™ SMAY

Smay

Ventilation
Systems

Ventilation safety
of tomorrow.
Today.

AGENDA:

- **SMAY** INTRODUCTION
- PDS DESIGN STANDARDS
- **SAFETYWAY** SYSTEM
- CASE STUDY
- DESIGN SUPPORT
- CAR PARKS
- DISCUSSION

SMAY

The key to safe evacuation.

Pressure differential systems

1989

SUŁKOWICE
MAREK MAJ

2001

2008

2022

1989
SUŁKOWICE
MAREK MAJ

2001
KRAKÓW
MAKUSZYŃSKIEGO

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2022

2022

Smay
Ventilation
Systems

GLOBAL RANGE

- Presence in 34 markets worldwide
- Focus on R&D and innovation
- Hundreds PDS implementations
- Opening of new branches soon!

™ SMAY

Smay

Ventilation Systems

Product categories


accessories


air dampers


air filters


air grilles


air pressure regulators


automation and control components intended for comfort ventilation


diffusers


external wall louvres


fans


fire automatics


fire dampers


pressure differential systems


silencers


smoke control vents


smoke extraction and air intake kits

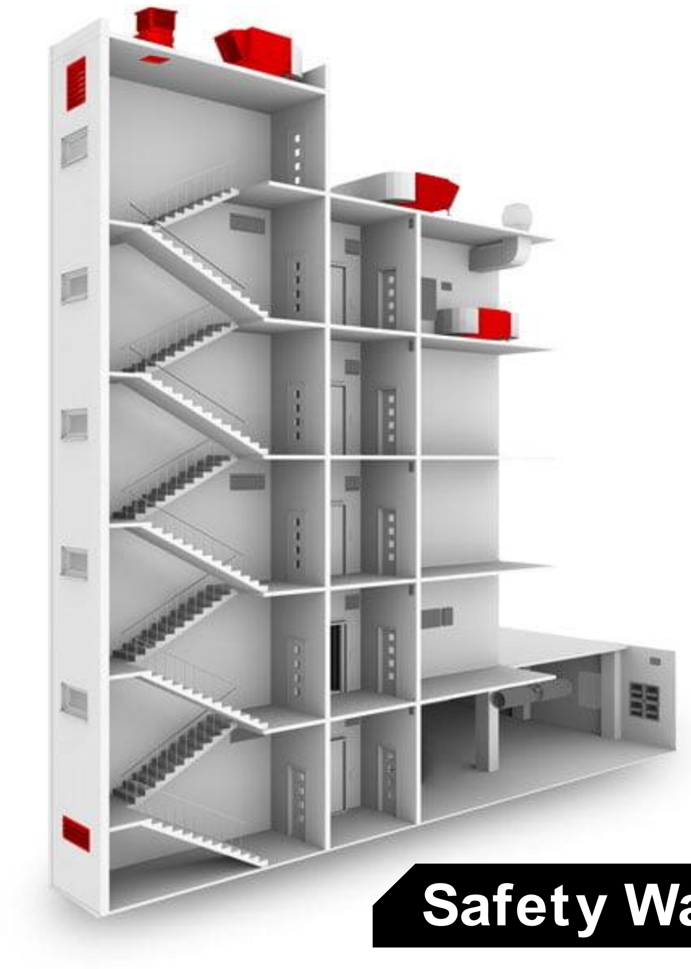

smoke extraction ducts


smoke extraction system for stairways

Safety Way – Pressurisation System

PRESSURISATION SYSTEM - SAFETY WAY
iSWAY FC PRESSURISATION KIT OF DEVICES FOR SMOKE AND HEAT CONTROL SYSTEMS

The iSWAY-FC® product set is intended to generate and maintain positive pressure in protected spaces to prevent smoke accumulation. All iSWAY-FC® units have compact structure, enabling quick access to the inner part of the device in order to carry out maintenance service. The units are provided with a rugged housing, resistant to adverse weather factors, and may be installed at virtually any location at the building, i.e. on the roof, in technical rooms, etc.



