



Smoke Ventilation – Technical Submittal

Project: Angel Meadows, Plots 2 & 3
Project No: MC1120
TSM No: MC1120/TSM019
Revision: D
Date: 29th July 2021

Revision Notes:

- 1) Includes new damper and grille info

Ameon Limited Unit 9-10 Olympic Court
Boardmans Way
Whitehills Business Park
Blackpool
FY4 5GU

Tel: 01253 760160
Fax: 01253 760150
Email: enquiries@ameon.co.uk



Contents

Introduction.....	3
Scheme Design Intent	4
<i>Mechanical Smoke Ventilation – Ventec Self-regulating.....</i>	<i>4</i>
<i>Mechanical Smoke Ventilation – Natural inlet mechanical extract (Pull).....</i>	<i>5</i>
<i>Direct Natural Ventilation from Corridors/Lobbies via AOV's</i>	<i>6</i>
Scheme Functionality.....	7
Schedule of Equipment.....	9
Data Sheets	10
Drawing Numbers	10
Formal Approval	11

Introduction

The purpose of this document is to provide an overview of the Vent Engineering system to be provided at the below mentioned site. It also provides details of the system makeup and the equipment to be used.

Vent Engineering have been instructed to design, supply and install the smoke ventilation system throughout the site. We are specialist in natural and smoke ventilation systems and have been manufacturing, supplying, installing and commissioning ventilation systems for over 30 years for a variety of projects of all shapes and sizes.

Project Name: Angel Meadows – Plots 2 & 3
Project Reference: MS-NS-50262
Basic Scheme Design: Smoke ventilation in accordance with, WSP - Westfields Construction, Plots 2 & 3 Meadowside, Stage 4 Fire Strategy Report, dated 20/09/2019 & BB7, Angel Meadows, Residential Common Corridor CFD Analysis, dated 25/08/20.
Please note, Plot 2 level 21 is being naturally vented via a 1.5m² ceiling mounted AOV directly to outside. Under BS 9991:2015 Corrigendum 1, section 14.2.1.1 Note 1, “Only natural smoke shafts, mechanical smoke ventilation systems or pressure differential systems are suitable for buildings over 30 m in height”. However as this is naturally venting via a vertically mounted AOV and due to its location should not be affected by wind. Therefore, we have been informed Building Control have accepted this design.
Ventilation Methods: Ventec Self-regulating, Ventec Pull - Natural Inlet (Static Fans) & Direct Natural Ventilation via AOV's.

Scheme Design Intent

Mechanical Smoke Ventilation – Ventec Self-regulating

Plot 3; Ground & Levels 1-16 and Plot 2 Ground.

The Ventec Self-regulating system is designed to deliver an improved ventilation over that provided by the systems described in Approved Document B: 2013 (ADB) for ventilation of corridors/lobbies and escape stairs in residential buildings. BS 9991:2015 recognises that basic mechanical systems are commonly provided simply as an equivalent to the natural ventilation systems described in Approved Document B.

Under design conditions with the stair door open the mechanical ventilation system provides a ventilation of $3.5\text{m}^3/\text{s}$ at the smoke damper, as per the corridor CFD analysis. When the lobby doors are closed the ventilation rate is automatically reduced, to avoid excess depressurisation of the lobby.

The system comprises:

- A run & standby fan system
- Lobby ventilators: Ventec Dampers to each level served by the shaft. The top of each lobby ventilator should be located as close to the ceiling of the lobby as is practicable and must be at least as high as the top of the door connecting the lobby to the stairwell.
- Pressure Sensors
- Fan Control Panel
- 1.0m^2 stairwell ventilator
- Firefighters Override Switches
- Main Control Panel

The shaft is a builder's work riser (by others). It must be to the agreed dimensions, with a reasonably smooth internal finish and sufficiently sealed to limit the leakage rate to $3.8\text{m}^3/\text{h}/\text{m}^2$ at 50Pa. No services other than those relating to the smoke shaft should be contained within the smoke shaft.

Mechanical Smoke Ventilation – Natural inlet mechanical extract (Pull)

Plot 2; Levels 1-20.

A mechanical extended corridor system is designed to provide improved ventilation over that provided by the systems described in Approved Document B: 2006 (ADB) for ventilation of common corridors and escape stairs in residential buildings. The improved ventilation is intended as a compensating feature for dead end travel distances exceeding the 7.5m limit set in paragraph 2.23 and Table 1 of ADB and 15m limit detailed within BS 9991:2015 Clause 11.2 when sprinklers are incorporated in accordance with BS 9251:2014 or EN 12845.

Under design conditions the system continuously flushes through the corridor, limiting any build-up of smoke and protecting the stairs from smoke entry. The mechanical ventilation system provide should provide an extract rate of $4.0\text{m}^3/\text{s}$ at the smoke damper, as per the corridor CFD analysis.

The system will be initiated by the fire detection system so that the fan closest to the initial point of detection is selected as the smoke extract fan, while the other will remain static, but the shaft will provide inlet air.

The system comprises:

- A run & standby fan system
- Lobby ventilators: Ventec Dampers to each level served by the shaft. The top of each lobby ventilator should be located as close to the ceiling of the lobby as is practicable and must be at least as high as the top of the door connecting the lobby to the stairwell.
- Two smoke shaft either side of the stair core with smoke dampers at each level served.
- Fan Control Panel
- 1.0m^2 stairwell ventilator
- Firefighters Override Switches
- Main Control Panel

The shaft is a builder's work riser (by others). It must be to the agreed dimensions, with a reasonably smooth internal finish and sufficiently sealed to limit the leakage rate to $3.8\text{m}^3/\text{h}/\text{m}^2$ at 50Pa. No services other than those relating to the smoke shaft should be contained within the smoke shaft.

Direct Natural Ventilation from Corridors/Lobbies via AOV's

Plot 2; Level 21

Approved Document B (ADB) and BS 9991:2015 set requirements for automatic opening ventilators (AOV) to protect common escape routes in residential buildings.

Ventilation is required to the escape stairs and to the corridors/lobbies adjoining the stairs.

There should be a ventilator, with a free area of at least 1.5m^2 , from each corridor or lobby to the outside. These ventilators should be located as high as practicable and such that the top edge is at least as high as the top edge of the stair door.

There should also be a ventilator, with a free area of at least 1.0m^2 , from the top storey of the stairwell to the outside.

The ventilators on the fire floor and in the stair should be actuated simultaneously by means of smoke detection in the common lobby or corridor containing the shaft and all other floors should remain closed.

As per section 6.2.2 of the fire strategy, BS 9991:2017 recommends not using natural smoke ventilation system in the form of AOV in buildings greater than 30m in height as adverse wind pressure can affect the performance of such a system. However, the AOV will be located horizontally at roof level and not vertically on an external wall where adverse wind effect is more likely to be an issue. Therefore, the use of natural ventilation on the top floor is considered as acceptable.

Please note Plot 2 level 21 is being naturally vented via a 1.5m^2 ceiling mounted AOV directly to outside. Under BS 9991:2015 Corrigendum 1, section 14.2.1.1 Note 1, "Only natural smoke shafts, mechanical smoke ventilation systems or pressure differential systems are suitable for buildings over 30 m in height". However as this is naturally venting via a vertically mounted AOV and due to its location should not be affected by wind. Therefore, we have been informed Building Control have accepted this design.

Scheme Functionality

Plot 2

A single fire fighting/means of escape stair serving accommodation on First to Twenty-First floor with corridors being ventilated via 2no 0.6m² minimum mechanical ventilation smoke shafts each with a Ventec 0.6m² Series 60 Smoke Damper and Grille at each level. The fan set closest to the seat of the fire will extract and the dampers on the opposing smoke shaft will open to provide natural replacement inlet air. Ground floor is only served by a single shaft and has a pressure sensor and functions as per Plot 3 described below. The Twenty First floor is to be ventilated using a Ventec 1.5m² Above Corridor Ventilator.

The mechanical system comprises:

- A run & standby fan system
- Lobby ventilators: Ventec Dampers to each level served by the shaft. The top of each lobby ventilator should be located as close to the ceiling of the lobby as is practicable and must be at least as high as the top of the door connecting the lobby to the stairwell.
- Ventec Main Control System
- Firefighters Override Switches

Duty and standby fans in series are to be placed adjacent to the head of the shafts and are supplied with EN12101-7 certified fire rated transition ductwork, mounting feet, AV mounts, air non return damper and bird beak cowl.

The associated common staircase will include a Ventec Folding Arm Actuator ventilator which will open with the shaft dampers in the corridors, supplied with a Ventec Orange Fire Override Switch at firefighter's entrance level.

Controls include a single incoming Ventec Main Control System incorporating a Ventec CPU Panel and interfaced Ventec Fan Control Panel with inbuilt inverter controls for the extract fans – please note a dedicated maintained supply is required on site.

Ventec Fire Override Switches will be provided at each level connected to local Ventec Interface Panels. A Ventec HMI Touch-Screen Mimic Panel will be provided for the attending fire brigade at the fireman's point of entry allowing investigation/local remote control. Smoke detection by others.

Plot 3

A single fire fighting/means of escape stair serving accommodation on Ground and First to Sixteenth floor with corridors being at ventilated via a single 0.6m² minimum mechanical ventilation smoke shafts each with a Ventec 0.6m² Series 60 Smoke Damper and Grille at each level.

The mechanical system comprises:

- A run & standby fan system
- Lobby ventilators: Ventec Dampers to each level served by the shaft. The top of each lobby ventilator should be located as close to the ceiling of the lobby as is practicable and must be at least as high as the top of the door connecting the lobby to the stairwell.
- Ventec Main Control System
- Firefighters Override Switches
- Ventec Pressure Sensors

Duty and standby fans in series are to be placed adjacent to the head of the shafts and are supplied with EN12101-7 certified fire rated transition ductwork, mounting feet, AV mounts, air non return damper and bird beak cowl.

The associated common staircase will include a Ventec Folding Arm Actuator ventilator which will open with the shaft dampers in the corridors, supplied with a Ventec Orange Fire Override Switch at firefighter's entrance level.

Controls include a single incomer Ventec Main Control System incorporating a Ventec CPU Panel and interfaced Ventec Fan Control Panel with inbuilt inverter controls for the extract fans – please note a dedicated maintained supply is required on site.

Ventec Fire Override Switches will be provided at each level connected to local Ventec Interface Panels. A Ventec HMI Touch-Screen Mimic Panel will be provided for the attending fire brigade at the fireman's point of entry allowing investigation/local remote control. Smoke detection by others.

Schedule of Equipment

- 3 no Ventec Duty & Standby Smoke Extract Fan Set – Ø630mm. Comprising 2no high temperature axial fan units installed in series, fans rated for 300°C for 2 hours, dynamically balanced and complete with mounting feet, AV mounts, flexible connections, air non return damper and bird beak cowl. Complete with EN 12101-7 certified fire rated transition ductwork.

- 60 no Ventec Series 60 Smoke Evacuation Damper fitted with a Belimo 24V motor, matt black finish. Supplied complete with a K15 decorative grille with RAL 9010 20% gloss finish.

- 18 no Ventec Pressure Sensors

- 2 no Ventec Folding Arm Actuator

- 1 no Ventec Ostro 140° opening flap ventilator providing 1.5m² measured free area manufactured from galvanized steel sheet fitted with 10mm Lexan flap. Internal throat dimensions 1100mm x 1500mm, overall base dimensions 1300mm x 1700mm. Suitable for installation onto roof upstands prepared, weathered and installed by others. EN 12101-2 tested and certified, 24V dc operation – motor open motor close.

- 2 no Ventec Master Control System for operation of mechanical systems including Ventec CPU, Ventec Fan Starter Panels and Ventec 3 Zone Local Interface Panels. Single incomer 415V/3ph/50Hz (mechanical systems) 230V/1ph/50Hz (natural system) – assumes dedicated maintained supplies available on site. Supplied complete with Ventec HMI Surface Mounted Mimic Panels.

- 61 no Ventec Fire Override Switches. One switch located at each corridor level and one at ground floor level within the stair.

Data Sheets

1. Ventec Duty & Standby Fans ($5.6\text{m}^3\text{s}^{-1}$ @ 650Pa)
2. Ventec Series 60 Dampers & Grilles
3. Ventec Folding Arm Actuator
4. Ventec Flap Ventilator
5. Ventec CPU External 10A Enclosure
6. Ventec Fan Control Panel 7.5-11kW (16.5A & 23.5A) Enclosure
7. Ventec HMI Enclosure
8. Ventec Pressure Sensors
9. Ventec Zone Panel 10A Advanced Compact Enclosure
10. Ventec Zone Panel 4A Standard Enclosure
11. Ventec Fire Override Switch Close-Auto-Open
12. Ventec Fire Override Switch Off-Auto-Run
13. Ventec Fire Override Key Switch Auto-Open

Drawing Numbers

Schematic - Plot 2	MS-NS-20262-001
Schematic - Plot 3	MS-NS-20262-002
Plot 2 - Ground Floor Layout	MS-NS-20262-100
Plot 2 - 1st - 20th Floor Layout	MS-NS-20262-101
Plot 2 - 21st Floor Layout	MS-NS-20262-102
Plot 2 - Roof Layout	MS-NS-20262-103
Plot 3 - Ground Floor Layout	MS-NS-20262-150
Plot 3 - 1st, 3rd - 16th Floor Layout	MS-NS-20262-151
Plot 3 - 2nd Floor Layout	MS-NS-20262-152
Plot 3 - Roof Layout	MS-NS-20262-153
Smoke Damper & Grille	MS-NS-20262-200
Plot 2 - Above Corridor Ventilator	MS-NS-20262-203
Plot 2 - LHS Smoke Extract Fan Arrangement	MS-NS-20262-204
Plot 2 - RHS Smoke Extract Fan Arrangement	MS-NS-20262-205
Plot 3 - Smoke Extract Fan Arrangement	MS-NS-20262-206
Constant Use Door AOV (Outward Opening)	MS-NS-20262-207
Bespoke Ventec Smoke Damper & Grille	MS-NS-20262-208
Plot 2 - Cause & Effects	MS-NS-20262-900
Plot 3 - Cause & Effects	MS-NS-20262-901

Formal Approval

Acknowledgement of technical Submission

To confirm your receipt of this technical submission and are happy to commence work on this basis. Please sign in the space below and return this form back to us as soon as possible.

Signed for and on behalf of the Customer

Name:			
Position:			
Signature:		Dated:	

Technical Data - Fan Model LCS071L2-A9/18 R&S Set

Location: Option 1

Designation:

Please Note: Data shown is for a non-standard product.

Performance - Required

Air Flow : 5.60 m³/s
 Static Pressure : 650 Pa
 Selection Pressure: 896 Pa
 Installation Type: TYPE D
 Air Density: 1.204 kg/m³
 - Atmos. Temp: 20 °C
 - Altitude: 0 m
 - Humidity: 0.0 %

Actual

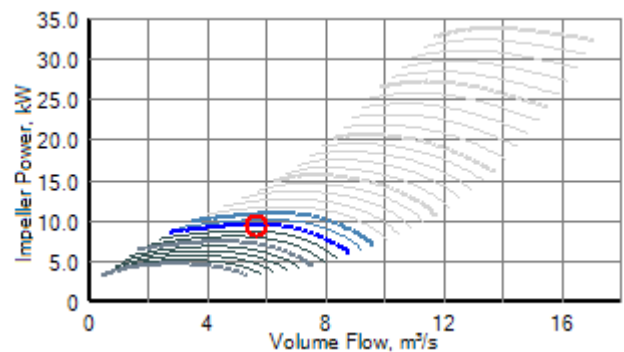
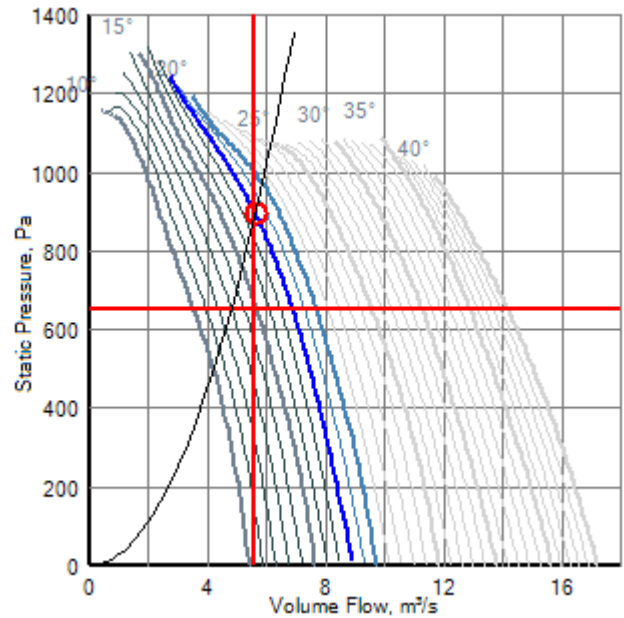
Air Flow: 5.61 m³/s
 Static Pressure: 894 Pa
 Total Pressure: 1015 Pa

Fan Data

Catalogue Code: LCS071L2-A9/18 R&S Set
 (LCS071-717-IE2-132-9.2-2-181-38-RA9)
 Description: LCS - 2x Long-Cased Smokevent
 Axial Fan
 Diameter: 710 mm Hub: 181 mm
 Impeller Type: Axial Pitch: 18°
 Blade Material: Aluminium Blades: 9
 Speed: 2915 r/min @50 Hz Form: B
 Power, Abs: 9.49 kW Peak: 9.49 kW
 Input Power: 10.64 kW
 Efficiency Total: 59.9% Static: 52.8%
 SFP: 1.90
 Fan Weight: 114.9 kg

Motor Data (at STP)

Motor Type: F300 (IE2)
 Electrical Supply: 400V 3ph 50Hz
 Motor Frame: 132M
 Motor Power: 11.00kW (AOM) (9.20kW IEC)
 FLC/Start (DOL): 21.04A (AOM) / 132.53A (17.60A FL IEC)
 Motor Speed: 2 pole
 Motor Efficiency: 89.2%



Sound Data

Spectrum (Hz):	63	125	250	500	1K	2K	4K	8K	dBW	dB(A) @ 3m
Inlet (dB):	93	90	102	109	111	108	101	95	115	94
Outlet (dB):	97	92	99	107	110	107	99	94	114	92

Sound levels are quoted as in-duct values. dB(A) values are average spherical free-field for comparative use only.

Technical Data - Fan Model LCS071L2-A9/18 R&S Set

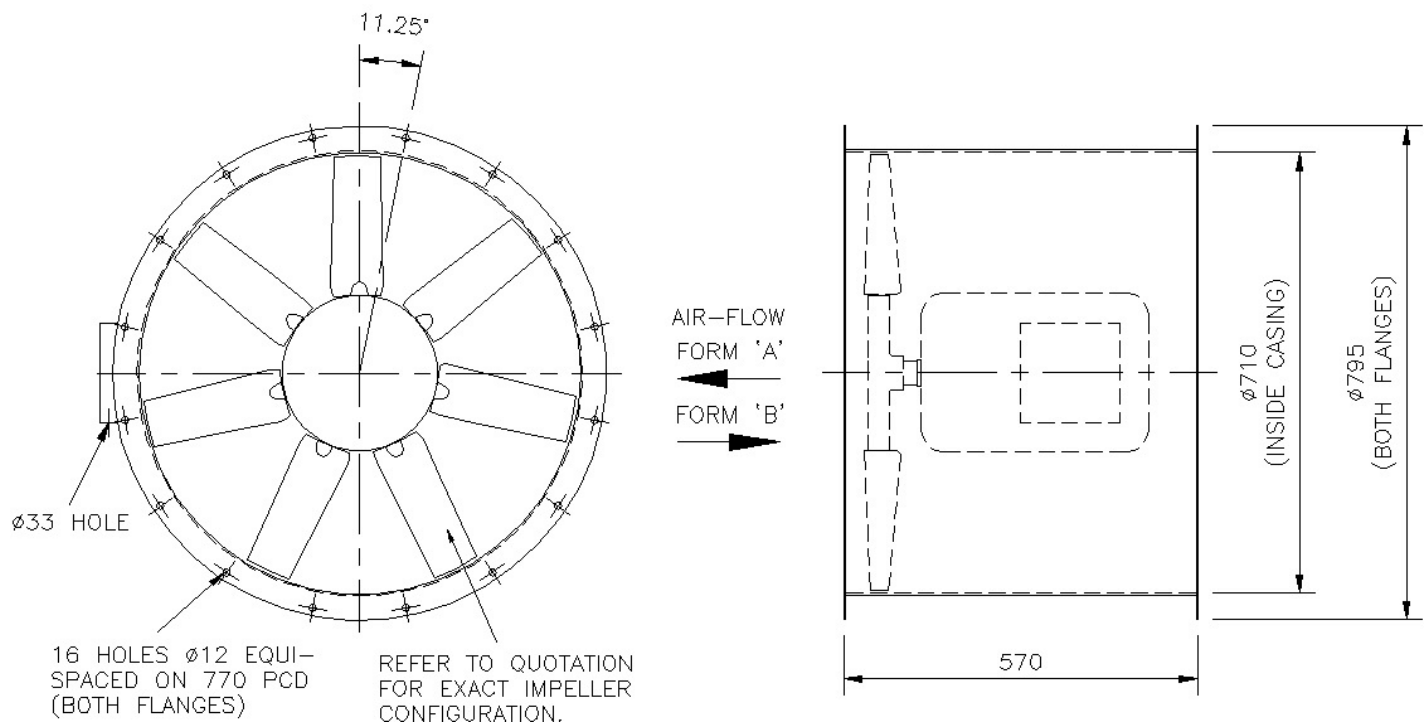
Location: Option 1

Designation:

Energy Related Product Data

Overall Efficiency:	47.1%	At Maximum Efficiency Point	
Measurement Category:	C	Input Power:	10.64 kW
Efficiency Category:	Static	Air Flow:	5.69 m ³ /s
FMEG:	47	Pressure:	881 Pa
Specific Ratio:	1	Speed:	2915 r/min

Drawing for Fan Model LCS071L2-A9/18 R&S Set



SERIES 60

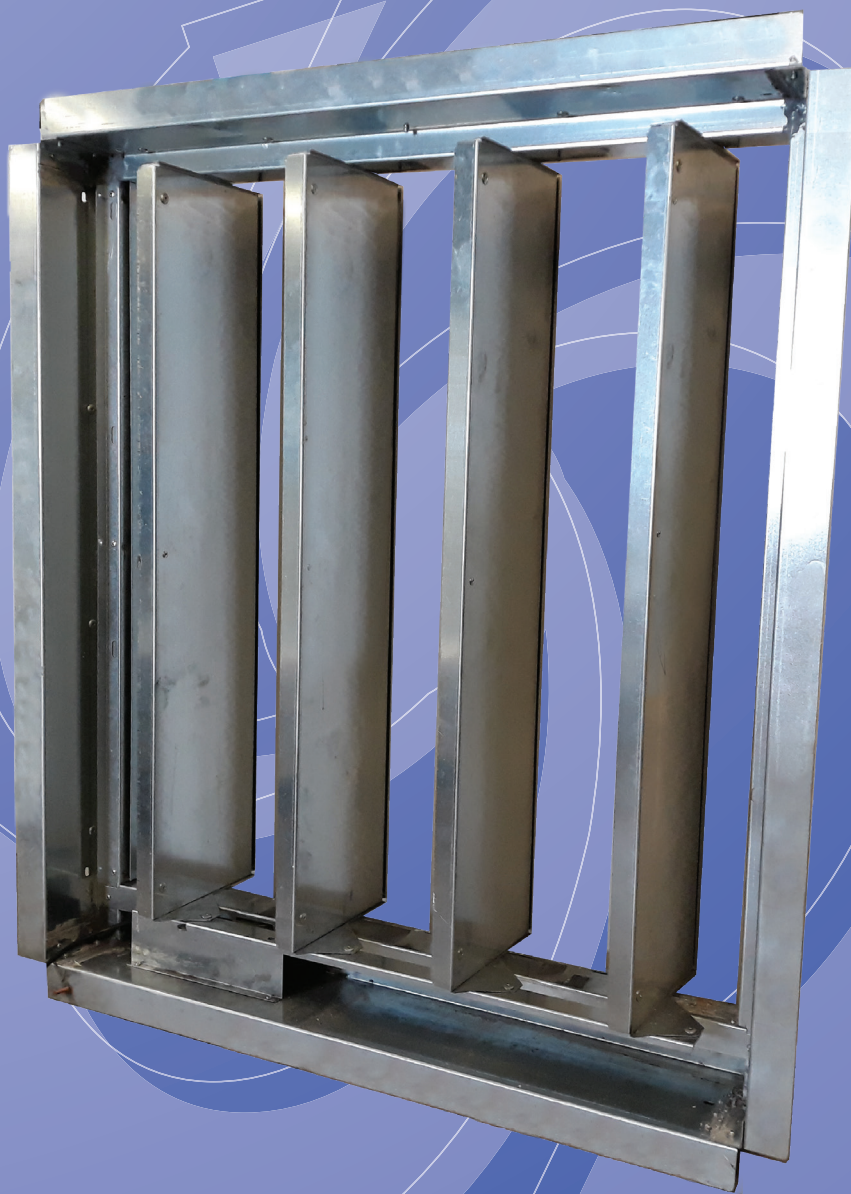
Smoke Evacuation Damper

CE

PUBLICATION

DAMPERS 8

MARCH 2020



Features

- 1.5 mm Galvanised steel construction
- Motor open or motor closed operation
- Low leakage rate
- High Free area design
- Optional Decorative Fascia grilles
- CE marked with classification to EN13501-4



GILBERTS

SERIES 60

Smoke Evacuation Damper

Introduction

The Series 60 smoke evacuation damper has been designed to satisfy smoke ventilation applications and is particularly suited for smoke evacuation shafts and risers in multi storey buildings.

A multi, parallel linked blade smoke damper the Series 60 is manufactured from robust 1.5 mm galvanised steel. Usefully the damper combines both a low leakage rate, when closed, with a high free area, when open, to support high smoke evacuation rates.

All Series 60 dampers are fitted with a Belimo actuator to offer a powered motor open/close actuation.

Series 60 has been designed to provide both a practical and aesthetic solution. It is available in a wide range of sizes ranging from 440 x 440 to 1000 x 1125 with sizes based on the structural opening (aperture) dimensions.

Effectively this means the largest size damper can provide up to 0.75m² of free area

As part of the EN12101-8 and EN1366-10 standard the damper has undergone an EN1366 Pt 2 test and lasted over 120 minutes for fire integrity [E120]. Dampers can be masked with a fixed blade type cover grille with blades angled at 40°, for virtual full damper masking, or 15° for a partial masking effect. These cover grilles can be face screw fixed or concealed fixed according to preference.

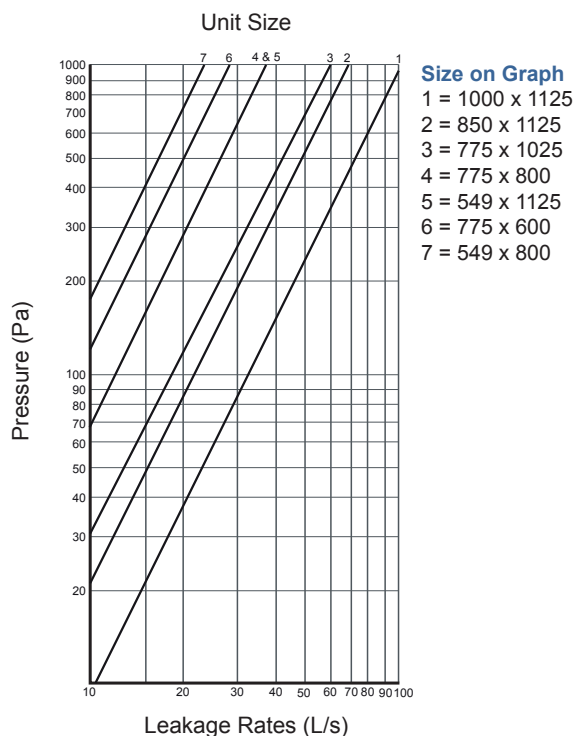
Features

- 1.5 mm Galvanised steel construction
- Motor open or motor closed operation
- CE marked with classification to EN13501-4
- Classified as smoke control damper E120 Vew 1000 AA i → o C10000 multi
- Low leakage rate
- Optional Decorative Fascia grilles

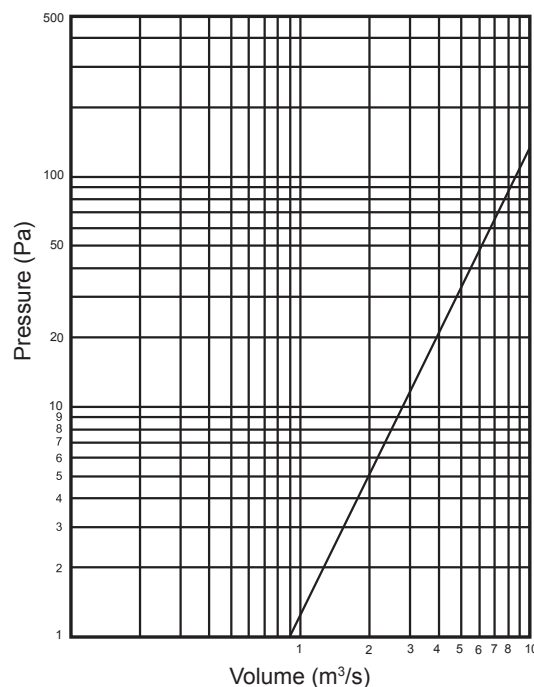


Pressure Graphs

Pressure Drop / Leakage Graph
(Damper Closed)



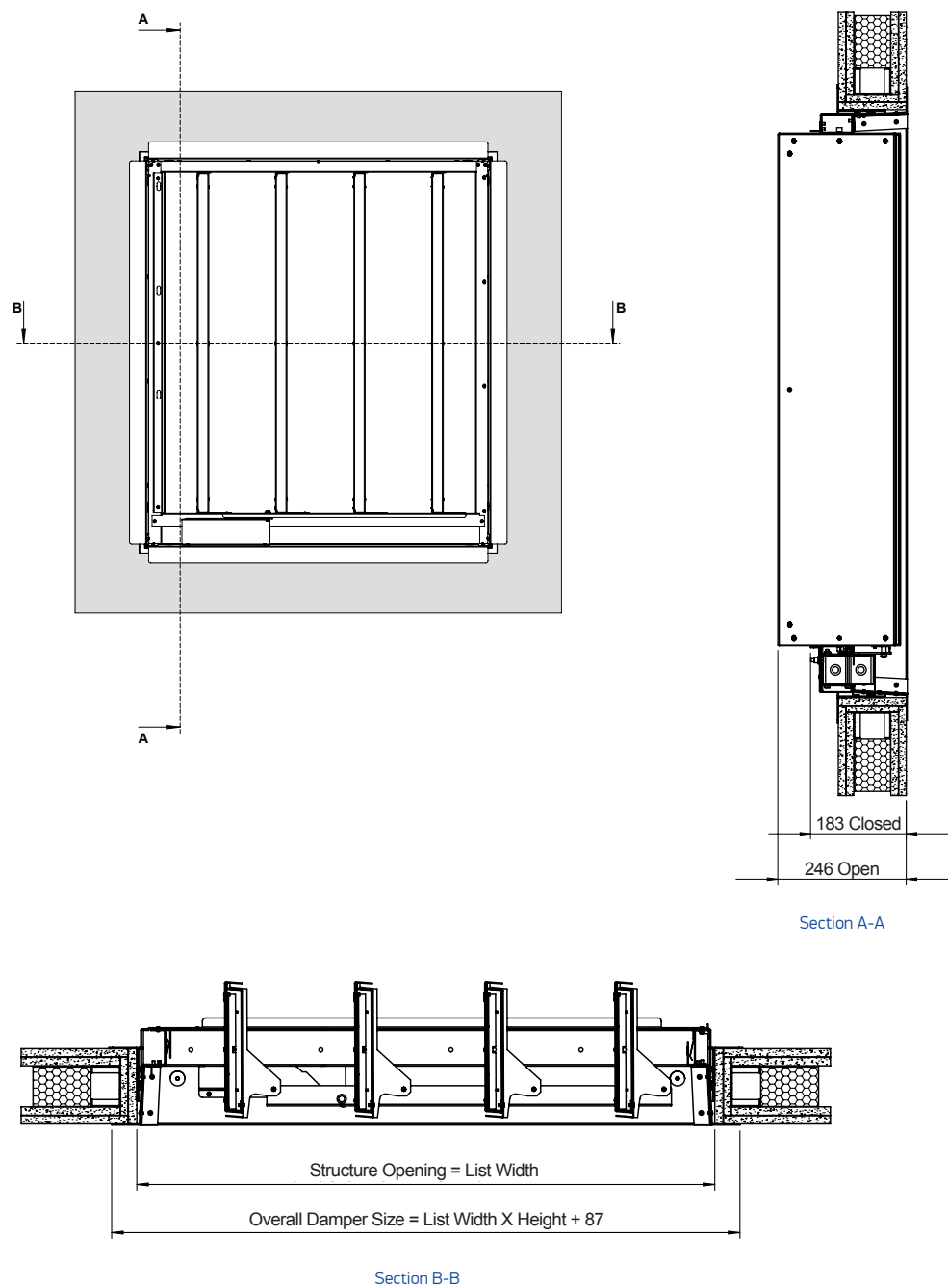
Pressure Drop / Volume Graph
(1000x1125 unit open)



SERIES 60

Smoke Evacuation Damper

Dimensional Data



SERIES 60

Smoke Evacuation Damper

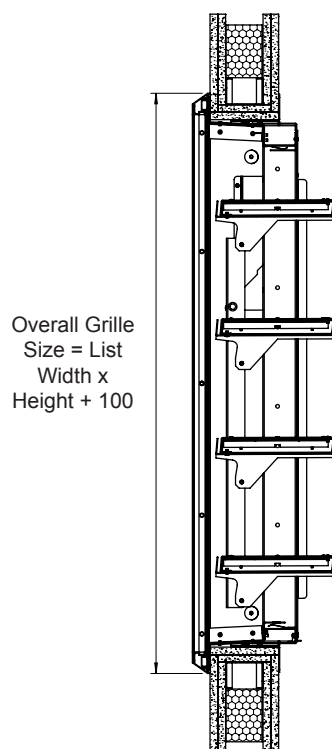
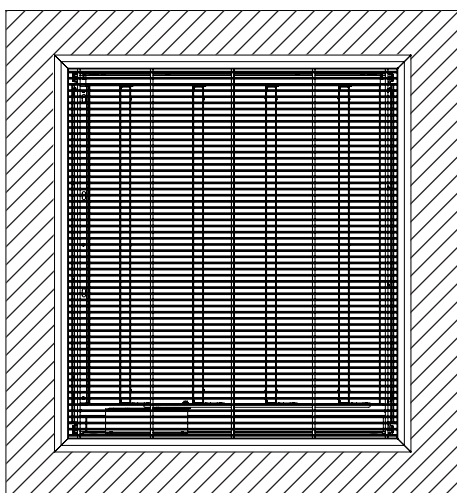
Engineering Specification

Free Area

Damper size (mm)	Weight (kg)	Geometric Free Area (m2)	Aerodynamic Free Area (m2)	Aerodynamic Free Area (m2) inc K0/K15 grille	Aerodynamic Free Area (m2) inc K40 grille
549 x 800	26.4	0.25	0.31	0.24	0.15
549 x 1125	34.4	0.37	0.43	0.34	0.21
775 x 600	28	0.26	0.33	0.25	0.16
775 x 800	35	0.38	0.44	0.34	0.21
775 x 1025	42.2	0.51	0.56	0.44	0.27
850 x 1125	50	0.61	0.67	0.53	0.33
1000 x 1125	56	0.75	0.8	0.62	0.38

Fascia Cover Grilles

For Fascia Grille options please refer to Gilberts Air Distribution Catalogue "Grilles" section



Overall Grille Size = List Width x Height + 100

Damper & Mounting Frame

Damper with vertical blades for air passage and 15mm returned edge all round for fixing to structure.

