coated
Vertical section (reinforcement)	Minimum 1.6 mm aluminium alloy (6000 series) profile systems (as shown in Figure 1)
Rivets (panel to vertical section)	11 mm, 14 mm or 16 mm head diameter with 5 mm diameter shank; aluminium body with stainless steel mandrel or aluminium pop rivet with steel mandrel which pops out on application
Mounting bracket	2 mm thick aluminium alloy (5000 series) (optional, used to carry dead load)
Fascia screw (vertical section to support rail)	4.8 mm diameter self drilling screw, stainless steel (grade 1.4301 material)
Clamping washer (edge grip system)	Screwed to the vertical support rail

RHSC and DCN
Little France
Edinburgh
Scotland United Kingdom

MULTIPLEX

MAIL TYPE	MAIL NUMBER	REFERENCE NUMBER
Transmittal	MPX-TRANSMIT-011190	WSP UK-TRANSMIT-000035

Re: Updated Fire Strategy - Cavity Barrier Text

From BMEdinburgh DocControl Multiplex Construction Europe

To [redacted] WSP UK

Cc (129) [redacted] A C FLOORING LTD
[redacted] A C FLOORING LTD
[redacted] A C FLOORING LTD
[redacted] A C FLOORING LTD
[redacted] - A C FLOORING LTD
[redacted] - ARJO MED AB LTD
[redacted] - Acoustic Logic
[redacted] - Acoustic Logic
[redacted] - Acoustic Logic
[redacted] - Allaway Acoustics Ltd
[redacted] - Arcadis LLP (UK)
[redacted] - Arcadis LLP (UK)
[redacted] - Arup
[redacted] - Ascot Sign Systems
[redacted] - Ascot Sign Systems
[redacted] - Astins Ltd
[redacted] - Astins Ltd
[redacted] - Astins Ltd
[redacted] - Astins Ltd
[redacted] - Astins Ltd
[redacted] - Avtek Scotland Limited
[redacted] - Baxter & Gillespie Ltd
[redacted] - Baxter & Gillespie Ltd
[redacted] - Bayards
[redacted] - Bouygues E&S FM
[redacted] - Bouygues E&S FM
[redacted] - Bouygues E&S FM

[redacted] - Bouygues E&S FM

[redacted] - Bouygues E&S FM

[redacted] - CAA International Ltd

[redacted] - CAA International Ltd

[redacted] - CDS - WILMAN

[redacted] - COLT INTERNATIONAL LTD

[redacted] - COLT INTERNATIONAL LTD

[redacted] - COLT INTERNATIONAL LTD

[redacted] - Charles Henshaw & Sons Ltd

[redacted] - Charles Henshaw & Sons Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Crummock (Scotland) Ltd

[redacted] - Deanestor Plc

[redacted] - Deanestor Plc

[redacted] - Deanestor Plc

[redacted] - Design Engine ltd

[redacted] - Design Engine ltd

[redacted] - ECL Contracts Ltd

[redacted] - ECL Contracts Ltd

[redacted] - Eco Green Roofs

[redacted] - Ginkgo Projects

[redacted] - Ginkgo Projects

[redacted] - Ginkgo Projects

[redacted] - Ginkgo Projects

[redacted] - Ginkgo Projects

[redacted] - Ginkgo Projects

[redacted] - HLM Architects

HLM Document Control - HLM Architects

[redacted] - HVP Security Shutters Ltd

[redacted] - Henley Stone Specialists Ltd

[redacted] - Henley Stone Specialists Ltd

[redacted] - Henley Stone Specialists Ltd

[redacted] - Henley Stone Specialists Ltd

[redacted] - Ironside Farrar

[redacted] - Ironside Farrar

[redacted] - Ironside Farrar

[redacted] - Lesterose Scotland Ltd

[redacted] - Lesterose Scotland Ltd

[redacted] - Linear Projects Ltd

[redacted] - Linear Projects Ltd

[redacted] - Linear Projects Ltd

[redacted] - M&S Engineering Ltd

[redacted] - M.R. Stephenson Limited

[redacted] - M.R. Stephenson Limited

[redacted] - MMM JOINERY LTD

[redacted] - Martec

[redacted] - Mercury Engineering

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[redacted] - Mercury Engineering

[redacted] - Mercury Engineering

[redacted] - Miller Fabrications Ltd

[redacted] - Miller Fabrications Ltd

[redacted] - Mott MacDonald Ltd (Head Office UK)

[redacted] - Mott MacDonald Ltd (Head Office UK)

[redacted] - Movawall Systems Ltd

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

[redacted] - Multiplex Construction Europe

NHSL RHSC + DCN - NHS Lothian

[redacted] - Novum Structures UK Ltd

[redacted] - Novum Structures UK Ltd

[redacted] - Novum Structures UK Ltd

[redacted] - Novum Structures UK Ltd

[redacted] - Ove Arup & Partners Scotland Ltd

PFP Admin - PFP Ltd

[redacted] - Reglit Glass Architecture

[redacted] - Robert Bird & Partners Ltd

[redacted] - Robert Bird & Partners Ltd

Mr RBG Document Control - Robert Bird & Partners Ltd

[redacted] - Schindler Lifts

[redacted] - Schindler Lifts

[redacted] - Scotdor

[redacted] - Solinear Ltd

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Stephenson

[redacted] - Telling Architectural

[redacted] - Topek Limited

[redacted] - Topek Limited

[redacted] - WJ Groundwater Limited

[redacted] - WJ Groundwater Limited

[redacted] - WJ Groundwater Limited

[redacted] - Wallace Whittle

[redacted] - Wallace Whittle

[redacted] - Workspace (Scotland) LLP

[redacted] - Workspace (Scotland) LLP

Sent Monday, 3 September 2018

Reason Returned with Comments and Review Status

MESSAGE

All

Please see attached for your information/action, documents which have been reviewed and given a status.

Should you have any queries please don't hesitate to contact me.

Many thanks

Document Control.
BM Edinburgh Document Control

Multiplex Construction Europe Ltd
RHSC & DCN Site Office
Little France Crescent
EDINBURGH
EH16 4TJ

T: [redacted]

From: [redacted]
Sent: 30/08/2018 8:22:53 AM BST (GMT +01:00)
To: BMEdinburgh DocControl, [redacted]
Mail Number: WSP UK-TRANSMIT-000035
Subject: Updated Fire Strategy - Cavity Barrier Text

Morning,
Please see attached updated fire strategy report taking into account all V13 changes and adding in additional text re: cavity barriers.
Thanks
[redacted]

Aluminium Composite Material (ACM) cassette cladding and soffit panels

- **Scope of Works**

CLIENT: BROOKFIELD MULTIPLEX

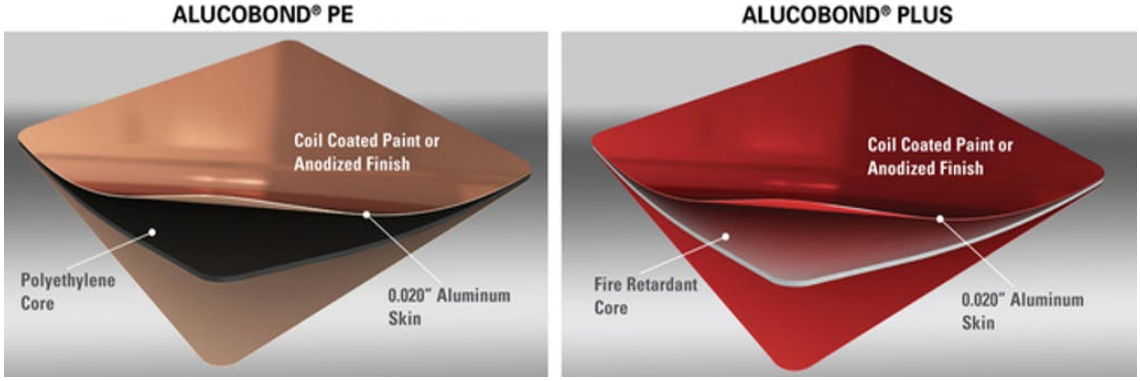
PROJECT: RHSC & DCN EDINBURGH

Introduction

ALUCOBOND® PLUS is one of the world's top brands of fire-retardant Aluminium Composite Material Panels (ACM) and is supplied by Booth Muirie (www.boothmuirie.co.uk). It is used on both the soffits and front elevation of the RHSC hospital building. ALUCOBOND® PLUS is produced with various core thicknesses and has a factory applied coil coated Fluoropolymer (PVDF or FEVE) paint finish which is one of the best architectural coatings available today for all climatic and environmental conditions.

Alucobond® PLUS has been developed exclusively for the higher requirements of the fire regulations in architecture. Due to its fire-resistant core (FR Core), Alucobond® PLUS meets the higher requirements of fire classifications. In the light of recent events in the UK as well as ongoing tests and expected changing building regulations, 3A Composites GmbH has published a general recommendation for the use of ALUCOBOND® PLUS material on buildings over 18m.

ALUCOBOND® PLUS consists of two aluminium cover sheets and a mineral-filled core that achieves a Group 1 result when tested to ISO9705. ALUCOBOND® PLUS also achieves a B Class rating and is deemed as limited combustibility or non-combustible in European countries when tested to EN13501.1.



Alucobond® Plus panels have a high degree of fire protection, formability, flatness, stability, rigidity and weather resistance.

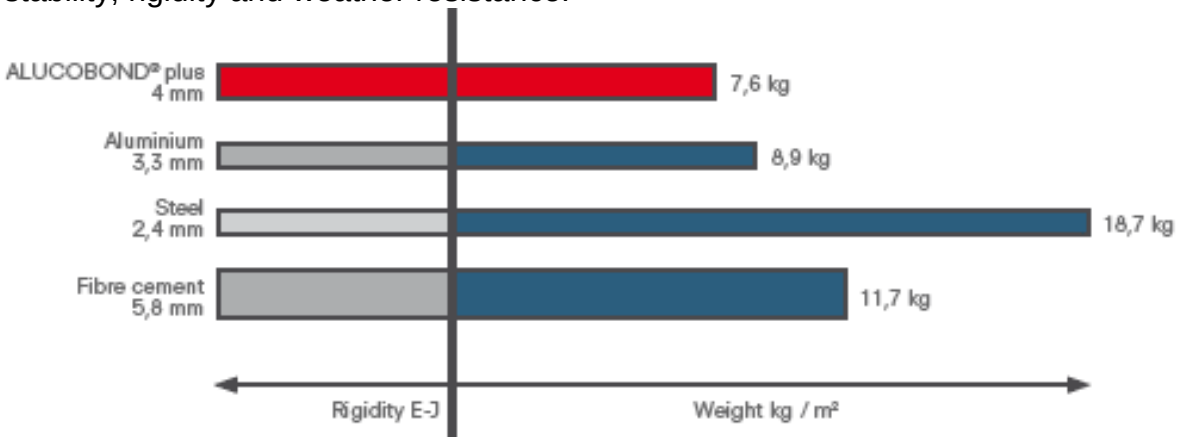


***Fig 1*. Wind load and permissible panel sizes for 4mm ALUCOBOND® PLUS**

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The graphs for 4 mm thick **ALUCOBOND® PLUS** indicate the maximum permissible panel length (σ = 51 N/mm²) (without having to add a stiffener) based in applicable design wind load and panel width. Values apply to 4-side supported panels.

Key Benefits of Alucobond Plus:

- High formability and stability
- Full manufacturer's warranty
- Internationally approved fire performance
- Weather resistant
- 5005 Marine grade alloy
- Applied coil coated Fluoropolymer (PVDF or FEVE) paint finish
- CodeMark Certified

Warranty

Alucobond® Plus has a five-year warranty against manufacturing / workmanship defects. The paint manufacturers offer warranties that range from 5 years to 20 years. The paint manufacturers' warranty covers the crack, chip, peal and allowable colour fade.

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Email Cavity Barrier

[redacted]

Hi [redacted]

Further to reviewing the attached report from Warrington Fire and Elevation Drawings showing location of cavity barriers I would preliminarily conclude that:

- 10m cavity barrier spacing would be required under NDTH.

The elevation drawings(Fire Strategy) appear to illustrate that a separating distance of no more than 20m is applied- this would equate to walls with a low risk or non-combustibility rating under the NDTH. I will assume that the elevation drawings are accurate and indicated cavity barriers are provided in all suitable locations and installed as per manufacturers specifications/requirements.

Although the increase in separation distance between barriers (20m instead of 10) is not per the NDTH, on the assumption that the CB noted on the elevation drawings are installed, the overall level of safety is not significantly reduced as:

- It would appear CB are provided to all openings, compartment floors and walls, this results in limited areas where there are 20m wide sections of continuous insulation.

- The cladding materials to the external walls are Euro Class B or better which will not contribute to fire spread. This will limit the heat build up with in cavities, thus reducing the ability for rapid fire spread.

- Lateral fire spread is slower and less likely than vertical fire spread.

- With cavity barriers around all openings, fire spread in external wall cavities will have limited opportunity to break back into the building.

- Given that CB are provided over compartment wall junctions, a fire should not have the opportunity to outflank a compartment wall/floor etc- should not lead to failure of compartmentation.

- Building is not high rise – fire fighting access to external walls possible.

I would recommend the following investigation/mitigation:

- Confirmation of CB Locations – especially in relation to compartment walls- will need detailed compartment plans.

- Investigation of external ignition risks- proximity of bins, car parking, plant etc.

- Regular checks on external walls to show their integrity-no exposed insulation etc.

- Dialogue with fire service.

In summary at this stage and subject to further investigation I am of the opinion that increase in the distance between CB does not significantly increase life safety risks in the building, however as it is not per NDTH requirements, corrective action may be required unless agreement from approval authorities can be gained for the actual installations.

Thanks [redacted]

[redacted]

Director – Fire Engineer

[redacted]

[redacted]

[redacted]

[redacted]

A close up of a sign

Description automatically generated

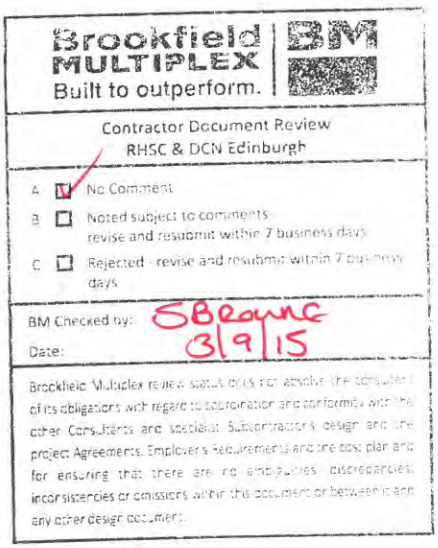
The information contained in this email may be commercially sensitive and/or legally privileged. If you are not the named recipient please tell us. If you have received this message in error, please notify the sender by reply e-mail and then delete this message from your system. You are requested not to disclose it to any other person, copy or distribute it or use it for any purpose.

Section Revision History

No.	Purpose	
FT	FINAL TENDER	16th Dec 2013
01	Issued for T1 Cost Check	26th Jun 2014
02	Updated for T1 Cost Check	18th Aug 2014
03	Issued for T2 Tender (excluding Energy Centre)	7th Apr 2015
A	Issued for T3 Construction - Excluding Energy Centre	6th Aug 2015

Clauses amended in Revision A

No.	Clause	
109	LIFE EXPECTANCY	Added
120D	METAL COMPOSITE PANEL	Added



H43 Metal composite panel cladding/ covering

To be read with Preliminaries/ General conditions.

109 LIFE EXPECTANCY

- Composite Cladding Panels: to be minimum 25 years

120A METAL COMPOSITE PANEL TO ENERGY CENTRE

- Support structure: Secondary steel cladding rails to structural engineers specifications.
  - Bearing width (minimum): Minimum 50 mm
- Panels:
  - Manufacturer: Kingspan Limited or equal and approved, horizontally laid wall cladding system for standard internal & external non-corrosive environments also Loss Prevention Certification Board certified to LPS 1181 Grade EXT - B..
    Product reference: Kingspan KS-1000-LV Louvre Profile.
  - External facing material: Hot-dip zinc coated steel to BS EN 10147, grade Fe E220G with Z275 zinc coating..
    Finish: PVDF Colourcoat 60 micron.
    Colour: RAL from standard colour range.
  - Internal facing material: Hot-dip zinc coated steel to BS EN 10147.
    Finish: 0.4mm Lining enamel.
    Colour: white.
- Core insulation: Zero ODP LPCB certified formulation.
- Panel thickness: 120mm to achieve maximum U-value of 0.2 W/m²K.
- Accessories: As required to complete installation.
- Primary fasteners: as recommended by cladding manufacturer.
  - Number and location of fasteners:
    - For panels: Each panel fixed to each support using not less than one fastener located through tongue section, as recommended by cladding manufacturer.
    - For panel bearers: Fix each one using two fasteners.
    - For flashings/trims at vertical joints: Fix to each support using one fastener.
- Vertical Joints: Male/Female Joint system with factory applied weatherseal.
- Finish/colour: Finish as external face of panels.
- Special features: Pre-formed corners.
- Incorporated components:
  - Vent Louvres to M&E requirements as Section L10.
  - Removable Panels as required for plant replacement strategy
- Other Requirements:
  - PPC aluminium flashings to louves/ doors etc
  - PPC aluminium cill flashings at base
  - Min life expectancy/ guarantee/ spare parts provision/ availability as required by BYES

120B METAL COMPOSITE PANEL TO PLANT ROOM ENCLOSURE

- Support structure: Secondary steel cladding rails or SFS set to curve all to structural engineers specifications.
  - Bearing width (minimum): Minimum 50 mm
- Panels:
  - Manufacturer: Kingspan Limited or equal and approved, vertically laid wall cladding system for standard internal & external non-corrosive environments also Loss Prevention Certification Board certified to LPS 1181 Grade EXT - B..
    Product reference: Kingspan KS-600-MR.
  - External facing material: Hot-dip zinc coated steel to BS EN 10147, grade Fe E220G with Z275 zinc coating..
    Finish: PVDF Colourcoat 60 micron.
    Colour: RAL from standard colour range.
  - Internal facing material: Hot-dip zinc coated steel to BS EN 10147.
    Finish: 0.4mm Lining enamel.
    Colour: white.
- Core insulation: Zero ODP LPCB certified formulation.
- Panel thickness: 120mm to achieve maximum U-value of 0.2 W/m²K.
- Accessories: As required to complete installation.
- Primary fasteners: as recommended by cladding manufacturer.
  - Number and location of fasteners:
    - For panels: Each panel fixed to each support using not less than one fastener located through tongue section, as recommended by cladding manufacturer.
    - For panel bearers: Fix each one using two fasteners.
    - For flashings/trims at vertical joints: Fix to each support using one fastener.
- Vertical Joints: Male/Female Joint system with factory applied weatherseal.
- Finish/colour: Finish as external face of panels.
- Special features: Pre-formed Corners
- Incorporated components:
  - Vent Louvres as Section L10.
  - Removable Panels as required for plant replacement strategy
- Other Requirements:
  - PPC aluminium flashing to access doors
  - PPC aluminium cill flashings at base
  - Min life expectancy/ guarantee/ spare parts provision/ availability as required by BYES

120C METAL COMPOSITE PANEL TO INSIDE FACE OF ROOF PARAPETS

- Support structure: Secondary steel cladding rails or SFS set to curve all to structural engineers specifications.
  - Bearing width (minimum): Minimum 50 mm
- Panels:
  - Manufacturer: Kingspan Limited or equal and approved, horizontally laid wall cladding system for standard internal & external non-corrosive environments also Loss Prevention Certification Board certified to LPS 1181 Grade EXT - B..
    Product reference: Kingspan RW panels.
  - External facing material: Hot-dip zinc coated steel to BS EN 10147, grade Fe E220G with Z275 zinc coating..
    Finish: PS200
    Colour: To match roof covering/parapets.
  - Internal facing material: Hot-dip zinc coated steel to BS EN 10147.
    Finish: 0.4mm Lining enamel.
    Colour: white.
- Core insulation: Zero ODP LPCB certified formulation.
- Panel thickness: 120mm to achieve maximum U-value of 0.2 W/m²K.
- Accessories: As required to complete installation.
- Primary fasteners: as recommended by cladding manufacturer.
  - Number and location of fasteners:
    - For panels: As recommended by cladding manufacturer.
    - For flashings/trims at vertical joints: Fix to each support using one fastener.
- Vertical Joints: as recommended by cladding manufacturer.
- Finish/colour: Finish as external face of panels.
- Special features: None.
- Incorporated components: Flashings to base of panels at gutter
- Other Requirements:
  - Min life expectancy/ guarantee/ spare parts provision/ availability as required by BYES

120D METAL COMPOSITE PANEL TO VERTICAL FACE OF ETFE ROOFLIGHTS

- Support structure: Secondary steel cladding rails or SFS set to curve all to structural engineers specifications.
  - Bearing width (minimum): Min 60mm intermediate, Min 130mm vertical joint
- Panels:
  - Manufacturer: Kingspan Limited or equal and approved, vertically laid wall cladding system for standard internal & external non-corrosive environments also Loss Prevention Certification Board certified to LPS 1181 Grade EXT - B..
    Product reference: KS1000 Optimo, Flat Architectural Insulated Wall Panel.
  - External facing material: S220GD+ZA hot-dip zinc/aluminium Galfan protected steel to BS EN 10346: 2009.
    Colour: Kingspan Spectrum, colour standard TBC.
  - Internal facing material: Hot-dip zinc coated steel to BS EN 10346: 2009.
    Finish: 0.4mm Lining enamel.
    Colour: CleanSafe 15.
- Core insulation: ECOsafe LPCB certificated PIR formulation. Receiving BREEAM Credit (Pollution 4: Insulant GWP) 2006 credit.
- Panel thickness: 120mm to achieve maximum U-value of 0.2 W/m²K.
- Accessories: As required to complete installation.
- Primary fasteners: as recommended by cladding manufacturer.
  - Number and location of fasteners:
    - For panels: As recommended by cladding manufacturer.
    - For flashings/ trims at vertical joints: Fix to each support using one fastener.
- Vertical Joints: as recommended by cladding manufacturer.
- Finish/colour: Finish as external face of panels.
- Special features: None.
- Incorporated components: Flashings to base of panels at gutter
- Other Requirements:
  - VJ1 EPDM 60 x 10mm self-adhesive air seal bubble gasket applied to vertical intermediate supporting steelwork and lapped over drip flashing.
  - Internal face of panel to be air sealed along the full length by an unbroken run of 6mm bead of non-setting gun-grade, PremSeal CV or similar.
  - Factory made pre-formed corner panels.
  - Integrated windows are not recommended with Optimo System D.
  - Manufacturers 30 year maintenance and inspection free coating guarantee. Manufacturers coating guarantee to be available on project completion and be fully transferrable for future changes of building ownership.
  - Min life expectancy/ guarantee/ spare parts provision/ availability as required by BYES

GENERAL REQUIREMENTS

165 CONTRACTOR'S DESIGN WALL/ ROOF CLADDING

- Design responsibility:
  Determine profile, sheet thickness and type, sizes and number of fixings to suit the layout and details of supporting steelwork shown on Structural engineers drawing.
- Design standard: In accordance with BS 5427-1.
- Structural and fire requirements:
  - Generally: As section B50.
  - Modifications: N/A.
  - Design: Complete the design in accordance with the designated code of practice to satisfy specified performance criteria.
- Functional requirements:
  - Air permeability - 5m³/hr/m²
  - Fire Resistance - As required to meet Technical Standards.
- Additional requirements:
  - Responsibility and coordination at design interfaces.
  - Location of service openings and plant.
  - Location of movement joints.
- Design and production information:
  - Schedules defining location and magnitude of loads to be transmitted to supporting structure not in the Contractor's design.
  - Detail drawings showing, e.g. fixings between units, anchorages to supporting structure, joint details, trimmers around openings, formation of upstands, kerbs, gutters and outlets and lifting details.
  - Method statements and quality plan for manufacture, transportation and installation. .
- Timing of submissions: To be agreed with Brookfiled Multiplex.

172 THERMAL PERFORMANCE/ BRIDGING

- Requirement: Complete thermal design of the cladding/ covering system to avoid excessive thermal bridging.
  - Standard: MCRMA Technical Paper 14 and BRE Information Paper 1/06.

175 PRODUCT SAMPLES

- General: Before commencing detailed design, submit labelled samples of the following:
  Cladding Panel Installation

176 FASTENER SAMPLES

- General: During detailed design, submit labelled samples of each type of fastener.

DESIGN/ PERFORMANCE REQUIREMENTS

185 PERFORMANCE COMPLIANCE

- Verification: Before commencing fabrication, submit evidence based on laboratory testing or computer modelling.
  - Verifying authority: UKAS .

192 SOUND TRANSMITTANCE OF CLADDING/ COVERING SYSTEM - WEIGHTED

- Location: Through external wall.
- Requirement: Measure within 100 to 3150 Hz frequency range to BS 5821-3.
  - Minimum weighted sound reduction index (Rw): To Acoustic Consultants Requirements.

198 WATER PENETRATION

- Requirement: Under site exposure conditions, moisture must not penetrate onto internal surfaces, or into cavities not designed to be wetted.

202 AVOIDANCE OF SURFACE CONDENSATION

- Requirement: Determine surface condensation risk of cladding system using the method described in BS EN ISO 13788. If necessary, revise thermal insulation to provide satisfactory temperature factor (fmin). Ensure that damage and nuisance from surface condensation and does not occur.

FIXING CLADDING/ COVERING

215 PAINTING STRUCTURE

- Sequence: Paint outer surface of supporting structure before fixing cladding/ covering.

219 FASTENERS

- Unspecified fasteners: Recommended for the purpose by the cladding/ covering manufacturer.

221 FITTINGS AND ACCESSORIES

- Unspecified fittings and accessories: Recommended for the purpose by the cladding/ covering manufacturer.

223 PREVENTION OF ELECTROLYTIC ACTION

- Isolating tape: Type recommended by cladding/ covering manufacturer.
  - Location: To contact surfaces of supports and sheets of dissimilar metals.

310 PURPOSE MADE COLD FORMED METAL ACCESSORIES

- Material: Aluminium Sheet.
  - Thickness/ gauge: 2 or 3mm dependant on coping width.
  - Finish/ Colour: PPC - RAL colour from standard range.
- Fasteners:
  - Type: Aluminium joint straps, stopends, internal and external corners and special items, fixings and joint sealant recommended for the purpose..
  - Location: Varies.
  - Fixing centres: To manafacturers guidance/ recommendations.

470 STRUCTURAL MOVEMENT JOINTS

- Type: Cover flashing fixed on one side over gap between panels.
- Location: Coincident with structural movement joint.
- Width of gap: To match structural movement joint requirements.
- Requirement: Weathertight.

480 FLASHINGS/ TRIMS GENERALLY

- Lap joint treatment:
  - Vertical and sloping flashings/ trims: End laps to be same as for adjacent panels.
  - Horizontal flashings/ trims: End laps to be 150 mm, sealed and where possible arranged with laps away from prevailing wind.
- Method of fixing: To structure in conjunction with adjacent panels. Otherwise to panels.
  - Fasteners: to manafacturers guidance/ recommendations .

540 ABUTMENTS

- Junctions with flashings: Weathertight and neatly dressed down.

550 SEALING EXTERNAL LAPS

- Sealant tape: Types recommended by panel/ sheet manufacturer.
- Position of tape: Below fixing positions in straight unbroken lines, parallel to and slightly back from edge of panel/ sheet.
- Seal quality: Effective, continuous and not overcompressed.
- End laps: Sealant tape positions:
  - Single line tape: Immediately below line of fasteners.
  - Second line tape (where specified): Slightly set back from the edge of external sheet.
- Side laps: Sealant tape positions:
  - Single line tape: Outside line of fasteners.
  - Second line tape (where specified): On other side of fasteners.

KINGSPAN COMPOSITE WALL PANEL SYSTEMS

- **Scope of Works**

CLIENT: BROOKFIELD MULTIPLEX

PROJECT: RHSC & DCN EDINBURGH

Introduction

Within the RHSC project there are three different profiles/types of Kingspan composite wall panels in two distinct colours, used in three specific areas:

- Energy Centre, Ground level (KS1000 LV, Colour Onyx/Anthracite - RAL 7016)
- Energy Centre, First Floor (KS1000 LV, Colour Silver - RAL 9006)
- Plantrooms AR7 & AR8 level 4 (KS800 Optimo, Colour Onyx/Anthracite – RAL 7016)
- Elevation C10 plantroom level 4 (KS600 MR Micro rib, Colour Silver - RAL 9006)

Kingspan KS1000 LV (Louvre), KS600MR (Micro-rib) Wall Panels & KS800 Optimo Wall Panels





Profiles: Flat, Louvre & Micro-Rib
Fixing detail: Secret-fix
Metal type: Steel
Application: Suitable for vertical or horizontal application
Lengths: From 1.8m to 17m
Cover width: 1000mm and 2000mm
Spanning Capability: Long span – up to 8.2m, frame to frame
Fire rating: LPCB, FM approved
Pre-formed corners and panels: Panels can be curved on the length or width, corners can be cranked or mitred depending on profile

Fire Safety

Kingspan Insurer Certified sandwich panels achieve high levels of reaction to fire performance in tests specified for regulatory purposes, large scale tests developed by the insurance industry and large-scale tests developed by other organisations including ISO, British Standards Institute (BSI) and the National Fire Protection Agency (NFPA).

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Expert Advisory Report for Multiplex Construction (Europe) Limited (“RHSC”) in relation to Cladding at Royal Hospital for Sick Children (“RHSC”) in Edinburgh

Document Number:	**MT19689R**
Date:	**28/10/2021**
Project No:	**304950**
Issue Number:	**02**

Report of [redacted] for MPX

Address of the Property:	Royal Hospital for Sick Children ("RHSC") 50 Little France Crescent Edinburgh bio Quarter Edinburgh EH16 4TJ
Specialist field:	Fire Safety
Assisted by:	[redacted]
On instructions of:	Brodies LLP Solicitors, 15 Atholl Cresent, Edinburgh, EH3 8HA.
On behalf of:	Multiplex Construction (Europe) Limited ('MPX')
Subject matter:	Report to provide expert opinion on materials used, and the installed external walling systems, at Royal Hospital for Sick Children ("RHSC") in Edinburgh, the Property.
Dated:	28/10/2021

Revision History

Revision	Date	Reason for Issue	Prepared By *For and on behalf of Warringtonfire Consulting Limited*	Reviewed By
01	15/09/2021	Issue 01	[redacted] General Manager Head of Fire Engineering (UK)	[redacted] Division Director Europe Consulting
02	28/10/2021	Issue 02, comments from client addressed	[redacted] General Manager Head of Fire Engineering (UK)	[redacted] Division Director Europe Consulting

VALIDITY

This report is formulated on the basis of the information and experience available at the time of preparation. It is applicable to the above-mentioned project only in accordance with the client's instructions. It is only valid provided no other modifications are made other than those for which a formal opinion has been sought and given by Warringtonfire.

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W: http://www.warringtonfire.com

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1 Introduction

1.1 Expert Qualifications

Name: [redacted]

Position: General Manager – Head of Fire Engineering UK

Qualifications:

- BSc, Building Legislation and Technology. (Manchester).
- BEng (Hons), Fire Engineering. (First Class (Preston)).
- MRICS, The Royal Institution of Chartered Surveyors. (Chartered Building Control Surveyor)
- MIFireE, Member of the Institution of Fire Engineers.
- FBEng, The Chartered Association of Building Engineers. (Fellow Chartered Building Engineer)
- Diploma in Building Control (Stockport).
- Higher National Certificate in Building Studies (Preston)

I am [redacted], General Manger and Head of Fire Engineering of Warringtonfire UK.

Warringtonfire is an independent fire testing, certification and consultancy business that has been providing specialist fire safety related services since 1965

I have 35 years' experience in the construction industry, 31 of which as a Regulator and Fire Engineer. My experience over this time has focused on fire safety regulatory compliance.

I have been a full member of the Building Regulations Advisory Committee (BRAC), which is a Statutory Scientific Advisory Committee, which the Secretary of State for Housing, Communities and Local Government consults when changes to the Building Regulations are proposed.

I have provided a copy of my CV with further details of experience and qualifications in Appendix A of this report.

I was assisted by my colleague [redacted] with collation of information and research, under my supervision (Senior Fire Consultant, BSc). Additionally, my colleague [redacted] has reviewed this report.

1.2 Summary of Query

1.2.1 Background to the query – The Parties

Muliplex Construction (Europe) Limited ("MPX") were employed as the main contractor. IHS Lothian Limited ("IHSL") were Project Co on the RHSC Project and therefore MPX's employer.

1.2.2 Background to the query – The Property and the Works

The Royal Hospital for Sick Children ("RHSC") in Edinburgh, the Property, was a new build hospital. The date of the Construction Contract was 13 February 2015, the works were carried out throughout 2016 / 2017 and the works were agreed practically complete in February 2019.



Figure 1 – The Property, RHSC

I understand that all building work was to meet the functional requirements of the Building Standards that were in force at the time the Building Warrant application was submitted. The Building (Scotland) Regulations 2004[1] was the relevant legislation.

The RHSC is a five storey hospital building (ground + 4). I have been informed that the height to the top storey is less than 18m and my report is written on that basis. MPX have communicated to me that the height has been verified and confirmed through measurements taken from site, measuring the height of the top storey using the method detailed in Schedule 4 of The Building (Scotland) Regulations 2004.

1.2.3 Background to the Query – Matter for Review

Following the evidence arising from the Grenfell inquiry, IHSL were requested by NHS Lothian to review the cladding materials installed at RHSC and confirm the suitability of these materials.

I have been informed that there is concern regarding the presence of combustible insulation (Kingspan K15) in the external wall system, and whether the presence of the insulations identified prevent the systems aligning with the Building Standards guidance applicable to this project at the time of construction.

My report does not consider whether the systems meet the Scottish advice note on external wall systems published in August 2021. This guidance applies to existing buildings to assist building owners / managers to determine the risk to life from the spread of fire on external wall systems. The advice note may apply more onerous requirements to those which applied at the time of construction (this may not be Multiplex's responsibility, but it would be imprudent of me not to note this needs to be addressed by the responsible person).

1.3 Report Purpose

The purpose of this report is to provide expert opinion in respect to questions raised by Brodies LLP Solicitors. I have been asked to review the systems against the requirements of the Building Standards guidance that applied at the following dates:

- 13 February 2015 (the date of the Construction Contract).
- 2016/2017 when the works were carried out; and
- February 2019 (when the works were agreed as practically complete).

Note. My field of expertise does not extend to contractual interpretation and therefore my opinions in this report are on the basis that MPX were contractually obliged to comply with the applicable Building Standards in respect to fire safety, as indicated by Brodies LLP.

I understand that the report could be used by MPX in connection with possible future dispute proceedings.

[1] The Building (Scotland) Regulations 2004

2 Instruction

2.1 Statement of Instruction

To advise in relation to the possible dispute between (1) Multiplex Construction (Europe) Limited ('MPX') and (2) IHS Lothian Limited ("IHSL") in relation to Royal Hospital Sick Children Edinburgh ('the Property')

I confirm that I, [redacted], of Warringtonfire have been instructed by Brodies LLP to act as an independent Expert Advisor for their client Multiplex Construction (Europe) Limited ('MPX').

I confirm that there are no circumstances which give rise to a conflict of interest in accepting these instructions.

2.2 Key Questions

The substance of my instructions, written and oral, which I have received in the preparation of this report, is to advise on:

1. Do you consider that the materials used, and the installed external walling systems, at RHSC were compliant with all relevant fire safety regulations? Please consider this question and provide your opinion on the position as at the following dates:
   - 13 February 2015 (the date of the Construction Contract);
   - 2016/2017 when the works were carried out; and
   - February 2019 (when the works were agreed as practically complete).
2. Do you consider that, in respect of each of the dates notes above, each of the installed external walling systems would have been capable of passing a desk-top assessment based on the criteria which were applicable at the time?

3 Response to Key Question 1

The first question I have been asked is:

> 1. Do you consider that the materials used, and the installed external walling systems, at RHSC were compliant with all relevant fire safety regulations? Please consider this question and provide your opinion on the position as at the following dates:
>
> 1.1. 13 February 2015 (the date of the Construction Contract);
>
> 1.2. 2016/2017 when the works were carried out; and
>
> 1.3. February 2019 (when the works were agreed as practically complete).

In answering this I have considered what the requirements were and whether the systems described to me of would meet those requirements.

However, my review has only been of the design information and therefore the opinions given below are based on that information only. I am unable to provide opinion on whether the as installed systems replicate the design information. I have not visited the site or surveyed works on the site.

3.1 Applicable Regulations and Guidance Documents

3.1.1 Building Regulations Requirements

The relevant statutory requirements applying to the design and construction of the external walls was the Building (Scotland) Regulations 2004, these regulations applied at all three of the dates I have been asked to consider. Schedule 5 to regulation 9 of the Building (Scotland) Regulations 2004 defines 'Building Standards' which must be achieved in relation to fire safety. The Building Standards set out the broad objectives or functions that the individual aspects of the building design and construction must set out to achieve. They are therefore often referred to as 'functional requirements' and are expressed in terms of what is 'reasonable', 'adequate', or 'appropriate'.

3.1.2 Technical Handbook – Non-Domestic (NDTH)

The Scottish Ministers have issued Technical Handbooks to provide practical guidance to comply with the Building Standards. Importantly the Technical Handbooks provide quantifiable criteria where the Building Standards may describe only qualitative requirements.

The Technical Handbook – Non-Domestic (NDTH) is the primary guidance document for fire safety in non-domestic buildings that are designed and constructed in Scotland.

NB. Alternative methods to prove compliance may be used.

The Technical Handbook states that if the guidance is followed in full then this should be accepted by the verifier as indicating that the Building Regulations have been complied with. The technical handbook goes on to state that proof of compliance with the guidance may be relied on in any proceedings as tending to negative liability for an alleged contravention of the building regulations. Following the advice in the Technical Handbooks is therefore the normal way of complying with Building Regulations.

I have been informed that the first warrant stage was submitted on 24th October 2014, on this basis the applicable edition of the NDTH was the Technical Handbook – Non-Domestic: 2013[2]. I have been asked to consider compliance at three specific project dates. Whilst later editions the NDTH had been published by some of these dates, these do not apply to this project because the edition that applies is dictated by the Building Warrant application date. are This is summarised in Table 1 below.

[2] Scottish Government (2013). Technical Handbook – Non-Domestic.

Project Dates	Latest Edition of NDTH Published at Specified Date	Applicable Edition of NDTH to the Project
13 February 2015 (the date of the Construction Contract)	Technical Handbook – Non-Domestic: 2013	Technical Handbook – Non-Domestic: 2013
2016/2017 (when the works were carried out)	Technical Handbook – Non-Domestic: 2015[3] until 30/06/16 Technical Handbook – Non-Domestic: 2016[4] from 01/07/16 until 30/06/17 Technical Handbook – Non-Domestic: 2017[5] from 01/07/17	Technical Handbook – Non-Domestic: 2013
February 2019 (when the works were agreed as practically complete)	Technical Handbook – Non-Domestic: 2017	Technical Handbook – Non-Domestic: 2013
Note. The edition of the NDTH that applies to the project is dictated by the Building Warrant application date.		

Table 1 – Project Dates, Latest Editions of NDTH and Applicable Edition of NDTH

Although the Technical Handbook – Non-Domestic: 2013 was the applicable guidance, it is noted that the recommendations detailed in the various editions of the Technical Handbook referenced in Table 1 are common with respect to the external walls.

I note that the NDTH: 2019, which applies to warrant applications after 1st October 2019, introduced significant changes to the requirements for external walls in buildings above 11m and / or hospitals of any height. The changes prevent the use of combustible products in the construction of the external wall systems, however, this did not apply to RHSC at the time of construction.

3.1.3 Scottish Health Technical Memorandum 81 Part 1 (SHTM 81-1)

The protection of patients from fire in the in-patient care areas of hospitals introduces specific considerations. The NHS Scotland's Firecode, SHTM 81 Part 1, provides recommendations and guidance additional to the statutory requirements of the Building (Scotland) Regulations 2004 for new healthcare premises.

The edition which applied at all three of the dates I have been asked to consider was SHTM 81 Part 1: 2009[6] (SHTM 81-1) The Firecode recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc. As a result, SHTM 81-1 introduces a higher standard of fire safety for the protection of patients from fire in the in-patient care areas of hospitals, and other treatment facilities. The guidance in SHTM 81-1 is supplementary to, and must be read in conjunction with, the NDTH.

With respect to external walls, SHTM 81-1 does not introduce any additional requirements and refers the reader to the recommendations specified in the 'Technical Handbook – Non-Domestic' (referred to as NDTH throughout this document).

3.1.4 Demonstrating Compliance with the Building Standards

SHTM 81-1 notes that its contents are provided by way of guidance only. Any party making any use thereof or placing any reliance thereon shall do so only upon exercise of that party's own judgement as to the adequacy of the contents in the particular circumstances of its use and application. I consider that it was reasonable for a competent contractor to consider that designing external walls at RHSC

3 Scottish Government (2015). Technical Handbook – Non-Domestic.
4 Scottish Government (2016). Technical Handbook – Non-Domestic.
5 Scottish Government (2017). Technical Handbook – Non-Domestic.
6 Health Facilities Scotland (2009). NHSScotland's Firecode, SHTM 81 Part 1.

to comply with the guidance detailed in the NDTH, thus SHTM 81-1, would meet the Building Standards.

3.2 Recommendations in the NDTH

Unless a building is within 1m of a boundary, then the requirements are primarily based on the height of the building. I have noted from the drawings (to be reconfirmed by MPX), that the boundary distance is greater than 1m when formulating this response, if it is within 1m the performance requirements would increase.

Paragraph 0.7.2 of the NDTH provides the method of measurement of building height and storey height. The methods are taken from Schedule 4 to regulation 7 of The Building Regulations.

Height and depth

4. The height of:

   a. a building shall be taken to be the height from the surface of the ground to the underside of the ceiling of the topmost storey or, if the topmost storey has no ceiling, one-half of the height of the roof above its lowest part, and

   b. a storey above the ground or the depth of a storey below the ground shall be taken to be the vertical height or depth as the case may be from the ground to the upper surface of the floor of the storey, and the expressions "a storey at a height" and "a storey at a depth" shall be construed accordingly.

Figure 2 – Measurement method, extract from NDTH: 2013

The parameters that the NDTH may recommend controls for are:

- the combustibility of the external surface material,
- the combustibility of the insulation; and
- the provision of cavity barriers.

Where the boundary distance is ≥1m, at the time of construction the recommendations for the external walls for hospitals were primarily governed by the building height. I have been informed that the height to the top storey is less than 18m and my report is written on that basis (more stringent requirements would have applied to the insulation if the building height was greater than 18m).

The recommendations that applied to external wall cladding at RHSC (being less than 18m in height) in relation to these parameters are detailed in Table 2 below.

Parameter	Recommendation for RHSC
Combustibility of the external surface material	Low risk
Combustibility of the insulation	None
Provision of cavity barriers	Provide cavity barriers, as per Section 2.4 of NDTH

Table 2 – Recommendations for External Wall at RHSC

3.2.1 Combustibility of External Surface

The NDTH recommends that the external surface of the wall should be low risk or better.

The definition of 'Low Risk' and 'Medium Risk' is provided in Annex 2.E of the Technical Handbook, the relevant extract is provided in Table 3 below.

Low risk	The surface material (or where it is bonded throughout to a substrate, the surface material combined with the substrate) has a surface of Class 1 and, when tested in accordance with BS 476: Part 6: 1981 or BS 476: Part 6: 1989 has an index of performance (I) not more than 12 and a sub-index (I_1) not more than 6.	The material has achieved a classification of B-s3,d2 or better when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.
Medium risk	The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 1 surface spread of flame.	The material has achieved a classification of C-s3,d2 or better when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.

Table 3 – Definition of 'Low Risk' and 'Medium Risk', copied from NDTH: 2013

It is noted from the extract above that there are two routes to claim a product is 'Low Risk', either using National test methods or European classification methods.

3.2.2 Combustibility of Insulation

For buildings which were less than or equal to 18m, there were no restrictions placed on the combustibility of the insulation used in the external wall.

3.2.3 Provision of Cavity Barriers

Cavity barrier provision in the external wall enables a building to achieve a number of the functional requirements of the building regulations. The specific requirement is detailed within Standard 2.4 of Schedule 5 to Regulation 9 of the Building Regulations (Cavities), but the functional requirement in relation to Standard 2.7 (Spread on external walls) is particularly interdependent upon this requirement being met.

Standard 2.4 of Schedule 5 to Regulation 9 of the Building Regulations is reproduced in Figure 3 below.

Cavities

2.4. Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

Figure 3 – Relevant extract from Building Regulations

It is noted that the term 'inhibited' within this requirement is unquantified. The NDTH clarifies the method to inhibit unseen spread of fire and smoke through such cavities, in order to comply with the functional requirement of the Building Regulations, is to seal and subdivide the cavity. This is the purpose of the cavity barriers.

The NDTH defines that in order to inhibit unseen spread of fire and smoke, cavity barriers must achieve at least a short fire resistance duration. A short fire resistance duration is defined in Annex 2.D of the NDTH as 30 minutes integrity (resistance to fire penetration when tested in accordance with one of the national or European methods detailed).

The extent to which any of these measures are necessary is dependent upon the use of the building and materials used in the construction.

3.2.3.1. Cavity Barriers at Defined Positions

The specific locations where cavity barriers are required for the RHSC is defined in Section 2.4 of the NDTH, this includes around openings and service penetrations that may be present in the external wall system. Cavity barriers are also generally required where a wall, floor or other part of a building with a fire resistance duration abuts a structure containing a cavity so as to extend the line of the structure.

3.2.3.2. Cavity Barriers to Divide Cavities

Clause 2.4.2 of the NDTH 2013 recommends that cavity barriers are provided to divide up cavities. The frequency of cavities is dependent upon the combustibility of materials facing into the cavity, with cavity barriers required every 20m if the materials facing the cavity were low risk or better, every 10m if materials facing cavity were not low risk. The relevant extract from the NDTH 2013 is provided in Figure 4 below.

> Cavities should be measured either horizontally or vertically, as the case maybe, along the centre-line of the cavity and not diagonally.
>
> Every cavity should be divided by cavity barriers so that the maximum distance between cavity barriers is not more than 20m where the cavity has exposed surfaces which achieve European Classification A1, A2 or B, or 10m where the cavity has exposed surfaces which achieve European Classification C, D or E. However for roof space cavities above an undivided space the guidance in clause 2.4.3 should be followed. Additional guidance for buildings containing a sleeping risk (other than residential care buildings and hospitals) is also provided in clause 2.4.4.

Figure 4 – Extract from clause 2.4.2 of NDTH 2013

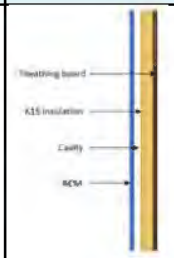
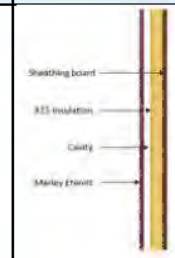
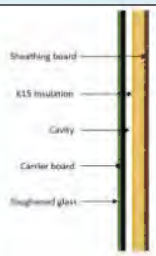
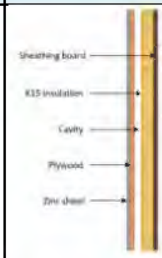
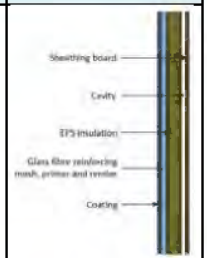
The definition of 'Low Risk' and 'Medium Risk' was provided in Table 3 above.

3.3 Description of Cladding Systems Installed at RHSC

I have been asked to consider five cladding systems:

a) ACM
b) Marley Eternit
c) Sto Ventec Glass Rainscreen
d) Zinc
e) StoTherm Vario

These are summarised in Table 4 below:

System	A. ACM	B. Marley Eternit	C. Sto Ventec Glass Rainscreen	D. Zinc	E. StoTherm Vario
Basic arrangement (not to scale)					
External surface material(s)	4mm thick Alucobond Plus ACM cassette	Marley Eternit panel	StoVentec Toughened glass	0.8mm thick Rheinzinc Zinc sheet	Coating and reinforcing system over EPS
Materials facing into cavity	Alucobond Plus ACM and K15	Marley Eternit fibre cement panel and K15	Carrier board and K15	Plywood and K15	EPS and Sheathing board

Cavity barriers	CW-FS-60 Lamatherm	SP60 Rockwool, Envirograf Fast-fit	SP60 Rockwool, Envirograf Fast-fit	Specific details not provided, but stated to be 60 minutes	Sto Mineral Fibre Lamella (manufactured by Rockwool)
	Positioned at compartment floor level, compartment wall, surrounding windows & doors, aligned with walls to hazard rooms and at no more than 20m distance within cavities.				

Table 4 – Overview of Cladding Systems Reviewed

The positions of cavity barriers within the external wall, as indicated above, is indicated on the elevation drawings, an example is provided in Figure 5 below.



Figure 5 – Extract from drawing number HLM-SZ-SL-EL-572-001 showing cavity barrier provision

3.4 Did the Cladding Align with NDTH Recommendations?

As I have not inspected the cladding, my responses are based on a review of the design information only. The review has been completed upon the assumption that the as built detail is as detailed within the information I have received. Furthermore, my review is on the basis that the building work has been completed in a workmanlike manner such that the systems behave as intended (as an example, cavity barrier installation aligns with approved details such that they can adequately perform their function inhibiting the spread of fire and smoke).

3.4.1 Combustibility of the External Wall Cladding

In accordance with the Annex 2.E of the NDTH, the external wall finishes would have been considered to meet the Low Risk fire rating or better. This is evidenced below, where the documents indicated cover the three dates I have been asked to consider (13 February 2015, 2016/2017 and February 2019).

- ACM system - BBA certificate 05/4214 Product Sheet 1 dated 23 July 2013[7] and 4 August 2017[8] indicated Alucobond Plus achieved a Euroclass B, as such the external surface was designated as Low Risk. Additionally the panels were also noted to achieve a Class 0 when tested against the national classification scheme, which would also support the Low Risk designation. See warning note 1 below.
- Marley Eternit system - BBA certificate 06/4355 Product sheet 3 dated 23 January 20149 indicates the panel achieves a Euroclass A2, as such the external surface was designated as Non-Combustible which exceeded the recommendation in the NDTH.
- StoVentec Glass Rainscreen system - BBA certificate 10/4792 Product Sheet 2 dated 28 June 201210 and 13 January 202011 indicates the external glass is classified as non-combustible which exceeds the recommendation in the NDTH.
- Zinc system – I have not been provided evidence that the decorative Zinc sheet product used over plywood achieves the required reaction to fire classification to enable it to be designated as low risk, however, from experience I would expect this product to achieve the required low risk rating (the test methods used to designate a material as low risk apply the heat source from the exposed face only, the zinc sheet would provide some protection to the plywood behind which can enable the low risk criteria to be achieved) This should be confirmed through existing test evidence or if required conductance of a test.
- StoTherm Vario system - The BBA certificate 95/3132 Product Sheet 2 dated 25 February 2013[12] and 8 August 2017[13] indicates the system achieves a Euroclass B, as such the external surface was designated as Low Risk. See warning note 2 below.

External wall cladding systems achieving a low risk fire rating would align with the recommendations of the NDTH, as such it is my opinion that they could be considered to meet the Building Standards at the time of construction.

Note 1 – The current BBA certificate dated 13 January 2020[14] states cassette systems would need reaction to fire classification to be confirmed.

Note 2 – Current BBA certificate dated 30 April 2020[15] states no reaction to fire performance is declared.

3.4.2 Combustibility of the Insulation

Not applicable because there are no performance requirements imposed for buildings with a height less than 18m (see notes above regarding confirming actual completed building heights).

3.4.3 Provision of Cavity Barriers

3.4.3.1. Cavity Barriers at Defined Positions

As detailed in Table 4 above, the elevation drawings and information provided indicate that cavity barriers were provided at compartment floor level, compartment wall, surrounding windows & doors and aligned with walls to hazard rooms. The inclusion of cavity barriers at these positions complies with the recommendations of NDTH.

The literature provided specifies that the cavity barriers provided are rated for 60 minutes which meets the recommendations of the NDTH. I would note that I have not confirmed the suitability of the cavity barriers installed because I understand this is not in question, the rating and locations are taken from the information provided to me.

7 BBA. (2013). BBA Certificate Number 05/4214 Product Sheet 1 Alucobond Cladding Systems.
8 BBA. (2017). BBA Certificate Number 05/4214 Product Sheet 1 Alucobond Cladding Systems.
9 BBA. (2014). BBA Certificate Number 06/4355 Product Sheet 3 Marley Eternit Façade Panels Equitone (Natura).
10 BBA. (2012). BBA Certificate Number 10/4792 Product Sheet 2 Sto Ventec Glass.
11 BBA. (2020). BBA Certificate Number 10/4792 Product Sheet 2 Sto Ventec Glass.
12 BBA. (2013). BBA Certificate Number 95/3132 Product Sheet 2 Sto Therm Vario.
13 BBA. (2017). BBA Certificate Number 95/3132 Product Sheet 2 Sto Therm Vario.
14 BBA. (2020). BBA Certificate Number 05/4214 Product Sheet 1 Alucobond Cladding Systems.
15 BBA. (2020). BBA Certificate Number 95/3132 Product Sheet 2 Sto Therm Vario.

3.4.3.2. Cavity Barriers to Divide Cavities

The literature provided specifies that the cavity barriers provided are rated for 60 minutes which meets the recommendations of the NDTH. As above, the rating and locations are taken from the information provided to me.

As detailed in Section 3.3 above, the elevation drawings provided indicate that the design intent was for cavity barriers to divide up cavities at maximum distances of 20m.

3.4.3.2.1. Cladding with K15 Insulation Facing into Cavity (Systems A to D)

Cladding system A (ACM), B (Marley Eternit), C (Sto Ventec Glass Rainscreen) and D (Zinc) all have Kingspan K15 insulation facing into the cavity. Whilst there were no restrictions on the combustibility of the insulation materials, it is recognised that as the K15 insulation faces into the cavity it impacts on the distance between cavity barriers to divide up large cavities.

The insulation facing into the cavity was Kingspan K15, this insulation would be required to achieve a Low Risk fire classification to justify 20m cavity barrier distances.

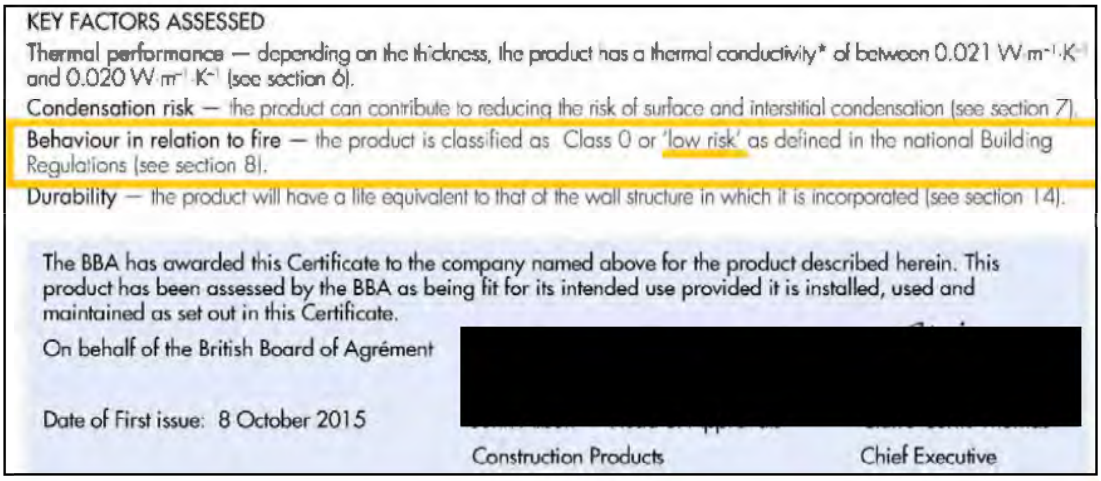
I have seen contradictory evidence which suggests Kingspan K15 insulation is either designated as Low Risk or Medium Risk. My colleague Beth Dean contacted Kingspan to obtain clarification regarding the reaction to fire classification. Kingspan have confirmed that they do not have evidence to confirm K15 was ever 'Low Risk', they have confirmed K15 was and is 'Medium Risk'.

Since K15 insulation is Medium Risk, additional cavity barriers should have been provided (every 10m). The key on the elevation drawings indicate the design intent, division every 20m, was not sufficient to meet the recommendations in the NDTH. In some cases compliance may still be achieved circumstantially, due to the location of cavity barriers around floor to floor windows, compartment walls / floors, etc. It is possible that this will apply to some areas of cladding, but not the complete cladding across the building. Where cavity barriers around windows are considered for this requirement, the cavity barriers would need to completely divide the cavity, as such it is likely this will only occur where windows run full floor to floor height. The detail would need to be checked in the as built drawings and/or on site.

I have considered whether the evidence which indicated the K15 insulation was Low Risk was relevant and should have been relied upon by MPX at the dates I have been asked to consider.

- K15 Reaction to Fire Designation at 13 February 2015

  At the date of the Construction Contract, 13 February 2015, the British Board of Agreement (BBA) certificate stated that K15 insulation was 'Low Risk'. Specifically I have reviewed certificate 08/4582[16] dated 27th October 2008, certificate 14/5134[17] dated 8th October 2015 and iterations between these dates; all of which state K15 was 'Low Risk'.



KEY FACTORS ASSESSED

Thermal performance — depending on the thickness, the product has a thermal conductivity* of between 0.021 W·m⁻¹·K⁻¹ and 0.020 W·m⁻¹·K⁻¹ (see section 6).

Condensation risk — the product can contribute to reducing the risk of surface and interstitial condensation (see section 7).

Behaviour in relation to fire — the product is classified as Class 0 or 'low risk' as defined in the national Building Regulations (see section 8).

Durability — the product will have a life equivalent to that of the wall structure in which it is incorporated (see section 14).

The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

[redacted]

Date of First issue: 8 October 2015

Construction Products Chief Executive

Figure 6 – Extract from BBA Certificate 14/5134 dated 8th October 2015

[16] BBA. (2008). BBA Certificate Number 08/4582 Product Sheet 1: Kooltherm K15 Rainscreen Insulation Board
[17] BBA. (October 2015). BBA Certificate Number 14/5134 Product Sheet 7: Kooltherm K15 Rainscreen Insulation Board

The British Board of Agrement (BBA) is a member of the EOTA. As such the Technical approvals that it issues in the form of BBA Certificates are evidence to show that the requirements of the Building Regulations that are applicable to the material, product or system can be achieved.

Therefore it was reasonable and acceptable to rely on the BBA Certificate when selecting the appropriate system for a project and determining whether the system could meet the required performance standards required by the Building Standards. This led me to conclude Building Standards compliance was achieved at the date of the Construction Contract.

- K15 Reaction to Fire Designation at 2016 / 2017

  When the works were carried out in 2016/2017, the BBA certificate referred to in Figure 6 above was no longer current. The BBA amended the certificate for this product in November 2015 (BBA certificate 14/5134[18] dated 16th November 2015), at which time the reference to the product being 'Low Risk' was removed and the only reaction to fire classification detailed was Euroclass C. This Euroclass classification falls outside of 'Low Risk' performance requirements, Euroclass C products are designed at Medium Risk materials.

  Although the BBA certificates which stated K15 was 'Low Risk' were not current at the time the RHSC was constructed, consideration may be given by others (legal team) as to the applicable standards based on the contract date and the submission for Building Warrant.

  I note that whilst the K15 system was no longer stated to be Low Risk on the BBA certificate, the Kingspan Kooltherm K15 Rainscreen Board data sheet[19] still specified that the product achieved a national Class 0 until September 2017. The term Class 0 was defined in Approved Document B[20], to achieve a National Class 0 test specimens need to achieve a Class 1 when tested against BS 476 Part 7[21] and an index of performance (I) of not more than 12 and sub-index of not more than 6 when tested against BS 476 Part 6[22]. The tests methods and criteria applied to obtain a Class 0 fire rating are the same as those detailed in the Technical Handbook to obtain a 'Low Risk' designation.

  Kingspan have confirmed that the wording within Approved Document B led to K15 being classified as Class 0 based on testing of the foil facing alone. For the K15 insulation to be classified as 'Low Risk' in accordance with the Technical Handbook these tests were required on the bonded composite, inclusive on phenolic insulation. As such, the National classification noted does not indicate that K15 is 'Low Risk'.

  At the time of construction I would consider that a reasonably competent contractor may have understood that the Class 0 rating, as described on the datasheet, meant that the product could be designated as 'Low Risk' (although this was incorrect).

- K15 Reaction to Fire Designation at February 2019

  When the works were agreed as practically complete in February 2019 it was known that K15 insulation was Medium Risk.

3.4.3.2.2. Cladding with Plywood Facing into Cavity (System D)

In addition to the Kingspan K15 insulation, cladding system D (Zinc) also has plywood facing into the cavity. Whilst there were no restrictions preventing the use of plywood in the cladding system, it's inclusion in this position impacts on the distance between cavity barriers to divide up large cavities.

The plywood facing into the cavity would be required to achieve a Low Risk fire classification to justify the 20m cavity barrier distances. For plywood to achieve a Low Risk designation, it would need to be treated with flame retardant additives and it's performance proven by test. MPX have informed me

18 BBA. (November 2015). BBA Certificate Number 14/5134: Product Sheet 7, Kooltherm K15 Rainscreen Insulation Board.
19 Kingspan (2016, 10th Issue). Kooltherm K15 Rainscreen Board.
20 MHCLG (2013). Approved Document B Volume 2 2006 incorporating 2007, 2010 & 2013 amendments – Building Other than Dwellinghouses
21 BSI. (2014) BS 476 Part 7: 1997 + A1 + Corr 1 Fire Tests On Building Materials And Structures. Method Of Test To Determine The Classification Of The Surface Spread Of Flame Of Products.
22 BSI. (2014) BS 476 Part 6: 1989 + Corr 1 Fire tests on building materials and structures. Method of test for fire propagation for products.

that the reaction to fire classification of the plywood installed is unconfirmed, on this basis I must consider the requirements on the assumption that the plywood is not Low Risk and conclude that cavity barriers were required to divide up cavities at 10m intervals.

Since K15 insulation and plywood is not considered as Low Risk, additional cavity barriers should have been provided (every 10m). The key on the elevation drawings indicate the design intent, division every 20m, was not sufficient to meet the recommendations in the NDTH. In some cases compliance may still be achieved circumstantially, due to the location of cavity barriers around floor to floor windows, compartment walls / floors, etc. It is possible that this will apply to some areas of cladding, but not the complete cladding across the building. Where cavity barriers around windows are considered for this requirement, the cavity barriers would need to completely divide the cavity, as such it is likely this will only occur where windows run full floor to floor height. The detail would need to be checked in the as built drawings and/or on site..

3.4.3.2.3. Cladding with EPS Insulation Facing into Cavity (System E)

Cladding system E (StoTherm Vario) has EPS insulation facing into the cavity. Whilst there were no restrictions preventing the use of this EPS insulation in the cladding system, it's inclusion in this position impacts on the distance between cavity barriers to divide up large cavities.

The StoTherm Vario BBA certificates referenced in Section 3.4.1 of this report confirm that the EPS insulation cannot be considered as low risk. On this basis I conclude that cavity barriers were required to divide up cavities at 10m intervals.

The key on the elevation drawings indicate the design intent, division every 20m, was not sufficient to meet the recommendations in the NDTH and additional cavity barriers would be required. In some cases compliance may still be achieved circumstantially, due to the location of cavity barriers around floor to floor windows, compartment walls / floors, etc. It is possible that this will apply to some areas of cladding, but not the complete cladding across the building. Where cavity barriers around windows are considered for this requirement, the cavity barriers would need to completely divide the cavity, as such it is likely this will only occur where windows run full floor to floor height. The detail would need to be checked in the as built drawings and/or on site.

3.4.1 Summary

I have summarised my opinions in Table 5 below.

System	Parameter	NDTH Recommendation for RHSC	Was there sufficient evidence to conclude Building Standards had been Met?		
			13 February 2015	2016/2017	February 2019
A (ACM); B (Marley Eternit); and C (Sto Ventec Glass Rainscreen)	Combustibility of the external surface material	Low risk	Yes	Yes	Yes
	Combustibility of the insulation	None	Yes	Yes	Yes
	Provision of cavity barriers	At positions detailed in section 2.4 of NDTH	Yes	Yes	Yes
		At recommended distances to divide up cavities	Yes	No*	No*
D (Zinc)	Combustibility of the external surface material	Low risk	Yes	Yes	Yes
	Combustibility of the insulation	None	Yes	Yes	Yes
	Provision of cavity barriers	At positions detailed in section 2.4 of NDTH	Yes	Yes	Yes

System	Parameter	NDTH Recommendation for RHSC	Was there sufficient evidence to conclude Building Standards had been Met?		
			13 February 2015	2016/2017	February 2019
		At recommended distances to divide up cavities	No*	No*	No*
E (StoTherm Vario)	Combustibility of the external surface material	Low risk	Yes	Yes	Yes
	Combustibility of the insulation	None	Yes	Yes	Yes
	Provision of cavity barriers	At positions detailed in section 2.4 of NDTH	Yes	Yes	Yes
		At recommended distances to divide up cavities	No*	No*	No*
* The key on the elevation drawings indicate the design intent was to provide cavity barriers at no more than 20m intervals which would not meet the NDTH recommendation, however, in some cases compliance may still be achieved circumstantially due to the location of cavity barriers around floor to floor windows, compartment walls / floors, etc.					

Table 5 – Summary of Review of Cladding at RHSC

4 Response to Key Question 2

The second question I have been asked is:

> 2. Do you consider that, in respect of each of the dates notes above, each of the installed external walling systems would have been capable of passing a desk-top fire assessment based on the criteria which were applicable at the time?