Safety Way

Pressure
Differential
System

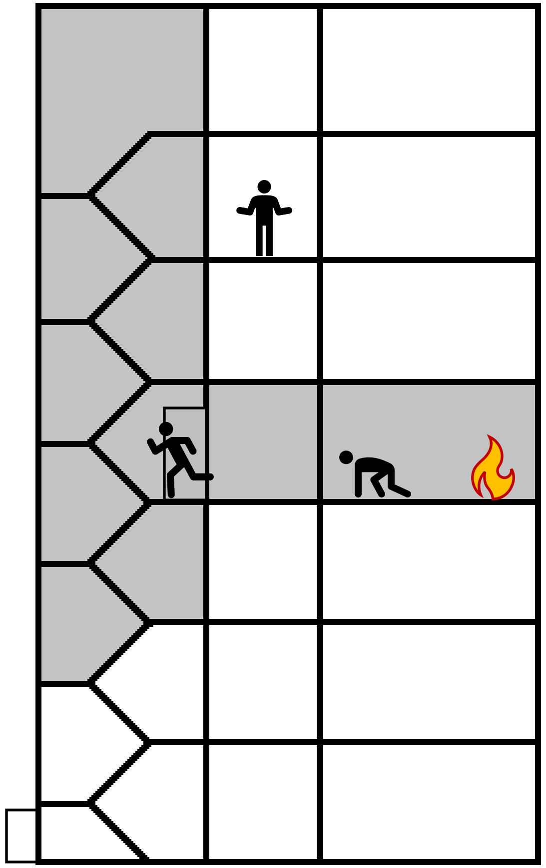
Safety Car Park

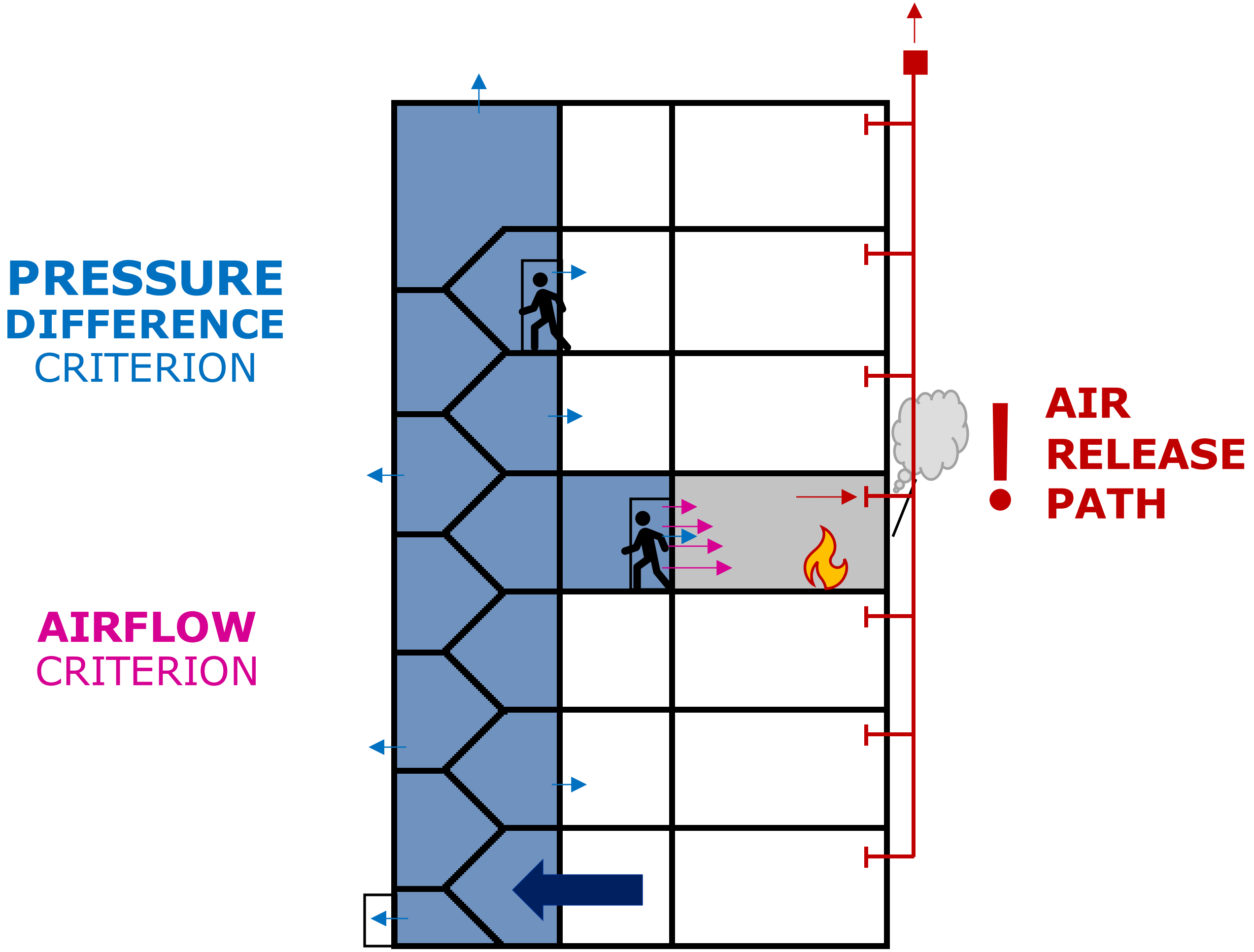
THE SAFETY CARPARK SYSTEM IS INTENDED FOR VENTILATION OF LARGE SPACES OF UNDERGROUND GARAGES AND TUNNELS.

The system is composed of SCF jet fans installed under the ceiling of the garage hall and reversible axial fans. In regular operation, the system operates in household ventilation mode, and if there is a fire, its purpose is to quickly pump smoke and heat through the extraction points and secure the zone as quickly as possible. The system reduces the temperature and removes smoke, which facilitates rescue and fire fighting efforts and evacuation of people from the facility and prevents the spread of fire to more cars.