Damper body formed in flanged Z sections 52 x 35 x 196. All manufactured from 1.5mm cold reduced galvanised steel to BS.EN.10142: 1991. The frame corners are joined using 6 No 4.8mm dia. sealed steel rivets on slotted holes to allow for expansion.

Blades

Vertical Parallel blade assembly constructed from 1.0mm thick x 100mm to 300mm wide cold reduced galvanised steel to BS.EN.10142: 1991 set at a 100mm to 300mm pitch selected to suit structure opening height. Each blade is connected to the link bar (1.5mm thick galv m/s) with 4.8 dia steel rivets.

Motor Drive

Belimo BLE drive motor 24 volt (open/closed) fitted as standard.

SERIES 60

Smoke Evacuation Damper

DECLARATION OF PERFORMANCE

GILBERTS SERIES 60 RANGE

1. Unique identification code of the product-type:

SERIES 60 Smoke control damper. To be used in conjunction with walls/partitions to maintain fire compartments in smoke evacuation installations in multi compartment applications.

2. Name, registered trade name or registered trade mark and contact address of the manufacturer as required under Article 11(5):

Gilberts (Blackpool) Ltd, Clifton Road, Blackpool, FY4 4QT

3. System or systems of assessment and verification of constancy of performance of the construction product as set out in CPR, Annex V:

System 1

4. In case of the declaration of performance concerning a construction, product covered by a harmonized standard:

IFC Certification (1720) performed the determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product, the initial inspection of the manufacturing plant and of factory production control and continuous surveillance, assessment and evaluation of factory production control under system 1 and issued the certificate of constancy of performance of the factory production control CPR0215

5. Declared performance according to:

EN12101-8: 2011

Fire resistance according to EN 1366-10 and Classification according to EN 13501-4

Range	Type	Supporting Construction	Document Ref	Classification
440 x 440mm 1000 x 1125mm	SERIES 60	Dry Wall	19/19137-994	E120 Vew 1000 AA i → o CI0000 multi
Nominal activation conditions/sensitivity; - - sensing element load bearing capacity - sensing element response time				Pass Pass
Response delay (response time) - closure time				Pass
Operational reliability - cycling				Pass
Durability of response delay - sensing element response temperature and load bearing capacity Pass				Pass
Durability of operational reliability according to EN 15650: -open and closing cycle				10000 cycles Pass

Note: NPD (No Performance Declared) for insulation or smoke

Signed for and on behalf of Gilberts (Blackpool) Ltd

**Roy Jones -Technical Director
November 2019**



SERIES 60

Smoke Evacuation Damper

Ordering Specification

Damper

SERIES 60 DAMPER	Series 60	850 x 1125	CB	MATT BLACK	QTY
LIST SIZE 850 X 1125, 1000 X 1125 775 X 1025, 549 X 1125 775 X 800, 549 X 800 775 X 600					
CONCEALED FIX FASCIA GRILLE					
DAMPER FACE FINISH OPTIONAL					
QUANTITY					

Fascia Grille

SERIES KS60 KS60	KS60	15	850 x 1125	CB	PPC RAL 9010 20% GLOSS (Standard Finish)	QTY
BLADE ANGLE 15 degrees 40 degrees						
LIST SIZE 850 X 1125, 1000 X 1125 775 X 1025, 549 X 1125 775 X 800, 549 X 800 775 X 600						
FIXING Concealed Bracket						
FINISH Please Specify						
QUANTITY						

Size Range

7 standard list sizes as detailed in the ordering specification.

Fixing

Damper: Tek screws into structure.
Please refer to our detailed fitting instructions

Fascia Grille: Concealed bracket fixing onto damper frame

Finish

Damper: Mill finish (Galvanised steel). Damper face can be optionally painted matt black

Fascia Grille: Polyester Powder coat White RAL 9010 20% Gloss. Special finishes available to stock BS or RAL colour

GILBERTS

Head Office and Works

GILBERTS (BLACKPOOL) LTD

Gilair Works, Clifton Road,
Blackpool, Lancashire FY4 4QT.

Telephone: **(01253) 766911**

e-mail: **sales@gilbertsblackpool.com**

Web: **www.gilbertsblackpool.com**

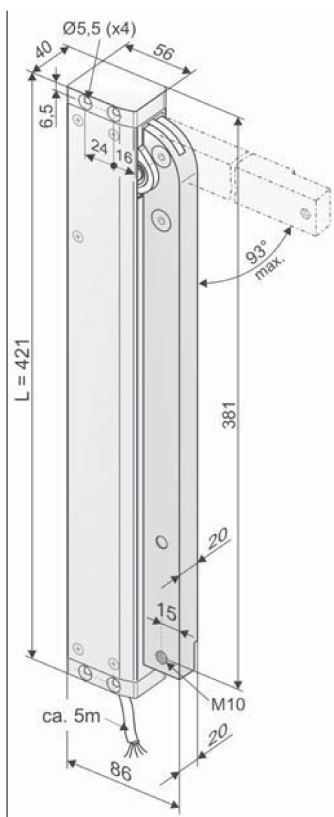
Gilberts (Blackpool) Ltd reserve the right to alter the specification without notice. For our latest product data please visit www.gilbertsblackpool.com. All images and drawings are for illustrational purposes only and are not intended to deliver an exact visual representation. Minor variations can be expected due to the different manufacturing processes. The information contained in this brochure is correct at time of going to press © 2019.



- Application: natural ventilation, SHEV
- Mainly for opening and closing of side-hung inward opening windows
- Internal intelligent cut-off switch S12
- Programmable contact for door opener

Options

- Programmable special functions
- M-COM for automatic synchronised run of multi drive systems and automatic sequence control with FV locking drives (S3/S12 SW V2)
- Various customised programmings on request



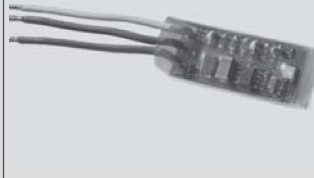
TECHNICAL DATA

U_N	Rated voltage	24V DC ($\pm 20\%$), max. 2 Vpp
I_N	Rated current	0,8 A
I_A	Cut-off current	1,4 A
P_N	Rated power	20 W
ED	Duty cycle	30 % (ON: 3 min. / OFF: 7 min.)
	Protection rating	IP 32
	Ambient temperature range	-5 °C ... +75 °C
M_A	Torque OPEN	215 Nm (600 N)
M_Z	Torque CLOSE	215 Nm (600 N)
F_H	Pullout force	3000 N (fastening depended)
	Lever arm	aluminium (RAL9006)
	Connecting cable	non-halogen, grey 5 x 0,5 mm ² , ~ 5 m
t	Running time (0° – 90°)	 45 s (2,0°/s)  45 s (2,0°/s)
s	Stroke	0 – 93 DEG ($\pm 5\%$)
L	Length	421 mm
	Potential free contact	max. 24VDC / 0,5A programmable

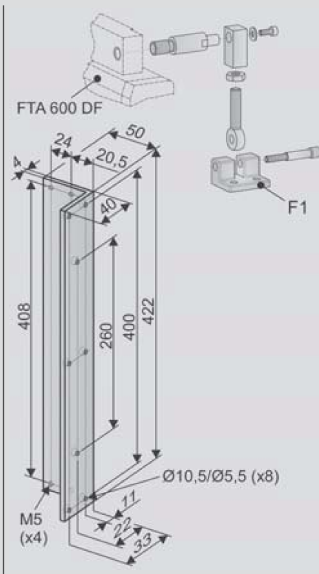
ORDER DATA						
s [DEG]	L [mm]	Version	Finish	PU/pcs.	Part.-No.	
0° – 93°	421	FTA600 DF S12 24V	E6/C-0	1	524142	
Accessories				PU/pcs.	Part.-No.	
K103 Casement bracket FTA600 DF				1	524172	

OPTIONS						
Special model				PU/pcs.	Part.-No.	
Drive housing painted/powder coated in other RAL colours						
Specify at order stage:				1 – 4	516004	
				5 – 9	516004	
				10 – 49	516004	
				50 – 99	516004	
				up 100	516004	
Extra length connecting cable:						
10 m – non-halogen, grey – 5 x 0,5 mm ²					501056	
Microprocessor programming S12						
Electrical stroke reduction				1	524190	
Special functions					524180	
Optional accessories				PU/pcs.	Part.-No.	
M-COM Comm. module for synchronised multi-drive systems				1	524177	

OPTIONAL ACCESSORIES

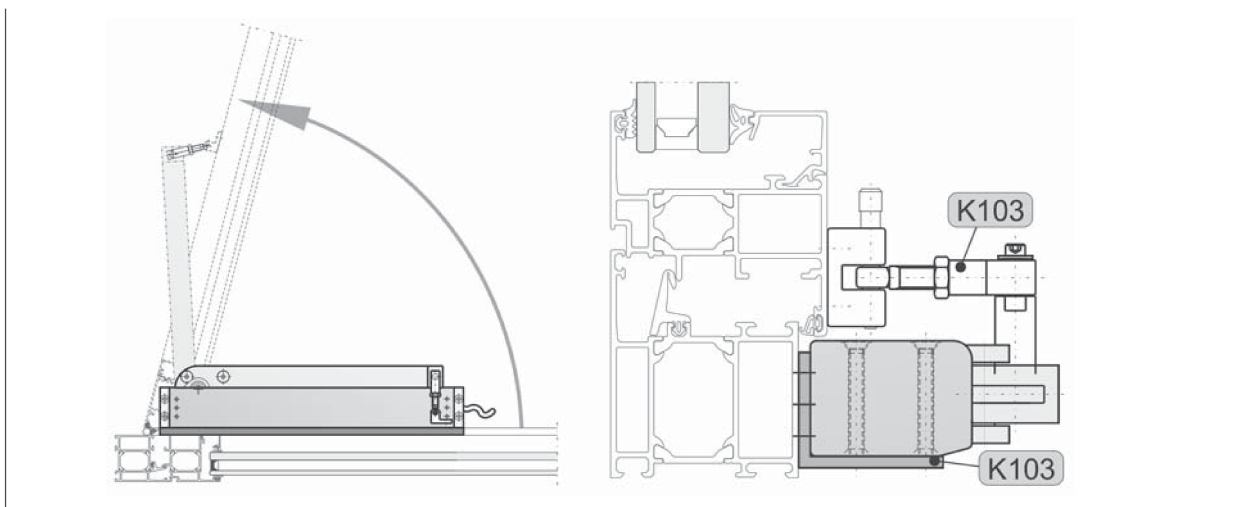
Main control unit				
M-COM		Application	Part.-No. 524177	
		Communication module for automatic configuration and surveillance of max. 6 opening or locking drives version S12/S3 (software version SW-V2) in synchronised multi-drive systems	Protection rating IP30 rubber envelope Ambient temperature range 0 °C ... + 70 °C Dimensions 45 x 17 x 6 mm Connecting wires 3 wires 0,5 mm ² x 50 mm Feature/Equipment Printed circuit board with components and connection wires to be installed in connection box to be supplied on site	
		Rated voltage: 24 V DC +/- 20%, (max. 2 Vss) Current consumption: <12 mA Drive type: S12		

ACCESSORIES

Casement bracket			
K103		Application Surface mounting on the side closing edge of window frame profiles of inward opening side-hung windows. Angle bracket 422 mm for mounting of FTA600-DF on the window frame profile. F1 for mounting on the casement profile and for the fixing with the knuckle joint, adjustable for compensation of the door overlap	Part.-No. 524172 Material/Finish aluminium Feature/Equipment 1x angle 50x40x422 (t = 4) mm 1x casement bracket F1 1x fixing accessories Load max. 600 N

Special model	PU/pcs.	Part.-No.			
Casement brackets painted / powder coated in other RAL colours					
Specify at order stage:	1 – 4	516026			
	5 – 9	516026			
	10 – 49	516026			
	50 – 99	516026			
	up 100	516026			
Frame brackets painted / powder coated in other RAL colours					
Specify at order stage:	1 – 4	516025			
	5 – 9	516025			
	10 – 49	516025			
	50 – 99	516025			
	up 100	516025			

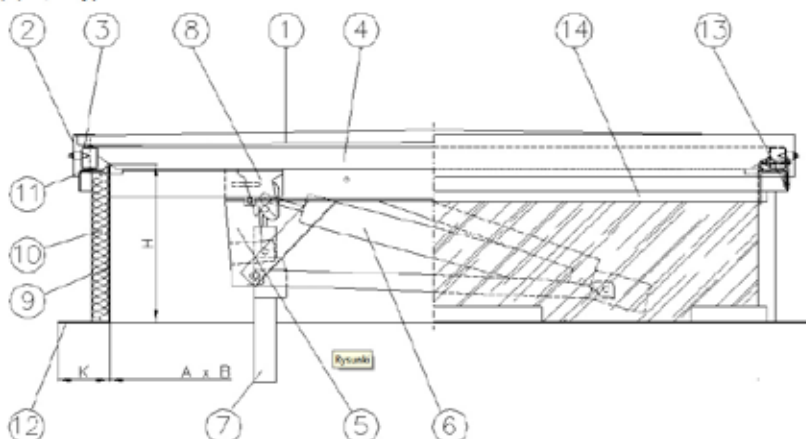
Typical applications



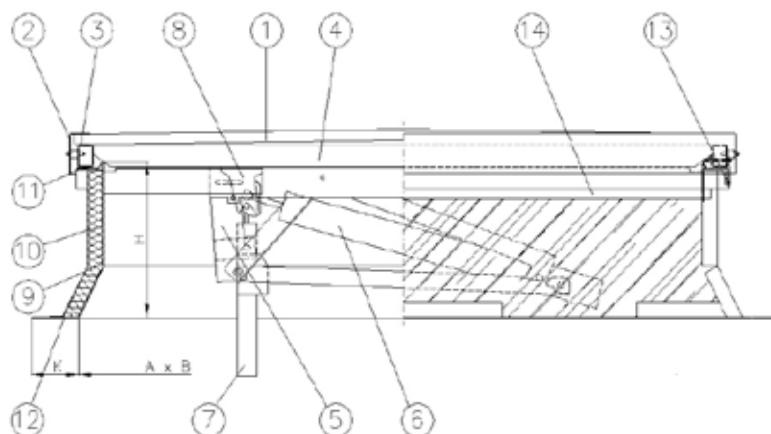
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COMPOSITION

(a) C, E type



1. Filling
2. Clamp frame
3. Frame bearer
4. Spreader boom
5. Actuator holder
6. Smoke exhaust actuator
7. Ventilation actuator (option)
8. Hooked bracket
9. Base
10. Base thermal insulation
11. Leaf seal
12. Base flange
13. Hinge
14. External detailing: zinc-coated galvanised steel sheet

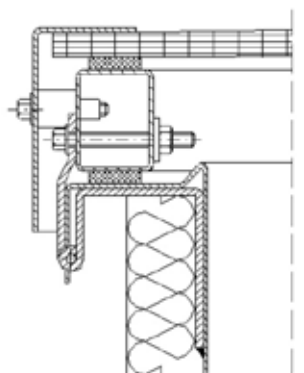


1. Filling
2. Clamp frame
3. Frame bearer
4. Spreader boom
5. Actuator holder
6. Smoke exhaust actuator
7. Ventilation actuator (option)
8. Hooked bracket
9. Base
10. Base thermal insulation
11. Leaf seal
12. Base flange
13. Hinge
14. External detailing: zinc-coated galvanised steel sheet

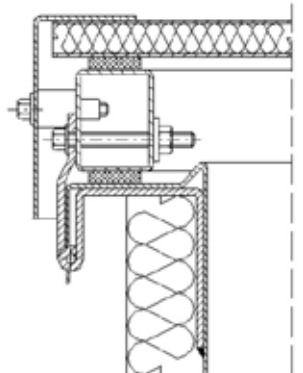


LID OPTIONS

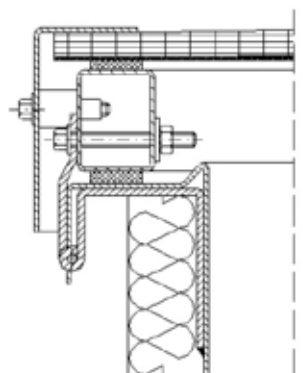
(a) polycarbonate panel



(b) ALU composite panel



(c) polycarbonate and polyester panels [Broof(t1) class]



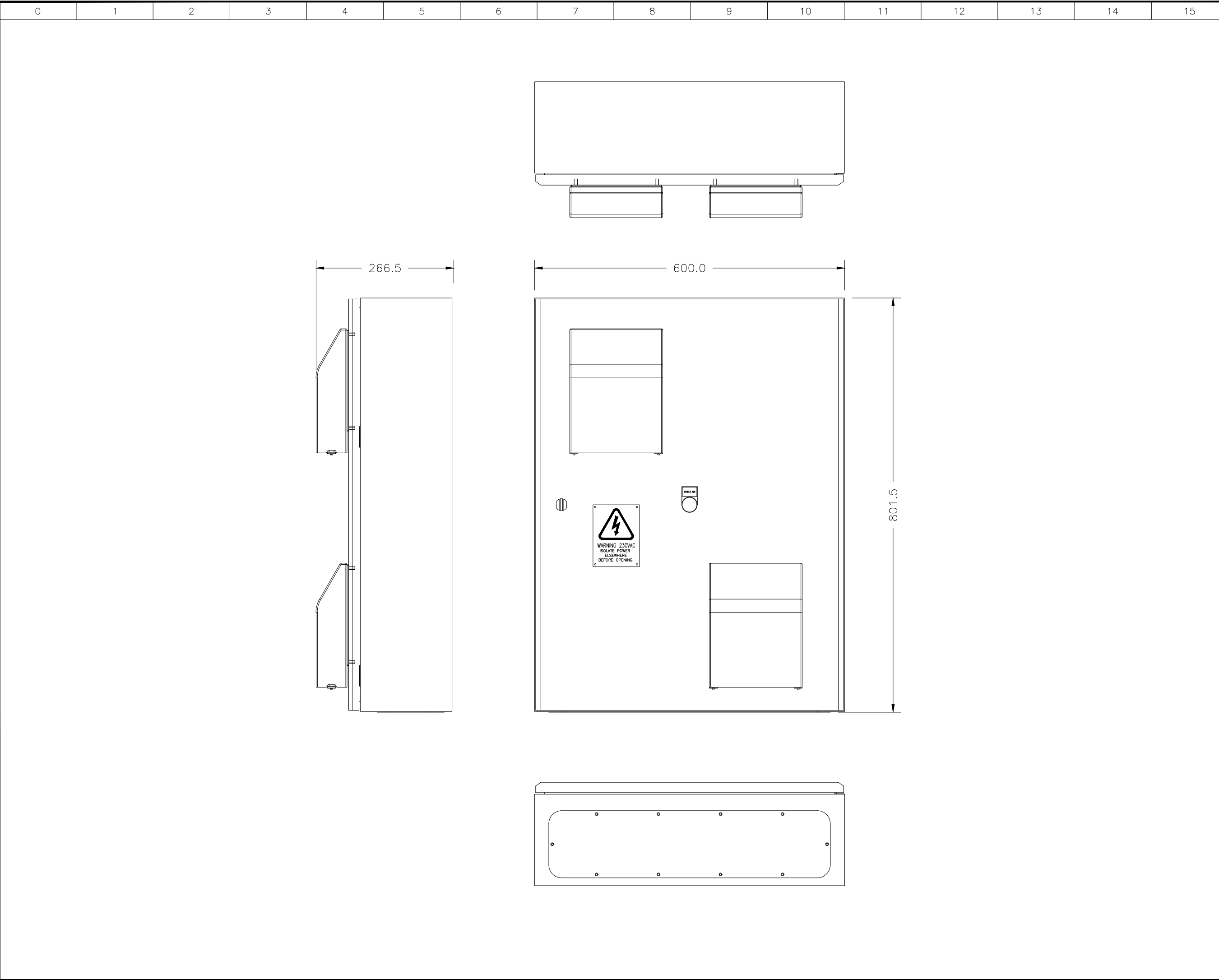
NO ONE OPENS MORE VENTS

tel 01202 744958, fax 01202 733026

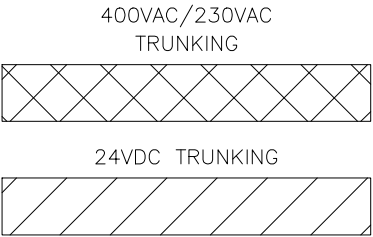
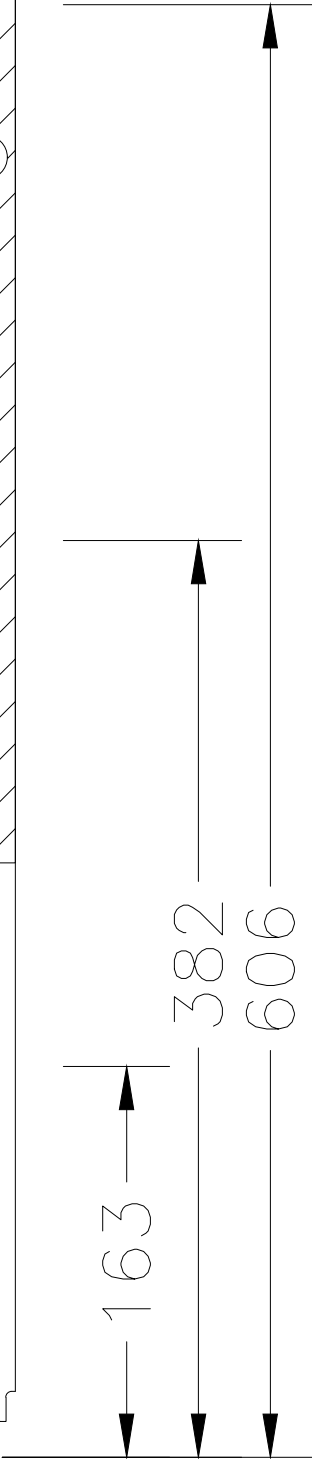
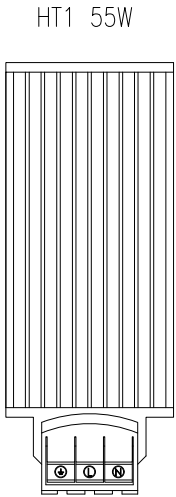
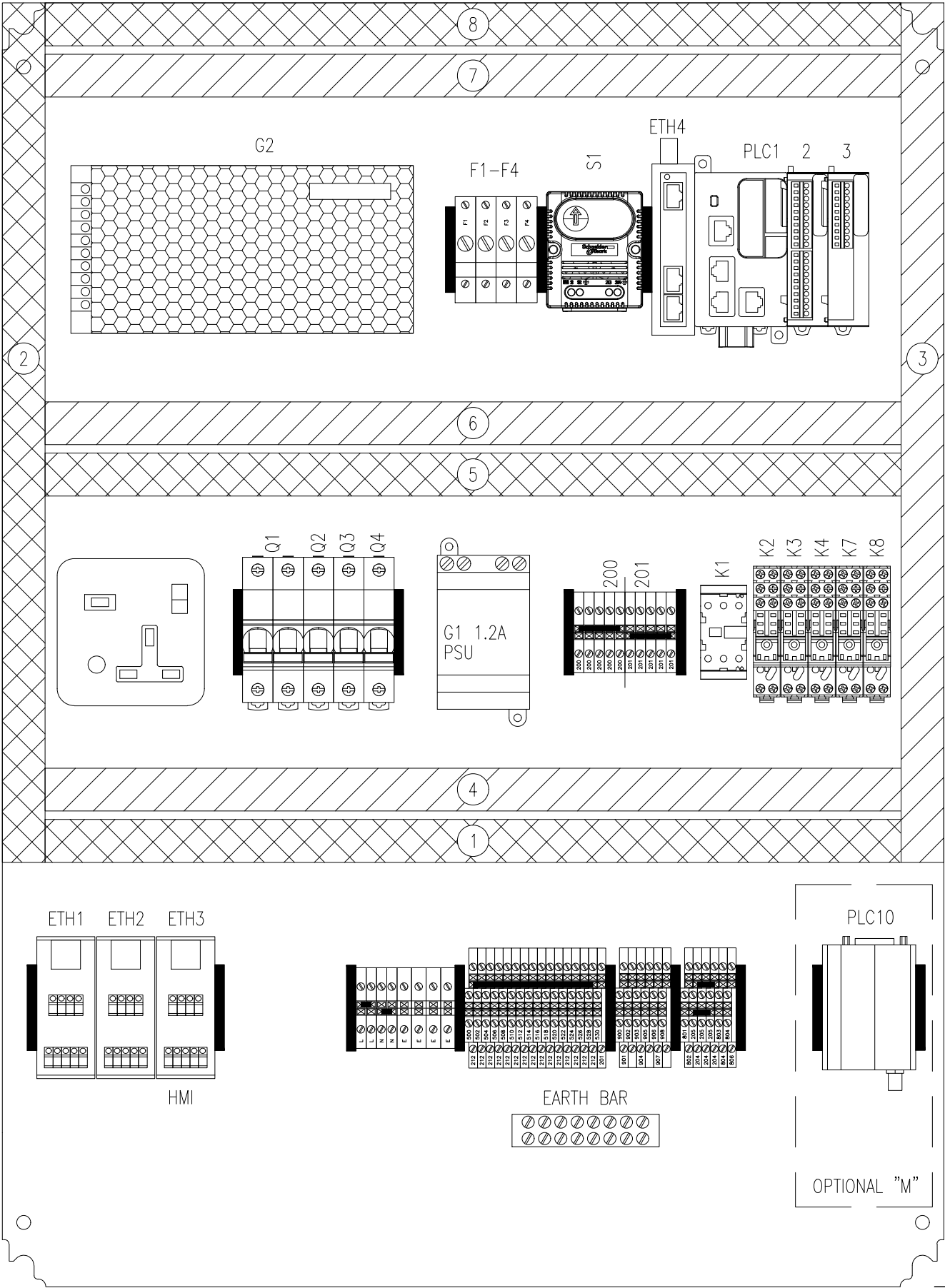
email info@vent.co.uk website www.vent.co.uk

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ENCLOSURE SPECIFICATION			
IP RATING		IP55 WEATHER PROOF	
MOUNTING		WALL MOUNTED	
PANEL TYPE		FORM 2B	
CABLE ENTRY		BOTTOM	
FINISH		POWDER COATED	
COLOUR		LIGHT GREY RAL7035	
MATERIAL		MILD STEEL	



Note:
All equipment to be fitted with a
Dymo printed label showing it's
identification.

Iss.	Date	Drawn By	DCR No.
A002	02/05/18	GPR	8,9,12,13,18

Drawing Status / Change Details
FOR PANEL BUILD

AutoCAD Drawing File
SV-CPU10AWM-003.dwg

Installation

Location

ISO SCALE
DO NOT SCALE

Third Angle Projection
Dimensions in Millimetres

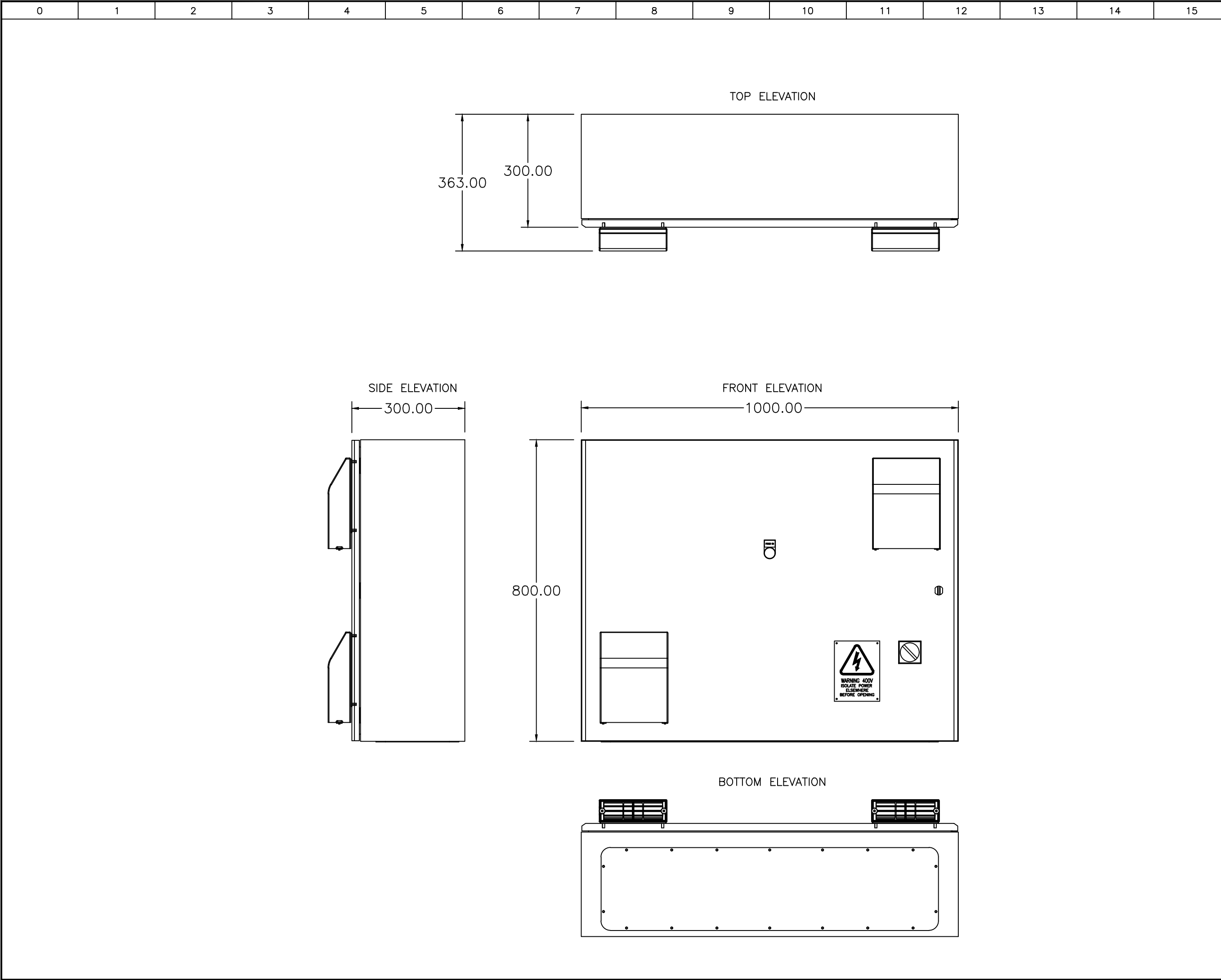


Vent Engineering
Units 16c & 16f,
Chalwyn Industrial Estate,
Poole, BH12 4PE
Tel: +44(0)1202 744958
Fax: +44(0)1202 733026
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CPU PANEL, 10A PSU,
WEATHER PROOF, OPTIONAL MODEM
EQUIPMENT LAYOUT



ENCLOSURE SPECIFICATION

IP RATING	IP55 WEATHER PROOF
MOUNTING	WALL MOUNTED
PANEL TYPE	FORM 2B
CABLE ENTRY	BOTTOM
FINISH	POWDER COATED
COLOUR	LIGHT GREY RAL7035
MATERIAL	MILD STEEL

Iss.	Date	Drawn By	DCR No.
A004	14/06/18	GPR	22, 23

Drawing Status / Change Details
FOR PANEL BUILD

AutoCAD Drawing File
SV-FPxxxKW-002.dwg

Installation

Location

ISO SCALE
DO NOT SCALE

Third Angle Projection
Dimensions in Millimetres

natural and smoke ventilation systems

Vent Engineering
Units 16C & 16F,
Chalwyn Industrial Estate,
Poole, BH12 4PE
Tel. +44(0)1202 744958
Fax. +44(0)1202 733026
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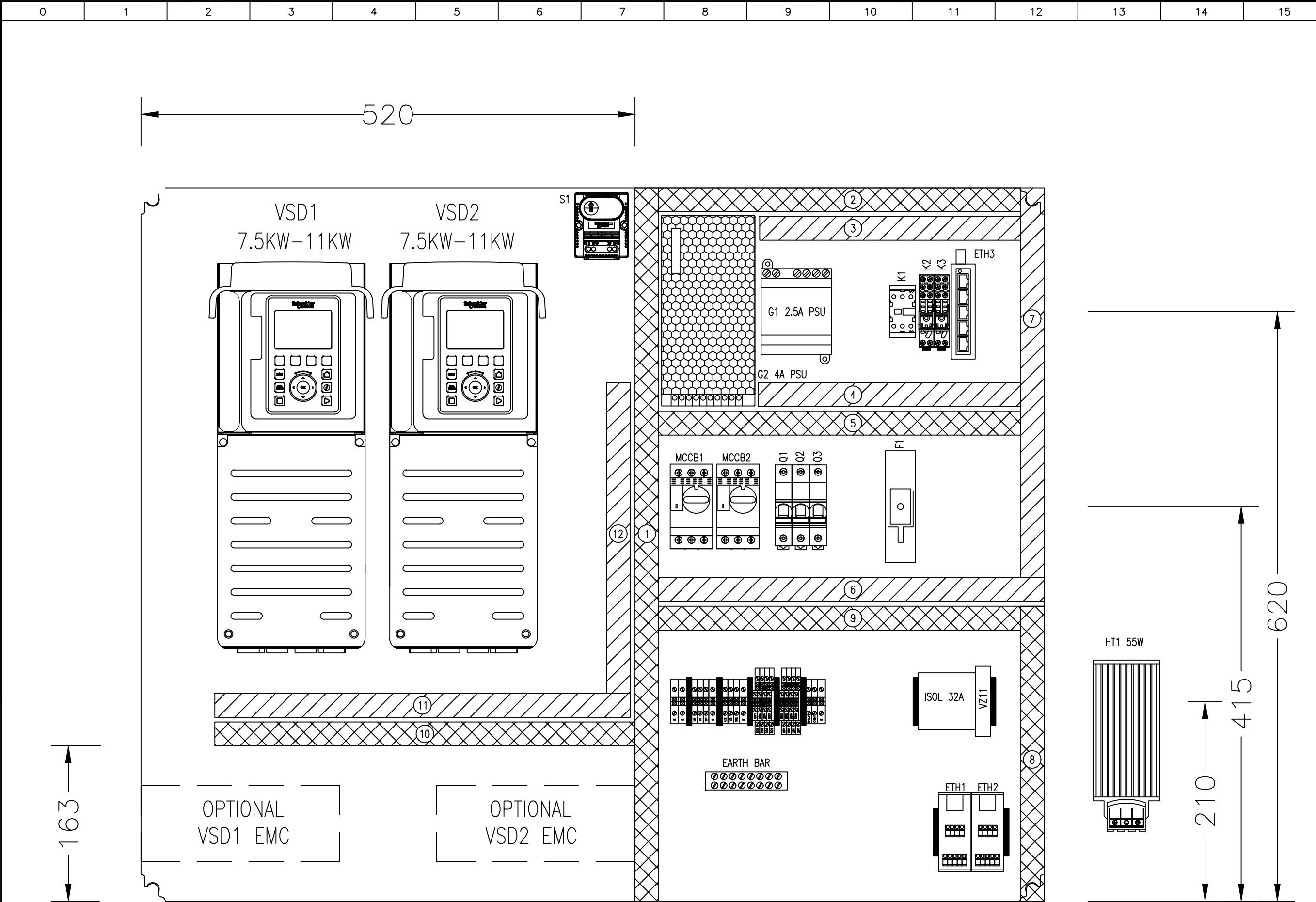
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FAN CONTROL PANEL
ENCLOSURE DETAILS
1.5KW (4A) TO 11KW (23.5A)

Drawing Number:
SV-FPxxxKW

Sheet No.:
002

A2



400VAC/230VAC TRUNKING

24VDC TRUNKING

Note:
All equipment to be fitted with a Dymo printed label showing it's identification.