4.1 Desktop Assessment

In this context, I understand a desktop assessment is referenced in relation to demonstrating compliance with the criteria detailed in BR 135: 2013 'Fire Performance of external thermal insulation for walls of multi-storey buildings'[23]. The classification criteria defined in BR 135 relates to test data obtained during a BS 8414[24] [25] large scale test. A desktop assessment is a process whereby test data obtained on a system directly tested against BS 8414, is used to validate a 'similar' system. At the time of construction, there were no rules which defined the term 'similar'. The publication of BS 9414: 2019[26] introduced procedures and rules to evaluate variations and changes to products and systems which have been tested in accordance with BS 8414. Only minor variations are permitted by BS 9414, more significant variations which may previously been assessed via a desktop assessment would not be permitted by BS 9414.

4.2 Reference to BR 135 in NDTH

At the time of construction, the NDTH detailed reaction to fire requirements that materials used in the construction of an external wall should meet. Meeting the combustibility requirements detailed within Section 3.2.1 and 3.2.2 of my report is commonly known as the linear route to demonstrate compliance with the Building Standards. At the time of construction, an alternative method to demonstrate compliance with respect to the combustibility of materials was to demonstrate the cladding system could meet the criteria defined in BR 135.

The use of BR 135 was not detailed as a route to reduce the frequency of cavity barriers to divide up cavities. The classification criteria defined in BR 135 relates to test data obtained during a BS 8414 large scale test. Although the BS 8414 test is considered to be a large scale method, the width of the test rig is not sufficient to assess the impact of larger cavities running horizontally throughout the cladding system.

4.3 Applicability of BR 135 to RHSC Cladding

In isolation of the cavity barrier requirements, the combustibility of the materials used in the cladding systems met the linear route. The use of BR 135 as an alternative route to demonstrate compliance, with respect to material combustibility, was therefore not required.

The cavity barrier provision did not align with the recommendations detailed in the NDTH, further division of the cavity would be required to align with the guidance. Demonstrating the cladding system meets the performance criteria detailed in BR 135 would not negate the recommendation to further divide the cavity.

4.4 Potential Method to Comply with the Building Regulations Applicable at the Time of Construction

23 BR 135: 2013. Fire Performance of external thermal insulation for walls of multi-storey buildings, Building Research Establishment Report.

24 *BSI (2005).* BS 8414-1: 2002. Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems applied to the masonry face of a building.

25 BSI (2005) BS 8414-2: 2005. Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a Structural Steel Frame.

26 BSI (2019). BS 9414. Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests

The addition of cavity barriers to divide the cavities at a maximum of 10m intervals would enable the system to align with the recommendations detailed within the NDTH at the time of construction.

I am aware that at the time of construction some projects were using holistic fire engineering solutions (such as incorporating suppression systems) to mitigate the risks associated with variations in the cladding system. I have not been aware of any such approach on this project.

4.5 Requirements Applying to Existing Buildings

A fire safety risk assessment is a legal requirement for “relevant premises”. Determining the risk to life from the spread of fire on external wall systems is just one element which needs to be considered as part of a fire safety risk assessment. The Scottish advice note on external wall systems was published in August 2021 to assist building owners / managers determine the risk posed from the external wall systems. The advice note may apply more onerous requirements to those which applied at the time of construction (this may not be Multiplex’s responsibility, but it would be imprudent of me not to note this needs to be addressed by the responsible person).

5 Conclusions

5.1 Key Question 1

1. Do you consider that the materials used, and the installed external walling systems, at RHSC were compliant with all relevant fire safety regulations? Please consider this question and provide your opinion on the position as at the following dates:

   1.1. 13 February 2015 (the date of the Construction Contract);

   1.2. 2016/2017 when the works were carried out; and

   1.3. February 2019 (when the works were agreed as practically complete).

Typically, the critical date with respect to which regulations are applicable to building work, is the date the Building Warrant application is submitted. I have been informed that the first warrant stage was submitted on 24th October 2014, on this basis the applicable edition of the NDTH was the Technical Handbook – Non-Domestic: 2013.

I have been asked to consider the compliance of five external wall cladding systems, at three specific dates:

- At the date of the Construction Contract, 13 February 2015, I consider that:
  - The ACM, Marley Eternit and Sto Ventec Glass Rainscreen systems as described within this report met the Building Standards.
  - The Zinc and StoTherm Vario systems as described within this report met the Building Standards; with the exception of the division of cavities.
- During the period when the works were carried out, 2016 / 2017, I consider that:
  - The five systems I have been asked to review (ACM, Marley Eternit, Sto Ventec Glass Rainscreen, Zinc and StoTherm Vario as described within this report) met the Building Standards; with the exception of the division of cavities.
- At the date of the works were agreed as practically complete, February 2019, I consider that:
  - The five systems I have been asked to review (ACM, Marley Eternit, Sto Ventec Glass Rainscreen, Zinc and StoTherm Vario as described within this report) met the Building Standards; with the exception of the division of cavities.

Where I have concluded that the division of cavities did not meet the Building Standards, I consider that the cavities should have been divided every 10m. The key on the elevation drawings supplied to me indicate the design intent, division every 20m, was not sufficient to meet the recommendations in the NDTH. In some cases compliance may still be achieved circumstantially, due to the location of cavity barriers around floor to floor windows, compartment walls / floors, etc. It is possible that this will apply to some areas of cladding, but not the complete cladding across the building. Where cavity barriers around windows are considered for this requirement, the cavity barriers would need to completely divide the cavity, as such it is likely this will only occur where windows run full floor to floor height. The detail would need to be checked in the as built drawings and/or on site.

In the answer I give above I conclude that compliance in respect of the system materials was achieved (with the exception of cavity barrier issues) on the basis that the systems complied with requirements of the NDTH and the various information that the material manufactures produced at the time supported this conclusion. However, we now know that a number of pieces of information that were relied on at the time have subsequently been shown to be incorrect. Therefore there is a legal point that Brodies LLP may need to consider and advise on. This point, is whether it could be successfully argued that compliance with the regulations was not actually achieved because the supporting information was incorrect? Albeit that MPX would appear to have done what was required to demonstrate compliance at the time by complying with and following the guidance in the NDTH.

5.2 Key Question 2

> 2. Do you consider that, in respect of each of the dates notes above, each of the installed external walling systems would have been capable of passing a desk-top fire assessment based on the criteria which were applicable at the time?

In this context, I understand a desktop assessment is referenced in relation to demonstrating compliance with criteria detailed in BR 135. It is my opinion that the use of BR 135 would not have been beneficial with respect to demonstrating that the requirements of the Building Standards had been met at RHSC. My conclusion is on the basis that:

- The combustibility of the materials used in the cladding systems met the linear route. The use of BR 135 as an alternative route to demonstrate compliance, with respect to material combustibility, is therefore not required.
- The cavity barrier provision did not align with the recommendations detailed in the NDTH, further division of the cavity would be required to align with the guidance. Demonstrating the cladding system meets the performance criteria detailed in BR 135 would not negate the recommendation to further divide the cavity.

Note. The Scottish Government have published advice on their website, in various iterations of the Scottish advice note 'Determining the fire Risk posed by External Wall Systems in Existing Multi-Storey Residential Buildings for External Walls'[27] (draft editions published prior to publication in August 2021). Hospital buildings are within the scope of the advice, the advice introduced additional fire safety requirements for external wall systems which may have been considered as exceeding those requirements detailed in the Technical Handbook. This would be a matter for the building operators to consider.

[27] Scottish Government (2021). Scottish Advice Note. Determining the fire Risk posed by External Wall Systems in Existing Multi-Storey Residential Buildings for External Walls.

6 Declaration - Brodies to advise on declaration requirements

I, Andrew McCracken, Declare that:

1. I understand that my duty in providing written reports and giving evidence may be used in the future to help an Adjudicator or similar (TBA), and that this duty overrides any obligation to the party by whom I am engaged or the person who has paid or is liable to pay me. I confirm that I have complied and will continue to comply with my duty.
2. I confirm that I have not entered into any arrangement whereby the outcome of the case has any bearing on the amount or payment of my fees is in any way.
3. I am not aware and have any knowledge of any conflict of interest of any kind relating to this instruction which affects my suitability as an expert witness on any issues on which I have given evidence.
4. I will make known to the party by whom I am instructed if, between the date of my report and any future the adjudication or similar, there is any change in circumstances which affect my answers above.
5. I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.
6. I have not, without forming an independent view, included or excluded anything which has been suggested to me by others, including my instructing lawyers.
7. I will notify those instructing me immediately and confirm in writing if, for any reason, my existing report requires correction or qualification.
8. I understand that:
    a) My report may form the evidence to be given potentially under oath or affirmation;
    b) Questions may be put to me in writing for the purposes of clarifying my report and that my answers shall be treated as part of my report and covered by my statement of truth;
    c) An Adjudicator or similar (TBA) may in the future direct a discussion to take place between experts for the purpose of identifying and discussing the expert issues in proceedings, where possible reaching an agreed opinion on those issues and identifying what action, if any, may be taken to resolve any of the outstanding issues between the parties;
    d) An Adjudicator or similar (TBA) may in the future direct that, following a discussion between the experts, a statement should be prepared showing those issues which are agreed and those issues which are not agreed, together with a summary of the reasons for disagreeing;
    e) I may be required to attend a hearing convened by an Adjudicator or similar (TBA) to be cross-examined on my report by a cross-examiner assisted by an expert;
    f) I am likely to be the subject of adverse criticism by an Adjudicator or similar (TBA) if Adjudication or similar (TBA) concludes that I have not taken reasonable care in trying to meet the standards set out above.

STATEMENT OF TRUTH

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

Signature [redacted]

Date 28 October 2021

Name in full [redacted]

Appendix A – Curriculum Vitae

Personal Details: [redacted]

[redacted]

[redacted] Summary:

[redacted]

Qualifications:

- [redacted]

Employment History:

[redacted]

Product Specification

Extruded aluminium, double glazed and thermally broken glazing systems all as listed below:

- Schüco FW60+ dry glaze curtain walling screens:

FW60+ curtain wall mullion drained system. Mullions and transoms are 60mm wide.
Curtain Walling screens incorporate a thermal break.

- Schüco FW60+ structural silicone curtain walling screens:

FW60+ curtain wall front sealed 4-side silicone system where each glass unit mechanically fixed via extruded aluminium fixing lugs. Mullions and transoms are 60mm wide.

- Schüco AWS55 top hung windows:

Windows are glazed into curtain walling, or at the energy centre are fixed back to others adequate and suitable structure using standard aluminium fixing lugs or direct fix through the frame depending on details.
AWS65 top hung outward opening windows to be fitted with Schüco BS7950 ironmongery comprising:
Standard locking multipoint handles, multi-point fastening mechanism, friction stays and fixed restrictor. All ironmongery is in a standard silver finish.Opening vents are internally glazed with standard beads. Fixed lights are internally glazed with standard beads.

- Schüco ADS65 HD Swing Doors:

Schuco ADS65 HD single door open out entrance /exit door with Schuco standard ironmongery comprising:
Surface mounted overhead closer; barrel hinges; multi-point lock with cylinder; standard lever handle both inside and outside; weatherstrip and ramped threshold (Rebated threshold above ground floor).

Schuco ADS65 HD open out emergency exit single door with Schuco standard ironmongery comprising:
Surface mounted overhead closer; barrel hinges; panic release bar and lock mechanism with a pull handle and cylinder to the outside; weatherstrip and ramped threshold (Rebated threshold above ground floor).

Schuco ADS65 HD single door open out entrance /exit door with Schuco standard ironmongery comprising:
Surface mounted overhead closer; barrel hinges; multi-point lock with cylinder; standard lever handle both inside and outside; lever-bolts; weatherstrip and ramped threshold (Rebated threshold above ground floor).

Schuco ADS65 HD open out emergency exit double door with Schuco standard ironmongery comprising:
Surface mounted overhead closer; barrel hinges; panic release bar to both leaves and lock mechanism; a single pull handle and cylinder to the outside of the master leaf; weatherstrip and ramped threshold (Rebated threshold above ground floor).

- Kawneer AA3110 Horizontal Sliding window

Thermally broken windows fixed back to suitable existing structure using standard lug fixings.

Kawneer AA3110 horizontal sliding windows are onto a thermally broken 2-track system allowing for 1no sliding leaf and 1no fixed light.

Sliding units are glazed as they are fabricated in our factory.

Each sliding unit comprises standard horizontal sliding gearing and flush / pull / raised handle and central lock.

- External Flashings to glazing areas:

All non-insulated single layer pressings, manufactured from 2 or 3mm aluminium.

Perimeter flashings to screens to be sheet aluminium pressed to profile and polyester powder coated one side only to match the curtain wall and windows.

- Automatic Bi-Parting Door Gearing:

Supply and installation of 4no automatic bi-parting door units at the main entrance areas.
Operator Type:GEZE Slimdrive SL NT Electro-mechanical sliding door operator with Microprocessor control and silent brushless DC motor.

- ACM Cladding:

Supply, manufacture and install of metal cladding works to the North Block only.

Specification A (External Walls)
- The fabrication, supply and install of 4mm thick ACM (Alucobond) cassette panels
- Main base colour panels are finished in standard PVDF Anthracite Grey 105, reverse face in mill finish
- Six Accent colours allowed from standard colours (Silver Metallic 500; Grey Metallic 502; Gold Metallic 601; Grey Blue Metallic 603; Seafoam Green 604; and Indiana Copper 704)
- System quoted is the Booth-Muirie BML200 standard to all walls
- Joint recess being 20mm wide nominally
- Panels being pre-routed, folded into trays and complete with Aluminium edge angle attachments fixed thereto for recessed discreet fixing
- All panels will be internally stiffened to suit Building Wind Load conditions and have relevant engineer backed calculations to suit

Specification B (First Floor Fascia's and Soffit)
- The fabrication and supply to site of 4mm thick ACM (Alucobond) cassette panels
- Panels are finished in standard PVDF Mouse Grey 125, reverse face in mill finish
- System quoted for BML200
- Joint recess being 20mm wide nominally
- Panels being pre-routed, folded into trays and complete with Aluminium edge angle attachments fixed thereto for recessed discreet fixing
- All panels will be internally stiffened to suit Building Wind Load conditions and have relevant engineer backed calculations to suit

Specification C (Caps)
- The fabrication and supply to site of ACM (Alucobond) panels
- Panels are finished in standard PVDF colour, reverse face in mill finish
- System quoted BML400 face-fix
- Panels pre-routered and cut to size
- Based on 600mm nominal girth

Specification D (Window Jamb pressing):
- The fabrication and supply of 1.5mm aluminium pressings
- Panels are finished on a standard RAL polyester powder coated finish, reverse face mill finish.
- Girth of pressing due to machine tolerances will be 183mm girth (20+33+30+100).
- Height of sections to be 3000mm with a make-up sizes butt-strapped to suit the floor heights

- Feature Flashings:

Non-insulated single layer pressing, manufactured from 2mm aluminium in a RAL7005 finish.
All pressings are butt strap jointed and fixed back to the cementitious board with the use of support angles.

- Fascia Flashings:

Insulated single layer pressing, manufactured from 3mm aluminium in a RAL7005 finish.
All pressings are butt strap jointed and face fixed to top hat supports behind.
All pressings are also backed by an EPDM from the cope to the face of the SFS board.

Project Co

THE ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE, EDINBURGH

Fire Strategy Report



highlight updates for ease of reference

Brookfield MULTIPLEX BM
Built to outperform.

Contractor Document Review
RHSC & DCN Edinburgh

A ☒ No Comment

B ☒ Noted subject to comments revise and resubmit within 7 business days

C ☐ Rejected revise and resubmit within 7 business days

BM Checked by

Date 03.09.18

Brookfield Multiplex review does not absolve the consultant of its obligations with regard to coordination and conformity with the other Consultants and specialist Subcontractors design and the Project Agreements Employers Requirements and the cost plan and for ensuring that there are no ambiguities, discrepancies, inconsistencies or omissions within this document or between it and any other design document.

WSP-SZ-XX-DC-572-500 V14
AUGUST 2018

CONFIDENTIAL

Project Co

THE ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE, EDINBURGH

Fire Strategy Report

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70003278
OUR REF. NO. WSP-SZ-XX-DC-572-500 V14

DATE: AUGUST 2018

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QUALITY CONTROL

Issue/revision	Issue 7	Issue 8	Issue 9	Issue 10
Remarks	Updated following initial BCO and SFRS comments	Updated for BYES risk register purpose only	Updated for BYES risk register purpose only (BLUE TEXT)	Updated for BYES risk register purpose only (BLUE TEXT)
Date	28/05/2015	24/05/2016	21/07/2016	04/08/2016
Prepared by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Checked by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Authorised by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				Issue 10
Project number	70003278	70003278	70003278	Updated for BYES risk register purpose only (BLUE TEXT)

Issue/revision	Issue 11	Issue 12	Issue 13	Issue 14
Remarks	Updated from V10 to include design notes	Updated to include final comments from the Board and new template	Updated to issue to Building Control	Updated to issue to Building Control inc cavity barrier changes
Date	15/06/2017	25/10/2017	24/07/2018	27/08/2018
Prepared by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Checked by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				

Authorised by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Project number	70003278	70003278	70003278	70003278

Previous version details available on request.

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EXECUTIVE SUMMARY

The fire safety design strategy has been developed to comply with the requirements of the Board's fire safety performance requirements.

This report has been developed using Scottish Health Technical Memorandum (SHTMs) and the Non Domestic Technical Handbook (NDTHs) where the key objectives for the building are:

- Life safety of occupants;
- Facilities for firefighting and life safety for fire fighters;
- Property protection;
- Minimising operational interruption;
- Cost effective design;
- Client aspirations;
- Building functionality and flexibility for future use.

Project Co has followed the guidance within Firecode & NDTH and other relevant guidance documents other than those areas we have identified within this report.

Fire engineered solutions have been developed wherever beneficial to enable the design flexibility required for the building to function appropriately and to achieve best value.

Where options are given within SHTM and the NDTH, Project Co's proposals identify which options they are proposing to adopt.

Contact name [redacted]
Contact details [redacted]

1

INTRODUCTION

1 INTRODUCTION

1.1 SCOPE & LIMITATIONS

This fire safety design strategy relates to Project Co Proposals (PCP) Submission for Section 4.12 Fire Strategy.

The objectives of this report are to:

- Provide description of proposed fire safety design strategy and fire engineered design proposals and ensure that the fire safety design strategy meets the key objectives for the building such as:
  - Life safety of occupants;
  - Facilities for firefighting and life safety for fire fighters;
  - Property protection;
  - Minimising operational interruption;
  - Cost effective design;
  - Client aspirations, and
  - Building functionality and flexibility for future use.

1.2 ACCEPTANCE OF APPROACH

The proposed fire safety design strategy has been developed to comply with the requirements of the Board's fire safety performance requirements.

It is understood that Project Co shall be responsible for the preparation of a Fire Safety Design Strategy (FSDS) and associated information for presentation to the Board.

The FSDS shall demonstrate compliance with building regulations relating to fire safety, the requirements of this specification and any other relevant recommendations and guidance documents. The report format shall be similar to that normally expected by local authorities but shall in the first instance be submitted to the Board. The document shall reflect the complex nature of fire protection in an environment such as this hospital facility.

2

BUILDING OVERVIEW

2 BUILDING OVERVIEW

2.1 BUILDING OVERVIEW

Description of accommodation

The proposed building will provide facilities for the use of the re-provision at the Royal Hospital for Children and Young People (RHCYP). The building will replace the existing childrens hospital facility at Sciences, Edinburgh. The building is made up of over 60 different departments offering specialist acute care for both RHCYP, to Edinburgh and the Lothian's as well as acting as a tertiary centre for Scotland.

The site for the proposed RHCYP sits within The Royal Infirmary of Edinburgh, Little France campus, to the south west of Edinburgh. The teaching hospital campus also houses the University of Edinburgh Medical School, The Queen Margaret Research Institute and the Anne Rowling Regenerative Neurology Clinic which sits directly adjacent to the Bio Quarter, Building Footprint.

The building comprises six storeys from Basement Level through to Fourth Floor.

The building will have the benefit of a large atrium adjacent to the main entrance area that extends generally from ground through to the second floor level. Other notable building features with regards the fire strategy include a helipad located at roof level.

2.2 DRAWINGS

The Fire Strategy drawings to be read in conjunction with this report are listed below:

Table 1 – Fire Strategy Drawings

Drawing Description	Drawing Reference
Basement Fire Strategy General Arrangement	HLM-SZ-B1-PL-571-001
Ground Floor Fire Strategy General Arrangement	HLM-SZ-00-PL-572-002
First Floor Fire Strategy General Arrangement	HLM-SZ-01-PL-572-003
Second Floor Fire Strategy General Arrangement	HLM-SZ-02-PL-572-004
Third Floor Fire Strategy General Arrangement	JLM-SZ-03-PL-572-006
Fourth Floor Fire Strategy General Arrangement	HLM-SZ-04-PL-572-007
Roof Fire Strategy General Arrangement	HLM-SZ-06-PL-240-001

3

DESIGN APPROVAL PROCESS

3 DESIGN APPROVAL PROCESS

3.1 OVERVIEW

Project Co proposals for both compliant and alternative solution issues are, as always, subject to the advice and consent of the approving authorities.

The relevant authorities and their associated responsibilities are:

- Building Standards – compliant issues as assessed against Section 2: Fire of the NDTH to satisfy the Building (Scotland) Regulations 2004,
- Building Standards – approval of alternative design solutions, based on fire engineering principles,
- The Board their advisors – all issues with respect to Firecode compliance,
- Scottish Fire & Rescue (Fire Authority) – fire-fighting access and facilities and compliance with the Fire (Scotland) Act 2005 as amended.

3.2 BUILDING STANDARDS

The following guidance is given within the NDTH on the status of the guidance.

The regulations are mandatory, but the choice of how to comply lies with the building owner. The Technical Handbooks have been issued by Scottish Ministers, through the Scottish Building Standards Agency, for the purpose of providing practical guidance with respect to the building regulations. If the guidance is followed in full then this should by accepted by the verifier as indicating that the building regulations have been complied with. However it is quite acceptable to use alternative methods of compliance provided they fully satisfy the regulations. Failure to comply with the Technical Handbook does not render a person liable to civil or criminal procedures, but proof of compliance with the guidance may be relied on in any proceedings as tending to negative liability for an alleged contravention of the building regulations.

3.3 ALTERNATIVE SOLUTIONS

It is recognised within the guidance that for certain building types or layouts, it may not be possible to follow the guidance in the Technical Handbook to satisfy the functional standard; therefore an alternative approach to achieve Fire Safety must be identified.

Fire safety engineering can provide such an alternative approach to the fire safety measures contained in the Technical Handbooks and this may be the only practical way to achieve a satisfactory level of fire safety in certain areas of a design. Such an approach has been identified in clause 2.0.6 of the NDTH.

Alternative Solutions to the guidance have been highlighted in red text to differentiate these areas from approaches that directly follow the guidance within the Non-Domestic Technical Handbooks. Both approaches are intended to meet the functional standard requirements of the Building Regulations.

3.4 FIRE SAFETY ENGINEERING

Specific areas of the design propose solutions that are supported by a fire engineering approach in order to provide a bespoke fire safety strategy for the installation. BS 7974:2001 (Application of fire safety engineering principles to the design of buildings — Code of practice) and the associated published documents that accompany the standard provide details of the various analysis methodologies used within Fire Engineering.

It is recognised within the guidance that although a large number of factors may potentially contribute to the development and consequences of a fire, in practice many of the factors will be insignificant. By carefully adopting the analysis technique appropriate to the problem under consideration, a pragmatic solution can be developed.

Comparative criteria

It can often be difficult to quantify the level of safety achieved in absolute terms. However, it can be relatively straightforward to demonstrate that the design provides a level of safety equivalent to that in a building that complies with recognized prescriptive codes.

Because the aim of the comparative approach is to show equivalency between the typical approach and the proposed building, the assessment is not usually sensitive to the initial assumptions. Any errors in the

assumptions will equally affect the typical design and proposed design and should not affect the relative ranking of the two designs.

Essentially, if it is explicitly demonstrated by logical deduction or calculation that the proposed design provides an equivalent or superior level of fire safety to a building complying with an appropriate prescriptive code, the comparative criteria will be met.

Sensitivity analysis

As part of the compliance process for alternative solutions sensitivity analysis has been carried out where necessary. The objective is to identify single event system failures (rather than cumulative events) or foreseeable events that might have a significant influence on the outcome of the study.

However it should also be recognised that a judgement needs to be made as to whether the “what if” event is likely to significantly affect the overall fire risk. In this respect, consideration has been given to whether:

- the event is credible;
- the consequences of the event are tolerable or no worse than in a code compliant design;
- additional fire protection measures are essential to provide a degree of redundancy.

3.5 FIRECODE

The primary remit of NHS organisations with regard to fire safety is the safety of patients, visitors and staff. For all premises under their control, NHS organisations need to select and effectively implement a series of measures to achieve an acceptable level of fire safety, taking into account:

- The guidance in the various parts of SHTM 81;
- The relevant guidance contained in other parts of Firecode;
- All relevant legislation and statutes, and
- The advice and approval of Building Standards and the Fire and Rescue authority.

Scottish Health Technical Memorandum (SHTM’s) provide comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

SHTM’s recognise the special requirements of fire precautions in the design of hospitals. They recognise the interaction between physical fire precautions, the dependency of the patient, the fire hazards within hospitals, management policies and procedures, and the availability of trained staff in achieving an acceptable level of fire safety.

3.6 SCOTTISH HEALTH TECHNICAL MEMORANDUM 81

The basis for the Fire Safety Design Strategy will be the guidance within the various sections of Scottish Health Technical Memorandum 81. Fire engineered solutions will be developed wherever beneficial to enable the design flexibility required for the building to function appropriately and achieve best value.

The SHTM 81 document provides guidance on the design of fire precautions in new hospitals and major extensions/refurbishments to existing hospitals in Scotland. Part 2 provides guidance on the use of fire engineering within healthcare premises and Part 3 on atria in healthcare premises.

The documents provide guidance to achieve a satisfactory standard of fire safety. The guidance will be read as a complete package for the measures to be effective. We have ensured the design fire safety strategy is able to justify any course of action that deviates from the recommendations, including the using of alternative solutions.

The guidance in SHTM 81 may not be appropriate for all areas of the building. Within the fire safety strategy design process we have exercised a degree of judgment based on a full understanding of the circumstances, taking into account the factors listed below and the requirement to ensure high levels of fire safety provision. The relevant factors include:

- Fire hazards within the premises;
- The dependency of the patient;
- Availability of sufficient and adequately trained staff;
- Management policies;
- Fire policy guidelines, and
- The advice and approval of building standards and fire authorities.

3.7 FIRE (SCOTLAND) ACT 2005

The Fire (Scotland) Act 2005 consolidates nearly all previous fire safety legislation and primarily affects employers and building owners and operators. This will require the organisation to carry out a fire risk assessment, act on the findings and record any significant issues.

The legislation seeks to ensure the safety of persons (whether they are employees, patients, visitors or others) in the premises in respect of harm caused by fire, by setting out fire safety responsibilities. The employer of the organisation is required to undertake and continually review a fire risk assessment to ensure that the employees and other occupants within the premises are not placed at risk from fire.

The responsibility for complying with the fire safety duties sits with the employer and other persons who have control of the premises to any extent, such as managers and contractors and volunteers working on site may also have some responsibilities. Employers are required to ensure the safety of employees so far as is reasonably practicable. This means that the sacrifice in terms of time, effort, expense and any other disadvantages associated with the provision of fire safety measures should be weighed against the magnitude of the fire risk if they were not taken.

All other persons with fire safety responsibilities in respect of the premises are required to take all reasonable measures regarding the safety of persons in, or in the immediate vicinity of the premises. Where premises or responsibilities are shared, each employer or other person who has control over any part of the premises is required to co-operate and co-ordinate in respect of complying with fire safety law and to inform each other of risks.

3.8 CONSULTATION

Through the development of the Fire Safety Design Strategy, Project Co have continued to consult with the NHS, NHS Fire Consultant, Fire Authority and the Local Authority Building Standards Department.

The management of staff responses to a fire incident will require discussion with clinical staff to ensure the strategy meets the operational principles for each area of the building.

The design and provision of Fire Fighting estate wide will be established following appropriate consultation with the Board, based on the evaluation of the interaction of various factors including occupant density, spatial organisation and fire load density. In reaching a firm conclusion as to the actual requirement, due cognizance will be taken of any existing fire safety design strategies and the latest relevant guidance documentation.

4

PRINCIPLES OF LIFE SAFETY

4 PRINCIPLES OF LIFE SAFETY

4.1 PROGRESSIVE HORIZONTAL EVACUATION

The principle of progressive horizontal evacuation is that of moving occupants from an area affected by fire through a fire-resisting barrier to an adjoining area on the same level, designed to protect the occupants from the immediate dangers of fire and smoke (a refuge). The occupants may remain there until the fire is dealt with or await further evacuation to another similar adjoining area or down the nearest stairway.

This procedure should give sufficient time for non-ambulant and partially ambulant patients to be evacuated down stairways to a place of safety, should it become necessary to evacuate an entire storey.

Active fire protection systems such as detection systems and warning systems are incorporated into the building so that the time available for escape may be maximised. This feature may be most beneficial for the occupants of adjacent spaces rather than those in the space immediately affected by the fire.

4.2 SEPARATION OF PATIENT ACCESS AREAS

In addition to the requirement for progressive horizontal evacuation, hospitals are designed to minimise the possibility of fires from the non-patient access areas affecting the patient access areas.

Within SHTM 81 and the NDTH, the provisions required to minimise the possibility of fire spread between patient access areas and non-patient access areas are based on patient dependency and the potential hazard presented by the non-patient access area.

The relative location of non-patient access areas and patient access areas and the level of fire safety performance of separating walls and floors within the proposals meet the intention of the guidance recommendations.

4.3 STAFFING LEVELS

The provision of an adequate number of staff who have received effective fire safety training is the best first line of defence against fire. The presence of trained staff who can respond quickly and effectively to any fire emergency is a vital factor in limiting the consequences of a fire, particularly where dependent patients are involved.

The fire strategy is based upon an adequate number of staff always on duty and aware of the suitably devised arrangements for the safe evacuation of patients in accordance with the emergency evacuation plan.

The number of staff forming a fire response team will be determined by the NHS based upon the size and complexity of the hospital, its operational functions and the number and type of occupants.

5

COMMUNICATIONS

5 COMMUNICATIONS

5.1 OBSERVATION

The early detection of fire by people is probably the best form of detection, and the design and layout of a building can make a positive contribution to fire safety.

Although it is unlikely that the staff bases will be permanently staffed, it is recognised that the designed location provides good observation that will improve the likelihood of a fire being detected at an early stage.

5.2 DETECTION AND ALARM SYSTEMS

The provision of effective fire detection and alarm systems in hospitals is a vital component of the overall fire safety strategy to protect patients, staff, visitors, contractors etc. and property from fire.

A fire alarm system will be provided in accordance BS 5839 Part 1, Category L1 as modified by SHTM 82, and be of the fully addressable analogue type.

The system will be a secured network with a number of repeater/slave panels, allowing system information to be made available at a number of agreed staff -bases and fire entrance points informing staff and the fire authority of fire alert and evacuation information.

The primary purpose of the system within patient care areas is for staff alert. The activation / warning design has considered this and the following features for other areas:

- Use of coded message for staff alert to certain areas;
- Use of indicators may be more appropriate at theatres to minimise disturbance during procedures and at staff base areas to ensure intelligibility of any phone conversations during alarm;

The warning tone and any beacons will operate continuously in the activated compartment and intermittently in adjacent compartments. This will enable staff to undertake management procedures (e.g. assigning staff to assist the fire area) at an earlier stage.

Break-glass call points will be provided where there is not a risk of malicious activation by patients. Options for call point types are to be considered with regard to security and risk of inappropriate usage.

Although a manual type without key or break-glass cover is preferred it may be the case that to minimise incidence of false alarm calls, call points are located at staff bases wherever possible. The location and type of call points will need to be agreed with the authorities.

Automatic detection will comprise either heat or optical smoke detectors as appropriate (i.e. single-point detectors) for the area being protected. The fire alarm system will be interfaced as necessary (e.g. with the mechanical ventilation system smoke actuated dampers, fire doors) and the alarm panel will be supplied from a separate dedicated circuit incorporating integral standby battery and charging facilities.

A mimic diagram for the various zones will be fixed adjacent to each fire alarm panel and repeat indicator panel. The fire authority will be notified in the event of a fire, in accordance with the Board's fire safety management procedures.

The main fire alarm panel will be at the atrium entrance with repeater panels recommended at certain staff bases.

The fire alarm system will be interfaced with the vent smoke actuated dampers. This will be further detailed within the Cause and Effect matrix produced by others.

Design Note 5 (Appendix E), references ME-XX-XX-DC-572-101 v3 (family hotel) and ME-XX-XX-DC-572-100 v5. These documents are Fire Detection Risk Assessments completed by others.

6

MEANS OF ESCAPE

6 MEANS OF ESCAPE

6.1 FIRE EVACUATION STRATEGY

The basic strategy for fire evacuation of patients is to move them, to a safer area on the same floor.

There are three main stages of evacuation:

- Stage 1 – horizontal evacuation from the sub-compartment where the fire originates to an adjoining sub-compartment or compartment;
- Stage 2 – horizontal evacuation from the entire compartment where the fire originates to an adjoining compartment on the same floor;
- Stage 3 – vertical evacuation to a lower floor substantially remote from the floor of origin of the fire (at least two floors below), or to the outside.

The following figures illustrate the concept of the evacuation strategy, the stage 1 movement will vary dependent upon the location of the fire incident, however a route of progressive horizontal evacuation out of the sub-compartment of fire origin and adjoining sub-compartments / compartments is always available.



The stage 1 (primary movement phase) is indicated on the figures as blue arrows



The stage 2 (secondary movement phase) is indicated on the figures as red arrows



The stage 3 (vertical / final exit movement phase) is indicated on the figures as solid green



Figure 1 – Indicative Evacuation Strategy at Ground Level



Figure 2 – Indicative Evacuation Strategy at First Floor Level

There are three fire conditions when evacuation is necessary or should be considered:

- Extreme emergency – where there is an immediate threat to safety from fire or smoke;
- Emergency – no immediate threat, but fire or smoke likely to spread from an adjoining area;
- Precautionary – no immediate threat to life or safety, but there is a fire on an adjoining floor or in an adjacent building.

In extreme emergency situations, the sequence of evacuation should be:

- Those in immediate danger;
- Ambulant patients;
- The remaining patients who are not ambulant.

Within Zone A as well as out-patients and offices there is a family hotel accommodation and office, therefore the family hotel will be evacuated simultaneously. This is detailed within a separate report but attached as Appendix L.

6.2 SUB-COMPARTMENTATION

To assist in the safe horizontal evacuation of the occupants, every compartment has been divided into at least 2 sub-compartments by a sub-compartment wall with short fire resistance duration, with the intention that sub-compartments are not more than 750m^2.

By providing a series of barriers, it is intended that patients will be able to remain in the building and avoid the need for complete evacuation.

All openings in sub-compartment walls are to be protected to provide a minimum period of fire resistance of 30 minutes.

Each sub-compartment has been designed to have a minimum of two exits to adjoining but separate compartments or sub-compartments.

6.3 TRAVEL DISTANCE

The distance to adjacent compartments, sub-compartments, stairways and final exits are limited within the guidance to ensure that the occupants can escape from the effects of a fire within a reasonable period of time.

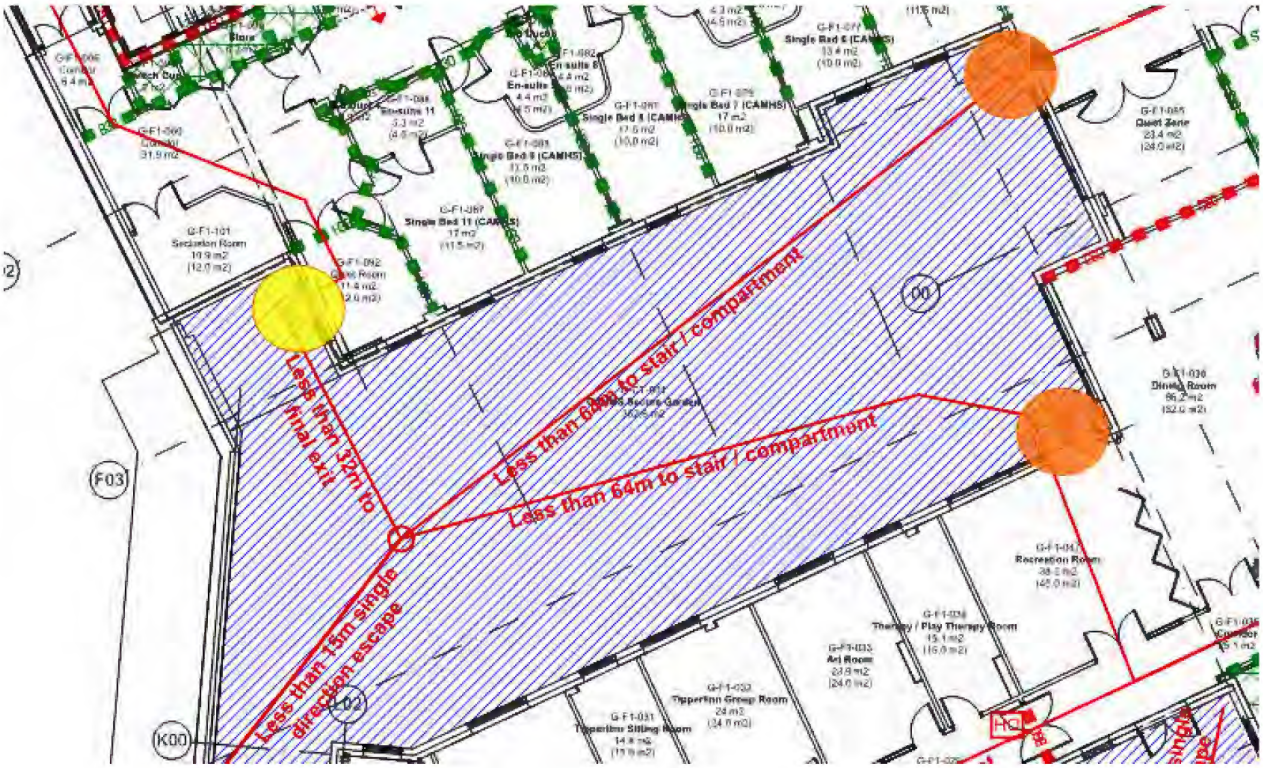
The maximum travel distance before there is a choice of escape routes is no more than 15m and 32m in more than 1 direction.

The guidance recommendations for 'maximum travel distance from any point within a 'compartment' is there no more than 64m to:

- Each of two adjoining compartments; or
- An adjoining compartment and an escape stair or a final exit; or
- An adjoining compartment and a final exit; or
- An escape stair and a final exit.

Where the escape route from a room into an unprotected zone passes a waiting area or sub-waiting area the escape route has been safeguarded by a fixed screen or similar item of furniture to maintain a clear escape width of 1m around placement of furniture. The waiting areas open into circulation routes are acceptable as they can be clearly de-lineated from the circulation routes.

Where the internal courtyard areas have patient access the means of escape from these areas back into the building are achievable within the required travel distances (any non-patient access courtyards will have increased travel distance allowances more than patient access ones). There is one exception to this, the CAMHS courtyard. Within this courtyard, there are 3 exits allowing escape within the recommended travel distances. However, the NHS Board have requested that one of these exits is lockable, and only accessible using a key with staff. This is due to the patient type where access must be controlled to this door. This is noted below in yellow:



The door is not required for escape in terms of number of escape routes or escape route width (as other doors are provided).

The travel distance in a single direction would be extended, however still compliant with the NDTH in that it's no more than 64m to a compartment. Due to the nature of the department the courtyard is under staff supervision whenever there are children within in, therefore there is never any unsupervised children in the courtyard. Whilst the door highlighted in yellow would not open in the fire alarm, it can be unlocked by staff if needed. The maximum number of children in the courtyard would be 12 and the ratio of staff to children is 1:2 and therefore if needed, the door can be unlocked by staff.

Doors allowing access into the building from external plant areas will be readily openable from the escape approach side without the use of a key. This includes in basement plant areas which are to be separated by

cages. An escape door will be provided within this cage line which will allow any occupants to break open and escape in the event that the alternative exit which will be accessible via a simple push bar or single action mechanism, is blocked by fire.

6.4 WIDTH OF ESCAPE ROUTES

The escape route widths are summarised below:

- Hospital Streets are at least 3.0m wide;
- Stair widths are a minimum of 1200mm (except where mattress evacuation is proposed, which requires minimum 1300mm width);
- Corridor widths for bed patient evacuation are at least 1500mm;
- Door widths are generally designed to accommodate bed-patient evacuation;
- Doors in non-patient areas are at least 850mm, reduced to 750mm, where number of occupants are less than 100.

As noted above generally doors are designed to accommodate bed-patient evacuation. However, in Zone A, doors have now been placed at the lift lobby which will lock out of hours which are not 1500mm wide.

The Board have confirmed (email dated 6th June 2018) that no bed evacuation will take place at these locations (waiting areas), therefore minimum width is acceptable. Should this change in the future, the Board will require to risk assess the location further. On the basis that these areas are outpatients and not occupied out of hours when the doors are locked, this is considered acceptable, provided the doors still fail unlock in the event of a fire alarm activation.

6.5 VERTICAL ESCAPE

The number of storey exits is appropriate to the number of patient beds, standard guidance recommends two storey exits for up to 100 beds, and 3 storey exits for 100 to 200 patient beds.

Stairways are located so that alternative means of escape is always available from every compartment and sub-compartment.

Stairways are remote from each other so that in the event of fire at least one is available for evacuation purposes. All stairways terminate at a final exit or escape level and provide access to the outside.

The fire-fighting stairs terminate at ground level and can be accessed from outside via a protected zone or via the Hospital Streets. Lift wells are to be constructed in accordance with the guidance contained within the NDTH – the requirement is for medium fire resistance duration.

Zone A

Within Zone A, a simultaneous evacuation was originally proposed as the building is outpatients and a family hotel. This evacuation was via the 3 escape stairs. To ensure there is sufficient capacity within the stairs to evacuate the occupants, we calculated the occupancy and stair sizes below. However, the design has prorgressed with the Board requesting a change of evacuation to Zone A. This is further discussed in Appendix L.

Table 2 – Occupancy of Zone A

Floor	Location	Area (m²)	Occupant Load Factor (m²/p)	Occupancy Per Room	Occupancy Total
Third	Family Rooms	19	8	2	24 x 2 = 48
	Family Acc	24	8	3	2 x 3 = 6
	Lounge (Non-Residents)	30	1	30	30
	Reception	6	6	1	1
	Offices	158 (total)	6	26	26
	Seminar / Meeting	65 (total)	1	65	65

				Total	**176**
Second	Office	1241 (total)	6	206	206
	Meeting	54 (total)	1	54	54
				Total	**260**
First	Consultants / treatment / Rehab	1776 (total)	6	296	**296**
Ground	Consultants / treatment /	600 (total)	6	100	100
	Meeting / Waiting	119 (total)	1	119	119
	Office	226 (total)	6	38	38
				Total	**257**

Stair Width

The total occupancy of the upper floors is 732. All stairs are lobbied and as such there is no requirement to discount the use of a stair, therefore, 3 stairs are considered in use; Stairs, 05, 06 and 07. The number of occupants using each stair is 244 therefore the formula within the NDTH is used to calculate the effective width of the stairs.

The appropriate capacity allows a 20% reduction to allow for occupants who will be standing within the stair. The appropriate capacity is 732 occupants, reducing by 20% allows for 586 occupants requiring to use the stairs for evacuation.

Using the calculation provided in the NDTH the effective width of each stair would be calculated as 1035mm. However, the minimum stair width as per the NDTH is 1200mm to assist occupants with sensory cognitive and/or mobility impairments.

The stairs within Zone A currently measure at 1500mm which is compliant.

Combined Escape Routes

The ground floor will have escape via the stair lobbies as well as some exits direct to outside.

The layout of the ground floor in Zone A allows escape via the atrium, however to provide a most onerous figure, these have been discounted in the event of a fire within the atrium. Therefore only the exits opposite the multi-purpose rooms have been counted as direct exits.

It is assumed that the occupants of these rooms only will use these exits and all other occupants will escape via the stair lobbies.

Ground floor occupancy = 257

Occupancy using direct exits = 74

Upper floors occupancy = 732 (244 each stair)

Ground floor occupants escaping via stair lobbies = 183 (61 each stair)

Therefore, the exit width at the bottom of each stair to outside is calculated as 1600mm.

Final exits within Zone A stairs are currently measured at 1700mm which is compliant.

6.6 ESCAPE BED LIFTS

Escape bed lifts are provided in sufficient numbers to facilitate vertical evacuation; the number of lifts will be subject to agreement with the Board as it is recognised that the use of these lifts requires sufficient number of trained staff to be available to operate a vertical evacuation procedure.

The lifts will require to be operated under the direction and control of lift wardens using an agreed evacuation procedure. Sufficient numbers of staff will be necessary to arrange the following duties during an evacuation:

- Lift wardens (floor) – to organise horizontal evacuation and assess the need for vertical movement;
- Lift wardens (control) – to man the evacuation control point of each escape bed lift;
- Lift wardens (car) – to man the car and control the lift.

The escape bed lifts and their lobbies will be designed and installed as per the guidance within SFPN No.3.

6.7 FIRE & SMOKE CONTROL IN CORRIDORS

NDTH recommends that for purposes of smoke control where a corridor provides at least 2 directions of escape and is more than 12m in length between the exits it serves, it should be divided in the middle third of the corridor.

Some corridors between sub-compartment / compartment lines that are in excess of 12m in length are not to be separated within the middle third.

Sub-compartment / compartment lines are not considered to form the exits serving the corridor. The exits are considered to be the protected zones whereby a place of safety can be reached.

In hospitals the protection of escape routes with fire-resisting walls, ceilings and doors (protected corridors) is not considered acceptable, since the excessive number of fire-resisting doors, all fitted with self-closing devices, would be a hindrance to staff and patients during the everyday running of a healthcare building. For this reason, the technique advocated for healthcare buildings is to identify and segregate fire hazard rooms by at least 30 minutes' fire-resisting construction.

An explanatory design note (design note 6) has been provided to support this. However, it has been established that where there are longer lengths of corridors, additional cross corridor doors have been placed where they do not hinder the operation of the hospital.

6.8 FINAL EXITS

The design of the final exits recognises the often conflicting requirements of means of escape and security of hospitals.

Final exit doors from public access areas will be freely openable by hand under any condition, including power failure; otherwise, adjacent non-automatic outward-opening doors will also be provided.

Final exit doors from patient-access areas will not be provided with a step.

Where it is proposed to have the exits secured via electrically powered locks their design will generally follow the guidance where they should return to the unlocked position:

- On operation of the fire alarm system;
- On loss of power or system error;
- On activation of a manual door release unit (Type A) to BS EN 54: Part 11: 2001 positioned at the door on the side approached by people making their escape and where the door provides escape in either direction, a unit should be installed on both sides of the door.

Where used, management procedures will require to be developed to cover a power failure eventuality to ensure patient safety is maintained. Discussions with the Board have deemed it appropriate to have the emergency release of one of the doors in the CAMHS courtyard delayed by a short time period to allow staff to respond.

6.9 LOCKS

Electrically powered locks should not be installed on a protected door serving the only escape stair in the building (or the only escape stair serving part of the building) or a protected door serving a fire-fighting shaft or on any door which provides the only route of escape from the building or part of the building.

Electrically powered locks on exit doors and doors across escape routes may be installed in buildings which are inaccessible to the general public or, when the building is accessible to the general public, the aggregate occupancy capacity of the rooms or storeys served by the door should not exceed 60 persons.

For security reasons 2 x doors have been added to the First Floor Zone A. This area and floor is outpatients only and only operates in normal working hours. The Board requested to have these doors secure out of hours.

Both sets of doors will be on hold-open devices during normal working hours. Once the clinics have completed, i.e. during out of hours when no staff or patients are in the area, these doors can be secure shut. This area of the hospital is not required to be accessed for progressive horizontal evacuation from any other areas.

Access control (alternative solution 2.9.15 / design note 7)

The majority of areas in the hospital fall into the category of 60 persons including public. Our design proposes the following alternative solution:

- In areas containing less than 60 public; all doors serving exits may have electrically powered locks
- In areas containing 60 or more public and have more than one exit; only one door will be fitted with an emergency exit device (e.g. manual opening device), the remaining doors may have electrically powered locks
- The design also proposes installing electrically powered locks that restrict access to some escape stairs outside of an immediate alarm situation.

An explanatory design note (design note 7) has been provided detailing the alternative solution for this approach.

6.10 EXTERNAL ESCAPE ROUTES

Adequate external assembly positions will be available should it become necessary to evacuate the entire building or part of the building (suitable positions can be roadways, hard standings or suitable parts of the landscaped areas).

The access to assembly positions will have the following considerations:

- The location of assembly positions to permit access for ambulances;
- The provision of adequate artificial lighting;
- The provision of adequate paved footpaths and dropped kerbs to the assembly points;
- The gradients of external escape routes;
- The proximity of external escape routes to the external wall of the building;
- Assembly area sufficiently remote from potential fire source.

6.11 ESCAPE LIGHTING

For hospitals, the general guidance on emergency lighting contained within BS5266: Part 1: 2011 is supplemented by SHTM 2007 ‘Electrical Services – supply and distribution’, SHTM 2011 ‘Emergency electrical services’ and the CIBSE LG 12 emergency lighting code guide ‘Lighting guide for hospitals and health buildings’ which provides additional guidance on hospital emergency lighting and details of the electrical supply required.

The guidance in the Technical Handbooks recommends that essential lighting circuits should be installed throughout a hospital and designed to provide not less than 30% of the normal lighting level. In an area where a 15 second response time would be considered hazardous, (e.g. a stairway), emergency lighting should be provided by battery back-up giving a response time of not more than 0.5 seconds.

The distribution boards for essential and non-essential circuits may be in the same location but should be in separate cabinets.

6.12 TEMPORARY WAITING SPACES

In hospitals the principle of evacuation for patients is that of progressive horizontal evacuation where occupants are moved from an area affected by fire through a fire-resisting barrier to an adjoining area on the same level, designed to protect the occupants from the immediate dangers of fire and smoke (a refuge). The occupants may remain there until the fire is dealt with or await further evacuation to another similar adjoining area or down the nearest stairway.

Progressive horizontal evacuation is primarily for patient evacuation, it is recognised that within a hospital environment there are many other occupants (e.g. visitors) who may have difficulty in negotiating vertical evacuation.

Temporary waiting spaces (alternative solution 2.9.30 / design note 4)

Should an incident occur that requires evacuation then staff will assist the inpatients with progressive horizontal evacuation. Since the majority of the inpatients will be children their parents, guardians or carers present during the incident will remain with the child to provide reassurance to them. Others not required for this will be directed to leave the affected area (compartment) and make their way out of the building.

Since hospitals are divided into compartments and sub-compartments vertical movement via stairs and lifts in adjoining areas to compartment affected by alarm will remain in use.

The functionality of these vertical routes (lifts & stairs) during a fire incident is considered as adequate mitigation for non-provision of temporary waiting spaces within the stair enclosures.

An explanatory design note (Design Note 4) has been provided detailing the alternative solution for this approach.

Temporary waiting spaces will be provided to the stairs within Zone A as this area of the hospital will be evacuated on a simultaneous basis.

7

CONTAINMENT OF FIRE AND SMOKE

7 CONTAINMENT OF FIRE AND SMOKE

7.1 COMPARTMENTATION

Each floor is defined as a compartment floor with medium fire resistance duration (60 minutes).

All compartment sizes for the hospital will be within 1500m² with sub-compartments 750m². However it is considered that there may be some sub-compartments that marginally exceed the 750m².

The compartments and sub-compartments sizes are noted in the Table below with those which exceed highlighted in red text:

Table 3 – Compartment and Sub-Compartment Sizes

Floor	Location	Compartment Size (m²)	Sub-Compartment Size (m²)
Fourth	Child Life and Health	651.5	197.8
			451.3
	Clinical Management Suite	541.8	162
		274.6	
	Health Records	530.9	
	Plant Spaces	133.3	
		135.4	
		554.5	
		449.9	
	Helipad Accommodation	48.4	
Third	Family Hotel	1315.7	753.8
			559.7
	Scottish Paediatric Health Education Resource	358.6	
	Surgical (short and long stay)	1255	666.6
			584.4
	Medical Inpatients	1065.1	561.1
			498
	Medical Day Care Unit	626.2	211.5
			412.7
	Biochemistry Lab	316.9	
	Haematology Oncology Ward	1025.5	788.8
			234.5
	Neuroscience Inpatients	740	652.3
			85.7
	Staff	103.7	
	Ancillary	121.9	
Second	Clinical Management Suite	843.2	505.1

			337
		1039.3	710.5
			325.4
	DCN Neurophysiology	945.5	573.7
			368.6
	DCN Therapies and Inpatients	960.8	272
			684.5
		1083.8	722.6
			358.6
	Staff	103.7	
	Treatment	87.4	
	Clean Equipment	58.2	
	Plant Spaces	305.8	
		1478.3	
		734.5	
First	RHSC Therapies	1048.9	279.1
			766.5
		376.5	260.7
			114.5
		456.9	99.7
			355.5
		72.3	
	Clinical Research Facility	398.3	
	PICU HDU	1499.1	338.3
			567.3
			588.2
		215.1	
		44.4	
		77.6	
	DCN Acute Care	1433.2	654.5
			777
	Operating Theatres and Surgical Day Care	1468.5	604.2
			246.3
			614.3
		473.5	
		1515.2	688.9
			323.6

			488.4
		540.7	
	Staff	103.7	
	Family Support Services	720.6	411.1
			308.2
Ground	Cardiology and Respiratory	872.2	233.9
			637.3
	CAHMS	947.2	582.3
			388.9
		641.1	367.3
			271.2
	Wards	1453.7	762.4
			689.6
		1427.2	777.6
			645.7
	DCN Outpatients	788.3	666.4
			120.2
		740.6	382
			352.4
		853.9	604.8
			244
		733	
		321	
Basement	Storage	119.6	
		30.9	
	Local Cook and Regen Kitchen	429.4	
	Estates	198.2	
		85.2	
	Materials Management	153.7	
	Domestic Services	286.9	
	Used Linen	38.2	
	Confidential Waste	17.7	
	Plant Space	185.9	
		55.4	
		227.6	
		541.1	

Fire-fighting shafts providing an enclosure protected from fire in adjoining accommodation will contain an escape stair and a fire-fighting lobby at every storey at which the fire-fighting shaft can be entered from the accommodation. The enclosing structure of a fire-fighting shaft is medium fire resistance duration.

Places of special fire risk will be enclosed by compartment walls with a medium fire resistance duration, and will have a maximum travel distance of 9m single direction and 18m (where more than one direction is available) to an exit. Where the escape route is in a protected zone serving another part of building, it will be separated from an escape route by a protected lobby.

Lift wells will be contained within compartment walls of medium fire duration construction and, where the lift well is not the full height of the building, a compartment floor with a medium fire resistance duration. Where a lift is installed, the landing controls and lift car controls will be of a type that do not operate on heat or pressure resulting from a fire.

Where service risers penetrate the compartment floors they are provided within medium fire resistant risers and fire doors. Where these risers do not completely rise through all floors, sufficient fire stopping will be provided and is indicated on the fire strategy drawings.

There is guidance given in annex 2B of the Technical Handbooks which gives additional recommendations for hospitals. Clause 2 B 1 deals with compartmentation, and has the following recommendations:

- Compartment walls and floors should be constructed of non-combustible material;
- Compartment walls will be taken up to the underside of the roof covering or deck, and designed / fire stopped to maintain the fire resistance;
- All openings in floors and compartment walls will be protected to provide at least the same period of fire resistance as the compartment structure.

The NDTH recommends the provision of 30 minute separating walls between sleeping accommodation and corridors. This has been incorporated into the fire strategy and noted on the fire strategy drawings. All bedroom corridors are protected with 30 minute fire resistance construction.

7.2 FIRE HAZARD DEPARTMENTS

The guidance for department adjacencies does not allow those defined as fire hazard departments (refer list below) to be directly below or directly adjoining operating theatres, intensive therapy units or special care baby units. Fire hazard departments directly below, or directly adjoining, any other hospital department to which patients have access are allowed provided that a fire suppression system is installed. The following are defined as being fire hazard departments:

- Boiler house;
- Central stores;
- Commercial enterprises;
- Flammable stores;
- Laundry;
- Main electrical switchgear;
- Main kitchens;
- Refuse collection and incineration;
- Works department.

Department adjacencies (alternative solution 2.B.1 / design note 2)

The atrium is considered to be a commercial enterprise and the theatres are located adjacent to this space. During the reference design stage the adjacency of the theatres to the atrium was discussed at fire strategy meetings (24th January 2012) with the NHS fire officer and support for this adjacency was provided by the NHS. This adjacency still exists with the proposed design and the same mitigation principles are proposed:

- Medium duration fire protection to walls of theatres adjacent to atrium;
- Fire load control to the atrium (noted within WSP-SZ-XX-DC-571-301);
- Smoke control to atrium.

An explanatory design note (design note 2) has been provided detailing the alternative solution for this approach.

The main kitchen and main electrical switchgear are located within the basement with patient departments over these areas. It is proposed that fire engineering will be adopted to demonstrate that sprinkler provision can be omitted. See later section on Provision of sprinklers.

The compartment slab between basement and ground storeys will be imperforate at the hazard department location with services contained within fire rated risers.

7.3 SUB-COMPARTMENTATION

Sub-compartment walls will be of short fire resistance duration and all openings in sub-compartment walls are to be protected to the same level as the wall.

7.4 INTENSIVE THERAPY UNITS

The design philosophy for Intensive Therapy Units (ITU) is to fire separate the units from adjoining areas by compartmentation to minimise the risk of moving a patient in the event of a fire emergency. The compartment will also be sub-divided into at least two sub-compartments. Entrance into the ITU will be from a hospital street or fire protected lobby.

7.5 FIRE HAZARD ROOMS

The guidance within the non-domestic handbooks for the protection of fire hazard rooms with short fire resistance duration will generally be followed. The following rooms are considered to be fire hazard rooms.

Table 4 – Fire Hazard Rooms

Fire hazard rooms		
Chemical stores	Cleaners' rooms	Clothes storage
Day rooms with a floor area greater than 20m^2	Smoking rooms	Disposal rooms
Laboratories	Lift motor rooms	Linen stores
*Bedrooms (elderly and mental health / learning difficulties occupancy)	Kitchens	Laundry rooms
Staff changing and locker rooms	Store rooms	X-ray film and record stores

*This guidance is based upon open ward type facilities where there could be a large number of beds within one open plan room. For the proposed design where the majority of beds are located within single rooms there is a much greater degree of smoke separation between beds than in a traditional open plan ward. Whilst these walls will not be designed as fire compartmentation it is considered that a degree of smoke separation will be provided by the rooms which will greatly assist in protecting occupants in the early stages of an evacuation which would be adequate for wards not specifically designated for elderly people, or those suffering from mental illnesses or learning difficulties.

The following additional rooms are agreed to be classed as fire hazard rooms and will have 30 minutes fire resistance separation:

- IT comms rooms (SER's) / data centre (possible medium duration to protect equipment);
- Sluice rooms;
- Dirty and clean utility rooms;
- DSR rooms.

It has been proposed that rooms containing I.T equipment (i.e. I.T node rooms) as well as workshops and labs will remain as individual fire hazard rooms with other fire hazard rooms (other than those intended for sleeping) are clustered.

It should also be noted that MRI equipment rooms are not considered plant rooms and therefore not fire hazard rooms. These rooms contain the vital support to MRI scanners which feed into the scanner rooms themselves.

Fire hazard room Clustering (alternative solution 2.B.1 / design note 11)

Where fire hazard rooms (other than those intended for sleeping) are back to back then they will be risk assessed to establish acceptance of a 'cluster room' approach where they are grouped together to form one hazard area.

An explanatory design note (design note 11) has been provided detailing the alternative solution for this approach.

7.6 WALL AND ROOF JUNCTIONS

Where a compartment wall or sub-compartment wall meets an external wall, the guidance recommends that there should be a 1m wide strip of the external wall which has the same level of fire resistance duration as the compartment wall or sub-compartment wall, to prevent lateral fire spread. This is included in the design and should be noted on the fire strategy drawings.

Where a lower roof abuts an external wall, the roof will provide medium fire resistance duration for a distance of at least 3m from the wall.

7.7 STRUCTURAL PROTECTION

To prevent the premature failure of the structure, the load-bearing elements of the building will have a period of fire resistance in terms of resistance to collapse or failure of load-bearing capacity.

Compartment walls will have medium fire resistance duration, and all other relevant structural elements of the building will have at least medium duration fire protection.

7.8 CAVITIES

In order to inhibit fire spread in a cavity, every cavity within the building will have cavity barriers with at least a 30 minutes fire resistance duration installed around the edge of the cavity. Where there are long corridors, cavity barriers are provided generally at 20m intervals. Cavities are measured either horizontally or vertically, as the case maybe, along the centre-line of the cavity and not diagonally.

A significant number of internal walls are provided for fire separation purposes (compartment / sub-compartment / fire hazard rooms). As such these walls will provide fire separation within the ceiling voids.

Other non-fire rated internal walls are constructed as full height partitions however penetrations through such walls have not been specified to achieve a fire separation performance. These walls provide an inherent fire resistance as they are deisgned to achieve 60 minutes FR, all service penetrations will be fully packed and sealed for acoustic reasons. This will effectively limit the spread of unseen smoke.

To use the proposed wall positions as much as possible and to avoid use of proprietary systems the cavity barriers positioning has been led by the location of the walls below ceiling level.

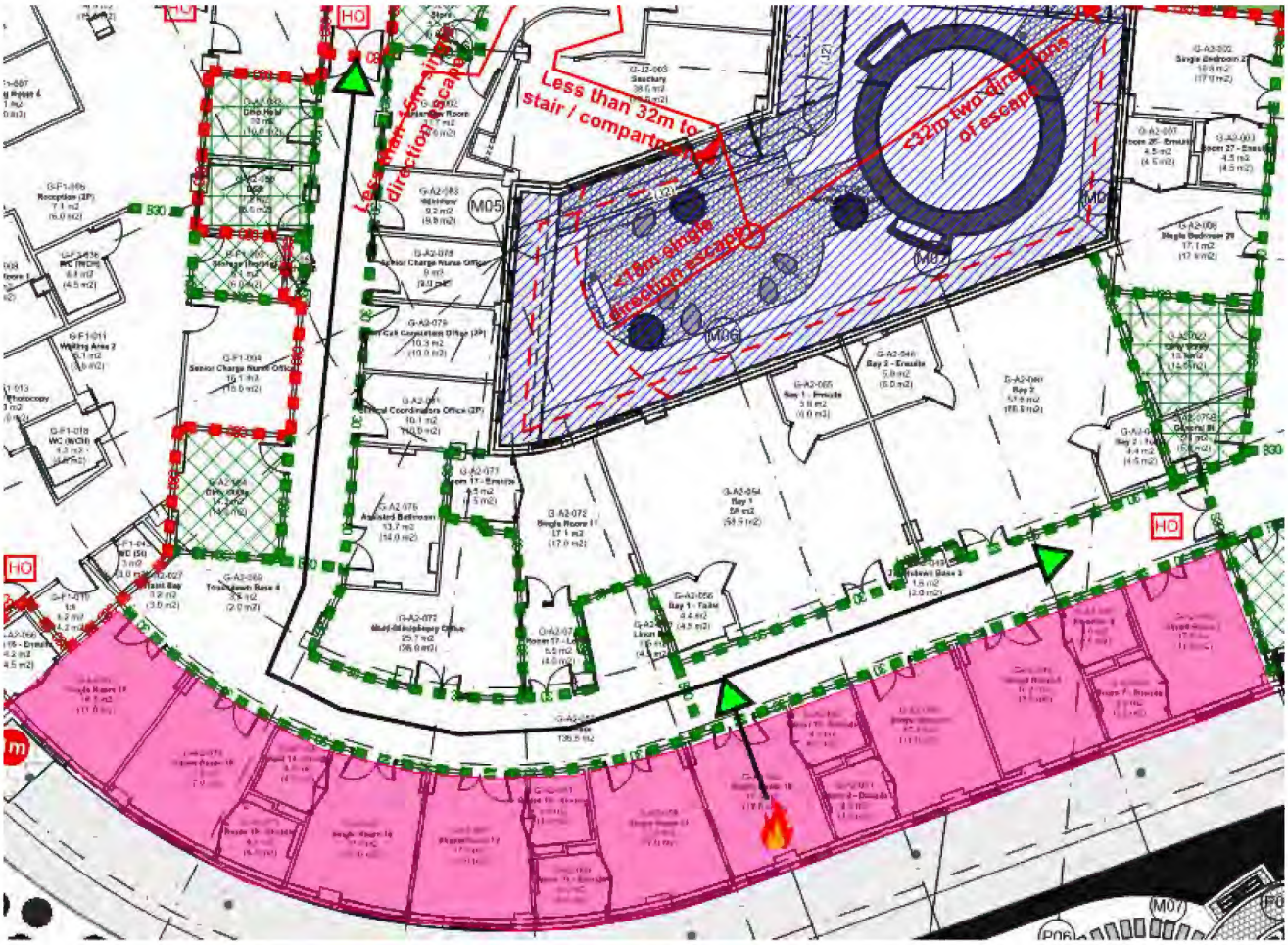
It is proposed that all ceiling void cavities within the corridors will be within a maximum separation distance of 26m in either vertical or horizontal measurement.

Out with corridors, it can be seen that where the distance is exceeded in one direction (e.g.length) it is within the 20m in the other direction (e.g. width). The provision of full height walls (although not fire rated) will hinder fire spread within the voids and where provided void detection addresses the issue of undetected fire / smoke spread.