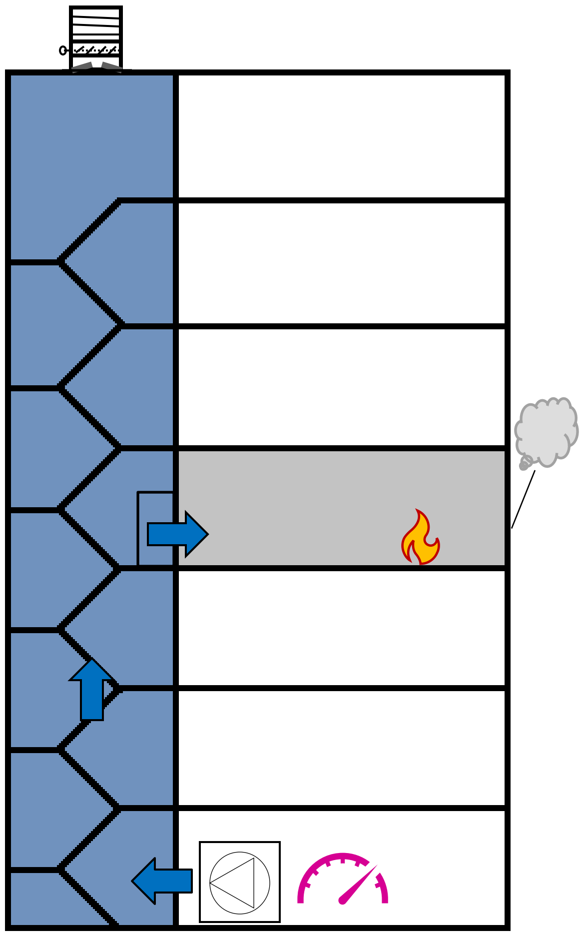
Safety Car Park

Smoke exhaust garages

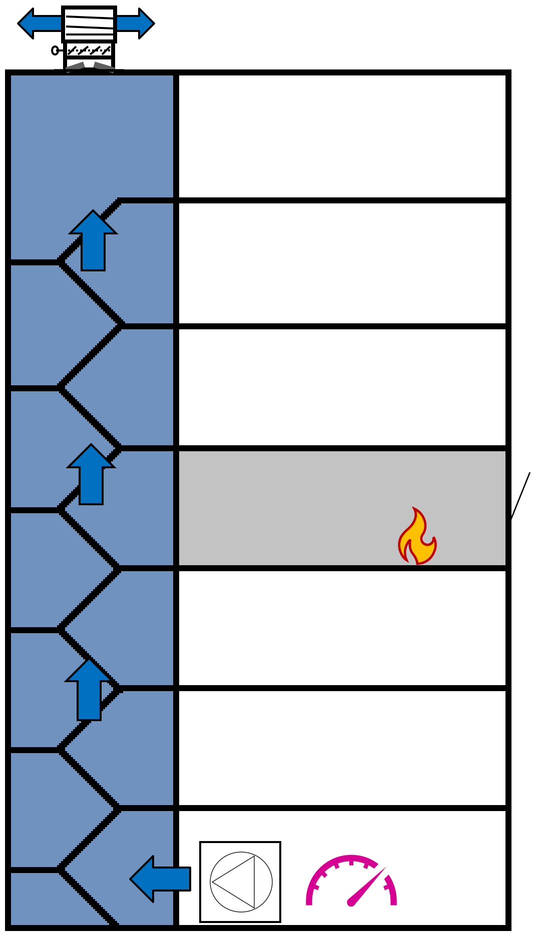



PRESSURE
DIFFERENCE
CRITERION
AIRFLOW
CRITERION
AIR
RELEASE
PATH

MECHANICAL SYSTEMS

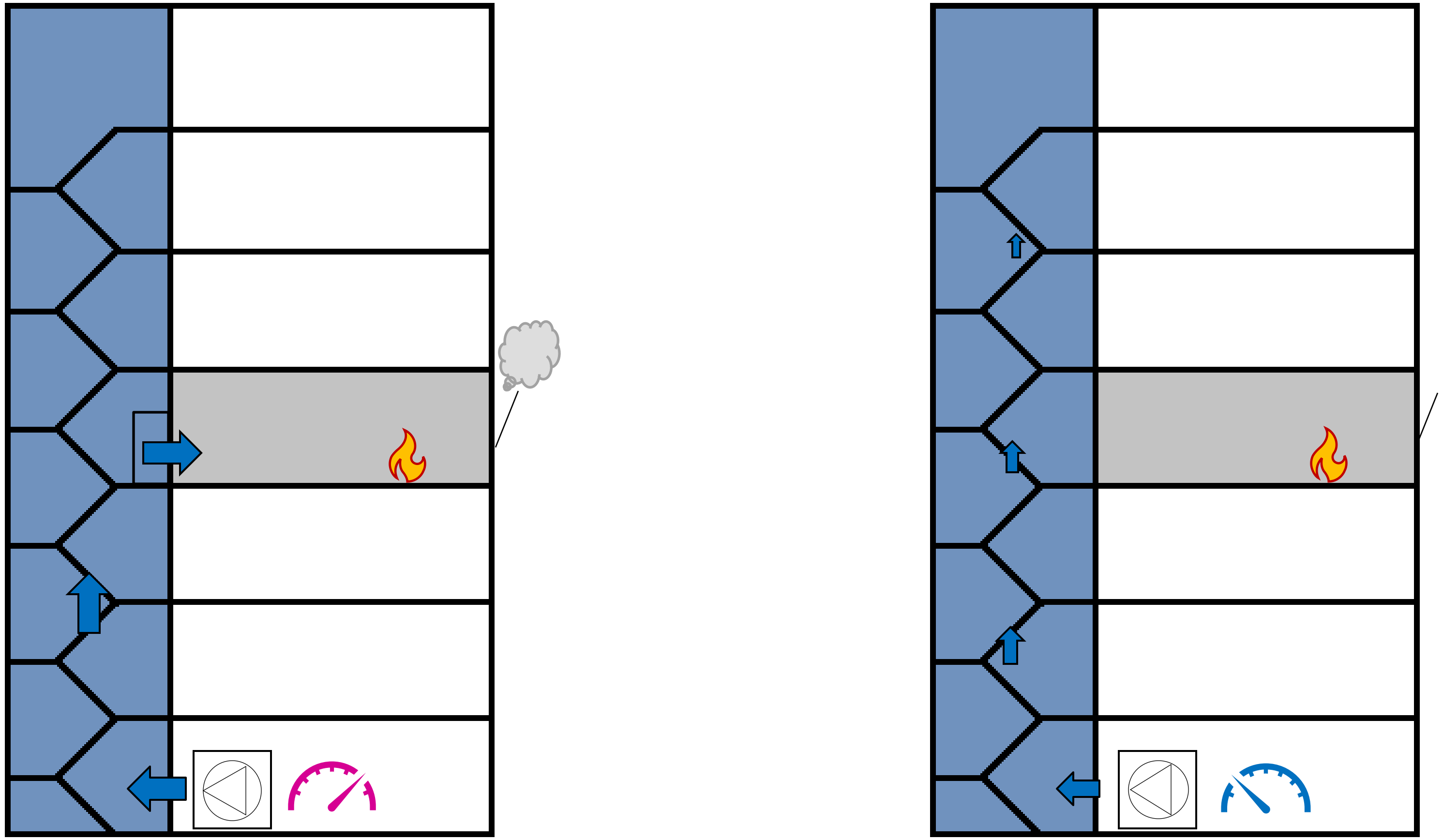


DOOR OPEN
AIR VOLUME SELECTED
FOR AIRFLOW CRITERION



DOOR CLOSED
CONSTANT AIR VOLUME.
EXCESS AIR IS RELEASED WITH
THE PRESSURE RELIEF DAMPER

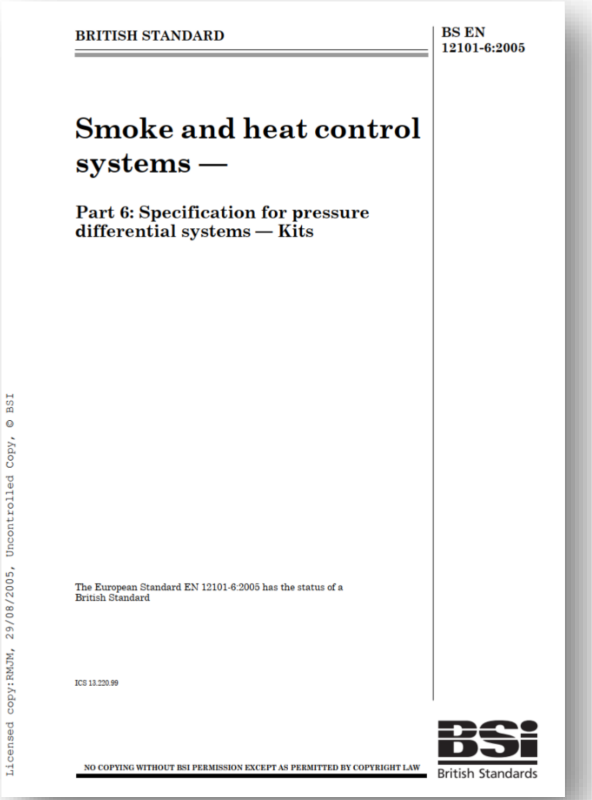
DYNAMIC FAN CONTROL SYSTEMS



DOOR OPEN
AIR VOLUME SELECTED
FOR AIRFLOW CRITERION

DOOR CLOSED
AIR VOLUME DECREASES
TO COMPENSATE AIR LEAKAGES
AND MAINTAIN OVERPRESSURE

DESIGN
STANDARDS


BRITISH STANDARD

BS EN 12101-6:2005

Smoke and heat control systems —

Part 6: Specification for pressure differential systems — Kits

The European Standard EN 12101-6:2005 has the status of a British Standard

ICS 13.220.99

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BSi British Standards

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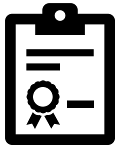
EN 12101-6:2005