Iss.	Date	Drawn By	DCR No.
A004	14/06/18	GPR	22, 23

Drawing Status / Change Details
FOR PANEL BUILD

AutoCAD Drawing File
SV-FPxxxKW-004.dwg

Installation

Location

ISO SCALE
DO NOT SCALE

Third Angle Projection
Dimensions in Millimetres

natural and smoke ventilation systems

Vent Engineering
Units 16C & 16F,
Chalwyn Industrial Estate,
Poole, BH12 4PE
Tel. +44(0)1202 734958
Fax. +44(0)1202 733026
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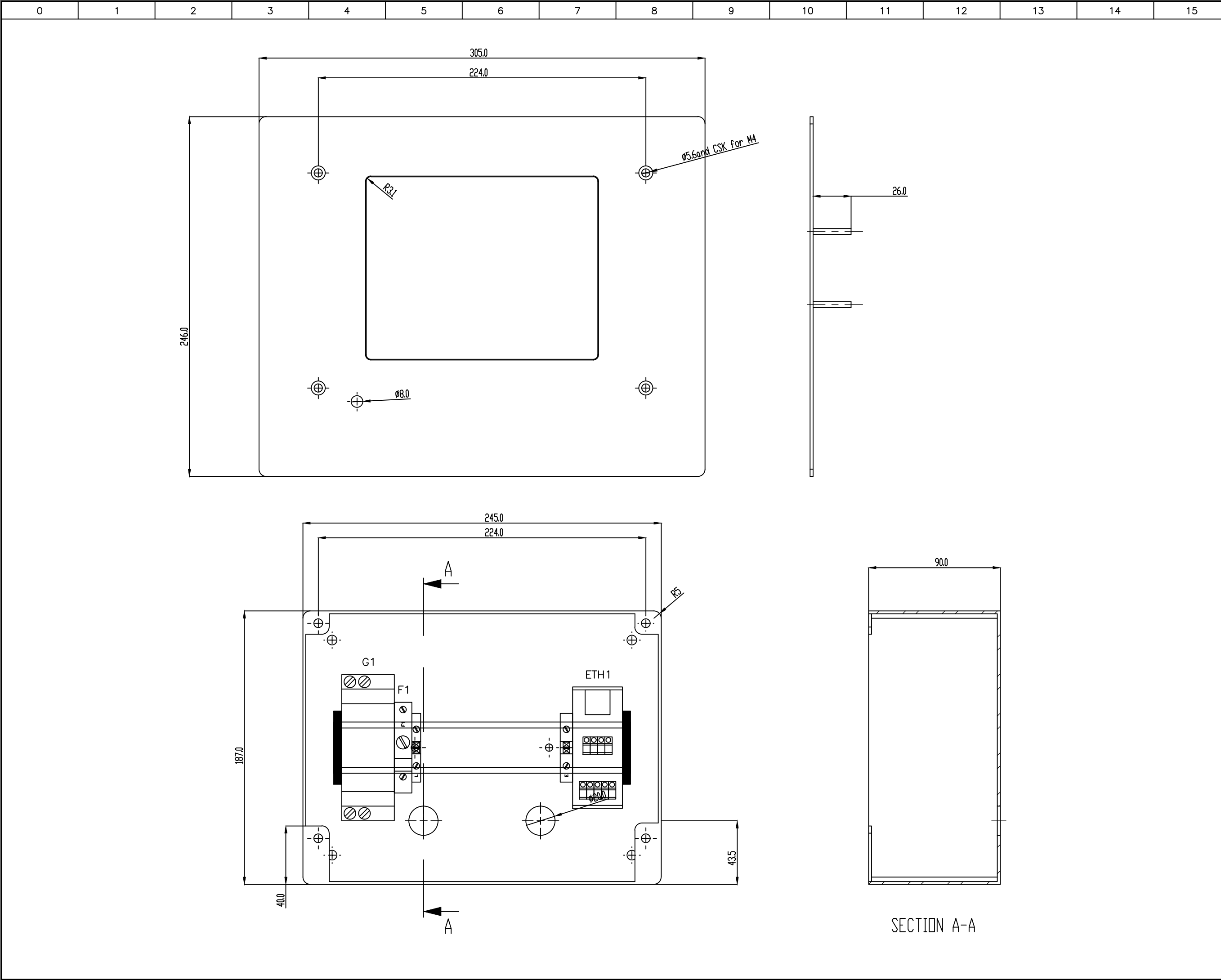
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FAN CONTROL PANEL
EQUIPMENT LAYOUT
7.5KW (16.5A) AND 11KW (23.5A)

Drawing Number:
SV-FPxxxKW

Sheet No.:
004

A2



ENCLOSURE SPECIFICATION			
IP RATING		IP20	
MOUNTING		WALL MOUNTED (SURFACE)	
FINISH		BRUSHED & Front Plate Screen Printed & Lacquered	
COLOUR		N/A	
MATERIAL		304 STAINLESS STEEL	

Model 267

Very Low Differential Pressure Transducer

Setra's Model 267 is the most rugged high accuracy, low differential pressure transducer on the market. It delivers accuracies of $\pm 1\%$ FS (without display), $\pm 0.5\%$ FS (with display), and optional $\pm 0.25\%$ FS and $\pm 0.4\%$ FS accuracies, and pressure ranges from 0.1" W.C. up to 100" W.C. The 267 is housed in a robust, NEMA 4 rated enclosure and has an optional static pressure probe reducing installation and material costs. The 267 is offered with an optional LCD display and a standard accuracy of $\pm 0.5\%$ making it ideal for high accuracy Pharmaceutical applications.

Customization is Standard

The 267, unlike most competitors, offers many mechanical and electrical options that can be integrated into existing designs. The optional 0.25" diameter pressure probe is made of sturdy extruded aluminum and is designed with baffles to prevent velocity pressure errors which saves money and reduces time on the job site.

Robust Enclosure for Difficult Applications

The 267 is housed in a NEMA 4 rated housing and is built to withstand harsh environments. The 267 is available in both wall and duct mount providing the installer with flexible mounting options. The wall mount allows the sensor to be installed anywhere, whereas the duct probe configuration is designed to maximize space efficiency in difficult applications.

The Setra Sensor

The core technology of the 267 is the all stainless steel capacitive sensing element. Setra designs and manufactures all of their sensing elements resulting in full control over the process and quality of every single sensor. The welded dead-ended capacitive sensors requires minimal amplification and delivers excellent accuracy and longterm stability. Setra's technology has been used in over 8 million installations and has the highest field acceptance rate in the industry.



- Suitable for Harsh Environments
- Optional LCD Display
- $\pm 0.25\%$, 0.4%, 0.5%, 1% FS Accuracy

Model 267 Features:

- Optional 3.5 Digit LCD Display w/ 0.5% FS Accuracy
- NEMA 4 Rated Housing
- Optional Static Pressure Probe
- PG-9, PG-13 or Conduit Electrical Termination
- 24 VAC or 24 VDC Excitation
- CE & RoHS Compliant

Applications:

- HVAC Systems
- Energy Management Systems
- Static Duct Pressure
- Cleanroom Pressure
- Oven Pressurization & Furnace Draft Controls

Model 267

Very Low Differential Pressure Transducer



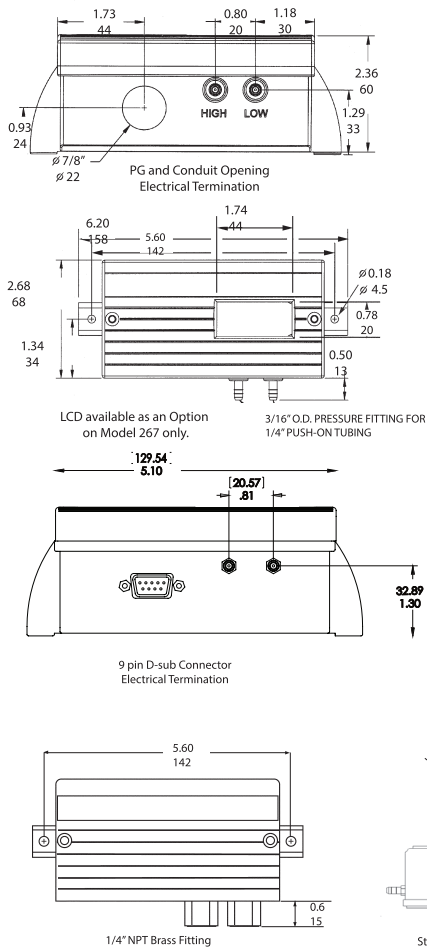
ORDERING INFORMATION

2	6	7	1	—					—			—			—				
Model				Range						Output		Pressure Fitting/Elec. Termination		Accuracy (Full Scale)					
2671 = 267				Unidirectional		Bidirectional		Unidirectional		Bidirectional		11	4-20 mA	3/16" Barbed Brass Fitting		CN	±1% FS with no LCD Display		
				OR1WD	0 to 0.1"W.C.	OR1WB	±0.1"W.C.	025LD	0 to 25 Pa	025LB	±25 Pa	2D	0-5 VDC	G1	PG-13.5 Strain Relief	EN	±0.4% FS* with no LCD Display		
				R25WD	0 to 0.25"W.C.	R25WB	±0.25"W.C.	050LD	0 to 50 Pa	050LB	±50 Pa	2E	0-10 VDC	G2	PG9 Strain Relief	FN	±0.25% FS* with no LCD Display		
				0R5WD	0 to 0.5"W.C.	0R5WB	±0.5"W.C.	100LD	0 to 100 Pa	100LB	±100 Pa			D9 ¹	9 pin D-Sub Conn.	GN	±1% FS* with no LCD Display		
				001WD	0 to 1"W.C.	001WB	±1.0"W.C.	250LD	0 to 250 Pa	250LB	±250 Pa			A1	1/2" Conduit Opening	HD	±0.5% FS* with LDC Display		
				1R5WD	0 to 1.5"W.C.	1R5WB	±1.5"W.C.	500LD	0 to 500 Pa	500LB	±500 Pa			1/4"NPTF Brass Fitting		ED	±0.4% FS* with LDC Display		
				2R5WD	0 to 2.5"W.C.	2R5WB	±2.5"W.C.	10CLD	0 to 1000 Pa	10CLB	±1000 Pa			1K	PG-9 Strain Relief	FD	±0.25% FS* with LDC Display		
				005WD	0 to 5.0"W.C.	005WB	±5.0"W.C.	25CLD	0 to 2500 Pa	25CLB	±2500 Pa			2K	PG-13.5 Strain Relief	*includes Cal Cert.			
				010WD	0 to 10"W.C.	010WB	±10"W.C.	40CLD	0 to 4000 Pa	40CLB	±4000 Pa			9K	9 Pin D-Sub Conn.				
				025WD	0 to 25"W.C.	025WB	±25"W.C.	70CLD	0 to 7000 Pa	70CLB	±7000 Pa			AK	1/2" Conduit Opening				
				050WD	0 to 50"W.C.	050WB	±50"W.C.							Static Duct Probe					
				100WD	0 to 100"W.C.	100WB	±100"W.C.							1P	PG-9 Strain Relief				
																2P	PG-13.5 Strain Relief		
																9P	9 Pin D-Sub Conn..		
																AP	1/2" Conduit Opening		

Ordering Example: Part No. 2671R25WD11G2CN for a 0 to .25 in. WC Unidirectional Range, 4-20 mA Output, 3/16" Barbed Brass Fitting, PG-9 Electrical Termination, 1% Accuracy with LCD Display

Ordering Example: Part No. 2671R25WD11G2CN for a 0 to .25 in. WC Unidirectional Range, 4-20 mA Output, 3/16" Barbed Brass Fitting, PG-9 Electrical Termination, 1% Accuracy with LCD Display

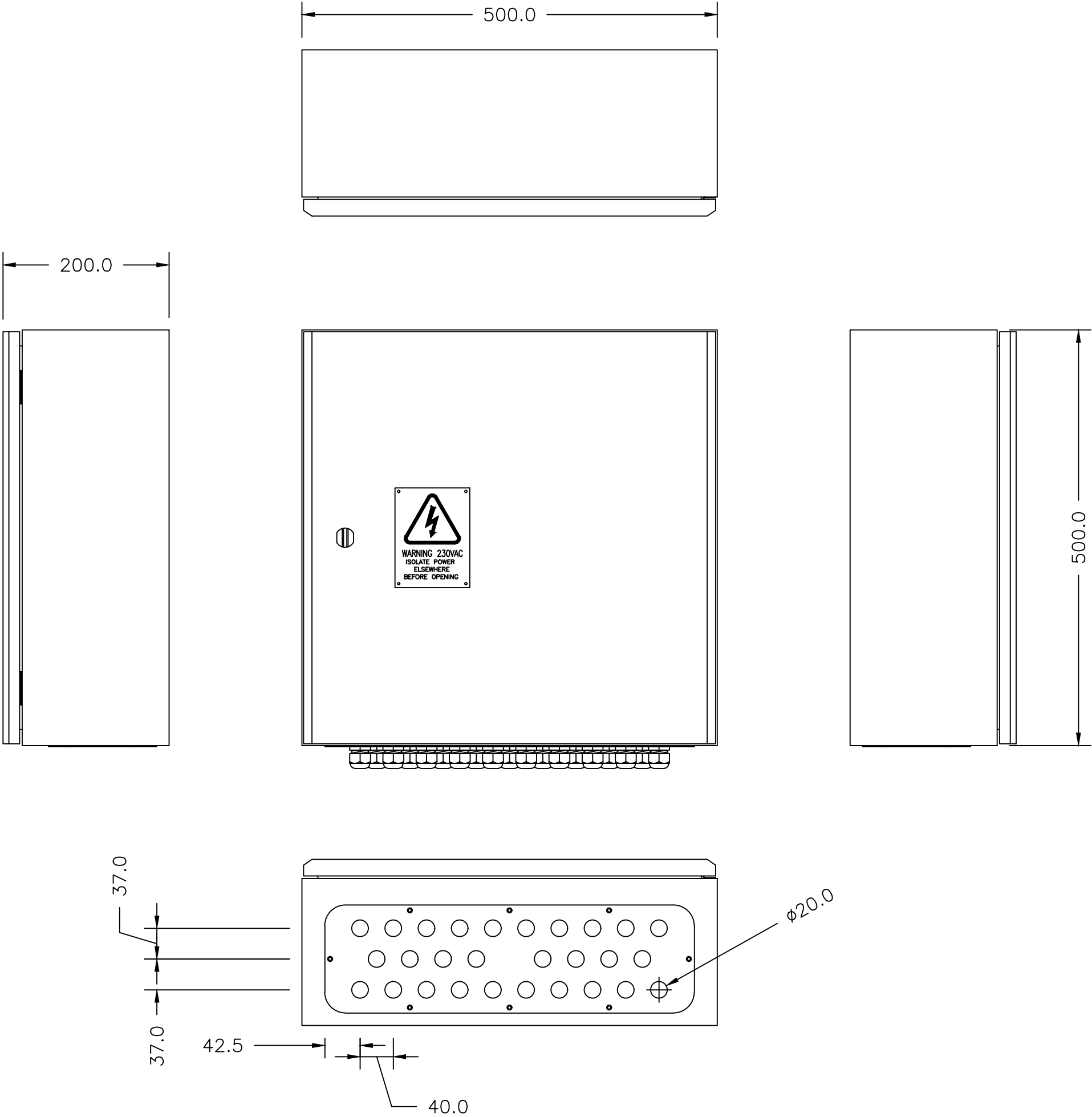
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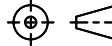


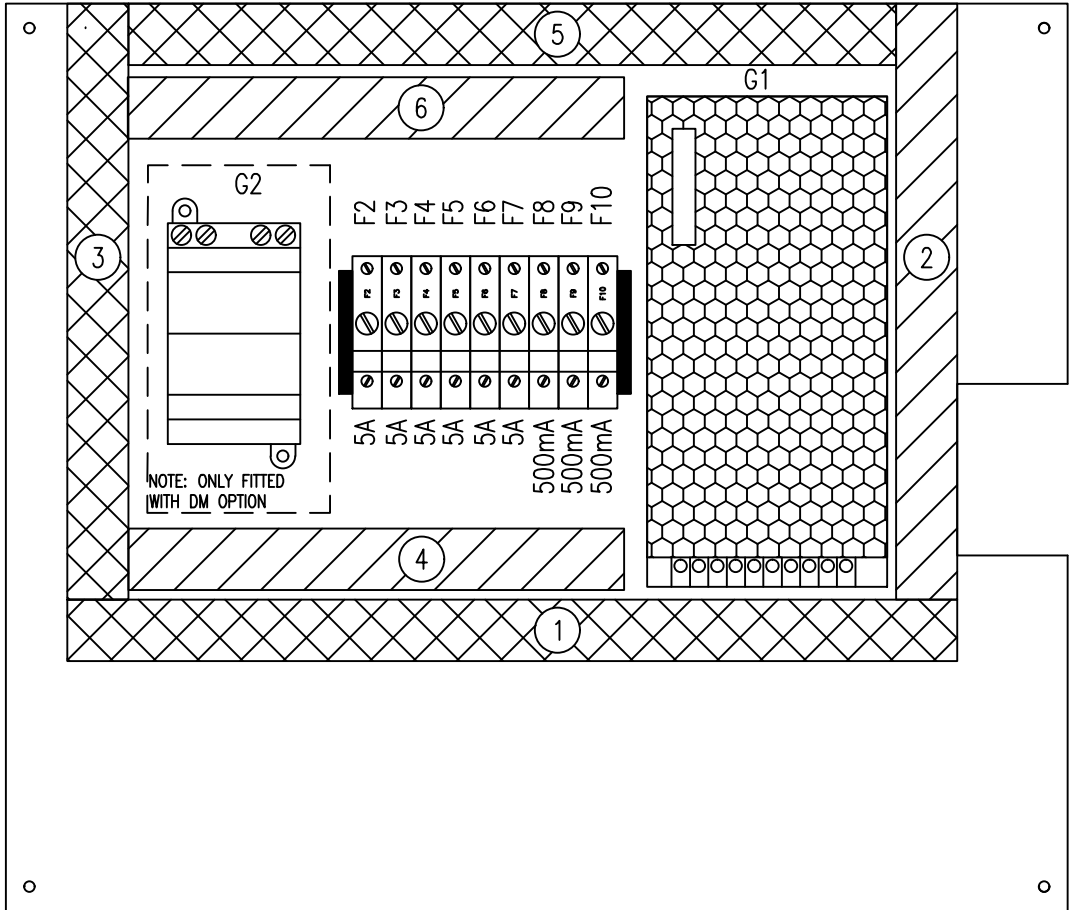
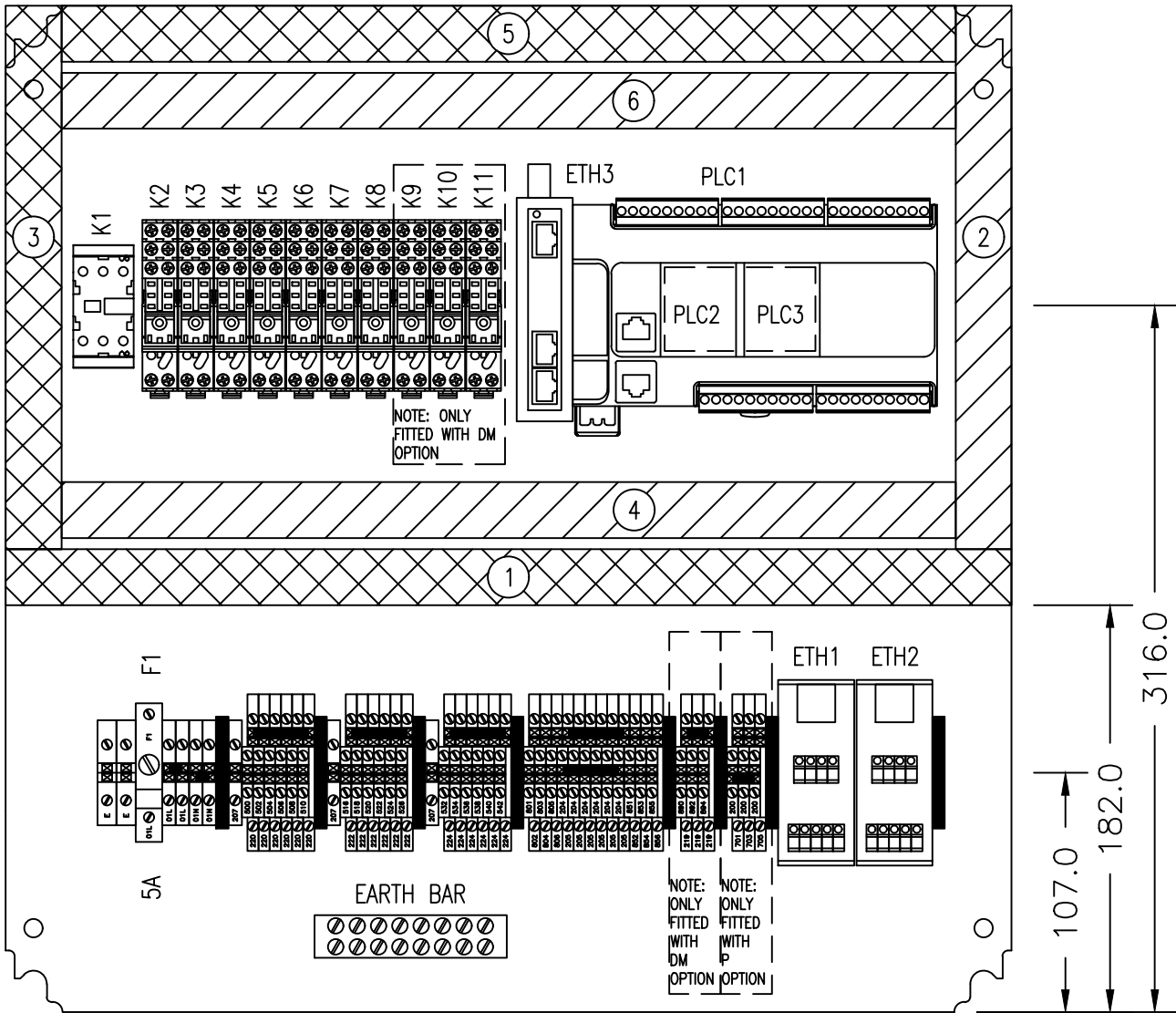
GENERAL SPECIFICATIONS

Performance Data				Physical Description	
	Standard	Optional		Case	IP65/NEMA 4 Plastic Glass-Filled Polycarbonate UL94V-0 Case
Accuracy RSS ¹ (at constant temp)	±1.0% FS	±0.4% FS	±0.25% FS	Electrical Connection	Screw Terminal Strip Inside of Case
Non-Linearity, BFSL	±0.98% FS	±0.38% FS	±0.22% FS	Electrical Terminations	PG-9/PG13.5 Strain Relief, 1/2" Conduit Opening, or 9 Pin D-Sub Connector*
Hysteresis	±0.10% FS	±0.10% FS	±0.10% FS	Zero and Span Adjustments	Accessible Inside of Case
Non-Repeatability	±0.05% FS	±0.05% FS	±0.05% FS	Weight (approx.)	9.0 Ounces (255 grams) 9.5 Ounces (Duct Probe Assembly)
Position Effect: Consult factory				Electrical Data (Current)	
Pressure Media				Circuit	2-Wire, Protected from Miswiring
Thermal Effects ^{2,3}				Output ⁷	4 to 20 mA ⁴
Compensated Range °F (°C)	+40 to +150 (+5 to +65)			Bidirectional Output at Zero	12 mA
Zero/Span Shift %FS/°F (°C)	±0.033 (±0.06)			Min. Loop Supply Voltage (VDC)	9 + 0.02 x (Resistance of Receiver plus line)
Maximum Line Pressure	10 PSI			Max. Loop Supply Voltage (VDC)	30 + 0.004 x (Resistance of Receiver plus line)
Overpressure	Up to 10 PSI (Range Dependent)			Electrical Data (Voltage)	
Long-Term Stability	0.1% FS Total			Circuit	3-Wire (Exc, Gnd, Sig), Protected from Miswiring
Environmental Data				Excitation (for 0-5 VDC Output)	9 to 30 VAC /12 to 40 VDC
Operating ⁶ Temperature °F (°C)	0 to +150 (-18 to +65)			Excitation (for 0-10 VDC Output)	11 to 30 VAC /13 to 40 VDC
Storage Temperature °F (°C)	-65 to +180 (-54 to +82)			Output ⁵	0 to 5 VDC ⁵ / 0 to 10 VDC ⁵

¹ RSS of Non-Linearity, Hysteresis, and Non-Repeatability.
² Units calibrated at nominal 70°F. Maximum thermal error computed from this datum.
³ Calibrated into a 50K ohm load, operable into a 5000 ohm load or greater.
⁴ Zero output factory set to within ±0.16 mA (±0.08 mA for optional accuracies). Span (Full Scale) output factory set to within ±0.16 mA (±0.08 mA for optional accuracy).
⁵ Zero output factory set to within ±50mV (±25 mV for optional accuracies). Span (Full Scale) output factory set to within ±50mV (±25 mV for optional accuracies).
⁶ Operating temperature limits of the electronics only. Pressure media temperatures may be considerably higher.
⁷ Calibrated at factory with a 24 VDC loop supply voltage and a 250 ohm load.



ENCLOSURE SPECIFICATION			
IP RATING		IP55 WEATHER PROOF	
MOUNTING		WALL MOUNTED	
PANEL TYPE		FORM 2B	
CABLE ENTRY		BOTTOM	
FINISH		POWDER COATED	
COLOUR		LIGHT GREY RAL7035	
MATERIAL		MILD STEEL	
Iss.	Date	Drawn By	DCR No.
A001	19/06/18	GPR	21, 25, 26
Drawing Status / Change Details DRAFT			
AutoCAD Drawing File ZPAC10A024-002.dwg			
Installation			
Location			
ISO SCALE DO NOT SCALE		 Third Angle Projection Dimensions in Millimetres	
 natural and smoke ventilation systems		Vent Engineering Units 16C & 16F, Chalwyn Industrial Estate, Poole, BH12 4PE Tel. +44(0)1202 744958 Fax. +44(0)1202 733026 www.vent.co.uk	
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ADVANCED ZONE PANEL COMPACT 10A 24VDC ENCLOSURE DETAILS			
Drawing Number: SV-ZPAC10A024		Sheet No.: 002	A2



230VAC TRUNKING

24VDC TRUNKING

Note:
All equipment to be fitted with a
Dymo printed label showing it's
identification.

Iss.	Date	Drawn By	DCR No.
A001	19/06/18	GPR	21, 25, 26

Drawing Status / Change Details
DRAFT

AutoCAD Drawing File
ZPAC10A024-003.dwg

Installation

Location

ISO SCALE
DO NOT SCALE

Third Angle Projection
Dimensions in Millimetres

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Units 16C & 16F,
Chalwyn Industrial Estate,
Poole, BH12 4PE
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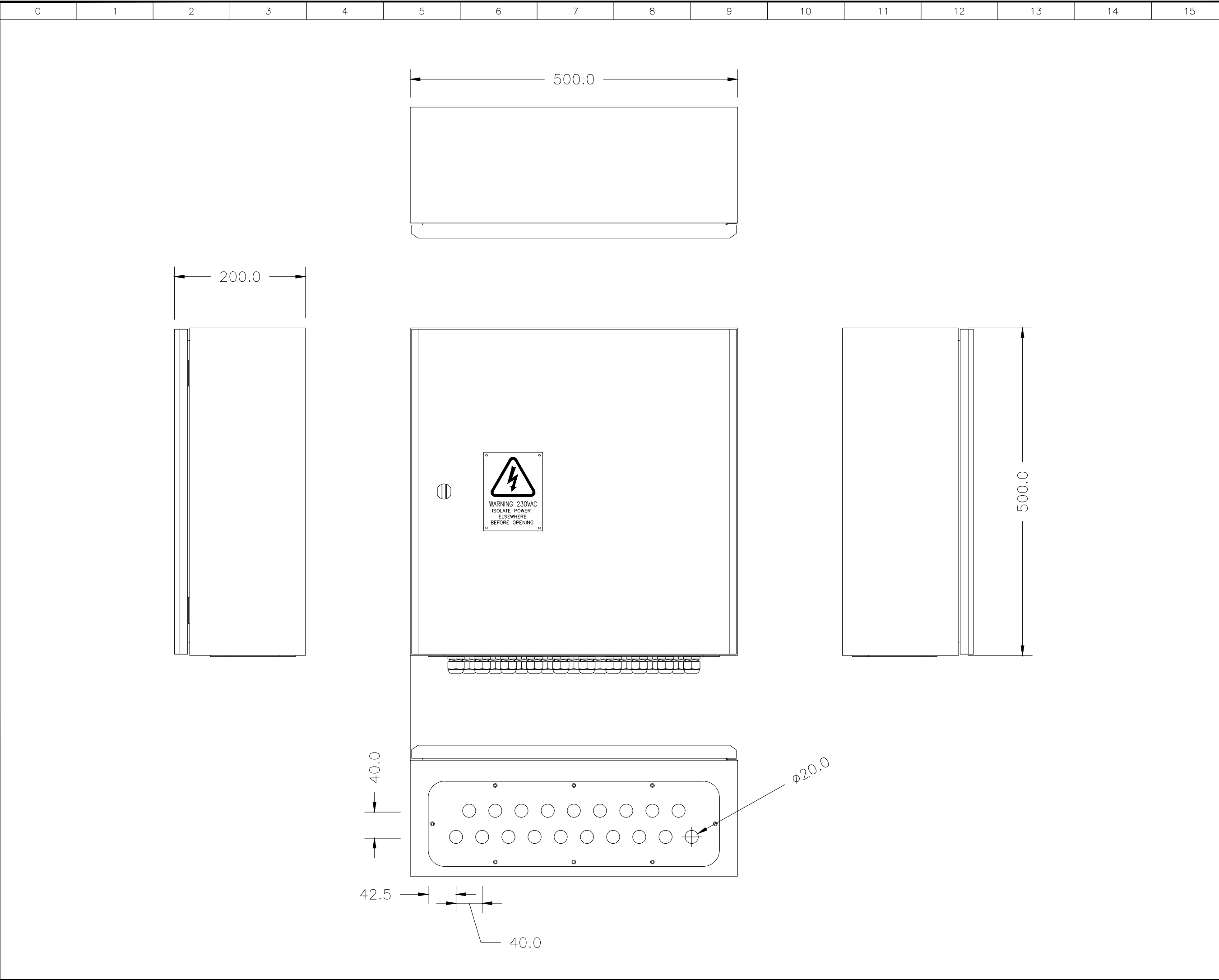
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ADVANCED ZONE PANEL COMPACT
10A 24VDC
EQUIPMENT LAYOUT

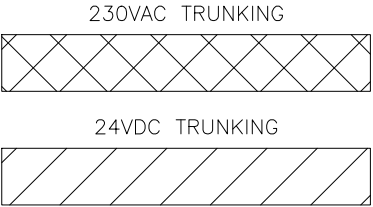
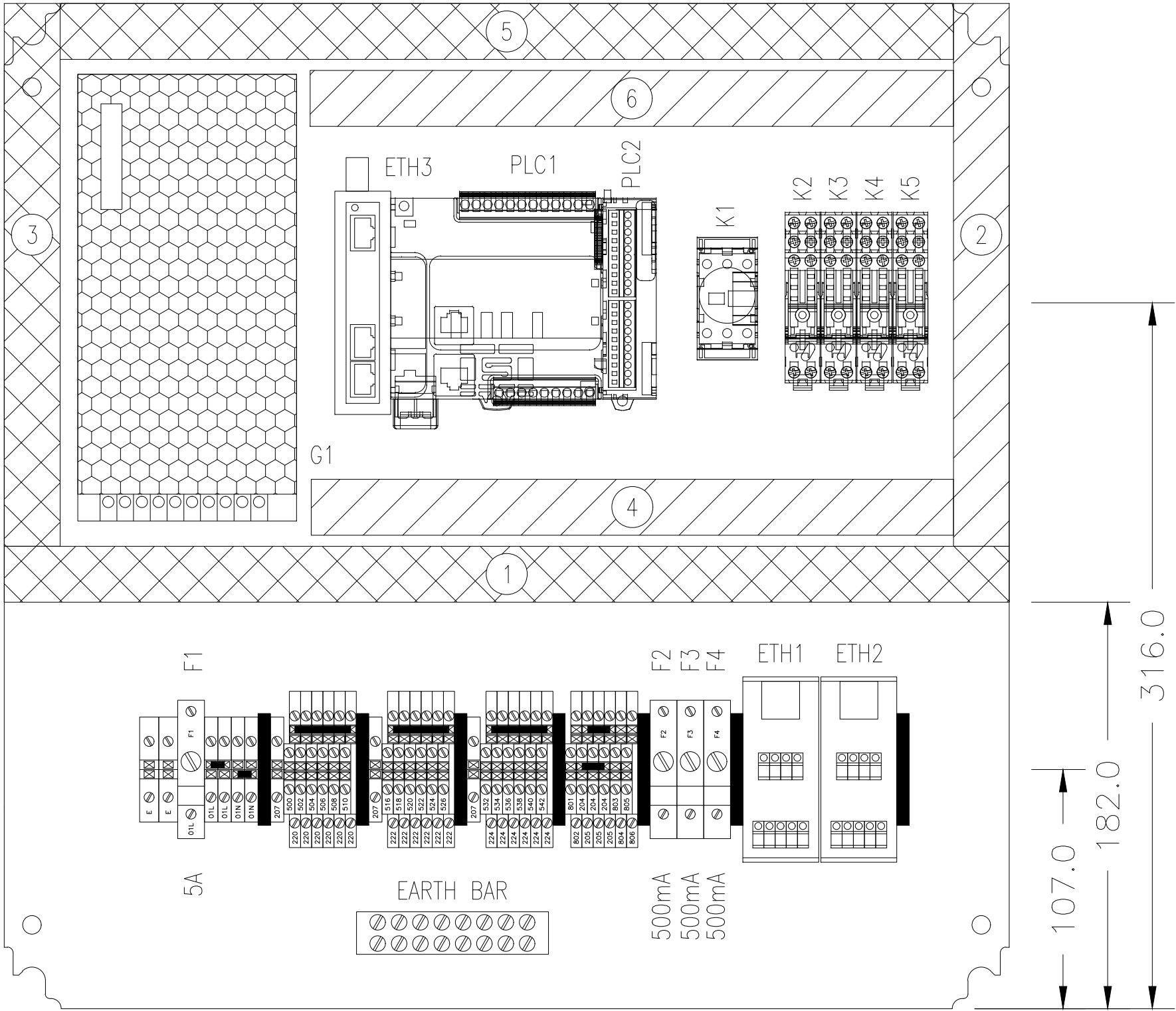
Drawing Number:
SV-ZPAC10A024

Sheet
No.:
003

A2



ENCLOSURE SPECIFICATION			
IP RATING		IP55 WEATHER PROOF	
MOUNTING		WALL MOUNTED	
PANEL TYPE		FORM 2B	
CABLE ENTRY		BOTTOM	
FINISH		POWDER COATED	
COLOUR		LIGHT GREY RAL7035	
MATERIAL		MILD STEEL	
</			



Note:
All equipment to be fitted with a
Dymo printed label showing it's
identification.