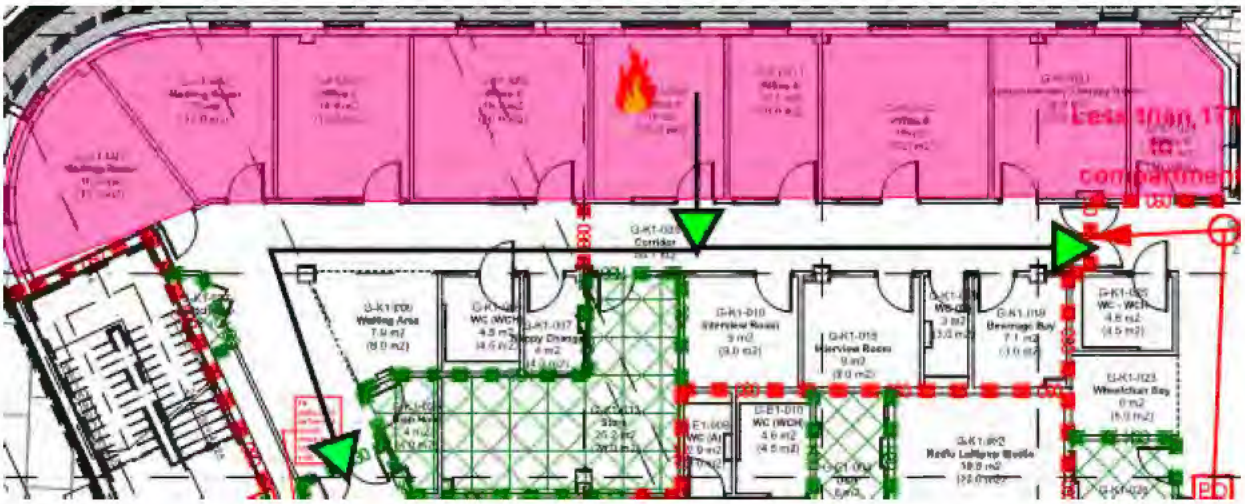
Please refer to HLM Fire Strategy Drawing Series for an indication of the cavity barrier positioning and separation distances.

If we consider an example below: In the event of a fire within the concealed space above a room, the room will evacuate. However, the entire sub-compartment also fully evacuates. In the example below, should a fire occur within the concealed space above a bedroom, whether in the duct or within the cavity itself, the 30 minutes fire rated residential corridor, as well as the fire smoke dampers present in any ductwork which penetrate these walls will prevent the spread of smoke into the corridor.

The full height partitions as noted earlier will hinder fire spread laterally, however, in the unlikely event of smoke spread along this concealed space (shown in pink below), as described, the sub-compartment will have evacuated into the next sub-compartment / compartment and hence will not be exposed. The prescence of an L1 detection system designed to BS 5839 as well as the inherent high level of compartmentation within the building in the form of compartment, sub-compartment and fire hazard room walls, it is therefore considered acceptable to have a cavity barrier constructed within the corridor only as this is where we have concealed space greater than 20m.



Another example shown below located out with the ward areas of the hospital. In the example below, should a fire occur within the concealed space above a room, the full height partitions as noted earlier will hinder fire spread laterally (shown in pink below), and across the corridor where full height partitions are also present. In the unlikely event of smoke spread along these rooms, the sub-compartment will have evacuated into the next sub-compartment / compartment. The prescence of an L1 detection system designed to BS 5839 as well as the inherent high level of compartmentation within the building , it is therefore considered acceptable to have a cavity barrier constructed within the corridor only as this is where we have concealed space greater than 20m.



7.9 INTERNAL LININGS

Materials used in walls and ceilings can significantly affect the spread of fire and its rate of growth. This can have a significant effect on the ability of occupants to escape in the event of a fire.

Every room, fire-fighting shaft, protected zone or unprotected zone therefore, will have wall and ceiling surfaces with a reaction to fire which follows the guidance in the table below (additional guidance is provided in clauses 2.5.1 of the Technical Handbooks).

Table 5 – Internal Linings

Area of hospital	Reaction to fire
Room not more than 30m^2	Medium risk
Room more than 30m^2	Low risk (ceilings may be medium)
Unprotected zone	Low risk
Protected zone	Low risk

7.10 SPREAD TO NEIGHBOURING BUILDINGS

In order to reduce the danger to the occupants of other buildings, the buildings will be isolated from another by separation of a sufficient distance to prevent the fire spreading to adjacent buildings by radiative heat flux.

The fire safety design strategy will show compliance with the above by reference to the methods outlined in the following documents:

- B.R.E. External Fire Spread: building separation and boundary distances (BR 187, 1991);
- NDTH 2013.

Table 6 – Spread to Neighbouring Buildings, Enclosing Rectangle Method

Department /Area	Elevation length (m)	Direction of Elevation	Current Distance to adjacent Department / Building /Boundary (m) (worst case)	Enclosed Rectangle height 6m, Distance to adjacent Department / Building /Boundary (m) if 100% unprotected	Acceptable with current glazed elements Yes/No

Ground Floor					
K1	44.4	North	24.75	9	Yes
D1	31	North	19.5	8.5	Yes
D1	21	East	8.5	7	Yes
Q1	17.5	North	13.6	6.5	Yes
M1	20.5	North	45	7	Yes
M1	29.5	East	30.2	8	Yes
M1	25.8	South	60	8	Yes
M1	28	South	17.3	8	Yes
M1	28.6	South	10.2	8	Yes
M1	42	South	9.8	9	Yes
F1	29.9	South	60	8	Yes
F1	10.7	West	80	5.5	Yes
F1	8.5	North	19.5	5	Yes
D8	13.6	West	75	6	Yes
First Floor					
D6	57	North	24.75	7.5	Yes
D6	30.6	East	8.5	8.5	Yes
P1	24.7	North	13.6	7.5	Yes
P1	18	East	45	6.5	Yes
L1	22.5	East	18	7	Yes
L1	26.7	South	60	8	Yes
L1	18.5	South	17.3	7	Yes
B1	24.8	South	10.2	7.5	Yes
B1	34.7	West	80	8.5	Yes
H2	18.9	North	19.5	7	Yes
D4	24.5	West	75	7.5	Yes
Second Floor					
R1	38.2	North	24.75	8.5	Yes
R1	23	North	19.5	8	Yes
R1	29	East	8.5	8	Yes

Plant	37	North	13.6	8.5	Yes
Plant	22.9	East	54.5	7	Yes
L2	18.8	East	25.6	7	Yes
L2	33	South	60	8.5	Yes
L2	32.5	South	60	8.5	Yes
L2	21.4	West	82.5	7	Yes
M4	26.7	North	19.5	7.5	Yes
R1	22.3	West	75	7	Yes
Third Floor					
K2	6.7	North	24.75	5	Yes
H3	7.3	North	19.5	5	Yes
H3	29.8	East	8.5	8	Yes
C1.4	22.3	North	13.6	7	Yes
C1.4	15.8	East	54.5	6.5	Yes
U1	18.4	East	45	7	Yes
D9	12.4	East	25.6	6	Yes
C1.1	13.4	South	60	6	Yes
C1.1	27.5	South	60	8	Yes
C1.2	25	West	82.5	7.5	Yes
C1.8	22	North	19.5	7	Yes
K2	6.4	West	75	5	Yes
Fourth Floor					
Plant Room 05	5.5	North	31.5	4	Yes
Plant Room 04	5.5	North	26.3	4	Yes
Plant Room 04	26	East	8.5	7.5	Yes
Plant Room 06	15.7	East	96	6.5	Yes
Plant Room 06	44	South	60	9	Yes
R1	37.8	South	60	8.5	Yes
H1	19.2	South	82.5	7	Yes
H1	12	North	20	5.5	Yes
Plant Room 05	5.5	North	31.5	4	Yes

As noted in the above tables, the unprotected areas provided in the design are acceptable with the given boundary distances.

7.11 SPREAD ON EXTERNAL WALLS

There is a risk of fire spread on the external walls of a building. In hospitals this can pose a high risk as the mobility, awareness and understanding of the occupants could be impaired and as a consequence, full evacuation may not be the most appropriate course of action.

To satisfy the building regulations external wall cladding not more than 1 m from the boundary will be constructed of non-combustible material.

Where the wall is more than 1 m from the boundary the external wall cladding will be constructed from materials with a reaction to fire classification of B-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2.

Guidance on how to meet these guidelines is provided in the following documents:

- NDTH;
- B.R.E. Fire performance of external thermal insulation for walls of multi storey buildings (BR 135, second edition); and
- BS 8414: part 1: 2002 test method for non-load bearing external cladding systems applied to the face of the building.

7.12 SPREAD FROM NEIGHBOURING BUILDINGS

Roofs are particularly vulnerable to fires and the amount of protection necessary is dependent on the distance to the boundary. The guidance in the technical handbook recommends the following:

- Not more than 6 m from a boundary the roof of a building, including any roof lights, but excluding any wall head fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low vulnerability if not more than 6 m from the boundary. Common materials that normally attain the criterion include slates, tiles, glazing, sandwich panels and certain plastic materials as described in the table to annex 2.F of the technical handbooks.
- More than 6 m but not more than 24 m from boundary the roof of a building, including any roof lights, but excluding any wall head fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low or a medium vulnerability if more than 6 m but not more than 24 m from the boundary. Common materials that normally attain the criterion include felts and certain plastic materials as described in the table to annex 2.F of the technical handbooks.
- More than 24 m from boundary, the roof may be of any material, including materials of high vulnerability classification.

7.13 OPERATION OF VENTILATION PLANT

The ventilation plant will not be automatically shut down on the operation of the automatic fire detection and alarm system. In the event of a fire emergency the system will operate to inhibit the spread of smoke and be provided with the facility for shut-down and start-up under the instruction of the Fire Service. Project Co shall develop proposals in coordination with the Board for how best to keep systems running in the likes of theatres where ductwork passes through fire barriers where fire / smoke or fire dampers are provided.

Fire Service control will be from panels located either at department entrances or adjacent to the main fire alarm indicator panels.

7.14 DUCTWORK OPENINGS

The ductwork design will take account of the guidance within SHTM 81 that requires ductwork passing through compartment and sub-compartment walls to be provided with remotely resettable fire and smoke dampers operated by smoke detection.

Ductwork passing through cavity barriers will also be provided with remotely resettable fire and smoke dampers operated by smoke detection unless the design and construction of the ductwork maintains the minimum level of fire safety performance of the cavity barrier.

Ductwork passing through all other fire rated construction will be provided with fire dampers.

Riser ductwork (alternative solution 2.1.14 / design note 1)

It is proposed that where ductwork within riser shafts pass through compartment boundaries from plant rooms then the ductwork at these locations need only have fire dampers installed.

These areas are non-patient access areas (areas are actually restricted access areas for all personnel) therefore, the threat from smoke transfer within ductwork affecting means of escape is not considered to be an issue.

An explanatory design note (design note 1) has been provided detailing the alternative solution for the riser ductwork.

7.15 TRANSFER GRILLES

To reduce the possibility of smoke transfer between compartments and sub-compartments, the installation of transfer grilles in fire resisting door sets in compartment and sub-compartment walls will be avoided. Where, however, they are essential as part of the designed air transfer system they will be provided with remotely resettable fire and smoke shutters operated by the detection and alarm system.

8

FIRE-FIGHTING PROVISIONS

8 FIRE-FIGHTING PROVISIONS

The report should be read in conjunction with the fire strategy plans.

8.1 SITE ACCESS

The following has been considered for site access for the fire and rescue service:

- The location and number of site access points;
- The design of the roadways with respect to width, radii of bends, gradients, clearance between and under buildings;
- The weight and turning circle of the fire appliances

A minimum of two access points to the site, suitable for use by the fire and rescue service, are provided for fire appliances (their location will be subject to agreement with all relevant authorities).

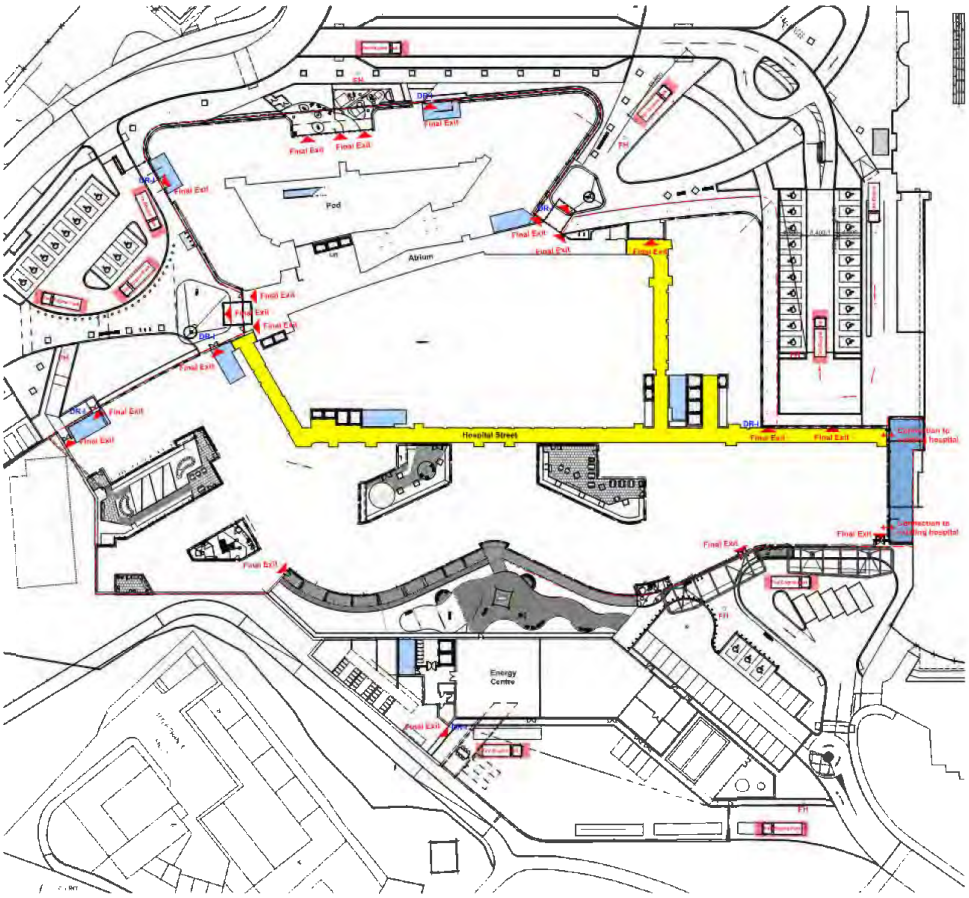


Figure 3 – Site Fire Strategy

8.2 ACCESS AROUND THE BUILDINGS

Access around a healthcare building is required to enable use of fire appliances and to enable pumping appliances to supply water and equipment for fire-fighting and rescue activities.

Vehicle access is generally recommended to more than one elevation of a hospital, however, the guidance recognizes that this may not always be possible due to the constraints of the site, and pedestrian access for fire service personnel may be sufficient. The design allows for access to more than one elevation.

Suitable turning facilities will be provided in any dead-end route that is more than 20m long.

The guidance notes that whilst the access for fire-fighting will depend to some extent on the vehicles and equipment used, assistance may be provided from adjoining fire and rescue services when the need arises. For this reason, the more demanding guidance for high reach appliances may be recommended by the fire and rescue service. This may have a significant impact on planning and a feasibility study may be appropriate. Consultation with the fire and rescue service at the earliest opportunity is strongly recommended.

8.3 FACILITIES FOR THE FIRE AND RESCUE SERVICE

The building height to top storey is 17.6m.

Fire service facilities will be provided to more than two escape stairs positioned at least 20m apart.

The following fire-fighting facilities will be provided:

- Fire-fighting stairs with a smoke clearance vent at top of stairs;
- Unvented fire-fighting lobbies;
- Dry fire main outlet located at every department entrance.

Project Co have submitted fire strategy plans to the approval authorities.

Dry riser locations have been noted on fire strategy plans to show effective hose laying coverage of 45m (with some areas showing extension to this distance). What risers that will be used in a particular fire-fighting situation are considered to be an operational matter for Scottish Fire and Rescue Service (SFRS) to manage during incident response.

These plans have been passed to SFRS.

Fire hose coverage (alternative solution 2.14 2 / design note 9)

For fire hose coverage, the standard recommendation is to position the fire-fighting outlet so that every part of the floor area can be covered within 45m measured along an unobstructed route.

Outlets are proposed within fire-fighting lobbies to the stairs and along the hospital streets at department entrances to maximise the coverage. Areas exist that are beyond the 45m coverage therefore an explanatory design note (design note 9) has been provided detailing the alternative solution for the coverage.

8.4 PROVISION OF FIRE HYDRANTS

Fire-fighting operations depend on a sufficient supply of water in order to control fire growth and assist in effective rescue operations. The water hydrants are positioned externally, for each building or where common to more than one building:

- Not more than 60 m from at least one normal entrance to the building; and
- Distributed around the building so that every external elevation of the building is within 60 m from a hydrant; and
- So that hydrants are at least 6 m from the building; and
- Located adjacent to a parking space for a pumping appliance; and
- So as to be accessible for use at all times; and
- So that there is a clear route for the fire hose between the hydrant and the building; and
- The hydrants are constructed in accordance with BS 750: 1984

Project Co have submitted fire service access plans to the approval authorities for comment. Agreement from SFRS Water Officer has been provided.

8.5 FIRE-FIGHTING EQUIPMENT

Introduction

Most fires that are discovered in their early stages can be successfully tackled and extinguished by the use of portable fire appliances. Portable fire extinguishers are valuable in the early stages of fire when their portability and immediate availability for use by one person enables a prompt attack to be made.

They cannot be expected to deal with a large fire since they are essentially a first aid fire-fighting measure with a limited capacity. Therefore for effective fire safety management the provision of effectual and sufficient portable fire extinguishers is essential and a requirement under the current fire safety regulations.

Provision & siting of fire extinguishers

RHCYP will have provision for fire-fighting equipment in accordance with BS 5306: Part 8 2012 Code of Practice for Fire Extinguishing Installations and Equipment on Premises – Selection and Installation of Portable Fire Extinguishers; SHTM 81 and generally as follows:

- Fire extinguishers will be provided based upon a risk assessment approach, in consultation with the Board rather than being based upon the area to be covered. They will generally be paired at designated 'fire points' with suitable extinguishers to deal with electrical fires.
- Where there is flammable liquid or liquefiable solid risk, suitable extinguishers will be provided to deal with Class B risks, which may also be used in conjunction with a fire blanket.
- Where areas require specialist fire extinguishers to deal with specific materials or risks; a copy of the 'product safety data sheet' for those substances will be required by the Board Fire Safety Advisor to confirm the correct fire extinguishing agent to be provided.
- Extinguishers will be sited in such a way that it is not necessary to travel more than 30 m from the site of the fire to reach an extinguisher. Fire extinguishers will generally be provided at a 'fire point' located in corridors, on landings or in stair enclosures – safe areas on the escape route out of the building.
- Extinguishers will generally not be placed inside rooms (including laboratories), unless there is a very specific risk identified.
- Fire points will be located as close as reasonably practicable to fire alarm break glass (manual call points). Manual call points are also generally sited do that no more than 30m is travelled to raise the alarm.
- Fire action will be provided at fire points so that persons raising the alarm can follow the correct action necessary.

General principles

The general principles governing the positioning of fire extinguishers are:

- In the event of a fire, occupants move away from the immediate location of the fire to a place of relative safety (i.e. corridor, landing or stair enclosure).
- Once there they can readily locate a 'fire point' containing fire-fighting equipment and manual call point for raising the alarm to warn others.
- A judgement on whether or not it is safe and practicable to return to tackle the fire can then be made by the individual. If in doubt occupants should leave by the nearest exit, ensuring that the alarm is raised by operating the nearest manual call point. Occupants should only go back and attack the fire with an appropriate fire extinguisher if it is safe and they are confident to do so. Occupants should not place themselves or others at risk.

Fire extinguisher provision

As a guide the following types of fire extinguishers are recommended; the final type and location of fire extinguishers will be based on risk assessment and the guidance within BS 5306.

Table 7 – Fire Extinguisher Guidance

Location:	Type of Extinguishers:
Patient areas	Each fire point to have: 1 x 9 litre Water extinguisher OR 1 x 6 litre Hydrospray extinguisher* 1 x 2 Kg carbon dioxide (CO_2) *Hydrospray- 6 litre version weighs a third less than conventional water-based fire extinguishers but has 150% of the fire-fighting ability- 21A fire rating.
Laboratories areas	1 x 6 litre Multi Purpose Foam (MPF) 1 x 2 Kg carbon dioxide (CO_2) 1 x fire blanket (1.1m^2 size)

	Specialist Monnex dry powder / alcohol resistant foam may be provided where alcohol / solvents / esters are present
Pantries	1 x fire blanket
Computer / server rooms	1 x 2 or 5 Kg carbon dioxide (CO_2) outside of entrance door for staff use
Plant rooms	6 litre multi purpose foam (MPF) – where class B products present 2 Kg carbon dioxide (CO_2) Number relating to area of plant room
Kitchen	6 litre multi purpose foam (MPF) 2 Kg carbon dioxide (CO_2) Fire blanket (1.1m^2 size) 6 litre wet chemical (specialist) extinguisher for 'Class F' (high temp fat frying) where necessary

9

SUPPRESSION

9 SUPPRESSION

9.1 PROVISION

The guidance within Firecode and the Technical Handbooks recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc.

Sprinklers are one component of the mix of fire safety measures, and current guidance suggests that design teams should consider the installation of fire suppression: (Firecode SHTM 82, Supplement A).

9.2 GUIDANCE RECOMMENDATIONS

The guidance recommends the provision of suppression where fire hazard departments are located adjacent to or below patient access departments.

There are three areas that this would apply to:

- The atrium; since it can be considered as a commercial enterprise where it contains shops / café etc.
- Basement kitchen below patient access area.
- Basement plant below patient access area.

Design note 2, and WSP-SZ-XX-DC-572-301 provide further details of the alternative solutions proposed for these areas.

Department adjacencies (suppression) (alternative solution 2.B.1 / design note 2)

The basement kitchen has regeneration facilities and some small areas of ‘live’ cooking. In regeneration kitchens the food is prepared elsewhere (off site in the case of RHCYP) and is then brought onto site where it is transported to the various departments of the hospital.

In hospitals regeneration trolleys are designed to accept chilled or frozen food, keep it chilled during transport, then heat it back up to a safe and pleasant serving temperature close to the point of service. They can take either individual plated meals or bulk food dishes and the heating process begins when the regeneration trolley is plugged in to an electricity source close to the point of service. Within the kitchen the regeneration trolleys are simply items of equipment that are plugged in.

There are sections of the kitchen which will involve more traditional methods of cooking therefore these areas will be provided with a local suppression system such as Ansul or similar type system.

An explanatory design note (design note 2) has been provided detailing the alternative solution.

10

ATRIUM

10 ATRIUM

The atrium shall generally be designed in accordance with the guidance within SHTM 81 Part 3: Atria in healthcare premises.

SHTM 81 Part 3 recognises the special requirements concerning fire precautions for the design of atria within healthcare premises and allows the statutory requirements to be applied sensibly in a risk appropriate framework. This guidance recognises the interaction between:

- The physical fire precautions;
- The dependency of the patient;
- Fire hazards within the healthcare premises;
- The management policies; and
- The availability of sufficient and adequately trained staff in achieving an acceptable level of fire safety within healthcare premises.

It is recognised within the design that an atrium space in a healthcare building may contain high numbers of dependent people, or others with some degree of disability, for whom additional time and assistance to escape will be necessary. To address this concern, it is therefore necessary to provide atria with higher standards of fire protection than would normally be provided within similar buildings put to a different use.

10.1 CONSULTATION

In order to ensure that the atria meets the specific requirements of the relevant regulatory bodies and the design objectives of the procuring body itself, including the appropriate standards fire safety, the health and nursing care objectives and other related matters; consultation has taken place between relevant stakeholders i.e. the design team, the client, the Health Board fire safety advisor, the relevant regulatory authorities and where appropriate, the client's insurers.

These discussions and consultation on fire engineering aspects has ensured all the parties with an interest in the project have a full understanding of the relevant standards, design objectives and regulatory requirements having specific regard to the inclusion of appropriate fire safety measures.

Atrium (alternative solution 2.1.14 / design note 10)

Since the atrium passes through several storeys and therefore compartment floors, the fire engineering design is considered as an alternative solution.

An explanatory design note (design note 10, Appendix J) and WSP-SZ-XX-DC-572-301 have been provided detailing the alternative solution for the atrium.

Also appended with Appendix J is the CFD report (WSP-SZ-XX-DC-572-600) and the Pod Fire Load Analysis (WSP-SZ-XX-DC-572-301). This is the complete analysis for the atrium.

11

BASEMENT

11 BASEMENT

11.1 OVERVIEW

The basement area provides accommodation for kitchen, FM and plant areas

11.2 MEANS OF ESCAPE

Escape from the basement area has adequate means of escape to ground level. Since no patients will have access to this area it is proposed to have a travel distance of 18 m for single direction and 45 m from where there is more than one direction available.

Where the escape stairs from the upper storeys also serve the basement storey, the protected zone enclosing the escape stair in the basement storey will be separated from the protected zone containing the escape stair serving the rest of the building, by a wall or screen, with or without a door, at the ground storey floor level. The wall, screen and self-closing fire door where provided, will have a medium fire resistance duration.

There are plant areas provided for maintenance access only. One of these plant areas has been sub-divided to separate HV and LV access. To maintain travel distances as noted above, an exit has been provided between these areas. This door has a break glass to exit function, and whilst this would involve a 2-step process, the other exit from the space is a simple, single-action exit. Therefore considered compliant.

11.3 SMOKE CLEARANCE

The basement level is within 4.5 m from ground level therefore no basement smoke clearance is required.

12

ENERGY CENTRE

12 ENERGY CENTRE

12.1 OVERVIEW

The Energy centre has been designed in accordance with the recommendations of both the Non-domestic Technical Handbook and BS 5410 Part 2 1978 Code of practice for Oil firing.

The building is single storey plus mezzanine, the building is divided into five main zones to provide robustness of design.

Additional levels of fire protection (walls and ceilings) are provided to separate the fuel storage and generator areas to meet the recommendations of the BS 5410.

Fire separation and good fire service access are provided therefore the provision of foam suppression or an inlet installation is not considered necessary.

13

HELIPAD

13 HELIPAD

13.1 OVERVIEW

The proposed roof level helipad will be subject to specialist design in accordance with the following documents.

- NFPA 418 - Standard for Heliports 2006, and
- Emergency care Health Building Note 15-03: Hospital helipads design

13.2 MAIN FEATURES

Helipads on rooftops require integral fire-fighting facilities and trained RFFS manpower.

The rooftop helipad should contain a rectangle with sides at least 25 m long (or a circle at least 35.4 m in diameter) to accommodate all helicopter types likely to make use of the facility.

Fire-resistant guttering is required around the perimeter of the helipad to carry rainwater, spilt (and possibly burning) fuel and fire-fighting media into the drainage system and prevent it falling onto the building below. Depending on the local water authority regulations for disposal of fire-fighting media, either the media will need to be contained in a collector tank or else permitted to discharge directly into the foul or waste water drainage system. If it needs to be contained for subsequent disposal by licensed tanker service, then the provision of an oil/water separator may not also be required since all contaminants and fluids discharged onto the helipad will be contained anyway. Where the water authority does permit discharge of media into the foul or waste water drainage system, in the event of a fire, a valve should divert aircraft fuel, fire-fighting media, and all other fluids to an oil/water separator on activation of the fire-fighting system. During normal operations any contaminant spillage can be considered negligible and discharged via the rain water disposal system. Where provided the capacity of the separator should be 3300 L for helicopters up to 15 m in overall length (ambulance helicopters), to accept 700 L of fuel, 2500 L of fire extinguishment, and rain or melted snow. The capacity of the separator for larger helicopters should be 8100 L (3000 L of fuel, 5000 L of extinguishment, and rain or melted snow). The down-pipes must be fire-resistant and should include a system to exclude air (sufficient to extinguish burning fuel).

The collector tank(s) need to be vented to atmosphere since the system is otherwise closed and subject to very high air pressures.

Water storage tanks for fire-fighting purposes should be provided with an independent, rapid top-up facility to enable re-suppression of any fire after initial discharge of the tank contents.

The helipad must have a minimum of two access points at opposite sides or corners. If a ramp is provided the ramp should include a landing 1 m below the level of the helipad on which the Rescue and Fire Fighting Services (RFFS) personnel can stand with their fire-fighting equipment to observe the arrival and departure of helicopters. It is preferable if the ramp runs away from the building to distance the RFFS personnel from a crash, and also to provide a walkway around the building below helipad height in case they need to approach the fire from the opposite side.

For H2 helicopters, two foam sprays at diametrically opposite positions on the helipad perimeter are mandated, each capable of a discharge rate of 500l/min for ten minutes (5 mins when both are in simultaneous use). It should be possible to cover the entire surface of the helipad with one of the monitors inactive under adverse wind conditions. Additionally, each of the foam spray units should be fitted with a hose line attachment to which a fire fighting hose line can be fitted. Such supplementary hose lines are intended to permit rapid suppression of fire when rescue of personnel is a priority and must be fitted with a branch pipe with an aspirated jet spray pattern capability.

In addition to the foam, 45 kg of dry powder (compatible with the foam) or 90 kg of CO_2 must also be available and portable for conveying up the access stairs or ramp to the helipad. Where the main complementary agent is dry powder, an additional 18 kg of CO_2 must be available to fight engine fires. Where the main complementary agent is gaseous, an additional 9 kg dry powder must be available for running fuel fires.

Special provision should be made close to the helipad for fire fighters' stowage of personal clothing and protective equipment and drying facilities for the equipment as well as normal domestic facilities, including toilets.

NHS fire procedures to include for a minimum of three trained RFFS personnel who must wear full protective equipment (helmet with flash hood, tunic, trousers, gloves and boots).

The rescue and medical equipment, and complementary fire-fighting agents should be kept in a weather-proof store near the helipad.

The helipad will not have any refuelling facilities.

14

FIRE SAFETY MANAGEMENT

14 FIRE SAFETY MANAGEMENT

14.1 OVERVIEW

For hospital buildings, the management of the fire safety is a key factor. Management will be expected to comply with the criteria outlined in Firecode and local NHS policy & principles.

A complete and properly maintained management system will need to be developed for the buildings. This will detail the interfaces between the various fire protection systems, and the staff responses to alarm incidents. The following summarises some of the necessary considerations:

- Appointment of a fire manager;
- Checks and maintenance of fire systems and equipment such as detection and alarm systems and emergency communication systems;
- Continuous staff training in fire safety awareness and regular fire drills for all staff;
- Maintaining records;
- Development of an evacuation procedures plan, detailing staff responsibilities, methods of giving alarm, and assisting evacuation of Service Users;
- SHTM outlines issues need to be addressed, such as fire precaution policies, staffing levels and training, fire safety audits;
- Fire plans and fire compartmentation.

14.2 EMERGENCY EXIT SIGNAGE

Emergency exit signage will conform to BS 5499 Part 4. An explanatory design note has been provided detailing the approach for signage (design note 3).

14.3 SECURITY

Due to the nature of the service users in a hospital the integration of security of the buildings with the fire safety design strategy is a key design factor. This will be carefully addressed through the design and will include consideration of the following issues:

- Location of final exits and control of service users evacuated from the building into external areas;
- Evacuation of service users between different departments. Selection of appropriate egress hardware, e.g. door locks and opening devices;
- Specification of fire safety systems to minimise nuisance false alarms, e.g. manual alarm point (key activated in patients area) locations, extinguisher locations.

14.4 MANAGEMENT OF FIRE LOAD WITHIN THE ATRIUM (POD)

Overview

In order to provide design flexibility to meet the needs of the Board the fire strategy has developed a strategy of limiting the size and separation of the combustibles within the atrium space, known as the Pod. This report can be found in WSP-SZ-XX-DC-572-301.

Management Responsibilities

The key point within this location is to ensure that the fire load is controlled within the permissible limits as noted within the above report.

It would be the recommendations of that report to, where possible, fix items of furniture. It is noted that the smaller children's seating of 'deer stools' and 'stag chairs' are to remain moveable to allow children to move around the area and enjoy the facilities. These items are of a relatively small fire load. However, as part of the management of this area, these items should be stored out with the current fire load islands noted in the report to ensure the fire sizes do not exceed those stated here.

From the analysis completed in Section 12 of the above report the introduction of a Christmas tree can be accommodated provided the following is complied with:

- The tree is artificial and fire retardant;
- The tree is no taller than 2.5m in height;
- An assumed maximum width is 2.5m and the tree should be no wider;

- 2.9kg of decorations is acceptable;
- Only LED lights are placed on the tree as these have a lower heat emitter, and the decorations are limited to those with no ignition sources.
- The separation distances of the tree from all other items is no less than 3.5m;
    - Please note, to achieve this, those other items should be moved such that the detailed analysis undertaken throughout this report is affected, i.e. no other items should be moved closer than is stated in the separation tables in Table 6, Table 7 and Table 8.
- As noted within SHTM 81, it is essential that appropriate person had delegated responsibility for the day to day fire safety management of the atrium. The nominate person and deputies should be available at all times when the atrium is in use:
    - To ensure that the fire load is controlled and within the permissible limits; and
    - To provide assistance and advice to the senior person responsible for co-ordinating the emergency response to a fire incident.

Calculated analysis within that report are specific to those furniture items only, where future arrangements result in old items being replaced with new or a total reintroduction of new items, a new risk assessment of the fire load and separation distances will be required.

The building management team have a responsibility to maintain as high a level of fire safety as can practicably be achieved at all times and, where practicable, materials used on the atria should be fire resisting, of limited combustibility or difficult to ignite.

The management of this space should include careful monitoring of the separation requirements as noted in the report where staff will be required to maintain these distances to ensure compliance with the fire strategy for the space.

It should be noted that any changes to the fire load in the area or additional materials introduced, the calculations should be re-assessed each time. Each location within the Pod highlights the maximum allowable fire load and the calculations contained within that report are based strictly on this layout analysed plus the additional Christmas tree scenario.

15

CONCLUSION

15 CONCLUSION

15.1 KEY FIRE SAFETY MEASURES

The basis for the fire safety Design strategy is the guidance within Scottish Health Technical Memorandum 81 and the Non Domestic Technical Handbook. Fire engineered solutions have been developed wherever beneficial to enable the design flexibility required for the building to function appropriately and achieve best value.

The principles of progressive horizontal evacuation are adopted throughout the clinical areas of the hospital. This procedure should give sufficient time for non-ambulant and partially ambulant patients to be evacuated to a place of safety, should it become necessary to evacuate an entire storey.

15.2 KEY ALTERNATIVE DESIGN SOLUTIONS

- Locks / Access control (alternative solution 2.9.18 / design note 7),
- Temporary Waiting Spaces (alternative solution 2.9.30 / design note 4),
- Fire hazard room clustering (alternative solution 2.B.1 / Design Note 11),
- Damper Actuation / Riser Ductwork (alternative solution 2.1.14 / design note 1),
- Hose Laying / Fire hose coverage (alternative Solution 2.14 2 / design note 9),
- Department Adjacencies (alternative solution 2.B.1 / design note 2),
- Atrium (alternative solution 2.1.14 / design note 10 and WSP-SZ-XX-DC-572-301).

16

REFERENCES

16 REFERENCES

Building (Scotland) Regulations 2004 as amended.

Building (Scotland) Non - Domestic Technical Handbook 2013; Section 2: Fire;

British Standards Institution (2001); BS 7974:2001 Application of fire safety engineering principles to the design of buildings - — Code of practice

Fire (Scotland) Act 2005 as amended.

Fire Safety (Scotland) Regulations 2006.

BS 5266: Part 1:2011 Emergency lighting; code of practice for the emergency lighting of premises;

BS 5266: Part 7 1999 / BS EN 1838: Lighting applications; emergency lighting;

BS 5266 BS / EN 50172 Part 8: 2005: Emergency lighting;

BS 5306: Part 1: 2006: Code of practice for fire extinguishing installations and equipment on premises. Hose reels and foam inlets;

BS 5306: Part 3; 2009: Code of practice for the inspection and maintenance of portable fire extinguishers;

BS 5306: Part 8: 2012: Emergency escape lighting systems;

BS 5839: Part 1: 2013: Fire detection alarm and control systems;

BS 5839: Part 3: 1988: Fire detection and alarm systems for buildings; specification for automatic release mechanisms for certain fire protection equipment;

BS 5839: Part 8: 2013: Code of practice for the design, installation and servicing of voice alarm systems;

BS 9999: 2008: Fire safety in the design, management and use of buildings;

BS EN 12845: 2004 + A2:2009: Fixed fire-fighting systems, automatic sprinkler systems;

http://www.fire.nist.gov/fire/fires/kiosk/kisk.html.

Fire policy for NHS Scotland CEL 11 (2011).

NHS Scotland ‘Firecode’ Scottish Health Technical Memorandum

SHTM 81 Part 1: Fire precautions in new healthcare premises, July 2009.

SHTM 81 Part 2: Guidance on the fire engineering of healthcare premises, July 2009.

SHTM 81 Part 3: Atria in healthcare premises, December 2013.

SHTM 82 Alarm and detection systems, April 2013.

SHTM 83 Fire safety in healthcare premises: General fire precautions, 2004.

SHTM 85 Fire precautions in existing hospitals, December 2007.

SHTM 86 Part 2: Fire risk assessment in healthcare premises, June 2013.

SHTM 87 Textiles and furniture, August 2009.

SFPN 3 Escape bed lifts, October 2010.

SFPN 4 Hospital main kitchens, December 1999.

SFPN 6 The prevention and control of deliberate fire-raising in NHS healthcare premises, September 2007.

SFPN 10 Laboratories on hospital premises, December 1999.

SFPN 11 Reducing unwanted fire signals in healthcare premises, June 2006.



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Appendix A

DESIGN NOTE 1 DAMPER

ACTUATION

Guidance:
SHTM81 requires ventilation ductwork passing through a compartment, sub-compartment boundary or cavity barrier must be provided with remotely resettable fire and smoke dampers operated by smoke detection

Compliance / Non-compliance:
Dampers to ductwork between the following spaces shall operate on fire actuation only.
Dampers between plant spaces
Dampers within ductwork serving Intensive Treatment Areas

Proposed Solution:
It is proposed that within the above noted spaces that the guidance within BS9999 Clause 33.4 Method 1 is followed.

This method does not require the ductwork to provide any degree of fire resistance, since the fire is isolated in the compartment of origin by the automatic actuation of fire dampers within the ductwork system.

Fire dampers are therefore sited in the duct at the point where it penetrates a fire-separating element:

- Fire Rated walls between noted spaces
- Compartment floors between risers and noted spaces

Hospital Guidance
The Non-domestic Technical Handbook has been used as design guidance together with SHTM 81.
The guidance recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc.

Damper Actuation
Within Section 6.7 Ventilation ductwork of SHTM81 Version 4 it recommends that ventilation ductwork must comply with the requirements of BS 9999: 33.4 and SHTM 2025: 'Ventilation in healthcare premises'.
Ductwork passing through a compartment or sub-compartment boundary must be provided with remotely resettable fire and smoke dampers operated by smoke detection. Ductwork passing through cavity barriers must be provided with remotely resettable fire and smoke dampers operated by smoke detection unless the design and construction of the ductwork in the adjacent spaces on each side of the cavity barrier provides the same minimum level of fire safety performance as the cavity barrier.

Explanation of Requirements
To understand the reason behind this level of actuation to dampers it is necessary to consider the fundamental principle that sub compartments are for the most part a component of escape design and are not provided in hospitals for the singular purpose of fire containment. On the basis of fire containment alone there would be no case to require smoke actuation, however the position changes significantly when you consider horizontal escape and sub compartment refuge. As these imperatives change the need for the early actuation of dampers (where appropriate) becomes an essential consideration.

Plant Spaces
Within the Plant areas the need for refuge as part of means of escape is not an issue; the plant spaces are more in line with traditional buildings where fire only dampers are acceptable.

Intensive treatment areas (ITA) (ITU & HDU etc)
The aim of any design is to prevent a fire in an adjacent compartment either on the same storey or on a storey above or below requiring the evacuation of an intensive treatment unit. The HVAC systems shall be designed so that an adequate period of time is provided to enable a fire to be detected and extinguished before it threatens the occupants.
The HVAC systems provided to intensive treatment areas are designed so that the pressure within the department is maintained at a level slightly above that of the adjacent areas. In a fire emergency, the continuing operation of these systems will assist in preventing smoke and other products of combustion entering the intensive treatment area.
Within SHTM 81 the requirement in intensive treatment areas and operating theatres, is that the HVAC systems must be designed so that they continue to operate in a fire emergency. The shut down of these systems should be on the instruction of the Fire and Rescue Service and must be controllable from remote panels located at either the department entrance or adjacent to the main fire alarm indicator panel.

Proposed Solution
It is proposed that that the guidance within BS9999 Clause 33.4 Method 1 is followed. This method does not require the ductwork to provide any degree of fire resistance, since the fire is isolated in the compartment of origin by the automatic actuation of fire dampers within the ductwork system.

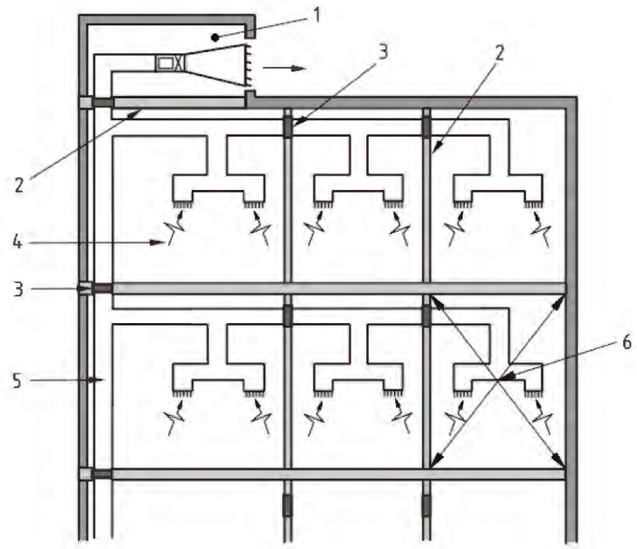
Fire dampers are therefore sited in the duct at the point where it penetrates a fire-separating element:

- Fire Rated walls between noted spaces,
- Compartment floors between risers and noted spaces.

Thermally operated fire dampers shall not be used to protect:

- escape routes,
- where ductwork passes into main circulation areas accessible to patients / visitors (e.g. Hospital Street),
- in smoke control systems,
- in the extract ductwork for kitchens.

Example of Ductwork Protection



Key
1 Plantroom
2 Fire compartment wall or floor
3 Fire damper
4 Air flow
5 Non-fire-rated ductwork
6 Extent of typical fire compartment

Figure 1 - Protection Using Fire Dampers (BS 9999)

Appendix B

DESIGN NOTE 2 DEPARTMENT

ADJACENCIES

Guidance:

The guidance within the NDTH and Firecode recommends that defined fire hazard departments are not located below or adjoin highly dependent patient areas also they should be provided with suppression where they adjoin other inpatient areas.

Compliance / Non-compliance:

Theatres will adjoin the atrium space and suppression is not proposed for the basement kitchen or plant areas.

Proposed Solution:

The theatres will be fire separated from the atrium space and the basement kitchen and plant areas will be low risk.

Hospital Guidance
The Non-domestic Technical Handbook has been used as design guidance together with SHTM 81.

The guidance recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc.

Separation of Patient Access Areas
Hospitals are designed to minimise the possibility of fires from non-patient access areas affecting the patient access areas.

Within SHTM 81 and the Non Domestic Technical Handbook the provisions required to minimise the possibility of fire spread between patient access areas and non-patient access areas are based on patient dependency and the potential hazard presented by the non-patient access area.

The guidance for department adjacencies does not allow those defined as fire hazard departments (refer list below) to be directly below or directly adjoining operating theatres, intensive therapy units or special care baby units. Fire hazard departments directly below, or directly adjoining, any other hospital department to which patients have access are allowed provided that a fire suppression system is installed.

The following are defined as being fire hazard departments:
- Boiler House,
- Central Stores,
- Commercial enterprises,
- Flammable stores,
- Laundry,
- Main electrical switchgear,
- Main kitchens,
- Refuse collection and incineration,
- Works department.

Within the design for RHSC & DCN we have three areas that will require consideration of alternative solutions:
- Basement kitchen below patient access area,
- Basement plant below patient access area,
- Theatre adjacent to atrium.

Basement Kitchen (r**egeneration)**
The basement kitchen is largely of the regeneration type.

In regeneration kitchens the food is prepared elsewhere (off site in the case of RHSC & DCN) and is then brought onto site where it is transported to the various departments of the hospital. Service points are often some distance from the kitchen and food needs to be kept hot between leaving the kitchen and presentation to the customer.

In hospitals regeneration trolleys are designed to accept chilled or frozen food, keep it chilled during transport, then heat it back up to a safe and pleasant serving temperature close to the point of service. They can take either individual plated meals or bulk food dishes and the heating process begins when the regeneration trolley is plugged in to an electricity source close to the point of service. Within the kitchen the regeneration trolleys are simply items of equipment that are plugged in.

In a traditional hospital kitchen the risk is far higher as this is where cooking takes place and this will involve fryers, live flame sources such as hobs etc. The guidance therefore considers this adjacency to patient areas as a hazard.

Since regeneration is a far lower risk then suppression is not considered necessary. Where small cooking areas exist within the kitchen that involve fryers or live flame cooking then local suppression will be provided in the form of an Ansul or similar suppression system.

Basement Plant
The basement plant will contain switchgear / transformer type equipment.

Oil filled equipment can present a significant fire risk therefore the separation requirement is provided within the guidance.

It is proposed that this is mitigated through the use of dry cast resin transformers.

Dry Cast Resin -
Fire-resistant dry type or "cast resin" transformers are well suited for installation in high-rise buildings, hospitals, underground tunnels, school, steel factories, chemical plants and places where fire safety is a great concern. Hazard free to the environment, dry type transformers have over the years proven to be highly reliable.

“Dry type” simply means it is cooled by normal air ventilation. The dry type transformer does not require a liquid such as oil or silicone or any other liquid to cool the electrical core and coils.

Dry type transformers are voltage changing (Step-up or Step-down) or isolation device that is air cooled rather than liquid cooled. The transformer case is ventilated to allow air to flow and cool the coil (coils).

Theatre Adjacency to Atrium
SHTM 81 Part 3: Atria in healthcare premises provides guidance that to minimise the potential for a large fire to develop and spread via the atrium space there should be no fire hazard departments within the atrium space (this includes. temporary or permanent cooking facilities and arrangements introduced by third parties such as external catering companies).

The SHTM guidance recommends that departments that provide care for very high dependency patients should not be located adjacent to an atrium, nor should any part of the department or their supporting facilities be located within the atrium.
During the reference design stage the adjacency of the theatres to the atrium was discussed with NHS Lothian fire officer. This adjacency still exists with the proposed design and the same mitigation principles are proposed:

- Medium duration fire protection to walls of theatres adjacent to atrium,
- Fire load control to the atrium (see WSP-SZ-XX-DC-572-301),
- Smoke control to atrium.

Appendix C

DESIGN NOTE 3 EXIT SIGNAGE

PRINCIPLES

Objective
The objective of the escape route signing system is to ensure that from any place within a building, where direct sight of an exit is not possible and/ or doubt may exist as to its position, a directional sign (or series of signs) is provided and placed so that a person moving within the means of escape is progressed towards a final exit.

Guidance
BS 5499-4:2000 Safety signs, including fire safety signs —Part 4: Code of practice for escape route signing is the reference document within the building regulations.
New signage should meet BS EN ISO 7010:2013.

Analysis
The following factors require to be considered as part of the escape route signing systems design:
- The use of each area.
- The management system controlling the use of the premises e.g. public access, security provisions; (security considerations may dictate preferred exits for normal use. Some regularly used exits may not be available at all times that a building is occupied and therefore will not form part of the escape route).
- The evacuation strategy for the premises; (strategies may rely on the occupants responding to an evacuation alarm, whilst other areas rely on trained staff to initiate and control evacuation).
- The degree of familiarity of the occupants with the premises.
- The location and lighting of any other signs, architectural features, decor or barriers that could conceal or divert attention from a fire safety sign.

Design of Signs
Signs will consist of a graphical symbol and will normally incorporate, or be accompanied by supplementary text and an arrow.

The graphical symbol used for escape route signs should conform to BS 5499-1. In order to avoid confusion all escape route signs to be of similar style, design, size and format.

Mounting Height
Escape route signs to be sited conspicuously within the normal field of vision.
The following principles are to be applied:
- Signs above doors or open spaces to be mounted between 2 m and 2.5 m from floor level, measured to the base of the sign and be sited as close to the centre line of the escape route as practicable (this mounting height is intended to ensure that signs can be readily seen, e.g. over the heads of people).
- Signs sited on walls to be mounted between 1.7 m and 2.0 m, from floor level measured to the base of the sign (this mounting height is intended to ensure the signs are within the immediate field of vision).
- Mounting heights greater than 2.5 m may be used, e.g. in large open spaces or for operational reasons provided such signs are both conspicuous and legible.
- Signs to be sited at the same height throughout the escape route, so far as is reasonably practicable.

Location of Signs
The primary escape route from each place within the premises will be identified. This is normally the shortest travel distance to a place of safety.

If there is a choice of escape routes, the escape route signing system will indicate the shortest travel distance. If at any place there is a choice of two escape routes of equal travel distance, both routes will be indicated by a separate series of signs.

The following principles will be applied:
- At least one escape route or doorway leading to an escape route should be visible from any place within every room or enclosure. Where this route is not conspicuous or confusion could occur, the route will be indicated by a sign.
- Where direct sight of the escape route or of the sign indicating the escape route is obstructed, one or more intermediate signs will be provided.
- Doors or passageways which might be confused as leading to a designated escape route will be marked clearly.
- Escape route signs to take precedence over all other signs. Signs with a potentially conflicting message (e.g. “no thoroughfare” and “fire exit”) will not be used in the same location. Where this conflict is unavoidable a supplementary text sign (e.g. except in an emergency) will be provided to override the prohibition message.
- All changes of direction in corridors, stairways and open spaces forming part of an escape route to be marked with intermediate signs. Each intermediate door or junction will be similarly signed (so that persons escaping along any designated escape route will always have an escape route sign in sight whenever a choice of direction or door has to be made).
- So far as is reasonably practicable, signs will be evenly spaced and consistently located so that the evacuee can effectively and quickly predict the location of the next sign within the escape route.
- Additional signs will be provided where the line of sight to the next sign would otherwise exceed the recommended maximum viewing distance for the chosen size of sign.
- A sign will be provided wherever confusion may otherwise occur.
- Every designated escape route will lead to a place of safety. A place of safety will not be provided with escape route signs but may be provided with a sign indicating “assembly point”;
- Signs will not be fixed to doors or sited where they may be obscured by opening doors.
- Where commercial or artistic considerations require signs or objects which, because of their size, brightness, design or proximity, might be confused with or prevent recognition of an escape route sign, the location of the escape route sign may be slightly displaced provided safety is not compromised. Otherwise the confusing signs or objects will be removed.
- The effectiveness of any escape route sign must not be adversely affected by the presence of other signs conveying directional information in a similar format or by other internally illuminated signs or by competing or distracting light sources.

Prepared by: [redacted]

Escape Route Signage Meaning

Sign	Meaning as viewed from in front of the sign	Examples of locations
	1. Progress down to the right (indicating change of level). See Figure A.3.	1. On wall or suspended at head of stairs or ramp. 2. On half landing wall or stairs. 3. Suspended at change of level.
	1. Progress up to the right (indicating change of level). See Figure A.9. 2. Progress forward and across to the right from here when suspended within an open area. See Figure A.17.	1. On wall or suspended at foot of stairs or ramp. 2. On half landing wall or stairs. 3. Suspended at change of level. 4. Suspended in open areas.
	1. Progress down to the left. (indicating change of level). See Figure A.6.	1. On wall or suspended at head of stairs or ramp. 2. On half landing wall or stairs. 3. Suspended at change of level.
	1. Progress up to the left (indicating change of level). See Figure A.8. 2 Progress forward and across to the left from here when suspended within an open area.	1. On wall or suspended at foot of stairs or ramp. 2. On half landing wall or stairs. 3. Suspended at change of level. 4. Suspended in open areas.
	1. Progress forward from here (indicating direction of travel). 2. Progress forward and through from here; when sign is sited above a door (indicating direction of travel). See Figure A.1. 3. Progress forward and up from here (indicating change of level). See Figure A.16.	1. Suspended in corridor leading to door. 2. Suspended in open areas. 3. Suspended in front of door. 4. Positioned above door. 5. Suspended at foot of stairs or ramp.
	1. Progress to the right from here (indicating direction of travel). See Figure A.13.	1. On corridor walls. 2. Suspended adjacent and left of the exit. 3. Suspended at change of direction.
	1. Progress to the left from here (indicating direction of travel). See Figure A.12.	1. On corridor walls. 2. Suspended adjacent and right of exit. 3. Suspended at change of direction.
	1. Progress down from here (indicating change of level). See Figure A.3.	1. Suspended at head of stairs or ramp. 2. Suspended at change of level.

Externally Illuminated Signs
Where a sign is illuminated by an external source, the vertical illumination will be a minimum of 100 lux under normal lighting conditions and provide a minimum of 5 lux with a uniformity of 0.7 under mains-failure conditions.

Photoluminescent Signs
Where a photoluminescent sign is used, the vertical illumination will be a minimum of 100 lux under normal lighting conditions and the in situ luminance will meet the minimum performance requirement specified in BS 5266-6.
Where emergency lighting is installed the vertical illumination should provide a minimum of 5 lux with a uniformity of 0.7 under mains-failure conditions.

Internally Illuminated Signs
The light source of an internally illuminated sign will provide a luminous contrast appropriate to its environment without producing glare.
The minimum luminance of any area of the sign to not be less than 2 cd/m 2 and under mains-failure conditions it should conform to BS 5266-7.

Sign Size and Viewing Distance
The viewing distance of a sign is the maximum distance from which the sign has to be comprehensible.

Escape route signs should be both conspicuous and legible. The size of a sign necessary to achieve these criteria will depend upon both the viewing distance and the illumination of the sign.

The viewing distance of an escape route sign will be determined by its position within the primary escape route (i.e. signs should not be sized by their position within any alternative escape route). Any variation of the sizes of signs within the premises should be kept to a minimum.

Within large open areas with multiple escape routes particular care to be taken to ensure that the signs are the appropriate size for the intended primary escape route.

Prepared by: K. Hamill

The maximum viewing distance, D, can be calculated from the overall height of the graphical symbol, a_s, by using the appropriate distance factor, Z:

$D = Za_s$ (where: a_s and D have the same units).

Distance factors for externally illuminated escape route signs under a range of different conditions of vertical illuminance are provided within Table 2.

Distance factors for internally illuminated escape route signs with different ranges of mean luminance of the contrast colour white are also recommended in Table 3.

Both tables are based on the BS 5499-1 graphical symbol with a ratio of overall height of graphical symbol to width of critical detail of not greater than 15:1.

Table 2 — Distance factor *Z* for externally illuminated escape route signs based on ordinary materials or photoluminescent materials

Vertical illuminance at sign lux	Distance factor, *Z*
≥ 5	95
≥ 100	170
≥ 200	185
≥ 400	200
NOTE BS 5266-7 requires $Z = 100$ in the mains-failure condition, based on the height of the sign.	

Table 3 — Distance factor *Z* for internally illuminated escape route signs

Mean luminance of white contrast colour cd/m²	Distance factor, *Z*
≥ 10.0	150
≥ 30.0	175
≥ 100.0	200
≥ 200.0	215
≥ 500.0	230
NOTE 1 If gaseous tritium signs are used $Z = 50$ may be accepted. NOTE 2 BS 5266-7 requires $Z = 200$ in the mains-failure condition, based on the height of the sign.	

Table 4 — Examples of maximum viewing distances for externally illuminated escape route signs of different graphical symbol height subject to a vertical illuminance of 100 lux

Graphical symbol height mm	Viewing distance m
75	12.7
100	17.0
110	18.7
120	20.4
130	22.1
150	25.5
NOTE 1 The appropriate value for *Z* selected from Table 2 is 170.	

Appendix D

DESIGN NOTE 4 TEMPORARY WAITING SPACES

Guidance:

Clause 2.9.30 recommends that temporary waiting spaces should be provided to allow occupants to wait temporarily, before completing their escape to a place of safety.

Compliance / Non-compliance:

Provision of temporary waiting spaces is not considered necessary with the exception of those stairs within Little Brother.

Proposed Solution:

Parents, guardians or carers will remain with child (patient) during an incident and their evacuation will be managed by staff through PHE.

Others will be directed to adjoining compartments not affected by fire where stairs and lifts will remain in use.

The functionality of these vertical routes (lifts & stairs) during a fire incident is considered as adequate mitigation for non-provision of temporary waiting spaces within the stair enclosures.

Hospital Guidance
The Non-domestic Technical Handbook has been used as design guidance together with SHTM 81. The guidance recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc.

NDTH Clause 2.9.30 Temporary waiting spaces
The guidance notes that the speed of evacuation of occupants with sensory, cognitive and/or mobility impairments can be much slower than other building users. Therefore, a space should be provided to allow them to wait temporarily, before completing their escape to a place of safety.

It goes on to say the safe evacuation of occupants with sensory, cognitive and/or mobility impairments is the responsibility of the employer or other person having control of the building and not that of the fire and rescue service. Therefore, occupants with sensory, cognitive and/or mobility impairments, should not be directed to remain in these spaces awaiting the arrival of the fire and rescue service. The employer or other responsible person should make the necessary arrangements for the safe evacuation of all occupants from the temporary waiting spaces.

Progressive Horizontal Evacuation (PHE)
In hospitals the principle of evacuation for patients is that of progressive horizontal evacuation where occupants are moved from an area affected by fire through a fire-resisting barrier to an adjoining area on the same level, designed to protect the occupants from the immediate dangers of fire and smoke (a refuge). The occupants may remain there until the fire is dealt with or await further evacuation to another similar adjoining area or down the nearest stairway.

This procedure should give sufficient time for non-ambulant and partially ambulant patients to be evacuated down stairways to a place of safety, should it become necessary to evacuate an entire storey.

Active fire protection systems such as detection systems and warning systems are incorporated into the building so that the time available for escape may be maximised. This feature may be most beneficial for the occupants of adjacent spaces rather than those in the space immediately affected by the fire.

Progressive horizontal evacuation is primarily for patient evacuation, it is recognised that within a hospital environment there are many other occupants (e.g. visitors) who may have difficulty in negotiating vertical evacuation.

RHSC & DCN Proposal
Should an incident occur that requires evacuation then staff will assist the inpatients with progressive horizontal evacuation. Since the majority of the inpatients will be children their parents, guardians or carers present during the incident will remain with the child to provide reassurance to them. Others not required for this will be directed to leave the affected area (compartment) and make their way out of the building.

Since hospitals are divided into compartments and sub-compartments vertical movement via stairs and lifts in adjoining areas to compartment affected by alarm will remain in use.
The functionality of these vertical routes (lifts & stairs) during a fire incident is considered as adequate mitigation for non-provision of temporary waiting spaces within the stair enclosures.

The exception to this is within Little Brother where simultaneous evacuation will be used and temporary waiting spaces will be provided designed in accordance with the NDTH.

Appendix E

DESIGN NOTE 5

ME-XX-XX-DC-572-101 V3
ME-XX-XX-DC-572-100 V5

Appendix F

DESIGN NOTE 6 SMOKE CONTROL

Issue

The Building Regulation Guidance recommends that for the purposes of smoke control where a corridor provides at least two directions of escape and is more than 12m in length between the exits it serves, it should be divided in the middle third of the corridor.

This could be interpreted that this should be taken as including corridors between sub-compartment / compartment lines that are in excess of 12m in length should be separated within the middle third.

Guidance

The following sections provide an overview of the various guidance documents within the United Kingdom. The unique nature of Hospital design has meant stand-alone guidance has been produced over the years to deal with their specific requirements (Firecode) therefore reference has been made to these guides also.

Non-Domestic Technical Handbook (NDTH)

The guidance under 2.9.13 recommends that for purposes of smoke control, a corridor should be subdivided with a wall or screen with a short fire resistance duration (insulation criteria need not be applied) and any door in the wall or screen should be a self-closing fire door and where the corridor provides at least 2 directions of escape and is more than 12m in length between the exits it serves, it should be divided in the middle third of the corridor. This does not mean that the corridor should be subdivided into 12m lengths.

Within Annex 2B it notes that due to the staffing levels within a hospital the fire safety strategy is normally based on the progressive horizontal evacuation of the patients. The object is to move the patients into adjoining compartments or sub-compartments within a short distance where further evacuation can be made if necessary depending on the severity of the risk. By providing a series of barriers through subcompartmentation it is intended that patients or residents will be able to remain in the building and avoid the need for complete evacuation.

NDTH Definitions

The following terminology is taken from the defined terms within the NDTH:

Exit - means a point of egress from a room, storey, protected zone, space, gallery, catwalk or openwork floor which forms part of, or gives access to, an escape route or place of safety.

Escape route - means a route by which a person may reach a place of safety, and in relation to:

- *a storey, a space or an access deck, means a route from an exit from that storey, space or access deck;*
- *a room, means a route from an exit of that room;*

Travel distance - is the distance measured along the actual route of escape from any point within a storey:

- *to the nearest protected door giving direct access to an escape stair or a place of safety (however, in the case of a building or part of a building where there are at least 2 available directions of travel, the travel distance may be measured to any protected door); or*
- *to a door in a sub-compartment wall as described in annex 2.A and annex 2.B*

Approved Document B (AD B)

For hospitals reference is made to compliance with Firecode (HTM 05-02); however comment on corridor sub-division is given:

Enclosure of corridors that are not protected corridors section 3.25 - *Where a corridor that is used as a means of escape, but is not a protected corridor, is enclosed by partitions, those partitions provide some defence against the spread of smoke in the early stages of a fire, even though they may have no fire resistance rating. To maintain this defence the partitions should be carried up to the soffit of the structural floor above, or to a suspended ceiling and openings into rooms from the corridor should be fitted with doors, which need not be fire doors. Open planning, while offering no impediment to smoke spread, has the compensation that occupants can become aware of a fire quickly.*

Sub-division of corridors section 3.26 - *If a corridor provides access to alternative escape routes, there is a risk that smoke will spread along it and make both routes impassable before all occupants have escaped. To avoid this, every corridor more than 12m long which connects two or more storey exits, should be sub-divided by self-closing fire doors (and any necessary associated screens). The fire door(s) and any associated screen(s) should be positioned approximately mid-way between the two storey exits to effectively safeguard the route from smoke (having regard to the layout of the corridor and to any adjacent fire risks).*

British Standard 9999

Subdivision of corridors section 17.3.11.3 - *If a corridor provides access to alternative escape routes, there is a risk that smoke will spread along it and make both routes impassable before all occupants have escaped. To avoid this, every corridor more than 12 m long which connects two or more storey exits should be subdivided by self-closing fire doors (and any necessary associated screens), so that the fire door(s) and any associated screen(s) are positioned approximately mid-way between the two storey exits. Any doors to the accommodation that would allow smoke to bypass the separating door should be self-closing.*

Firecode SHTM 81

Provides recommendations and guidance additional to the statutory requirements of the Building (Scotland) Regulations 2004. Therefore the guidance aligns with the recommendations of the NDTH and no additional reference is made to cross corridor door provision.

Firecode HTM 05-02

Within the document there are no requirements for corridor subdivision; the emphasis is placed upon compartmentation / sub-compartmentation / fire hazard rooms. An explanation for this approach is provided under Fire hazard rooms and areas Section 6.28 - *For most building types, it is normally required to protect escape routes with fire-resisting walls, ceilings and doors (protected corridors). In hospitals this is not considered acceptable, since the excessive number of fire-resisting doors, all fitted with self-closing devices, it would be a hindrance to staff and patients during the everyday running of a healthcare building. For this reason, the technique advocated for healthcare buildings is to identify and segregate fire hazard rooms by at least 30 minutes' fire-resisting construction.*

Comparison

From the guidance provided there is no requirement for subdivision of corridors within HTM 05-02 since hospitals are subdivided through compartmentation and subcompartmentation; also risk areas are separated through fire hazard rooms.

Within the other guidance documents the principle is that at one point during escape from a fire, escape must be possible in an alternative direction unless a place of relative safety can be reached within a short distance. The alternative escape route will be viable if it is protected from smoke. This is achieved by either self-closing fire doors across the escape route or by pressurisation of the escape route; however pressurisation is not applicable in hospitals or residential care.

The principle difference between Building Regulation guidance for North and South of the border is that the subdivision relates to storey exits in England and Wales and in Scotland relates to exits.

We consider interpretation of this to subcompartment lines is onerous within healthcare design and the specific design as indicated meets the functional standard 2.9 - *Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the occupants, once alerted to the outbreak of the fire, are provided with the opportunity to escape from the building, before being affected by fire or smoke.*

Ward design

The design of hospital wards has evolved over the years to the current preference for single rooms; the following sections look at typical designs and consider their layout in relation to fire spread and evacuation.

Nightingale Wards

Originally, the design of Hospital Ward accommodation was based around open wards with bed bays, a central nursing point that provided observation throughout the ward.



Figure 1 Nightingale Ward

In terms of fire protection and evacuation the Nightingale wards provided good observation of the beds; however should a fire occur then everyone would have to have been moved out of the ward as soon as possible before the ward was filled with smoke. Safe evacuation of patients is dictated by their dependency rather than traditional measures such as travel distance.

1 / 4 / 6 Bed Wards
Most existing hospitals today have a variety of single, four or six bed rooms. In a fire situation, the subdivision of the wards into separate rooms has the advantage of decreasing the number of patients that need to be first moved from the room of fire origin compared to the older Nightingale style wards.