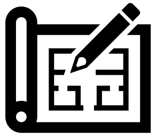
Smoke and heat control systems — Part 6: Specification for pressure differential systems — Kits

MAIN ISSUES:

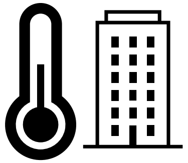
no testing methodology,



no possibility of CE marking,



more design- than product-oriented



ignoring real problems (e.g. stack effect)

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12101-6

April 2022

ICS 13.220.99

Supersedes EN 12101-6:2005

English Version

Smoke and heat control systems - Part 6: Specification for pressure differential systems - Kits

Systèmes pour le contrôle des fumées et de la chaleur - Partie 6 : Spécifications relatives aux systèmes à différentiel de pression - Kits

Rauch- und Wärmefreihaltung - Teil 6: Festlegungen für Differenzdrucksysteme - Bausätze

This European Standard was approved by CEN on 14 February 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12101-13

April 2022

ICS 13.220.99

Supersedes EN 12101-6:2005, EN 12101-6:2005/AC:2006

English Version

Smoke and heat control systems - Part 13: Pressure differential systems (PDS) - Design and calculation methods, installation, acceptance testing, routine testing and maintenance

Systèmes pour le contrôle des fumées et de la chaleur - Partie 13 : Systèmes à différentiel de pression (SDP) - Méthodes de conception et de calcul, installation, essais de réception, essais périodiques et maintenance

Rauch- und Wärmefreihaltung - Teil 13: Differenzdrucksysteme - Rauchschutz-Druckanlagen (RDA) - Planung, Bemessung, Einbau, Abnahmeprüfung, Funktions-Tests, Betrieb und Instandhaltung

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN 12101-6:2022

Smoke and heat control systems — Part 6: Specification for pressure differential systems — Kits

EN 12101-13:2022

Smoke and heat control systems — Part 13: Pressure differential systems (PDS) - Design and calculation methods, installation, acceptance testing, routine testing and maintenance

SMAY™

LABORATORY TESTS

1. DYNAMIC BEHAVIOUR TEST
   PERFORMANCE WHEN DOOR IS OPENED AND CLOSED

2. FIRST FUNCTIONALITY TEST
   20 CYCLES WITH CHECKING TIMES TO ACHIEVE SET VALUES

3. DURABILITY TEST
   10000 CYCLES TO CHECK THE COMPONENTS' RELIABILITY

4. SECOND FUNCTIONALITY TEST
   FUNCTIONALITY TEST AFTER DURABILITY TEST

5. OSCILLATION TEST
   10 SUBTESTS OF 20 OPENING AND CLOSING DOOR CYCLES WITHOUT WAITING TIME

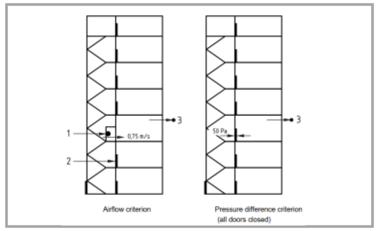
Institut für Industrieaerodynamik

ITI®

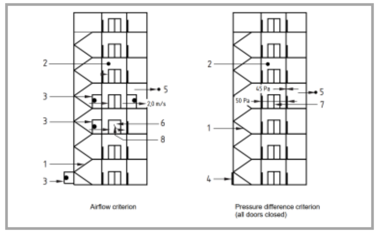
SYSTEM CLASSIFICATION

EN12101-6:2005

SYSTEM CLASS	PURPOSE OF USE
A	For means of escape. Defend in place.
B	For means of escape and fire-fighting.
C	For means of escape by simultaneous evacuation.
D	For means of escape. Risk of sleep.
E	For means of escape by phased evacuation.
F	Firefighting system and means of escape.



A



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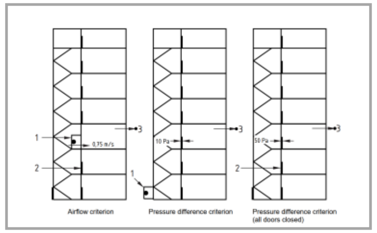
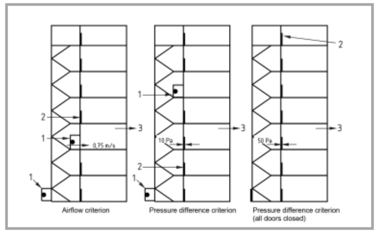
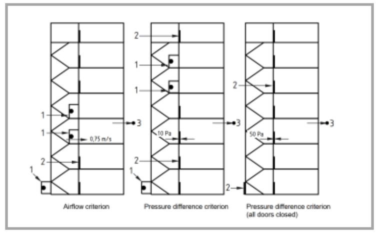