Iss.	Date	Drawn By	DCR No.
A004	02/02/18	GPR	8,9,12,13,18

Drawing Status / Change Details
DRAFT

AutoCAD Drawing File
ZPS04A024--003.dwg

Installation

Location

ISO SCALE
DO NOT SCALE

Third Angle Projection
Dimensions in Millimetres



Vent Engineering
Units 16c & 16f,
Chalwyn Industrial Estate,
Poole, BH12 4PE
Tel. +44(0)1202 744958
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STANDARD ZONE PANEL 4A 24VDC
EQUIPMENT LAYOUT

SPECIFICATION

MATERIAL:

ABS PLASTIC WITH
TRANSPARENT COVER.

SIZE

86W x 86H x 52D

COLOUR

ORANGE

IP

IP24D

SWITCH

Rocker Switch, Non Illuminated,
DPDT, Spring to Centre
(On)–Off–(On), Black, Panel,
16 A

F0.5/WH

AUTO

OFF

RUN

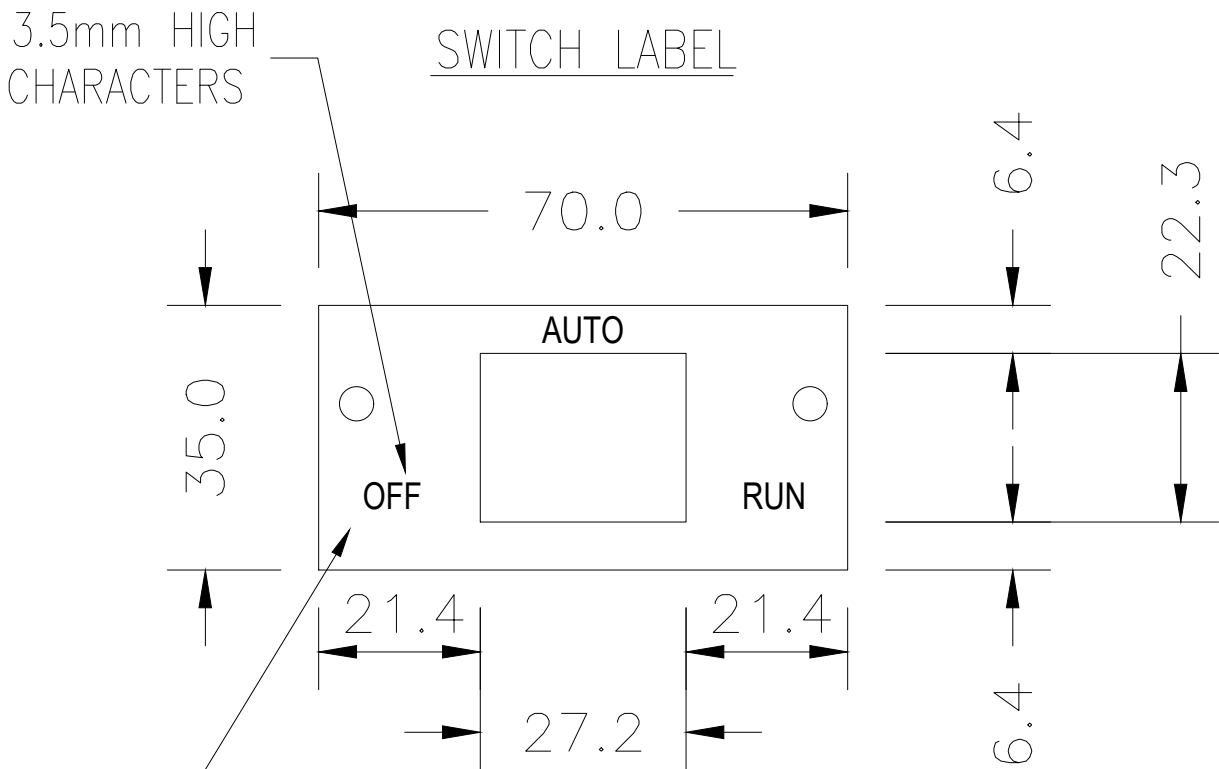
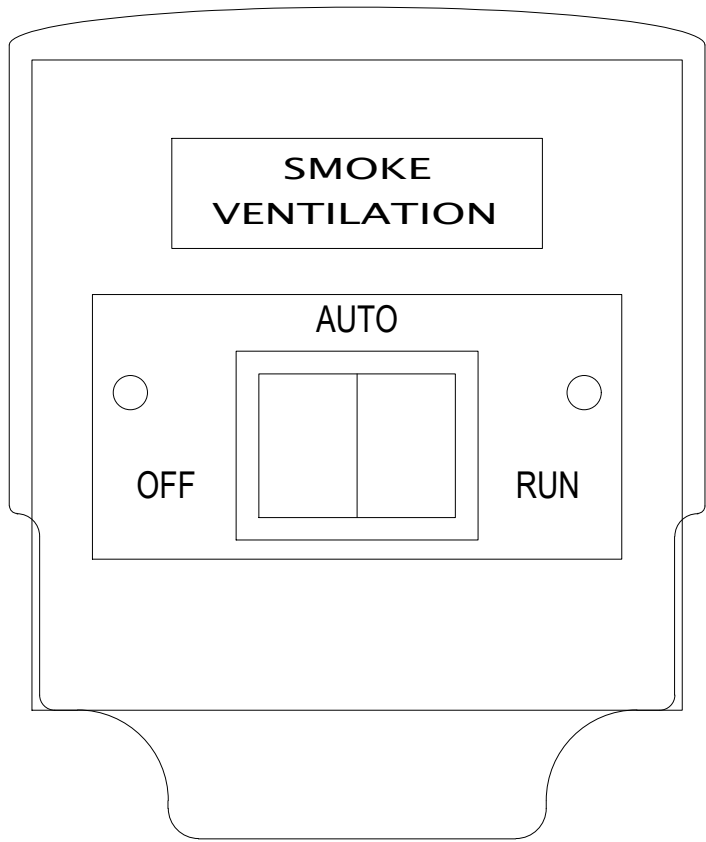
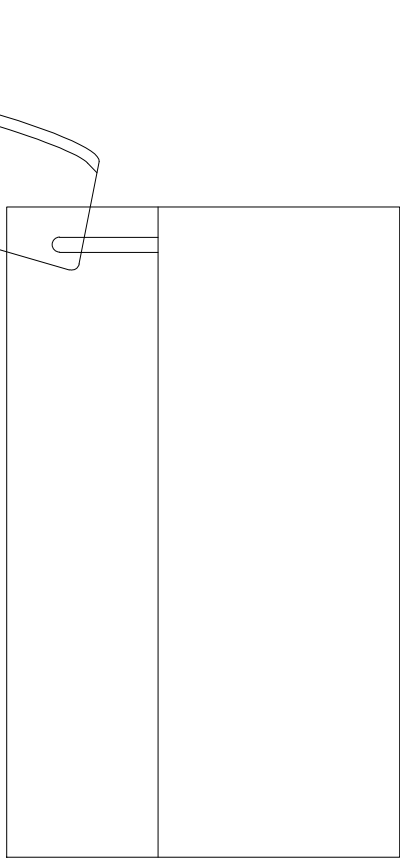
F0.5/WH

SPARE

SPARE

SPARE

SPARE



Material
PCAB ABS

MATERIAL:
CLEAN AND SCRATCH FREE
NOTE:
ALL CHARACTERS TO HAVE HEIGHT
AS SHOWN AND EQUALLY SPACED
ABOUT THE VERTICAL CENTER LINE.

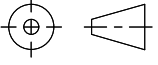
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A002	03/02/17	GPR	N/A

Drawing Status / Change Details

AutoCAD Drawing File
SV-OSL-001.dwg

Installation

Location

ISO SCALE DO NOT SCALE	 Third Angle Projection Dimensions in Millimetres
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life safety smoke ventilation systems

Vent Mechanical
Units 16c & 16f
Chalwyn Industrial Estate,
Pools, BH12 4PE
Tel. +44(0)1202 744958
Fax. +44(0)1202 733026
www.vent.co.uk

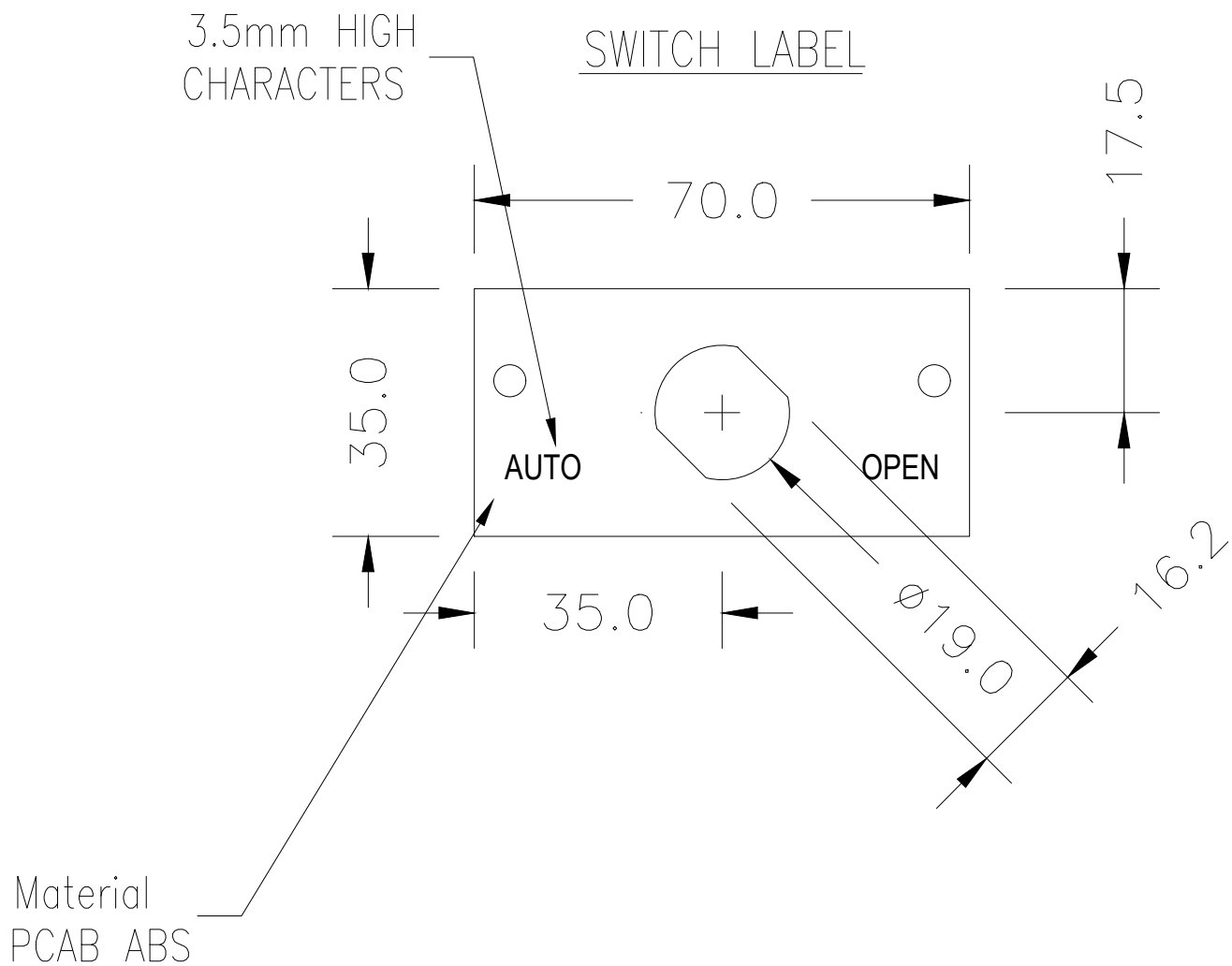
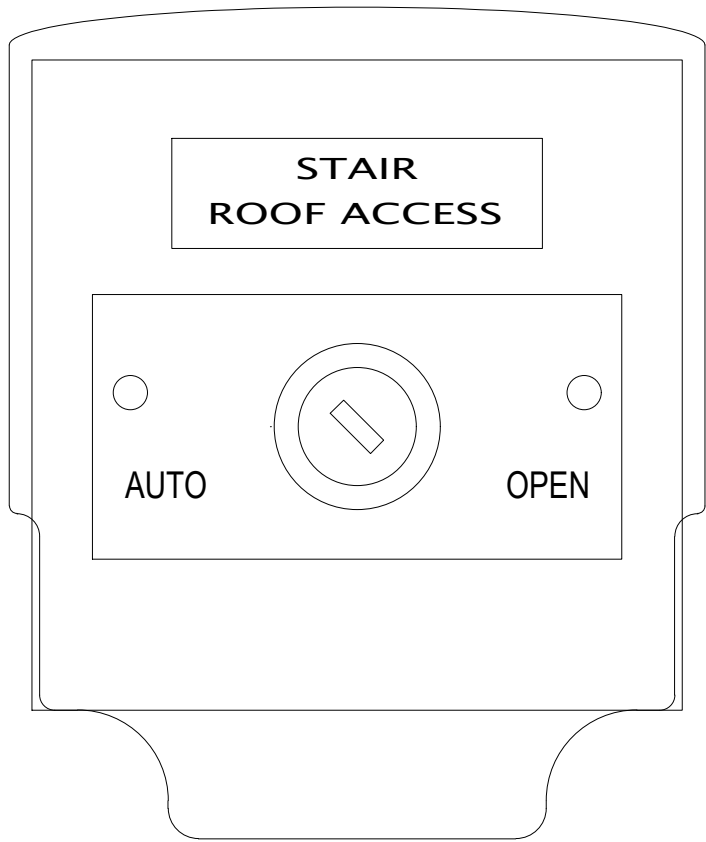
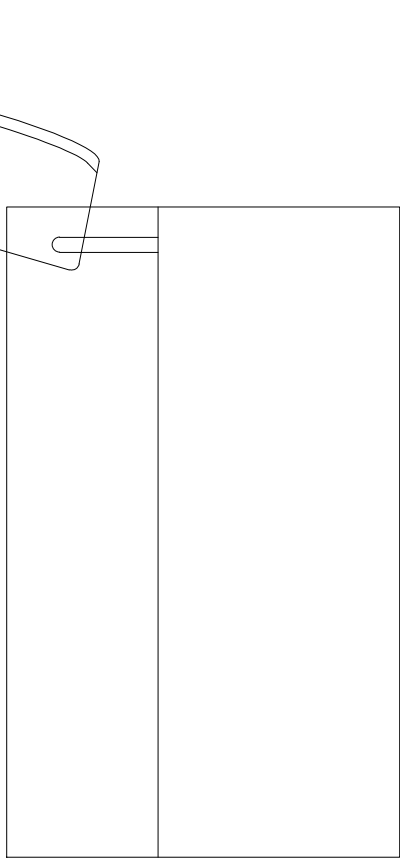
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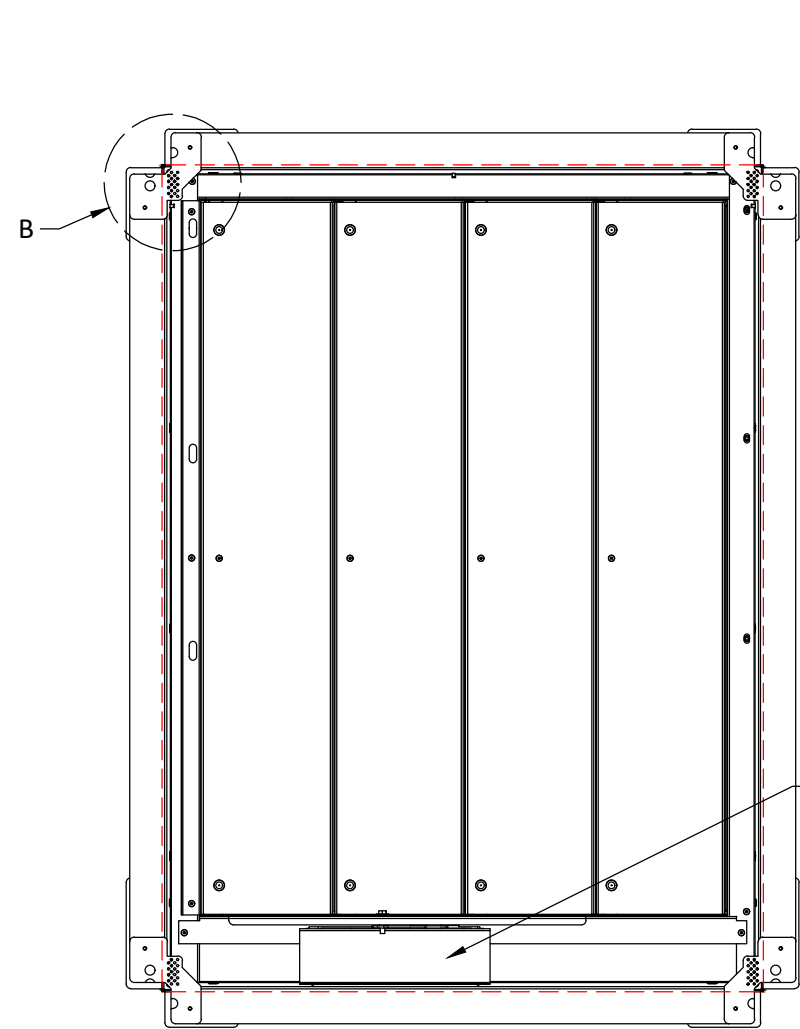
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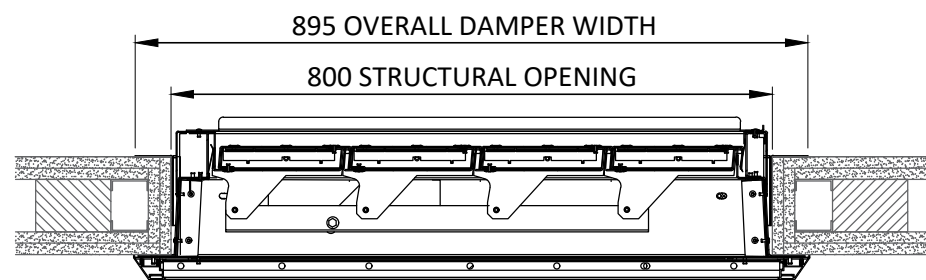
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MATERIAL:	ABS PLASTIC WITH TRANSPARENT COVER.
SIZE	86W x 86H x 52D
COLOUR	ORANGE
IP	IP24D
SWITCH	Key Switch, DPST, Stay Put On–Off, Nickle, 2A, Key Removal in Both Positions



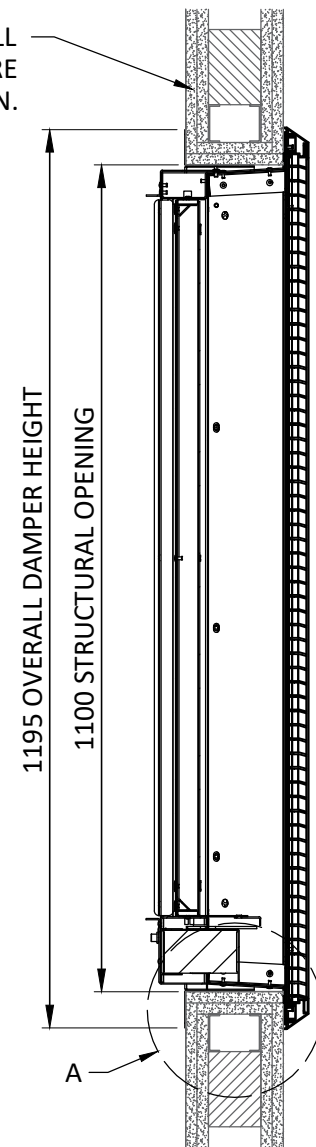
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CLEAN AND SCRATCH FREE			
NOTE:			
ALL CHARACTERS TO HAVE HEIGHT AS SHOWN AND EQUALLY SPACED ABOUT THE VERTICAL CENTER LINE.			



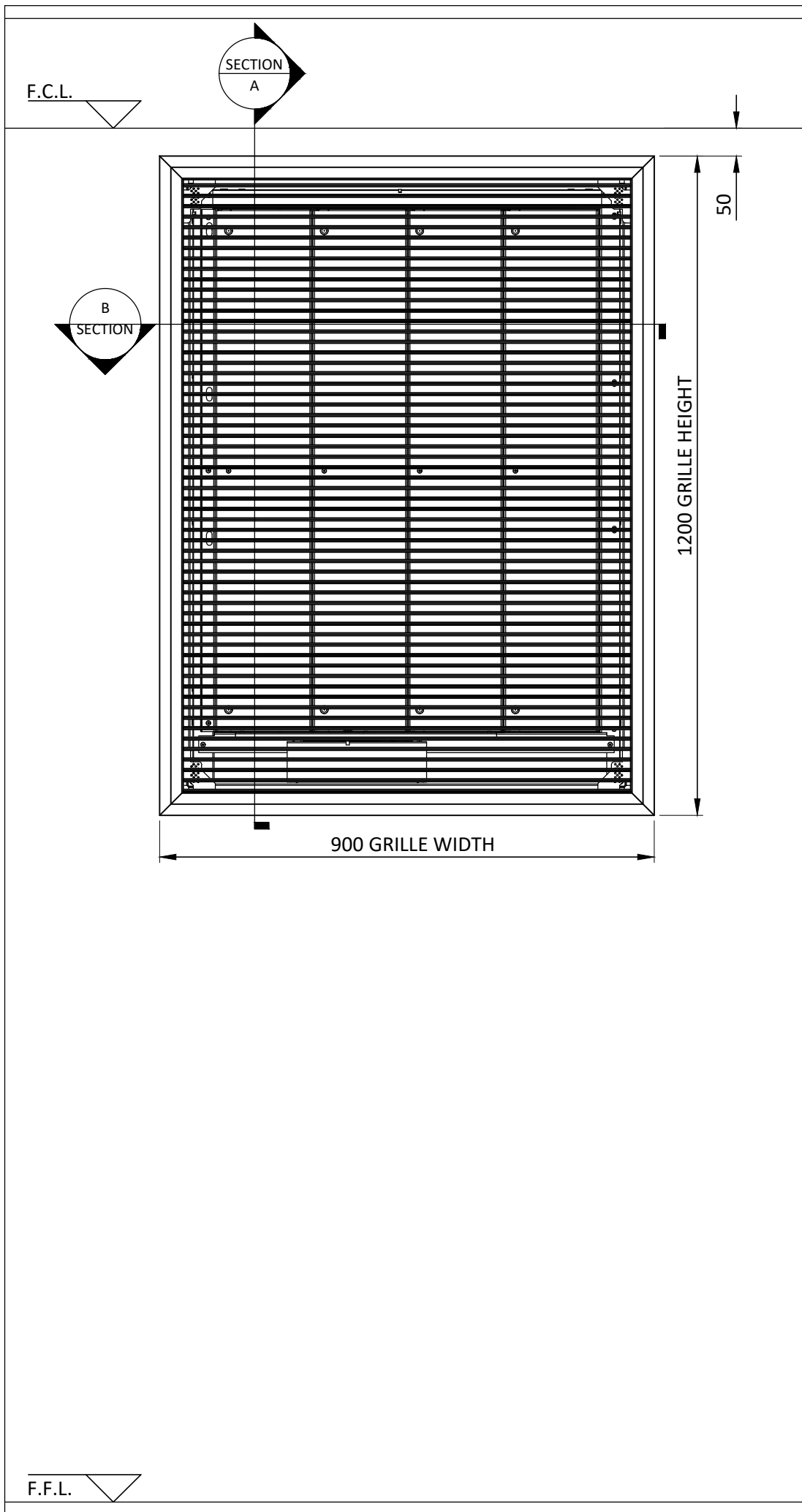
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SCALE 1:10



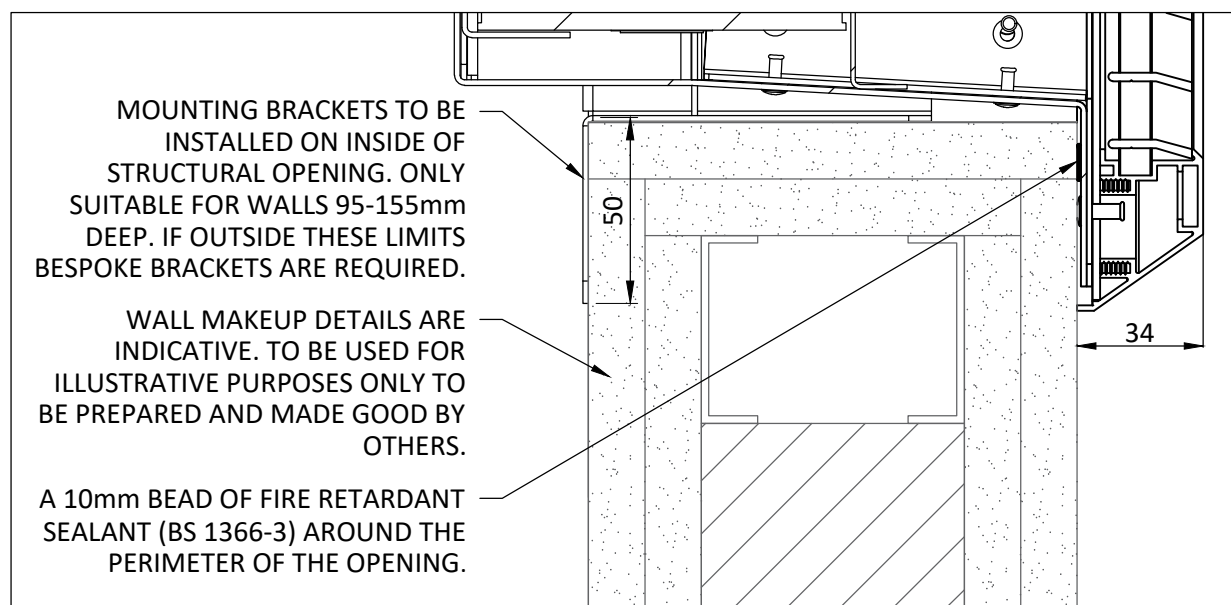
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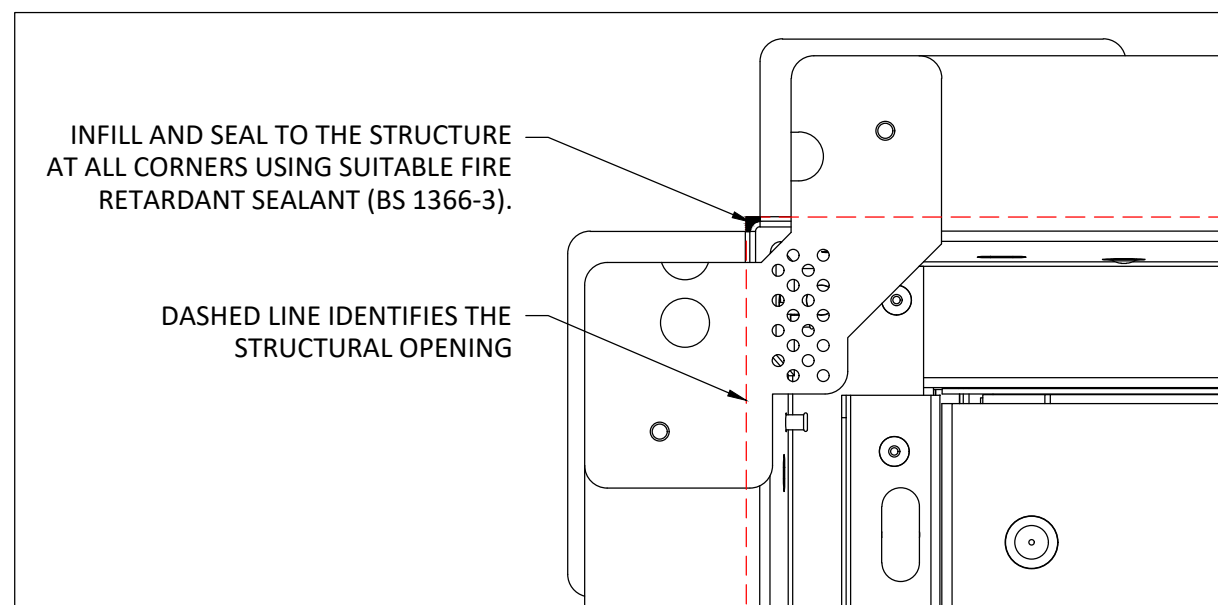
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SCALE 1:10



DAMPER POSITION DETAIL
SCALE 1:10



DETAIL A
SCALE 1:2

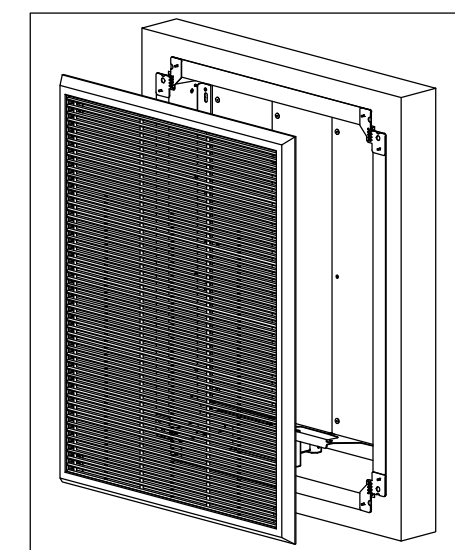


DETAIL B
SCALE 1:2

ALL DIMENSIONS ARE IN MILLIMETERS

NOTES:

- DAMPER TYPE - SERIES 60
- STRUCTURAL OPENING; 800mm (W) x 1100mm (H)
- AS PART OF THE EN 12101:8 & EN 1366:10 STANDARDS THE DAMPER HAS UNDERGONE AN EN 1366:2 TEST AND LASTED OVER 120 MINUTES FOR FIRE INTEGRITY (E120).
- LOW LEAKAGE RATE
- MANUFACTURED FROM 1.5mm GALVANISED STEEL
- OPERATED VIA A BELIMO ACTUATOR 24Vdc, POWER OPEN / POWER CLOSE.
- FITTED WITH 15° FRONT COVER GRILLES, WITH CONCEALED FIXINGS TO ENABLE THE COVER GRILLES TO BE FIXED TO THE DAMPER FRONT.
- COVER GRILLES POLYESTER POWDER COATED RAL 9010 WHITE 20% GLOSS.
- APPROXIMATE WEIGHT: 50kg
- GEOMETRIC FREE AREA OF DAMPER: 0.6m²



ISOMETRIC VIEW
INDICATIVE SIZED DAMPER

C	21.07.21	DAMPER CHANGED TO SERIES 60	CIP	AJM
B	30.10.19	QUANTITIES	CIP	AJM
A	23.10.19	FIRST ISSUE FOR APPROVAL	CIP	AJM
REV	DATE	DETAILS	DRW BY	CHK BY
DRAWING REVISION DETAILS				



VENT ENGINEERING
UNITS 16C & 16F,
CHALWYN INDUSTRIAL ESTATE
POOLE, BH12 4PE
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CLIENT
AMEON

PROJECT
ANGEL MEADOWS
PLOTS 2 & 3

SALES ORDER No.
TBC

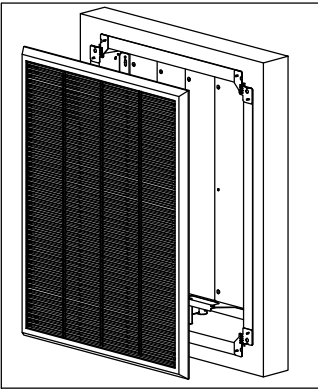
DRAWING TITLE
VENTEC SMOKE DAMPER & GRILLE

DRAWING STATUS
☐ PRELIMINARY ☒ APPROVAL
☐ CONSTRUCTION ☐ AS BUILT
☐ INFORMATION ONLY

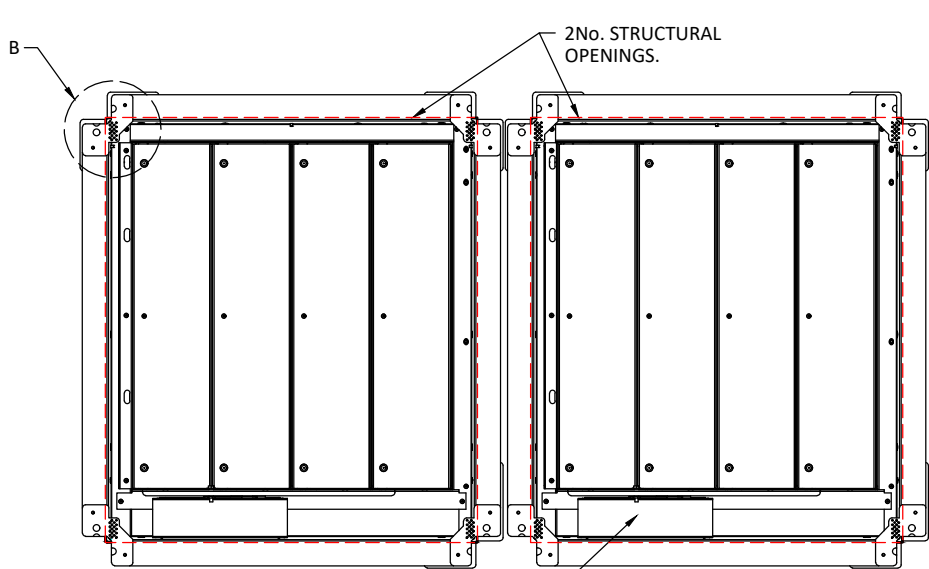
DRAWN DATE SCALE SHEET
CIP 23.10.19 NTS A2

DRAWING No. REV
MS-DS-20262-200 C

DAMPER QUANTITIES			
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	LHS	RHS	
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2	1	1	1
3	1	1	1
4	1	1	1
5	1	1	1
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21	0	0	
	21	20	17
TOTAL 58			

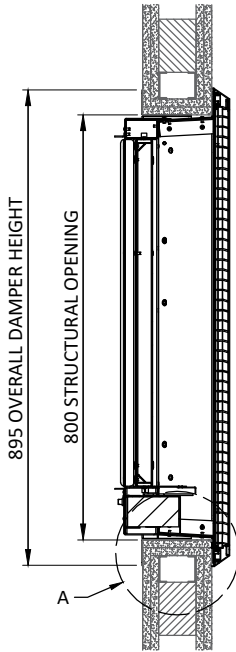


ISOMETRIC VIEW
INDICATIVE SIZED DAMPER

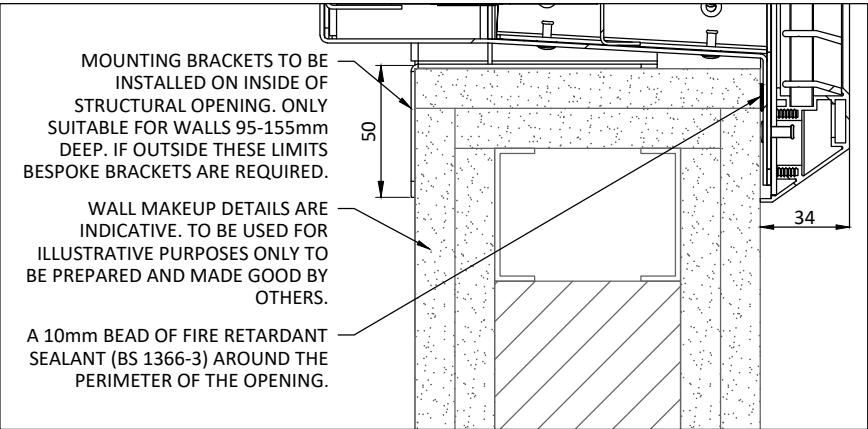


24Vac ACTUATOR.
CABLE ROUTE THROUGH BODY MUST BE
SEALED BY A FIRE RATED GROMMET AND
OR SEALANT TO THE REQUIRED BUILDING
LEAKAGE SPECIFICATION (BS 1366-3) AND
NOT FOUL ANY MOVING PARTS.