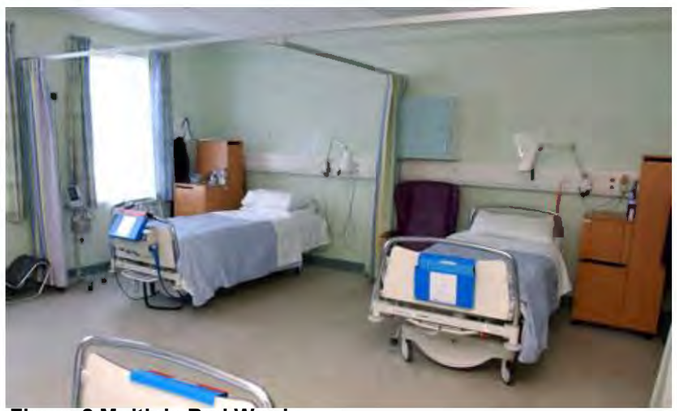


Figure 2 Multiple Bed Ward

The layout has a reduced level staff observation compared to the Nightingale ward since the nurse station is within the corridor outside of the rooms. However the requirement for a category L1 Fire Alarm Detection System provides early warning of an incident.

Single Room Ward
RHSC + DCN has been designed on the basis of single rooms. The move to single rooms has been brought about through the following:

- Reduction of hospital acquired infections (HAI),
- Flexibility,
- Dignity, privacy and confidentiality,
- Patient environment and patient choice.

In a bedroom fire situation, single rooms have a significant advantage since immediate evacuation movement will involve a single patient. Once the patient has been moved the door to the room can be closed to limit the spread of fire and smoke throughout the ward thus providing time to move others from the ward as required.
Glasgow

Bed Bay Wards
Within most hospitals (including RHSC + DCN) a number of patient areas are formed by bed bays. The bays are formed by curtains around the bed area (typical bed bay arrangement as shown below).

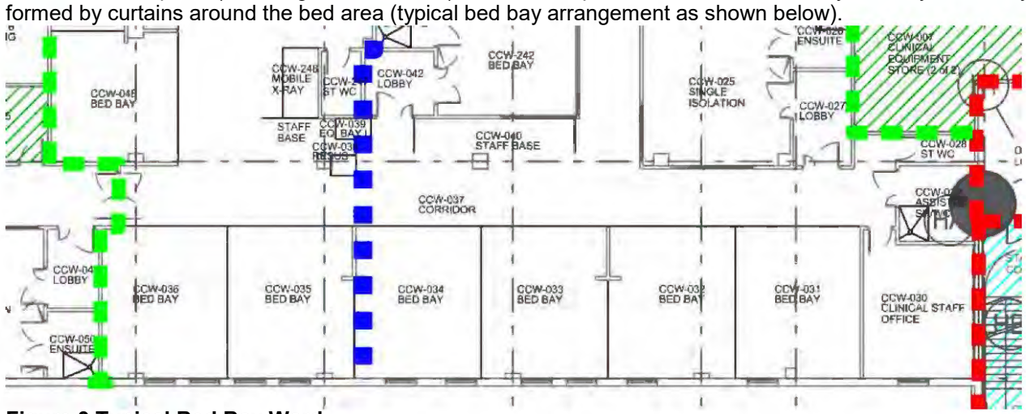


Figure 3 Typical Bed Bay Ward

This type of layout can create a circulation area in excess of 30m. However since there are no walls around the bed bays then no subdivision would be required along the circulation route. It is suggested that an enclosed ward room layout is of no greater risk than this layout without subdivision.

Summary
It can be seen that the development of reduced patient numbers per room has a positive impact on limiting fire spread and ability to evacuate those at immediate risk within the room of fire origin.

Open Nightingale wards and multiple bed wards require a significantly greater evacuation time to move those at immediate risk of a fire within the room; the same principle also applies to bed bay wards and in each case no further division is required.

Analysis

Within the NDTH guidance travel distance in a hospital should not exceed 15m in single direction of travel and 32m in more than one direction. Travel distance may be measured to a protected door in a compartment wall or a sub-compartment wall however; the escape route should not pass through any fire hazard room.
The diagram below represents a hospital ward where the corridor distance could be 50m long.

Following the guidance a door would be required within the middle third as it is greater than 12m; therefore a compliant situation could develop where even when divided there could be a 33m long section of corridor.

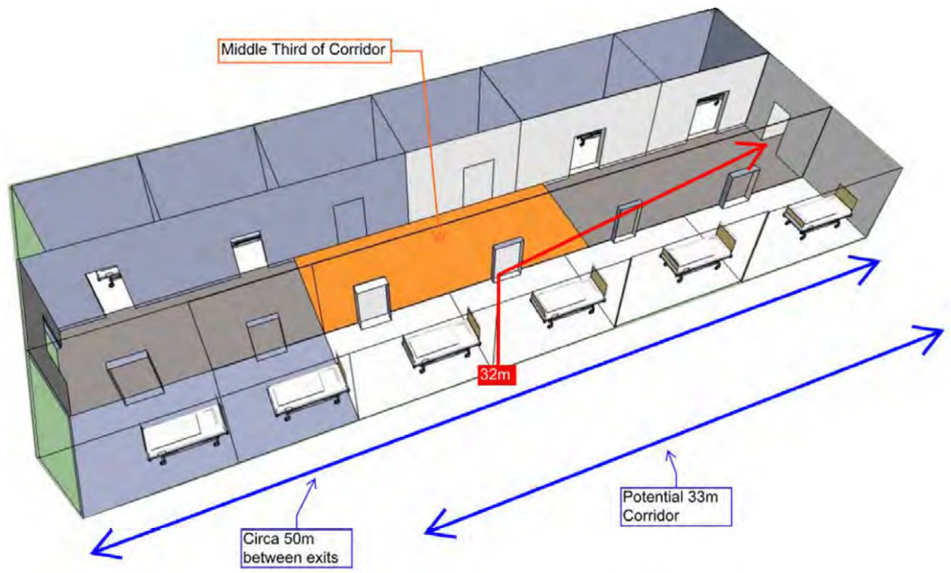


Figure 4 Corridor Sub-division

This leads to potential situations where corridors just over 12m in length are treated the same way as one circa 50m in length.

The principle behind cross-corridor doors is that at one point during escape from a fire, escape must be possible in an alternative direction unless a place of relative safety can be reached within a short distance. However the example shows the potential for a significant corridor can still exist and be compliant with the NDTH.

Within a hospital the provision of cross corridor doors is not the decisive factor for safe evacuation due to the potential for a prolonged evacuation time. A far more important factor is the movement of those at immediate risk and the staff procedures in place to contain and limit the potential spread of fire and smoke from the room of fire origin.

Staff Procedures
In a fire situation ward staff are trained to first identify if there is a real fire or if it is a false alarm by a rapid visual inspection of all rooms and corridors also checking the status of red LED lights on the smoke detectors and manual call points (closing all windows and doors).

Staff then carry out the necessary clinical preparations of patients and their medical equipment and prioritise patients for evacuation in the following order:

- Ambulant patients first,
- Non ambulant patients on their beds.

For evacuation movement several team members are required to open and close fire doors on the escape routes to assist with the evacuation whilst other staff are positioned along the evacuation route so beds can be passed onto them creating a bucket chain principle to speed up the evacuation.

Summary
The evacuation procedures are highly managed sequential events going from identification, containment to movement. The first phase of movement is out of the sub-compartment and this may require a high level of staff resource to move patients and beds. Doors subdividing corridors will act more as a hindrance since these will require to be held open in order to move all occupants out of the sub-compartment.

Conclusion
The Building Regulation Guidance recommends that corridors in excess of 12m should be subdivided for the purposes of smoke control.

The principle is that at one point during escape from a fire, escape must be possible in an alternative direction unless a place of relative safety can be reached within a short distance and the alternative escape route will be viable if it is protected from smoke.

The guidance within Scotland varies from other parts of the United Kingdom in that subdivision relates to storey exits in England and Wales and in Scotland relates to exits.

Firecode HTM 05-02 notes that protecting corridors in a hospital is not considered acceptable, since the excessive number of fire-resisting doors, all fitted with self-closing devices, would be a hindrance to staff and patients during the everyday running of a healthcare building. For this reason, the technique advocated for healthcare buildings is to identify and segregate fire hazard rooms by at least 30 minutes' fire-resisting construction.

Over the years patient accommodation has moved from open Nightingale wards to single rooms. Single room layouts have a positive impact on limiting fire and smoke spread and the ability to evacuate those at immediate risk within the room of fire origin. Bed bay wards with a central circulation route would not require further division to meet the NDTH requirements. The proposed layout is considered to represent less of a risk than these type of wards.

The guidance leads to potential situations where corridors just over 12m in length are treated the same way as one circa 50m in length. Within longer subdivided corridors there could still be sections circa 33m in length.

Hospital evacuation procedures are highly managed sequential events going from identification, containment to movement. The first phase of movement is out of the sub-compartment and this requires staff resource to move patients and beds.

The Design team have worked in parallel with the NHS to ensure that robust management procedures coupled with the design have been developed to allow horizontal evacuation to be successfully managed.

The NHS and design team are concerned that additional doors subdividing corridors will act more as a hindrance since these will require to be held open in order to move all occupants out of the sub-compartment.

Taking the above into consideration the proposed layout is considered to meet the functional standard 2.9 – *Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the occupants, once alerted to the outbreak of the fire, are provided with the opportunity to escape from the building, before being affected by fire or smoke.*

Following discussions with the local authority and local fire officer, it has been established that where there are longer lengths of corridors, additional cross corridor doors have been placed where they do not hinder the operation of the hospital.

Appendix G

DESIGN NOTE 7 LOCKS

Access Control

The design of the access control systems for the doors has been carefully considered in relation to clinical requirements and patient, staff and public safety. This has included in depth review with the NHS who will be responsible for the management and safe running of the healthcare facility. Where appropriate, details of their management procedures are included and will form part of their Management Procedures documentation suite.

Management

A managed approach to access control is acknowledged in NDTH 2.B.3:

Hospitals can present difficulties when assessing the risks associated with security against the need to evacuate the building safely in the case of fire. Some parts of hospitals could have patients who might put themselves at risk. An example could be a patients ward on an upper floor providing accommodation for the elderly or mentally infirm, where there is concern about residents falling down stairs. In such cases, variation in the guidance to Standard 2.9 would be entirely appropriate where the risk of death or injury from falls is assessed against the hazard associated with fire. The security measures proposed should therefore take account of these hazards and extra emphasis may need to be placed on management control and/or any automated life safety systems to ensure the safe evacuation of the building.

Non Domestic Technical Handbook Guidance

The guidance in the NDTH under paragraph 2.9.18 - 2.9.21 Locks states:

2.9.18 - Locks on exits doors or locks on doors across escape routes present difficulties when assessing the need for security against the need to allow safe egress from a building in the event of a fire. Security measures however should not compromise the ability of the occupants to escape from a building in an emergency. In general, all doors on escape routes, should either not be fitted with locks, or they should only be fitted with fastenings that can be readily operated from the side approached by occupants making an escape. The operation of these locks should be readily apparent, without the use of a key or access control tokens and without having to manipulate more than one mechanism. This is not intended to prohibit the use of locks to secure a room, storey or building when unoccupied.

This guidance may also need to be adapted in a building used as place of lawful detention due to the unique operational factors.

Where an exit door from a room, storey or a door across an escape route has to be secured against entry when the building or part of the building is occupied, it should only be fitted with a lock which is readily operated, without a key, from the side approached by occupants making their escape. Similarly, where a secure door is operated by a code, combination, swipe or proximity card, biometric data or similar means, it should also be capable of being overridden from the side approached by occupants making their escape (see also electrically operated locks).

Guidance on the types of hardware for timber fire and escape doors can be obtained from the Code of Practice, 'Hardware for Fire and Escape Doors' Issue 2, June 2006, published by the Door and Hardware Federation and the Guild of Architectural Ironmongers.

2.9.19 Mechanical or electro-mechanical panic exit locking devices - Different groups of users will have differing needs to enable them to escape quickly and easily from a building in the case of fire and this should be reflected in the type of lock chosen. For example, in buildings frequented by the general public it is important that the locks can be released by occupants who may be unfamiliar with the building and have received no training in the emergency procedures or the types of exit locks used in the building.

These locks are designed to operate on body pressure alone and require no knowledge of their operation to enable safe and effective evacuation of the building. In these cases, panic exit locks operated by a horizontal bar should be designed and installed in accordance with BS EN 1125: 1997.

2.9.20 Mechanical or electro-mechanical emergency exit - locking devices In buildings, or parts of buildings, that are not open to the general public, such as in offices or other working environments, the occupants should be awake and familiar with the building. When staff in such areas are trained both in the emergency procedures and in the use of the specific emergency devices fitted (see clause 2.0.8) then emergency exit devices to BS EN 179: 1997 can be installed. This type of locking device is released mechanically by a single action applied to the door lever handle or push pad to allow people familiar with the building to escape in an emergency.

Locking devices to BS EN 179: 1997 can also be used in buildings or areas used by the general public where the occupancy capacity is low. Therefore these devices should not be installed on any door accessible to the general public where the aggregate occupancy capacity of the rooms or storeys served by the door is more than 60 persons.

2.9.21 Electric locking devices that unlock on electrical power being withdrawn - Where there is a choice of escape routes and the doors on one direction of escape are fitted with devices giving mechanical escape which operate on body pressure alone to BS EN 1125: 1997 or by the use of a lever handle or push pad to BS EN 179: 1997, the alternative escape route could be fitted with fail unlocked, electric locking device, such as an electro-magnetic lock. These are devices that require electrical power to be withdrawn from them to unlock.

Fail unlocked, electric locks, may be installed on exit doors and doors across escape routes, which are inaccessible to the general public or, on any door accessible to the general public where the aggregate occupancy capacity of the rooms or storeys served by the door does not exceeds 60 persons. Where the locks are intended to be used by occupants who are familiar with the building, staff in such areas, will need to be trained both in the emergency procedures and in the use of the specific locking devices fitted (see clause 2.0.8).

Fail unlocked devices are not designed to be used by people in a panic. Where installed in buildings that feature fail unlocked electric locks, they should operate in conjunction with a fire alarm system, the design of which should be determined by a fire risk assessment (see clause 2.0.8).

More detailed guidance on the type of fire alarm system most appropriate to the circumstances is contained in BS 5839: Part 1: 2002.

This type of 'fail unlocked electric locking device' should unlock instantly when electrical power is withdrawn and should unlock even when pressure is being applied to the escape door by occupants trying to escape at the time that electrical power is withdrawn.

'Fail unlocked electric locks' should not be installed on:

- *a protected door serving the only escape stair in the building (or the only escape stair serving part of the building) or,*
- *a protected door serving a fire-fighting shaft or,*
- *on any door which provides the only route of escape from the building or part of the building or,*
- *on any door accessible to the general public where the aggregate occupancy capacity of the rooms or storeys served by the door exceeds 60 persons.*

A delay in the opening of a door across an escape route, can lead to an increase in anxiety of occupants or possible panic. Therefore, 'fail unlocked electric locks' should be programmed to fail to the unlocked position:

- *on operation of the fire alarm system,*
- *on loss of electrical power or system error,*
- *on activation of a manual door release unit (Type A) to BS EN 54: Part 11: 2001 they are connected to, positioned at the door on the side approached by occupants making their escape and where the door provides escape in either direction, a unit should be installed on both sides of the door.*

Some electric locking devices fail locked on both sides of the door when electrical power is withdrawn and does not give mechanical escape by panic bar, handle or push pad. This type of electric locking should not be used on exit doors and doors across escape routes.

British Standard BS EN 7273-4: 2007

It is noted that BS EN 7273-4: 2007 Clause 4 states:
In some instances, there is a need to secure doors on the means of escape by, for example, use of electric door magnets, electromechanical locks or electromechanical strikes. Such arrangements are common in certain hospitals or departments within hospitals.

The intended use of electrically operated locks with electrical actuation of release mechanism is supported by BS EN 7273-4: 2007. Clause 5 states;
All electrical systems have the potential to fail. However, if the recommendations of this standard for electrical actuation of release mechanism, and the recommendations of BS 5839-1 for the associated fire detection and fire alarm systems, are followed in respect of design, installation, commissioning and maintenance, the likelihood of failure of a release mechanism to operate correctly on demand is expected to be very low. Since a fire in a building is normally a very uncommon event, the likelihood of failure of a release mechanism at the time of a fire is then so low as to constitute a tolerable risk in most circumstances.
In the design of the interface between the release mechanism and the fire detection and fire alarm system, account does, however, need to be taken of at least, a single failure of equipment power supplies on which the correct transmission of a signal to the release mechanism depends....In some circumstances two independent, simultaneous failures must be taken in account.

Clause 7:
Variations from the recommendations of this standard; There will be applications in which the recommendations (of this standard) are unsuitable and would for example, lead to measure that could be detrimental to other measures for safety of occupant In extreme cases, the recommendations might even place persons at serious risk of, for example, physical attack.

Proposed Principles

In the event of a fire alarm, members of the public and staff that are not engaged in the PHE (Progressive Horizontal Evacuation) of patients will make their own way out of the area. Patients (and guardians of patients in the Children's Hospital) in the fire alarm zone and Staff that are engaged in the evacuation will follow the PHE strategy. They will move from sub-compartment/compartment to sub-compartment/compartment until reaching a place of safety.

In areas of the hospital that have less than 60 members of the general public during operating hours; the doors across escape routes will be free swinging or held open and released to a free state on alarm. Where they form part of a secure boundary they will be fitted with electromagnetic locks linked to the fire alarm system to cause them to release to a free state when required for escape, or release on withdrawal of power or system error to BS EN 7273-4: 2007. During normal use these locks will be released on the secure side by way of a green push button located on an adjacent wall in compliance with BS EN 54: Part 11: 2001.

The need for electrically operated locks to meet with the complex clinical, functional and safety requirements of the hospital are acknowledged.

It will be demonstrated that through compliance with British Standards and the implementation of robust management procedures, supported by a fire alarm system, the proposed strategy meets with the requirements of the mandatory standard set out in section 2.9 of the Building Regulations (Scotland) Non Domestic Technical Handbook 2013.

- Where the general public numbers do not exceed 60 persons it is considered reasonable to meet the above guidance in 2.9.15
- The design of the building escape is based upon managed phased evacuation; in the event of an alarm to evacuate part of the building, only the general public (i.e. not trained staff or patients) will be required to evacuate the area initially.
- Release of locks will require review within more secure mental health areas of the hospital where the automatic release of locks could put the patients at risk by allowing them to leave the safety of the ward.
- In the absence of specific Firecode Guidance, we would recommend category A actuation is appropriate to the hospital installation. This is recommended for residential care premises and a place of public entertainment.
- Final exit doors on the perimeter of the building will comply with the requirements for safe egress. Manual swing doors will be fitted with single action release ironmongery that will release on body pressure in accordance with BS EN: 1125: 1997.
- Automatic swing doors, on the release of power, will function as manual swing doors in accordance with BS EN 7036-3: 1996.
- Automatic sliding doors will fail safe to open in accordance with BS EN 7036-2: 1996.

Appendix H

DESIGN NOTE 8 DELETED

Appendix I

DESIGN NOTE 9 HOSE LAYING

Guidance:
NDTH (2.14.7)
If a building is not fitted with an automatic fire suppression system, no point on any storey should be more than 45m from the nearest main outlet measured along an unobstructed route for laying a fire hose.

Compliance / Non-compliance:
Small sections of the design at ground, first, second and third floors result in areas in excess of the 45m distance. The worst case scenario is 60m, 15m in excess of the guidance requirements.

The number of areas in which the hose laying distance exceeds 45m is negligible. All areas in which non-compliance occurs are highlighted in Figures 1, 2, 3 and 4 of this document.

Proposed Solution:
Historically up until the issue of NDTH 2010, a hose laying length of 60m was permitted within buildings not fitted with an automatic fire suppression system. This change in guidance which resulted in reducing the hose laying length from 60m to 45m came following The Building Disaster Assessment Group research on behalf of the UK Government. This research was to assess the interaction between building design and the operational response of fire and rescue services.

Within this technical report the evaluation in reduction of fire hose laying lengths during fire fighting operations derived from the physiological demands on firefighters engaged in search and rescue and on the restrictions that may be imposed by their equipment.

In practice, attending Fire and Rescue Services appliances are fitted with hoses which are much longer than 45m this is to take account of when operating fire hoses within buildings the fire hoses have a tendency to "snake" when charged thus limiting their effective length.
The report also looks at the common practice to trim the ends of hoses where they become damaged during fire fighting procedures.

Also the time and effort it takes to lay out a hose during operation procedures and the actual distance that the Fire & Rescue Service need to carry kit and lay hoses from the vehicle to a bridge head and potential point of fire.

SHTM 81: Part 2, the guidance on the fire engineering of healthcare premises in Scotland is based on HTM 05-03: Operational Provisions: Part J: Guidance on the fire engineering of healthcare premises. Both of these guidance documents have been developed by the National Fire Policy Advisory Group (NFPAG) and other NHS stakeholders.

HTM 05-03: Part J (which SHTM 81 Part 2 is based on) supports a number of HTM guidance documents when applying fire safety engineering principles to a building design. One of the guidance documents in which it supports is HTM 05-02: Guidance in support of functional provisions for healthcare premises. Specified within Section 7.24 of HTM 05-02, it states that if the building is not fitted with sprinklers, every part of every storey should not be more than 60 m

In support of the above observations and solutions, NDTH 2013, Appendix B permits the use of a wide range of standards when applying fire safety engineering principles to buildings in Scotland, amongst the list of standards permitted is BS 5588 Part 5: 2004, Code of practice for fire-fighting stairs and lifts.

Stated within Section 7.1.2 (b) of BS 5588 Part 5, in a building not fitted with an automatic sprinkler system, the distance along which a hose can be laid from the doorway between the fire-fighting shaft and the accommodation to any point on that storey should not exceed 60 m.

Both SHTM and HTM guidance documents express that a hospital street and fire fighting shaft should both provide the same functional fire safety parameters to fire service personal when exercising their fire fighting procedure.

Therefore it is considered that the extended hose laying distance required within RHSC & DCN are acceptable when assessed against the above guidance and standards.

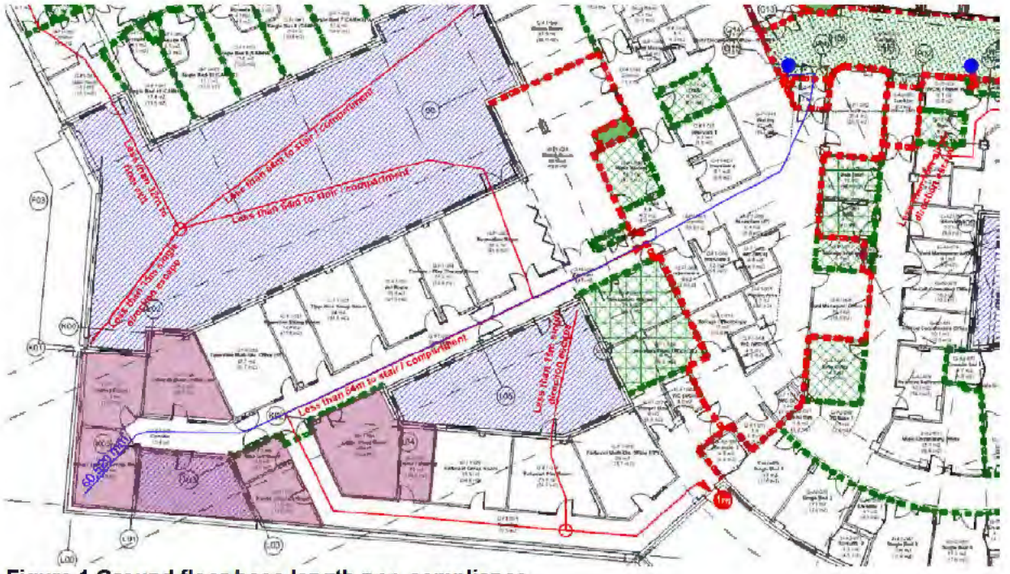


Figure 1 Ground floor hose length non-compliance

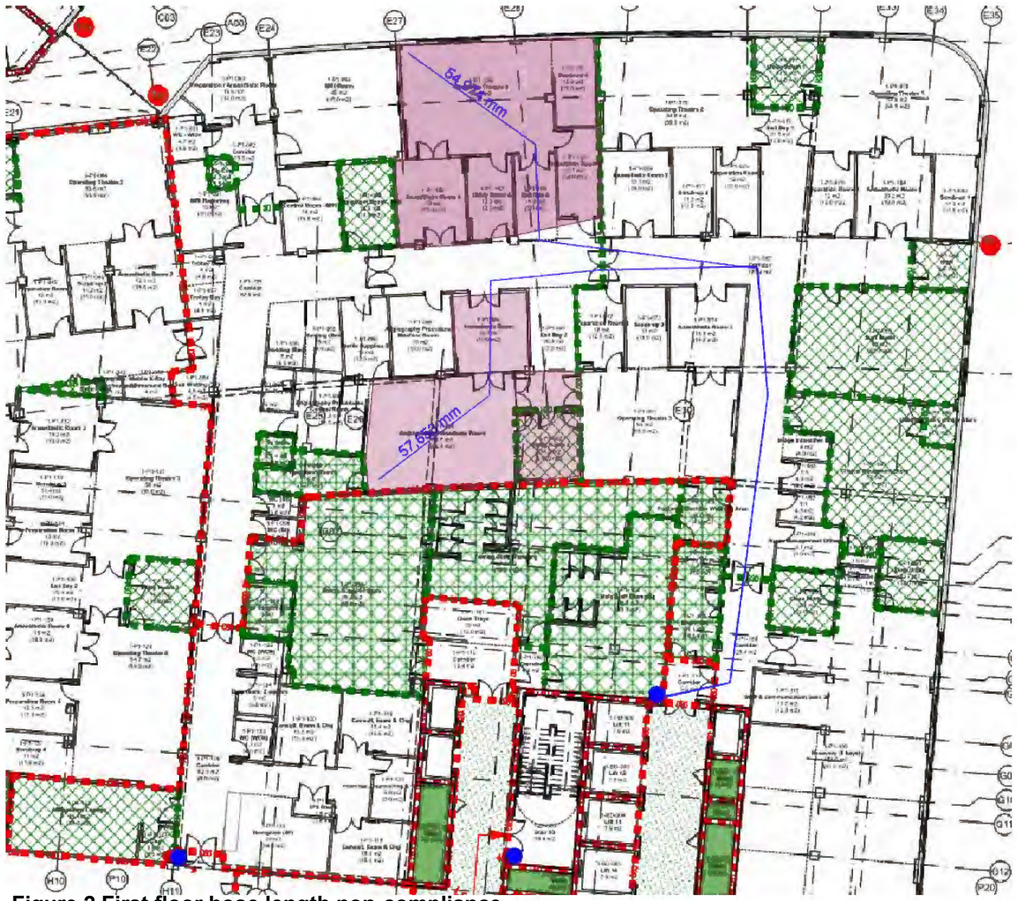


Figure 2 First floor hose length non-compliance



Figure 3 Second floor hose length non-compliance





Figure 4 Third floor hose length non-compliance

Appendix J

DESIGN NOTE 10 ATRIUM

REPORT Nº 70003278

RHSC & DCN

DN 10 ATRIUM EVACUATION

MARCH 2017

wsp

RHSC & DCN

DN 10 ATRIUM EVACUATION

Type of document (version)

Project no: 70003278
Date: March 2017

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QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks		Update to include smoke modelling results	Update to include evacuation calculations	Update of calculation figures
Date	14/07/2014	20/01/2015	20/08/2015	13/04/2016
Prepared by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Checked by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Authorised by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Project number	[redacted]	[redacted]	[redacted]	[redacted]
Report number				
File reference				

ISSUE/REVISION	REVISION 4	REVISION 5
Remarks	Update into new template with final Evacuation calculations	Update to take into account final Board Comments
Date	28/03/2017	26/10/2017
Prepared by	[redacted]	[redacted]
Signature		
Checked by	[redacted]	[redacted]
Signature		
Authorised by	[redacted]	[redacted]
Signature		
Project number	70003278	70003278
Report number		
File reference		

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FIGURE 3 ATRIUM EXITS SECOND FLOOR 3

1 ATRIUM EVACUATION

1.1 INTRODUCTION

The atrium shall be designed with reference to the guidance within SHTM 81 Part 3: Atria in healthcare premises.

SHTM 81 Part 3 recognises the special requirements in regard to fire precautions for the design of atria within healthcare premises and allows the statutory requirements to be applied sensibly in a risk appropriate framework. This guidance recognises the interaction between:

- The physical fire precautions;
- The dependency of the patient;
- Fire hazards within the healthcare premises;
- The management policies; and
- The availability of sufficient and adequately trained staff in achieving an acceptable level of fire safety within healthcare premises.

It is recognised within the design that an atrium space in a healthcare building may contain high numbers of dependent people, or others with some degree of disability, for whom additional time and assistance to escape will be necessary. To address this concern, it is therefore necessary to provide atria with higher standards of fire protection than would normally be provided within similar buildings put to a different use.

1.2 CONSULTATION

In order to ensure that the atria meets the specific requirements of the relevant regulatory bodies and the design objectives of the procuring body itself, including the appropriate standards fire safety, the health and nursing care objectives and other related matters; consultation will take place between relevant stakeholders i.e. the design team, the client, the Health Board fire safety advisor, the relevant regulatory authorities and where appropriate, the client's insurers.

Such early discussion and consultation on fire engineering aspects will ensure all the parties with an interest in the project have a full understanding of the relevant standards, design objectives and regulatory requirements having specific regard to the inclusion of appropriate fire safety measures.

1.3 SMOKE AND FIRE SPREAD

Smoke and fire may spread from storey to storey much more quickly when an atrium is included in a building design – the atrium allows for a larger volume of smoke to be created by entrainment through atrium height and provides a route by which smoke and fire can spread to areas of the building that are somewhat remote from the fire incident itself. The combination of increased quantities of smoke and the potential for that smoke to spread far beyond the area of the fire itself may result in many more building occupants being at risk simultaneously than would be the case in a similar building without an atrium.

1.4 UTILISATION OF THE ATRIUM SPACE

The atrium will accommodate a number of outpatient waiting spaces, the main reception area, play / activity areas, communication spaces and a through route to other areas of the building. The design recognises that for many visitors, this will be the first time that they have entered the building. They will be unfamiliar with the building layout and the facilities for escape should a fire prevent their exit via the main entrance.

The atrium will not be used for:

- Sleeping accommodation;
- Nursing or medical care; or
- Seating areas such as dayrooms or lounges for use by in-patients.

1.5 SEGREGATION OF HOSPITAL SERVICES

To ensure that a fire within an atrium cannot disrupt or damage any of the services supplying hospital departments, it will be necessary to segregate hospital services from the atrium.

Services supplying hospital departments will not be routed through the atria spaces. Where this is not practical, they will be accommodated within medium duration enclosures (minimum period of fire resistance of at least 60 minutes). Piped medical gases will not be routed through the atrium.

1.6 POTENTIAL EFFECTS ON PATIENTS IN ADJACENT AREAS

The design will consider the effect of glazed areas adjacent to the atrium that accommodates patients that are not able to evacuate without assistance. The design will recognise that witnessing the atrium filling with smoke may increase patients' anxiety and exacerbate their condition, particularly if staff are unable to provide assistance or reassurance due to their being involved in the evacuation of the atrium's occupants.

1.7 RELATIONSHIP TO OTHER DEPARTMENTS

To minimise the potential for a large fire to develop and spread via the atrium space there will be no fire hazard departments within the atrium space (this includes. temporary or permanent cooking facilities and arrangements introduced by third parties such as external catering companies).

Departments that provide care for dependent patients will have access to the atrium via circulation spaces.

It is proposed that the guidance in SHTM 81 Part 3 will be followed except clause (3.6) which states:

"Departments that provide care for very high dependency patients shall not be located adjacent to an atrium, nor should any part of the department or their supporting facilities be located within the atrium."

PROPOSED SOLUTION

As high dependency areas (theatres) are located adjacent to the atria a fire engineered approach has been taken to demonstrate that with the proposed level of fire protection in the atria and adjacent areas the functional requirements of the guidance will be achieved.

The objective of this SHTM guidance is that should a fire occur in the atrium the adjacent areas do not need to evacuate. To achieve this functional objective the atrium will be provided with smoke ventilation designed to maintain tenable conditions within the atrium, and 60 minute fire separation will be provided between the atrium and adjacent clinical accommodation. In addition lobbies are provided where clinical in patient accommodation is accessed from the atrium and suppression is provided within the atrium. It is considered that the functional objectives of the guidance have been achieved with this fire strategy approach to the atrium.

1.8 FIRE LOAD

The atrium will not be a sterile space therefore a fire load will exist. Control measures will be applied to the space to limit the quantity of combustible materials that may become involved in any fire incident, and therefore the size of fire, within the atrium. Such control measures will be to limit the size of the fire involving those combustible materials.

Further information is provided in a separate report WSP-SZ-XX-DC-572-301_01

1.9 FIRE DETECTION AND ALARM

The fire alarm installation covering the atrium space will be configured as a separate zone in the fire detection and alarm system.

Air aspirating has been confirmed as being installed with the atrium to a Category Level Class B System.

The interaction of alarm signals between the atrium zone and adjacent zones will be in accordance with the fire alarm strategy for the remainder of the building. However, it may be necessary for an alarm signal to be given in areas outside the atrium space itself e.g. lift landings, stairways or in adjacent circulation spaces which are not within the relevant detection zone. This will form part of the on-going cause and effects fire safety meetings with the operator during the design development process.

1.10 EMERGENCY ESCAPE ROUTES

The atrium occupants are independent therefore the maximum travel distance in a single direction will be no more than 18 metres and 45 metres where more than one direction is available.

There are in total 12 separate exits from the atrium space to adjoining areas via circulation spaces that lead to outside. The guidance minimum is three. These are arranged such that at least two exits remain available in the event of any single fire, and in any case sufficient exits proportionate to the potential occupant load of the space in accordance with the requirements of the NDTH.

The 12 exits are located such that there are 6 separate exits provided from the main atrium space at ground floor. The longer narrow section of atrium is provided with 3 exits, 2 of which are direct to outside. First floor of the atrium is provided with 3 separate exits into 3 different compartments.



Figure 1 Atrium exits ground storey

A minimum of two exits arranged such that at least one remains available in the event of a fire will be provided from each balcony or bridge.



Figure 2 Atrium exits first floor

At levels 1 and 2 it is proposed that open walkways are provided across the atrium that would connect compartments. The means of escape in the northern compartments which are adjacent to the atrium at levels 1 and 2 would have the following escape routes available:

- An escape route into adjacent fire compartments and sub-compartments at the same level;
- An escape route available via the three stair cores located in this section of the building; or
- An alternative means of escape via the atrium.

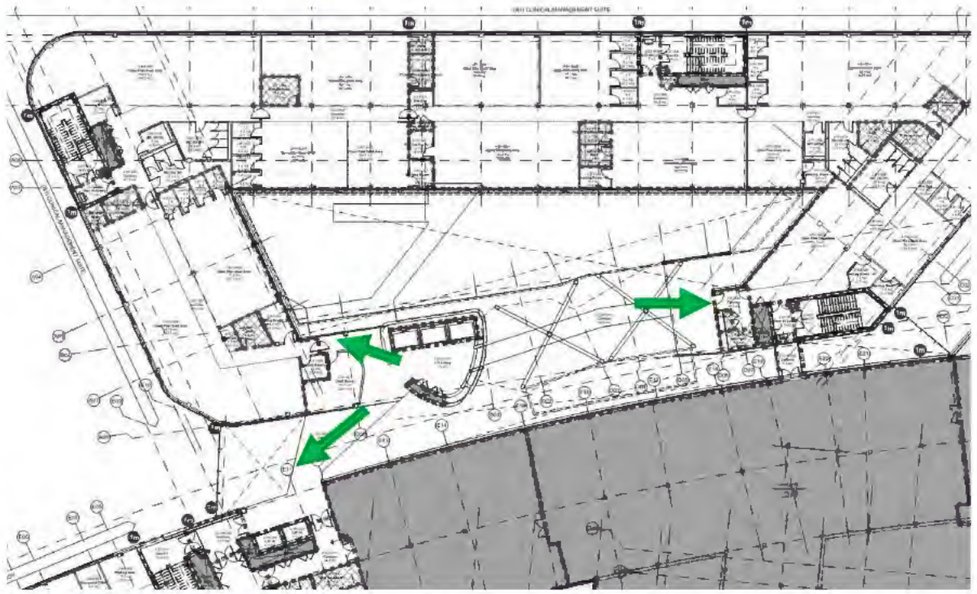


Figure 3 Atrium exits second floor

Due to these escape options it would not be possible to operate progressive horizontal evacuation in these compartments without passing through the atrium. However the occupants in this block will be of the type where the majority can escape to and down the stairs without assistance, i.e. they are independent and evacuation can be more simultaneous as opposed to progressive.

Should a fire occur in the atrium it would be possible for occupants to escape away from the atrium to adjacent compartments and if necessary via stairs to a final exit.

Should a fire occur in one of the compartments next to the atrium it would be possible for occupants to evacuate to adjacent compartments and away from the fire. If occupants want to escape across the atrium bridges it would be considered safe to do so due to the fire separation provided between the accommodation and the atria. It is therefore considered that the functional objectives for means of escape would be achieved for non-dependent patients and staff.

1.11 ATRIUM ENCLOSURE

The SHTM 81 Part 3 guidance recommends that an atria façade shall be enclosed with wall construction that provide a minimum period of fire resistance of at least medium duration fire protection - 60 minutes (integrity, insulation and where applicable, load-bearing capacity).

It also notes where the atrium enclosure incorporates glazed elements, the glazed elements must provide the minimum period of fire resistance (integrity and insulation) of the atrium enclosure.

SHTM 81 Part 3 notes that in circumstances where the rise in smoke temperature within the atrium can be demonstrated not to exceed 140°C above ambient temperature, and there are no balconies or bridges on the atrium side of the enclosure, any glazed elements incorporated into the atrium enclosure at levels above the atrium base need not meet the requirement for insulation.

PROPOSED SOLUTION

It is proposed that the atrium enclosure walls meet the medium duration fire protection integrity and insulation.

Calculations shown in the CFD report WSP-SZ-XX-572-600 that the smoke temperature is significantly below 140°C therefore it is proposed that glazing within the atrium enclosure will be fixed lights of toughened glass in a suitable framing structure with the exception of glazing serving the first storey theatre department. This area has an obvious higher patient dependency category therefore 60 / 60 glazing in a suitable framing will be provided to these areas.

The National Research Council of Canada (NRCC) has had a program for developing sprinkler protection for glazing. As part of that work, a few non-sprinklered tests have been run where glass 6 mm thick tempered glass was exposed to simulated room fire conditions, but without a sprinkler.

Tempered (toughened) glass behaves differently, in that it shatters upon initial cracking, but the initial cracking does not occur until the glass reaches rather high temperatures. An exposed-surface temperature of 290-380ºC has been found to be needed, with the unexposed surface temperatures being about 100ºC lower. Such glass temperatures are normally not reached until after room flashover has occurred.

Although the design has link bridges at first and second storey these are not general through routes for in patient departments. Protected lobbies have been provided to any clinical access points entered off the atrium to ensure that two door protection is provided between atria and clinical accommodation. This will mitigate the risk of smoke leakage into adjoining compartments from the atrium.

At first floor level the atrium is open to a waiting area to the north of the atrium. It is proposed to maintain tenable conditions on the walkway to allow occupants to escape. Where the link bridge enters the accommodation from the atrium there will be fire separation to the same standard as a 60 minute fire rated door. It is proposed that the waiting area will be separated from the atrium with a fire/smoke curtain (designed to achieve the same level of fire rating as a door). This will therefore provide an equivalent level of fire separation between the atrium and clinical areas as a lobby, as required by SHTM guidance.

At second floor level it is proposed that the link bridge across the atrium will be open. Where the link bridge enters the accommodation from the atrium there will be fire separation to the same standard as a 60 minute fire rated door. At this level the accommodation adjacent to the atrium is staff management offices therefore the atrium is not directly open to clinical accommodation at second floor. The clinical areas located to the south of the atrium will be fire separated by at least three doors at second floor level which is considered suitable separation to prevent smoke from a fire in the atrium entering near any clinical accommodation.

2 SMOKE CONTROL

The guidance within SHTM 81 part 3 notes that where access is possible from the atrium space to adjacent accommodation above the atrium base level, or the atrium is not considered to have a limited fire load, smoke control measures are necessary to prevent the spread of smoke to areas adjacent to the atrium.

Where there is no access to adjacent accommodation from the atrium space above the atrium base level, the compartmentation enclosing the atrium space should be sufficient to prevent the spread of smoke to adjacent areas. Therefore, additional passive or active smoke control measures are not required.

PROPOSED SOLUTION

In order to justify the open balcony walkways at first and second floor it is proposed that smoke control will be provided in the atrium. SHTM 81: Part 3 recommends that smoke control should be designed to ensure the smoke layer is kept to a height that is 3m above the floor level of balconies / bridges in order to reduce the risk of fire spread to adjoining clinical areas off the atrium and to allow those on the balconies / bridges greater time to escape. Occupants of seating areas on balconies or bridges above an atrium base may be sufficiently remote from any fire incident and its direct effects that the risk associated with the smoke produced by a fire on the atrium base may go unnoticed, which could delay their evacuation.

Within RHSC + DCN the highest clinical opening / waiting area is provided at first floor level from the atrium space. At second floor level the adjacent accommodation is staff management offices therefore there is not a clinical ward adjacent to the atrium at second floor. Clinical accommodation at second floor is suitably remote and fire separated by at least three fire doors. At this level there are no waiting spaces within the atrium only circulation routes.

It is therefore proposed that the smoke control system would be designed to keep the smoke layer 3m above first floor level where the highest clinical opening occurs and waiting spaces are provided.

To achieve the required smoke layer for the given fire size, natural smoke ventilation will be provided in the roof of the atrium with natural smoke inlet being provided via the doors at the base of the atrium. Both the outlet vents and doors used for inlet air would need to open automatically upon a confirmed fire in the atrium.

When smoke spills out from underneath a balcony edge increased volumes of smoke are created, therefore the chance of spill plumes occurring have been limited wherever possible.

Waiting areas off the atrium but open to it at ground storey will have limited width openings to control the width of the flow from the opening.

It is proposed that the area underneath the level 1 walkway at atrium base would form a sterile path to reduce the chances of a spill plume occurring at this point. This can be seen from the furniture plans noted in our separate report WSP-SZ-XX-572-301.

3 SMOKE MODELLING

3.1 INTRODUCTION

This section summarises the preliminary modelling study carried out for RHSC + DCN as part of the Fire Safety Strategy. A CFD report has been completed as is provided as part of this report.

It is proposed to justify open walkway circulation routes within the atrium space at first and second storey levels by demonstrating that the first floor areas will be smoke free throughout the duration of a fire event. The second storey shall be within the smoke reservoir however travel distances to exit these open areas are relatively short and the use of this level is non-patient.

It is considered in this project that the smoke conditions shall not be allowed to impinge on occupants within the atrium, and that fire will not spread to spaces adjoining the atrium.

Computer modelling is used to explore the likely conditions in the atria during fire scenarios and justify the efficacy of the performance based design. The modelling will demonstrate what happens to smoke layer temperatures, and the time for smoke to build down to noted levels.

TEMPERATURE FOR SMOKE ABOVE OCCUPANTS	<60°C	FOR LAYER 2M-3M ABOVE FLOOR LEVEL
VISIBILITY DISTANCE FOR MEANS OF ESCAPE	10M	HEAD HEIGHT

Table 1 Acceptance Criteria for Tenable Conditions

A Computational Fluid Dynamics (CFD) model has been developed using the Fire Dynamics Simulator (FDS) modelling software to investigate the smoke development within the atria.

A separate CFD report has been produced which demonstrates two fire scenarios; Axisymmetric and Spill.

The key input parameters are outlined as follows:

- 2.5MW medium growth rate fire - axi-symmetric on the atrium base
- 2.5MW medium growth rate fire – spill plume
- Fuel based on plastics content ($C_{6.3}H_{7.1}O_{2.1}$) with soot yield of 10%.
- 0.25m mesh cells

3.2 FIRE LOCATED AT THE BASE OF THE ATRIUM, (AXI-SYMMETRIC PLUME)

These types of fires are likely to represent the most onerous in the area as there is limited fuel load in the atrium base and a fire at low level will entrain more air as it rises and therefore produces a larger volume of smoke.

The purpose of this base model is to give an initial indication as to the performance of the space under a worst case fire scenario, key outputs are:

- Temperature at roof
- Smoke development and ‘smoke fill time’

RESULTS

From the CFD modelling works undertaken on the main atrium, a clear layer has been maintained 3m above first floor for the majority of the simulation.

Tenable conditions are maintained at first floor for 9 minutes with tenability maintained at second floor for 5 minutes.

3.3 FIRE LOCATED IN A ROOM OFF THE ATRIUM, (SPILL PLUME)

Consideration has also been given to a spill plume scenario. This considers a fire breaking out from a small waiting room adjacent to the atrium and then spilling into the atrium.

RESULTS

From CFD modelling works undertaken on the main atrium, a clear layer has been maintained 3m above first floor for the majority of the simulation.

Tenable conditions are maintained at first floor for 9 minutes with tenability maintained at second floor for 4.5 minutes.

3.4 SMOKE VENTILATION REQUIREMENTS

The smoke ventilation requirements are provided within the CFD report.

4 EVACUATION CALCULATIONS

4.1 OVERVIEW

Evacuation calculations have been completed to highlight the time taken to evacuate anyone on the walkways to demonstrate safe egress by the time untenable conditions. Calculations provided in PD 7974-6 are used to calculated the RSET (required safe egress time) with the CFD modelling providing the ASET (available safe egress time).

4.2 SECOND FLOOR (STAFF)

The CFD report indicates that the second floor becomes untenable after 270 seconds. This is the worst case scenario of a spill plume. As such as have considered an evacuation of the second floor occupants to ensure they have sufficient time to escape before the walkways become untenable.

DETECTION TIME

Detection time is the time from ignition to detection by an automatic system or first occupant to detect fire cues.

The building will be provided throughout with an automatic fire detection and alarm system and as noted above, an air aspirating system is provided within the atrium. It has been confirmed that a Class B system will be installed providing a time of 80 seconds for detection time including the transport lag.

ALARM TIME

Alarm time is the time from detection to a general alarm. Due to the provision of an automatic system triggering a general alarm on manual call point breakage the alarm time is effectively zero.

PRE-MOVEMENT TIME

Based on Table C.1 of PD 7974-6, pre-movement time is considered to be between 1 and 3 minutes as occupants of walkway within the atrium are deemed to be unfamiliar with the escape routes and as these occupants are located in waiting areas, they are considered awake. With this being a hospital environment, the fire safety management is of a level that would be expected to be of M2 standard.

Scenario Category and Modifier	First Occupants (1st Percentile)	Occupant Distribution (99th Percentile)
A: Awake and Familiar		
M1 B1 A1 – A2	0.5 minutes	1.0 minutes
M2 B1 A1 – A2	1.0 minutes	2.0 minutes
M3 B1 A1 – A3	>15 minutes	> 15 minutes

TRAVEL TIME

The travel time is the time taken for all occupants to move through the escape route. In accordance with PD 7974-6, a travel speed of 0.6m/s (to account for a slower walking pace), and a flow rate of 1.33 persons/s/m are used for horizontal flow.

Travel time is calculated from the travel speed and distance across the floor that the furthest away occupant has to travel towards the void is 20m:

$$t_{trav} = \frac{Distance}{Speed} = \frac{20}{0.6} = 34s$$

FLOW RATE

Flow Rate is controlled by flow through the escape stair or place of relative safety (2 x 1600mm doors and a third 1600mm door discounted), and is calculated as follows:

$$t_{flow} = \frac{Occupancy}{SpecificFlow \times Width} = \frac{24}{(1.33 \times 3.2)} = 6s$$

EVACUATION TIME

The total travel time is given by the equations 3 and 4 of PD7974-6.

For the first case the evacuation time depends upon the pre-movement time of the last few occupants to decide to leave and the time required for them to travel to the exits and walk through. Since the occupant density is low the walking speed to the exits is essentially unimpeded and there is no queuing at the exits. Evacuation time is then given by equation 3.

For the second case the evacuation time depends upon the pre-movement and walking time of the first few occupants plus the flow time of the exits, which is given by equation 4.

The longer case is then used for design purposes.

Eqn. 3 $\Delta t_{EVAC} = \Delta t_{pre(99th)} + \Delta t_{trav(walking)} = 120 + 34 = 154s$

Eqn. 4 $\Delta t_{EVAC} = \Delta t_{pre(1st)} + \Delta t_{trav(walking)} + \Delta t_{trav(flow)} = 60 + 34 + 6 = 100s$

Including time to detection, the total evacuation time is therefore 234 seconds.

$$\Delta t_{RSET} = \Delta t_{det} + \Delta t_{a} + \Delta t_{pre} + \Delta t_{trav} = 80 + 0 + 120 + 34 = 234\,\text{sec}$$

It should be noted that the scenario in which a spill plume can occur is such that a fire is within the small waiting room in view of the second floor walkway. Therefore, the evacuation time here is considered conservative as we would expect that occupants would stand on the walkway whilst a visual cue of fire was present.

RESULTS SUMMARY

ASET	RSET	SAFETY FACTOR
270s	234s	1.15

4.3 FIRST FLOOR (PATIENTS)

The CFD report for the first floor indicates that for the majority of the 20 minute simulation time, the walkway remains clear of smoke with the exception of a small section of the walkway linking Little Brother with Big Brother. The evacuation calculations below highlight that evacuation of the waiting areas at first floor can still be achieved before this part of the walkway becomes untenable.

To indicate this, we have taken that there is only one escape route from the walkway i.e. 1 x 1600mm and also that all occupants have to travel the furthest distance to this exit, i.e. 37m).

DETECTION TIME

Detection time is the time from ignition to detection by an automatic system or first occupant to detect fire cues.

The building will be provided throughout with an automatic fire detection and alarm system and as noted above, an air aspirating system is provided within the atrium. It has been confirmed that a Class B system will be installed providing a time of 80 seconds for detection time including the transport lag.

ALARM TIME

Alarm time is the time from detection to a general alarm. Due to the provision of an automatic system triggering a general alarm on manual call point breakage the alarm time is effectively zero.

PRE-MOVEMENT TIME

Based on Table C.1 of PD 7974-6, pre-movement time is considered to be between 1 and 3 minutes as occupants of walkway within the atrium are deemed to be unfamiliar with the escape routes and as these occupants are located in waiting areas, they are considered awake. With this being a hospital environment, the fire safety management is of a level that would be expected to be of M2 standard.

SCENARIO CATEGORY AND MODIFIER	FIRST OCCUPANTS (1ST PERCENTILE)	OCCUPANT DISTRIBUTION (99TH PERCENTILE)
A: AWAKE AND UNFAMILIAR		
M1 B1 A1 – A2	0.5 minutes	2.0 minutes
M2 B1 A1 – A2	1.0 minutes	3.0 minutes
M3 B1 A1 – A3	>15 minutes	> 15 minutes

TRAVEL TIME

The travel time is the time taken for all occupants to move through the escape route. In accordance with PD 7974-6, a travel speed of 0.6m/s (to account for a slower walking pace), and a flow rate of 1.33 persons/s/m are used for horizontal flow.

Travel time is calculated from the travel speed and distance across the floor that the furthest away occupant has to travel towards the void is 37m:

$$t_{trav} = \frac{Distance}{Speed} = \frac{37}{0.6} = 62s$$

FLOW RATE

Flow Rate is controlled by flow through the escape stair or place of relative safety (2 x 1600mm doors and a third 1600mm door discounted), and is calculated as follows:

$$t_{flow} = \frac{Occupancy}{SpecificFlow \times Width} = \frac{69}{(1.33 \times 1.6)} = 32s$$

EVACUATION TIME

The total travel time is given by the equations 3 and 4 of PD7974-6.

For the first case the evacuation time depends upon the pre-movement time of the last few occupants to decide to leave and the time required for them to travel to the exits and walk through. Since the occupant density is low the walking speed to the exits is essentially unimpeded and there is no queuing at the exits. Evacuation time is then given by equation 3.

For the second case the evacuation time depends upon the pre-movement and walking time of the first few occupants plus the flow time of the exits, which is given by equation 4.

The longer case is then used for design purposes.

Eqn. 3 $\Delta t_{EVAC} = \Delta t_{pre(99th)} + \Delta t_{trav(walking)} = 180 + 62 = 242s$

Eqn. 4 $\Delta t_{EVAC} = \Delta t_{pre(1st)} + \Delta t_{trav(walking)} + \Delta t_{trav(flow)} = 60 + 62 + 32 = 154s$

Including time to detection, the total evacuation time is therefore 322 seconds.

$\Delta t_{RSET} = \Delta t_{det} + \Delta t_a + \Delta t_{pre} + \Delta t_{trav} = 80 + 0 + 180 + 62 = 322\text{sec}$

RESULTS SUMMARY

ASET	RSET	SAFETY FACTOR
540s	322s	1.7

REPORT N^{O} 70003278

RHSC & DCN

CFD MODELLING REPORT



CONFIDENTIAL

MARCH 2017

[redacted]

WSP | PARSONS BRINCKERHOFF

RHSC & DCN

CFD MODELLING REPORT

Project Co.

Type of document (version)
Confidential

Project no: 70003278
Date: March 2017

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QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	CFD Report for Building Warrant	Updated to reflect change to natural inlet air	Updated to reflect vent size changes during construction	
Date	20/08/2015	13/04/2016	03/03/2017	
Prepared by	[redacted]	[redacted]	[redacted]	
Signature				
Checked by	[redacted]	[redacted]	[redacted]	
Signature				
Authorised by	[redacted]	[redacted]	[redacted]	
Signature				
Project number	70003278	70003278	70003278	
Report number				
File reference				

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1 INTRODUCTION

1.1 SCOPE

WSP | Parsons Brinkerhoff have been appointed to provide Computational Fluid Dynamics (CFD) modelling support to validate the performance of the atrium space located within the Royal Hospital for Sick Children and Department of Clinical Neurosciences, Edinburgh (RHSC & DCN).

The RHSC & DCN building comprises six storeys from Basement Level through to Fourth Floor with a large atrium running the full height on one side.

Due to the presence of an atrium located on one side of the hospital adjacent to the entrance doors, a ventilation system has been proposed for the atrium utilising natural inlet along with natural exhaust. The performance of this atrium under a fire scenario has been demonstrated using CFD modelling.

A successful demonstration of the proposed atrium design will confirm that the design meets the functional requirements of the Non Domestic technical Handbook and SHTM 81 Part 3.

1.2 AIMS AND OBJECTIVES

The aim of the analysis is to demonstrate that tenable conditions are maintained within the base of the atrium to facilitate occupant escape. In addition the time to untenable conditions has been determined for the first floor walkway level.

The CFD analysis has also been used to determine likely smoke layer temperatures and demonstrate that fire rated glazing is not required for the atrium with the exception of the glazing to the theatres (which will achieve 60/60 fire rating).

1.3 ACCEPTANCE CRITERIA

For the purposes of this report, tenability criteria have been based on BS 7974 part 6: 2004.

- Visibility through smoke not less than 10m within areas of the occupied parts of the atrium;
- Temperature of smoke not above 60 °C for human tenability within occupied areas

This is a conservative value based on inhalation of hot gases with the potential to burn the respiratory tract. (A less onerous value of 100 °C could be considered for relation to physical pain.)

To determine whether toughened glass would be sufficient for the windows adjacent to the atrium, a maximum smoke layer temperature of 200 °C has been used.

2 DESIGN CONSIDERATIONS

2.1 BUILDING CHARACTERISTICS

The proposed building will provide facilities for the use of the re-provision at the Royal Hospital for Sick Children & the Department of Clinical Neurosciences at Little France (RHSC + DCN). The building will replace the existing RHSC facility at Sciences, Edinburgh. The building is made up of over 60 different departments offering specialist acute care for both RHSC + DCN, to Edinburgh and the Lothian's as well as acting as a tertiary centre for Scotland.

The site for the proposed RHSC + DCN sits within The Royal Infirmary of Edinburgh, Little France campus, to the south west of Edinburgh. The teaching hospital campus also houses the University of Edinburgh Medical School, The Queen Margaret Research Institute and the Anne Rowling Regenerative Neurology Clinic which sits directly adjacent to the Bio Quarter, Building Footprint.

The building comprises six storeys from Basement Level through to Fourth Floor.

The building contains a large atrium adjacent to the main entrance area which extends generally from ground through to the second floor level. The location of the atrium is shown in light blue, below:

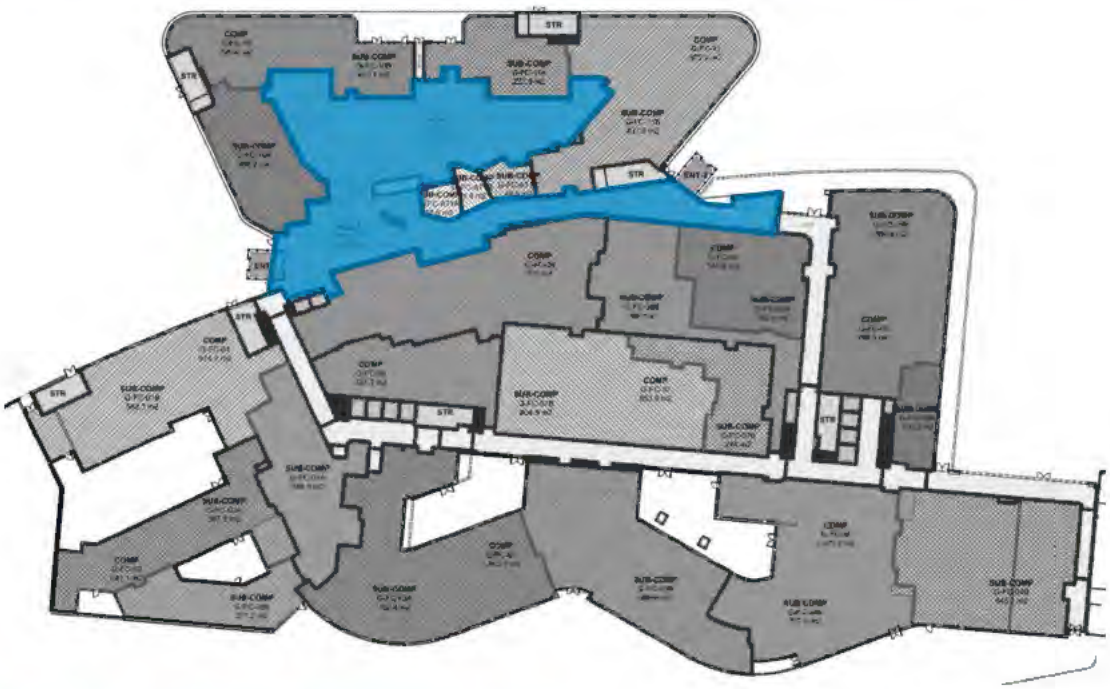


Figure 1: Plan view showing RHSC & DCN floor plan

A more detailed view of the atrium is shown below. The atrium is highlighted in green with natural low level make up air paths at low level shown by blue arrows and a additional low level make up air path direct into the larger atrium shown by red arrows.

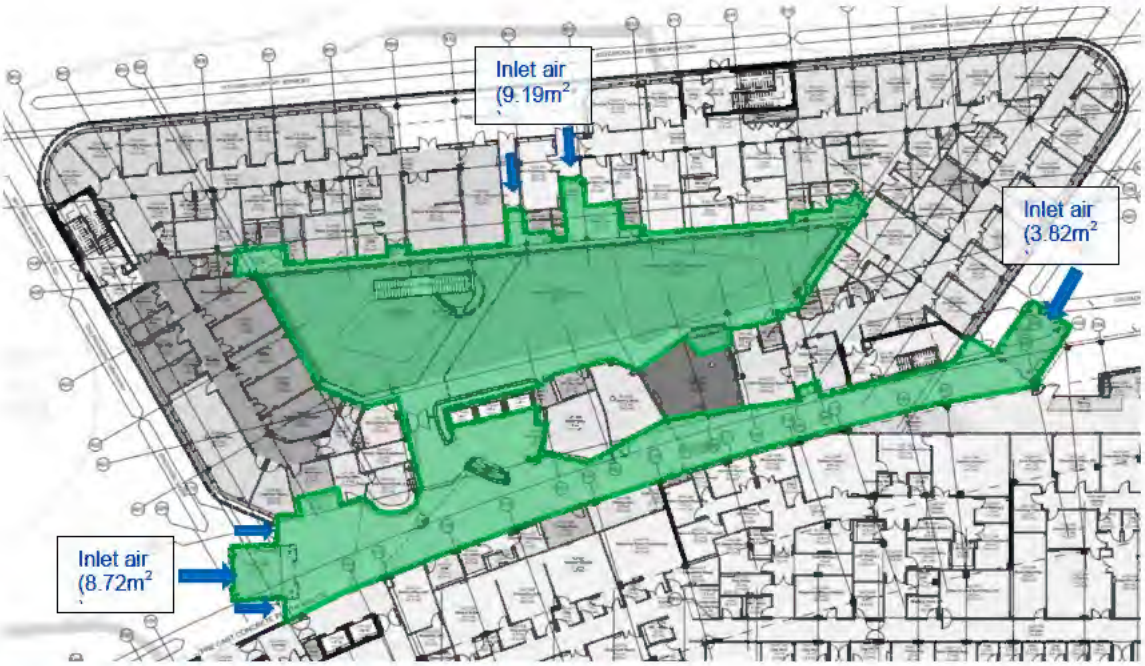


Figure 2: Plan view of the ground floor of the atrium

Shown below is a plan view of the atrium at high level. Natural smoke exhaust is provided to the 2 main roof pop-ups.

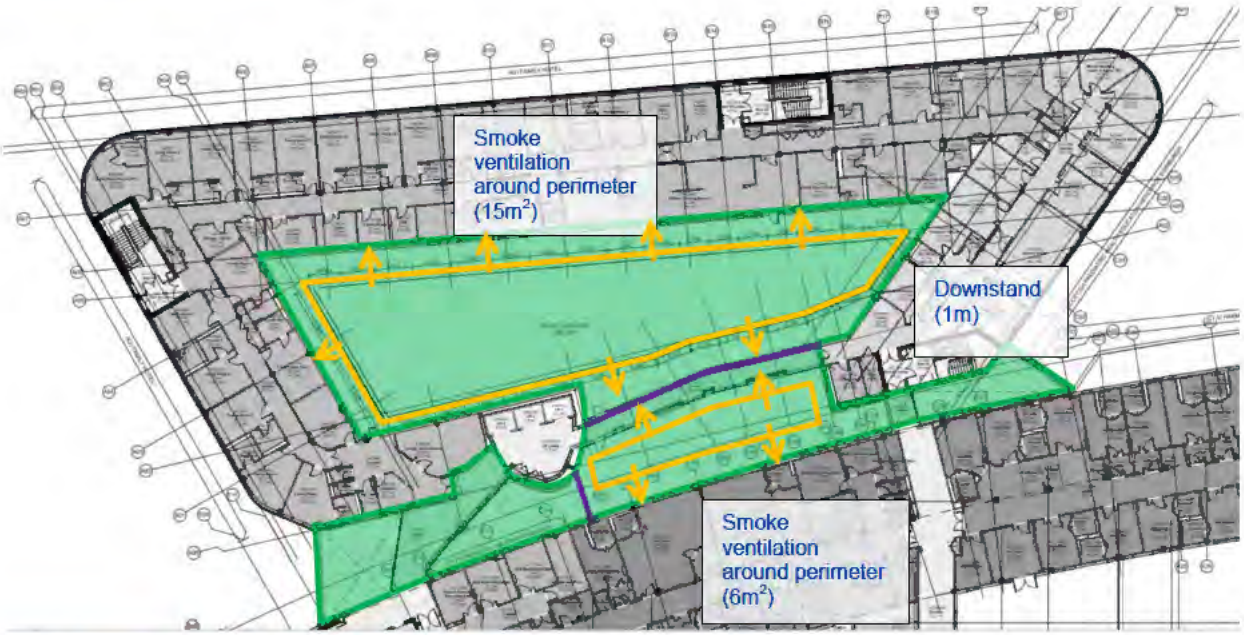


Figure 3: Plan view of the atrium at high level

- 21m² of natural ventilation distributed on the vertical sides of the atrium roof with a 15 / 6 m² split across the atrium;
- Inlet air provided by sliding doors at RHSC, 3.82m²,
- Inlet air provided by the pass doors at the main RHSC entrance, 4m²;
- Inlet air provided by openable windows above RHSC entrance, 0.9m²,

- Inlet air provided by sliding doors at DCN, 3.82m^2,
- Additional inlet air of 9.19m² provided in the main atrium provided by fail open doors leading direct to fresh air;
- Downstand between the large and small atrium to reduce smoke spread between the two;
- Downstand across the front of the high level walkways in the small atrium.

3 MODELLING METHODOLOGY

3.1 CFD

Computational Fluid Dynamics (CFD) allows a virtual physics model of a specific design concept to be tested with a level of accuracy that can be orders of magnitude greater than simplified equations. CFD is used to explore complex scenarios and provide a greater level of detail and accuracy than is achievable with simple hand calculations. The principle of CFD modelling is to split a physical domain into millions of individual cells in which transport equations are solved for important physical conditions such as conservation of mass, momentum and energy, and the transport of defined species such as 'soot'.

In this study the Fire Dynamics Simulator (FDS 6.1.2) is used, which is produced by the US National Institute of Standards and Technology (NIST). A validation and verification document for this software is available online from the NIST website.

3.2 GENERAL ASSUMPTIONS

- Solid boundaries treated as thermally inert material
- Air temperature at 20°C
- 4.0 m2 fire area
- Medium growth rate fire to 2.5MW peak heat output
- 10% soot yield assumption based on polyurethane fuel reaction

3.3 COMPUTATIONAL DOMAIN

A cell size of 0.25m x 0.25m x 0.25m has been used throughout the model.