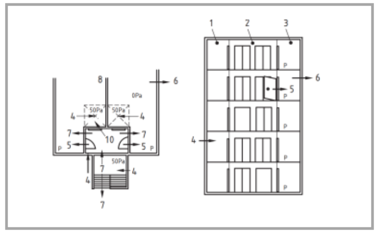
C



D



E

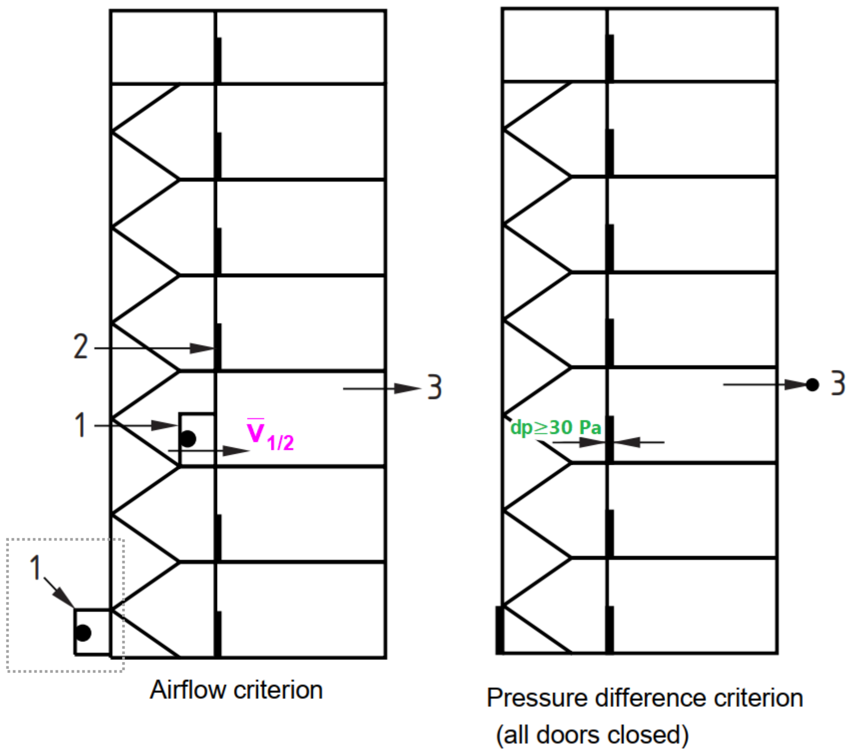


F

SYSTEM CLASSIFICATION

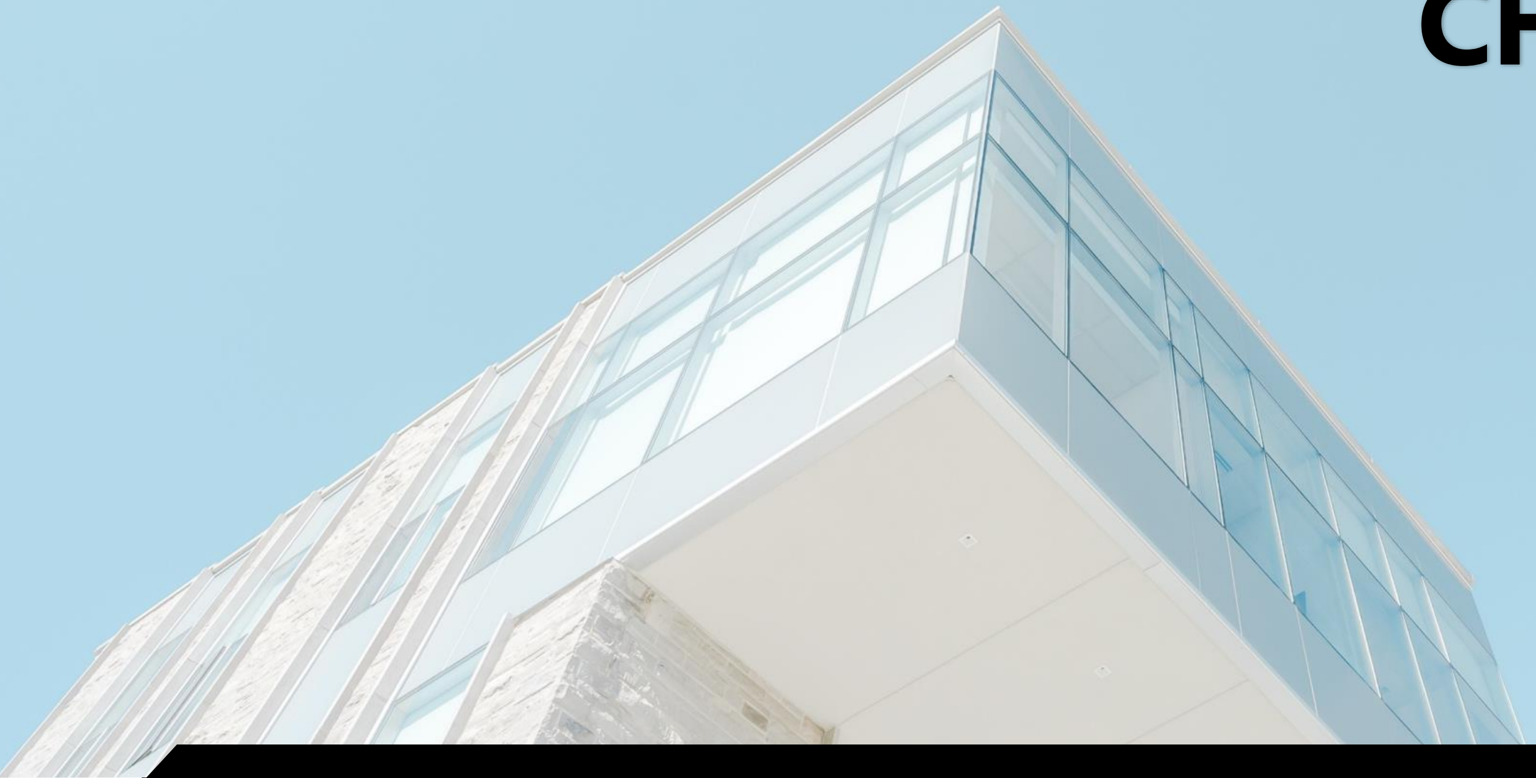
EN12101-13

SYSTEM CLASS	PURPOSE OF USE
1 $\bar{v}_1$= 1 m/s	• Low-/mid-rise residential buildings • Water extinguishing systems • Accepted by authorities
2 $\bar{v}_2$= 2 m/s	• Class 1 not sufficient • No water extinguishing systems • Required by authorities



Key
1 Door open
2 Door closed
3 Air release path

THE MOST COMMON CHALLENGES



1. NATURAL	2. TECHNICAL	3. HUMAN FACTOR
WIND IMPACT	CHANGING TIGHTNESS	REARRANGEMENTS
STACK EFFECT	MALFUNCTIONS	WRONG USE

1 Scope

This document gives calculation methods, guidance and requirements for the design, installation, acceptance testing, routine testing and maintenance for pressure differential systems (PDS).

PDSs are designed to hold back smoke at a leaky physical barrier in a building, such as a door (either open or closed) or other similarly restricted openings and to keep tenable conditions in escape and access routes depending on the application.

It covers systems intended to protect means of escape e.g. staircases, corridors, lobbies, as well as systems intended to provide a protected firefighting space (bridgehead) for the fire services.

It provides details on the critical features and relevant procedures for the installation.

It describes the commissioning procedures and acceptance testing criteria required to confirm that the calculated design is achieved in the building.

This document gives rules, requirements and procedures to design PDS for buildings up to 60 m.

For buildings taller than 60 m the same requirements are given (e.g. Table 1), but additional methods of calculation and verification are necessary. Requirements for such methods and verification are given in Annex D, but the methods fall outside the scope of this document [e.g. Additional mathematical analysis and/or Computational Fluid Dynamics (CFD)].