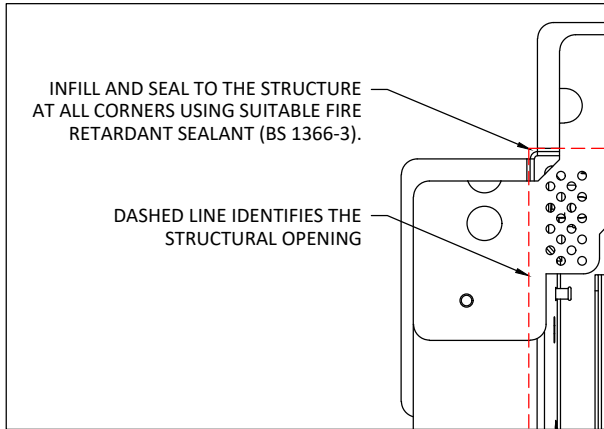
FRONT VIEW (WITHOUT GRILLE)
SCALE 1:10



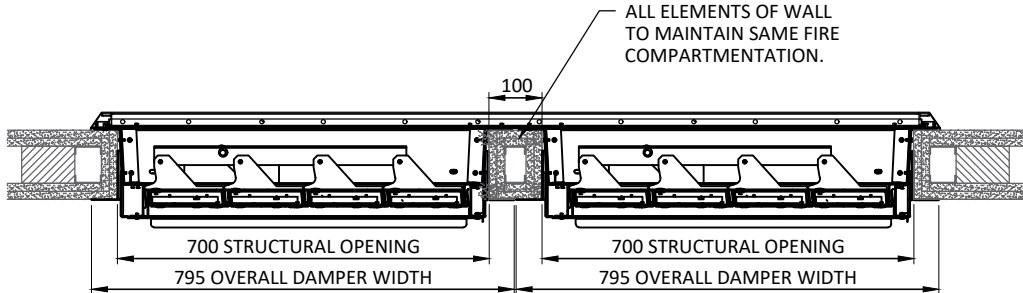
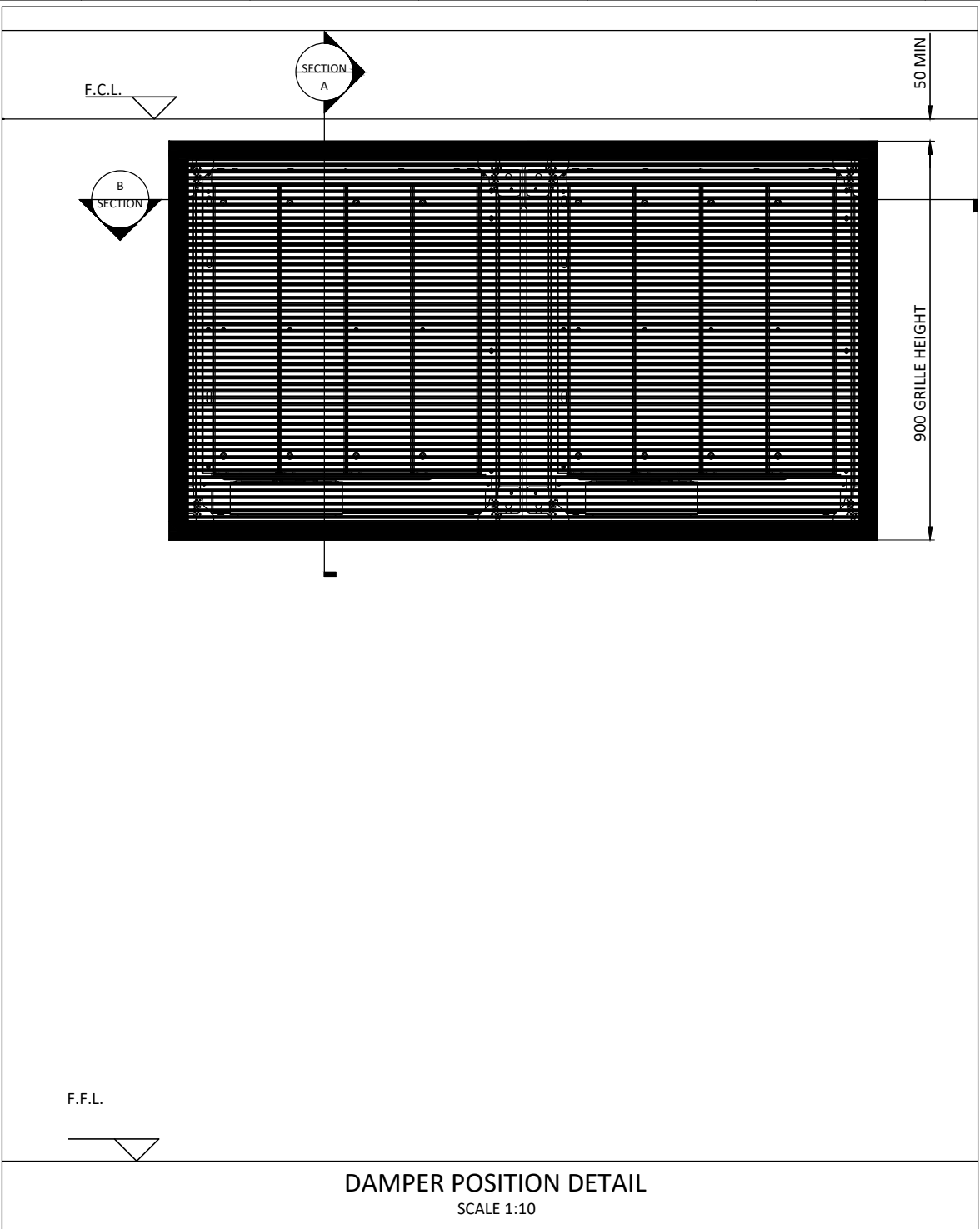
SECTION A
SCALE 1:10



DETAIL A
SCALE 1:2



DETAIL B
SCALE 1:2



SECTION B
SCALE 1:10

- ALL DIMENSIONS ARE IN MILLIMETRES
- NOTES:
- DAMPER TYPE - SERIES 60
 - STRUCTURAL OPENINGS; 2No 700mm (W) x 800mm (H), WITH MIN 200mm GAP BETWEEN
 - AS PART OF THE EN 12101:8 & EN 1366:10 STANDARDS THE DAMPER HAS UNDERGONE AN EN 1366:2 TEST AND LASTED OVER 120 MINUTES FOR FIRE INTEGRITY (E120).
 - LOW LEAKAGE RATE
 - MANUFACTURED FROM 1.5mm GALVANISED STEEL
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 - FITTED WITH 15° FRONT COVER GRILLES, WITH CONCEALED FIXINGS TO ENABLE THE COVER GRILLES TO BE FIXED TO THE DAMPER FRONT.
 - COVER GRILLES POLYESTER POWDER COATED RAL 9010 WHITE 20% GLOSS.
 - APPROXIMATE WEIGHT 35kg (EACH)
 - COMBINED GEOMETRIC FREE AREA OF DAMPERS: 0.6m²

F	21.07.21	DAMPER DESIGN CHANGED FROM 54 SERIES TO 60 SERIES	RK	AJM
E	12.11.20	RAL COLOUR CHANGED	RK	RA
D	04.08.20	CHART ADDED. RAL COLOUR CHANGED	CIP	AJM
C	22.07.20	WIDTH REDUCED TO 1500mm	AJM	AF
B	04.06.20	CONSTRUCTION ISSUE DAMPER SIZE CHANGE	CIP	AJM
A	27.04.20	FIRST ISSUE FOR APPROVAL	AJM	CB
REV	DATE	DETAILS	DRW BY	CHK BY

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VENT ENGINEERING
UNITS 16C & 16F,
CHALWYN INDUSTRIAL ESTATE
POOLE, BH12 4PE
TEL. +44(0)1202 744958
www.vent.co.uk

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CLIENT
AMEON

PROJECT
ANGEL MEADOWS
BESPOKE SIZE

SALES ORDER No.
TBC

DRAWING TITLE
BESPOKE VENTEC SMOKE
DAMPER & GRILLE

DRAWING STATUS
☐ PRELIMINARY ☐ APPROVAL
☒ CONSTRUCTION ☐ AS BUILT
☐ INFORMATION ONLY

DRAWN DATE SCALE SHEET
AJM 23.10.19 NTS A2

DRAWING No. REV
MS-NS-20262-208 F

Angel Meadows
Residential Common
Corridor CFD Analysis

25th August 2020

Vent Engineering

Revision History

Version	Date	Author	Comments
01	25/08/2020	Alex Whitehouse	First issue

Document reference
BB-CFD-10278-OF-01

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Prepared by	Alex Whitehouse Alex.whitehouse@bbseven.com	2 Jordan Street Manchester M15 4PY
Reviewed by	Stuart Crick Stuart.crick@bbseven.com	2 Jordan Street Manchester M15 4PY
Prepared for	Anthony Munn Anthony.munn@vent.co.uk	Unit 16c Chalwyn Ind Estate Poole BH12 4PE United Kingdom

Contents

1.	Introduction	4
2.	Acceptance Criteria	7
3.	Model Input Values	8
4.	Case F1	11
5.	Case F2	13
6.	Case F3	15
7.	Case F4	16
8.	CFD Analysis Results	17
9.	Conclusion	18
10.	Additional Simulation Results	19
11.	Contractors Considerations	31

1. Introduction

1.1 Purpose and Scope

- 1.1.1 The purpose of this report is to evaluate the smoke ventilation strategy proposals within Plots 2 and 3 of the Angel Meadows development. It should be noted that the scope of BB7's involvement on this scheme is limited to the CFD modelling, and ultimately it is the responsibility of the Fire Engineers / Architects for the scheme to ensure an acceptable level of safety.
- 1.1.2 The recommendations of BS 9991 permit a single direction travel distance of up to 7.5m within a corridor that is ventilated by a natural vent of 1.5m² located on an external wall or a vent of 1.0m² that discharges into a 1.5m² vertical smoke shaft. This is increased to 15m in a vented corridor when the accommodation is also provided with sprinkler protection.
- 1.1.3 Plot 2 of the development, which is provided with sprinkler protection, features residential corridors which extend beyond the prescriptive limit of 15m in terms of travel distance. To compensate for the extended travel distance an enhanced mechanical smoke ventilation system is proposed. Plot 3 of the development, which is also provided with sprinkler protection, features residential corridors of compliant length, but a mechanical system is proposed as an alternative to the prescriptive natural ventilation solution.
- 1.1.4 This section will detail the Computational Fluid Dynamics modelling, and general fire engineering principles, which were used to evaluate the effectiveness of the alternative solutions. A deterministic approach has been adopted, whereby the conditions in the corridor and stair are assessed against recognised tenable limits. Provided that the results of the alternative solution achieve the acceptance criteria described in Section 2 of this report, then the designs will be deemed to be satisfactory to meet the functional requirements of Part B of the Building Regulations.

1.2 Building Description

- 1.2.1 Plot 2 is comprised of Ground and 1st – 21st Floor with residential accommodation on floors above Ground Floor. Plot 3 is comprised of Ground and 1st – 16th Floor with residential accommodation on floors above Ground, with the exception of the 2nd floor level which houses ancillary accommodation.
- 1.2.2 The CFD analysis incorporates a floor-ceiling height of 2.5m in apartments, 2.4m in ancillary accommodation, and 2.3m in common corridors as indicated in building sections:
- 1002-A-CTA-DRG-21-ZZ-2050_C01 - Plot 2 Section 2A-2A General Arrangement
 - 1002-A-CTA-DRG-21-ZZ-3050_C01 - Plot 3 Section 3A-3A General Arrangement
- 1.2.3 The floor plans are based on the typical floor layout in the following typical floor plan:
- MS-NS-20262-101-A - Plot 2 1st - 20th Floor Layout (see Figure 3)
 - MS-NS-20262-152-A - Plot 3 2nd Floor Layout (see Figure 4)
 - MS-NS-20262-151-A - Plot 3 1st, 3rd-16th Floor Layout (see Figure 5)

1.3 Plot 2 Ventilation Strategy

- 1.3.1 The system should consist of mechanical extract shaft with an internal cross-sectional free area of 0.6 m², serving all floor levels, with replacement inlet air provided by 0.6m² natural shaft, see Figure 1, which would automatically open upon the detection of fire. Openings into the extract shaft on each floor served need to achieve an approximate geometric free area of 0.6m². Confirmation these provisions are sufficient should be provided from the smoke control installer.
- 1.3.2 The extraction rate will remain steady throughout all stages of the fire. Note, the extraction rate of 4.0m³/s is to be achieved on all levels served by the ventilation system.

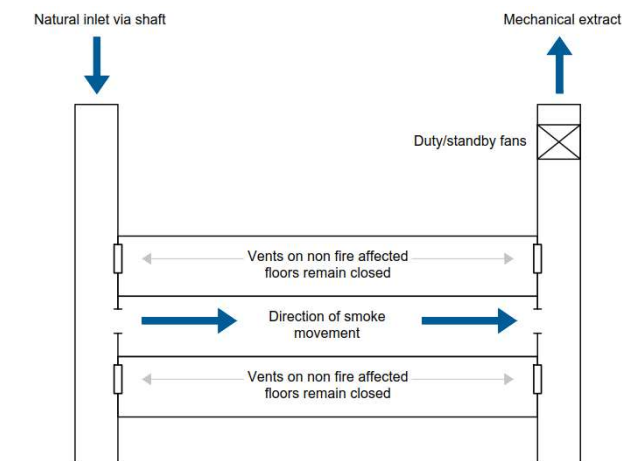


Figure 1: Plot 2 System diagram

1.4 Plot 3 Ventilation Strategy

- 1.4.1 The system should consist of mechanical extract shaft, serving all floor levels, which would automatically open upon smoke detection, see Figure 2. Openings into the extract shaft on each floor served need to achieve an approximate geometric free area of 0.6 m². Note, the system will be a pressure-controlled system where, the fan will automatically ramp up, and ramp down based on the pressure levels in the corridor. The system has been designed to ensure that the pressures in the corridor do not drop below -25Pa. Confirmation these provisions are sufficient should be provided from the smoke control installer.
- 1.4.2 The extract rate will depend on the pressure levels within the corridor. The extraction rate will increase up to 3.5m³/s when suitable inlet is provided via the stair, or reduce as the pressure decreases when the stair door is closed.

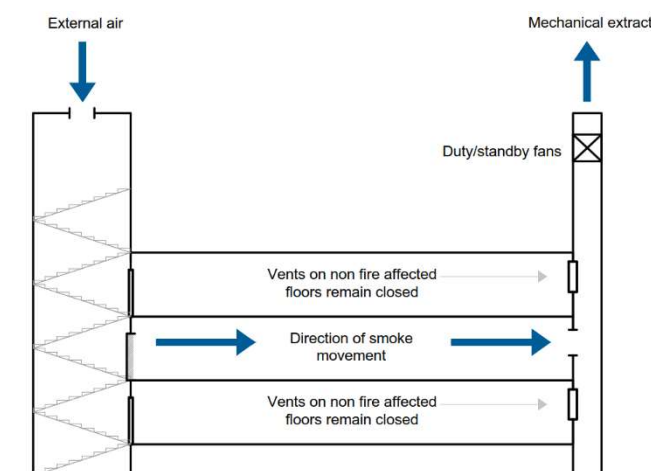


Figure 2: Plot 3 System diagram

1.5 General Provisions / Assumptions

- 1.5.1 Upon detection of smoke the systems should activate; the smoke vents on the fire floor, the vent at the top of the smoke shaft and the vent at the head of stair should open and fans should begin to run at design speed. The vents on all other lobbies should remain closed to avoid spread of smoke and loss of ventilation rate, regardless if smoke is detected on levels other than the fire origin level.
- 1.5.2 For the purposes of this model, an additional ramp-up time before the fans achieve full speed will be considered; a steady ramp up will occur for 30s until fans achieve full speed.

- 1.5.3 For both systems the location of the extract should be designed to ensure protection of the stair, and to reduce potential heat and smoke in the corridor, with consideration to the escaping occupants and firefighters. The extract vent should be located as close to the ceiling as is practicable; for the purposes of this model, the extract point has been positioned 200mm from the ceiling level.
- 1.5.4 The smoke shafts are to include duplicate fans (duty and standby) with alternative power supplies. The fans in the extract shafts are to be fire rated in accordance with BS EN 12101-6.

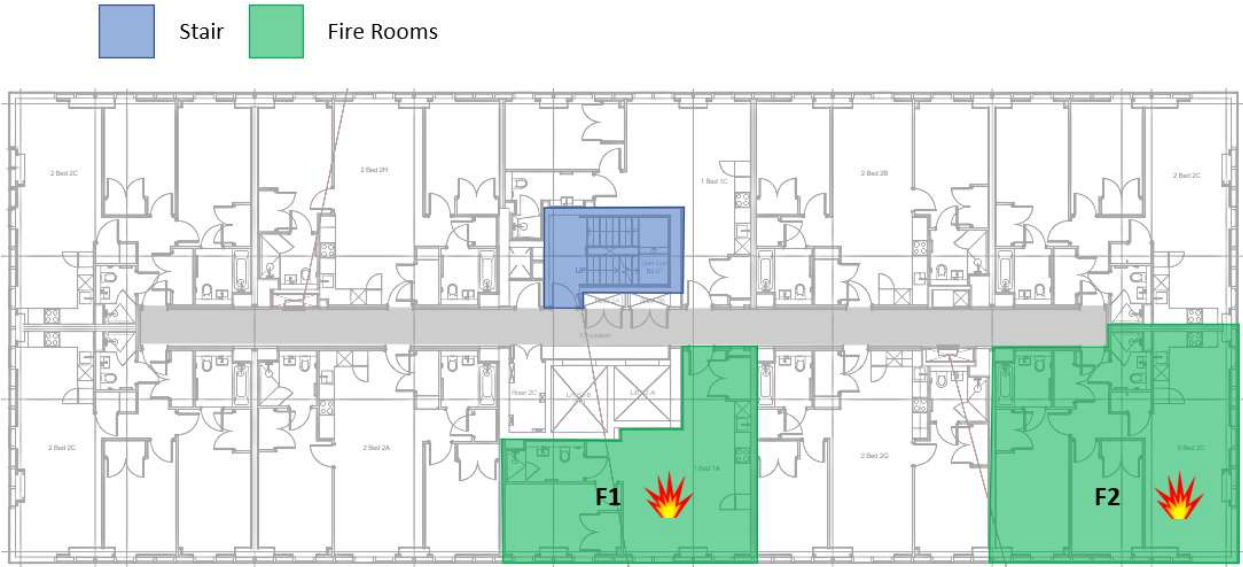


Figure 3: Plot 2 Typical Floor Plan



Figure 4: Plot 3 2nd Floor Ancillary Space

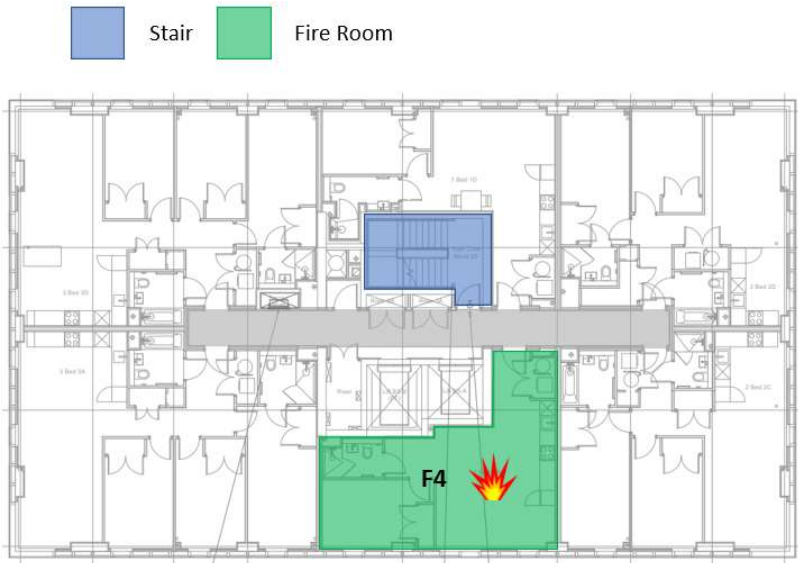


Figure 5: Plot 3 Typical Floor Plan

1.6 CFD Software

- 1.6.1 The software that will be used to complete the analysis consists of two main elements; these are the Computational Fluid Dynamics (CFD) Modelling Software ‘Fire Dynamics Simulator’ (FDS v6.7.0) which has been developed by the National Institute of Standards and Technology (NIST), and the visualisation software Smokeview also developed by NIST. Both FDS and Smokeview are the most extensively used and validated fire-related CFD software packages across the globe therefore, it is considered that their use on this project is justified.
- 1.6.2 The CFD code FDS allows the user to define a variety of parameters relating to the fire and the compartment geometry and materials of which the building is constructed. The model allows the user to visualise and numerically analyse the effect that fire and smoke will have on the building and the proposed ventilation system. This provides an invaluable insight into the movement of smoke and temperature of fire gases within the building prior to construction. By selecting the appropriate parameters one is able to test the building against the worst credible fire scenario, which provides confidence that any alternative solutions based on the modelling will perform under onerous conditions. The visualisation software Smokeview allows the user to view the movement of the smoke and a variety of outputs in the form of slice files such as velocity, visibility and temperature. These allow the user to assess the effect of the fire on the trial design.

1.7 Guidance

- 1.7.1 The design philosophy of this smoke control system will primarily follow the guidance of BS 7974. The assessment methodology has been produced through consideration of the following guidance documents, engineering judgement and through experience and discussions with approvals authorities. The methodology will not directly follow any single guidance document and has instead been produced through consideration of a number of sources, such as:
- Guidance on Smoke Control to common Escape Routes in Apartment Buildings (Flats and Maisonettes), Smoke Control Association, October 2015
 - Mechanical Smoke Venting of Residential Lobbies and Fire Fighting Shafts, LDSA Performance Criteria Paper, July 2006
 - CIBSE Guide E, Fire Safety Engineering, May 2015
 - Guidance on Firefighter Tenability and CFD Analysis, Fire Safety Engineering, Kent Fire & Rescue Service, January 2018

1.8 Fire Engineering Analysis Approach

- 1.8.1 The analysis, and hence the conditions within the models, will be structured to replicate the chain of events that are deemed to occur when a fire starts within an apartment, albeit in an exaggerated fashion in an attempt to test the design under the worst credible scenario.
- 1.8.2 For scenarios modelled within Plot 2 (F1 and F2) the design will be tested during the escape phase and the firefighting phase in order to compare conditions at both of these critical times. For scenarios modelled within Plot 3 (F3 and F4) only the firefighting phase will be modelled as travel distances within the part of the development are understood to be compliant.
- 1.8.3 Various fire locations will be chosen to show if the ventilation works effectively no matter which apartment a fire is located in. The fire locations chosen will be those deemed most likely to cause smoke ingress to the stair, as well as those which will result in the most challenging conditions for corridor clearance.
- 1.8.4 The assessment will be based on a deterministic analysis in accordance with the guidance of BS 7974. Temperature, visibility and velocity will be measured within each scenario and compared against recognised tenability criteria.

1.9 Functional Requirements

- 1.9.1 The area of non-compliance in this case relates to means of escape provisions, however, the effect on the firefighting phase will also be considered; therefore, the following functional requirements will need to be fulfilled;
- B1-Means of Warning and Escape – “The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape from fire from the building to a place of safety outside the building capable of being used at all material times”.
 - B5-Access and facilities for the fire service – “(1) The building shall be designed and constructed so as to provide reasonable facilities to assist firefighters in the protection of life - (2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building”.

2. Acceptance Criteria

- 2.1.1 For scenarios modelled within Plot 2, which features extended travel distances in residential corridors, the acceptance criteria for the design will be that the ventilation system must provide recognised tenable conditions within the common corridor within a reasonable time period during the escape phase, and it must also protect the stair from smoke ingress during the firefighting phase.
- 2.1.2 For scenarios modelled within Plot 3, which features compliant travel distances in residential corridors, the acceptance criteria for the design will be that the ventilation system must protect the stair from smoke ingress during the firefighting phase.
- 2.1.3 The recommendations in guidance of the Smoke Control Association, the LDSA and Kent Fire Service have been considered to determine the acceptance criteria for this study.

2.2 General

- 2.2.1 Performance criteria are generally based on tenability in the common corridor areas and the stair. This is based on the performance of the mechanical smoke ventilation system and includes assessing the conditions of visibility, temperature and velocity at appropriate stages of fire growth. The primary aim will be to ensure that the stair is adequately protected from the ingress of smoke.
- 2.2.2 The SCA guidance states the pressure differences between the corridor/lobby, adjacent stair and fire origin apartment should be limited such that the force required to open doors does not exceed 100N. Additionally, BS EN 12101 references that the pressure difference across a door should not exceed 60Pa. Due to many variables such as type of hinges, door weight, angle, leakage rates, friction etc, this will not be recorded in this report and should be tested on site by the smoke control installer. However, a pressure slice will be included in the model at 1.5m from the floor level, for reference, if required.
- 2.2.3 There is no specific criteria for velocities in the common corridors in design guides however, the recommendations of Building Regulation 368 document will be followed as a good practice. In BR 368 it is mentioned that although movement is not impeded for airspeeds below 10m/s, the escaping occupants may believe they are being slowed down and sense discomfort. It is therefore recommended the velocity through doors that act as inlet air to the mechanical ventilation, which are also used as escape/firefighting routes, should not exceed 5m/s, to avoid adverse effects on people escaping through those doors. As good practice, the CFD analysis will aim for 5m/s throughout the corridors, but slight increases in limited areas are not considered a failure.

2.3 Means of Escape Phase (Plot 2 only – F1 and F2)

- 2.3.1 For means of escape it is commonly accepted that conditions will become untenable when the apartment door first opens, this is acceptable so long as the conditions in the corridor return to tenable within a reasonable time period. The SCA guidance recommends a time of two minutes before conditions return to tenable. As such, for the purposes of the CFD analysis it will be demonstrated that the conditions in the common corridor will be tenable 120 seconds after the fire compartment door closes.
- 2.3.2 The SCA guidance recommends a visibility distance of 10m, whilst the CIBSE Guide E recommends a similar value of 8m. These values are corroborated in BS 7974 which states a 10m distance would be acceptable for large spaces, 5m would be acceptable for small or domestic enclosures. The tenable limit for visibility will be 10m.
- 2.3.3 The SCA guidance states that a temperature of 60°C is a generally accepted limit, BS 7974 verifies this value. CIBSE Guide E recommends 60°C would be acceptable for short exposures and 50°C would be more appropriate for exposure of up to 6 minutes. As occupants are not expected to spend a significant amount of time in the common corridor a tenable temperature limit of 60°C will be used.
- 2.3.4 The stair should be kept free of any significant amounts of smoke which could hinder escape for an extended period of time. Small amounts of smoke which enter the stair when initially opened is not considered to result in failure of the system.
- 2.3.5 The SCA guide states it is generally recognised that for the exposure time during the escape phase, the toxicity levels associated with the smoke are likely to be acceptable if visibility is acceptable.

2.4 Firefighting Phase (all scenarios)

- 2.4.1 It should be noted that there is no requirement for the corridor to remain clear of smoke in the firefighting phase; the intent is to demonstrate protection to the stair with the conservative assumptions that the apartment door is fully open and stair door is partially open.
- 2.4.2 There is no strict requirement for temperature limitations in the common corridors, although temperatures will be considered at head height (1.5m).
- 2.4.3 The SCA Guidance suggests that the temperatures within Table 1 are not exceeded to provide safe conditions for fire service. This is based on the criteria adopted by Australasian Fire Authorities Council (AFAC), along with the additional remarks made by SCA. This criterion will be used to determine possible conditions during the firefighting actions however, it will act only as an indication of conditions in the corridor, and will not be considered a temperature tenability restriction.

Table 1: Firefighter Tenability Conditions

Exposure conditions	Maximum exposure time (minutes)	Maximum air temperature at 1.5m (°C)	Remarks	Recommended distance from apartment door
Routine	25	100	General fire-fighting	15-30m
Hazardous	10	120	Short exposure with thermal radiation	4-15m
Extreme	1	160	For example, snatch rescue scenario	2-4m
Critical	<1	>235	Considered life threatening	0-2m

2.5 Summary

- 2.5.1 Once the stated acceptance criteria are achieved, then it will be considered that the design has achieved the functional requirements of the Building Regulations. This will be determined by comparing the visibility and the smoke temperature within the common corridor and stair during key stages in the simulations.

3. Model Input Values

3.1.1 The FDS software works by discretising the computational domain into finite grids, the programme numerically solves a form of the Navier Stokes equation for each grid and calculates the smoke and heat transfer from each cell. Generally, the finer the grid the more accurate the results, although a balance has to be determined between the grid size used and the computational demands of the model. For simulations involving buoyant plumes a measure of how well the flow field can be resolved is given by the non-dimensional expression $D^*/\delta x$ where D^* is the characteristic dimension of the fire (calculated as shown in Equation 1 below) and δx is the nominal size of a mesh cell.

$$D^* = \left(\frac{\dot{Q}}{\rho_{\infty} C_p T_{\infty} \sqrt{g}} \right)^{\frac{2}{5}} \quad \text{(Equation 1)}$$

3.1.2 The FDS user guide suggests a $D^*/\delta x$ ratio between 4 and 16, generally the finer mesh is used around the fire and primary areas of interest, whilst areas further from the fire or outside the zone of interest can employ a coarser mesh. Detailed within Table 2 the grid sizes used in the modelling. A mesh size of 0.1 m has been used throughout the models except for the staircase where a cell size of 0.2 m has been used. Note, the mesh in the staircase at the fire floor level has remained at 0.1 m cell size to ensure accurate data transfer between the cells.

Table 2: Grid Size Ratio

	Category	Grid Size Recommended (m)	Grid Size Used (m)
$D^*/4$	Coarse	0.258	0.2
$D^*/10$	Moderate	0.103	0.1
$D^*/16$	Fine	0.064	0.1

3.2 Model Materials

- 3.2.1 The building is assumed to be constructed of concrete with a density of 2280 kg/m³, conductivity of 1.8 W/m K and a specific heat capacity of 1.04 kJ/kg K.
- 3.2.2 The specified extract rate is to be achieved at the vent into the corridor. The smoke control contractor should ensure that velocities through escape doors do not exceed 5 m/s.

3.3 Design Fire used in Fire Scenarios

- 3.3.1 Both Plot 2 and Plot 3 have been provided with sprinklers. The peak fire size used in the calculations was a 1.2MW fire which is considered to be conservative for sprinkler protected residential type dwellings and is in line with the peak fire size recommended in the SCA guidance. A fast fire growth rate was used in each scenario.
- 3.3.2 The type of reaction that was incorporated into the model is a polyurethane fire with a 10% soot yield; this is considered to be appropriate for the significant items of fuel load located within an apartment, such as chairs, sofas and beds.
- 3.3.3 The fire’s heat of combustion is 20,000 kJ/kg, which results in a conservative smoke production rate according the SCA Guide. The implementation of the fire parameters used is shown in Figure 6.
- 3.3.4 The modelled fire has a fast t^2 growth rate, and its growth curve fire curve is shown in Figure 7. The curve shows how the key times in the simulation relate to different fire sizes outlined in Table 3.
- 3.3.5 The fire measures 4m² with a heat release rate per unit area of 300kW/m².

```
& REAC ID='POLYURETHANE',
FYI='NFPA Babrauskas',
FUEL='REAC_FUEL',
C=6.3, H=7.1, O=2.1, N=1.0,
SOOT_YIELD=0.1,
HEAT_OF_COMBUSTION=2.0E4 /
```

Figure 6: Fire Code

Table 3: Fire Sizes

Fire Size in Dwelling (kW)	Stage of Fire Growth	Time of Occurrence based on a Fast-Growing Fire
250	Early stages of fire, relevant for MOE from fire compartment (Plot 2 scenarios only)	74s
1000	Later stages of fire, relevant for MOE from other compartments and arrival of fire service (Plot 2 scenarios only)	150s
1200	Later stages of fire, relevant for fire service intervention (all scenarios)	160s

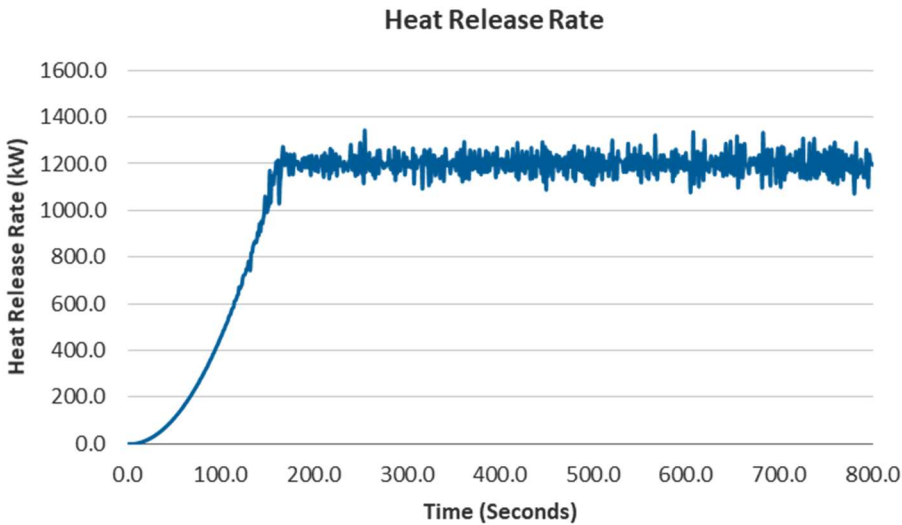


Figure 7: Design Fire Curve

3.4 Window Failure and Leakage

- 3.4.1 To avoid a significant amount of smoke leaving the fire compartment we have allowed for a single 1m² window located in the same room as the fire to fail. This would prevent excessive amount of smoke leaving to external but allow the fire to grow to its peak size. Window failure will occur at 165s which is after the escape phase, and before the firefighting phase, to allow the fire to grow to its peak size.
- 3.4.2 Leakage is required to provide airflow to the apartment and permit the fire to grow to its full size. This should be sized large enough to allow the fire grow but not so large as to release excessive amounts of heat/smoke from the apartment. A leakage area of 0.2m² has been incorporated into the model which is sufficient to allow the fire to grow prior to window failure. Additional leakage has been incorporated around each apartment and lift door in the fire scenarios to regulate the pressure and mimic more realistic environment. This leakage areas measure 0.01m² and 0.06m² respectively; these values are in line with the recommendations of BS EN 12101-6.

3.5 Timeline

- 3.5.1
- The timeline of events is designed to correlate with the stages of fire growth such that each event occurs at a relevant time, and to test the smoke control system to a reasonable worst case scenario. It is not intended to predict fire service arrival or operation times, or occupant pre-movement times. The ventilation system is activated from detection in the common corridor.
- 3.5.2
- The simulation is split into three main phases, the initial and second means of escape phases (MOE) and the firefighting phase (FF). Key events within these phases are summarised in Table 4.

Table 4: CFD Simulation Timeline

Phase	Time (s)	Event
Initial Means of Escape Phase (Plot 2 Scenarios only)	0	Ignition. Fire grows at a fast t ² rate.
	74	Fire reaches 250kW. Fire room door opens for 10s.
	See Table 5	Stair door opens for 30s (time depends on travel distances).
Second Means of Escape Phase (Plot 2 Scenarios only)	150	Fire reaches 1000kW. Fire room door opens for 10s.
	See Table 5	Stair door opens for 30s (time depends on travel distances).
	280	End of Means of Escape Phase
Intermediate (all scenarios)	165	Glazing within the compartment fails.
Firefighting Phase (all scenarios)	340	Firefighting phase begins. Ground floor stair door opens until 800s.
	350	Fire room door opens 200mm. Stair door fully opens.
	380	Fire room door fully opens. Stair door closes, leaving a 200mm gap.
	600	Fire room door closes.
	800	End of simulation

- 3.5.3
- The modelling begins at zero seconds, this signifies the start of the fire growth and represents the initial escape phase. The fire has reached 250kW in size by 74 seconds, which is considered to be a size relevant to occupants making their early escape, such as if they were awake. For scenarios modelled within Plot 2, At 74 seconds the apartment door opens signifying occupants leaving. The door remains open for 10 seconds and closes at 84 seconds, this is to represent the operation of the self-closing device. The stair door opens shortly after the apartment door opens, delayed simulating an occupant travelling through the corridor (see Table 5) and remains open for 30 seconds. The stair door is assumed to be open for a longer period as occupants would not be in an urgent rush once they have reached the relative safety of the protected corridor and stair, compared to leaving the fire compartment.