3.4 MODELLED SCENARIOS

Two fire scenarios have been considered:

- A 2.5MW axi- symmetric fire in the middle of the atrium
- A 2.5MW fire located in the seating area.

4 RESULTS

4.1 AXI-SYMMETRIC FIRE

VISIBILITY

Shown in Figure 4 is section showing visibility through the fire plume along the length of the atrium. Untenable smoke has been maintained above the ground floor throughout the simulation with a clear smoke layer developing at high level.

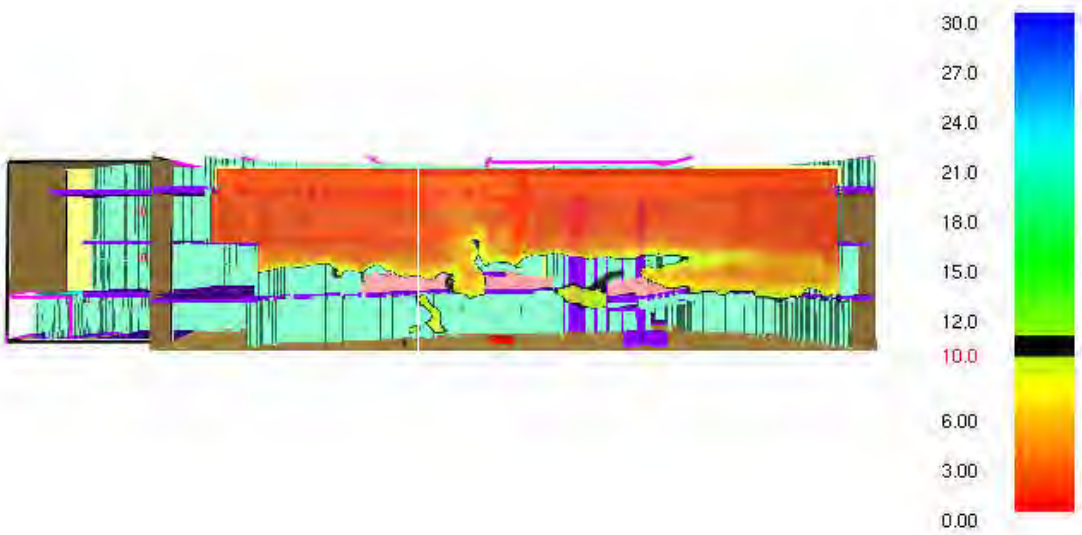


Figure 4: Visibility section for an axi-symmetric fire

Visibility has been maintained on the ground floor for the duration of the simulation with visibility only compromised within the fire plume.

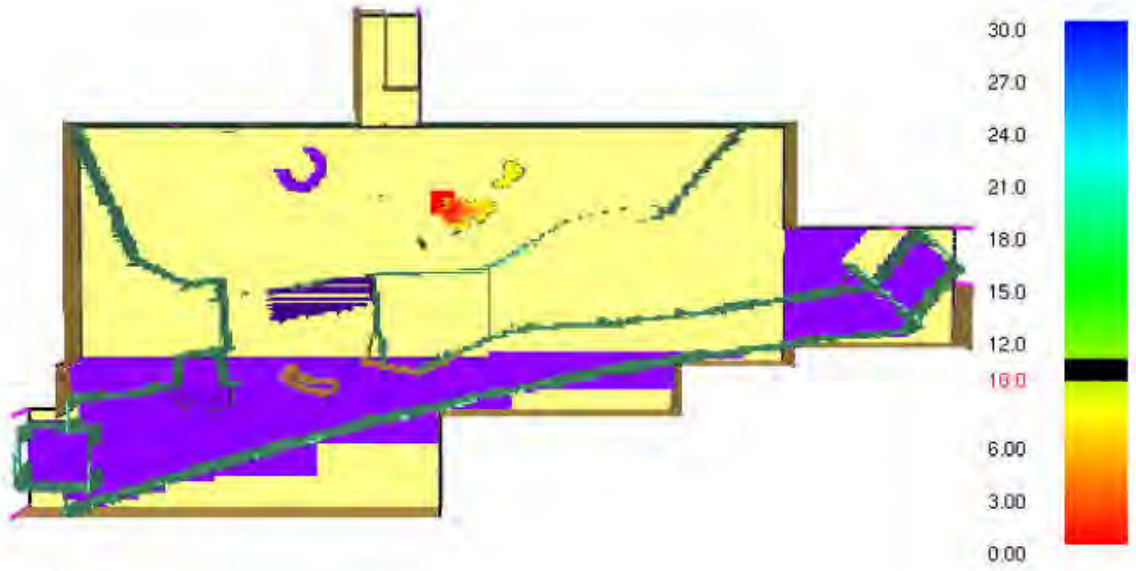


Figure 5: Visibility plan image on the ground floor for an axi-symmetric fire

On the first floor visibility on a small section of walkway has been compromised after 9 minutes

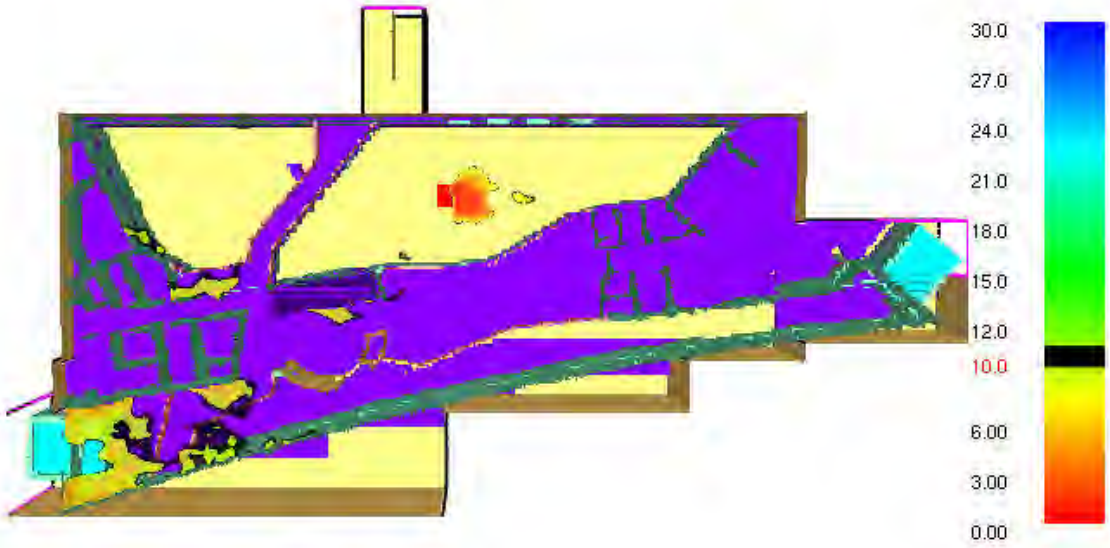


Figure 6: Visibility plan image on the first floor for an axi-symmetric fire after 10 minutes

On the uppermost occupied floor conditions remain tenable for 5 minutes.

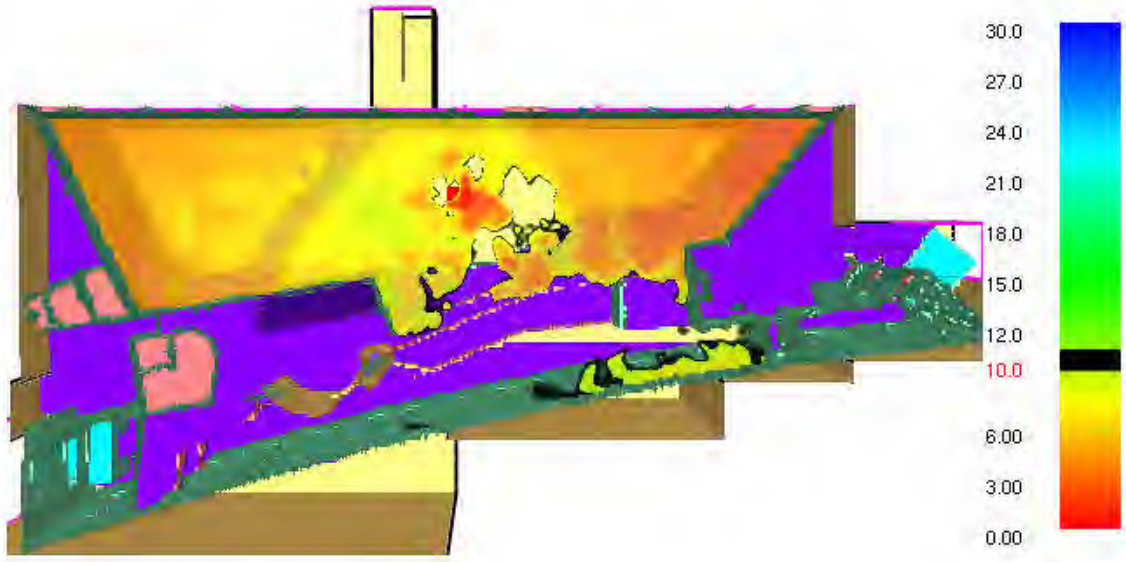


Figure 7: Visibility plan image on the second floor when conditions become untenable.

TEMPERATURE

Shown is Figure 8 is a section showing temperature through the roof section. Once steady state conditions have been reached the top of the smoke layer remains around 50 °C. This is considerably below the 200 °C temperature threshold that would cause glazing failure.

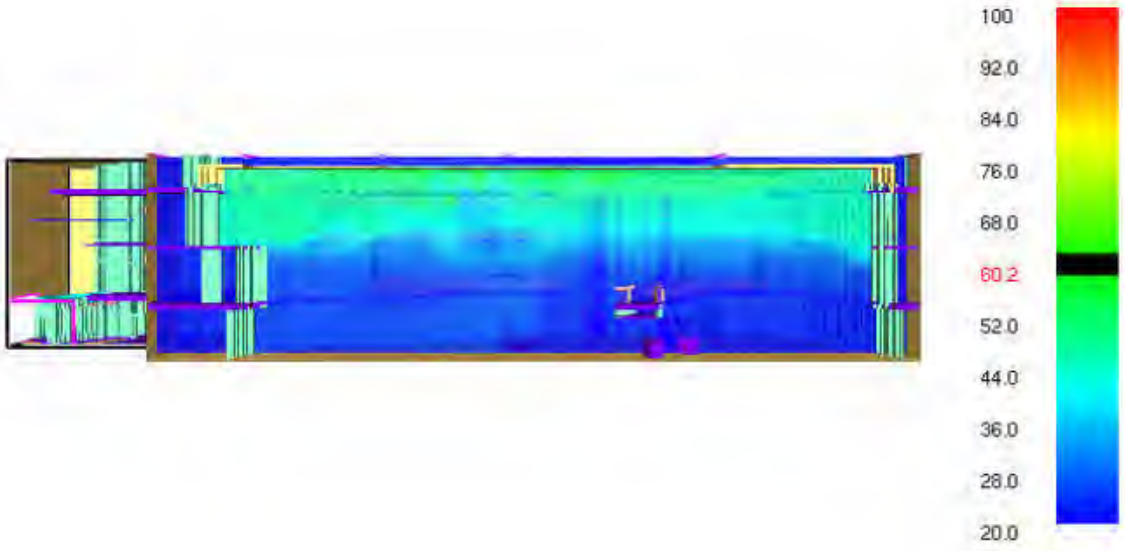


Figure 8: Section showing smoke layer temperature

On the uppermost occupied floor the temperature remains tenable throughout the simulation.

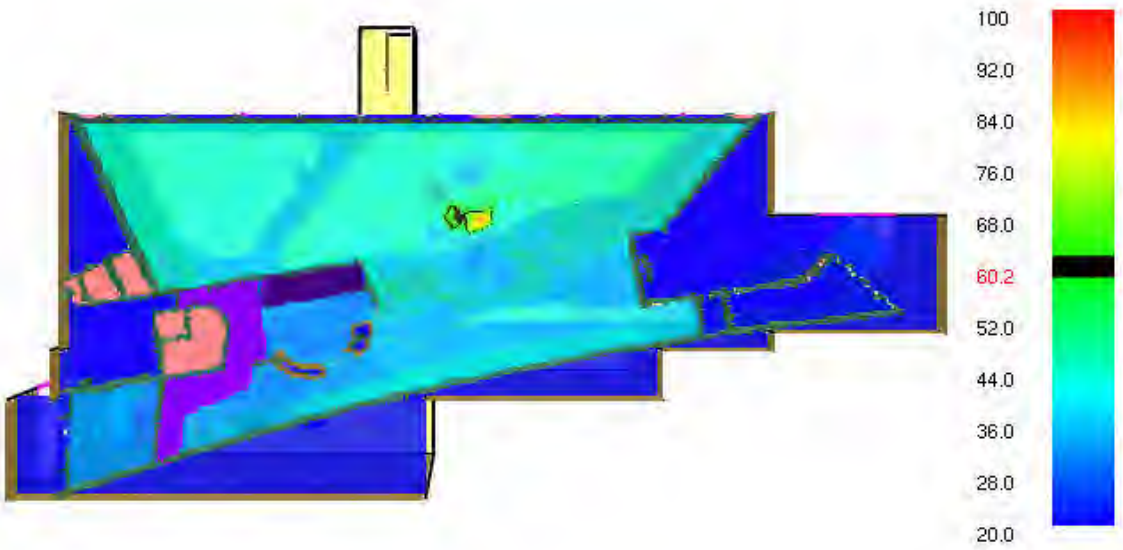


Figure 9: Temperature on the second floor

4.2 SPILL PLUME FIRE

VISIBILITY

Shown in Figure 10 is a section showing visibility through the unit of fire origin and the upper smoke layer. A clear smoke layer has formed at high level with the atrium.

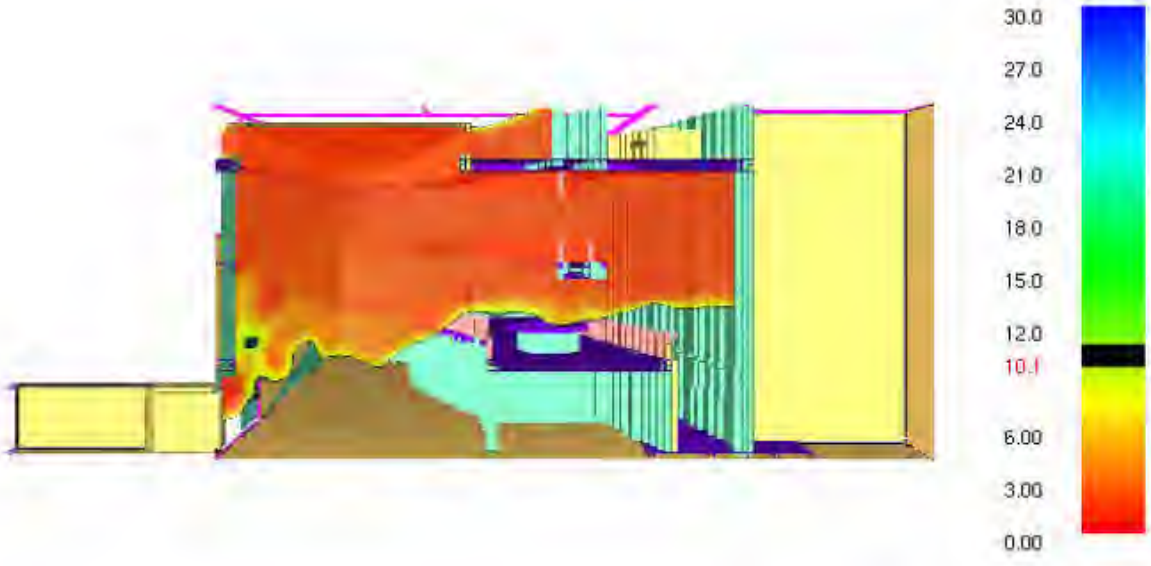


Figure 10: Visibility section for a spill plume scenario.

Shown below is a plan image showing visibility at head height for the ground floor. Visibility is tenable in all areas apart from the unit of fire origin and the area immediately in front of the unit where the smoke plume leaves the shop.



Figure 11: Visibility plan view on the ground floor

Tenability has been maintained on the first floor until 9 minutes

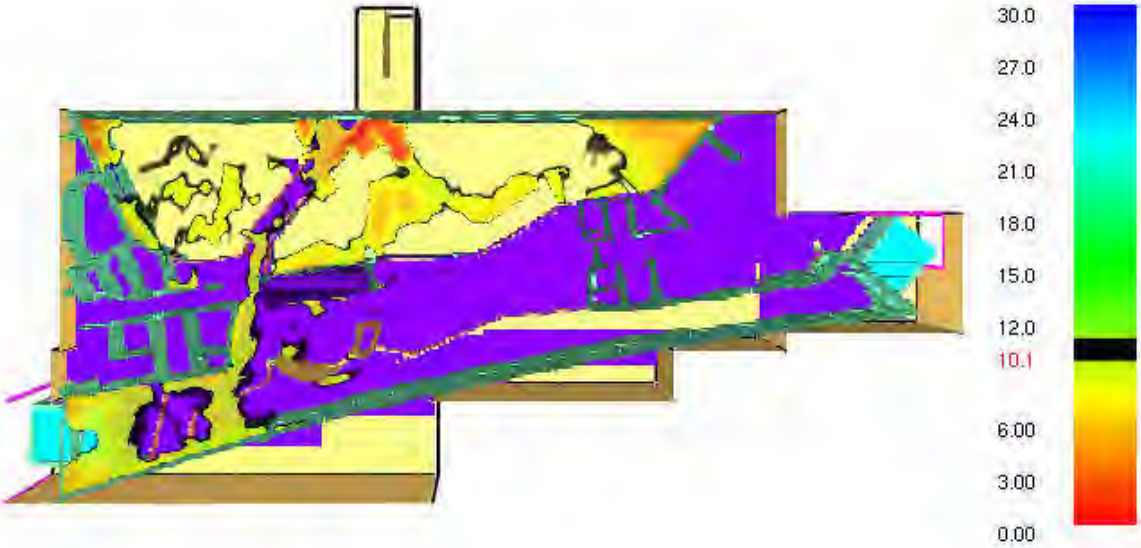


Figure 12: Visibility plan view on the first floor

On the uppermost occupied floor, conditions first become untenable in terms of visibility at 270s.

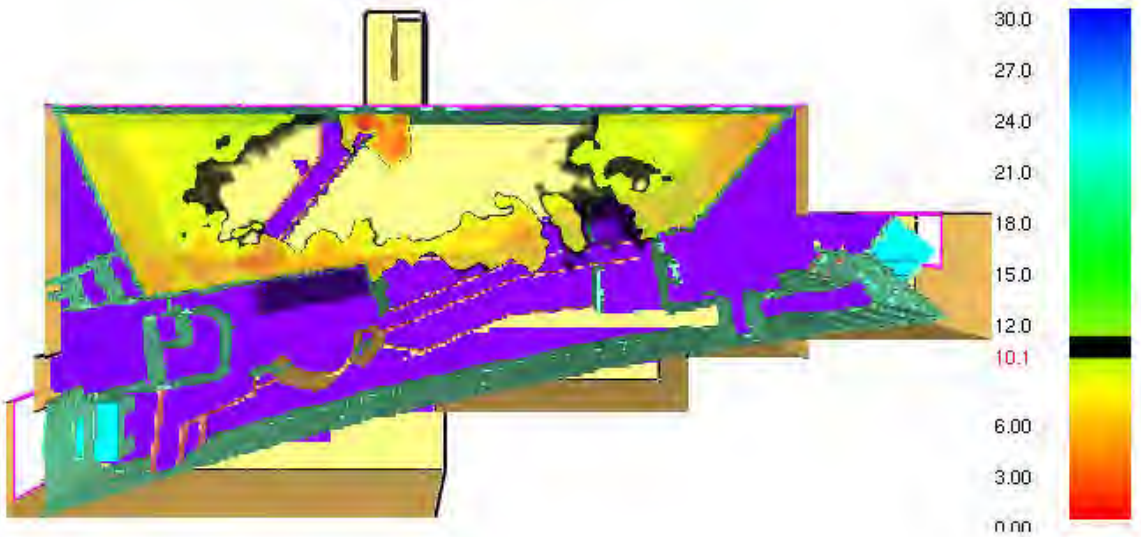


Figure 13: Visibility on the second floor

TEMPERATURE

Shown is Figure 8 is a section showing temperature through the fire plume. Once steady state conditions have been reached the top of the smoke layer remains around 50 °C. This is considerably below the 200 °C temperature threshold that would cause glazing failure.

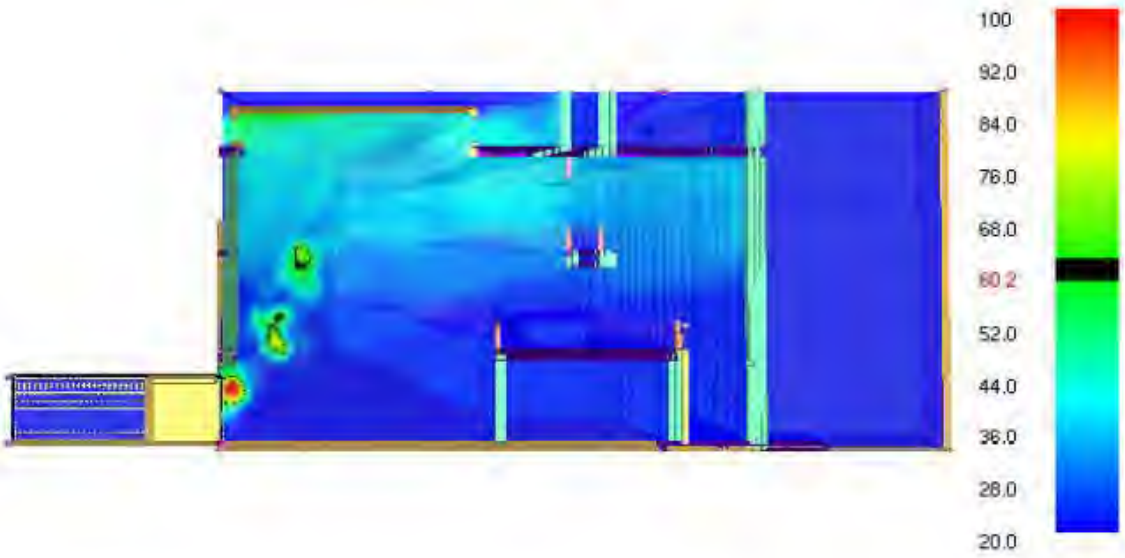


Figure 14: Temperature section through the unit of fire origin

Shown below is a plan view showing temperature on the highest occupied floor. There are no untenable temperatures.

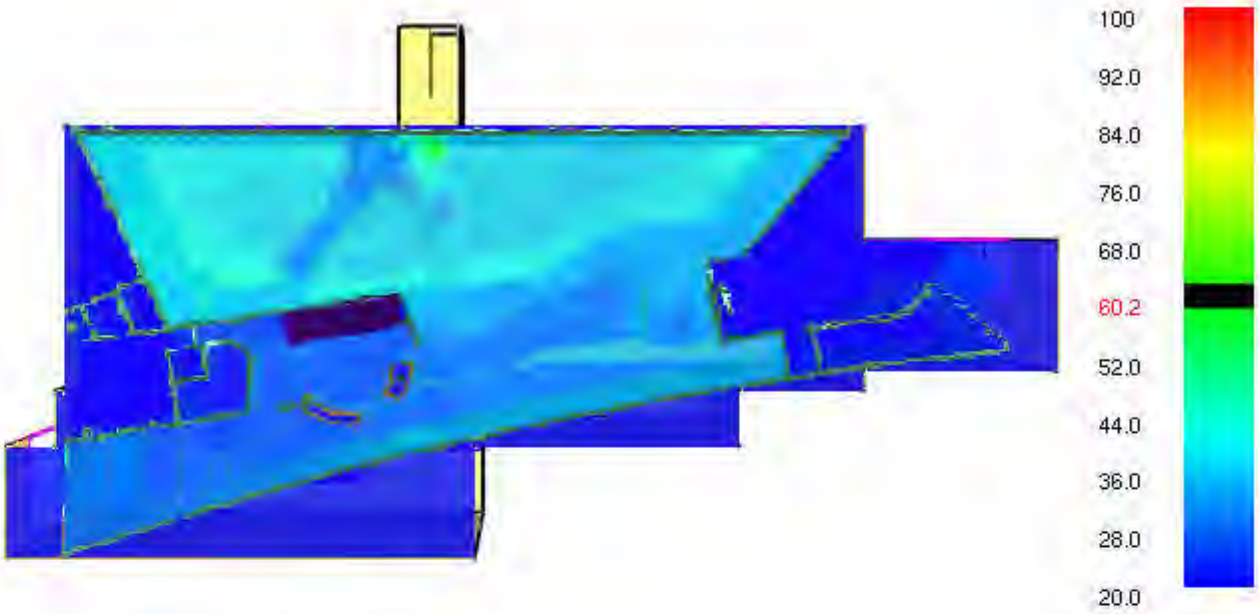


Figure 15: Temperature on the highest occupied floor

5 CONCLUSION

The modelling demonstrates that the atrium ventilation system satisfies the functional requirements of the Non Domestic Technical Handbook and the SHTM 81 Part 3 by maintain safe conditions within the atrium facilitating safe egress.

The modelling also demonstrates that non fire rated glazing is acceptable as smoke temperatures are considerably lower than the failure temperature for toughened glass.

RHCYP

Pod Fire Load Design Note

WSP-SZ-XX-DC-572-301 Rev 7

August 2018
70003278

Classification Confidential

RHCYP

Pod Fire Load Design Note

WSP-SZ-XX-DC-572-301 Rev 7

Type of document (Version) Confidential

PROJECT NO.70003278

August 2018

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QUALITY CONTROL

Issue/revision	Revision 3	Revision 4	Revision 5	Revision 6
Remarks	Issue to Building Control	Including a review with a Christmas Tree	Updated following Board comments	Updated following final Board comments
Date	28/02/2017	15/06/2017	28/08/2017	26/10/2017
Prepared by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Checked by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Authorised by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Project number	70003278	70003278	70003278	70003278
Report number				
File reference				

Issue/revision	Revision 7			
Remarks	Updated following additional information supplied to include model dragon and clock			
Date	22/08/2018			
Prepared by	[redacted]			
Signature				
Checked by	[redacted]			
Signature				
Authorised by	[redacted]			
Signature				
Project number	70003278			
Report number				
File reference				

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1 INTRODUCTION

It is now common practice to incorporate atria in the design of new healthcare premises; an atrium usually provides not only a readily identifiable focal point for visitors to the main building entrance but also a welcoming introduction to the building and its facilities.

Atria are widely recognised as attractive and desirable design features that permit natural light to penetrate the internal areas of the building and create stimulating space that reduces what may otherwise have an institutional ambience.

Atria in hospitals present some specific fire safety issues such as the protection of routes through which smoke and fire may spread from storey to storey (much more rapidly than it would in an equivalent building without an atrium); the impact of possible fire spread on the number of persons initially at risk, the time available for escape, and the activity of fire-fighters.

An atrium space in a healthcare building may contain high numbers of people with some degree of disability, for whom additional time and assistance to escape will be necessary. To address this concern, it is necessary to provide atria with higher standards of fire protection than would normally be provided within similar buildings put to a different use.

The atrium design has primarily followed the principles of the guidance within the building regulations (the Non-Domestic Technical Handbook) and Firecode (SHTM 81 Part 3: Atria in healthcare premises and other relevant other documents comprising NHS Scotland Firecode). As part of the design development on-going regular discussions on fire strategy issues have taken place with Building Control; Scottish Fire & Rescue Service and NHS fire advisors.

The design has been developed to ensure any potential negative impact on the fire safety of the building has considered and mitigated.

This design note provides an overview of the design development of the atrium fire load and its control.

1.1 GUIDANCE COMPARISON

Guidance by its very nature is generic therefore fire engineering solutions have been developed for aspects of the proposed design to achieve a bespoke fire safety design for the building.

The guidance within SHTM 81 part 3 notes that where access is possible from the atrium space to adjacent accommodation above the atrium base level, or the atrium is not considered to have a limited fire load, smoke control measures are necessary to prevent the spread of smoke to areas adjacent to the atrium. Where there is no access to adjacent accommodation from the atrium space above the atrium base level, the compartmentation enclosing the atrium space should be sufficient to prevent the spread of smoke to adjacent areas. Therefore, additional passive or active smoke control measures are not required.

Within RHCYP the atrium has open balcony walkways at first and second floor therefore smoke control is provided in the atrium. The smoke control system is designed to operate on activation of the fire alarm system (to ensure the earliest possible detection an air aspirating system is being provided). The efficiency of the smoke control system is dependent upon the volume of smoke generated from a fire, therefore the potential fire size needs to be known. Our separate fire strategy report, CFD report and associated design notes provides the design of the smoke control system

2 DESIGN DEVELOPMENT

At the early design stages, the atrium content was not known however it was appreciated there would be a fire load. The figure below highlights the Pod space:

Figure 1 RHCYP Atrium Pod



Control measures applied to the space to limit the quantity of combustible materials that may become involved in any fire incident were considered. Flexibility was built into the fire engineered design by providing options for control by either:

- Limiting the size and separation of combustibles; or,
- The use of low level side-wall sprinklers*.

*The effectiveness of a standard sprinkler system to control a fire in the base of the atrium is reduced (due to longer activation times) where the height of an atrium is above a certain limit (typically 10m). Therefore, low level side-wall sprinklers were suggested since the atrium is greater than 10m in height.

The initial approach favoured the sprinkler system with side-wall sprinkler heads as the atrium content was still unknown.

With recent development of the art strategy the contents of the atrium are now better understood and a full understanding of any potential suppression system within the area is now clear. We have therefore reviewed the fire engineering approach in relation to this and would note the following points:

- A side wall sprinkler system requires to be divided into operational zones to manage the quantity, flow and pressure of the water supply. The art strategy structures are at various locations through the atrium with some being quite extensive in length therefore making division into zones impractical. Increased zone sizes mean an increase in water storage or reduced operation times;
- The scale of the art strategy structures will affect smoke flow within the space therefore the practicalities for activation of the suppression system (within a defined zone) through the fire detection system is impacted upon;

The above points will affect the design of a side wall suppression system. Such systems operate on a deluge operation. Deluge systems are beyond the scope of BS 12845 therefore would not be considered a compliant sprinkler system. The figures below highlight the proposed art strategy showing the arches:

Figure 2 Proposed Art Strategy



3 PROPOSED SOLUTION

In order to provide design flexibility to meet the needs of the Board it is proposed to use the previous option of limiting the size and separation of the combustibles within the atrium space.

The smoke control system has been designed on the basis of a 2.5MW fire, WSP have provided a deterministic analysis to assess the fire load and separation distance requirements for the proposed art strategy.

This is considered to be a simpler option that could allow the art strategy within the space in particular with the location of the large feature arch structures that would otherwise have impacted upon side wall sprinkler effectiveness.

The art strategy would have a controlled fire load through use of appropriate structure and finishes whilst allowing for inclusion of the proposed electronic equipment. Our assessment considers the separation distances where items should be placed and what those items should be constructed of to ensure a fire size remains a maximum of 2.5MW.

Table 1 Items of Furniture within the Pod

Item	Drawing No.	Construction Materials
Sofa	GINK-xx-xx-SK-470-003-7.1-02-ATD 7.1	Medite FR (treated as plywood) Polyurethane foam
Sofa Stool	GINK-xx-xx-SK-470-004-7.1-01-ATD 7.1	Medite FR (treated as plywood)
		Polyurethane foam
Deer Stool	GINK-xx-xx-SK-470-010-7.1-01-ATD 7.1	Plywood Steel Frame
Stacked Chair	GINK-xx-xx-SK-470-011-7.1-01-ATD 7.1	Plywood
Stacked Chair with Arms	GINK-xx-xx-SK-470-012-7.1-01-ATD 7.1	Plywood
Beam Seat	GINK-xx-xx-SK-470-013-7.1-02-ATD 7.1	Plywood Polyurethane foam
Activity Table	GINK-xx-xx-SK-470-015-7.1-01-ATD 7.1	Plywood
Café Table	GINK-xx-xx-SK-470-016-7.1-01-ATD 7.1	Plywood
Laptop Table	GINK-xx-xx-SK-470-017-7.1-01-ATD 7.1	Plywood
Wall Unit	GINK-xx-xx-SK-470-019-7.1-02-ATD 7.1	Plywood
Stag Chair	GINK-xx-xx-SK-470-031-7.1 ATD 7.1	Plywood Steel Frame
Beam Bench	GINK-xx-xx-SK-470-026-7.1-01-ATD 7.1	Aluminium Polyurethane Foam
Beam Bench with Table	GINK-xx-xx-SK-470-026-7.1-01-atd 7.1	Aluminium Plywood Polyurethane Foam
Orkney Chair	GINK-xx-xx-SK-470-032-7.1 ATD 7.1	Plywood Polyurethane Foam

3.1 NHS MATERIAL FIRE REGULATION REQUIREMENT

To ensure commissioned items comply with current fire regulations, all materials used will have to satisfy NHS Scotland Firecode SHTM 87 Textiles and Furniture requirements. Materials and Furniture should satisfy the relevant re safety standard:

- Ignition and cigarette test laid down in British Standard BS 5852: 2006 Part 1
- British Standard BS 5852: 2006 Part 2 'Fire tests for furniture. Methods of tests for ignitability of upholstered composites for testing by flaming source'.

In the UK all items of domestic upholstered furniture must meet the Furniture and Furnishings Fire Safety Regulations 1988 with amendments. BE 5852: Part 1 and Part 2 have been withdrawn by BSi but as still referred to as part of the regulations above

4 ANALYSIS

4.1 INTRODUCTION

Introducing exhibition items to within the Pod requires detailed analysis to be carried out in order to determine that the fire load limitations specified within WSP-SZ-XX-DC-572-600 and WSP-SZ- XX-DC-572-300 are observed at all times.

Within WSP-SZ-XX-DC-572-600 detailed CFD analysis was carried out to determine a tenable fire size for this area, as a result a 2.5MW fire was the concluded maximum fire size which the smoke control system would be able to cope with.

For this reason items introduced into this space must be restricted to the designed limitations concluded within the CFD analysis.

To guarantee that the accumulation of items introduced doesn't exceed the design fire size the positioning and separation of exhibitions will require to be examined as well as the characteristics of each exhibition item for their potential fire size.

4.2 METHODOLOGY

To establish the potential fire size introduced into the Pod the following fire engineering analysis has been carried out:

1. Determine exhibition fire size by calculating each items *Heat Release Rate* (HRR),
2. The maximum separation distance between exhibitions items by *Radiant Heat Flux* to ensure the ignition of one item will not contribute to the spontaneous ignition of adjacent exhibition items.

4.3 HEAT RELEASE RATE (HRR)

BS 7974: Part 1[(1)] provides a methodology for heat release rate based upon unit area. However due to the bespoke design of commissioned items, it is proposed that a combined material fire is used in evaluating the HRR of items.

COMBINED MATERIAL FIRE

The combined material fire will be assessed taking into consideration the key materials used in the construction of each item, for this method the below values have been considered:

- 221 kW/m^2 [(2)] unit area for plywood;
- 440 kW/m^2 [(3)] unit area for Polyurethane Foam – Non-fire retardant, and
- 290 kW [(4)] Television set.

The principal material used for the construction of all seating will be plywood, for these calculations the peak heat release for engineered Douglas Fir plywood shown above will be used, this being that the most commonly used material for plywood is Douglas Fir.

1 BS 7974: Part 1-2003, Application of fire safety engineering principles to the design of buildings – Part 1: Initiation and development of fire within the enclosure of origin.
2 Nuclear Regulatory Commission (NRC) – Thermal properties of solid combustible material
3 NIST Technical Note 1495, Assessment of a Medium-Scale, Polyurethane Foam Flammability Test
4 American institute of Aeronautics & Astronautics (AIAA) – Heat Release Rate of Burning Items

As well being constructed of plywood most seating benches will be furnished in soft padding ensuring that the comfort of patients is adhered to as specified within the design brief. For the purpose of these calculations Polyurethane Foam will be used as the material of choice for the seat padding.

The unit area for Polyurethane Foam has been calculated using the combined average comparison of the Chair Cushion Test and Vee Test specified within NIST Technical Note 1495 for a metre square area value, both tests were carried out using the same material specification within its testing procedure.

It should be noted that this value is for non-fire-retardant Polyurethane Foam, items which were tested with fire retardant Polyurethane Foam also contained other materials within the HRR test giving a collective value and not an individual entity value for fire retardant Polyurethane Foam, therefore this is why the above values was used for these calculations. The polyurethane foam within the Pod will be of fire retardant material.

Within the design of the arches, LCD display screens and televisions will play an integral part of the overall concept in allowing patients to seek comfort and distraction through interactive involvement.

There are several sizes of televisions and monitors throughout the Pod:

- 55" screen which equates to 0.78m^2
- 47" screen which equates to 0.47m^2
- 12" screen which equates to 0.04m^2

HRR EQUATION

Having determined all relevant characteristics and appropriate unit area heat release rate for the proposed exhibition items the fire sizes for the fuel bed controlled fire and combined material fire will be calculated using the following equation.

$Q=Q"Afire$

Where:

Q is total heat release rate from the fire (kW)

Q" is the total heat release rate per unit area of fire (kW/m^2) Afire is the area of fire (m^2)

RADIANT HEAT EQUATION

Once the heat release rates for the seating are calculated the location and positioning of each item can then be assessed to ensure that in the event of a fire the thermal radiation imposed from one item onto another will not result in a fire size of greater than 2.5 MW, for that reason a radiant heat flux equation is applied to each item to determine their maximum permissible separation distance.

$Ir=\emptyset\varepsilon\sigma T^4$

Where:

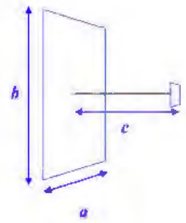
Ir = Incident radiation (kW/m^2)

$\emptyset$ = Configuration factor ε = Emissivity

σ = Stefan-Boltzmann Constant (5.67×10^{-11}kW/m^1/K^1)

T^4 = Temperature(K)

Figure 3 – Configuration factor diagram



Configuration factor equation:

$$\emptyset = \frac{2}{\pi}\left[\frac{x}{\sqrt{1+x^2}}\tan^{-1}\frac{Y}{\sqrt{1+x^2}} + \frac{Y}{\sqrt{1+y^2}}\tan^{-1}\frac{Y}{\sqrt{1+y^2}}\right]$$

Where:

X = a/2c; and

Y = b/2c

5 RESULTS

5.1 HEAT RELEASE RATE OF SPECIFIC ITEMS

Below illustrated within the tables are the HRR results for each item for a combined material fire evaluation as stated within Analysis section of this report.

Table 2 HRR for Furniture Items within the Pod

Heat Release Rate – Combined Materials					
	AREA PLYWOOD (m^2)	AREA POLYURETHANE (m2)	HRR PER UNIT AREA PLYWOOD (kW/m^2)	HRR PER UNIT AREA POLYURETHANE (kW/m^2)	CALCULATED HRR (kW)
Sofa	5.9	0.28	221	440	1427
Sofa Stool	1.8	0.04	221	440	415
Deer Stool	0.16	N/A	221	N/A	36
Stacked Chair	0.39	N/A	221	N/A	87
Stacked Chair with Arms	0.45	N/A	221	N/A	100
Beam Seat	1.38	N/A	221	N/A	305
Activity Table	0.66	N/A	221	N/A	146
Café Table	0.49	N/A	221	N/A	109
Laptop Table	0.72	N/A	221	N/A	160
Wall Unit	6.6	N/A	221	N/A	1459
Stag Chair	0.39	N/A	221	N/A	87
Beam Bench (Aluminium)	N/A	0.04	N/A	440	18
Beam Bench with Table	0.26	0.03	221	440	75
Orkney Chair	5.95	0.03	221	440	1328

It should be noted that the above results are specific to the seating units specified within the main body of this report and Appendix A. Where future items are introduced they will be subject to an individual assessment and cannot be applied as a substitute from any of the above values.

5.2 ARCH 1, ARCH 2 AND ARCH 3 HEAT RELEASE RATES

The proposed design layout of seating units can be assessed to identify the potential accumulated fire load within the Pod. The table below provides the total HRR for each combination of furniture and subsequently these areas are indicated in the figures below.

Table 3 Fire Size of Individual Islands of Furniture - Pod

Location	Arch 1 (kW)	Arch 2 (kW)	Arch 3 (kW)
1	1619	2275	1811
2	1619	830	1860
3	2294	1708	561
4	2275	2275	2123
5	1708	1708	415
6	830	1708	1459
7		2275	1459
8		1860	
9		1796	
10		830	
12" LCD Screen	12	12	12
42" LCD Screen	136		226
55" LCD Screen			

Figure 4 Arch 1

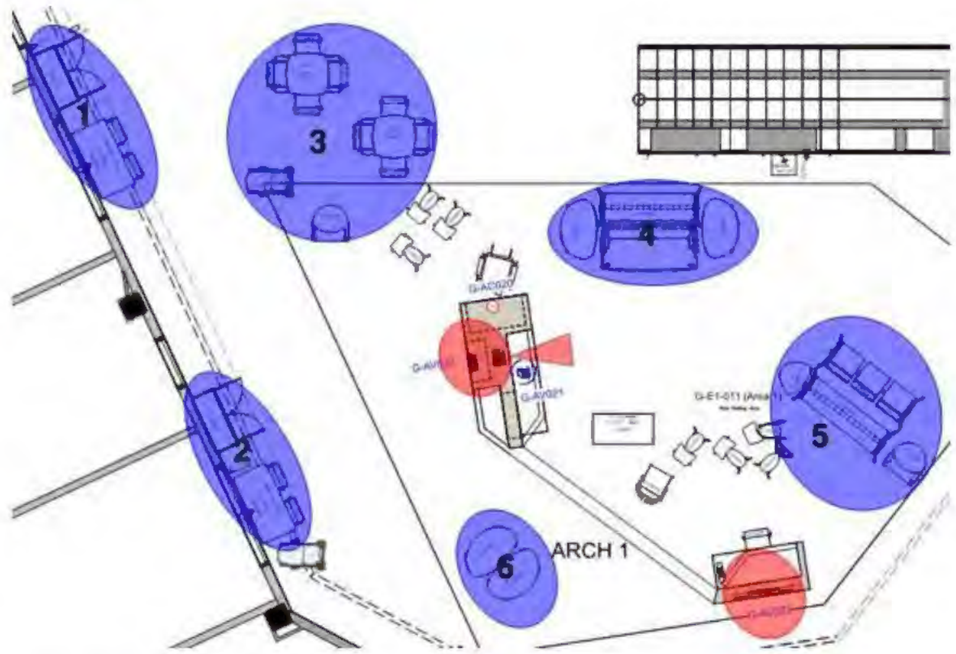


Figure 5 Arch 2

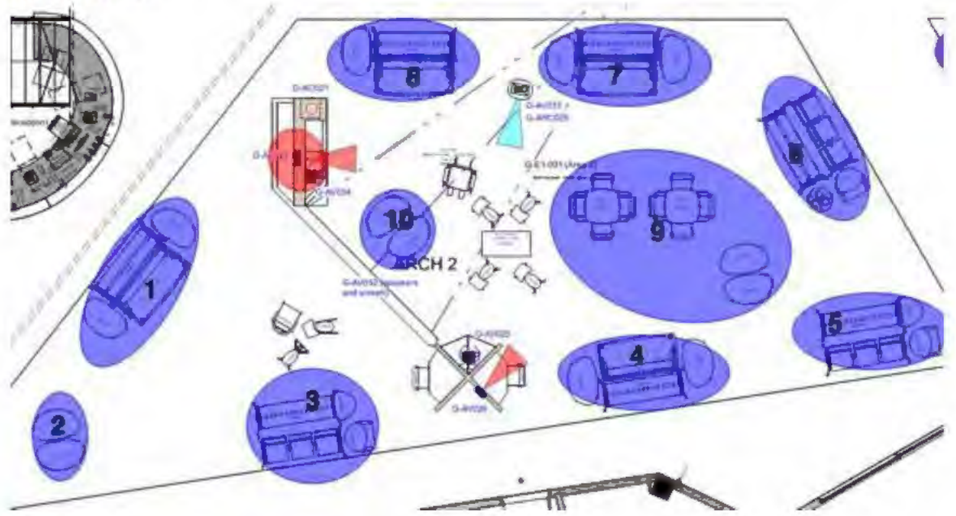
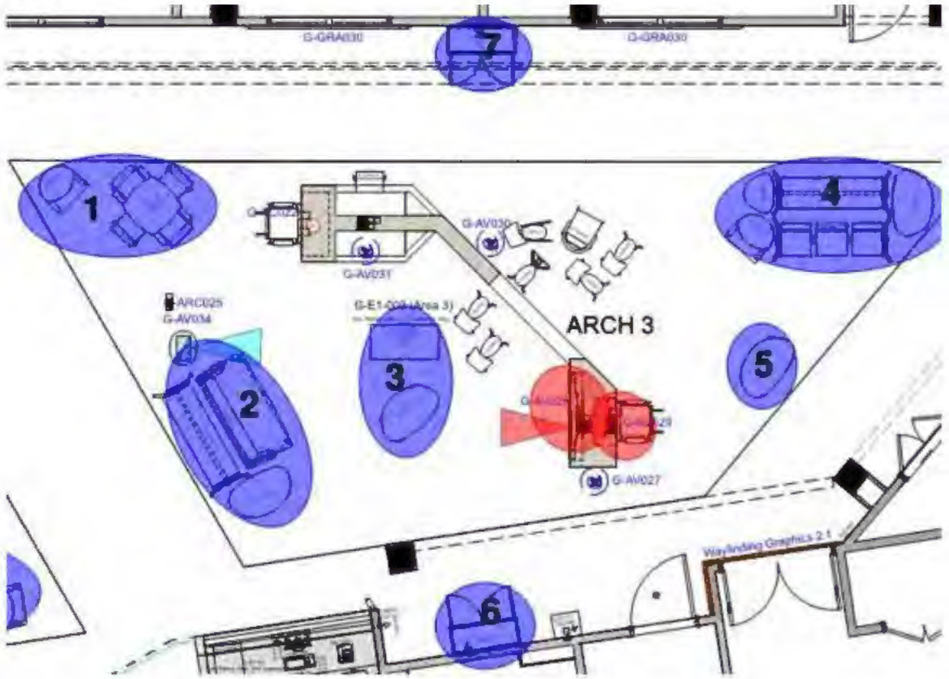


Figure 6 Arch 3



5.3 FIRST FLOOR HEAT RELEASE RATE

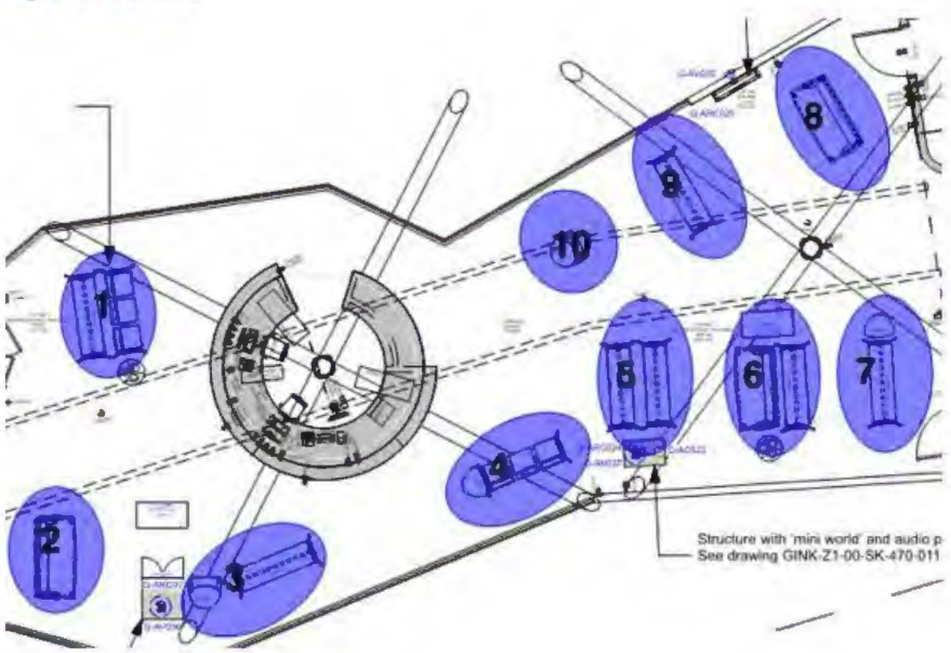
The proposed design layout of seating units at first floor can be assessed to identify the potential accumulated fire load. The table below provides the total HRR for each combination of furniture and subsequently these areas are indicated in the figures below.

Table 4 Fire Size of Individual Islands of Furniture – First Floor

Location	First Floor (kW)
1	323
2	1427
3	1346
4	75
5	36
6	1445
7	75
8	1427
9	18
10	1328

It is noted that several of the above fire load islands could be grouped together and still be under the 2.5MW threshold. However, for radiative heat purposes, as calculated below, it has been decided to remain as separate islands.

Figure 7 First Floor



From the analysis above, it can be seen that each seating area that is grouped together is limited to ensure the fire load is less than 2.5MW. This is considered acceptable.

6 RADIATION HEAT FLUX

6.1 INTRODUCTION

Following the result of the HRR calculations, the maximum separation distance has been calculated to establish the appropriate separation between items.

As noted within PD 7974-3, it is difficult to state accurately what level of incident is required to cause ignition of combustible items outside the enclosure of fire origin, however, the widely used threshold is 12.6kW/m². As such, the radiation heat flux calculations below take into consideration this figure and separation distances are such that 12.6kW/m² is never exceeded.

As noted above, the calculation takes into account several factors:

$Ir=\emptyset\varepsilon\sigma T^4$

Where:

Ir = Incident radiation (kW/m²)

Ø = Configuration factor

ε = Emissivity (0.9 as per SFPE Handbook Table 4.3 for relevant materials)

σ = Stefan-Boltzmann Constant (5.67×10^{-11}kW/m¹/K¹)

T^4 = Temperature(K)(1073K)

6.2 ARCH 1

Below provides the calculations for Arch 1 of the Pod and the distances between them:

Table 5 Arch 1 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	0.4
Height of emitter	b	2.6
Distance to adjacent surface	c	1.1
	X	0.182
	Y	1.182
	Ø	0.18
Separation between 1 & 3		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	2.85
	X	0.386
	Y	0.456
	Ø	0.182
Separation between 2 & 3		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	2.85
	X	0.386
	Y	0.456
	Ø	0.182
Separation between 2 & 6		
Radiant Heat Flux	1r	12.60kW/m²

Width of emitter	a	1.2
Height of emitter	b	0.75
Distance to adjacent surface	c	1.2
	X	0.5
	Y	0.313
	Ø	0.163

Separation between 3 & 6		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	2.44
Height of emitter	b	1.22
Distance to adjacent surface	c	2
	X	0.61
	Y	0.305
	Ø	0.185

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2
	X	0.686
	Y	0.275
	Ø	0.184

Separation between 4 & 9		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	3.6
Height of emitter	b	2.44
Distance to adjacent surface	c	3.5
	X	0.514
	Y	0.349
	Ø	0.183

6.3 ARCH 2

Below provides the calculations for Arch 2of the Pod and the distances between them:

Table 6 Arch 2 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.3
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.433
	Y	0.366
	Ø	0.167

Separation between 1 & 3		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2
	X	0.687
	Y	0.275
	Ø	0.184

Separation between 2 & 3		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.3
Height of emitter	b	0.4
Distance to adjacent surface	c	0.9
	X	0.722
	Y	0.222
	Ø	0.157

Separation between 3 & 6		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.3
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.433
	Y	0.366
	Ø	0.167

Separation between 4 & 9		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2
	X	0.687
	Y	0.275
	Ø	0.184

Separation between 5 & 6		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1
	X	0.968
	Y	0.2
	Ø	0.173

Separation between 5 & 9		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.3
Height of emitter	b	0.4
Distance to adjacent surface	c	0.9
	X	0.722
	Y	0.222
	Ø	0.157

Separation between 6 & 7		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.4
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.467
	Y	0.367
	Ø	0.177

Separation between 6 & 9		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	2.4
Height of emitter	b	0.4
Distance to adjacent surface	c	1.1
	X	1.091
	Y	0.182
	Ø	0.171

Separation between 7 & 8		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.4
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.467
	Y	0.367
	Ø	0.177

Separation between 7 & 9		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	3
Height of emitter	b	1.1
Distance to adjacent surface	c	2.1
	X	0.714
	Y	0.262
	Ø	0.181

Separation between 7 & 9		
Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	3
Height of emitter	b	1.1
Distance to adjacent surface	c	2.1
	X	0.714
	Y	0.262
	Ø	0.181

Separation between 8 & 10		
Radiant Heat Flux	1r	12.60kW/m²

Width of emitter	a	2.3
Height of emitter	b	1.1
Distance to adjacent surface	c	1.9
	X	0.605
	Y	0.289
	Ø	0.176

Separation between 9 & 10		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1.2
Height of emitter	b	0.4
Distance to adjacent surface	c	0.8
	X	0.75
	Y	0.25
	Ø	0.179

6.4 ARCH 3

Below provides the calculations for Arch 3 of the Pod and the distances between them:

Table 7 Arch 3 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1.437
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.479
	Y	0.367
	Ø	0.181

Separation between 2 & 3		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	2.145
Height of emitter	b	1.1
Distance to adjacent surface	c	1.8
	X	0.596
	Y	0.306
	Ø	0.182

Separation between 2 & 6		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1
Height of emitter	b	2.6
Distance to adjacent surface	c	1.9
	X	0.263
	Y	0.684
	Ø	0.176

Separation between 3 & 4		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1.4
Height of emitter	b	2.44
Distance to adjacent surface	c	2.2
	X	0.318
	Y	0.555
	Ø	0.179

Separation between 3 & 6		
Radiant Heat Flux	**1r**	**12.60kW/m²**

Width of emitter	a	1
Height of emitter	b	2.6
Distance to adjacent surface	c	1.9
	X	0.263
	Y	0.684
	Ø	0.176

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	3
Height of emitter	b	2.44
Distance to adjacent surface	c	3.1
	X	0.483
	Y	0.394
	Ø	0.193

Separation between 4 & 7		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1.4
Height of emitter	b	2.44
Distance to adjacent surface	c	2.2
	X	0.318
	Y	0.555
	Ø	0.179

6.5 FIRST FLOOR

Below provides the calculations for First Floor and the distances between them:

Table 8 First Floor Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**12.60kW/m²**

Width of emitter	a	0.787
Height of emitter	b	1.1
Distance to adjacent surface	c	1.1
	X	0.358
	Y	0.5
	Ø	0.183

Separation between 2 & 3		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	1.6
	X	0.5
	Y	0.344
	Ø	0.177

Separation between 3 & 4		
Radiant Heat Flux	**1r**	**12.60kW/m²**
Width of emitter	a	0.65
Height of emitter	b	0.4
Distance to adjacent surface	c	0.6
	X	0.542
	Y	0.333
	Ø	0.183

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**12.60kW/m²**

Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1
	X	0.968
	Y	0.2
	Ø	0.173

Separation between 5 & 6

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	1.6
	X	0.5
	Y	0.344
	Ø	0.177

Separation between 5 & 10

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.22
Height of emitter	b	2.44
Distance to adjacent surface	c	2
	X	0.305
	Y	0.61
	Ø	0.185

Separation between 6 & 7

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1
	X	0.968
	Y	0.2
	Ø	0.173

Separation between 6 & 9

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.424
Height of emitter	b	0.1
Distance to adjacent surface	c	1.1
	X	0.358
	Y	0.5
	Ø	0.183

Separation between 7 & 8

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	0.787
Height of emitter	b	1.1
Distance to adjacent surface	c	1.1
	X	0.358
	Y	0.5
	Ø	0.183

Separation between 8 & 9

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	1.6
	X	0.5
	Y	0.344
	Ø	0.177

Separation between 9 & 10

Radiant Heat Flux	1r	12.60kW/m²
Width of emitter	a	1.22
Height of emitter	b	2.44
Distance to adjacent surface	c	2
	X	0.305
	Y	0.61
	Ø	0.185

7 ARCHWAYS

7.1 OVERVIEW

During the design process, WSP discussed the need to ensure that the archways themselves are constructed of non-combustible materials to ensure that they do not contribute to the fire load.

The art team consisting of Gingko and Warren Designs have confirmed that the archways are constructed of steel framing and Rock-panel FS-Xtra providing A2-s1, d0 classification, which as per the Non-Domestic Technical Handbook, is the equivalent of non-combustible.

Within the arches are a series of 'mini-worlds'. These items range from telephones, lego art etc. Whilst these elements may be of combustible materials, it is deemed low risk as they are in small quantities, and located within the non-combustible materials in the arches.

8 MANAGEMENT OF FIRE LOAD

8.1 OVERVIEW

For hospital buildings, the management of the fire safety is a key factor. Management will be expected to comply with the criteria outlined in SHTM's and local NHS policy & principles.

Effective fire safety management requires that the roles and responsibilities of staff are clearly defined and communicated. As noted within SHTM 81, it is essential that appropriate person had delegated responsibility for the day to day fire safety management of the atrium. The nominate person and deputies should be available at all times when the atrium is in use:

- To ensure that the fire load is controlled and within the permissible limits; and
- To provide assistance and advice to the senior person responsible for co-ordinating the emergency response to a fire incident.

A complete and properly maintained management system will need to be developed for the building. This will detail the interfaces between the various fire protection systems, and the staff responses to alarm incidents.

The following summarises some of the necessary considerations:

Appointment of a fire advisor;

- Checks and maintenance of fire systems and equipment such as detection and alarm systems and emergency communication systems;
- Continuous staff training in fire safety awareness and regular fire drills for all staff;
- Maintaining records;
- Development of an evacuation procedures plan, detailing staff responsibilities, methods of giving alarm, and assisting evacuation of Service Users;
- SHTM outlines issues need to be addressed, such as fire precaution policies, staffing levels and training, fire safety audits;
- Fire plans and fire compartmentation.

It would be the recommendations of this report to, where possible, fix items of furniture. It is noted that the smaller children's seating of 'deer stools' and 'stag chairs' are to remain moveable to allow children to move around the area and enjoy the facilities. These items are of a relatively small fire load. However, as part of the management of this area, these items should be stored out with the current fire load islands noted in this report to ensure the fire sizes do not exceed those stated here.

The management of this space should include careful monitoring of the separation requirements as noted in this report where staff will be required to maintain these distances to ensure compliance with the fire strategy for the space.

9 SENSITIVITY ANALYSIS NO.1

9.1 OVERVIEW

To establish the potential fire size of the items provided within the Pod, we have provided an analysis above based on the combined materials HRR. To further this analysis we have provided a second set of calculations based on a fuel bed controlled fire.

9.2 FUEL BED CONTROLLED FIRE

The fuel bed controlled fire will be assessed using 250kW/m². For a hospital waiting room fire load, we have looked to Eurocode 1 (BS EN 1991-1-2:2002) which highlights HRR's for various types of occupancies. Table E.5 within the document notes a figure of 250kW/m² for hospital rooms.

Given that within a hospital room, the type of contents are similar to those within the Pod in that furniture including seating, wall unit etc are provided also televisions.

9.3 HEAT RELEASE RATE OF SPECIFIC ITEMS

Below illustrated within the tables are the HRR results for each item for a fuel bed controlled material fire evaluation as stated within Analysis section of this report.

Table 9 HRR Results for Furniture Items within the Pod - Fuel Bed Controlled

	Area (m^2)	HRR Per Unit Area (kW/m^2)	Calculated HRR (kW)
Sofa	5.9	250	1475
Sofa Stool	1.8	250	453
Deer Stool	0.16	250	41
Stacked Chair	0.39	250	98
Stacked Chair with Arms	0.45	250	113
Beam Seat	1.38	250	344
Activity Table	0.66	250	165
Café Table	0.49	250	123
Laptop Table	0.72	250	180
Wall Unit	6.6	250	1650
Stag Chair	0.39	250	98
Beam Bench (Aluminium)	N/A	250	N/A
Beam Bench with Table	0.26	250	65
Orkney Chair	5.95	250	1488

It should be noted that the above results are specific to the seating units specified within the main body of this report and Appendix A. Where future items are introduced they will be subject to an individual assessment and cannot be applied as a substitute from any of the above values.

9.4 ARCH 1, ARCH 2 AND ARCH 3 HEAT RELEASE RATES

The proposed design layout of seating units can be assessed to identify the potential accumulated fire load within the Pod. The table below provides the total HRR for each combination of furniture and subsequently these areas are indicated in the figures below.

Table 10 Fire Size of Individual Islands of Furniture - Pod - Fuel Bed Controlled

Location	Arch 1 (kW)	Arch 2 (kW)	Arch 3 (kW)
1	1830	2387	233
2	1830	912	1931
3	2578	1897	621
4	2387	2387	2353
5	1897	1897	456
6	912	1832	1650
7		2387	1650
8		1931	
9		2002	
10		912	
12" LCD Screen	12	12	23
42" LCD Screen	136		226
55" LCD Screen			

9.5 FIRST FLOOR HEAT RELEASE RATE

The proposed design layout of seating units at first floor can be assessed to identify the potential accumulated fire load. The table below provides the total HRR for each combination of furniture and subsequently these areas are indicated in the figures below.

Table 11 Fire Size of Individual Islands of Furniture - First Floor - Fuel Bed Controlled

Location	First Floor (kW)
1	344
2	1475
3	N/A
4	409
5	N/A
6	1640
7	65
8	1475
9	N/A
10	1488

From the analysis above, it can be seen that each seating area that is grouped together is limited to ensure the fire load is less than 2.5MW with the exception of Location 3 in Arch 1. This fire load island exceeds the maximum 2.5MW by 78kW. Where required, further separation of items can be included.

10 SENSITIVITY ANALYSIS NO.2

10.1 OVERVIEW

Following comments from The Board a sensitivity was completed taking into account 10kW/m² for pilot ignition as well as a temperature of 830°C.

It should be noted that the separation distances will be increased slightly and during fit out, this should be closely monitored.

10.2 ARCH 1

Below provides the calculations for Arch 1 of the Pod and the distances between them:

Table 12 Arch 1 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	0.4
Height of emitter	b	2.6
Distance to adjacent surface	c	1.4
	X	0.143
	Y	0.929
	Ø	0.122
Separation between 1 & 3		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	3.5
	X	0.314
	Y	0.371
	Ø	0.129
Separation between 2 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**

Width of emitter	a	1.2
Height of emitter	b	0.75
Distance to adjacent surface	c	1.4
	X	0.429
	Y	0.268
	Ø	0.126

Separation between 3 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.44
Height of emitter	b	1.22
Distance to adjacent surface	c	2.5
	X	0.488
	Y	0.244
	Ø	0.128

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2.5
	X	0.549
	Y	0.22
	Ø	0.127

Separation between 5 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	3.6
Height of emitter	b	2.44
Distance to adjacent surface	c	4.3
	X	0.419
	Y	0.284
	Ø	0.13

10.3 ARCH 2

Below provides the calculations for Arch 2 of the Pod and the distances between them:

Table 13 Arch 2 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.3
Height of emitter	b	1.1
Distance to adjacent surface	c	1.5
	X	0.361
	Y	0.306
	Ø	0.122

Separation between 1 & 3		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2.5
	X	0.549
	Y	0.22
	Ø	0.127

Separation between 2 & 3		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.3
Height of emitter	b	0.4
Distance to adjacent surface	c	1.0
	X	0.65
	Y	0.2
	Ø	0.132

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.3
Height of emitter	b	1.1
Distance to adjacent surface	c	1.8
	X	0.361
	Y	0.306
	Ø	0.122

Separation between 4 & 9		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.745
Height of emitter	b	1.1
Distance to adjacent surface	c	2.5
	X	0.549
	Y	0.22
	Ø	0.127

Separation between 5 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1.2
	X	0.807
	Y	0.167
	Ø	0.129

Separation between 5 & 9		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.3
Height of emitter	b	0.4
Distance to adjacent surface	c	1.0
	X	0.65
	Y	0.2
	Ø	0.132

Separation between 6 & 7		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.4
Height of emitter	b	1.1
Distance to adjacent surface	c	1.8
	X	0.389
	Y	0.306
	Ø	0.13

Separation between 6 & 9		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.4
Height of emitter	b	0.4
Distance to adjacent surface	c	1.3
	X	0.923
	Y	0.134
	Ø	0.131

Separation between 7 & 8		
Radiant Heat Flux	**1r**	**10kW/m²**

Width of emitter	a	1.4
Height of emitter	b	1.1
Distance to adjacent surface	c	1.9
	X	0.398
	Y	0.305
	Ø	0.13

Separation between 7 & 9		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	3
Height of emitter	b	1.1
Distance to adjacent surface	c	2.6
	X	0.577
	Y	0.212
	Ø	0.127

Separation between 8 & 10		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.3
Height of emitter	b	1.1
Distance to adjacent surface	c	2.3
	X	0.5
	Y	0.239
	Ø	0.128

Separation between 9 & 10		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.2
Height of emitter	b	0.4
Distance to adjacent surface	c	1.0
	X	0.6
	Y	0.2
	Ø	0.124

10.4 ARCH 3

Below provides the calculations for Arch 3 of the Pod and the distances between them:

Table 14 Arch 3 Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.437
Height of emitter	b	1.1
Distance to adjacent surface	c	1.9
	X	0.378
	Y	0.289
	Ø	0.121

Separation between 2 & 3		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.145
Height of emitter	b	1.1
Distance to adjacent surface	c	2.2
	X	0.488
	Y	0.25
	Ø	0.131

Separation between 2 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1
Height of emitter	b	2.6
Distance to adjacent surface	c	2.3
	X	0.217
	Y	0.565
	Ø	0.129

Separation between 3 & 4		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.4
Height of emitter	b	2.44
Distance to adjacent surface	c	2.7
	X	0.26
	Y	0.452
	Ø	0.127

Separation between 3 & 6		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1
Height of emitter	b	2.6
Distance to adjacent surface	c	2.3
	X	0.217
	Y	0.565
	Ø	0.129

Separation between 4 & 5		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	3
Height of emitter	b	2.44
Distance to adjacent surface	c	3.9
	X	0.385
	Y	0.313
	Ø	0.132

Separation between 4 & 7		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.4
Height of emitter	b	2.44
Distance to adjacent surface	c	2.7
	X	0.26
	Y	0.452
	Ø	0.127

10.5 FIRST FLOOR

Below provides the calculations for First Floor and the distances between them:

Table 15 First Floor Separation Distances

Separation between 1 & 2		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	0.787
Height of emitter	b	1.1
Distance to adjacent surface	c	1.4
	X	0.281
	Y	0.393
	Ø	0.122

Separation between 2 & 3		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	2.0
	X	0.4
	Y	0.275
	Ø	0.121

Separation between 3 & 4		
Radiant Heat Flux	**1r**	**10kW/m²**

Width of emitter	a	0.65
Height of emitter	b	0.4
Distance to adjacent surface	c	0.8
	X	0.406
	Y	0.25
	Ø	0.113

Separation between 4 & 5

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1.2
	X	0.807
	Y	0.167
	Ø	0.129

Separation between 5 & 6

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	2.0
	X	0.4
	Y	0.275
	Ø	0.121

Separation between 5 & 10

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.22
Height of emitter	b	2.44
Distance to adjacent surface	c	2.5
	X	0.244
	Y	0.488
	Ø	0.128

Separation between 6 & 7

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.936
Height of emitter	b	0.4
Distance to adjacent surface	c	1.2
	X	0.807
	Y	0.167
	Ø	0.129

Separation between 6 & 9

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.424
Height of emitter	b	1.1
Distance to adjacent surface	c	1.8
	X	0.396
	Y	0.306
	Ø	0.132

Separation between 7 & 8

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	0.787
Height of emitter	b	1.1
Distance to adjacent surface	c	1.4
	X	0.281
	Y	0.393
	Ø	0.122

Separation between 8 & 9

Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.6
Height of emitter	b	1.1
Distance to adjacent surface	c	2.0
	X	0.4
	Y	0.275
	Ø	0.121
Separation between 9 & 10		
Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	1.22
Height of emitter	b	2.44
Distance to adjacent surface	c	2.5
	X	0.244
	Y	0.488
	Ø	0.13

11 CONCLUSION

From the calculated analysis of this report, the introduction of furniture into the Pod at the RHCYP can be controlled to within 2.5MW's where:

- The grouping of the items remain as per proposed design layout, and
- The maximum separation distances shown in Table 6, Table 7 and Table 8 are obtained.