PRESSURE TOO LOW
<30 Pa

PRESSURE TOO HIGH
>100 N

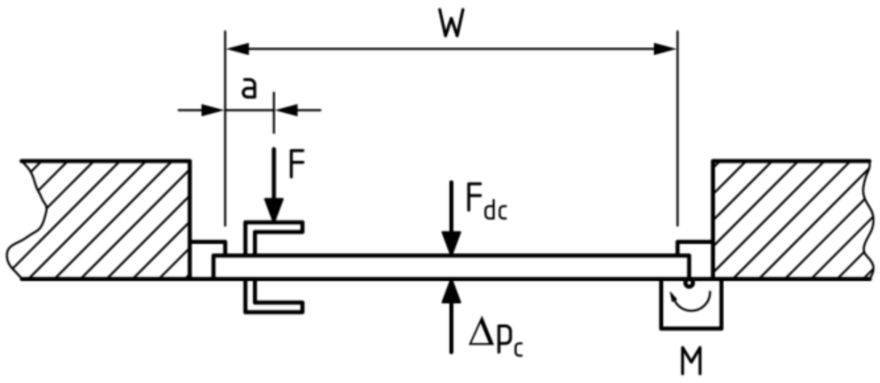
A.6.4.2 Estimation of door opening forces; Maximum pressure across doors

The pressure difference corresponding to a door opening force F = 100 N applied at the door handle, can be determined with the following equation:

$$\Delta P_{100N} = \frac{(100N - F_{dc}) \times 2 \times (W - a)}{W^2 \times H} \quad [Pa] \qquad (A.27)$$

where

F_{dc}	s the door closer force at handle without pressure difference	(N)
NOTE	$F_{dc} = M / (W-a)$	
M	is the opening torque of the door closer	(Nm)
W	Is the door width	(m)
H	is the door height	(m)
a	is the distance door handle	(m)
ΔP_{100N}	is the pressure difference corresponding to 100 N opening force	(Pa)



Key

a	handle distance
F	door opening force
F_{dc}	door closer force
M	opening torque of door closer
W	door width
Δp_c	pressure difference

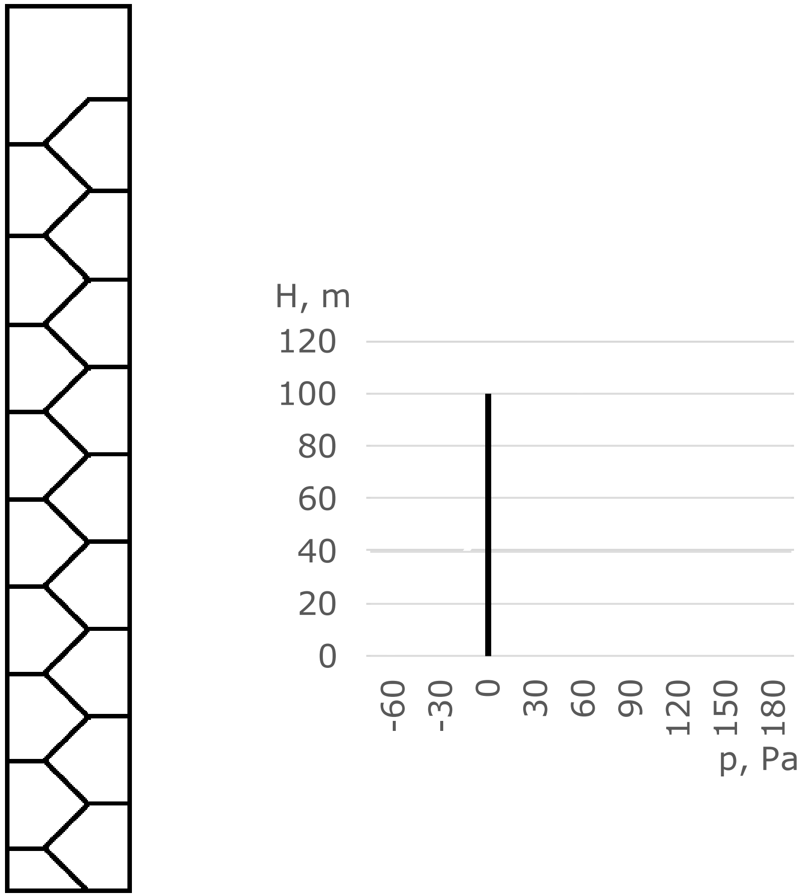
Figure A.5 — Door opening force parameters

Table A.6 — Maximum values of overpressure (Pa) across doors with different widths and different door closer forces in order not to exceed the 100 N force to open the door

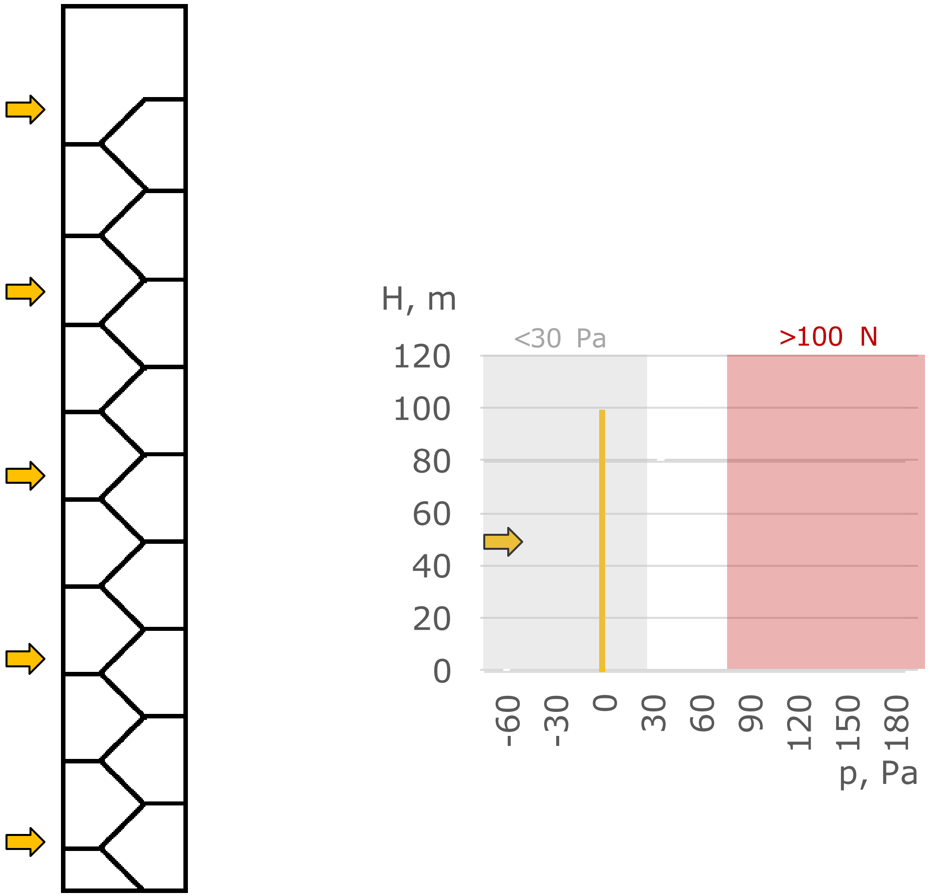
Door closer force – F_{DC} (N)	Door width				
	0,8 m	0,9 m	1,0 m	1,1 m	1,2 m
25	82 Pa	74 Pa	68 Pa	62 Pa	57 Pa
35	71 Pa	64 Pa	59 Pa	54 Pa	50 Pa
45	60 Pa	54 Pa	50 Pa	45 Pa	42 Pa
55	49 Pa	44 Pa	41 Pa	37 Pa	34 Pa
65	38 Pa	35 Pa	32 Pa	29 Pa	27 Pa

NOTE If F_{DC} is 65 N, without the PDS running, on 2,0 m high doors with width > 1,0 m, the minimum pressure differential value of 30 Pa (Table 1) will not be fulfilled – see highlighted cells in Table A.6.