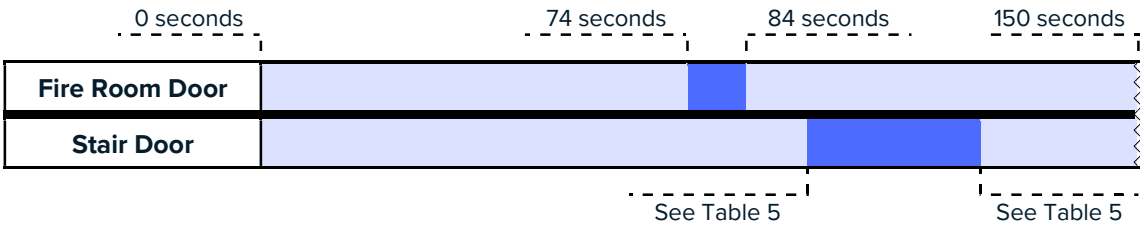


Figure 8: Timeline of Initial Escape Phase

- 3.5.4
- For scenarios modelled within Plot 2 the apartment door opens at 150 seconds and remains open for 10 seconds, closing at 160 seconds. The stair door opens shortly after the apartment door opens (see Table 5) and remains open for 30 seconds. At this point the active stage of the secondary escape is complete and the stage continues to demonstrate that the corridor returns to tenable conditions.

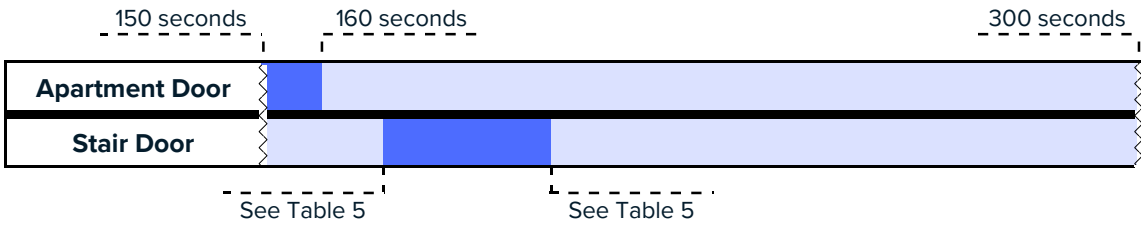


Figure 9: Timeline of Secondary Escape Phase

- 3.5.5
- In all scenarios at 165 seconds the glazing within the fire compartment fails, and at 340 seconds the door at the base of the stair opens. These times have been selected as it is after the active stage of the escape but prior to the firefighting stage.
- 3.5.6
- In all scenarios at 340 seconds the firefighting phase begins, this is when the fire has reached its full size of 1.2MW. At 350 seconds the apartment door and the stair door both open at the same time, allowing large quantities of smoke to spill into the common corridor. The apartment door firstly opens 200mm for 30 seconds, then opens fully for further 220 seconds and closes at 600 seconds; this is considered a sufficient amount of time to demonstrate that the smoke control system maintains tenable conditions in the stair. The stair door remains fully open for 30 seconds to simulate firefighters entering the corridor, then partially closes leaving a 200mm gap to imitate the width of firefighter's hose. The remaining 200mm gap stays open until the end of simulation to allow additional inlet to be drawn into the corridor through the vent at the head of the stair. At 600 seconds the apartment door closes and at the firefighting phase is complete. The model continues to 800 seconds to assess the clearance time of the smoke remaining in the corridor.

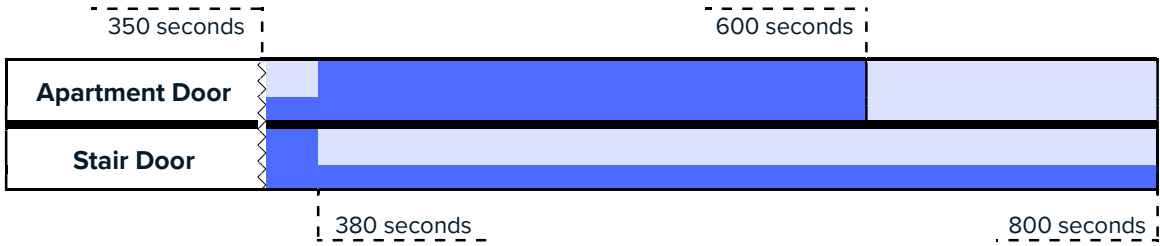


Figure 10: Timeline of Firefighting Phase

Table 5: Stair Door Opening Times During MOE

Case	Fire Room to Stair Door Travel Distance (m)	Times for Stair Door Openings (s)	
		First Means of Escape Phase	Second Means of Escape Phase
F1	6.0	79 – 109	155 – 185
F2	21.0	92 – 122	168 – 198
F3	N/A	N/A	N/A
F4	N/A	N/A	N/A

Note: The average walking speed of 1.2m/s has been used to calculate the door opening times, as recommended in PD 7974.

3.6 Inputs and Assumptions

- 3.6.1 The sequence of events and assumptions are not strictly in accordance with any specific document but do consider the guidance of the Smoke Control to common Escape Routes in Apartment Buildings (Flats and Maisonettes), Smoke Control Association, January 2020.
- 3.6.2 All doors within the model are assumed to be 2m high, unless specified otherwise. Please note that where the apartment and/or stair doors are taller, this may detrimentally affect the performance of the proposed ventilation system.
- 3.6.3 The 'ambient' air temperature is defined as 20°C.
- 3.6.4 The smoke detector should be placed no more than 1m away from apartment door which is closest to the stair door, and no more than 7.5m away from any apartment.
- 3.6.5 During the firefighting operation, it is expected that the stair door at ground floor level will be wedged open once the fire service arrives and will remain open until the end of the simulation, as per LDSA guidance.

4. Case F1

4.1 General

- 4.1.1 The fire builds and a small amount of smoke spills into the common corridor during the first escape phase. This smoke is sufficient to activate the smoke detection; a 30 second ramp-up time has been included to account for the activation of the extraction fans.
- 4.1.2 During the second escape phase, a significant amount of smoke spills into the corridor, although no smoke enters the stair, and the corridor clears within the two minute limit of the fire room closure.
- 4.1.3 During the firefighting phase, a significant amount of smoke spills into the corridor, due to the apartment door remaining fully open for seconds. No smoke enters the stair during this period and the corridor is quickly returned to tenable conditions once the door is closed.

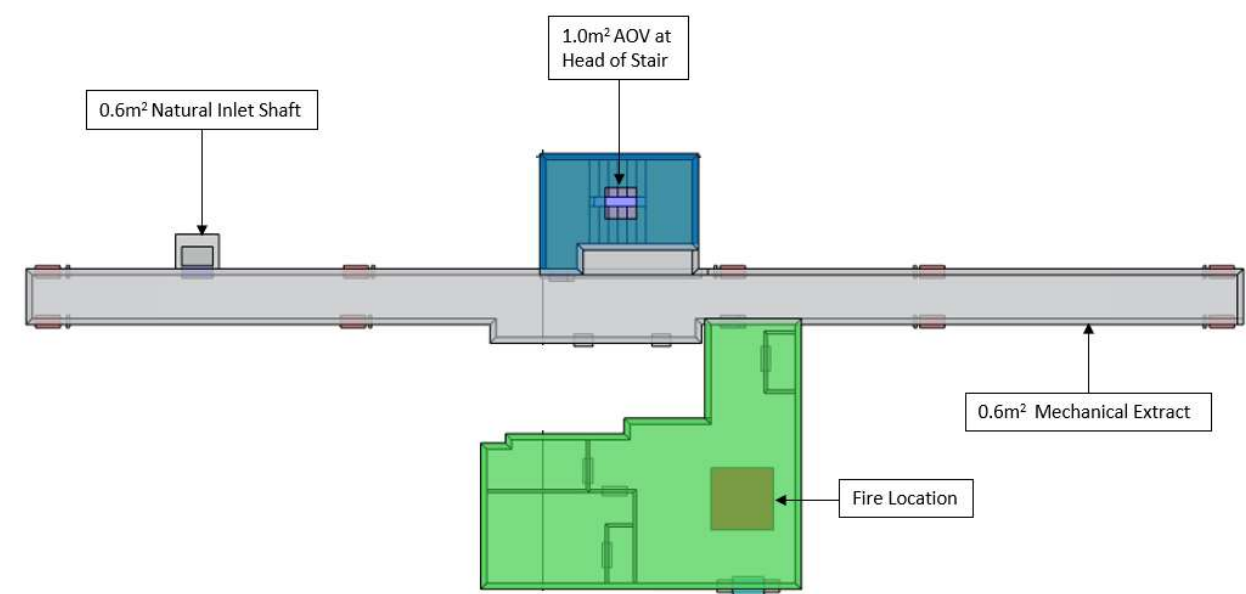


Figure 11: Case F1 Geometry

Table 6: Case F1 System Design

Level	Inlet Air	Outlet Vent	Stair Vent
1-20	0.6m² natural inlet shaft	0.6m² mechanical extract shaft	1.0m² AOV

Notes: The minimum extraction rate to be achieved by this system is [4.0m³/s] on any floor that it serves.

4.2 Means of Escape

- 4.2.1 A time dependant analysis has been carried out to determine how long it takes to return the corridor to specified tenability criteria once the apartment door has closed and the smoke ventilation system activates.
- 4.2.2 The means of escape tenability criteria is assessed by analysis of the visibility, temperature, and velocity conditions in the common areas and the stair, as per the recommendations in the Smoke Control Association guidance (see Acceptance Criteria Section of this report).

Visibility

- 4.2.3 In the means of escape phase after the apartment door closes (160s) the corridor ventilation system has clears the corridor to a tenable level within 2 minutes (280s), which is the maximum period of time permitted for the common corridor to clear. The visibility conditions for this case are hence considered acceptable. Figure 12 shows the visibility at 280s, truncated such that untenable regions show as red.

Temperature

- 4.2.4 Exposure gas temperature limits of 60°C represent typical acceptance limits in respect to tenability for means of escape. The temperature at 280s (the end of the means of escape phase) does not exceed 60°C and thus meets the tenability criteria. Figure 13 shows the temperature at 280s, truncated such that untenable regions show as red.

Velocity

- 4.2.5 Figure 14 shows velocities in the common corridor at the end of the escape phase. It can be seen the velocities do not exceed 5m/s, except at the point of extraction and the inlet which is permitted to reach up to 10m/s, which is considered acceptable.

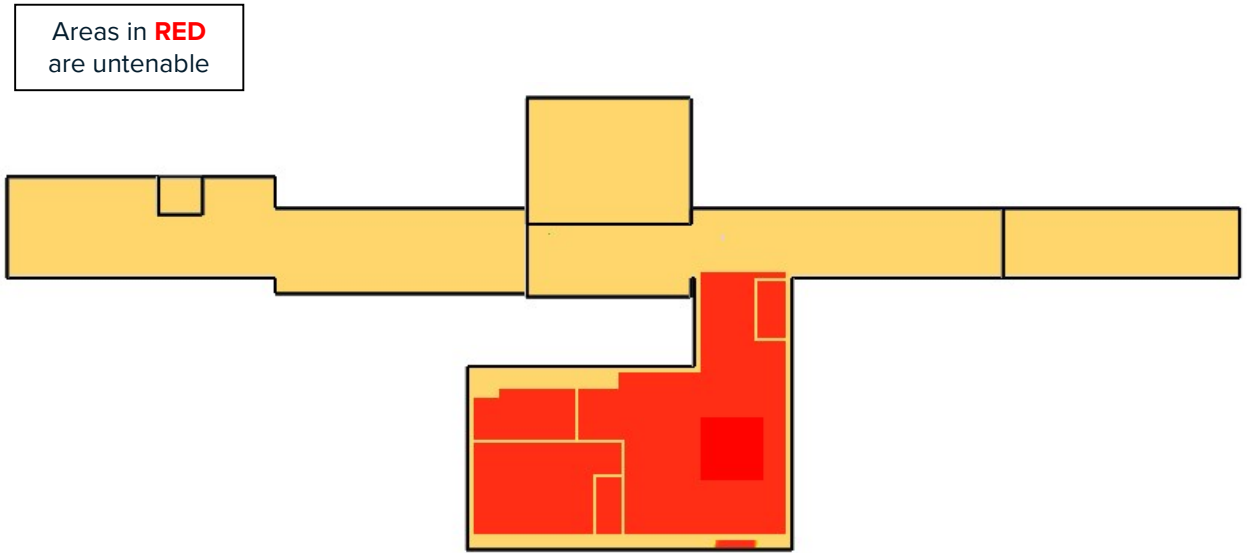


Figure 12: F1 Visibility at 280s

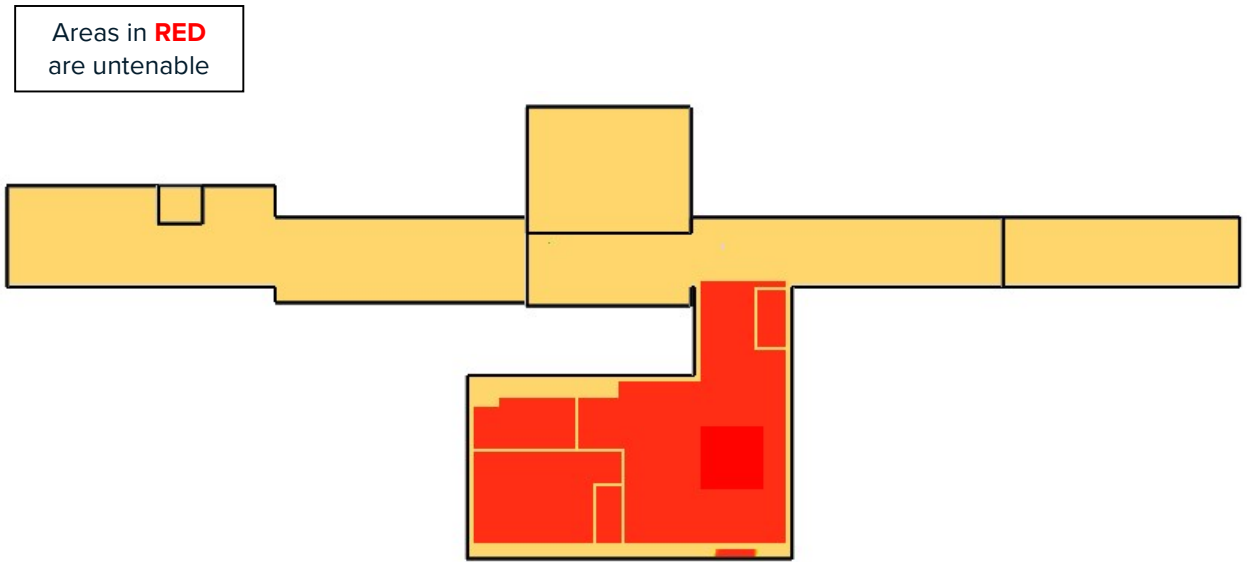


Figure 13: F1 Temperature at 280s

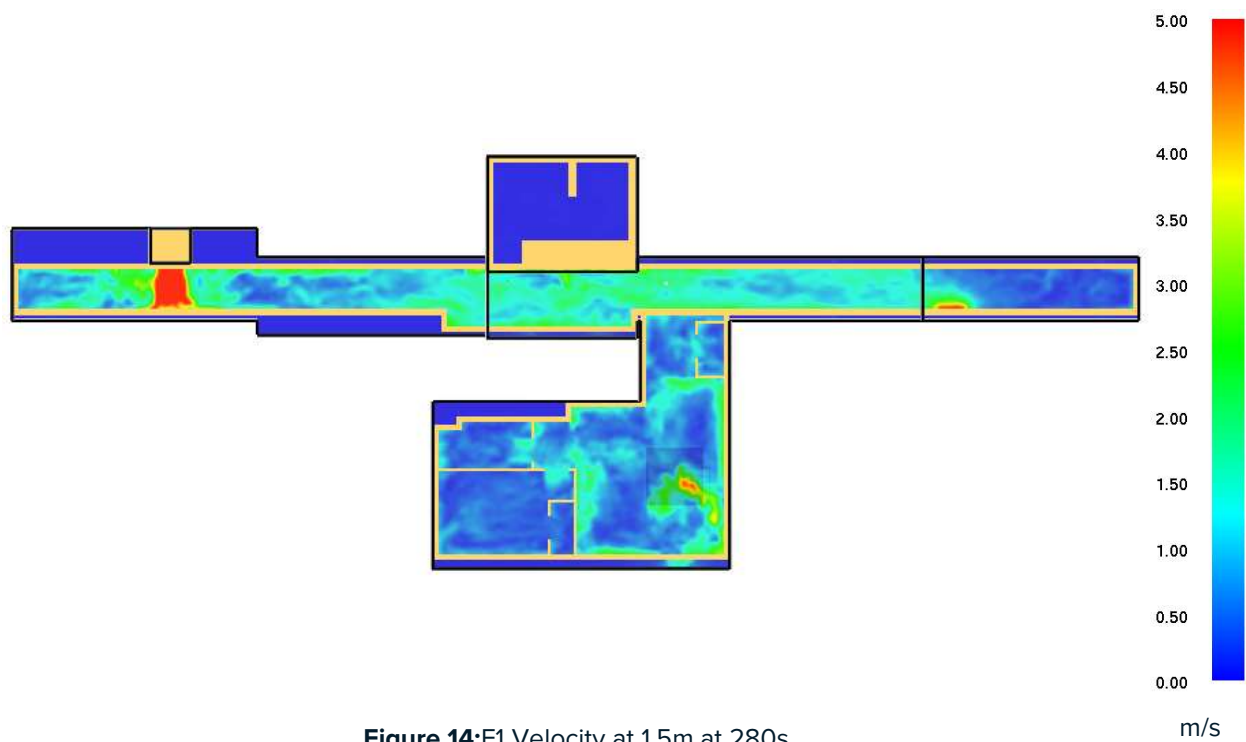


Figure 14:F1 Velocity at 1.5m at 280s

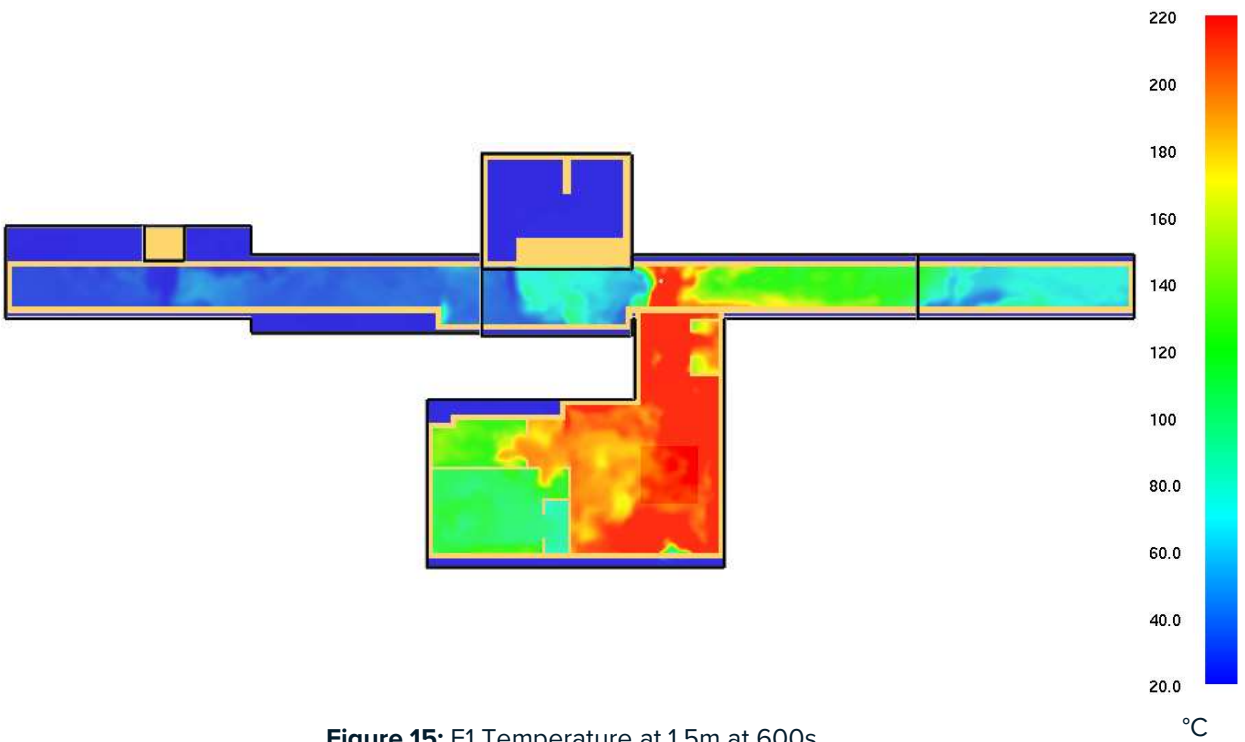


Figure 15: F1 Temperature at 1.5m at 600s

4.3 Firefighting Phase

- 4.3.1 The primary aspect of this model is to demonstrate that the stair is adequately protected from the ingress of smoke during firefighting operations. The Results Section of this report demonstrates that the ventilation system is sufficient to achieve this.
- 4.3.2 The impact of the additional protection the smoke ventilation system can offer to firefighters during firefighting operations has been considered, as per the recommendations of the Kent Fire service CFD analysis report.

Temperature

- 4.3.3 As the door to the compartment of fire origin opens, a significant amount of smoke and fumes spill into the corridor, potentially increasing the temperature to levels that pose risk to the firefighters. The temperature in the areas near the fire origin are expected to be higher however, and the temperature throughout the rest of the common corridor are significantly less, as shown in Figure 15.
- 4.3.4 This model demonstrates that the proposed ventilation system is adequate for the conditions in the common corridor to remain tenable at 1.5m from the floor level during firefighters' intervention as per temperature recommendations stated in the SCA guide.

4.4 Conclusion

- 4.4.1 The stair is shown to remain tenable during both Means of Escape phase and Firefighting phase. Also, the conditions for the escaping occupants and the Fire Service are considered acceptable.
- 4.4.2 Given the margin of safety of the fire room location, the performance of the mechanical extraction system is considered acceptable for this fire location.

Table 7: Case F1 Performance Summary

Smoke clears from the corridor at 280s	Smoke enters the stair during an escape phase	Smoke enters stair during firefighting phase	Tenable temperature for firefighters
Yes	No	No	Yes

5. Case F2

5.1 General

- 5.1.1 The fire builds and a small amount of smoke spills into the common corridor during the first escape phase. This smoke is sufficient to activate the smoke detection; a 30 second ramp-up time has been included to account for the activation of the extraction fans.
- 5.1.2 During the second escape phase, a significant amount of smoke spills into the corridor, although no smoke enters the stair, and the corridor clears within the two minute limit of the fire room closure (160s).
- 5.1.3 During the firefighting phase, a significant amount of smoke spills into the corridor, due to the apartment door remaining fully open for seconds. No smoke enters the stair during this period and the corridor is quickly returned to tenable conditions once the door is closed.

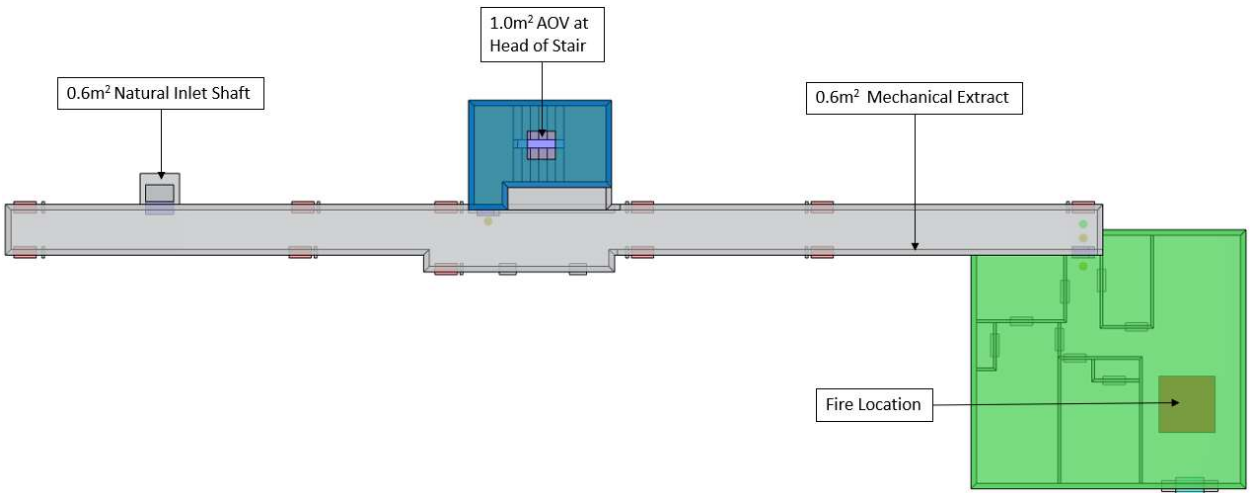


Figure 16: Case F2 Geometry

Table 8: Case F2 System Design

Level	Inlet Air	Outlet Vent	Stair Vent
1-20	0.6m² natural inlet shaft	0.6m² mechanical extract shaft	1.0m² AOV

Notes: The minimum extraction rate to be achieved by this system is [4.0m³/s] on any floor that it serves.

5.2 Means of Escape

- 5.2.1 A time dependant analysis has been carried out to determine how long it takes to return the corridor to specified tenability criteria once the apartment door has closed and the smoke ventilation system activates.
- 5.2.2 The means of escape tenability criteria is assessed by analysis of the visibility, temperature, and velocity conditions in the common areas and the stair, as per the recommendations in the Smoke Control Association guidance (see Acceptance Criteria Section of this report).

Visibility

- 5.2.3 In the means of escape phase after the apartment door closes (160s) the corridor ventilation system has clears the corridor to a tenable level within 2 minutes (280s), which is the maximum period of time permitted for the common corridor to clear. The visibility conditions for this case are hence considered acceptable. Figure 17 shows the visibility at 280s, truncated such that untenable regions show as red.

Temperature

- 5.2.4 Exposure gas temperature limits of 60°C represent typical acceptance limits in respect to tenability for means of escape. The temperature at 280s (the end of the means of escape phase) does not exceed 60°C and thus meets the tenability criteria. Figure 18 shows the temperature at 280s, truncated such that untenable regions show as red.

Velocity

- 5.2.5 Figure 19 shows velocities in the common corridor at the end of the escape phase. It can be seen the velocities do not exceed 5m/s, except at the point of extraction and the inlet which is permitted to reach up to 10m/s, which is considered acceptable.

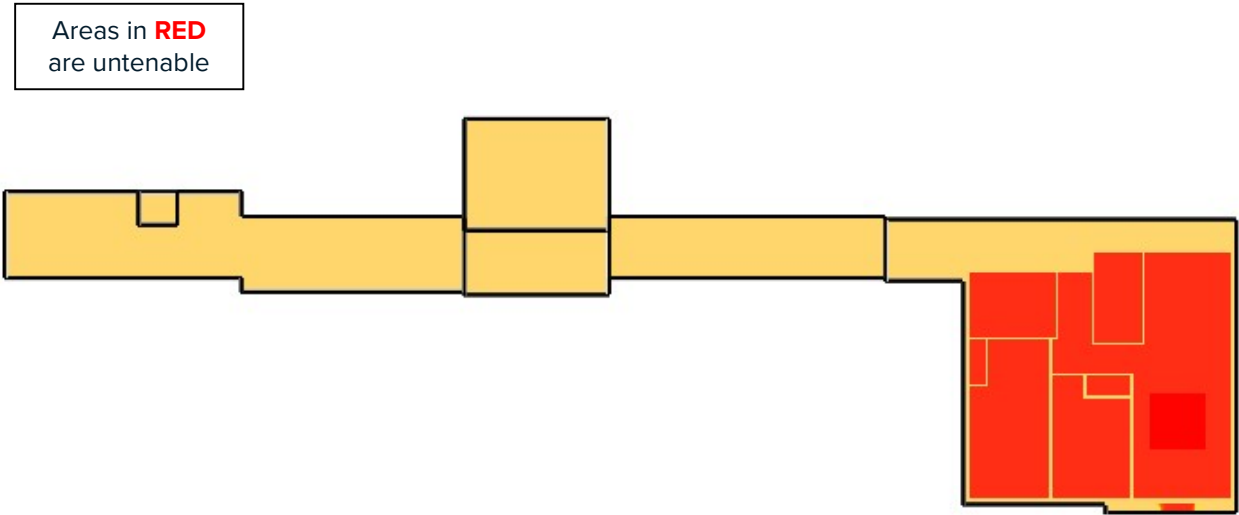


Figure 17: F2 Visibility at 280s

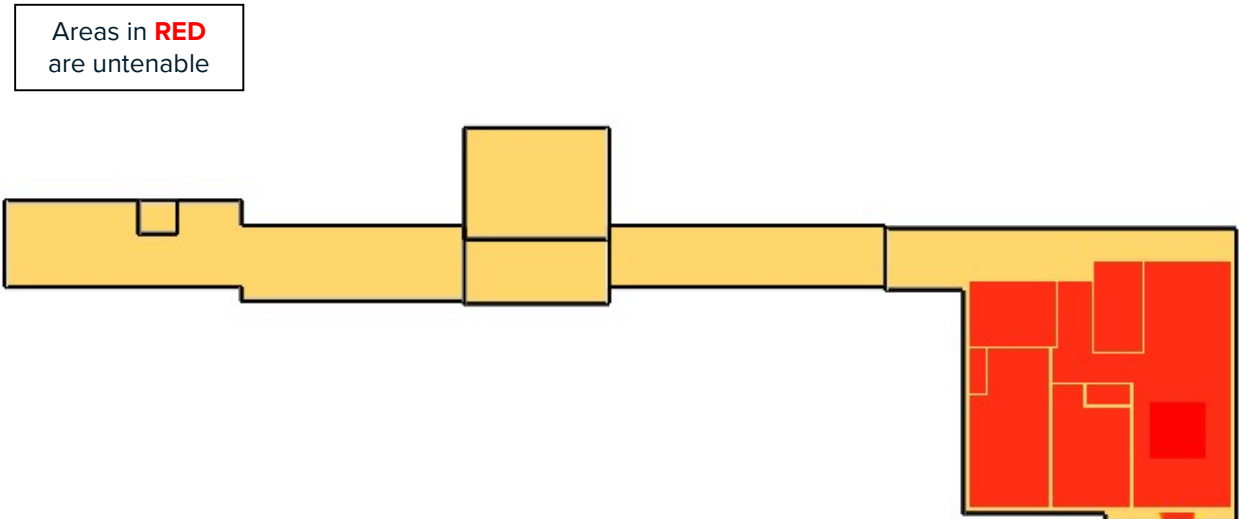


Figure 18: F2 Temperature at 280s

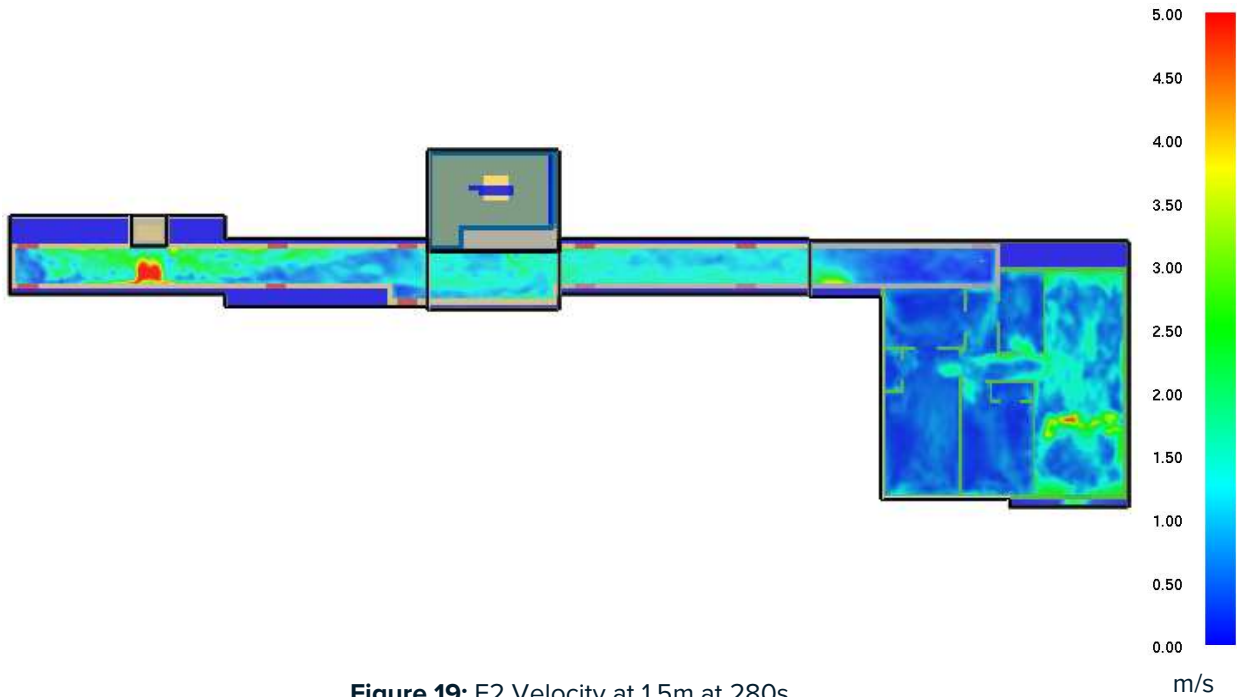


Figure 19: F2 Velocity at 1.5m at 280s

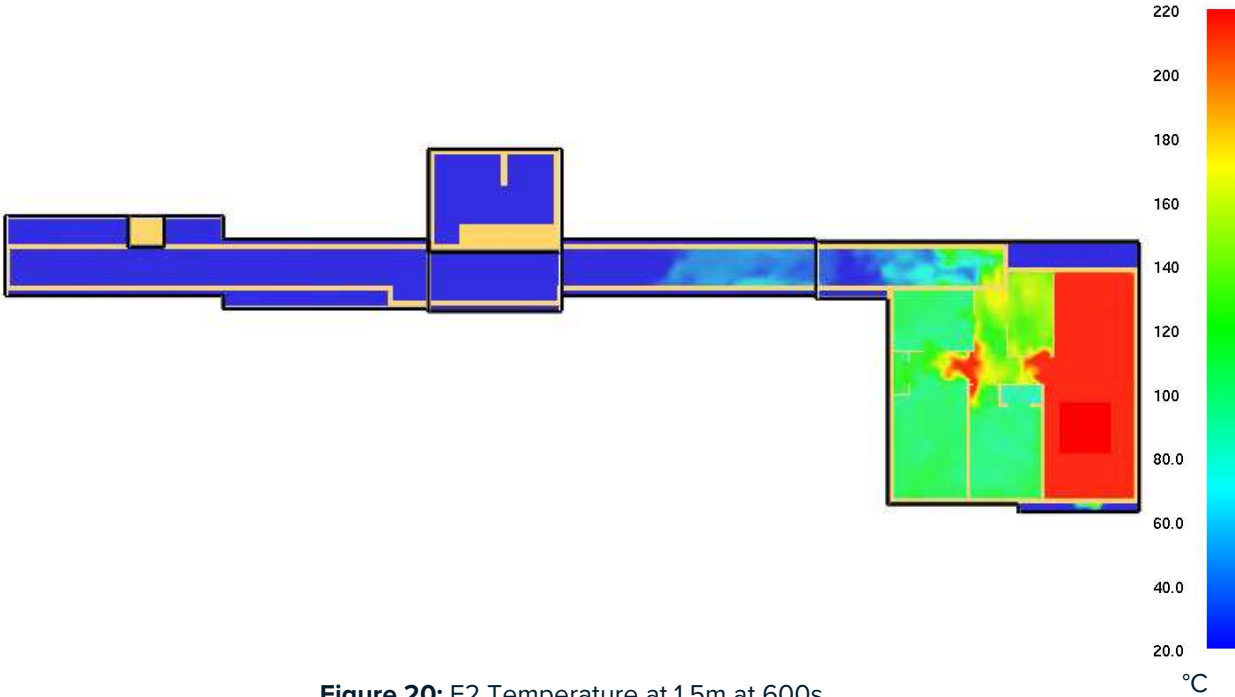


Figure 20: F2 Temperature at 1.5m at 600s

5.3 Firefighting Phase

- 5.3.1 The primary aspect of this model is to demonstrate that the stair is adequately protected from the ingress of smoke during firefighting operations. The Results Section of this report demonstrates that the ventilation system is sufficient to achieve this.
- 5.3.2 The impact of the additional protection the smoke ventilation system can offer to firefighters during firefighting operations has been considered, as per the recommendations of the Kent Fire service CFD analysis report.