As a result of following the above mentioned and the contents of this report it is concluded that the proposed introduction of furniture into the RHCYP satisfy the design specifications set out within WSP-SZ-XX-DC-572-600 for maximum fire size.

Calculated analysis within this report are specific to these furniture items only, where future arrangements result in old items being replaced with new or a total reintroduction of new items, a new risk assessment of the fire load and separation distances will be required for these.

The building management team have a responsibility to maintain as high a level of fire safety as can practicably be achieved at all times and, where practicable, materials used on the atria should be fire resisting, of limited combustibility or difficult to ignite.

It should be noted that any changes to the fire load in the area or additional materials introduced, the calculations should be re-assessed each time. Each location within the Pod highlights the maximum allowable fire load and the calculations contained within this report are based strictly on this layout.

Under no circumstances should there be items placed underneath walkways.

12 ALTERNATIVE LAYOUT

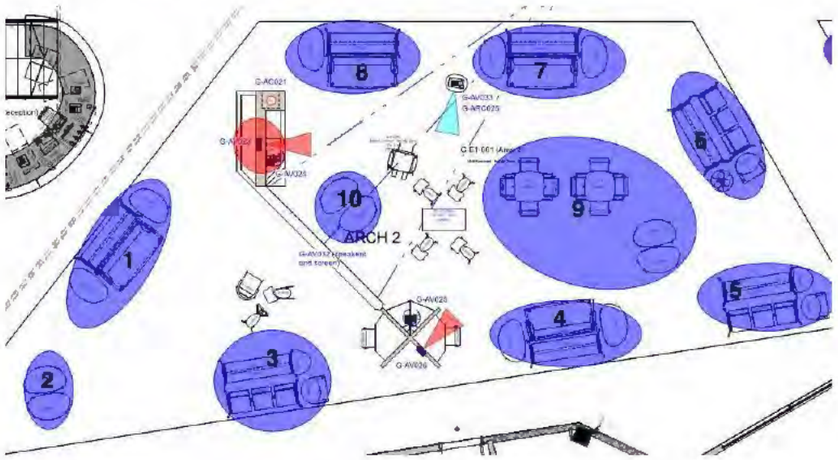
12.1 INTRODUCTION

WSP have been asked to provide a review of an alternative layout for The Board to allow them to install a Christmas tree during the festive period.

12.2 LOCATION

The intended location for the Christmas tree would be in Arch 2. The current contents of which are noted below:

Figure 8 Current Arch 3 Layout



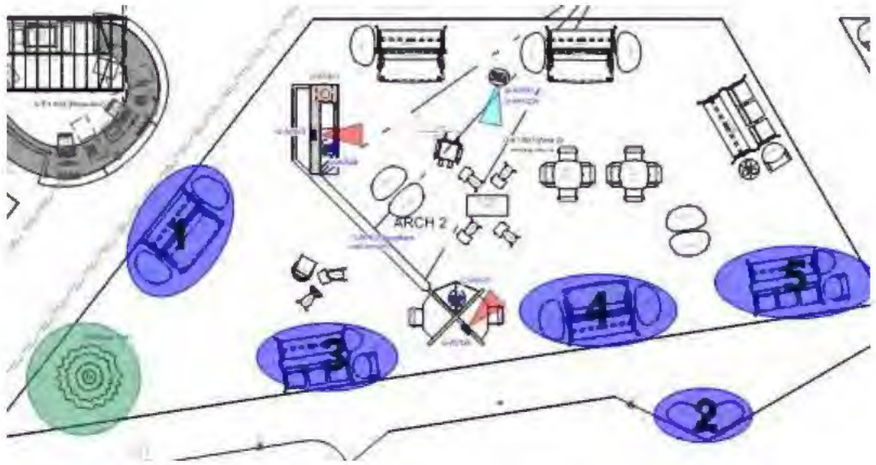


Figure 9 Christmas Tree Location

12.3 ANALYSIS

INTRODUCTION

Introducing a Christmas tree to within the Pod requires detailed analysis to be carried out in order to determine that the fire load limitations specified within WSP-SZ-XX-DC-572-600 and WSP-SZ- XX-DC-572-300 are observed at all times.

Within WSP-SZ-XX-DC-572-600 detailed CFD analysis was carried out to determine a tenable fire size for this area, as a result a 2.5MW fire was the concluded maximum fire size which the smoke control system would be able to cope with.

For this reason items introduced into this space must be restricted to the designed limitations concluded within the CFD analysis.

To ensure that the accumulation of items introduced doesn't exceed the design fire size the positioning and separation of exhibitions to include a Christmas tree will require to be examined as well as the characteristics of each exhibition item for their potential fire size.

METHODOLOGY

To establish the potential fire size of the Christmas tree introduced into the Pod the following fire engineering analysis has been carried out:

3. Determine the fire size by calculating the *Heat Release Rate* (HRR),
4. The maximum separation distance between exhibitions items by *Radiant Heat Flux* to ensure the ignition of one item will not contribute to the spontaneous ignition of adjacent exhibition items.

HEAT RELEASE RATE (HRR) – REAL CHRISTMAS TREE

The BRE publication Design Fires for Use in Fire Safety Engineering was published to provide technical data and guidance for defining a robust, appropriate and acceptable design fire for the fire engineering design of a building. The study was based on 29 experimental fires which were categorised into two groups:

- Occupancies: This considered design fire scenarios that are representative of a type of building occupancy. These experimental fire scenarios can include a number of different combustible materials. The arrangement of the combustible contents was intended to represent that of a typical example of such an occupancy.
- Commodities: Of which some of the examples, like the occupancies, may contain a number of different combustible materials. The fire tests were intended to document the fire performance of stand-alone items.

The table below highlights the Christmas tree tests that were completed:

Table 16 BRE Experimental Christmas Tree Data

Experiment No.	Description	Mass (KG)	Fire Size (kW)	Time to Reach Max Fire Size
1	Height 2.6m, width at widest point 1.7m, moisture content 30%	17.2	4250	50s
2	Height 2.7m, width at widest point 1.3m, moisture content 27%	15.9	1750	45s
3	Height 2.3m, width at widest point 1.7m, moisture content 30%	20.0	5250	55s
4	Height 2.5m, width at widest point 1.7m, moisture content 30%	9.5	1750	70s
5	Height 2.5m, width at widest point 1.7m, moisture content 38%	19.1	3500	65s
6	Height 2.5m, width at widest point 1.1m, moisture content 32%	12.7	1900	90s
7	Height 3.1m, width at widest point 1.5m, moisture content 25%	18.6	3100	45s

Of those results above, Nos. 2, 4 and 6 are the only applicable trees as the fire sizes are below 2500kW (2.5MW). It has been noted that the time taken to reach this fire size is exceptionally quick as expected with a real Christmas tree fire. Therefore, we have conducted additional modelling to ensure this does not affect the means of escape from the Second Floor balcony and First Floor waiting area as described in WSP-SZ-XX-DC-572-300.

Zone Modelling

We conducted 3 scenarios within B-Risk Zone Model.

B-Risk by Branzfire allows a virtual physics model of a specific design concept to be tested providing a level of accuracy greater than that of simplified equations. Zone modelling is used to explore relatively simple scenarios and provide a higher level of detail and accuracy than is achievable with simple hand calculations. The principal of zone modelling is to split the physical domain in to two layers (zones) the upper layer and the lower layer. The modelling software solves transport equations between the two zones for important physical conditions such as, smoke layer height, upper and lower temperatures and visibility.

The two scenarios modelled were as follows:

- 2.5MW fire, specifically calculated growth rate based on tree No.2
- 2.5MW fire, specifically calculated growth rate based on tree No.4
- 2.5MW fire, specifically calculated growth rate based on tree No.6

To calculate the specific growth rates for Tree's 4 and 6, equation (4) from PD 7974-1 was used based on those figures above:

TREE NO.2

$Q=\propto T^2$

$1750 = \propto 45^2$

$\propto = 0.864$

TREE NO.4

$Q=\propto T^2$

$1750 = \propto 70^2$

$\propto = 0.357$

TREE NO.6

$Q=\propto T2$

$1900 = \propto 902$

$\propto = 0.235$

ACCEPTANCE CRITERIA

For the purposes of this report, tenability criteria have been based on PD 7974-6.

1. An upper layer height greater than 2.5m
2. With a temperature within the above layer of no more than 200°C with a lower layer temperature no greater than 60°C, or;
3. Alternatively if a clear layer height of more than 2.5m cannot be achieved, visibility must be greater than 10m and the temperature of the upper layer must not exceed 60°C.
4. Asphyxiant and irritant smoke products: As detailed in PD 7974 part 6 there is a relationship between smoke density and the concentrations of irritant and asphyxiant gasses, a smoke density limit of 0.2 Dm-1 is given. This correlates to a visibility of 5m. Therefore, the 10m visibility criterion above is conservatively used.

The top most open balcony is 2.5m above the Second Floor Balcony, this is 11.5m from Ground level. Within report WSP-SZ-XX-DC-572-300, the Required Time for Safe Escape was noted as 234 seconds. In order to determine whether either of those trees can be utilised within the Pod, the above tenability criteria measured at 11.5m in the Pod must be met.

13 RESULTS

TREE NO. 2

The graph below highlights the layer height descends below 11.5m within the 234 second escape time. As such this is not compliant with tenability criteria No.1 above.

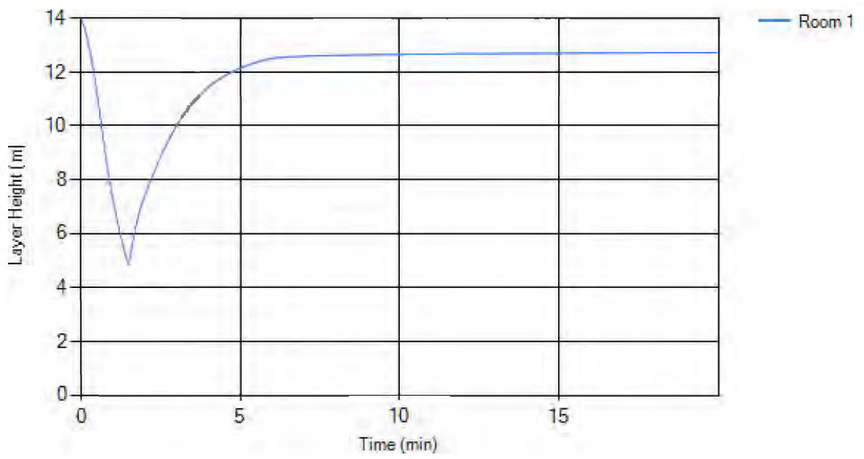


Figure 10 Layer Height Tree No.2

As the layer height cannot be achieved, an additional measurement of visibility was taken. The graph below highlights the visibility is not maintained above 10m. The visibility drops below 10m at 140 seconds. As such, this is not compliant with tenability criteria No.3 above

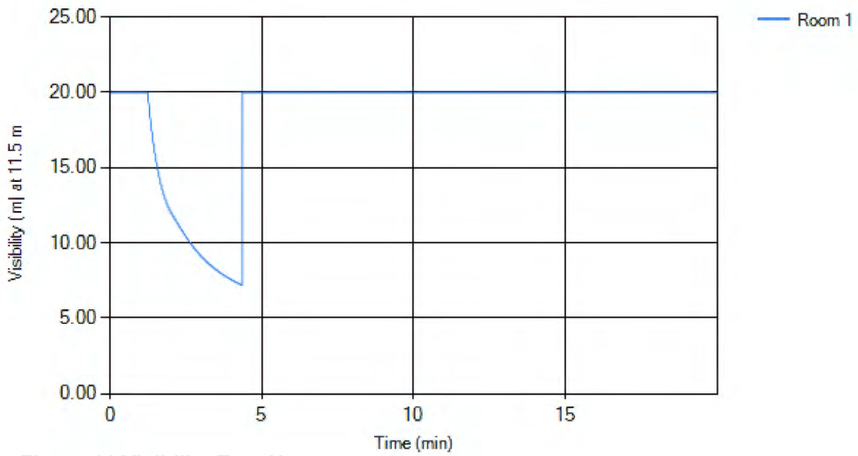


Figure 11 Visibility Tree No.2

Given the above results, Tree No.2 is not permitted

TREE NO. 4

The graph below highlights the layer height descends below 11.5m within the 234 second escape time. As such this is not compliant with tenability criteria No.1 above.

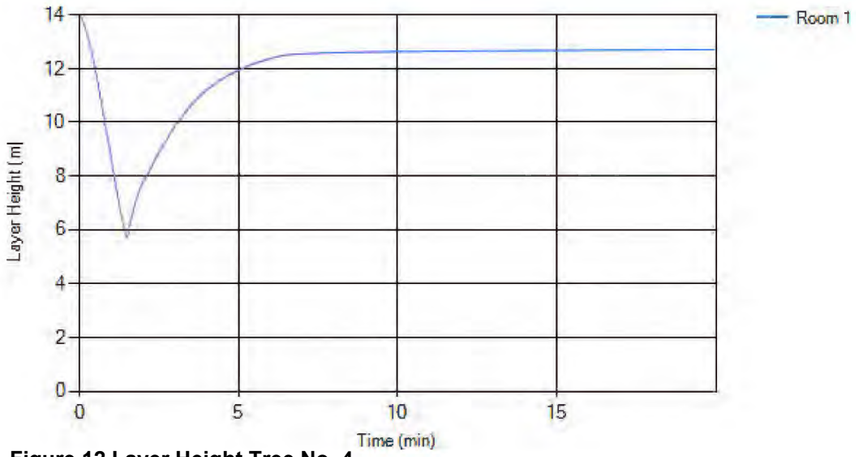


Figure 12 Layer Height Tree No. 4

As the layer height cannot be achieved, an additional measurement of visibility was taken. The graph below highlights the visibility is not maintained above 10m. The visibility drops below 10m at 140 seconds. As such, this is not compliant with tenability criteria No.3 above.

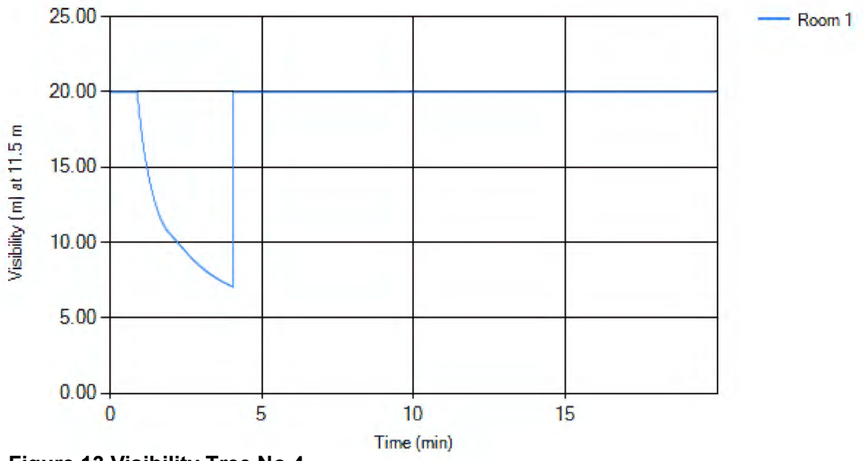


Figure 13 Visibility Tree No.4

Given the above results, Tree No.4 is not permitted.

TREE NO. 6

The graph below highlights the layer height descends below 11.5m within the 234 second escape time. As such this is not compliant with tenability criteria No.1 above.

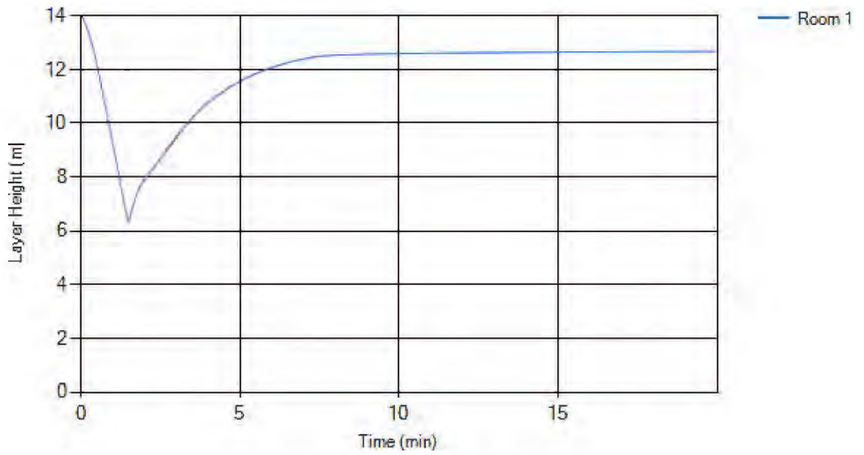


Figure 14 Layer Height Tree No. 6

As the layer height cannot be achieved, an additional measurement of visibility was taken. The graph below highlights the visibility is not maintained above 10m. The visibility drops below 10m at 140 seconds. As such, this is not compliant with tenability criteria No.3 above.

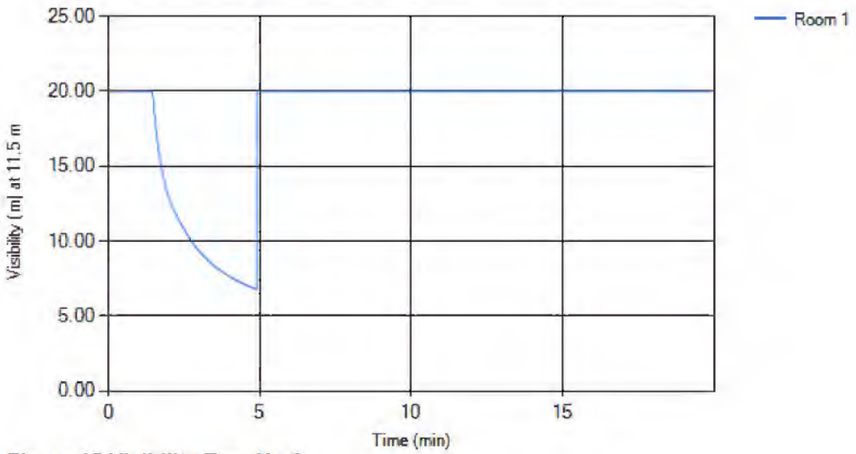


Figure 15 Visibility Tree No.6

Given the above results, Tree No.6 is not permitted.

CONCLUSION – REAL TREE

It is concluded that to ensure means of escape is not affected on the upper levels, a real Christmas tree cannot be permitted within the Pod.

HEAT RELEASE RATE (HRR) – ARTIFICIAL CHRISTMAS TREE

PD 7974: Part 1[4] provides data showing the heat release rate for artificial trees.

Table 17 PD 7974-1 Heat Release Data for Artificial Trees

Description	Height	Peak Heat Release Rate
Non-Fire Retardant series of interlocking plastic tubes onto which are fixed radial extending plastic coated wire branches 2.9kg of tree decorations	2.1m	328kW
Fire Retardant consisting of central tubular steel framework from which plastic-coated metal wire branches protrude	2.5m	100kW

The table above highlights those two options which would be possible for the Pod.

CONCLUSION – ARTIFICIAL TREE

Given the low heat release rate, we would consider that a 2.5m high fire retardant tree, with 2.9kg of decorations is acceptable to be placed within the Pod.

We would recommend however, that only LED lights are placed on the tree as these have a lower heat emitter, and the decorations are limited to those with no ignition sources.

13.1 RADIATION HEAT FLUX ANALYSIS

INTRODUCTION

Following the result of the HRR calculations, the maximum separation distance has been calculated to establish the appropriate separation between items.

As noted within PD 7974-3, it is difficult to state accurately what level of incident is required to cause ignition of combustible items outside the enclosure of fire origin, however, the widely used threshold is 12.6kW/m². As such, the radiation heat flux calculations below take into consideration this figure and separation distances are such that 12.6kW/m² is never exceeded.

As noted above, the calculation takes into account several factors: $Ir=\emptyset\varepsilon\sigma T4$

Where:

I_r = Incident radiation (kW/m^2)

[4] BS 7974: Part 1-2003, Application of fire safety engineering principles to the design of buildings – Part 1: Initiation and development of fire within the enclosure of origin

$\emptyset$ = Configuration factor

ε = Emissivity (0.9)

σ = Stephen-Boltzmann Constant (5.67×10^{-11}kW/m^1/K^1)

T^4 = Temperature(K)(1073K)

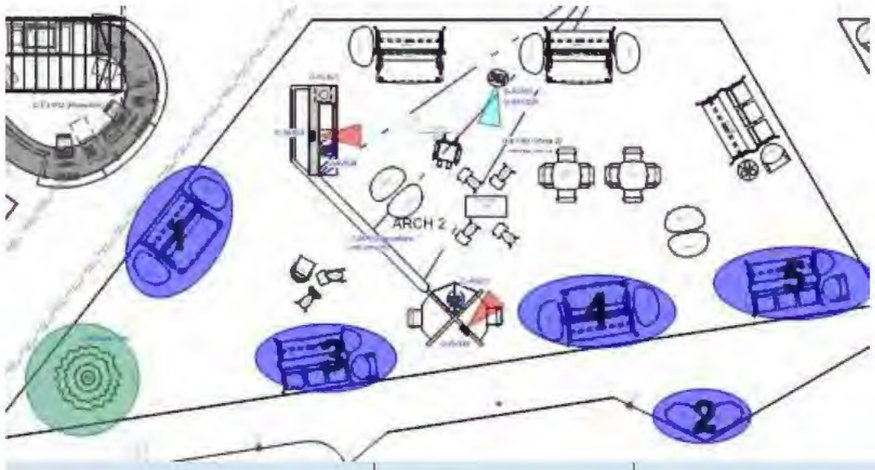
ARCH 2

The figure below highlights the location of the proposed Christmas tree and the fire load islands nearby which have to be considered in reference to radiative heat.

Below provides the calculations for Arch 1 of the Pod and the distances between them:

Table 18 Separation Distances

Separation between Tree & 1		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	0.4
Height of emitter	b	2.6
Distance to adjacent surface	c	1.4
	X	0.142
	Y	0.929
	Ø	0.122
Separation between Tree & 2		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	3.5
	X	0.314
	Y	0.371
	Ø	0.129
Separation between 2 & 4		
Radiant Heat Flux	**1r**	**10kW/m²**
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	3.5
	X	0.314
	Y	0.371
	Ø	0.129
Separation between 2 & 5		



Radiant Heat Flux	1r	10kW/m²
Width of emitter	a	2.2
Height of emitter	b	2.6
Distance to adjacent surface	c	3.5
	X	0.314
	Y	0.371
	Ø	0.129

13.2 CONCLUSION

From the analysis completed in Section 12 of this report the introduction of a Christmas tree can be accommodated provided the following is complied with:

- The tree is artificial and fire retardant;
- The tree is no taller than 2.5m in height;
- An assumed maximum width is 2.5m and the tree should be no wider;
- 2.9kg of decorations is acceptable;
- Only LED lights are placed on the tree as these have a lower heat emitter, and the decorations are limited to those with no ignition sources.
- The separation distances of the tree from all other items is no less than 3.5m;
    - Please note, to achieve this, those other items should be moved such that the detailed analysis undertaken throughout this report is affected, i.e. no other items should be moved closer than is stated in the separation tables in Table 6, Table 7 and Table 8.

- As noted within SHTM 81, it is essential that appropriate person had delegated responsibility for the day to day fire safety management of the atrium. The nominate person and deputies should be available at all times when the atrium is in use:
  - To ensure that the fire load is controlled and within the permissible limits; and
  - To provide assistance and advice to the senior person responsible for co-ordinating the emergency response to a fire incident.
- Calculated analysis within this report are specific to these furniture items only, where future arrangements result in old items being replaced with new or a total reintroduction of new items, a new risk assessment of the fire load and separation distances will be required for these.
- The building management team have a responsibility to maintain as high a level of fire safety as can practicably be achieved at all times and, where practicable, materials used on the atria should be fire resisting, of limited combustibility or difficult to ignite.
- It should be noted that any changes to the fire load in the area or additional materials introduced, the calculations should be re-assessed each time. Each location within the Pod highlights the maximum allowable fire load and the calculations contained within this report are based strictly on this layout analysed plus the additional Christmas tree scenario.
- Under no circumstances should there be items placed underneath walkways

14 MODEL DRAGON AND CLOCK TOWER

14.1 INTRODUCTION

Since this report was completed, additional items have been considered for the Pod, namely a model dragon and a clock. This report has been updated to take into account both those items and their impact (if any) on the fire load and separation distances within the atrium. Drawings reviewed are as follows as well as technical testing report for various products:

Drawing Title	Drawing Name
Lighting Detail: Clock Tower	GINK-Z1-XX-DT-470-003-7.1
Lighting Detail: Dragon Eye and Nostril	GINK-Z1-XX-DT-470-008-7.1
Enhancement Clocktower	GINK-Z1-00-SK-470-031-7.1
Clocktower Panels	(Works No – 231180)
Enhancement Dragon Structure	GINK-Z1-00SK-470-014-7.1

14.2 MODEL DRAGON

A model dragon is to be placed within the Pod of RHCYP. The dragon will be placed upon an existing protruding element therefore will have no effect on the smoke flow if the event of a fire below it.

The art team, Gingko have confirmed that the dragon itself is constructed of steel framing and Rock-panel FS-Xtra providing A2-s1, d0 classification, which as per the Non-Domestic Technical Handbook, is the equivalent of non-combustible.

The Rockpanel product sheet highlights that the product has been tested to EN 13501-1 and achieves A2-s1, d0 and test results are only valid for a metal subframe. It is confirmed that the subframe is constructed of steel.

Additional features of the model dragon include lighting to the eyes and snout. LED's should be used for this lighting where possible. LED lighting whilst not entirely risk free, the risk is lower as the diodes themselves maintain lower temperatures.

14.3 CLOCK TOWER

The clock tower is a lining structure attached to the bank of lifts within the Pod. The clock tower is essentially an internal lining and as such should be compliant with B, s3, d2 or better (low risk). The materials for the clock are listed as:

- Aluminium;
- Vinyl;
- Acrylic.

Whilst aluminium is considered to be Low Risk, the Acrylic test certificate noted it achieves Class 3, the equivalent in the Technical Handbook is High Risk.

The coverage of Acrylic in terms of surface area is limited when compared to the size of the Pod. The acrylic is 8.2m² and is a small proportion. The acrylic is located 5.7m above floor level within the Pod and in a supervised location where occupants are simultaneously evacuated should the need occur. This is considered a low risk in terms of fire.

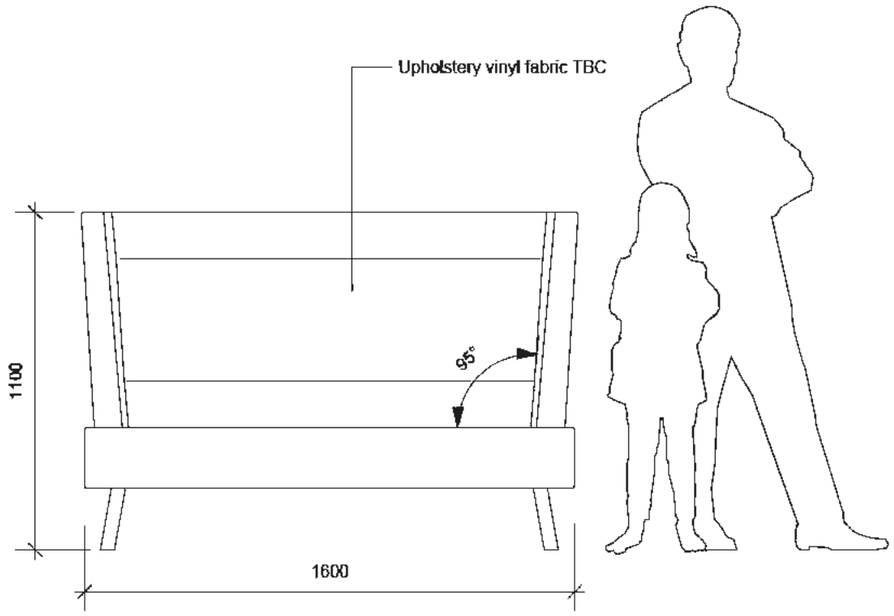
The vinyl has been noted on the Technical Specification as being self-extinguishing, therefore when heat is removed no further spread occurs.

Additional features of the clock include lighting. LED's should be used for this lighting where possible. LED lighting whilst not entirely risk free, the risk is lower as the diodes themselves maintain lower temperatures.

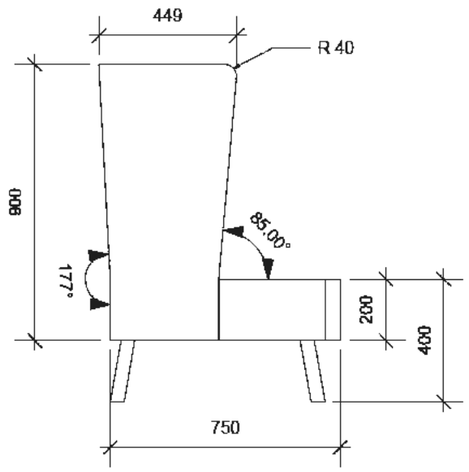
It has been noted on the drawing provided, that LED's are to be designed in.

APPENDIX A

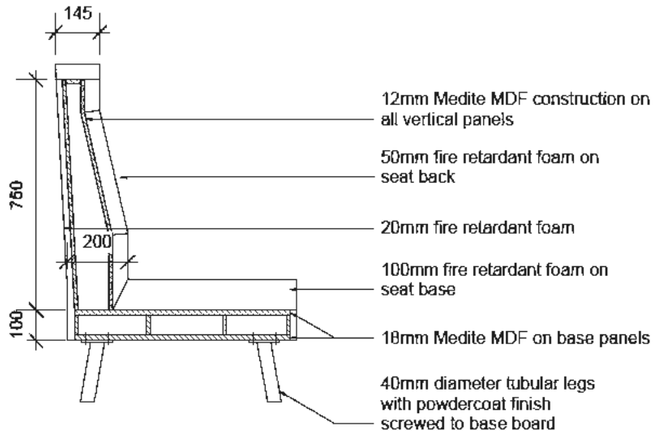
FURNITURE DRAWINGS PROVIDED BY GINGKO AND WARREN DESIGNS



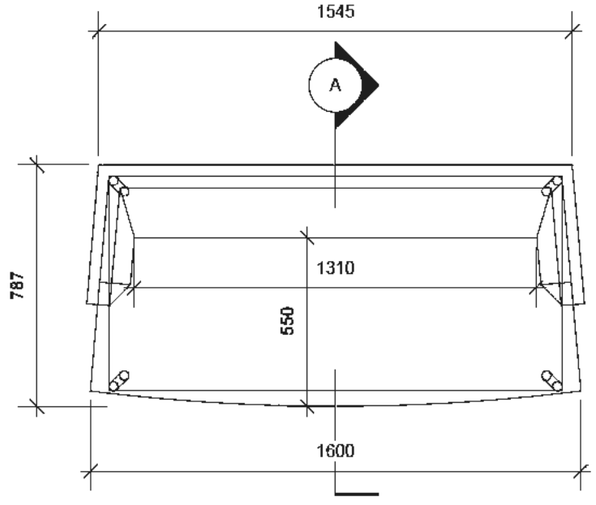
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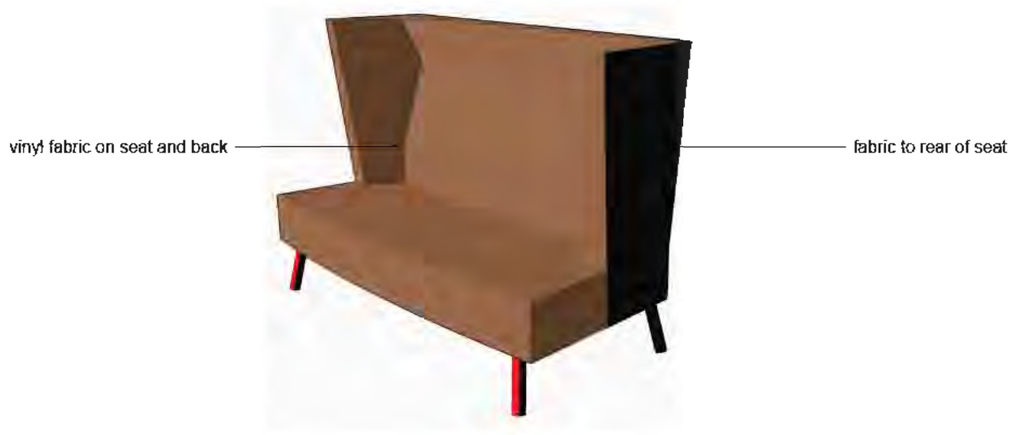
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Section A
Scale: 1:20



Plan
Scale: 1:20



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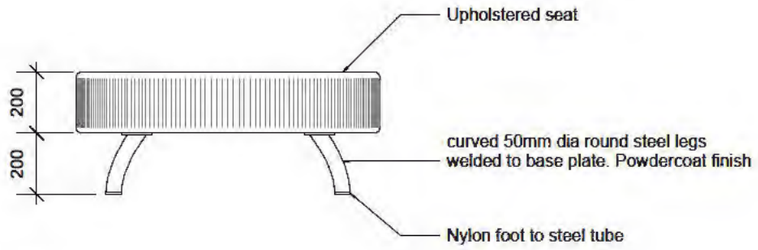
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02	Details updated	DW	WW	27/05/2016
01	FIRST ISSUE	DW	WW	13/02/2016

Daniel & William Warren

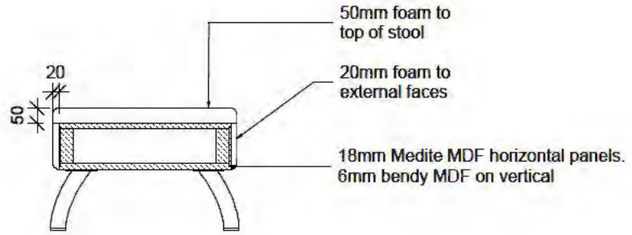
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Sofa

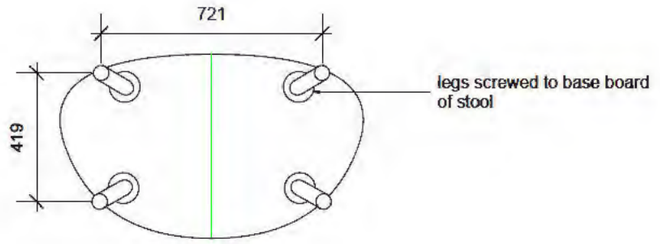
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DRAWING	GINK-xx-xx-SK-470-003-7.1			REV	02



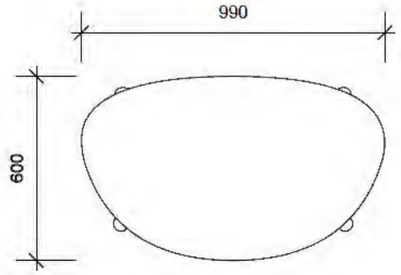
Front Elevation
Scale: 1:20



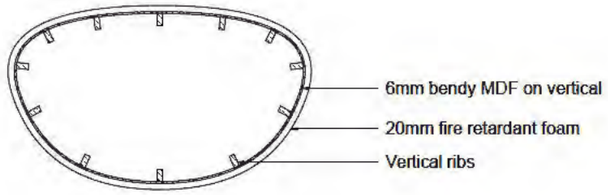
Section
Scale: 1:20



Underside
Scale: 1:20



Plan
Scale: 1:20



Section through seat
Scale: 1:20



CODE: G-SOF022

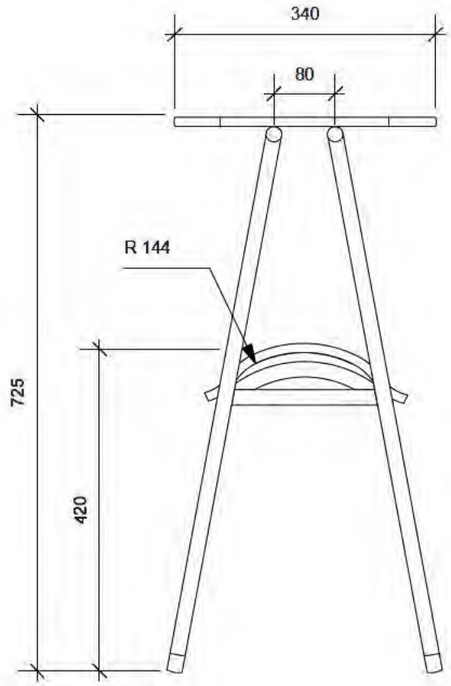
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01	FIRST ISSUE	DW	WW	11/02/2016

Daniel & William Warren

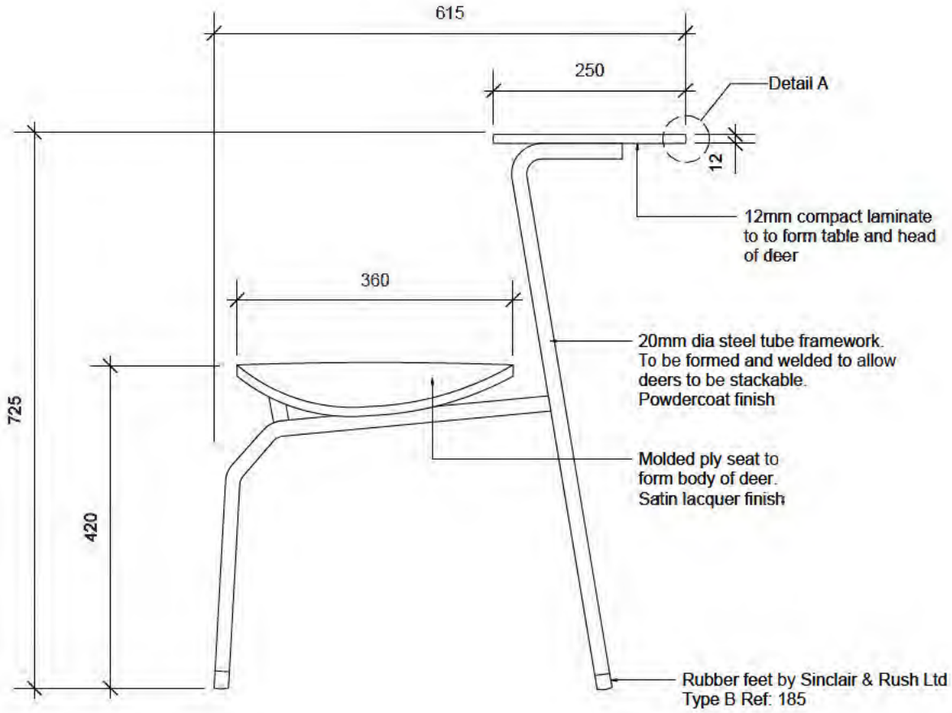
PROJECT: **ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH**
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING: ATD 7.1 Sofa stool

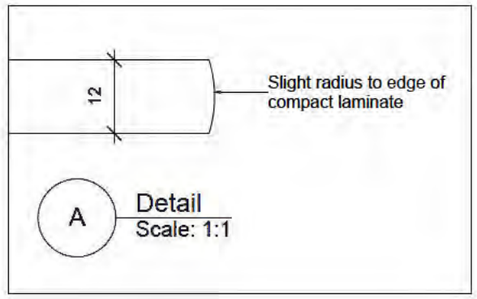
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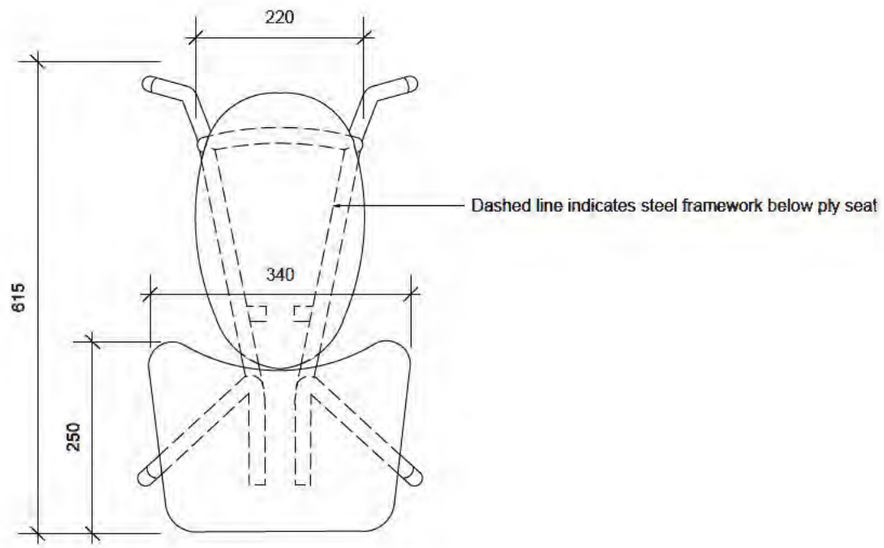


Front Elevation
Scale: 1:8

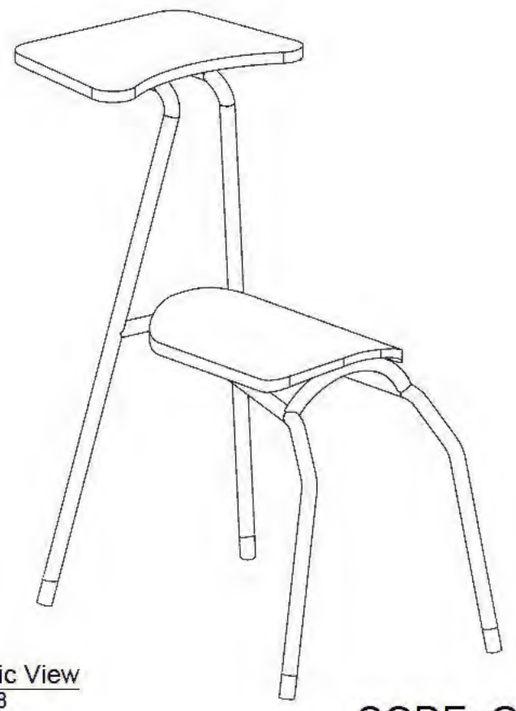


Side Elevation
Scale: 1:8





Plan
Scale: 1:8



Isometric View
Scale: 1:8

CODE: G-CHA023

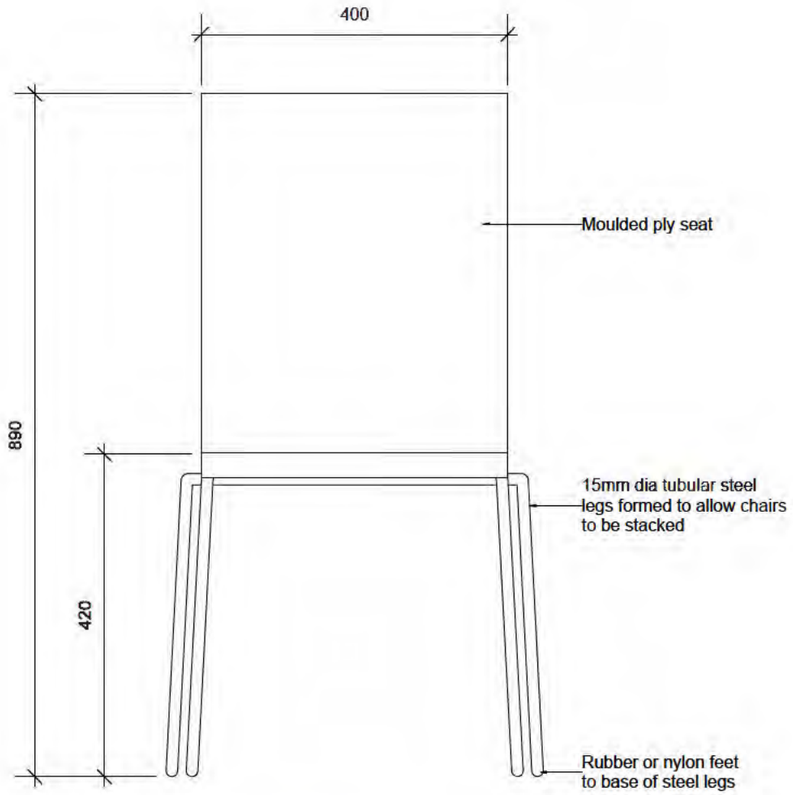
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Daniel & William Warren

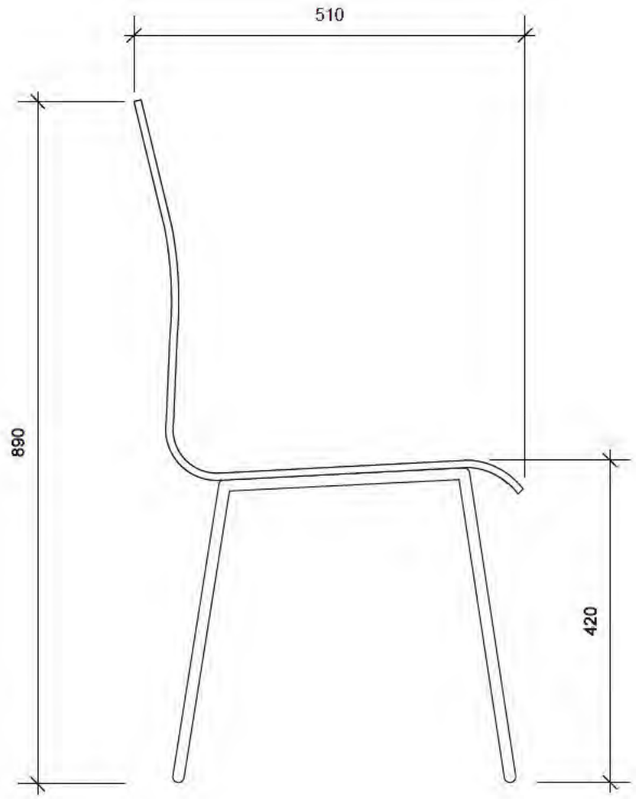
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Deer Stool

DATE	11/02/2016	DRAWN BY	SM	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A1	1:50	PAPER SIZE	A3
DWG NO	GINK-xx-xx-SK-470-010-7.1			REV	01



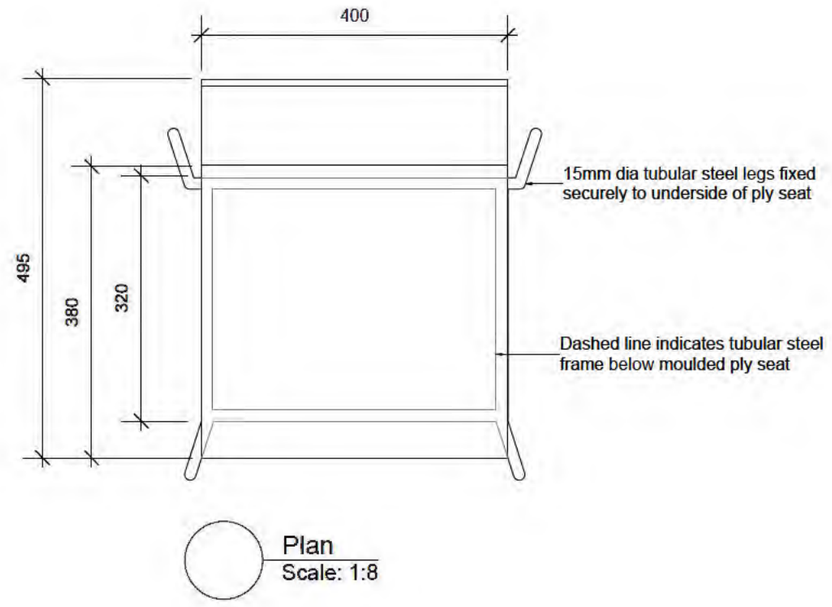
Front Elevation
Scale: 1:8



Front Elevation
Scale: 1:8



Isometric View
Scale: 1:8



Plan
Scale: 1:8

CODE: G-CHA024

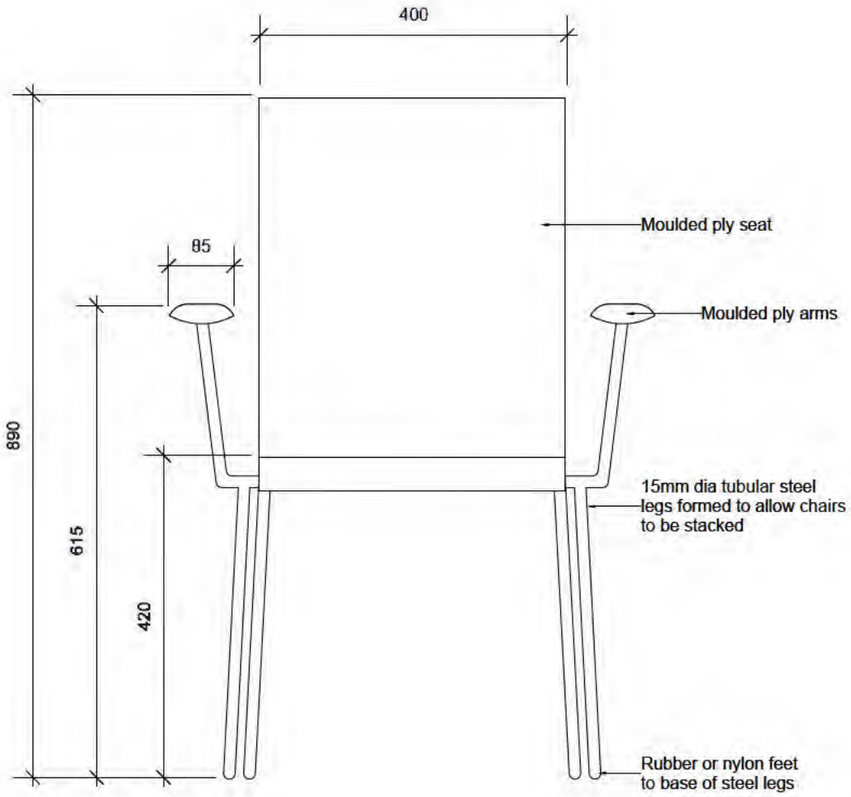
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Daniel & William Warren

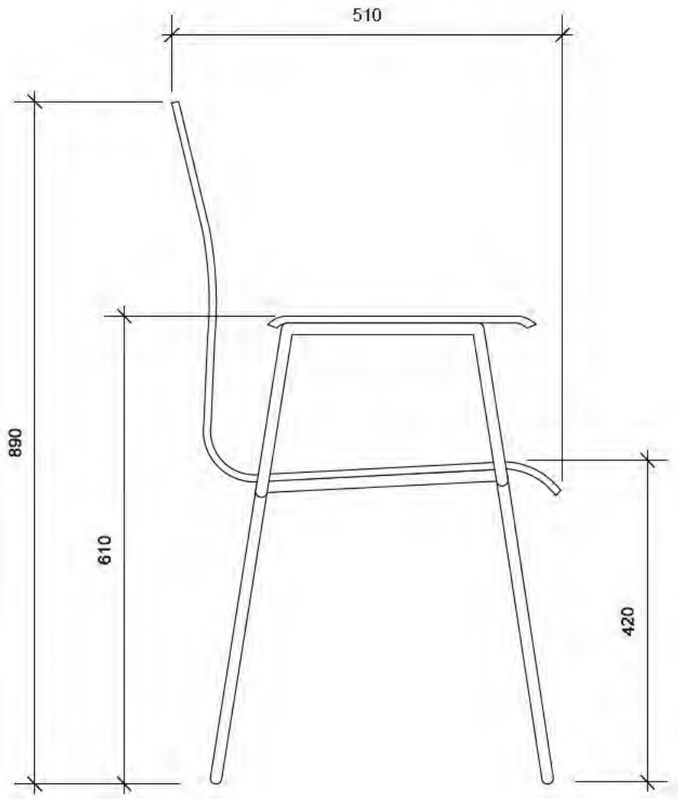
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Stacking chair

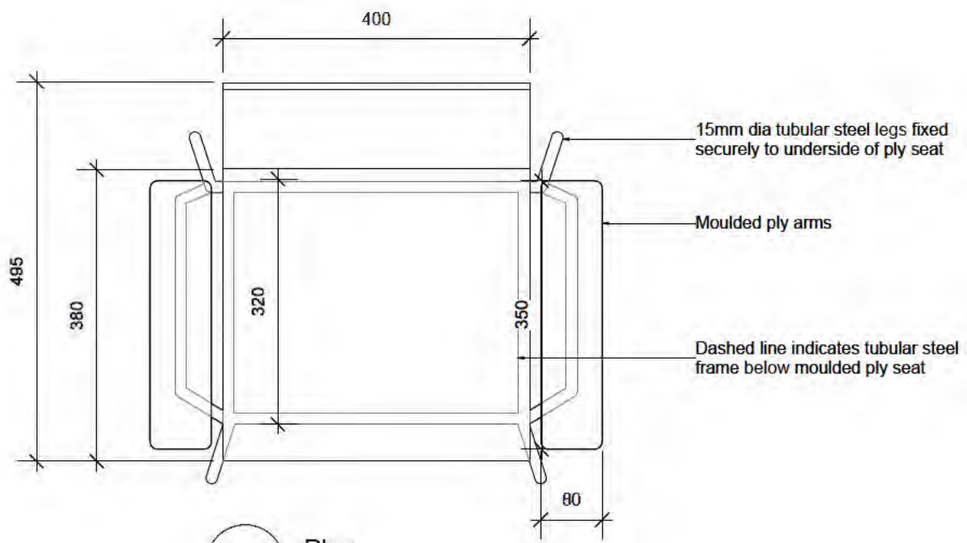
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STATUS	DETAIL	SCALE @ A3	1:50	PAPER SIZE	A3
DWG NO	GINK-xx-xx-SK-470-011-7.1			REV	01



Front Elevation
Scale: 1:8



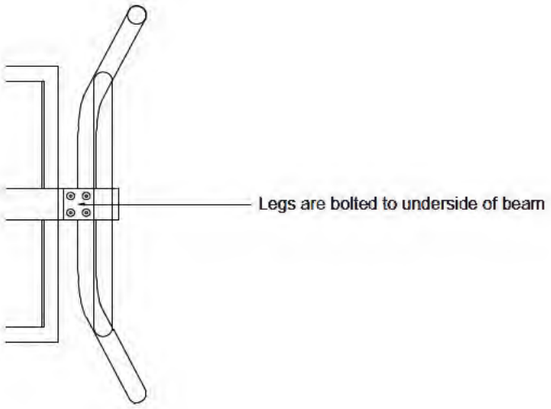
Front Elevation
Scale: 1:8



Plan
Scale: 1:8

CODE: G-CHA025

REVISIONS	01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016
	Daniel & William Warren
PROJECT	ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH ATD 7.1 POD AND WAITING / PLAY SPACES
DRAWING	ATD 7.1 Stacking chair with arms
DATE	11/02/2016 — DRAWN BY SM — CHECKED BY WW
STATUS	DETAIL — SCALE @ A3 1:50 — PAPER SIZE A3
DWG NO	GINK-xx-xx-SK-470-012-7.1 — REV 01



Underside
Scale: 1:10

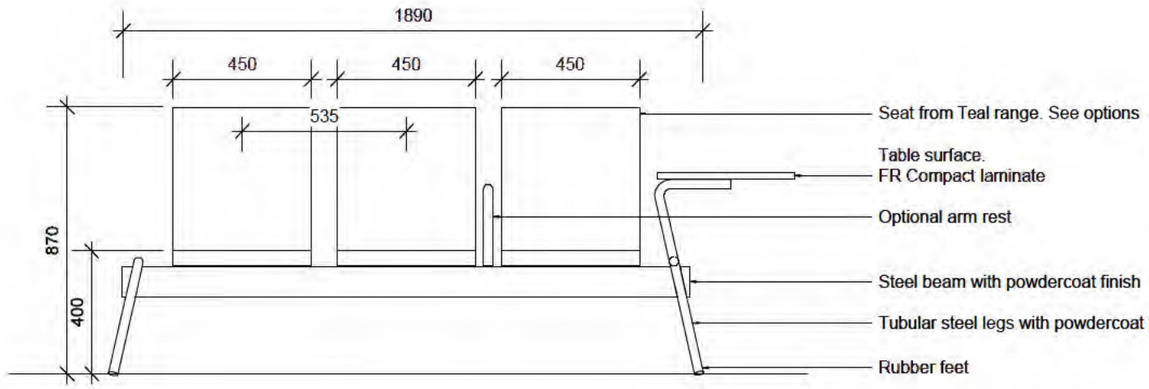
SEAT OPTIONS



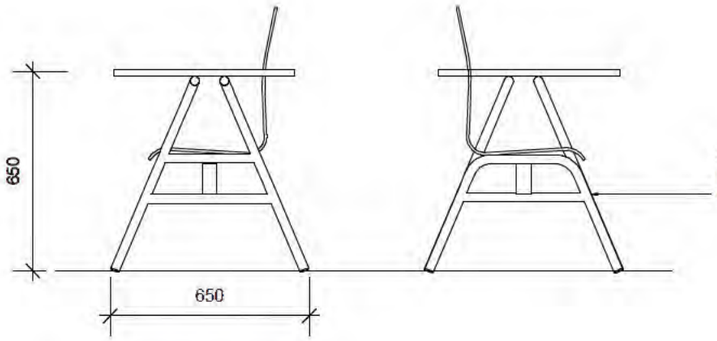
OPTION 1. ADEO SEAT
Moulded Medipur™polyurethane seats with anti-bacterial finish technology (tested Furniture and Furnishings (Fire) (Safety) Regulations 1988No 1324 Schedule 1 – pt 1 & amendment No 2358 (1989). Ignition source applied – No 5 (Crib 5)



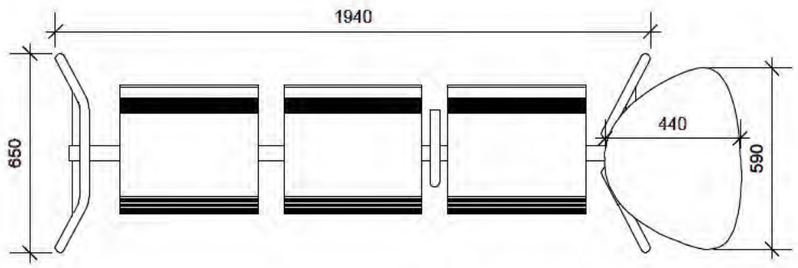
OPTION 2. SKANIA SEAT
Moulded plywood seat



Front Elevation
Scale: 1:20



Side Elevation
Scale: 1:20



Plan
Scale: 1:20



CODE: G-BEA020

REVISIONS
02 Details updated — DRAWN BY DW — CHECKED BY WW — DATE 13/05/2016
01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016

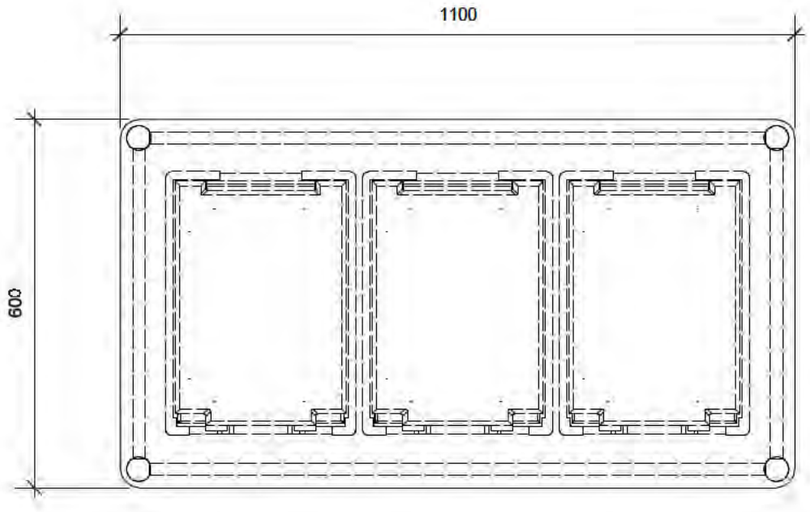
Daniel & William Warren

PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

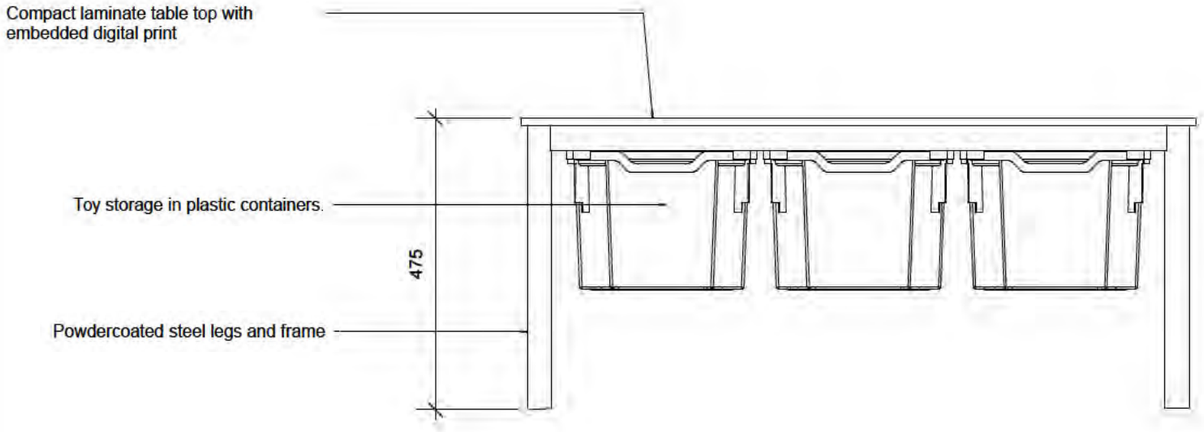
DRAWING
ATD 7.1 Three Beam Seat

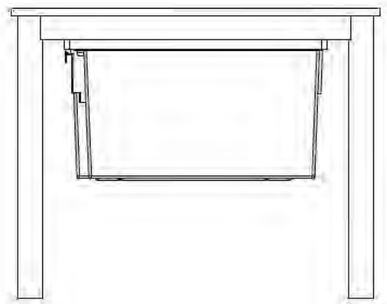
DATE 11/02/2016	DRAWN BY SM	CHECKED BY WW	
STATUS DETAIL	SCALE @ A3 1:20	PAPER SIZE A3	
DWG NO. GINK-xx-xx-SK-470-013-7.1	REV 02		

CODE: G-TAB020









REVISIONS
01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016

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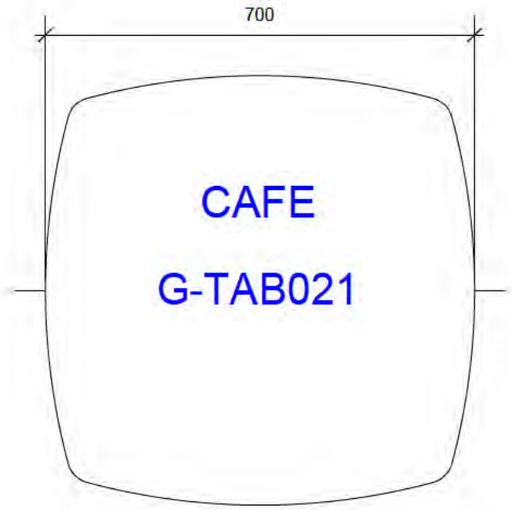
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Activity Table