ISOTHERMAL
T_{out}= 20°C



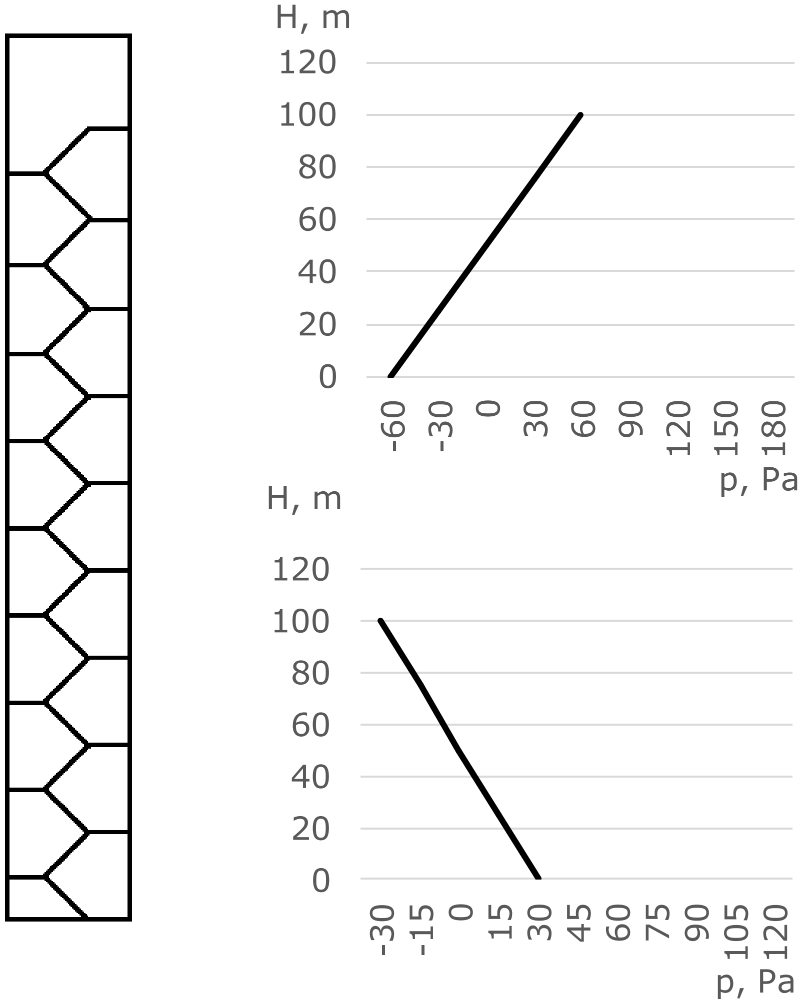
NATURAL DISTRIBUTION



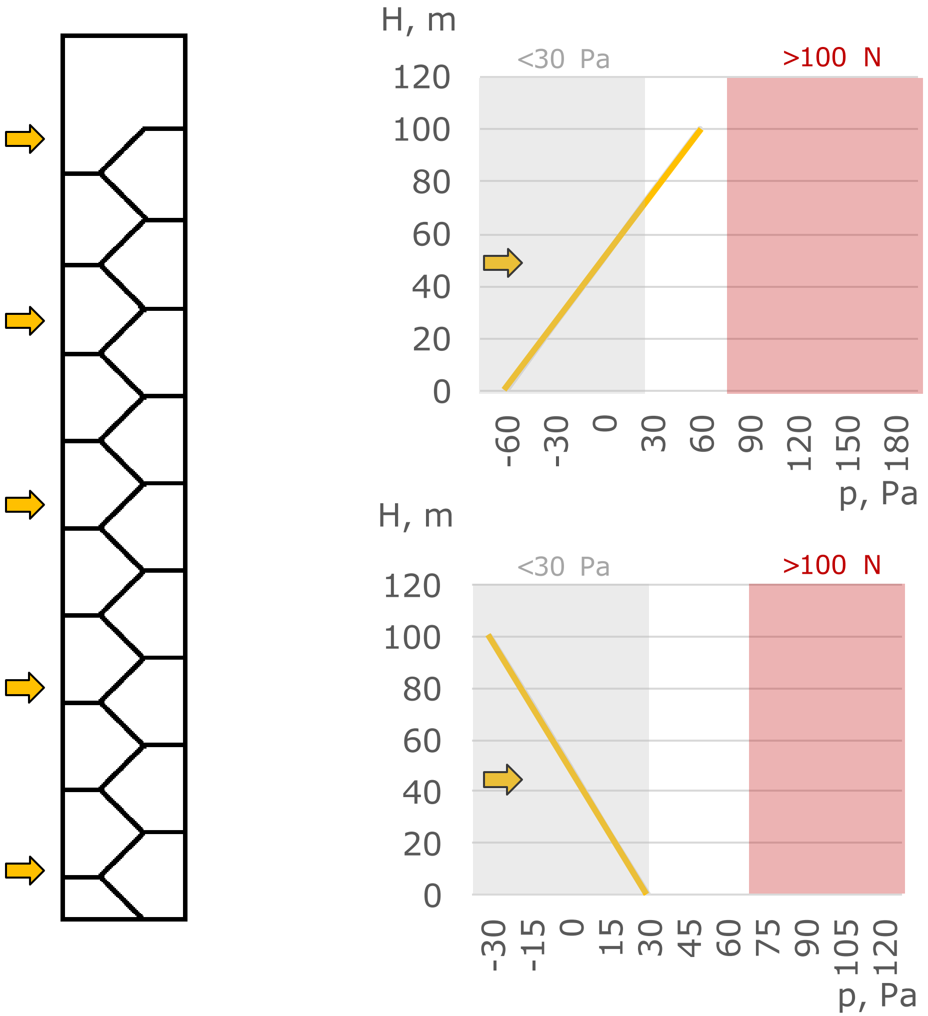
PRESSURIZATION

WINTER
T_{out}= -10°C

SUMMER
T_{out}= 38°C

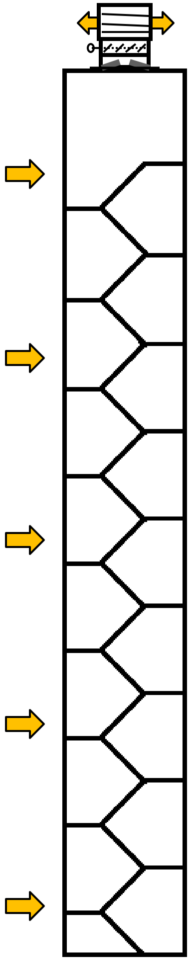