Temperature

- 5.3.3 As the door to the compartment of fire origin opens, a significant amount of smoke and fumes spill into the corridor, potentially increasing the temperature to levels that pose risk to the firefighters. The temperature in the areas near the fire origin are expected to be higher however, and the temperature throughout the rest of the common corridor are significantly less, as shown in Figure 20.
- 5.3.4 This model demonstrates that the proposed ventilation system is adequate for the conditions in the common corridor to remain tenable at 1.5m from the floor level during firefighters’ intervention as per temperature recommendations stated in the SCA guide.

5.4 Conclusion

- 5.4.1 The stair is shown to remain tenable during both Means of Escape phase and Firefighting phase. Also, the conditions for the escaping occupants and the Fire Service are considered acceptable.
- 5.4.2 Given the margin of safety of the fire room location, the performance of the mechanical extraction system is considered acceptable for this fire location.

Table 9: Case F2 Performance Summary

Smoke clears from the corridor at 280s	Smoke enters the stair during an escape phase	Smoke enters stair during firefighting phase	Tenable temperature for firefighters
Yes	No	No	Yes

6. Case F3

6.1 General

6.1.1 During the firefighting phase, a significant amount of smoke spills into the corridor, due to the fire room door remaining fully open for seconds. No smoke enters the stair during this period and the corridor begins clearing once the door is closed.

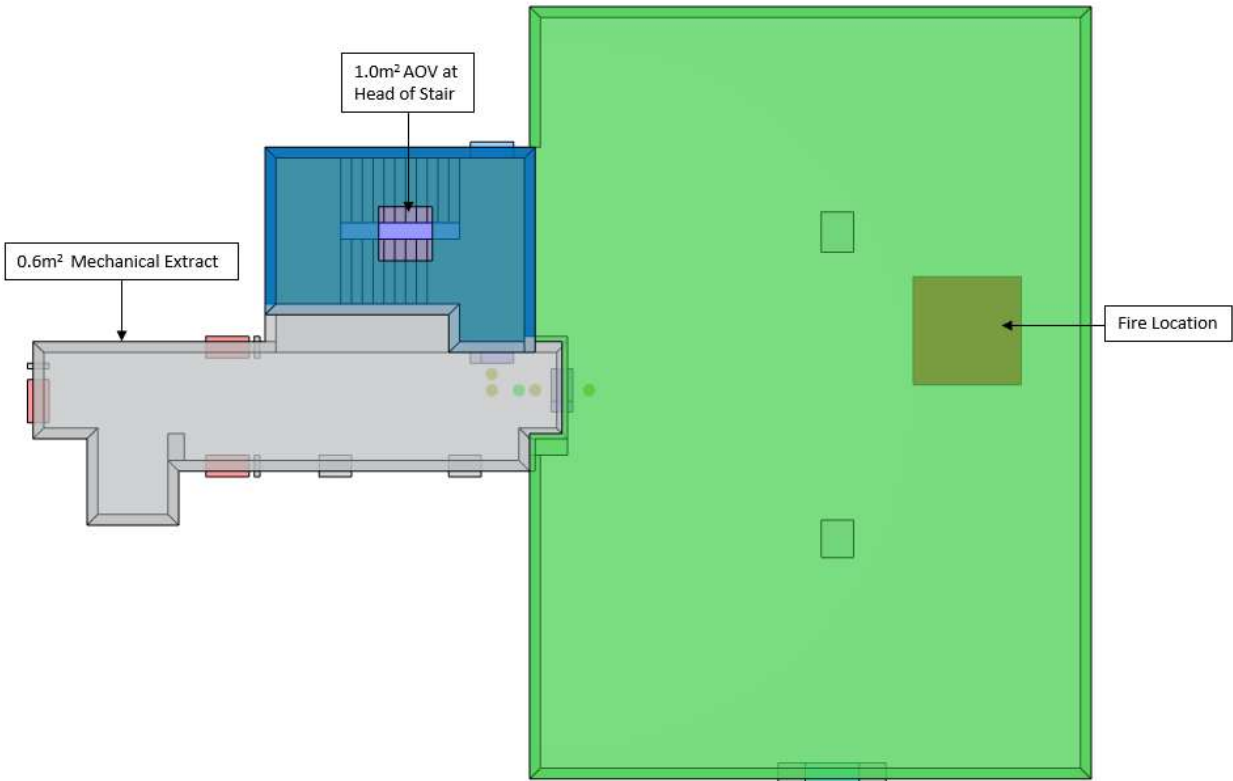


Figure 21: Case F3 Geometry

Table 10: Case F3 System Design

Level	Inlet Air	Outlet Vent	Stair Vent
1-20	N/A – pressure regulated system	0.6m² mechanical extract shaft	1.0m² AOV

Notes: The minimum extraction rate to be achieved by this system is [3.5m³/s] on any floor that it serves.

6.2 Firefighting Phase

- 6.2.1 The primary aspect of this model is to demonstrate that the stair is adequately protected from the ingress of smoke during firefighting operations. The Results Section of this report demonstrates that the ventilation system is sufficient to achieve this.
- 6.2.2 The impact of the additional protection the smoke ventilation system can offer to firefighters during firefighting operations has been considered, as per the recommendations of the Kent Fire service CFD analysis report.

Temperature

6.2.3 As the door to the compartment of fire origin opens, a significant amount of smoke and fumes spill into the corridor, potentially increasing the temperature to levels that pose risk to the firefighters. The temperature in the areas near the fire origin are expected to be higher however, and the temperature throughout the rest of the common corridor are significantly less, as shown in Figure 20.

6.2.4 This model demonstrates that the proposed ventilation system is adequate for the conditions in the common corridor to remain tenable at 1.5m from the floor level during firefighters’ intervention as per temperature recommendations stated in the SCA guide.

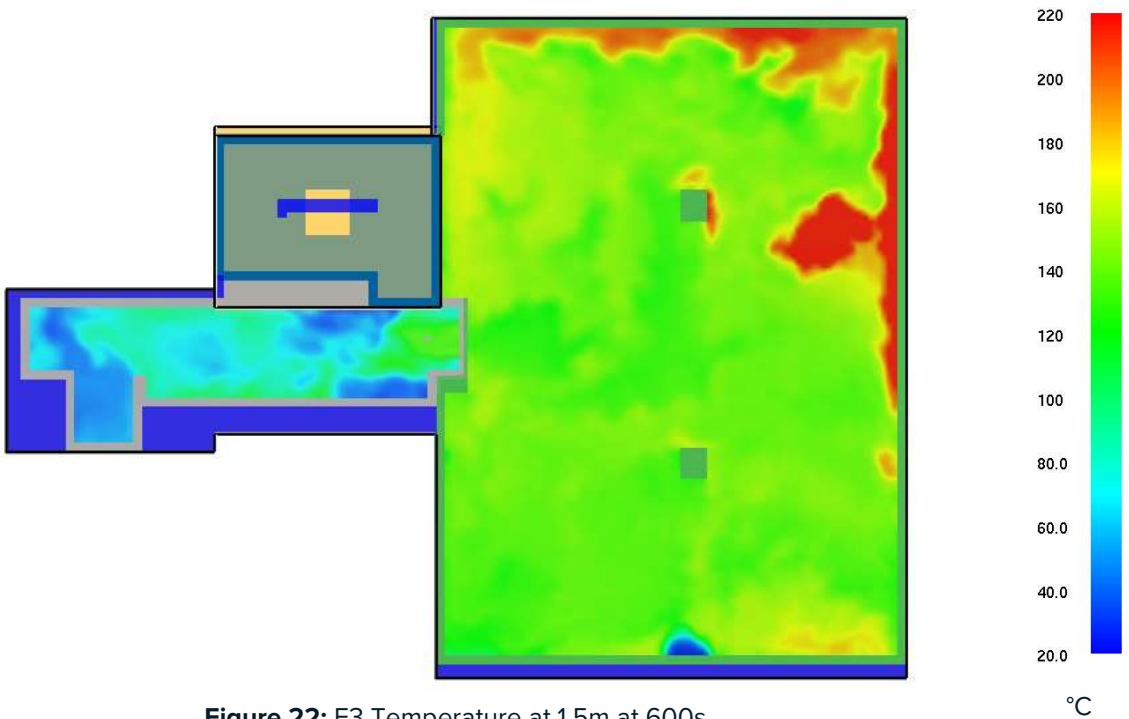


Figure 22: F3 Temperature at 1.5m at 600s

6.3 Conclusion

- 6.3.1 The stair is shown to remain tenable during the Firefighting phase, and the Fire Service are considered acceptable.
- 6.3.2 Given the margin of safety of the fire room location, the performance of the mechanical extraction system is considered acceptable for this fire location.

Table 11: Case F3 Performance Summary

Smoke clears from the corridor at 280s	Smoke enters the stair during an escape phase	Smoke enters stair during firefighting phase	Tenable temperature for firefighters
N/A	N/A	No	Yes

7. Case F4

7.1 General

7.1.1 During the firefighting phase, a significant amount of smoke spills into the corridor, due to the apartment door remaining fully open for seconds. No smoke enters the stair during this period and the corridor begins clearing once the door is closed.

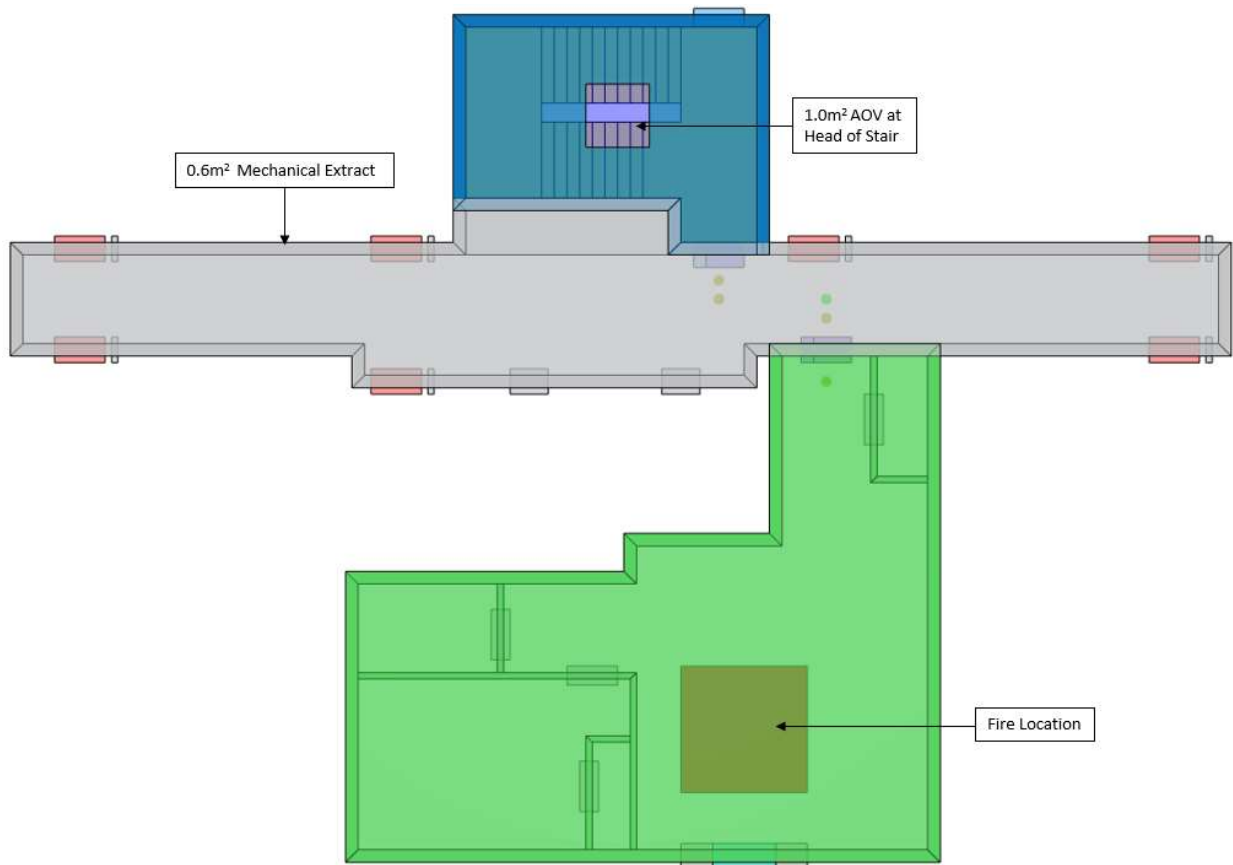


Figure 23: Case F4 Geometry

Table 12: Case F4 System Design

Level	Inlet Air	Outlet Vent	Stair Vent
1-20	N/A – pressure regulated system	0.6m² mechanical extract shaft	1.0m² AOV

Notes: The minimum extraction rate to be achieved by this system is [3.5m³/s] on any floor that it serves.

7.2 Firefighting Phase

- 7.2.1 The primary aspect of this model is to demonstrate that the stair is adequately protected from the ingress of smoke during firefighting operations. The Results Section of this report demonstrates that the ventilation system is sufficient to achieve this.
- 7.2.2 The impact of the additional protection the smoke ventilation system can offer to firefighters during firefighting operations has been considered, as per the recommendations of the Kent Fire service CFD analysis report.

Temperature

- 7.2.3 As the door to the compartment of fire origin opens, a significant amount of smoke and fumes spill into the corridor, potentially increasing the temperature to levels that pose risk to the firefighters. The temperature in the areas near the fire origin are expected to be higher however, and the temperature throughout the rest of the common corridor are significantly less, as shown in Figure 20.
- 7.2.4 This model demonstrates that the proposed ventilation system is adequate for the conditions in the common corridor to remain tenable at 1.5m from the floor level during firefighters’ intervention as per temperature recommendations stated in the SCA guide.

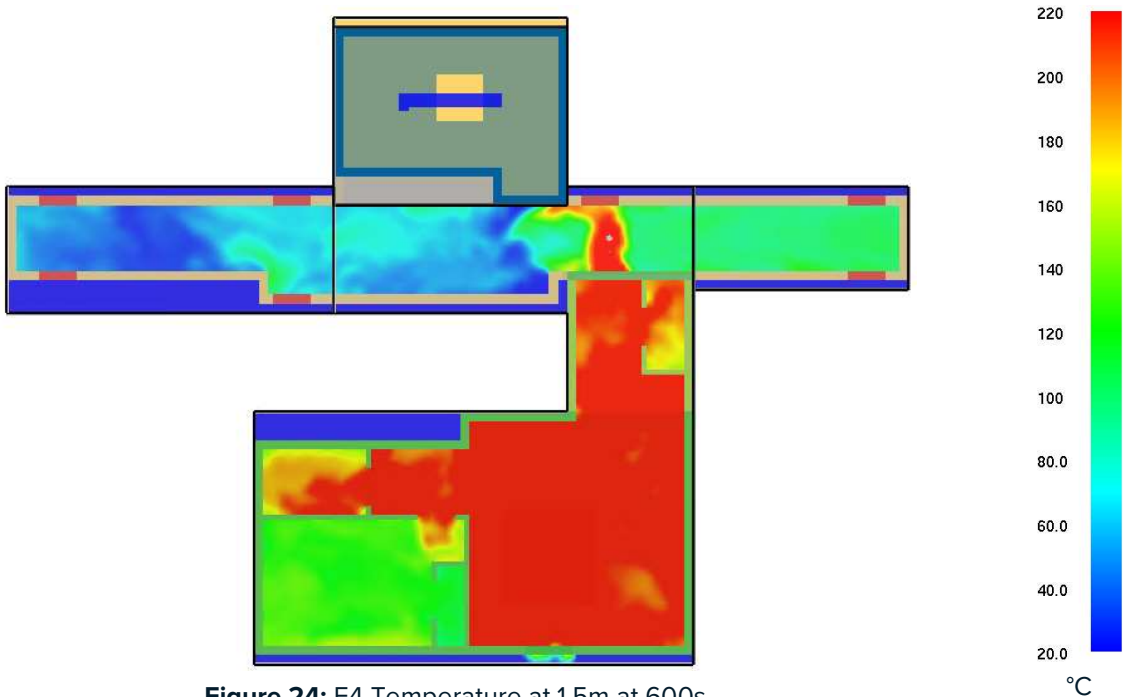


Figure 24: F4 Temperature at 1.5m at 600s

7.3 Conclusion

- 7.3.1 The stair is shown to remain tenable during the Firefighting phase, and the Fire Service are considered acceptable.
- 7.3.2 Given the margin of safety of the fire room location, the performance of the mechanical extraction system is considered acceptable for this fire location.

Table 13: Case F4 Performance Summary

Smoke clears from the corridor at 280s	Smoke enters the stair during an escape phase	Smoke enters stair during firefighting phase	Tenable temperature for firefighters
N/A	N/A	No	Yes

8. CFD Analysis Results

8.1.1 A summary of the analysis of the performance of the proposed ventilation system can be seen in Table 14.

Table 14: Summary of Performance

Case	Tenable visibility at end of MOE	Smoke enters stair during...		Temperature remains tenable during FF	Velocity remains acceptable
		MOE Phase	FF Phase		
F1	Yes	No	No	Yes	Yes
F2	Yes	No	No	Yes	Yes
F3	N/A	N/A	No	Yes	Yes
F4	N/A	N/A	No	Yes	Yes

Notes: *Remove if no notes necessary

- 8.1.2 The guidance recommends that extended residential corridors should return to tenable conditions 120 seconds after the escape phase, and no smoke should enter the stair during firefighting.
- 8.1.3 Where escape phases have been modelled (Plot 2 – scenarios F1 and F2) the corridor is returned to tenable within 120 seconds of the apartment door closing, and no smoke enters the stair during firefighting in any of the scenarios modelled.
- 8.1.4 It is considered that the results of the CFD modelling demonstrate that the proposed systems provide acceptable levels of safety. The provision of the smoke ventilation systems ensures that the conditions within the common corridors are satisfactory when the fire door is opened. The model has assumed the worst case fire scenarios for each corridor, these being that which would have the greatest impact upon the stair, and that which would be most challenging for corridor clearance. It is recognised that if the ventilation system performs adequately in the worst case locations, the performance in any other locations is deemed to be equal, or better.
- 8.1.5 Graphical slice files have been taken from the FDS model and included in the report after the conclusion. The slice files for visibility has been truncated to 30m, visibility greater than this is set to transparent. Temperature slices have not been truncated.

9. Conclusion

- 9.1.1 By carrying out the fire engineering analysis and CFD modelling, it is considered that the level of safety provided by the smoke ventilation system within the corridor provided a safe environment for both means of escape and firefighting. Where required, the conditions in the common corridor return to a tenable level within 120 seconds as required by the guidance of the Smoke Control Association. During the firefighting stage no smoke enters the common stair.
- 9.1.2 It is therefore considered that the results of the analysis are sufficient to demonstrate that the alternative solution fulfils the intent of the functional requirements of the Building Regulations and provides an acceptable level of safety.
- 9.1.3 This report provides performance specifications for the smoke ventilation system proposed. All other aspects are to be in full accordance with the requirements of BS EN 12101, however this report does not include a detailed system specification. Section 11 of this report describes some key items that should be considered.