DATE	11/02/2016	DRAWN BY SM	CHECKED BY WW
STATUS	DETAIL	SCALE @ A3 1:50	PAPER SIZE A3
DWG NO.	GINK-xx-xx-SK-470-015-7.1	REV 01	

CODE: G-TAB021





PLAN VIEW



REVISIONS		DRAWN BY	CHECKED BY	DATE
01	FIRST ISSUE	DW	WW	11/02/2016

Daniel & William Warren

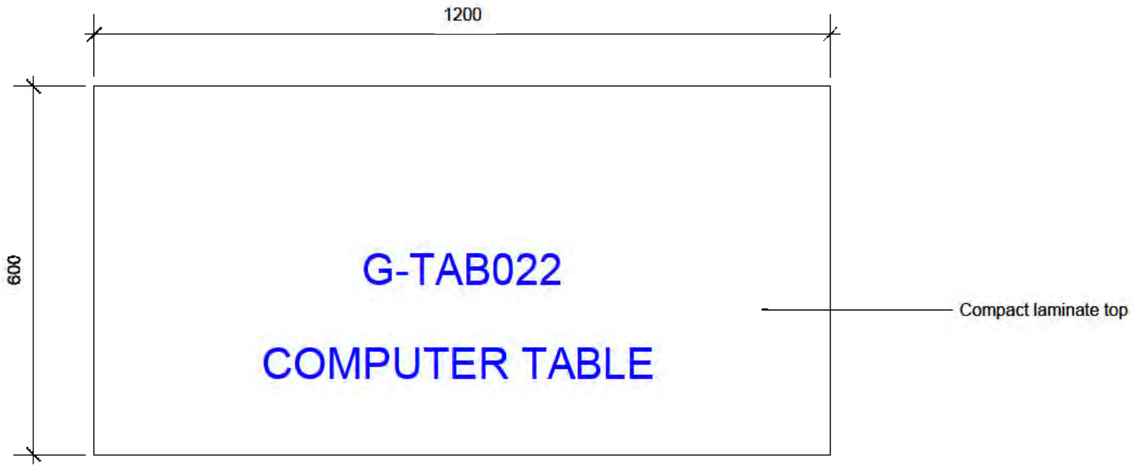
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

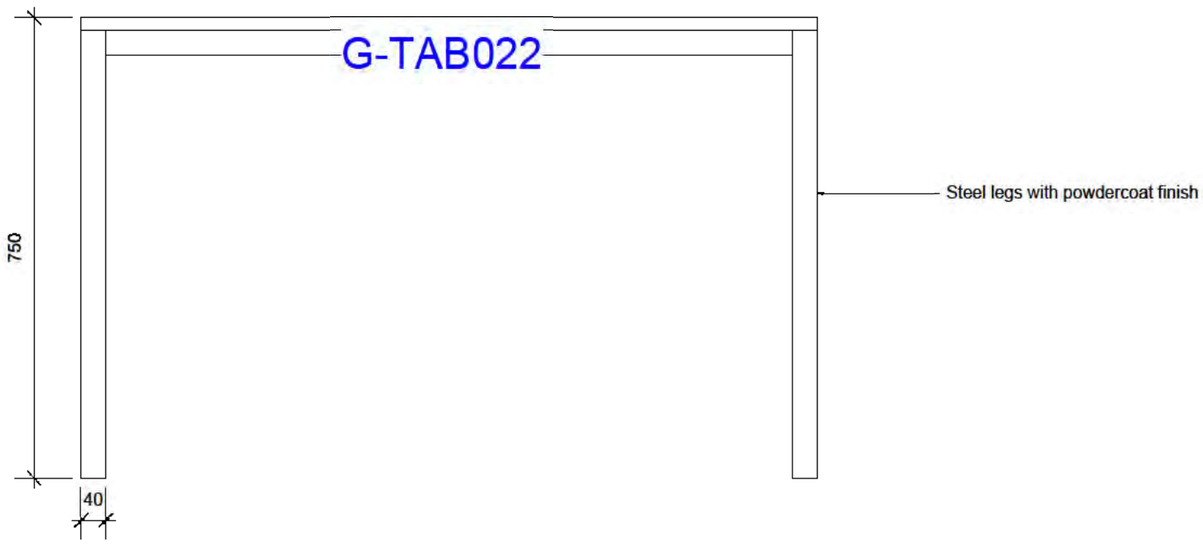
DRAWING: ATD 7.1 Cafe Table

DATE	DRAWN BY	CHECKED BY
11/02/2016	SM	WW
STATUS	**SCALE @ A3**	**PAPER SIZE**
DETAIL	1:50	A3

DWG NO: GINK-xx-xx-SK-470-016-7.1 REV: 01

CODE: G-TAB022





REVISIONS
01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016

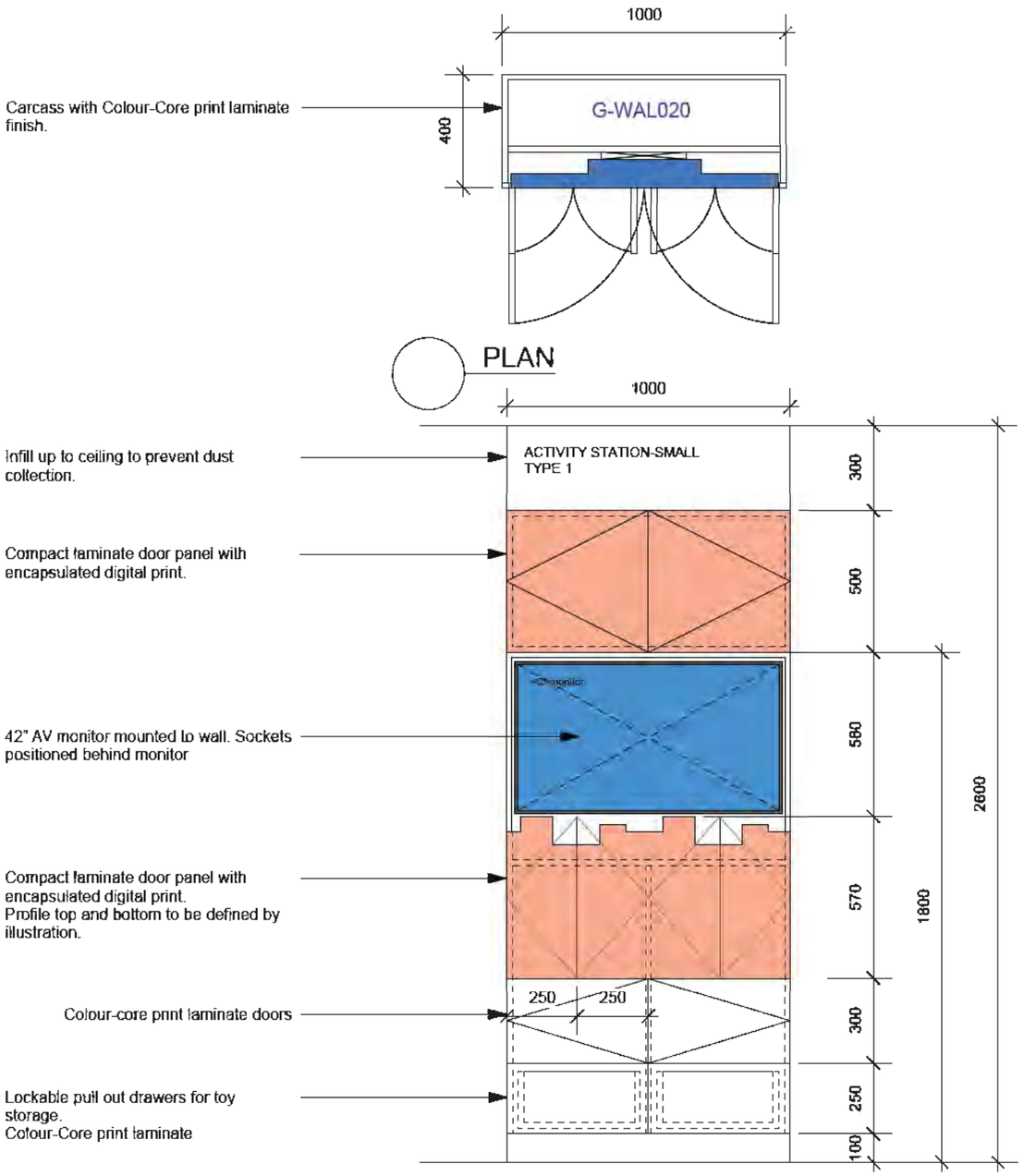
Daniel & William Warren

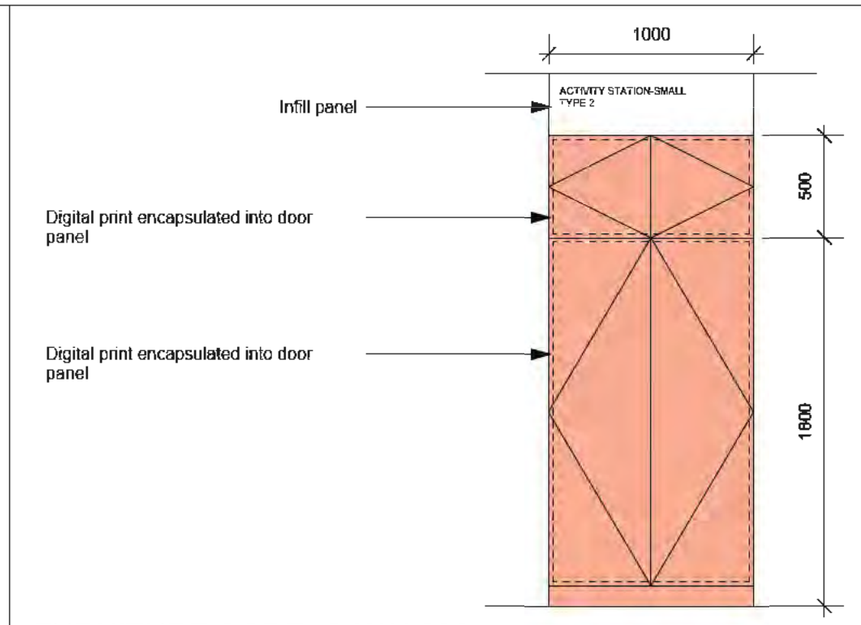
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Laptop Table

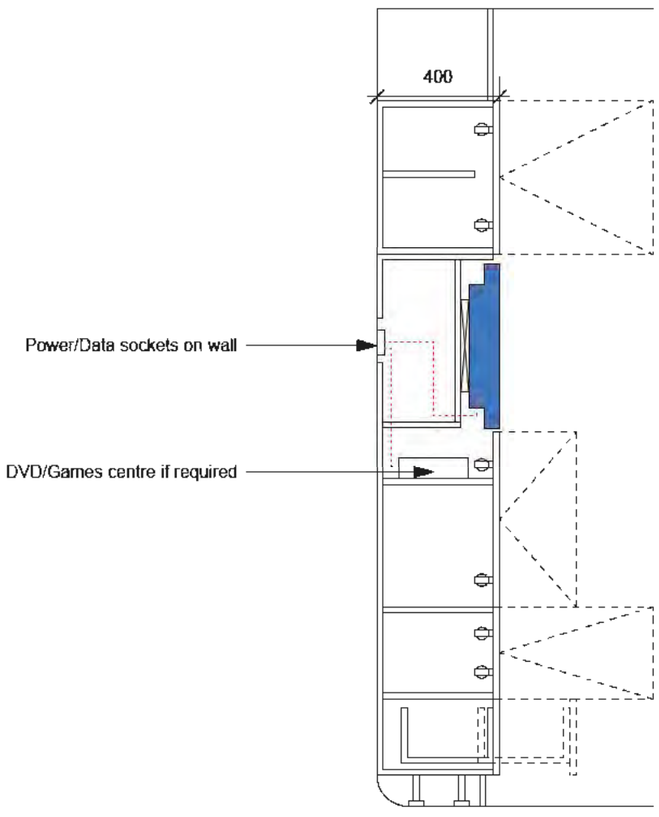
DATE 11/02/2016	DRAWN BY SM	CHECKED BY WW
STATUS DETAIL	SCALE @ A3 1:10	PAPER SIZE A3
DWG NO. GINK-xx-xx-SK-470-017-7.1		REV 01

FURNITURE CODE: G-WAL020
TOTAL QUANTITY (Incl. larger configurations) : 10





FURNITURE CODE: G-WAL022
TOTAL QUANTITY : 5



Small	020	022	021
G-E1-011		3	
G-E1-003		2	
G-K1-006	1		
1-D6-022			1
1-D4-001			1
1-P1-178			1
1-H2-002			1
3-C1-3.002			1
3-C1.2-033	1		
3-C1.2-037			1
TOTAL	**2**	**5**	**6**

REVISIONS
02 DETAILS UPDATED — DRAWN BY DW — CHECKED BY WW — DATE 02/06/2016
01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016

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PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Wall Unit Small

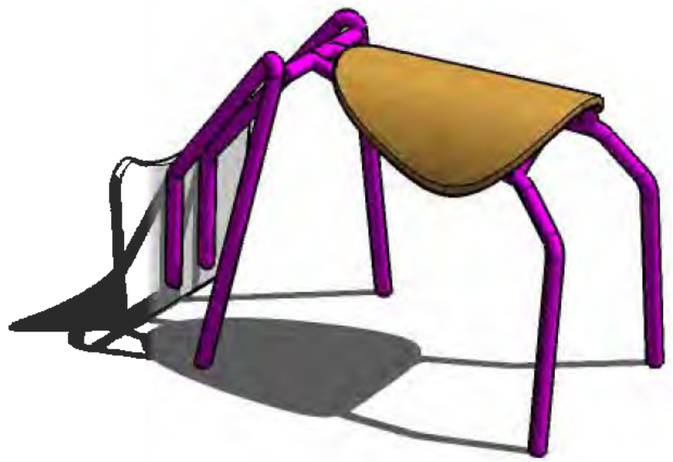
DATE 11/02/2016 — DRAWN BY SM — CHECKED BY WW

STATUS DETAIL — SCALE @ A3 1:50 — PAPER SIZE A3

DRG NO GINK-xx-xx-SK-470-019-7.1 — REV 02



CODE: G-CHA026



CODE: G-CHA027



CODE: G-CHA028

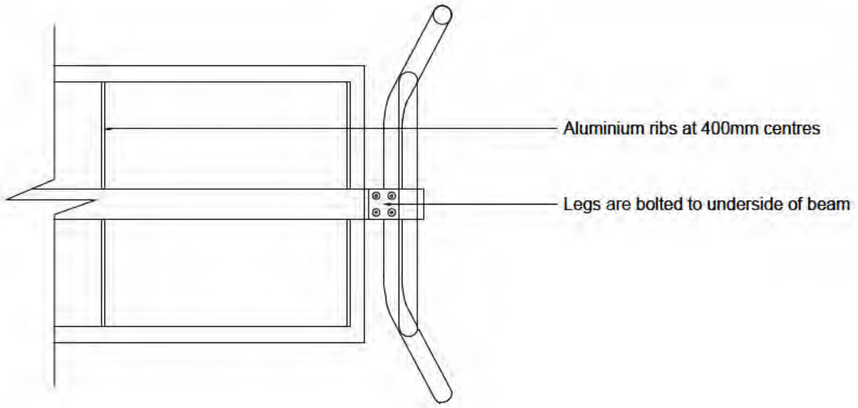
REVISIONS
01 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 11/02/2016

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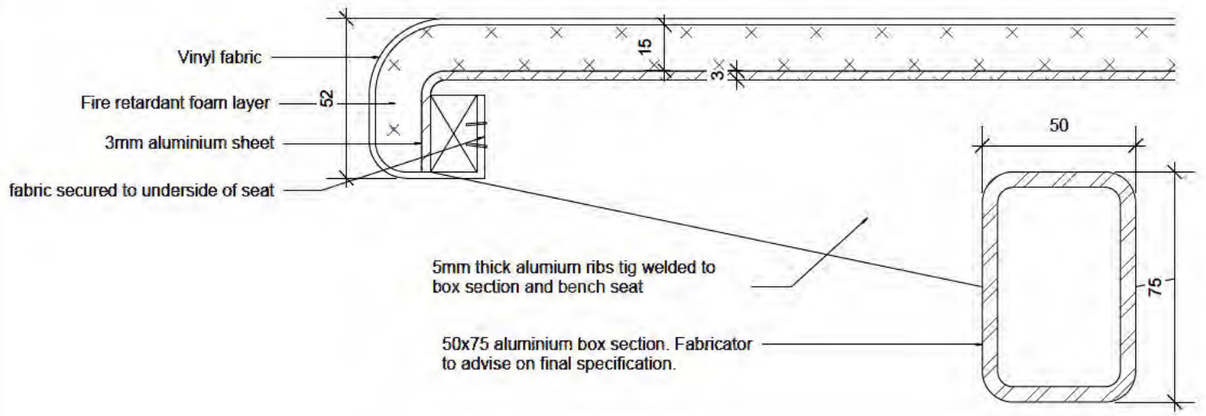
PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Deer chair variations

DATE	11/02/2016	DRAWN BY	SM	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A3	1:50	PAPER SIZE	A3
DWG NO.	GINK-xx-xx-SK-470-022-7.1			REV	01

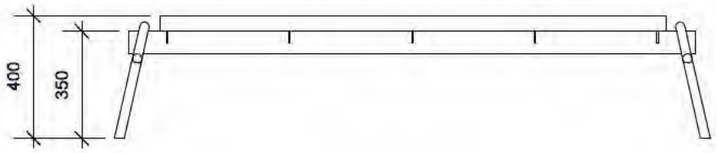


Underside
Scale: 1:10

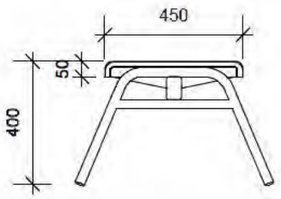


Section Detail
Scale: Half Actual Size

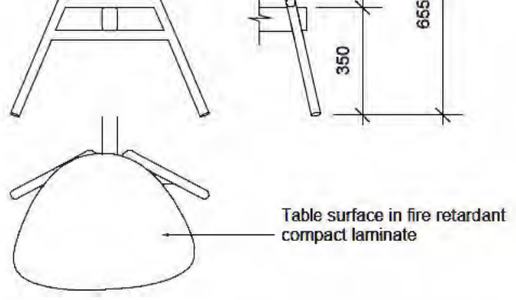
SEAT FINISH
OPTION 1. As shown on section above
OPTION 2. Beech plywood bench seat to match deer and stacking chairs



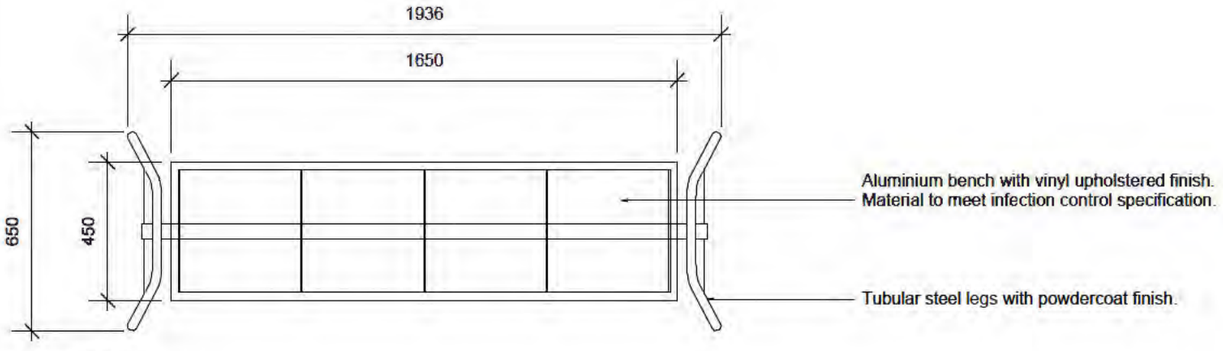
Front Elevation
Scale: 1:20



Side
Scale: 1:20



Alternative table leg
Scale: 1:20



Plan
Scale: 1:20





CODE: G-BEA022

REVISIONS	01 FIRST ISSUE	DRAWN BY DW	CHECKED BY WW DATE 27/05/2016

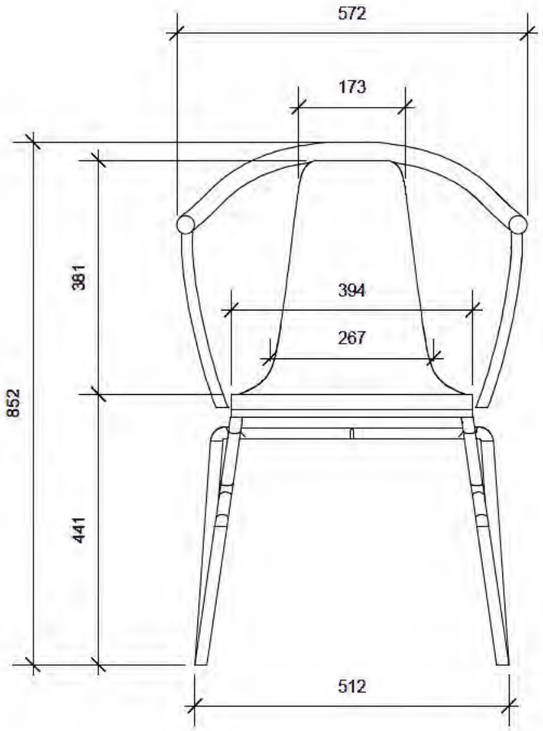
Daniel & William Warren

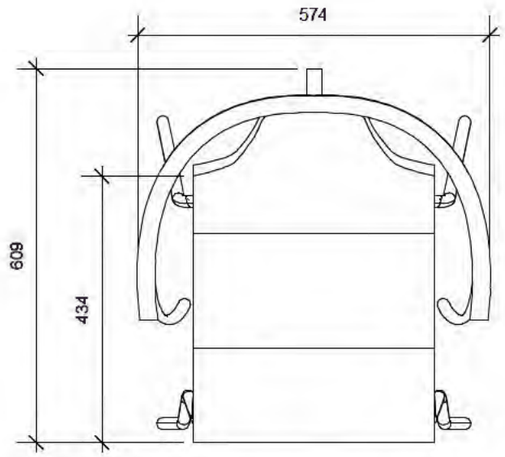
PROJECT: **ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH**
ATD 7.1
POD AND WAITING / PLAY SPACES

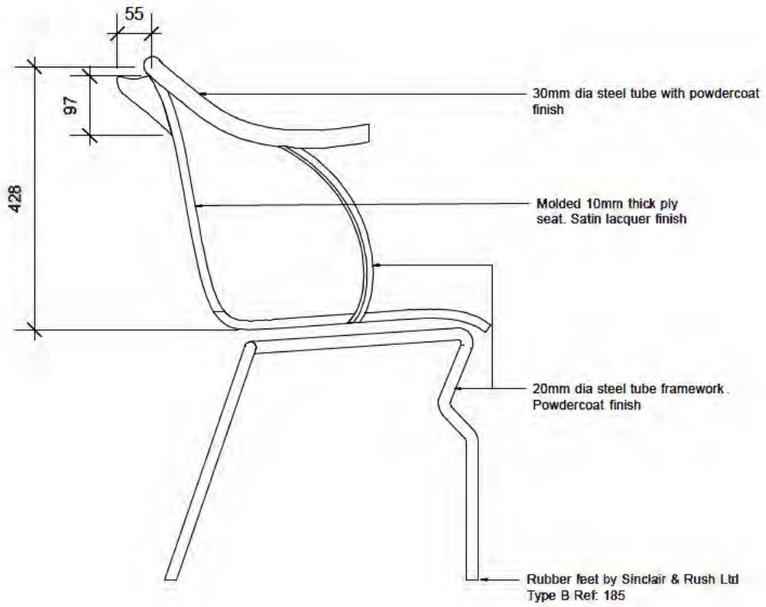
DRAWING: ATD 7.1 Beam Bench

DATE	27/05/2016	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A3	1:20	PAPER SIZE	A3
DWG NO.	GINK-xx-xx-SK-470-026-7.1			REV	01

CODE: G-CHA028









Stag Chair sketch

REVISIONS

		DRAWN BY	CHECKED BY	DATE
01	FIRST ISSUE	DW	WW	18/01/2017

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PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 G-CHA028 Stag Chair

DATE	18/01/2017	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A3	1:10	PAPER SIZE	A3
DWG NO	GINK-xx-xx-SK-470-031-7.1			REV	01

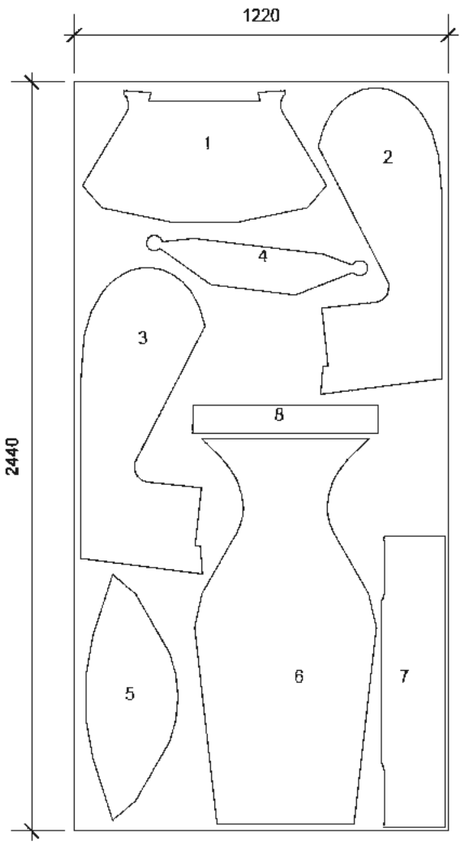
CODE: G-CHA022



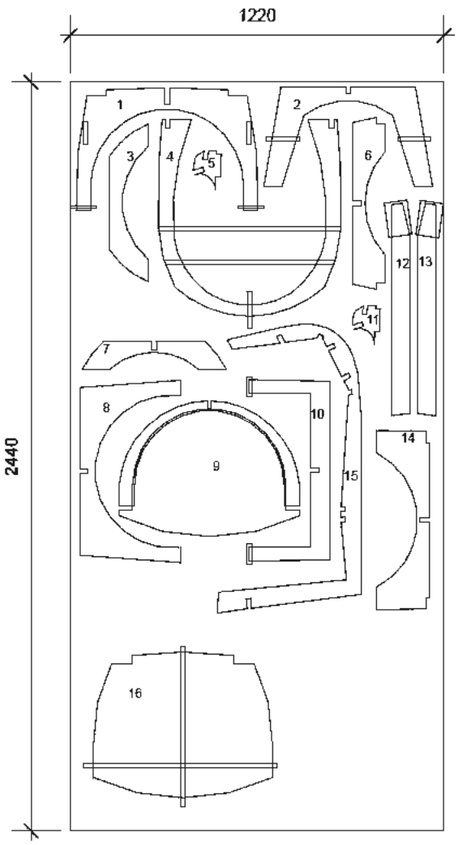
Sketch view of chair with skins and foam



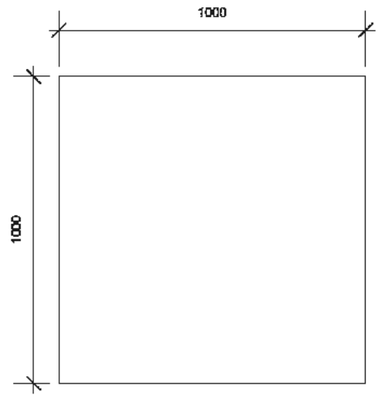
Sketch view of carcass assembled



ORKNEY CHAIR PROTOTYPE
Component set 1 (8 pieces)
Material: 3mm MDF
Surface area of components: 1.3sq.m



ORKNEY CHAIR PROTOTYPE
Component set 2 (16 pieces)
Material: 15mm plywood
Surface area of components: 1.1sq.m



ORKNEY CHAIR PROTOTYPE
Component set 3 (ponding confirmation of prototype)
Material: 25mm foam
Surface area of components: Approx. 1sq.m

REVISIONS
D1 FIRST ISSUE — DRAWN BY DW — CHECKED BY WW — DATE 27/05/2016

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PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

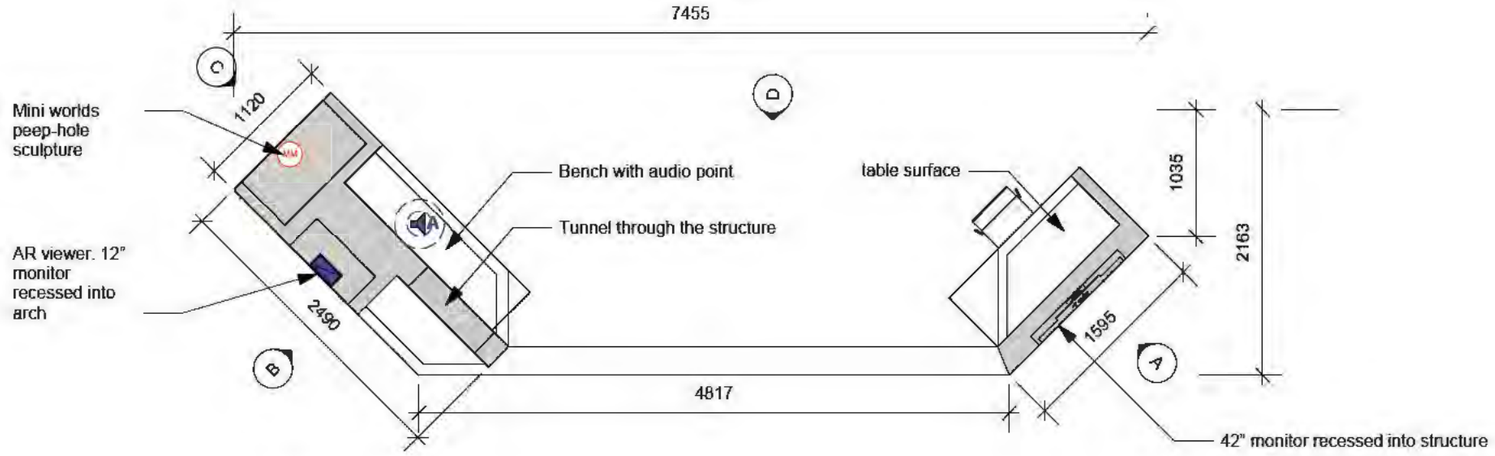
DRAWING
ATD 7.1 Orkney Chair

DATE	27/05/2016	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A3	1:20	PAPER SIZE	A3
DWG NO	GINK-xx-xx-SK-470-027-7.1			REV	01

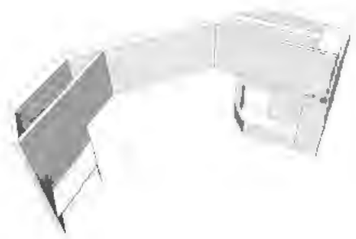
APPENDIX B

ARCHWAY DRAWINGS PROVIDED BY GINGKO AND WARREN DESIGNS

ARCH 1 - sheet 1



Plan
Scale: 1:50



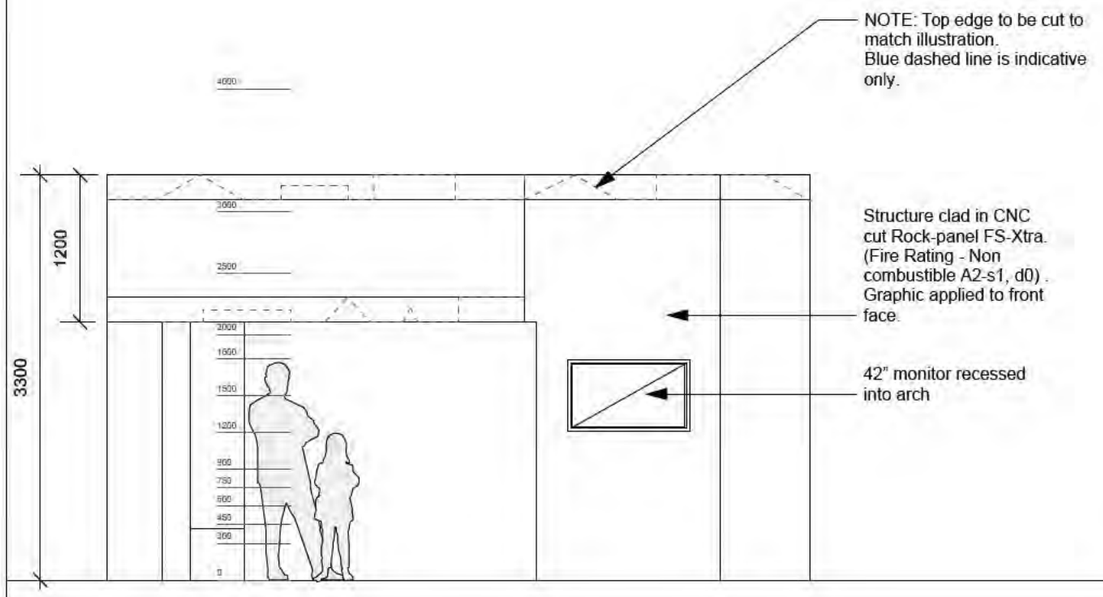
Arch 1 3D views



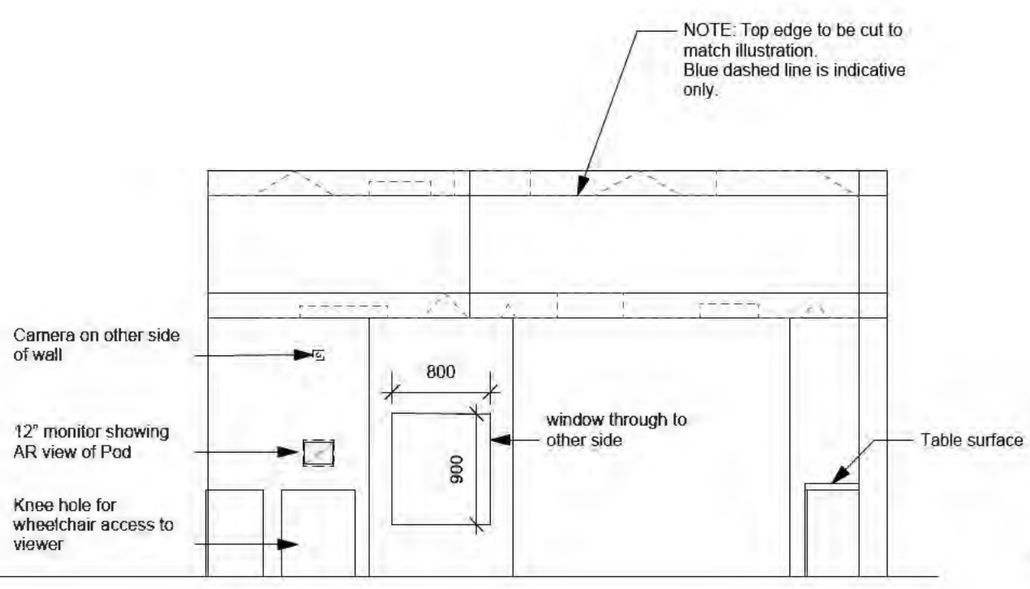




Illustration example



Elevation A



Elevation B

REVISIONS				
02	Arch size and materials updated	DRAWN BY	DW	27/05/2016
01	FIRST ISSUE	CHECKED BY	WW	03/02/2016

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PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

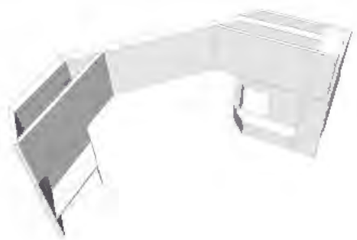
DRAWING
ATD 7.1 Enhancement Arch 1 sheet 1

DATE	11/02/2016	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A1	1:50	PAPER SIZE	A3
DWG NO	GINK-Z1-00-SK-470-001-7.1	REV	02		

ARCH 1 - sheet 2



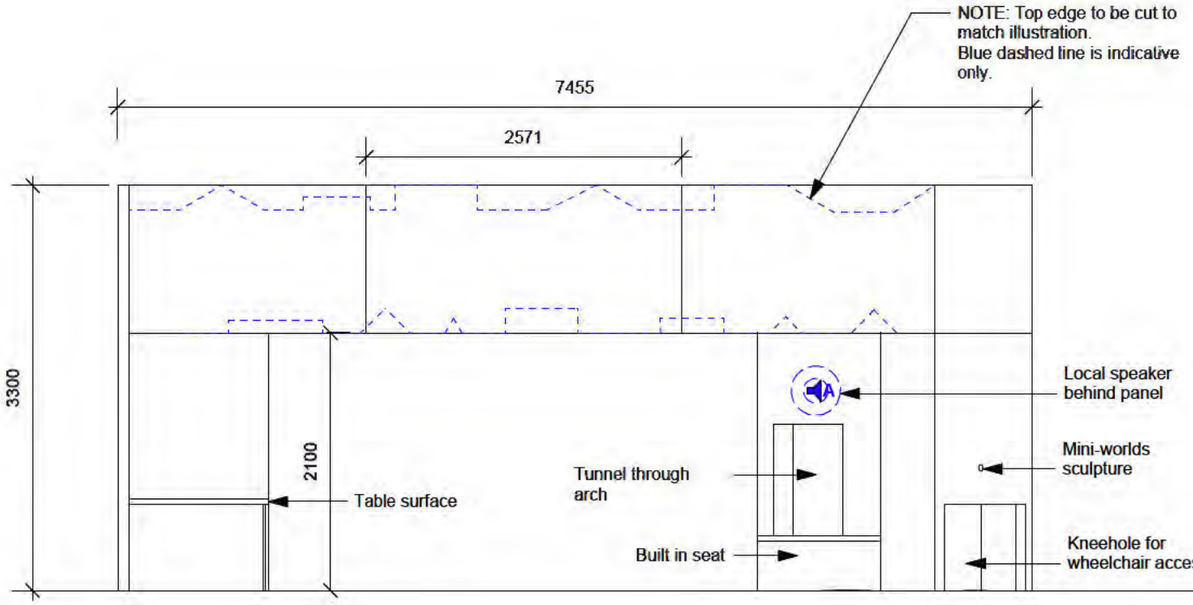
Illustration example



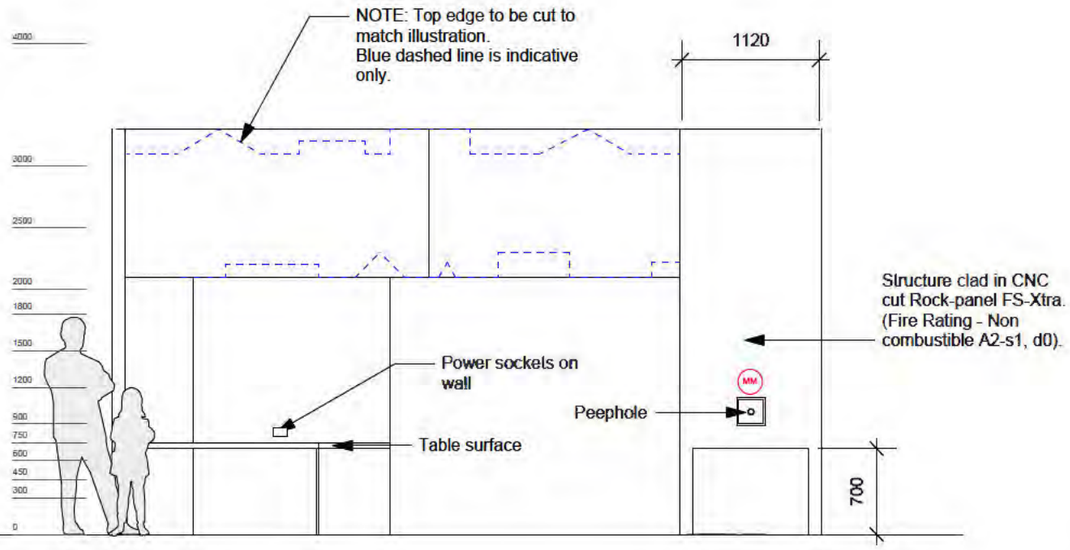




Arch 1 3D views



D Elevation
Scale: 1:50



C Elevation
Scale: 1:50

REVISIONS		DRAWN BY	CHECKED BY	
02	Arch dim and materials updated	DW	WW	27/05/2016
01	FIRST ISSUE	DW	WW	11/02/2016

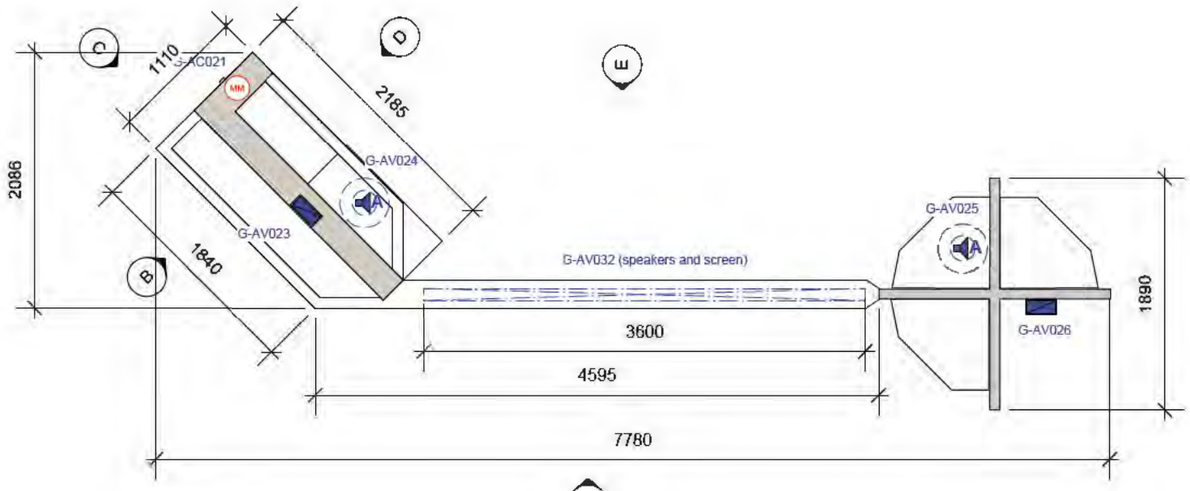
Daniel & William Warren

PROJECT: **ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH**
ATD 7.1
POD AND WAITING / PLAY SPACES

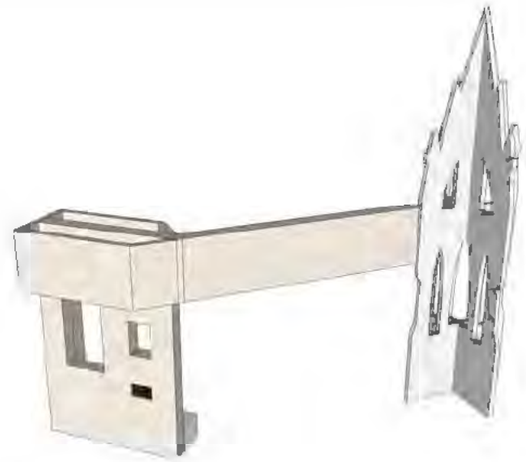
DRAWING: ATD 7.1 Enhancement Arch 1 sheet 2

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STATUS	DETAIL	SCALE @ A3	1:50	PAPER SIZE	A3
DWG NO.	GINK-Z1-00-SK-470-002-7.1			REV	02

ARCH 2 - sheet 1



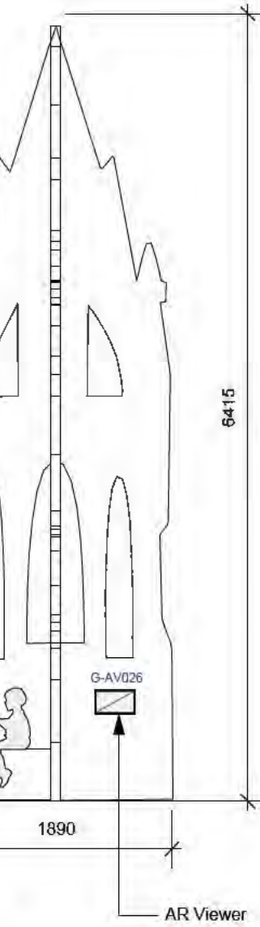
- Plan
Scale: 1:50



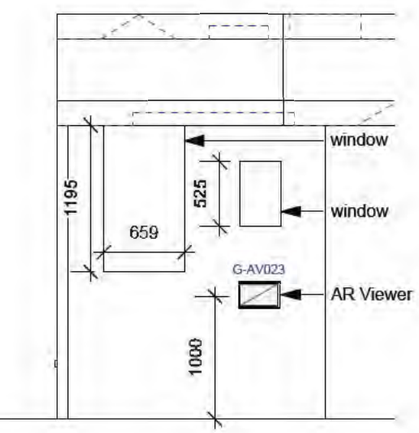
- Arch 2 3D views



- Illustration example



A Elevation
Scale: 1:50



B Elevation
Scale: 1:50

REVISIONS				
02	Arch, site and materials updated	DW	WW	27/05/2016
01	FIRST ISSUE	DW	WW	11/02/2016

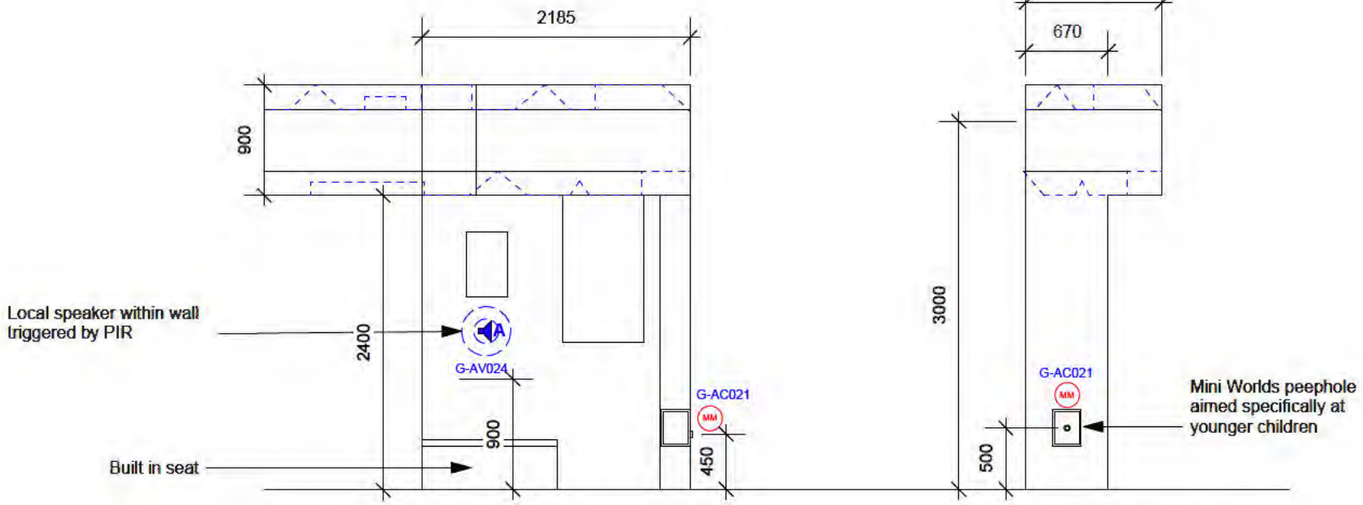
Daniel & William Warren

PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING
ATD 7.1 Enhancement Arch 2 sheet 1

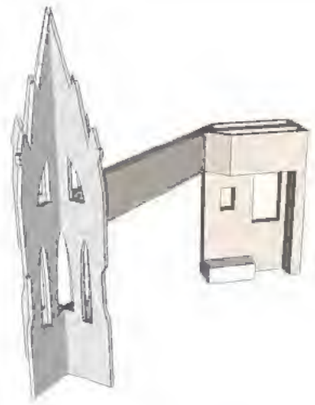
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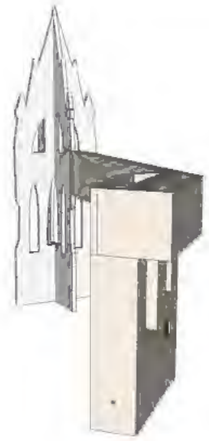
ARCH 2 - Sheet 2



D Elevation
Scale: 1:50

C Elevation
Scale: 1:50

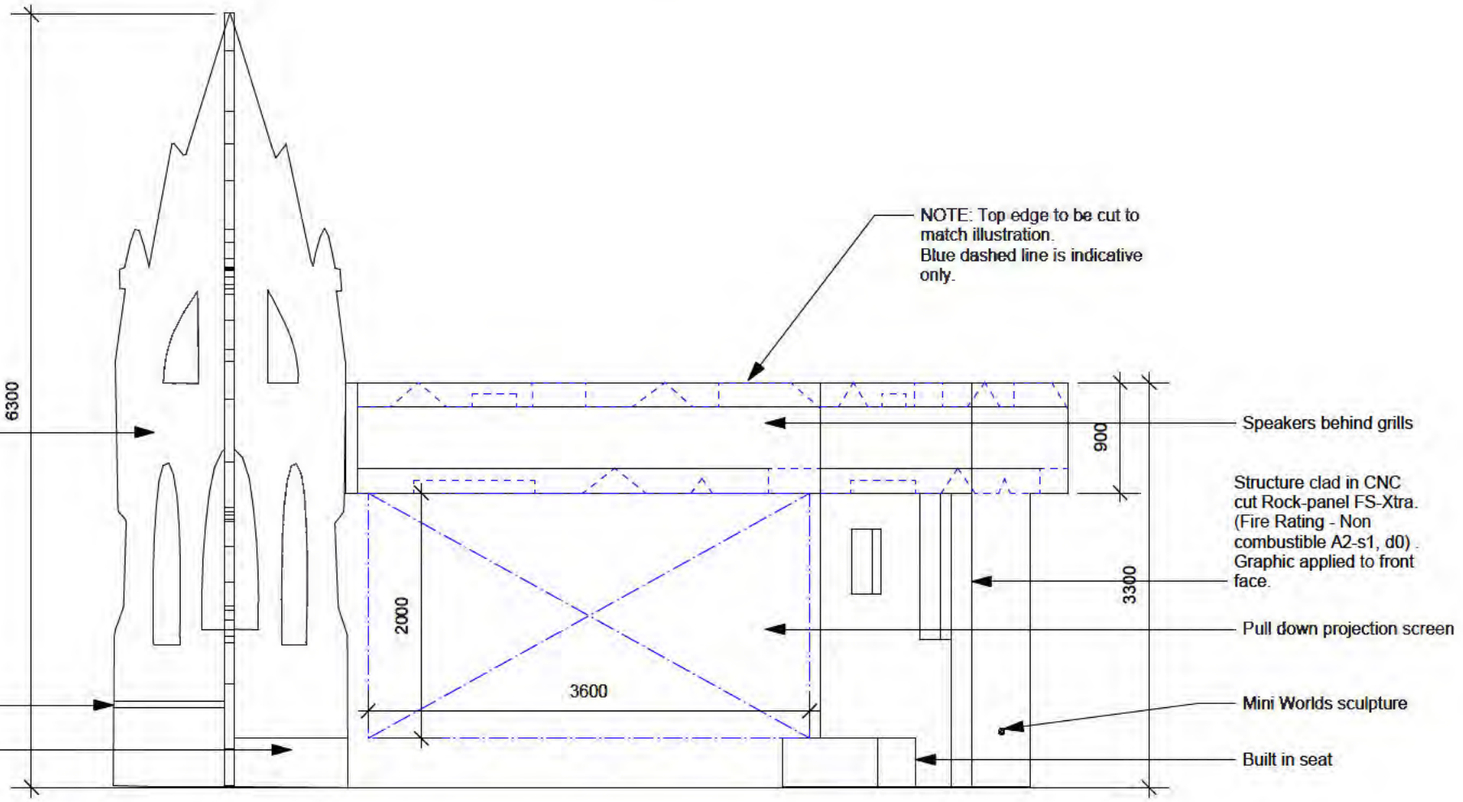




- Arch 3 3D views



- Illustration example



D Elevation
Scale: 1:50

REVISIONS			
02	Arch idea and materials updated	DRAWN BY: DW	27/05/2016
01	FIRST ISSUE	CHECKED BY: WW	11/02/2016

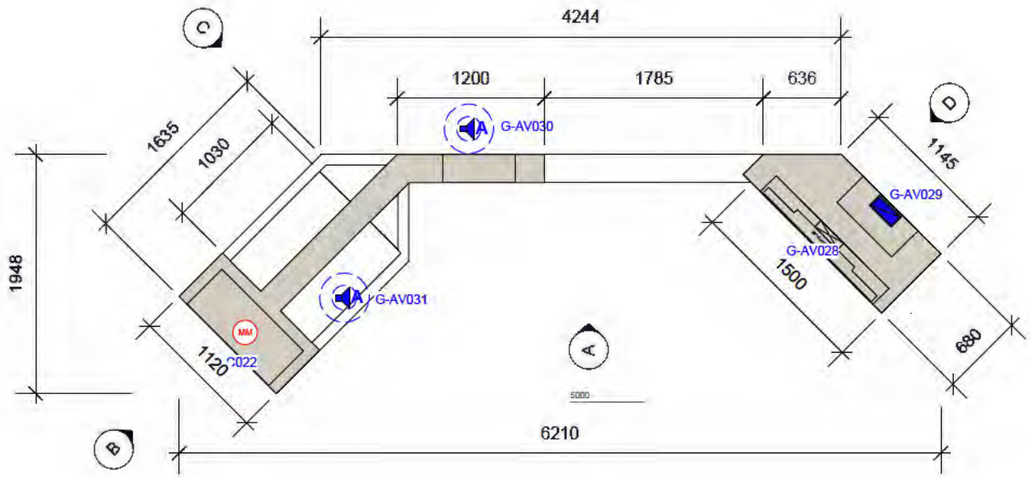
Daniel & William Warren

PROJECT: **ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH**
ATD 7.1
POD AND WAITING / PLAY SPACES

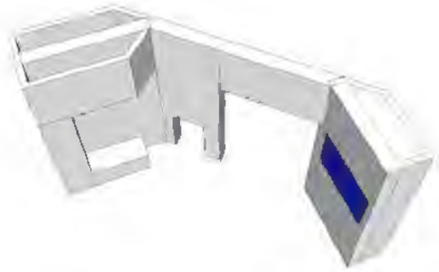
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STATUS	DETAIL	SCALE @ A3	1:50	PAPER SIZE	A3
DWG NO.	GINK-Z1-00-SK-470-004-7.1			REV	02

ARCH 3 Sheet 1



Plan
Scale: 1:50



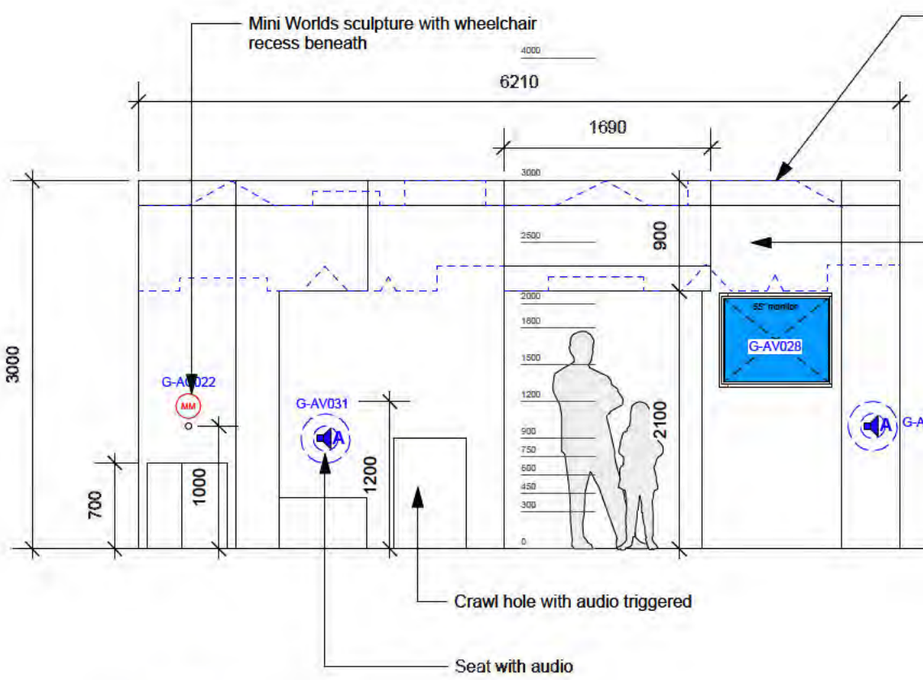


3D views to show basic form only. Refer to drawing GINK-Z1-00-SK-470-007-7.1-01 for details

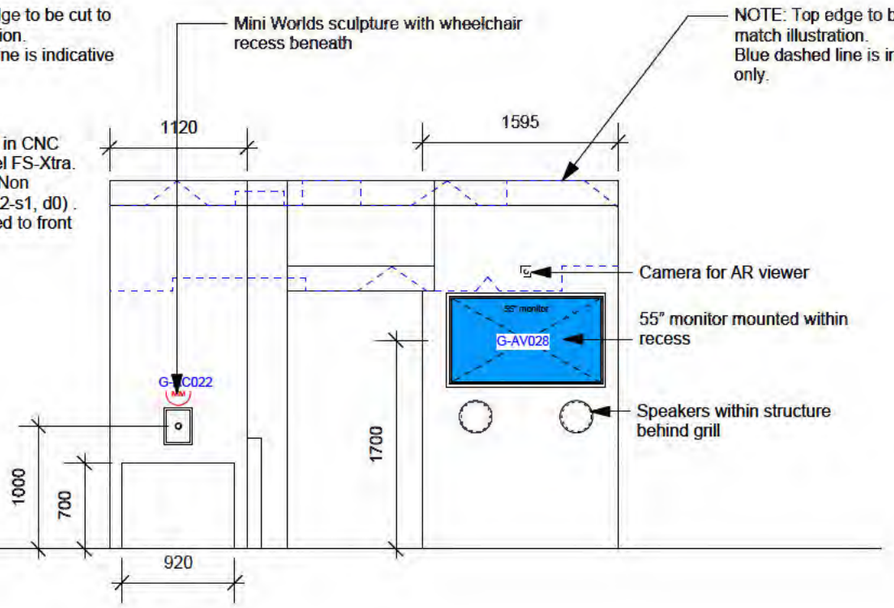
Arch 3 3D views



Illustration example



A Elevation
Scale: 1:50



B Elevation
Scale: 1:50

REVISIONS	02 Arch stes and materials updated — DRAWN BY DW, CHECKED BY WW, 27/05/2016 01 FIRST ISSUE — DRAWN BY DW, CHECKED BY WW, 11/02/2016
	Daniel & William Warren
PROJECT	ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH ATD 7.1 POD AND WAITING / PLAY SPACES
DRAWING	ATD 7.1 Enhancement Arch 3 sheet 1
DATE	11/02/2016
DRAWN BY	DW
CHECKED BY	WW
STATUS	DETAIL
SCALE @ A3	1:50
PAPER SIZE	A3
DWG NO.	GINK-Z1-00-SK-470-005-7.1
REV	02

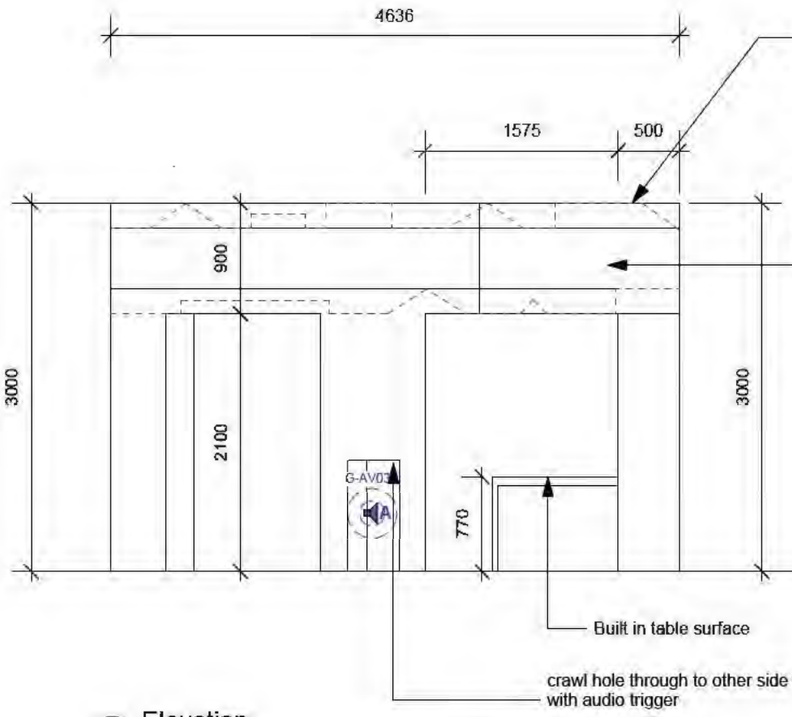
ARCH 3 Sheet 2



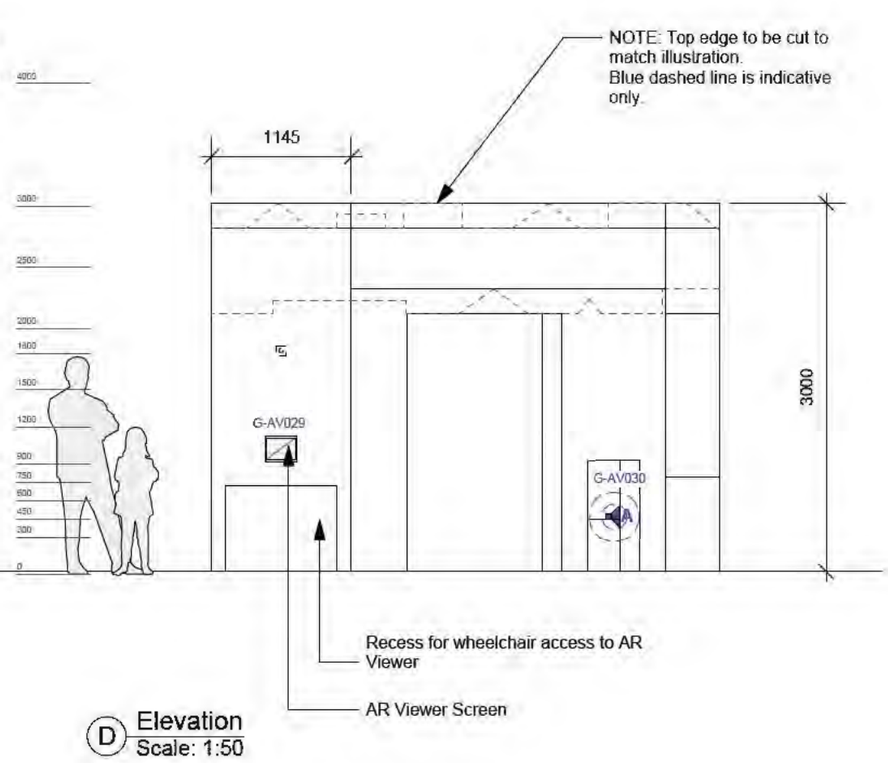
A Arch 3 3D views



B Illustration example



C Elevation
Scale: 1:50



D Elevation
Scale: 1:50

REVISIONS		DRAWN BY	CHECKED BY	
02	Arch plan and materials updated	DW	WW	27/05/2016
01	FIRST ISSUE	DW	WW	11/02/2016

Daniel & William Warren

PROJECT
ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH
ATD 7.1
POD AND WAITING / PLAY SPACES

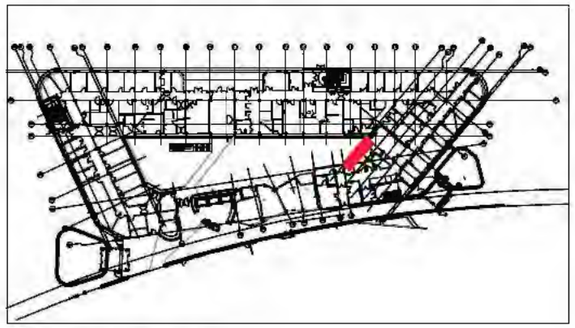
DRAWING
ATD 7.1 Enhancement Arch 3 sheet 2

DATE	11/02/2016	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A1	1:50	PAPER SIZE	A3
DWG NO	GINK-Z1-00-SK-470-001-7.1			REV	02

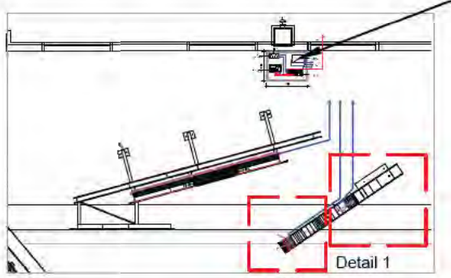
APPENDIX C

MODEL DRAGON AND CLOCK DRAWINGS PROVIDED BY GINGKO

Dragon Eye & Nostril



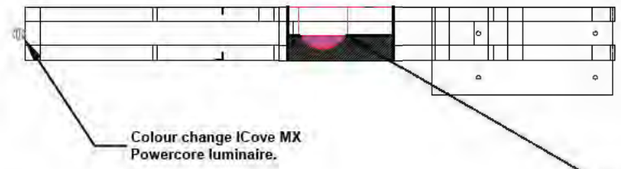
Plan view of Dragon location.



Plan view of Dragon 1:100 @ A3

Lighting controllers to be located in an dry, ventilated and accessible MDF box, by Elmwoods.

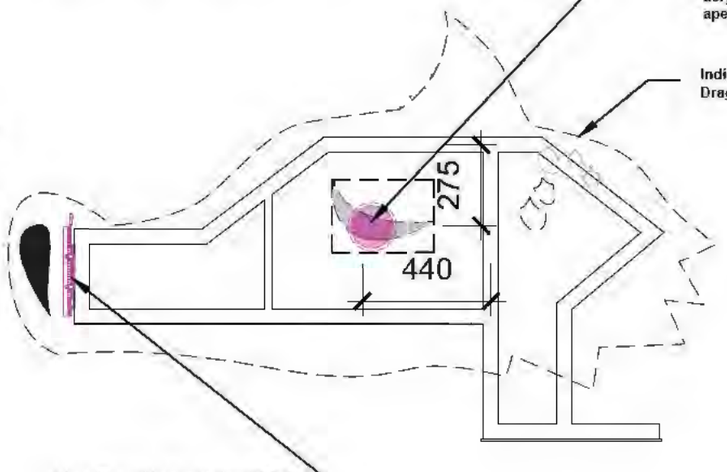
See dwg no. 7461 (63) 008 for more information.



Plan View of Dragon's Head 1:20 @ A3

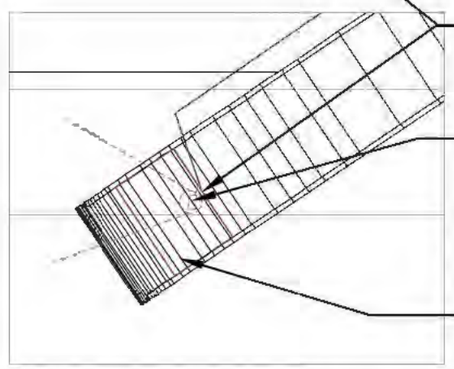
1no. Philips Archipoint Ø164mm positioned within eye cutout. Domed lens to protrude out from eye through hole cutout in acrylic piece to eye aperture.

Indicative position for Dragon head.



Elevation of Dragon's Eye 1:20 @ A3

Mounting board to fix light fittings to steel structure by others.

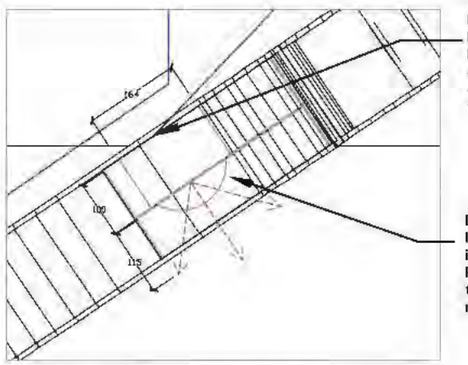


Color Kinetics Powercore dynamic colour change luminaire mounted to wash light to internal surface of nostril.

Nostril aperture to have depth to it to allow light to reflect around internal built out surfaces. Preferable white finish to maximize light effect.

Detail 2. Plan view of Dragon Nostril 1:10 @ A3

Archipoint fixed to back board of Dragon head. Frame work to be built out with a circular cutout to expose domed lens of the luminaire.



Depth to be allowed for light to reflect within the internal eye socket. Preferable white finish to this area to allow for maximum light effect.

Detail 1. Plan view of Dragon Eye 1:10 @ A3

DESIGN COPYRIGHT
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Not to be distributed, published, copied or edited without prior written consent. Confidential information.

ALL DIMENSIONS TO BE CONFIRMED BY WARREN DESIGN.

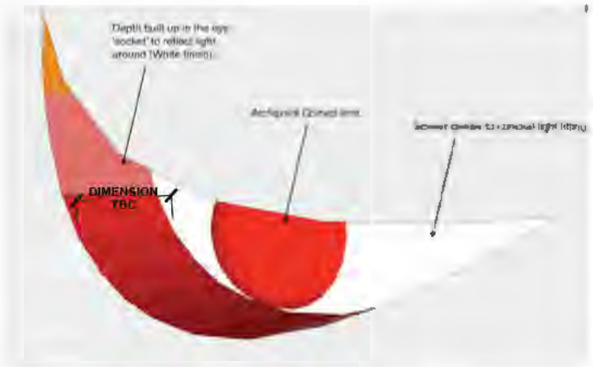
See dwg no. 7461 (63) 008 for set-out information.

See dwg no. 7461 (66) 050 for control schematic / wiring information.

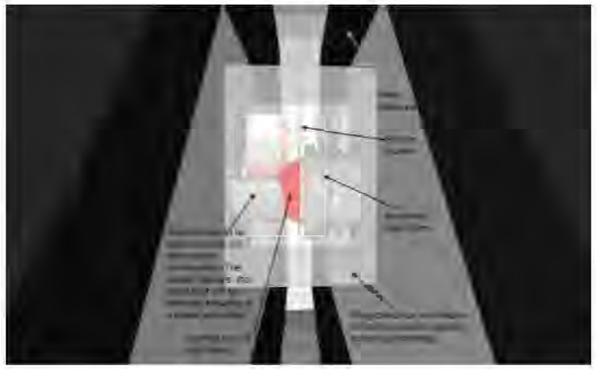
INSTALLATION:
"Contractor to be appointed" Installation by specialist contractor. Installation method, process and programme, to be agreed with Ginkgo Projects.



Area location visual of lighting details



External view of Dragon eye.



Archipoint as Dragon Eye in situation.

GENERAL INSTALLATION NOTES:

1.0. All electrical work to be carried out in accordance with the latest edition of the Institute of Electrical Engineers Regulations and to the approval of the Local Authority. The electrical infrastructure installation shall be designed, constructed, installed and tested by the contractor in full compliance with IET 17th Edition BS7671:2008 incorporating all additional amendments to satisfy current requirements.
1.1.The electrical installation shall be carried out by a NICEIC approved or Select registered contractor.
1.2.The contractor shall be deemed to have visited the site to familiarise themselves with the extent of the works, any variation claims arising due to lack of site knowledge will not be considered valid.
1.3.Generic legend only. Please refer to specification documentation for more specific luminaire detail.
1.4. Do not scale. Final set-out to be coordinated and confirmed by principal designers on site to be coordinated with other building services and furniture layouts.
1.5. Contractor shall be responsible for providing all necessary equipment for safe installation not limited to but including all access equipment such as ladders, scaffold towers, lift, etc. for working at height.
1.6. Contractor should conduct a Health & Safety review before works commence, with written Risk Assessment highlighting any risks and Method Statements to mitigate such risks presentable during the construction phase of works.
1.7. Contractor to consult with manufacturers' installation documents prior to installation commencing to satisfy themselves of wiring requirements.
Quantities of drivers shown on drawing are for illustrative guidance only. For exact quantities and technical information refer to luminaire specification schedule and manufacturer installation for more information.
All testing and commissioning will be carried out in accordance with the current code of practice. All test certificates and commissioning reports will be included in the operating and maintenance manual.
1.8. Fire safety integrity between floors to meet current Building Regulations and Local Authority requirements. Integrity to be maintained to 60 minutes as per current guidelines by approved manufacturers fire rated product to be installed on all recessed fixtures installed in ceilings deemed a fire barrier.
1.9. If in doubt, please ask, contact the lighting designer immediately.

DESIGN AND SPECIFICATION NOTES:

2.0. Dimensions noted on lighting plan as illustrative guidelines. All should be checked and coordinated on site to suit actual room versus layout site sizes. Luminaire symbol may not be to scale. Any discrepancy between written dimension and site dimensions must be reported to lighting designer before cutouts and works begin.
2.1. This drawing should be read in line with supporting documents including written luminaire specification schedule, electrical infrastructure drawings (by others) and relevant documentation. Quantities shown as courtesy only, final quantities and part numbers must be verified and confirmed by manufacturer/supplier before order is placed.
2.2. Recess depths assumed to be a minimum of 150mm available throughout, if construction restricts use of recessed products as per this layout please advise ASAP to designer for review.
2.3. Final finishes to be confirmed in line with interior scheme to ensure the luminaire finishes are correct and there is no conflict with other specified material finishes.
2.4. All light fittings and accessories should be inspected by contractor within 24 hours of receiving the equipment. Any flaws, failures or damages should be reported immediately to the manufacturer or supplier to arrange replacements and/or testing of relevant fittings.
2.5. The contractor will ensure that all light fittings and accessories are thoroughly protected to prevent damage during the works as any flaws noticed during the course of the contract shall be rectified at no extra cost to the end client. The contractor assumes responsibility once the manufacturer/supplier has delivered the goods for the condition of the goods.

HEALTH AND SAFETY NOTES:

3.0. Health and safety to be assessed on a project by project basis. All designers and contractors must take responsibility for individual areas and carry out checks to satisfy themselves of requirements to meet CDM 2015.
3.1. Contractor will provide a Risk Assessment and Methods Statements prior to work commencing.
3.2. The aims and objectives of the design process with the intention of 'designing out' any unreasonable risk, both for installation, and maintenance of the the design scheme. Where a risk may be present either during installation, or maintenance the designer will report this to the principal designer and end client.
3.3. The Lighting Designer does not take on the sole role responsibility of Health & Safety but will provide information on any particular risk associated with the design to feed into the larger design and construction team on behalf of the client. It is understood the client will either have a designated CDM coordinator appointed to the design team, or the Principal Designer or Main Contractor will undertake a Risk assessment and provide Method Statements before works commence to ensure compliance with CDM 2015.

Rev.	Date.	Des.	Work.
-	30.08.17	SJ	DRAFT
1	04.09.17	SJ	DRAFT
2	08.09.17	SJ	DRAFT
3	19.09.17	SJ	Revisions following design meeting. Combined Dragon Ey & Dragon Nostril drawings.
4	10.11.17	SJ	Revisions following design meeting.
5	23.05.18	SJ	FOR INFORMATION

Note:
1. Do not scale.
2. All dimensions to be checked on site prior to the start of any work and any discrepancies notified in writing.
3. All electrical work to be carried out in accordance with the latest edition of the Institute of Electrical Engineers Regulations and to the approval of the Local Authority.
4. All revisions shown in red cloud.

Project Title:
The Royal Hospital for Children and Young People, Edinburgh

Client:
Ginkgo Projects

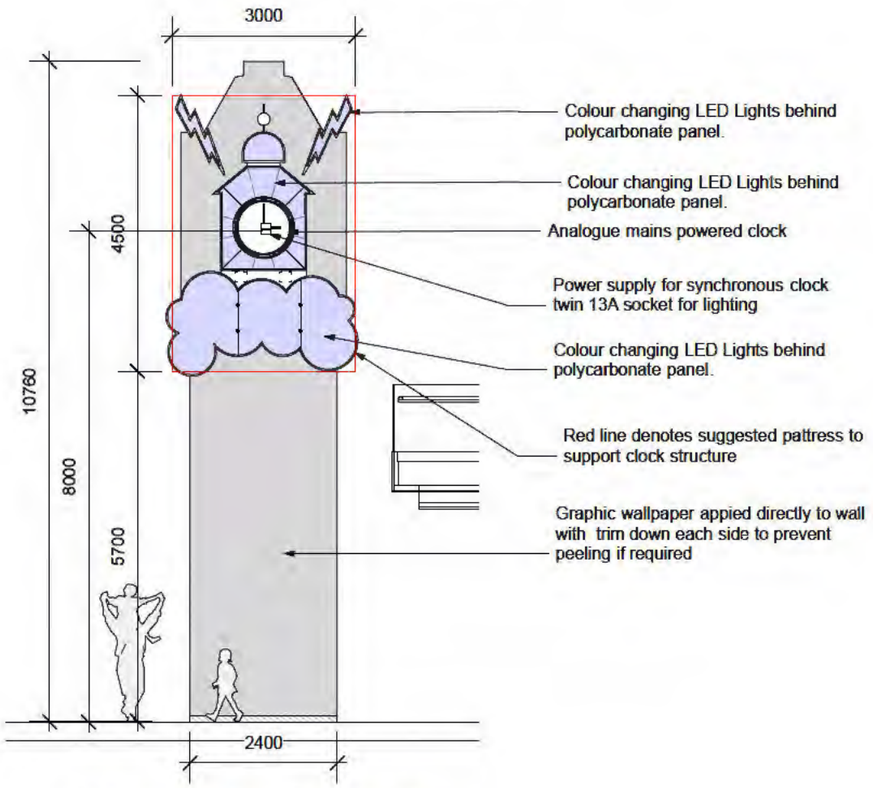
Drawing Title:
Lighting Detail:
Dragon Eye & Nostril

Status:
FOR INFORMATION

Date: **30.06.17** Scale: **NTS**
Drawing: **SJ** Checked: **SF**

Drw No. **7461 (63) 002** Rev **5**

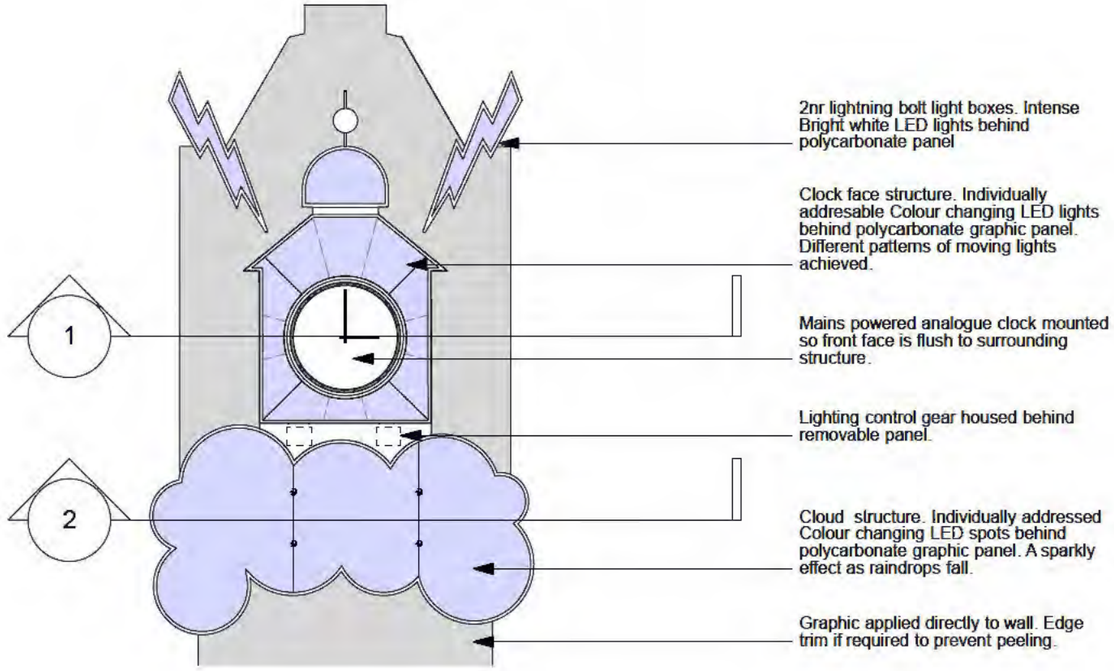
LightMedium
Studio: 56 Constitution Street Edinburgh EH6 6RS
Tel: +44 (0)7966561918
Email: info@lightmedium.co.uk
Internet: www.lightmedium.co.uk



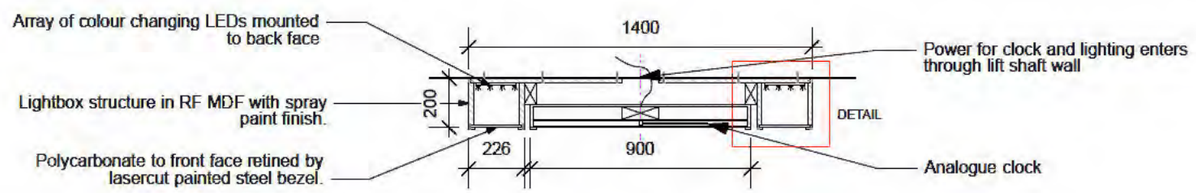
- Pattress to support 3D structure



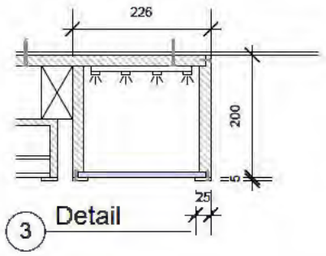
- 3D view of clocktower



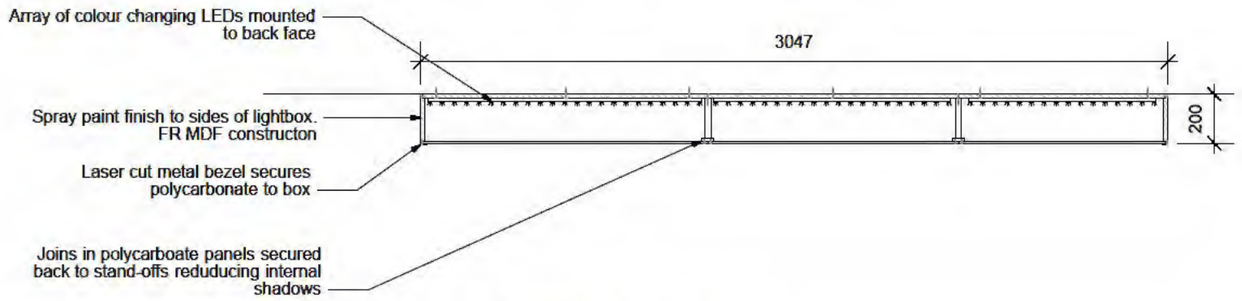
- Detail showing lighting



1 Section through clock



3 Detail



2 Section through rain cloud

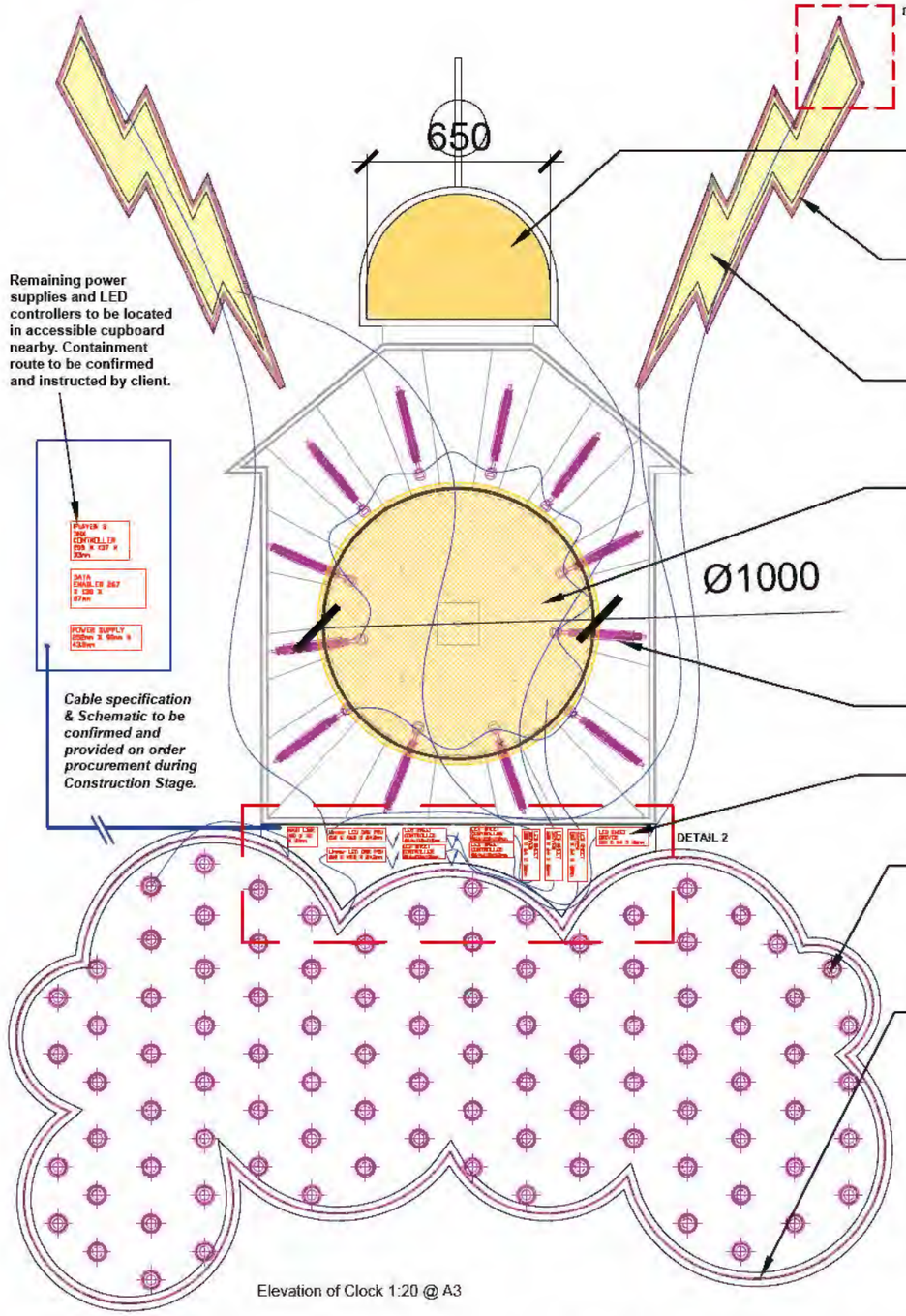
REVISIONS		DRAWN BY	CHECKED BY	DATE
02	Construction of clock updated	DW	WW	07/04/2017
01	FIRST ISSUE	DW	WW	13/06/2016

Warren Design Ltd

PROJECT: **ROYAL HOSPITAL FOR SICK CHILDREN EDINBURGH**
ATD 7.1
POD AND WAITING / PLAY SPACES

DRAWING: ATD 7.1 Enhancement Clocktower

DATE	13/06/2016	DRAWN BY	DW	CHECKED BY	WW
STATUS	DETAIL	SCALE @ A3	N/A	PAPER SIZE	A3
DWG NO	GINK-Z1-00-SK-470-013-7.1			REV	02



Elevation of Clock 1:20 @ A3

ALL DIMENSIONS TO BE CONFIRMED BY WARREN DESIGN.

8mm custom LED Light sheet mounted directly behind opal acrylic sheet 3000K warm white.

10mm flexible linear LED mounted to perimeter of lightning bolts. Cool white. Approx 5m meters allowance to each lightning bolt.

8mm custom LED Light Sheet mounted directly behind opal acrylic sheet. 6500K Cool White.

8mm custom circular LED Light Sheet Ø1000mm mounted to Di-bond (by others) directly behind opal acrylic sheet. 3000K Warm White. Exact size to be confirmed by Warren Design.

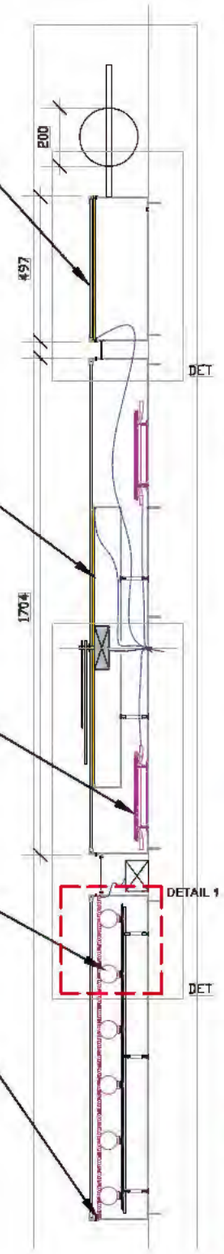
Color Kinetics Powercore colour changing luminaires mounted behind 12 White striped opal acrylic.

Power supplies and LED controllers mounted behind removable panel. Access to be confirmed by Elmwoods.

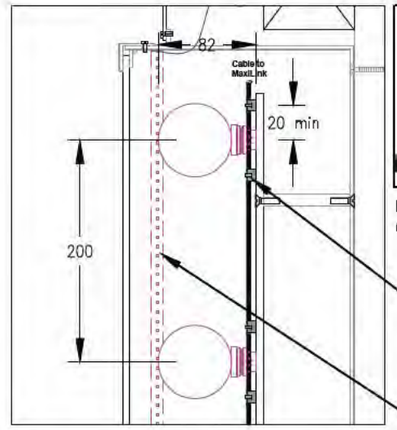
MaxiLED LED light globes evenly distributed behind opal acrylic sheet mounted to Di-bond panel (by others).

10mm flexible linear LED mounted to perimeter of lightning bolts. Warm white. Approx 10 meters allowance to perimeter.

INSTALLATION:
"Contractor to be appointed" Installation by specialist contractor. Installation method, process and programme, to be agreed with Ginkgo Projects.



Section of Clock 1:20 @ A3



DETAIL 1. Section of MaxiLED Globes 1:5 @ A3



MaxiLED luminaire reference image.

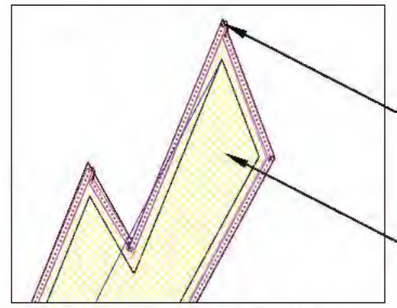
MaxiLED light globe mounted to Di-bond panel using fixing clips and cable ties supplied by Manufacturer.

Flexible linear LED mounted to cloud surround.

DESIGN COPYRIGHT
LIGHTMEDIUM © 2017
Not to be distributed, published, copied or edited without prior written consent. Confidential information.



Clock Tower Elevation Overview

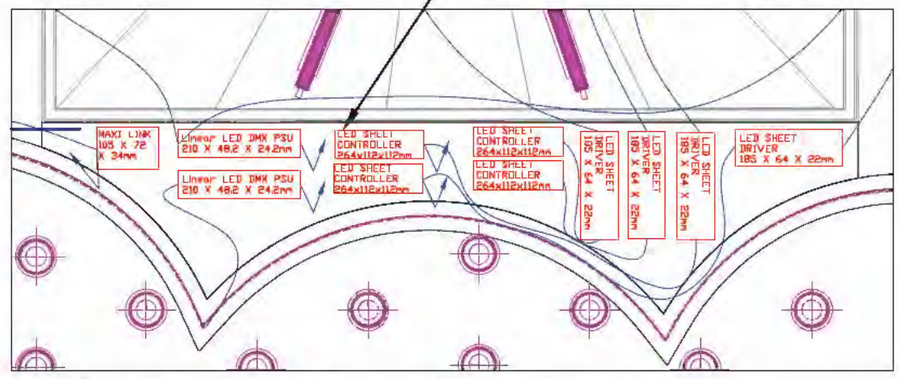


DETAIL 3. Section of Lightning bolt 1:10 @ A3

Soldering required to make a low voltage electrical connection between LED tape lengths.

Custom 8mm LED Light sheet.

Indicative layout for LED drivers and controllers mounted behind removable panel and secured in place. Cable clearance to be accounted for when installing and wiring. Remaining controllers and drivers to be stored in accessible cupboard near by.



DETAIL 2. Section of LED Drivers & Controllers mounted in accessible panel 1:10 @ A3

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Rev.	Date.	Des.	Work.
-	30.06.17	SJ	DRAFT
1	06.09.17	SJ	DRAFT
2	27.09.17	SJ	Revisions following updated design.
3	09.11.17	SJ	Revisions following design meeting.

Note:
1. Do not scale.
2. All dimensions to be checked on site prior to the start of any work and any discrepancies notified in writing.
3. All electrical work to be carried out in accordance with the latest edition of the Institute of Electrical Engineers Regulations and to the approval of the Local Authority.
4. All revisions shown in red cloud.

Project Title:
The Royal Hospital for Children and Young People, Edinburgh

Client:
Ginkgo Projects

Drawing Title:
Lighting Detail:
Clock Tower

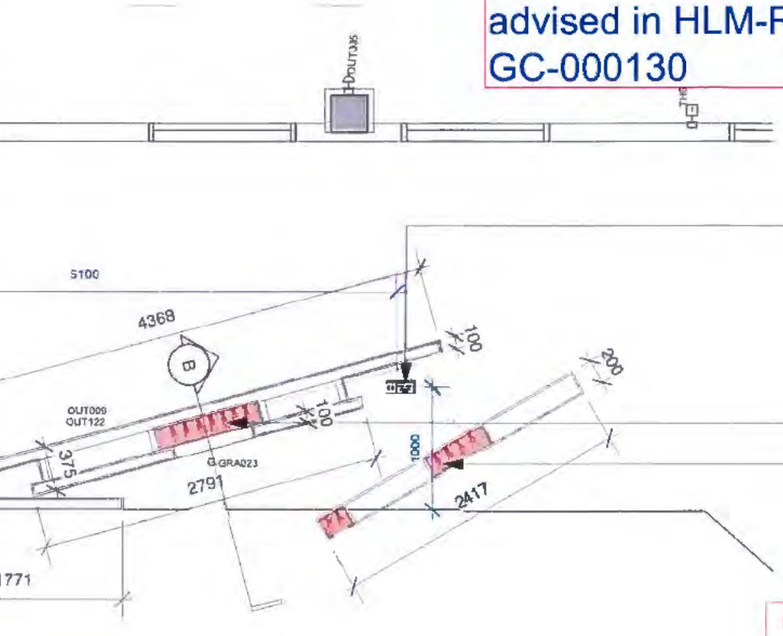
Status:
PROPOSED

Date: **30.06.17**
Scale: **NTS @ A3**
Drawing: **SJ**
Checked: **SF**

Drw No. **7461 (63) 004**
Rev. **3**

LightMedium
Studio: 55 Constitution Street Edinburgh EH6 6RS
Tel: +44 (0)7966561916
Email: info@lightmedium.co.uk
Internet: www.lightmedium.co.uk

Please confirm all materials used meet the fire rating requirements as previously advised in HLM-RFI-000354 & WSP UK-GC-000130



Sockets positioned behind door of ledge. Built to outer form.
Setting out dimensions shown in blue.

Lighting behind castle door.

Lighting within head

Brookfield MULTIPLEX | BM

Contractor Document Review
RHSC & DCN Edinburgh

A ☐ No Comment
B ☑ Noted subject to comments- revise and resubmit within 7 business days
C ☐ Rejected - revise and resubmit within 7 business days

Name: [illegible] Date: 14/03

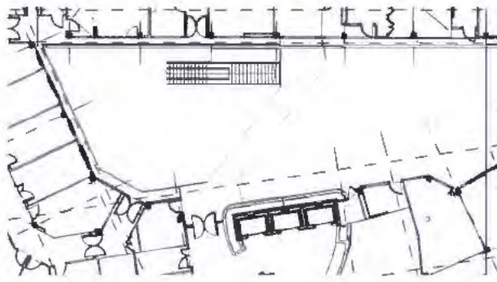
Brookfield Multiplex review status does not absolve the consultant of its obligations with regard to coordination and conformity with the other Consultants and specialist Subcontractors design and the project Agreements, Employer's Requirements and the cost plan and for ensuring that there are no ambiguities, discrepancies, inconsistencies or omissions within this document or between it and any other design documents.

HLM DRAWING REVIEW STATUS

A : NO COMMENTS
B : COMMENTS AS ANNOTATED/ ATTACHED
C : UNACCEPTABLE RE-SUBMIT

HLM Architects are unable to approve specialised drawings. The Architect's review of this drawing is for the purpose of ascertaining conformity with the basic design concept, profiles and general arrangement only. Any comments are not necessarily exhaustive at this time and shall not be construed to mean that the Architect accepts the detailed design inherent in the drawing, the responsibility for which remains with the originator, who is responsible for any errors or omissions, and for meeting all the requirements of the Contract Documents.

Received	Returned	Initial
07.02.18	14.02.18	JD



Pod Plan

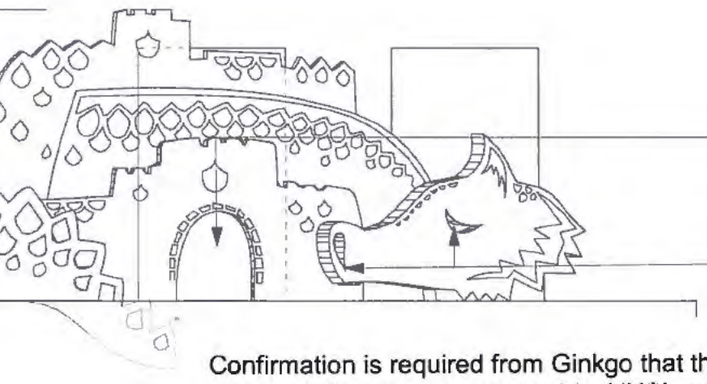


3D Views



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LIGHTING UNDER DEVELOPMENT



Colour changing LED strip lights mounted BEHIND the first layer and angled so it shines onto the back layer.

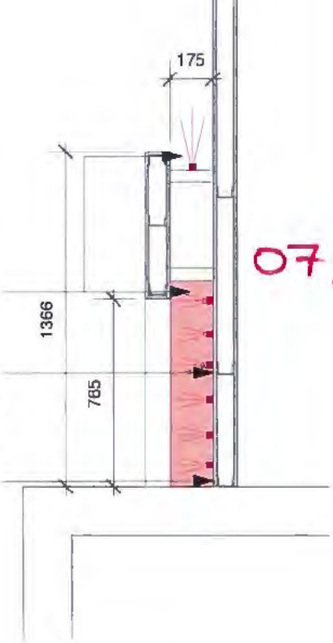
Lighting within nostril and eye

Lighting shines onto back face

Metal studding framework clad in plasterboard/non-combustible material. Graphic applied to front and rear face.

Structure bolted to ledge

painted onto wall of building



Section B
Scale: 1:25

Elev
Scale

07/03/18

Confirmation is required from Ginkgo that the proposals have been approved by NHSL and BYES. Please refer to EWN MPX-EW-001201issued by Liane Edwards on 5th December 2017.

TUV SUD
DRAWING REVIEW STATUS

☑ A : NO COMMENTS
B : COMMENTS AS ANNOTATED/ ATTACHED
C : UNACCEPTABLE RE-SUBMIT

THIS DOCUMENT HAS BEEN REVIEWED FOR BUILDING SERVICES COMPLIANCE WITH THE DESIGN INTENT.
ANY COMMENTS ARE NOT NECESSARILY EXHAUSTIVE AT THIS TIME AND SHALL NOT BE CONSTRUED TO MEAN THAT THE BUILDING SERVICES ENGINEER ACCEPTS THE DETAILED DESIGN INHERENT IN THE DRAWING, THE RESPONSIBILITY FOR WHICH REMAINS WITH THE ORIGINATOR, WHO IS RESPONSIBLE FOR ANY ERRORS OR OMMISSIONS, AND FOR MEETING ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS

RECEIVED	RETURNED	INITIAL
15.02.18	20.02.18	PC

Appendix K

DESIGN NOTE 11 CLUSTERING

The Challenge:

In order to contain a fire in its early stages fire hazard rooms are recommended to have enclosure by walls providing short fire resistance duration.
It is proposed that where fire hazard rooms are grouped together then they would be treated as a cluster of rooms and walls between the rooms are unprotected only their perimeter is fire rated

The Concept:

Enclosure of individual fire hazard rooms can cause functionality / maintenance issues due to provision of fire rated walls and fire protection of services passing between adjoining rooms.
The provision of clusters will still ensure that fire and smoke are inhibited from spreading beyond the fire enclosure of origin until any occupants have had the time to leave that compartment and any fire containment measures have been initiated.

Proposed solution:

Where two or more fire hazard room are adjacent, then the enclosure of the rooms (the cluster) will be treated as a fire hazard room.
Patient-access fire hazard rooms are not to be regarded as part of a cluster.
Additionally, those fire hazard rooms which are I.T node rooms, labs or workshops will not be regarded as a cluster.

Guidance
The Non-domestic Technical Handbook has been used as design guidance together with SHTM 81.
SHTM 81 document provides recommendations and guidance, additional to the statutory requirements of the Building (Scotland) Regulations 2004, as amended. In doing so, it recognises the need for a higher standard of fire safety for the protection of patients from fire in the in-patient care areas of hospitals, and other treatment facilities. The guidance in the document is supplementary to, and must be read in conjunction with, the 'Non-domestic technical handbook'.
The guidance recognises that whilst the incidence of fire in hospitals is low compared to that in other occupancy types, the consequences of fire in a hospital may be especially serious because of the difficulties and dangers associated with the emergency evacuation of patients, some of who may be highly dependent on life support equipment and staff assistance etc.

Fire Hazard Rooms
In order to contain a fire in its early stages, the following rooms are considered to be hazardous and the guidance recommends enclosure by walls providing short fire resistance duration:

Fire Hazard Rooms		
Chemical stores	Cleaners' rooms	Clothes storage
Day rooms with a floor area greater than 20m^2	Smoking rooms	Disposal rooms
Laboratories	Lift motor rooms	Linen stores
*Bedrooms (elderly and mental health / learning difficulties occupancy)	Kitchens	Laundry rooms
Staff changing and locker rooms	Store rooms	X-ray film and record stores

*This guidance is based upon open ward type facilities where there could be a large number of beds within one open plan room. For the proposed design where the majority of beds are located within single rooms there is a much greater degree of smoke separation between beds than in a traditional open plan ward. Whilst these walls will not be designed as fire compartmentation it is considered that a degree of smoke separation will be provided by the rooms which will greatly assist in protecting occupants in the early stages of an evacuation which would be adequate for wards not specifically designated for elderly people, or those suffering from mental illnesses or learning difficulties.
It is also proposed that the following rooms are to be risk assessed with the Board and the approval authorities to clarify the need for enclosure:

- IT Comms rooms (SER's) / Data centre (possible medium duration to protect equipment);
- Sluice rooms;
- Dirty and clean utility rooms;
- DSR rooms.

It has been proposed that rooms containing I.T equipment (i.e. I.T node rooms) as well as workshops and labs will remain as individual fire hazard rooms with other fire hazard rooms (other than those intended for sleeping) are clustered.

Cluster Approach
The intention of sub-compartmentation and the enclosure of fire hazard rooms is to provide physical barriers to a fire and to limit the development of a fire to the room or space of fire origin.
The threat is from a fire in a fire hazard rooms spreading to adjoining patient areas and not the threat of spread between fire hazard rooms therefore where two or more fire hazard room are adjacent, then the enclosure of the rooms (the cluster) will be treated as a fire hazard room. Patient-access fire hazard rooms are not to be regarded as part of a cluster.
The combination of active and passive fire protection should afford staff and occupants the additional time necessary to evacuate the building safely.

Appendix L

ZONE A

Multiplex Construction Europe

RHSC & DCN

Change of Evacuation to Zone 2



70003278
MAY 2018

CONFIDENTIAL

Multiplex Construction Europe

RHSC & DCN

Change of Evacuation to Zone 2

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70003278
OUR REF. NO. 70003278

DATE: MAY 2018

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft to Client	Issue	Update following Board Comments	Update following Building Control and SFRS Comments
Date	17/10/2017	19/10/2017	09/11/2017	06/03/2018
Prepared by	[redacted]	[redacted]	[redacted]	[redacted]
Signature				
Checked by		[redacted]	[redacted]	[redacted]
Signature				
Authorised by		[redacted]	[redacted]	[redacted]
Signature				
Project number	70003278-300	70003278-300	70003278-300	70003278-300

Issue/revision	Revision 4			
Remarks	Update following compartment line change			
Date	11/05/2018			
Prepared by	[redacted]			
Signature				
Checked by	[redacted]			
Signature				
Authorised by	[redacted]			
Signature				
Project number	70003278-300			

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1 INTRODUCTION

1.1 GENERAL

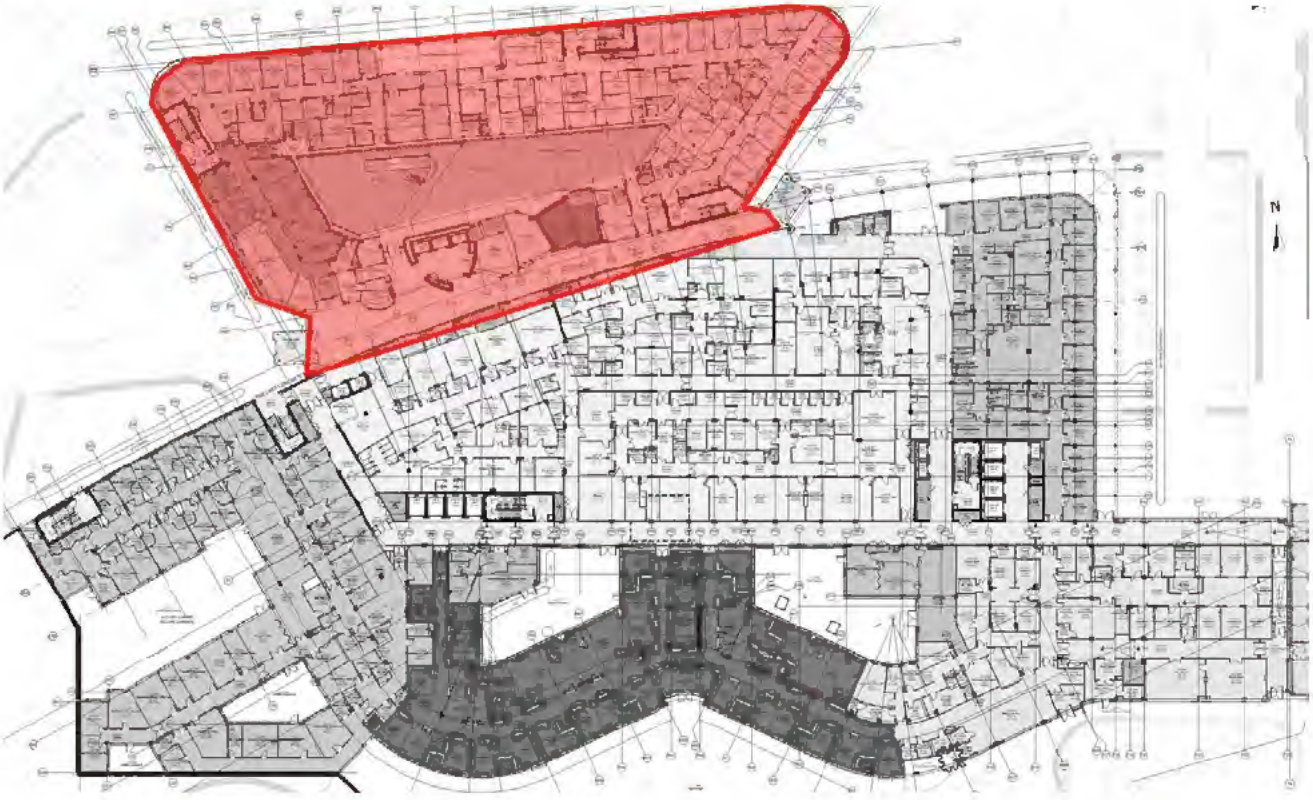
The Royal Hospital for Sick Children and Department of Clinical Neuroscience (RHSC & DCN) is a new built hospital located within the same site as The Royal Infirmary of Edinburgh, Little France Campus.

The building comprises 6 storeys from Basement Level through to Fourth Floor.

The building has a large atrium adjacent to the main entrance area that extends from Ground Floor through to the Third Floor. For the purposes of this report, the atrium is referred to as the Pod.

The building is separated into two distinct parts: 1. acute hospital accommodation, and 2. a block dedicated to out-patients, family hotel accommodation and education centre for family and staff, and staff offices. The latter block is the focus of this report and is shown in Red in Figure 1. For the purposes of this report, it will be referred to as Zone 2.

Figure 1 - Layout



WSP are the fire engineers on the project and have provided a fire strategy report and relevant supporting documents such as CFD Report and design notes. As part of the fire strategy the hospital evacuation for the most part is as per the Non-Domestic Technical Handbook (NDTH), i.e. progressive horizontal evacuation. However, for Zone 2, as the occupancy of this area is outpatients, family hotel accommodation and offices, the evacuation is simultaneous.

The Board (NHS Lothian) have considered that it would be more operationally effective to change the evacuation of Zone 2 to be more akin to the remainder of the hospital, i.e. progressive horizontal evacuation. Through Project Co. WSP have been asked to review the Board requirements and establish its feasibility.

2 THE BOARD REQUIREMENTS

2.1 CHANGES PER FLOOR

The following information in italics has been provided directly from the Board as their operation requirements:

Ground Floor

A continuous fire alarm requires the whole floor to be laterally evacuated to the outside. The floor above and the POD/Atrium will have an intermittent alarm (be in alert mode).

First Floor

Due to the type of patients there is a need to create a 4th compartment to allow progressive horizontal evacuation to adjacent compartments. There may be a need for an additional fire panel and/or firefighting equipment in this area. A continuous fire alarm requires the affected zone to be evacuated to adjacent compartments. The adjacent compartments on this floor as well as floor above, below and POD/Atrium will have an intermittent alarm (be in alert mode).

Second Floor

A continuous fire alarm requires the whole floor to be evacuated vertically to outside. Third floor which includes family hotel and SPHERE, also requires to be evacuated vertically at the same time. Both floors (2nd and 3rd) will have a continuous signal. The first floor and POD/Atrium will receive an intermitted signal (be in alert mode).

Third Floor

The third floor needs to be treated as a hotel for fire purposes. A continuous fire alarm requires the whole floor to be evacuated vertically to outside. The second and fourth floor as well as POD/Atrium will receive an intermittent signal (be in alert mode).

Fourth Floor

A continuous fire alarm requires the whole floor to be evacuated vertically to outside. The fire alarm will also sound continuously on Level 3 indicating vertical evacuation to outside. POD/Atrium will receive an intermittent signal (be in alert mode).

Pod

A continuous fire alarm will sound in the whole building (zone A) and requires the whole building to be evacuated simultaneously.

2.2 WSP COMMENTARY

From the aforementioned Board requirements, the most affected floor in terms of additional works is the First Floor. This will require changes to the compartmentation to allow for progressive horizontal evacuation.

The walkways as part of the first floor are within the Pod and will be treated as the Pod. Therefore if the Pod goes into alarm as do the walkways, this is the same for the Pod going into alert.

With the third floor containing hotel accommodation, the hotel will evacuate regardless of where the activation is. This is to take into consideration people who may be asleep and that are unfamiliar with the building.

The remaining floors and Pod have only minor changes to the reprogramming of the fire alarm and detection system.

3 COMPARTMENTATION

3.1 NON-DOMESTIC TECHNICAL HANDBOOK GUIDANCE

The fire strategy is based on the guidance within the Non-Domestic Technical Handbook (NDTH). It states the following in reference to compartmentation for hospitals:

- Compartments no greater than 1500m² achieving 60 minutes fire resistance;
- Each compartment separated into 2 sub-compartments no greater than 750m² achieving 30 minutes fire resistance.

3.2 EXISTING COMPARTMENTATION

As per the fire strategy, all floors are designed to be compartment floors achieving 60 minutes fire resistance.

Zone 2 is currently separated into 3 compartments as shown in Figure 2:

- Compartment 1 = 1049m²
- Compartment 2 (First Floor Pod) = 346m²
- Compartment 3 = 837m²

Each of these compartments are separated into 2 sub-compartments:

- Compartment 1:
  - 767m²
  - 280m²
- Compartment 3:
  - 358m²
  - 476m²

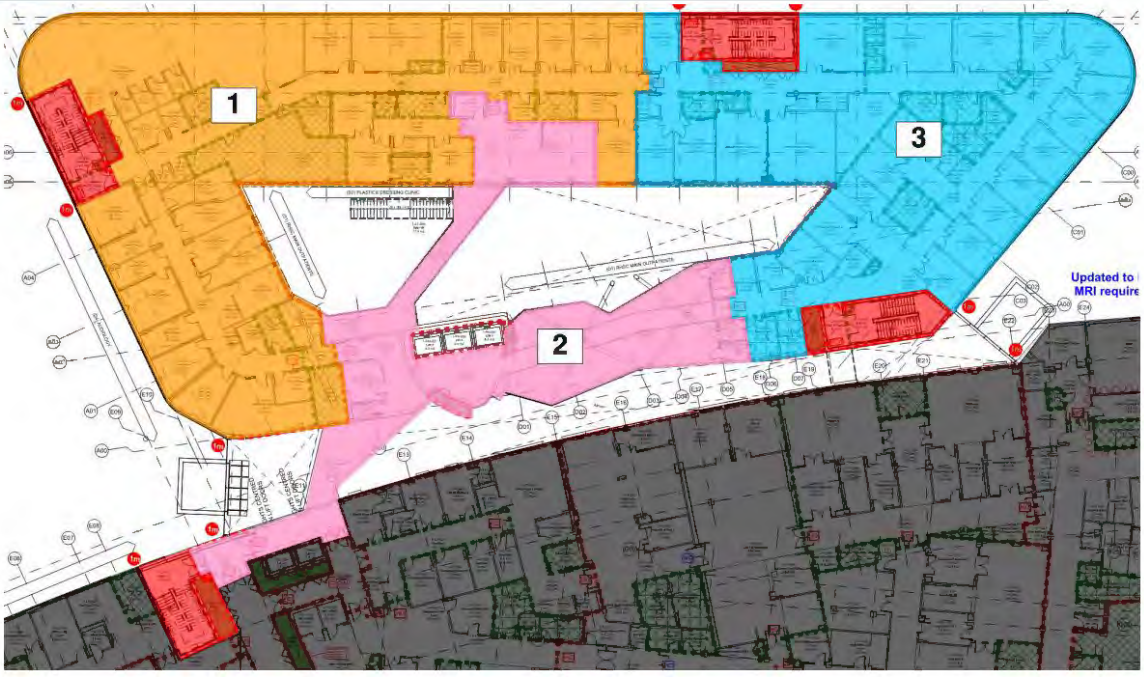
Compartment 2 is a single compartment with no sub-compartments as it consists of an open atrium.

Figure 2 – Existing Compartments

Key:

Compartment 1 Orange; Compartment 2 Pink; Compartment 3 Blue; Escape Stairs Red

Remainder of hospital is shadowed in Black.



3.3 PROPOSED COMPARTMENTATION

In order to achieve the required progressive horizontal evacuation, the NDTH states that compartments should achieve 60 minutes fire resistance with sub-compartments achieving 30 minutes fire resistance.

To accommodate this type of evacuation on the first floor, a fourth compartment is needed and the suggested location is shown in Figure 3. This is due to the means of escape requirement discussed in Section 4.3 and by providing compartmentation in this position allows the design to remain compliant with the NDTH.

The proposed compartments are as follows and show in Figure 3 as a sketch but appended to this report in Appendix A:

- Compartment 1 = 1049m²
- Compartment 2 = 346m²
- Compartment 3 = 376m²
- Compartment 4 = 457m²

Each of these compartments are separated into 2 sub-compartments (with the exception of Compartment 2):

- Compartment 1:
  - 767m²
  - 280m²
- Compartment 3:
  - 260m²
  - 115m²
- Compartment 4:
  - 100m²
  - 357m²

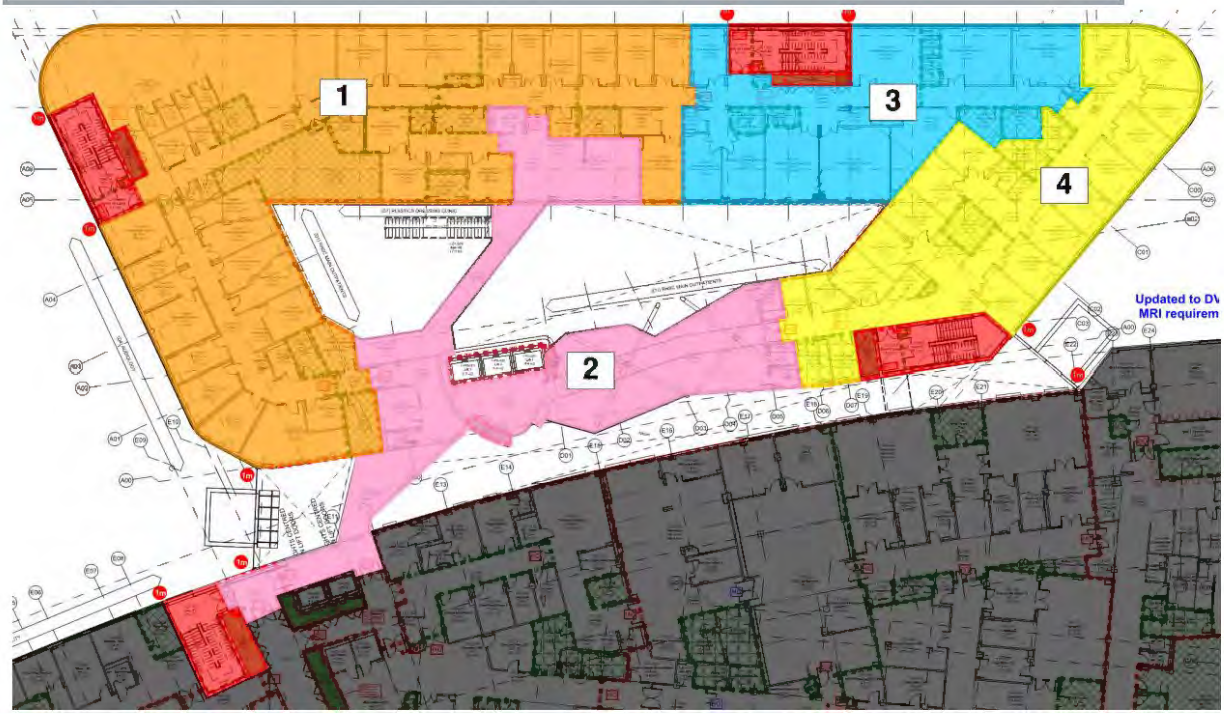
Figure 3 – Proposed Compartments

Key:

Compartment 1 Orange; Compartment 2 Pink; Compartment 3 Blue; Compartment 4 Yellow;

Escape Stairs Red

Remainder of hospital is shadowed in Black.



3.4 ADDITIONAL FIRE RESISTANT CONSTRUCTION

The proposed compartmentation will require additional fire rated partitions and fire doors, as well as upgrading of existing fire rated partitions and fire doors as well as further fire stopping, protection of services etc. (noted in sections below in further detail). These are noted below:

- Additional 30 minute fire resistant construction integrity and insulation to create sub-compartments within Compartments 3 and 4, location indicated on drawing in Appendix A;
- Additional 30 minute fire doors in Compartment 3 and 4;
- Upgrade of walls to 60 minutes fire resistance construction integrity and insulation to create a new compartment line between Compartments 3 and 4;
- Additional 60 minute fire doors.

3.5 COMBUSTIBILITY

Compartment walls and compartment floors must be constructed of non-combustible material. However, sub-compartment walls are permitted to be constructed of combustible material provided they achieve 30 minutes fire resistance.

Where walls were previously designed as a sub-compartment walls and may have been constructed of materials which are combustible, confirmation must be obtained that the upgrade to these walls to achieve 60 minutes fire resistance also includes that they are constructed of non-combustible material.

3.6 OPENINGS AND PENETRATIONS

3.6.1 FIRE DOORS

As noted above, new fire doors are required. Where there are new sub-compartments, new 30 minute fire doors are required to be provided. Where the new compartment line is being provided new 60 minute fire doors are required to be installed.

3.6.2 SERVICE OPENINGS

Service openings penetrating the fire rated walls should be fire stopped with the appropriate fire resistance, i.e. 60 minutes fire resistance where penetrating compartment walls and 30 minutes fire resistance where penetrating sub-compartment walls.

3.6.3 VENTILATION DUCTWORK

Ventilation ductwork passing through compartment and sub-compartment walls must be provided with remotely resettable fire and smoke dampers operated by smoke detection achieving the required fire resistance.

New sub-compartments will be created and as such fire and smoke dampers would not necessarily have been provided originally. Therefore, the Building Services team will require to amend the design to incorporate these.

3.7 JUNCTIONS WITH EXTERNAL WALLS

Where a compartment wall or sub-compartment wall meets an external wall, a 1m wide strip of the external wall should have the same fire resistance to integrity and insulation as the compartment or sub-compartment wall.

Therefore, where previously no sub-compartment walls existed, this will need to be added to the external wall and where previously sub-compartment wall met the external wall, this 1m strip will require to be upgraded to achieve 60 minutes fire resistance.

4 MEANS OF ESCAPE

4.1 COMPARTMENT EXITS

Where the storey is divided into 3 or more compartments, each compartment should have exits to:

- A compartment and a hospital street; or
- A compartment and an escape stair; or
- A compartment and a final exit.

The proposed changes to the compartments achieve following and is therefore compliant:

- Compartment 1 has exits into Compartments 2, 3 and an escape stair;
- Compartment 2 has exits into Compartments 1, 4 and an escape stair
- Compartment 3 has exits into Compartment 1, Compartment 4 and an escape stair;
- Compartment 4 has exits into Compartments 2, 3 and an escape stair.

Figure 4 – Escape Routes from Compartments

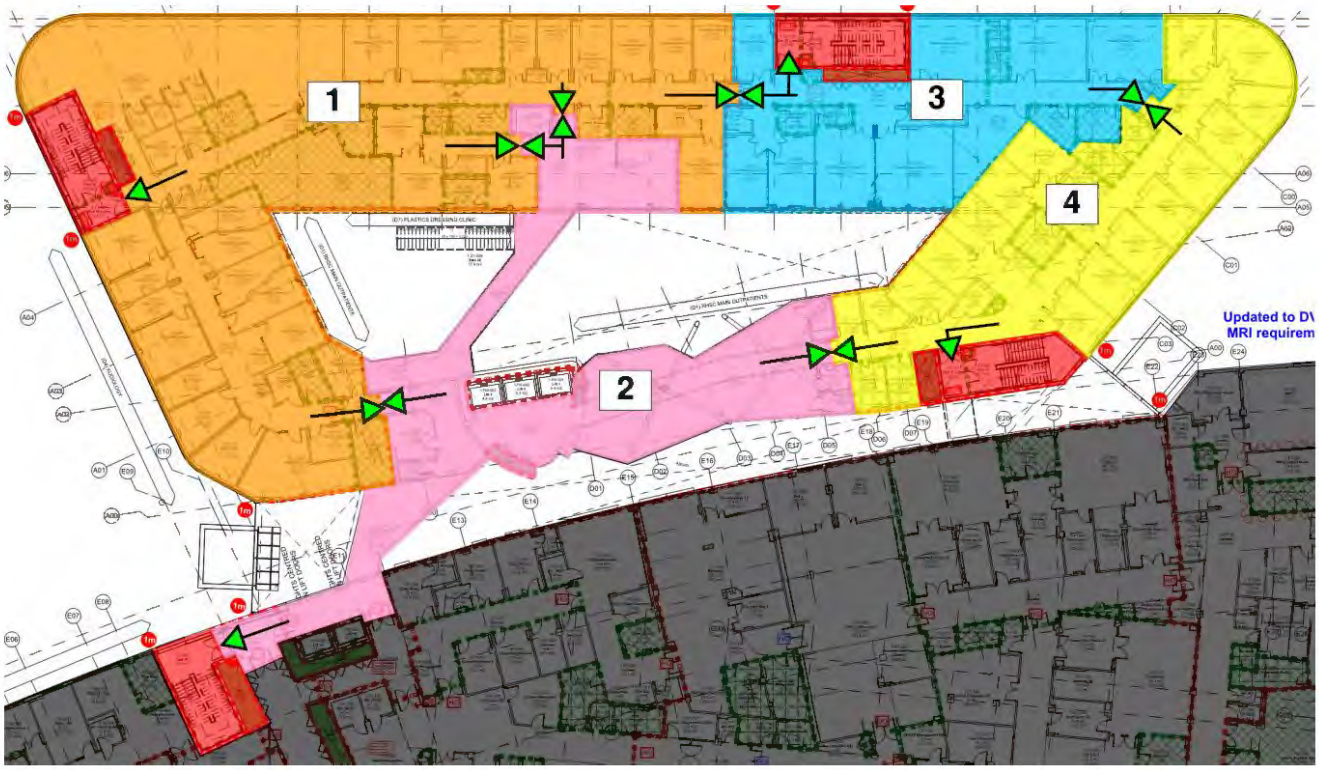
Key:

Compartment 1 Orange; Compartment 2 Pink; Compartment 3 Blue; Compartment 4 Yellow;

Escape Stairs Red

Exits into adjacent compartments and escape stairs noted with Green arrows.

Remainder of hospital is shadowed in Black.



4.2 TRAVEL DISTANCE

Travel distances should not exceed 15m in a single direction of escape and 32m where there is more than one direction of escape.

The maximum travel distance from any point within a compartment should be no more than 64m to:

- Each of two adjoining compartments, or
- An adjoining compartment and an escape stair or a final exit, or
- An adjoining compartment and a final exit, or
- And escape stair and a final exit.

By introducing this additional compartment travel distances are not extended and remain compliant.

4.3 HORIZONTAL EVACUATION

Within Zone 2 first floor we can measure travel distance to the protected door of a compartment. At that point, occupants are seen to have reached a place of relative safety.

However, the adjoining compartment must be large enough in area (m²) to accommodate both its own occupancy and that occupancy of the adjoining compartment. This is provided by the sum of the occupancy capacities of both compartments multiplied by 0.3 (as per NDTH).

Table 2 below provides the results of this equation taking each compartment in turn. The occupancy is taken from the fire strategy report and provided in the table below in more detail:

Table 1 - Occupancy

	Location	Area (m²)	Occupant Load Factor	Occupancy	Total
1	Staff Office	32.8	6	3	3
	Fields Test Room	9	6	2	2
	Mould Room	9	6	2	2
	ABR Room	16	6	3	3
	Test Room	16	6	3	3
	Work Room	12	6	2	2
	Staff Office	16	6	3	3
	Consulting Room	15.5	6	3	10
	Consulting Room	21	6	4	7
	Meeting Room	9	1	9	9
	Meeting Room	6	1	6	6
	Staff Office	162	6	27	27
	Management	20.5	6	3	3
	Staff Office	37	6	6	6
	Clinical Room	16	6	3	3
	Clinical Room	16	6	3	3
	Clinical Room	12	6	2	4
	Treatment Room	15	6	3	10
	Treatment Room	20	6	3	3
				Total	**111**
2	Waiting Area	35.7	2	18	18
	Reception	6.6	6	1	1
	Waiting Area	133.5	2	67	67
	Waiting Area	12.8	2	6	6

				Total	**92**
3	Treatment Room	15	6	3	3
	Treatment Room	20	6	3	7
	Rehab Room	30	6	5	120
	Rehab Room	39	6	7	7
				Total	**136**
4	Play Room	18	6	3	3
	Consulting Room	24	6	4	4
	Consulting Room	16	6	3	3
	Consulting Room	18	6	3	6
	Consulting Room	16.8	6	3	17
	Consulting Room	15.7	6	3	8
	Consulting Room	8.8	6	1	1
				Total	**42**
				Overall Total	**381**

Table 2 - Horizontal Evacuation

C = Compartment

	C1 into C3	C3 into C4	C4 into C3	C3 into C1	C2 into C1	C1 into C2	C2 into C4	C4 into C2
Occupancy	111	136	42	136	92	111	92	42
Occupancy	136	42	136	111	111	92	42	92
Total	247	178	178	247	204	204	134	134
NDTH Constant	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Area Required	74m²	52m²	52m²	74m²	61m²	61m²	40m²	40m²
Area Provided	376m²	457m²	376m²	1049m²	1049m²	346m²	457m²	346m²

As noted in the Table 2 sufficient exit width is provided to accommodate all occupants who need to evacuate into the adjoining compartments.

5 FIRE ALARM AND DETECTION

5.1 CATEGORY OF FIRE ALARM

The fire alarm and detection system currently installed is specified as meeting the criteria of BS5839-1 for an L1 level of coverage supplemented by manual call points. . This system currently evacuates all of Zone 2 (i.e. all floors) simultaneously.

With changing Zone 2 to be progressive horizontal evacuation as per the Board requirements in Section 2.1 above, a change to the programming of the fire alarm system will be required.

5.2 CAUSE AND EFFECT

The Board have provided a cause and effect extract which is noted below. This provides a general overview. The responsibility still lies with the Building Services team and will have to include releasing of hold open devices, fire damper activation etc.

- Alarm denotes the floor or compartment evacuates at the same time as the floor in which the detector has actuated.
- Alert denotes the floor or compartment prepares for evacuation but does not evacuate
- None denotes no direct effect to the floor or compartment.

Table 3 – Example Cause and Effect

		EFFECT								
		Ground	1st Floor (1)	1st Floor (2) (in pod)	1st Floor (3)	1st Floor (4)	2nd Floor	3rd Floor (Hotel)	4th Floor	Pod
CAUSE	Ground	Alarm	Alert	Alert	Alert	Alert	None	Alarm	None	Alert
	1st Floor (1)	Alert	Alarm	Alert	Alert	None	Alert	Alarm	None	Alert
	1st Floor (2) (in pod)	Alert	Alert	Alarm	Alert	Alert	Alert	Alarm	None	Alarm
	1st Floor (3)	Alert	Alert	Alert	Alarm	Alert	Alert	Alarm	None	Alert
	1st Floor (4)	Alert	None	Alert	Alert	Alarm	Alert	Alarm	None	Alert
	2nd Floor	None	Alert	Alert	Alert	Alert	Alarm	Alarm	None	Alert
	3rd Floor (Hotel)	None	None	Alert	None	None	Alert	Alarm	Alert	Alert
	4th Floor	None	None	Alert	None	None	None	Alarm	Alarm	Alert
	Pod	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm

6 CONCLUSIONS

WSP have concluded that changing the evacuation method in Zone 2 to progressive horizontal as per the Board requirements in Section 2.1 can be accommodated into the fire strategy design.

As noted above several changes will be required to ensure the design remains compliant with the fire strategy:

- Additional 30 minute fire resistant construction integrity and insulation to create sub-compartments within Compartments 3 and 4, location indicated on drawing in Appendix A;
- Additional 30 minute fire doors in Compartment 3 and 4;
- Upgrade of walls to 60 minutes fire resistance construction integrity and insulation to create a new compartment line between Compartments 3 and 4, location indicated on drawing in Appendix A;
- Additional 60 minute fire doors.
- Addition of the 1m strip of 60 minutes and 30 minutes fire resistance construction of the external walls;
- Fire and smoke dampers to be installed where ventilation ducts penetrate compartments and sub-compartments;
- Fire-stopping of service penetrations of appropriate fire resistance dependant on location;
- Re-programming of the fire alarm and detection system;
- Provision of a detailed cause and effect taking into account all fire safety items as required (Building Services team).

This report can be used to present to Building Control for an amendment to Warrant for Zone 2, as the design involves amending areas of the building from simultaneous to progressive horizontal evacuation, which is subject to Building Warrant approval