10. Additional Simulation Results

Case F1 – Smoke

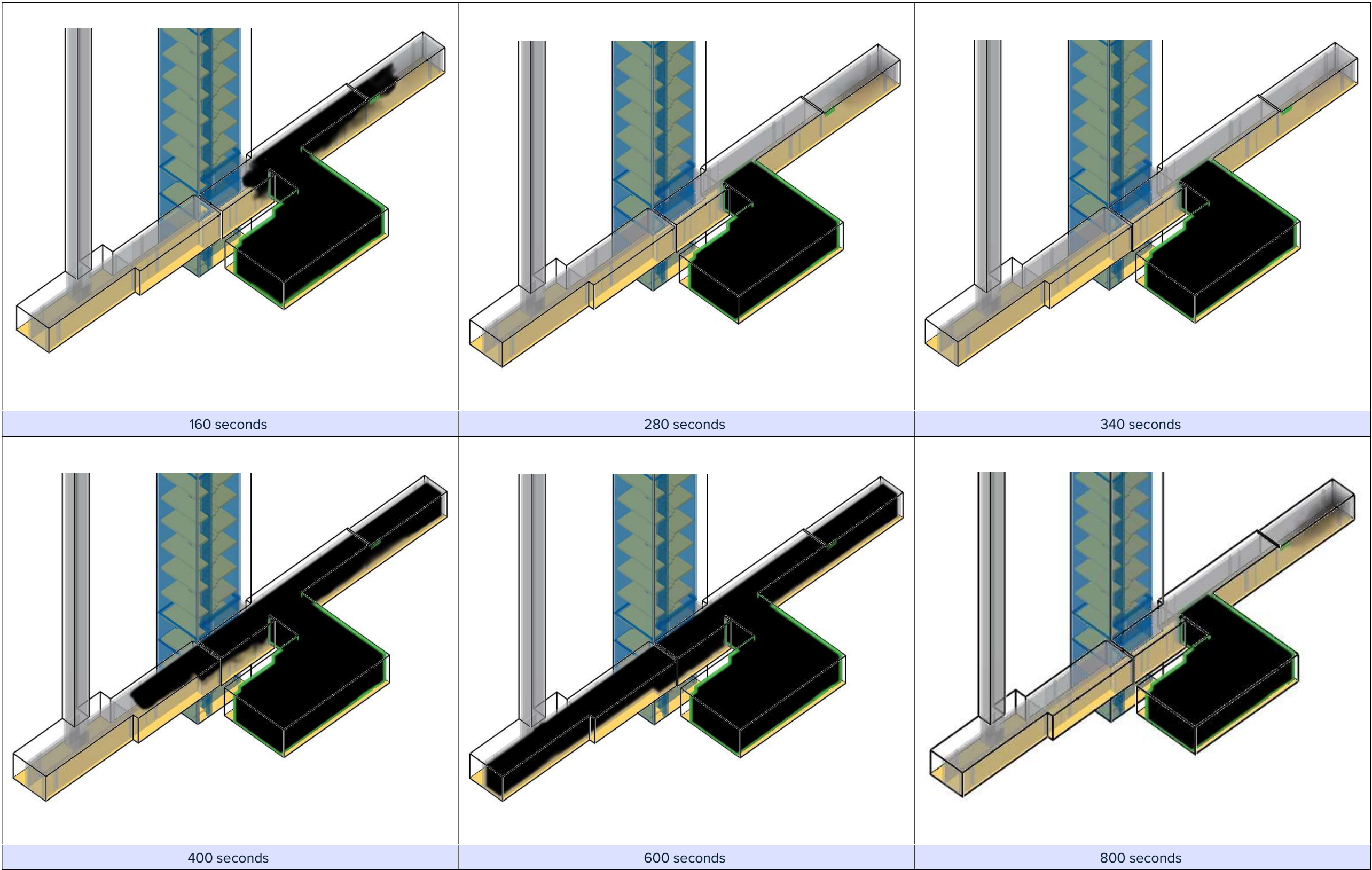


Figure 25: Case F1 Smoke Timeline

Case F1 - Visibility

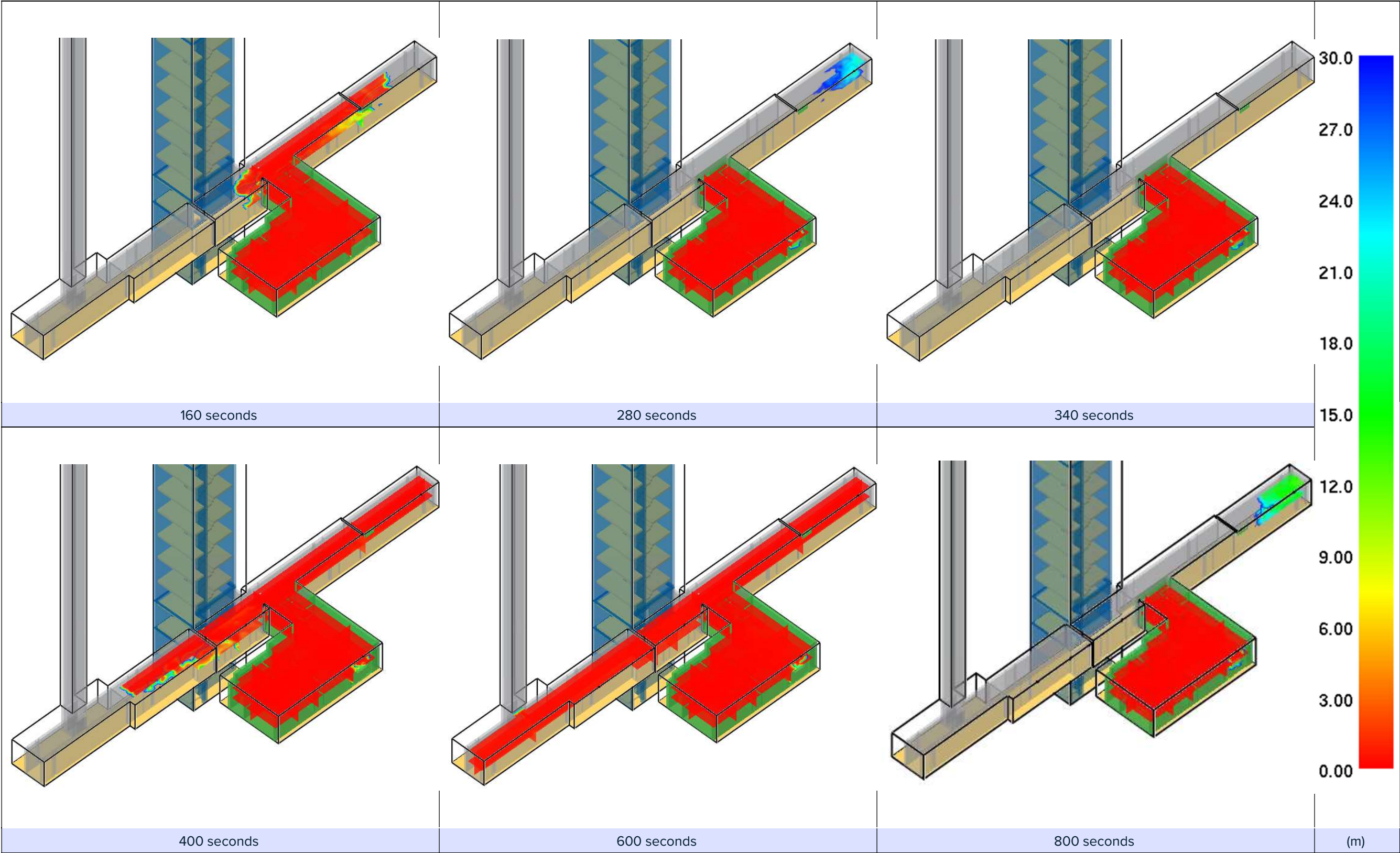


Figure 26: Case F1 Visibility Timeline

Case F1 - Temperature

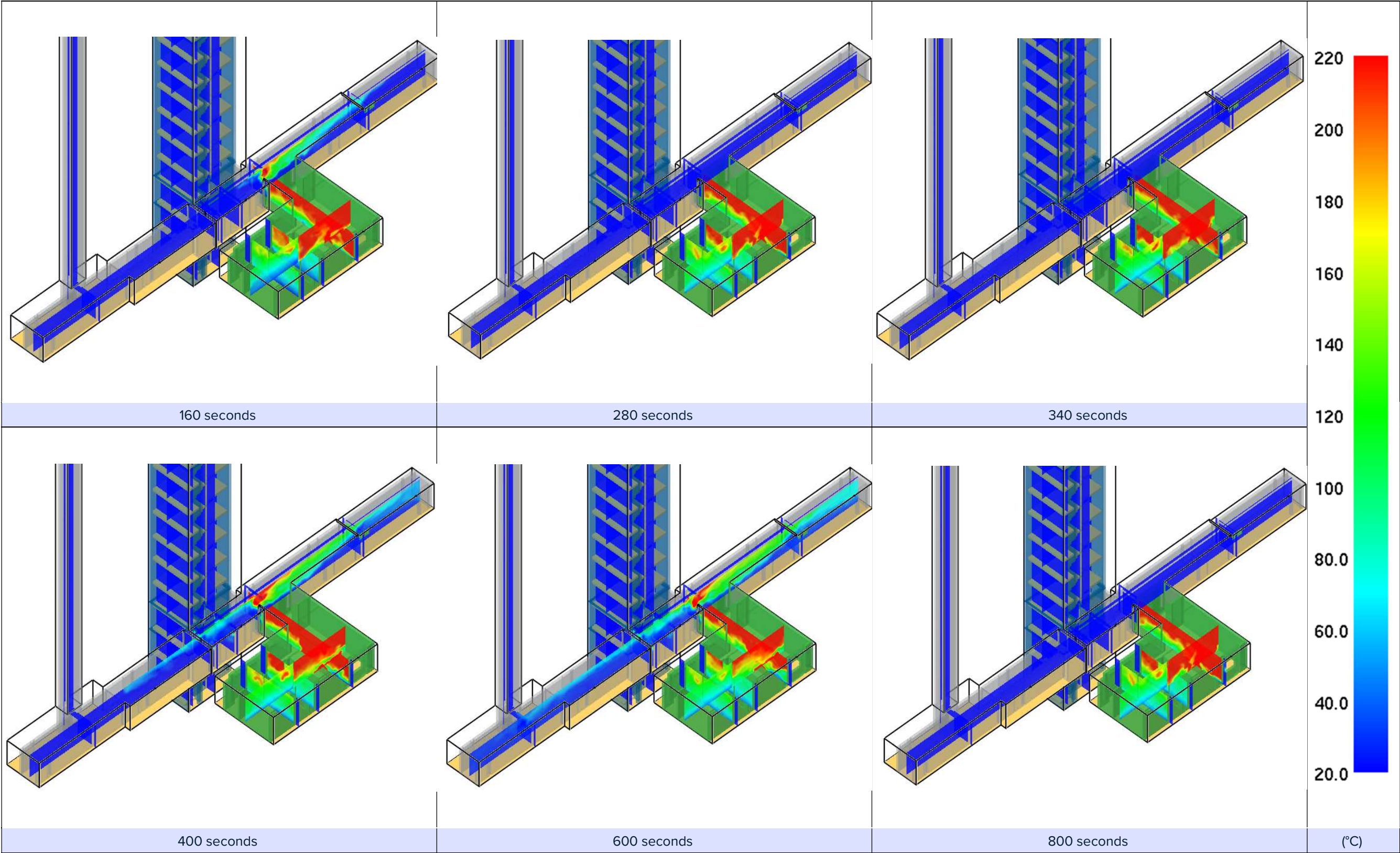


Figure 27: Case F1 Temperature Timeline

Case F2 - Smoke

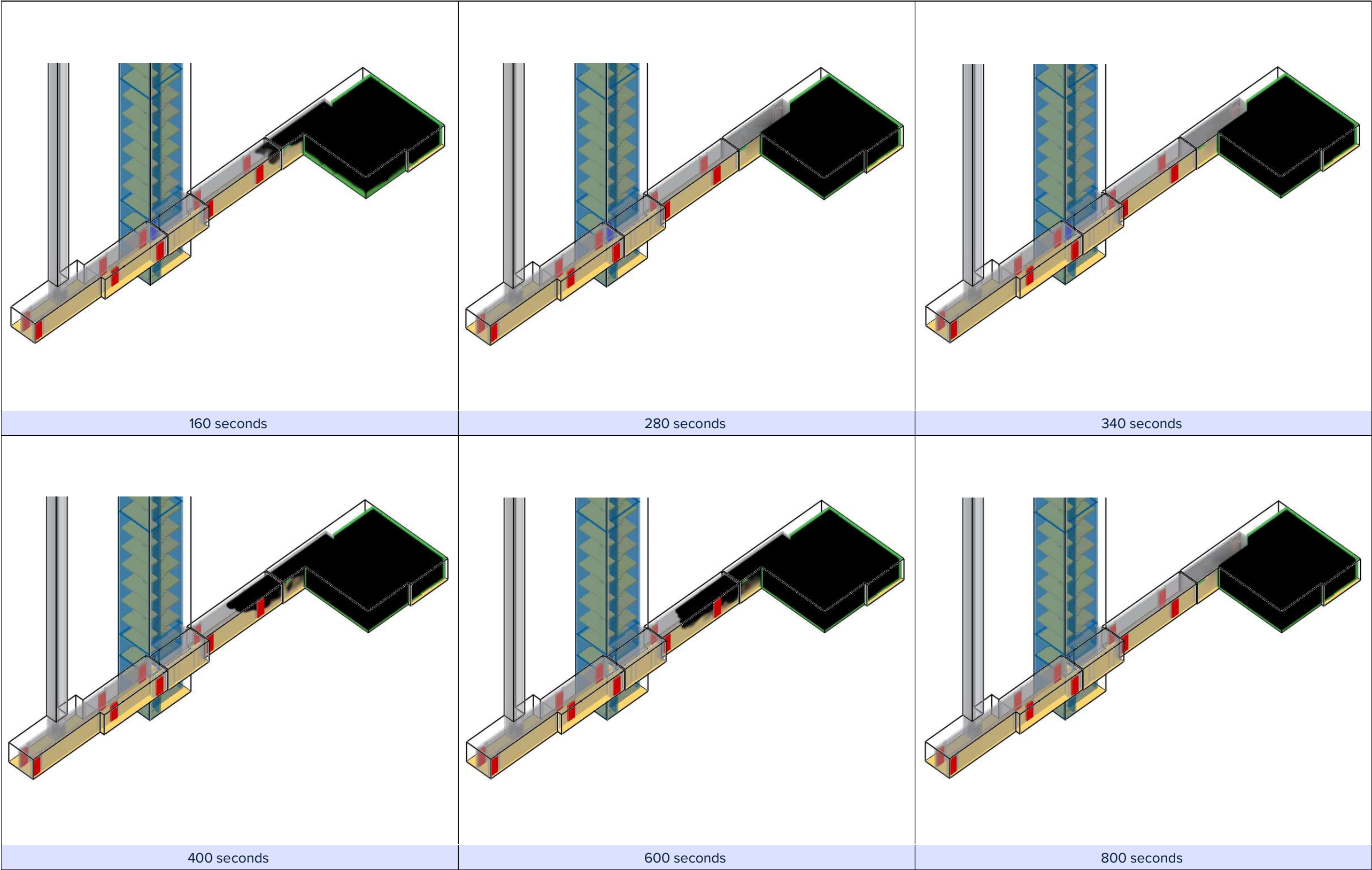


Figure 28: Case F2 Smoke Timeline

Case F2 - Visibility

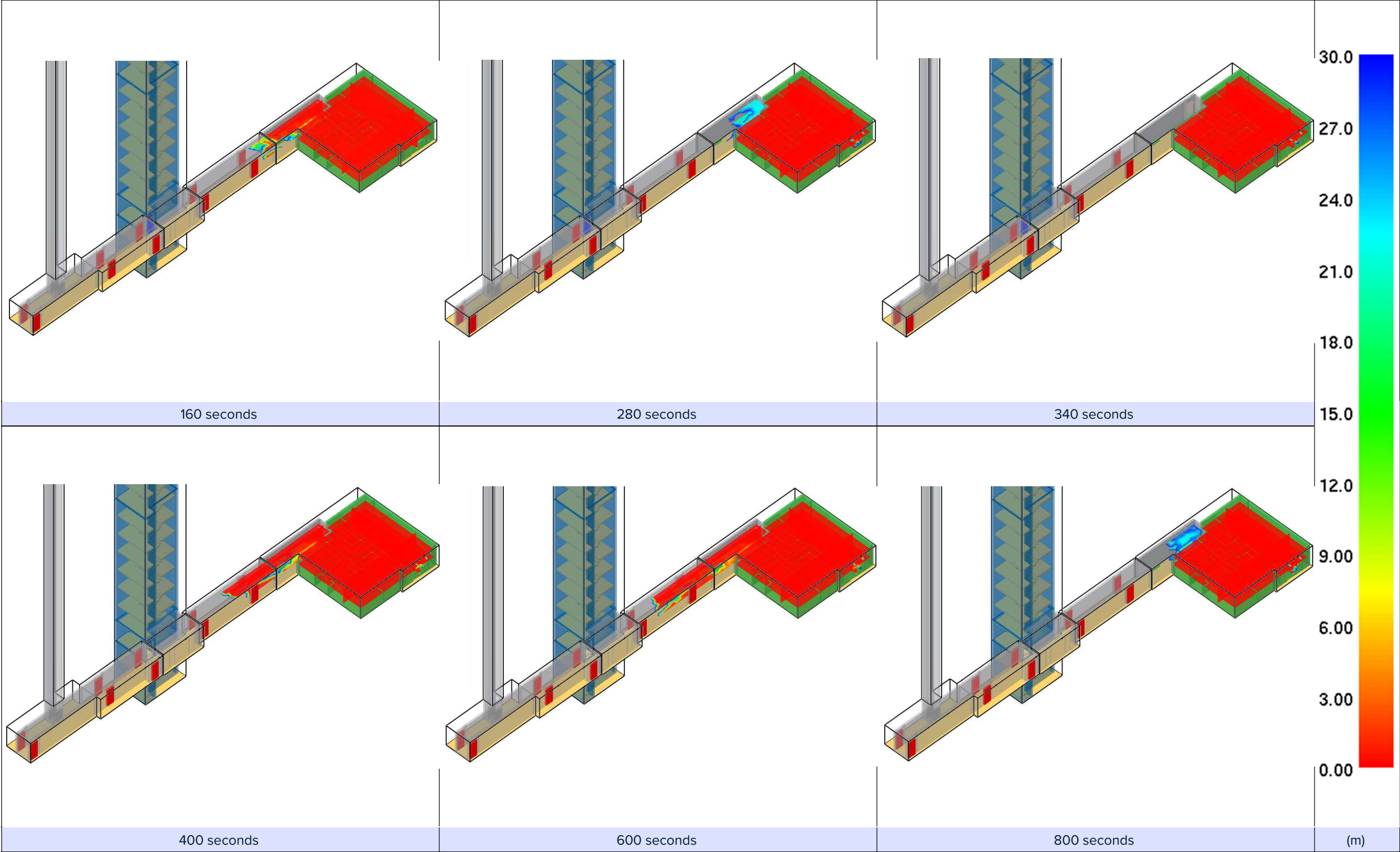


Figure 29: Case F2 Visibility Timeline

Case F2 - Temperature

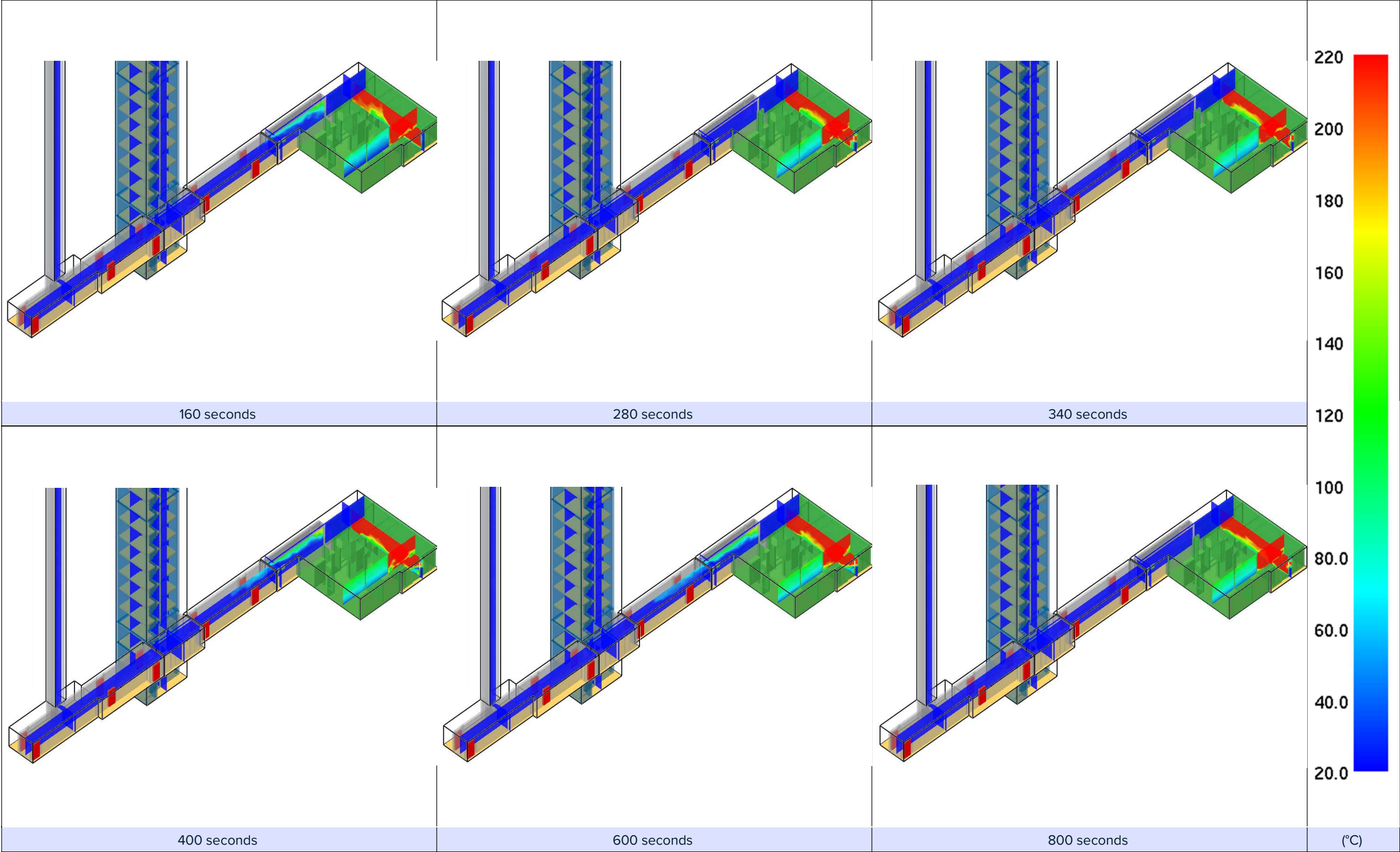


Figure 30: Case F2 Temperature Timeline

Case F3 - Smoke

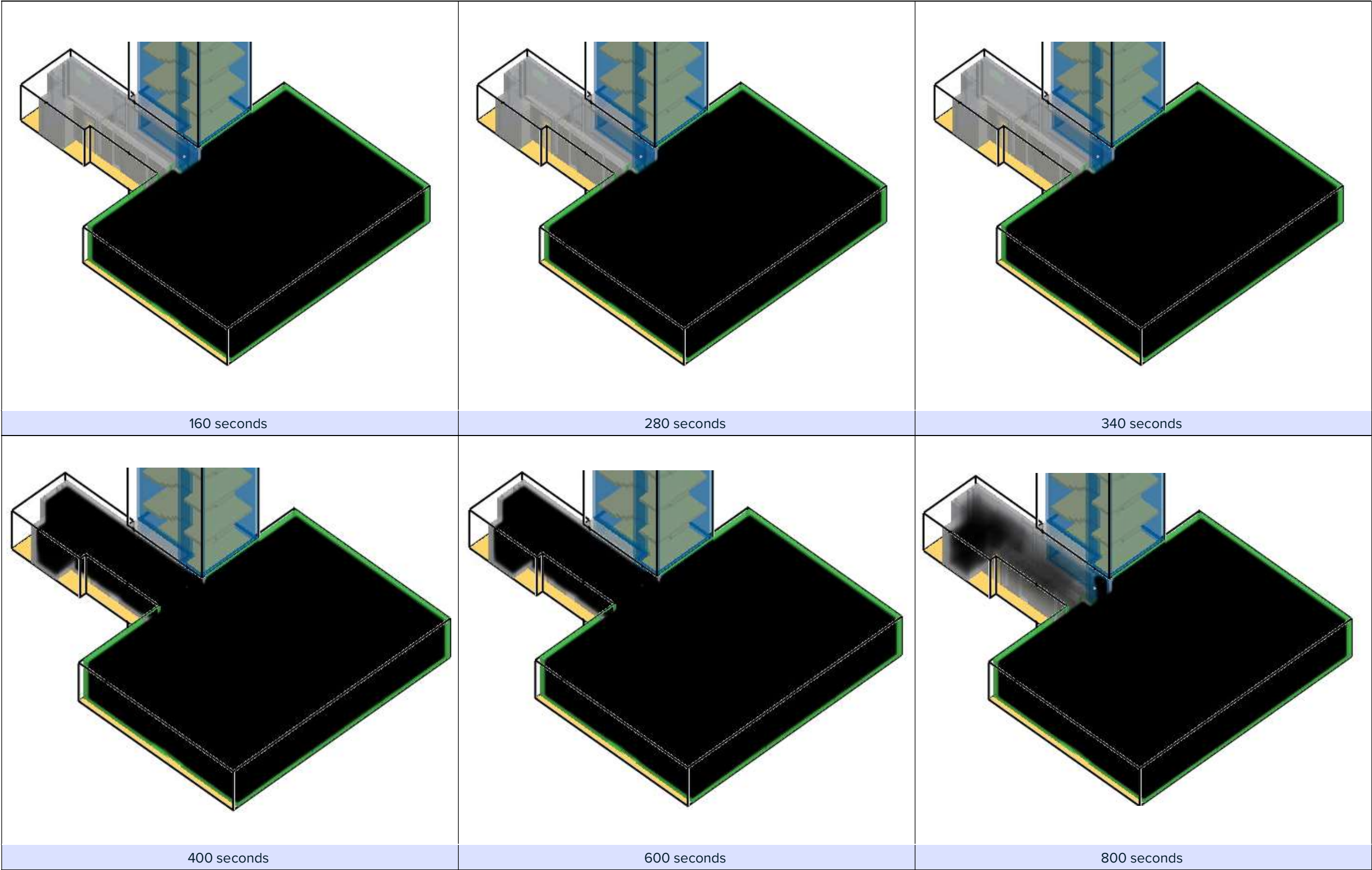


Figure 31: Case F3 Smoke Timeline

Case F3 - Visibility

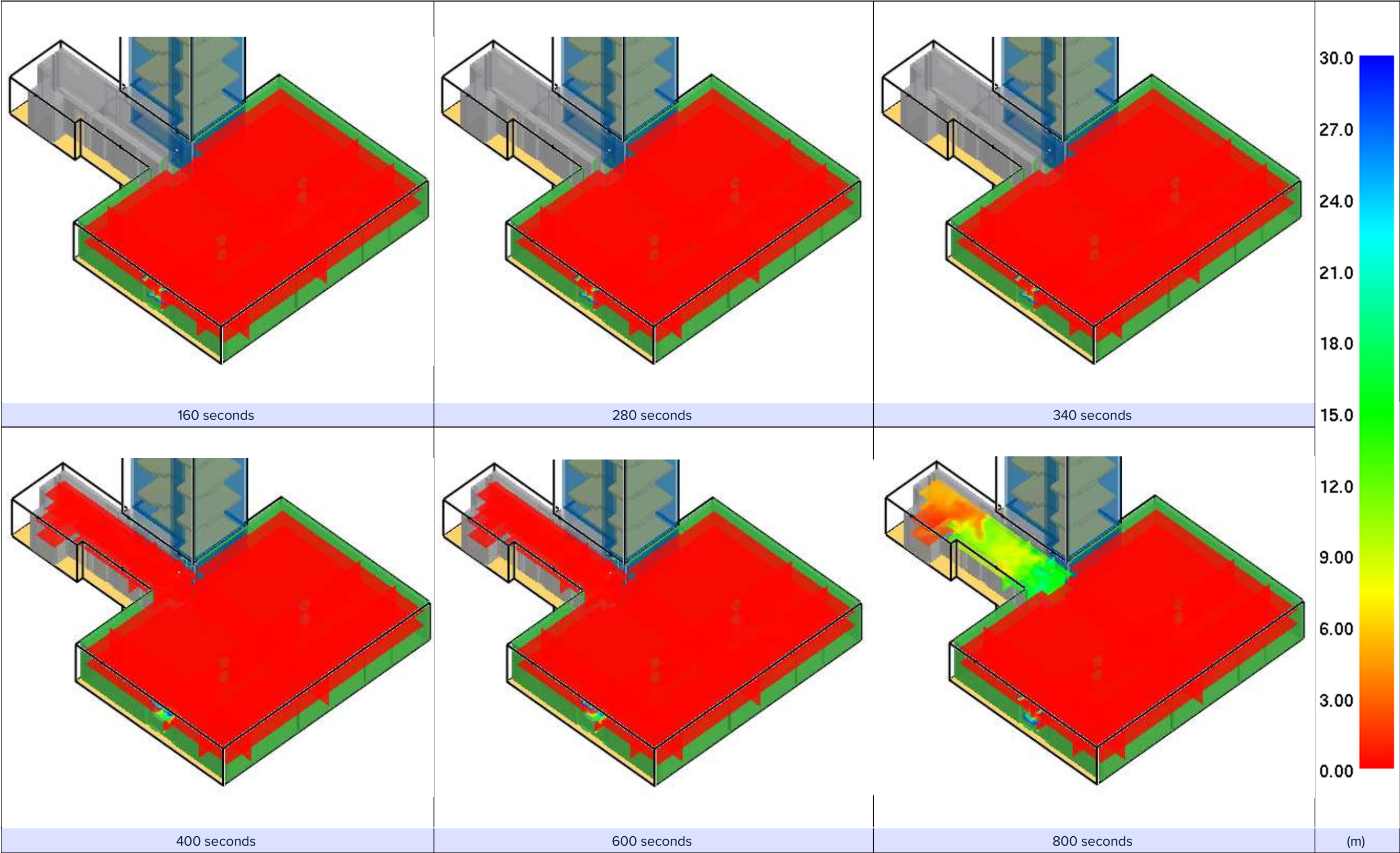


Figure 32: Case F3 Visibility Timeline

Case F3 - Temperature

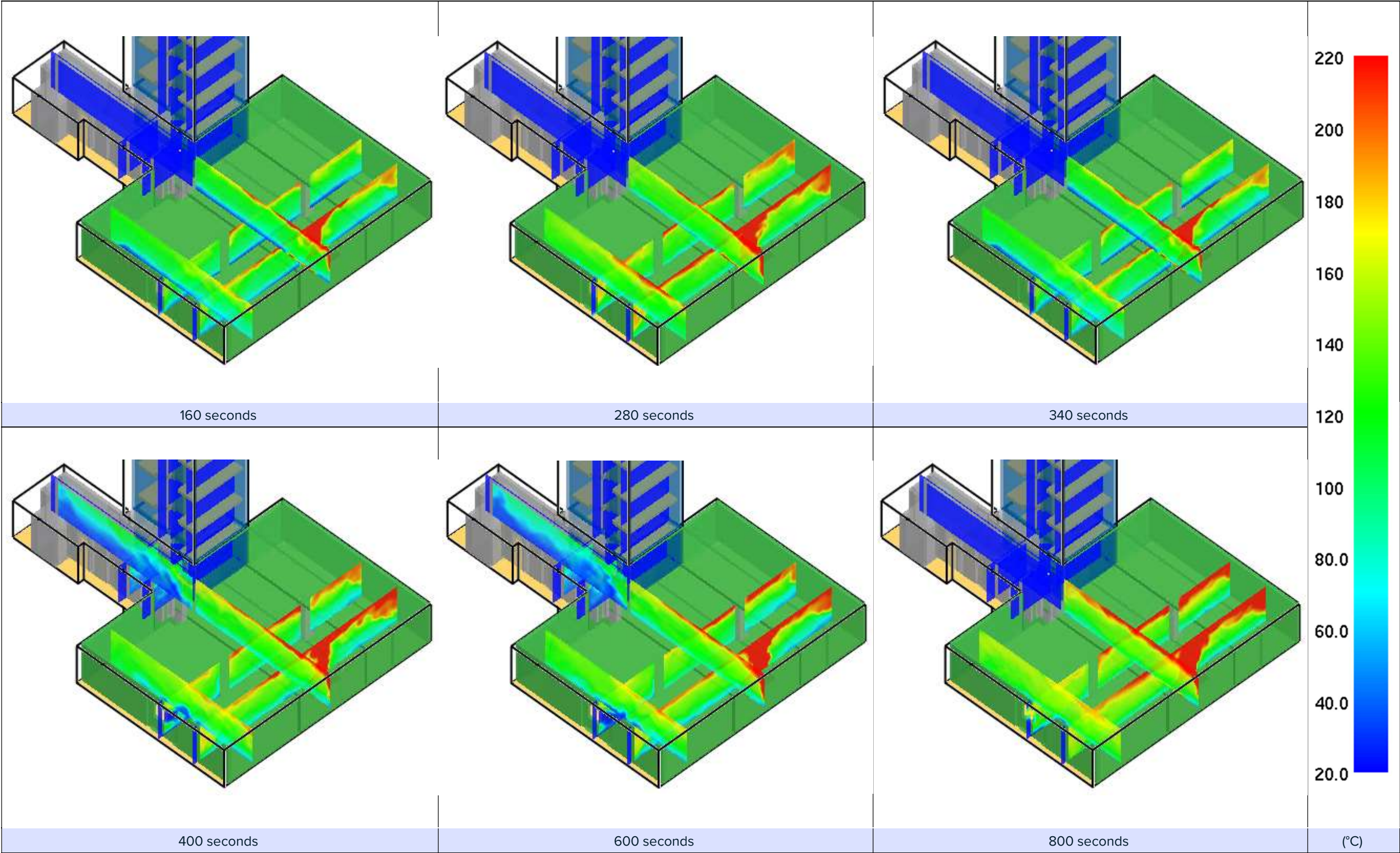


Figure 33: Case F3 Temperature Timeline

Case F4 - Smoke

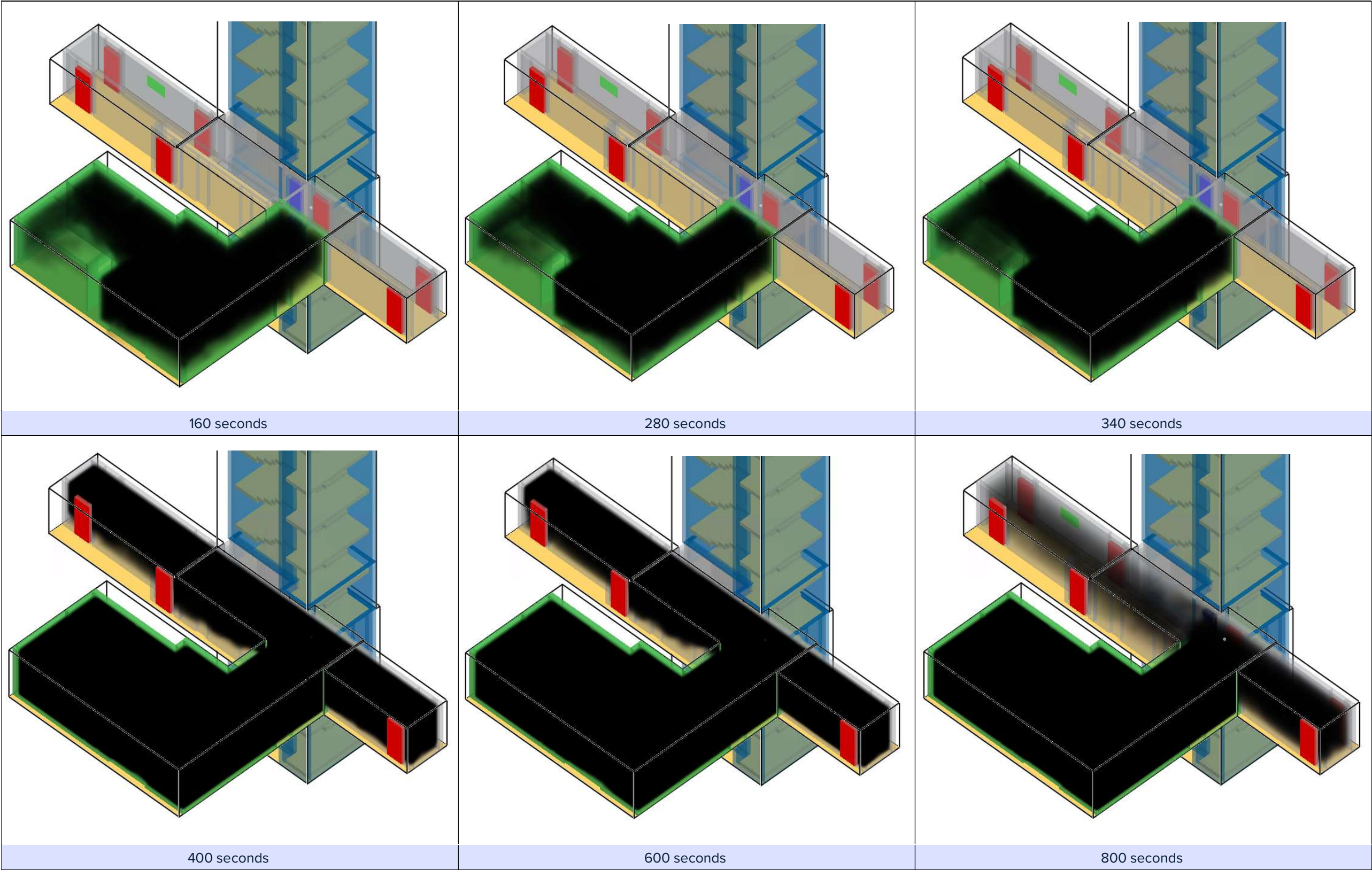


Figure 34: Case F4 Smoke Timeline

Case F4 - Visibility

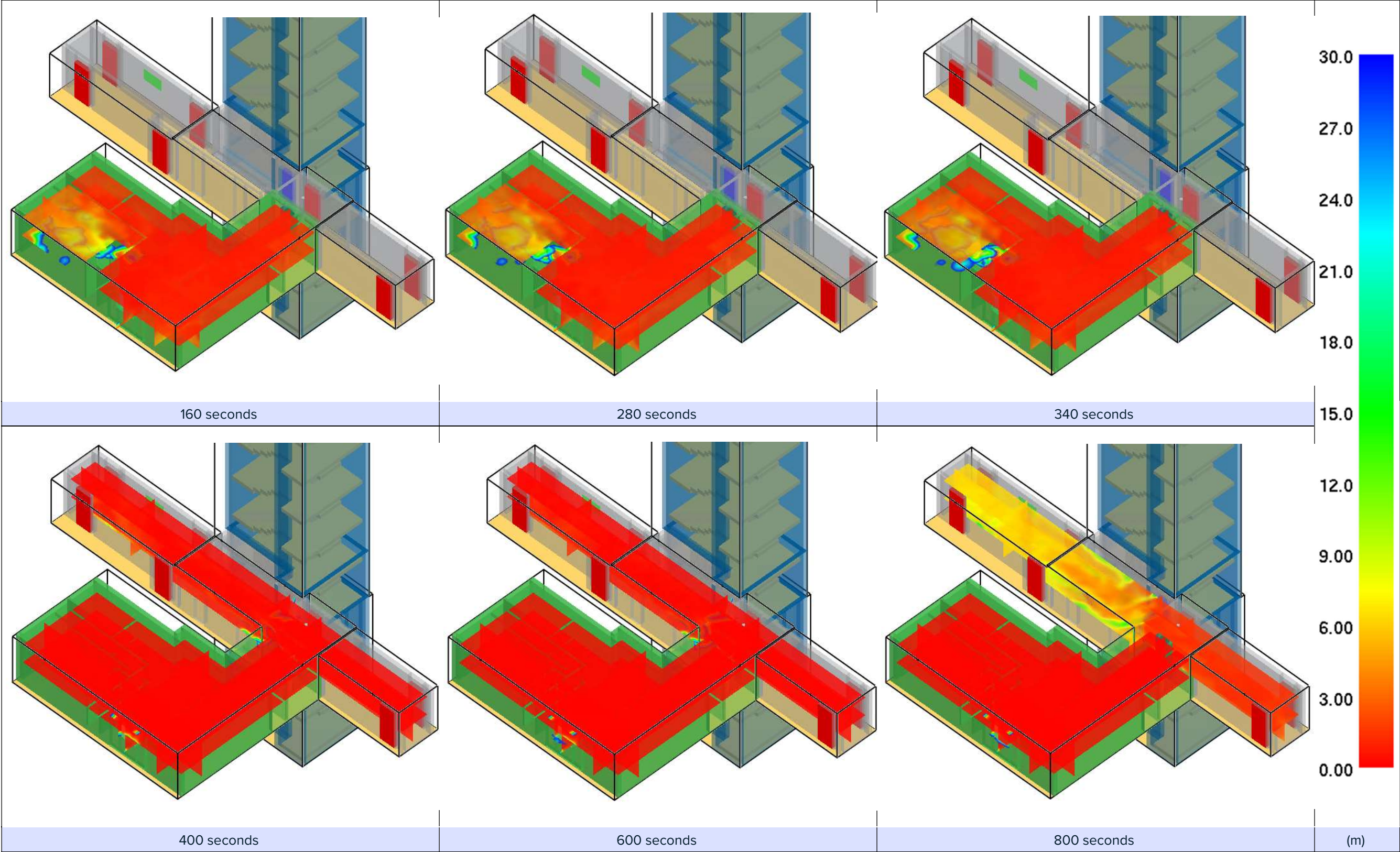


Figure 35: Case F4 Visibility Timeline

Case F4 - Temperature

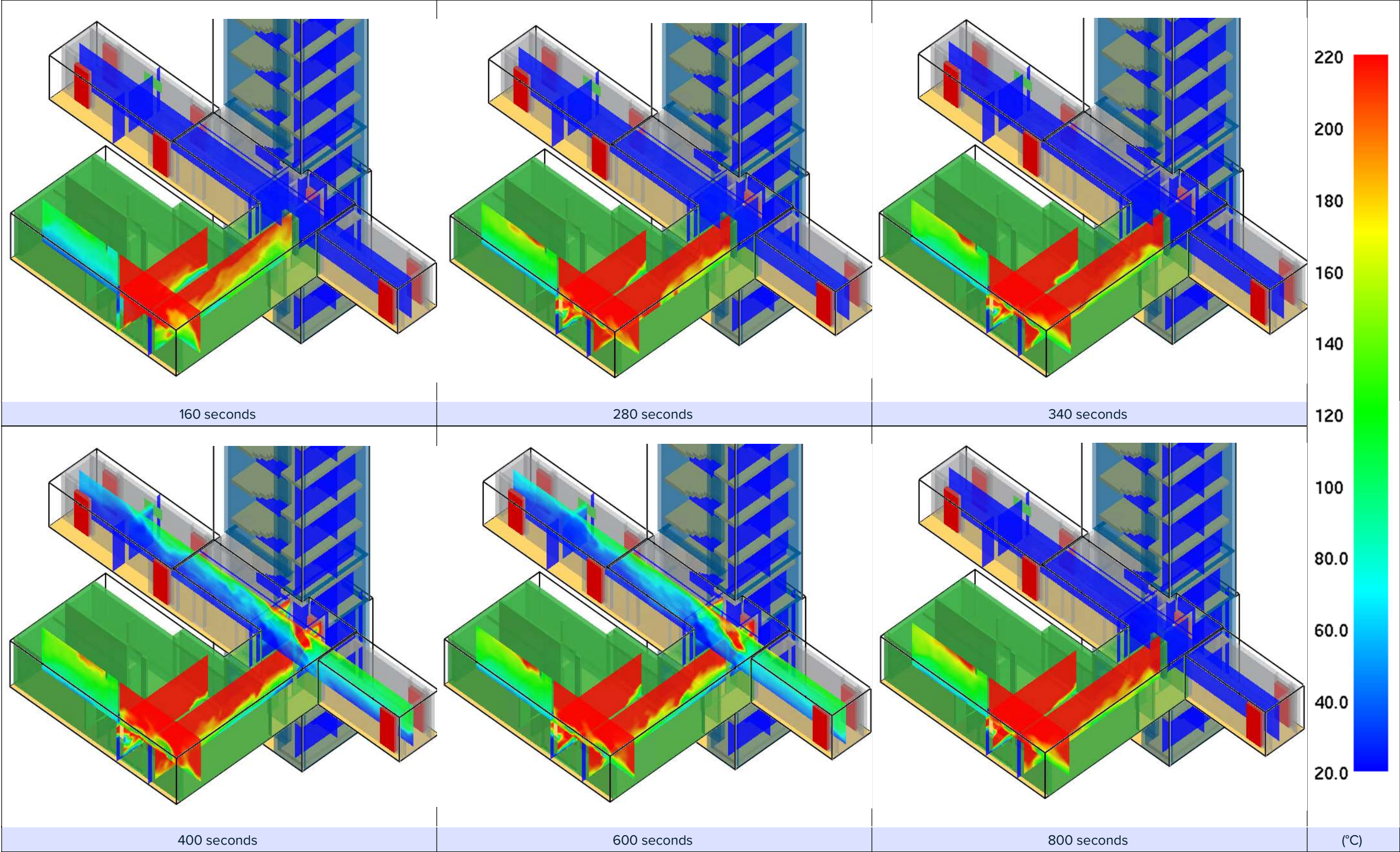


Figure 36: Case F4 Temperature Timeline

11. Contractors Considerations

11.1 Introduction

11.1.1 Whilst the CFD analysis demonstrates the acceptability of the proposed system, this level of performance relies on the following:

- Adequate installation by competent persons, fit for use items.
- Components which are fit for use.
- Adequate maintenance.

11.1.2 In addition to the items highlighted in this Section, reference to the SCA Guide is recommended.

11.2 Extract Fans

11.2.1 The extract fans should be capable to provide an extract rate of $4.0\text{m}^3\text{s}^{-1}$ within Plot 2, and $3.5\text{m}^3/\text{s}$ within Plot 3; this should be measured from the opening in the shaft at each floor. The extract rate at the fan situated on the roof should be provided such the required extract rate can be achieved on all floors served by the mechanical extract system.

11.2.2 Mechanical fans and associated equipment should fire rated and CE marked in accordance with BS EN 12101-3.

11.3 Ventilation shafts

11.3.1 Whilst it is recommended mechanical shafts be no less than 0.6m^2 , it should be noted that this free area should be confirmed with the smoke control installer and mechanical engineer. The 0.6m^2 recommendation does not account for any proposals for an internal fire rated lining to negate the impact on poor workmanship in buildings on mechanical shafts.

11.3.2 It is recommended the system is installed by a contractor with experience of installing residential corridor smoke ventilation systems, and should be done in accordance with the requirements of this report. It should be noted a comprehensive specification of the system should be provided by the smoke control installer as systems can vary.

11.3.3 In the event of a fire, the opening on the floor of fire origin should open, openings of other floors should be closed in the event of a fire.

11.3.4 The smoke shaft should be made up of materials classified as A1 or of materials known to be non-combustible when tested.

11.4 Additional information

11.4.1 The system should have an independent power supply which would operate in the event of failure of the main supply.

11.4.2 Any ductwork should be fire-resistant, the fire resistance should withstand 60 minutes or equivalent to the fire resistance rating of any compartment boundary through which it passes, whichever is the greater.

11.5 Installer Experience

11.5.1 The installer should be aware of the requirements of the system including implications and requirements imposed related to life safety systems, for example resistance of power supply equipment.

11.6 Installer Checks

11.6.1 It is recommended the SCA Guide is referred to for a full list of checks, which include recommendations for the force required for opening escape doors when the mechanical extraction system is active. It should be ensured the opening force does not exceed 100N.

11.7 Documentation

11.7.1 Information to be provided to end user and/or building management is as follows:

- Design information detailing the performance criteria for the system and description of the system.
- A control philosophy or cause and effect diagram.
- As installed drawings.
- Relevant CE marking or type test certificated
- Installation and commissioning certificates
- Witness testing certificates or other evidence that the system was tested in front of the AHJ.
- Operation, maintenance and testing instructions.
- Instructions for fire service use.

11.8 Control Panel

11.8.1 The fan control panel should be located in a separate fire compartment to that which it is designed to serve, and should be remote from potential fire location.

11.8.2 It is recommended that the control panel ensures automatic changeover from duty to standby fan, and starting circuit, in case of a duty fan failure.

11.9 Fire Detection and Alarm Systems

11.9.1 The spacing of the detection should be in accordance with BS 5839 Part 1 and consider the requirements of the Fire Strategy. The detection coverage specified in the detailed fire strategy (i.e. L5 AFDA to BS 5839 Part 1), should achieve at least an L2 detection coverage – all areas of the corridors must be no more than 7.5m of a smoke detector.

11.9.2 As an additional precaution, a smoke detector should be provided no more than 1m away from the apartment nearest to the stair to prevent excess amount of smoke entering the stair before the fans achieve full speed.

11.10 Maintenance

11.10.1 It is recommended maintenance of the system is carried out considering the recommendations of the SCA guide and BS 9999 Annex I.

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LONDON AND THE SOUTH EAST

23 Star Hill
Rochester
Kent
ME1 1XF

CENTRAL AND EAST

Castle Hill House
Huntingdon
Cambridgeshire
PE29 3TE

WEST AND WALES

The Hive
6 Beaufighter Road
Western Super Mare
North Somerset
BS24 8EE

NORTH EAST

Century Way
Thorpe Park
Business Park
Leeds
LS15 8ZA

NORTH WEST

Claremont House
2 Kelvin Close
Birchwood
Warrington
WA3 7PB

NORTH WEST

2 Jordan Street
Manchester
M15 4PY

SCOTLAND

Pentagon Centre
26-38 Washington Street
Glasgow
Scotland
G3 8AZ

NORTHERN IRELAND

Nextspace
Antrim Enterprise Park
58 Greystone Road
Antrim
BT41 1JZ

IRELAND

The Brickhouse
Block 1
Clanwilliam Court
Mount Street Lower
Dublin
D02 CF97