NATURAL DISTRIBUTION



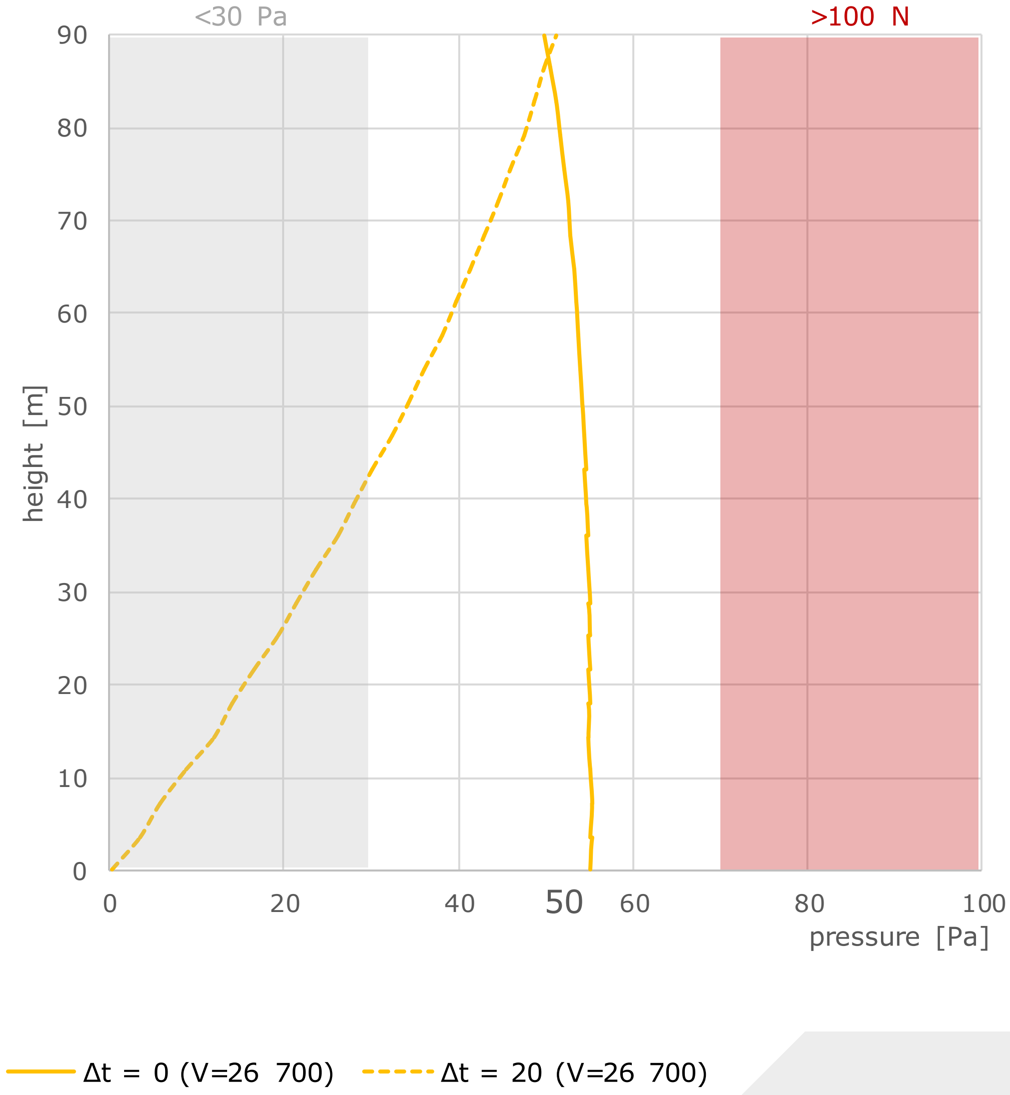
PRESSURIZATION

PRESSURE DISTRIBUTION
DIFFERENT PDS, 90m BUILDING

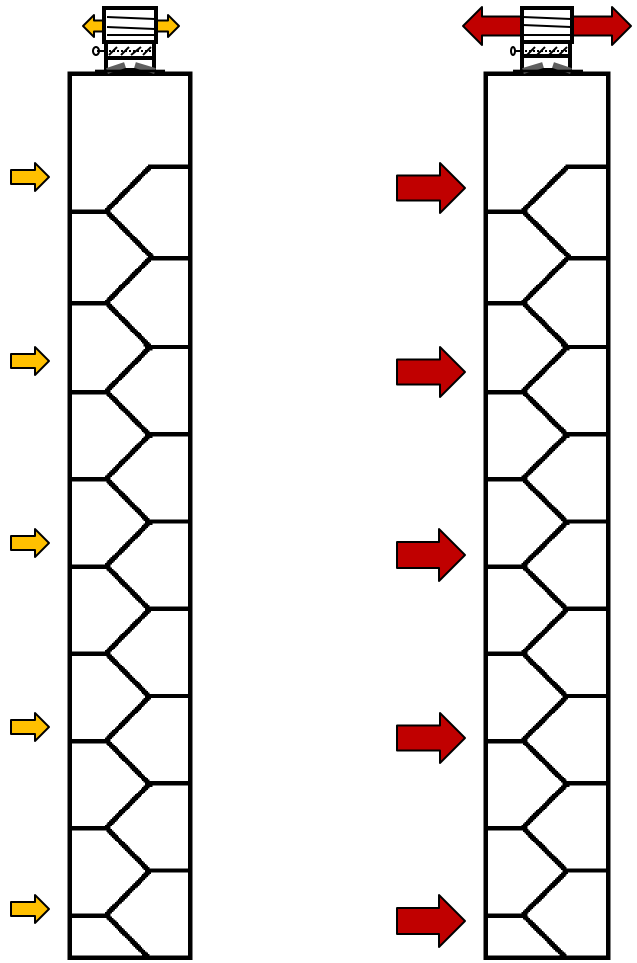


CONSTANT AIR VOLUME

V=26700 m³/h

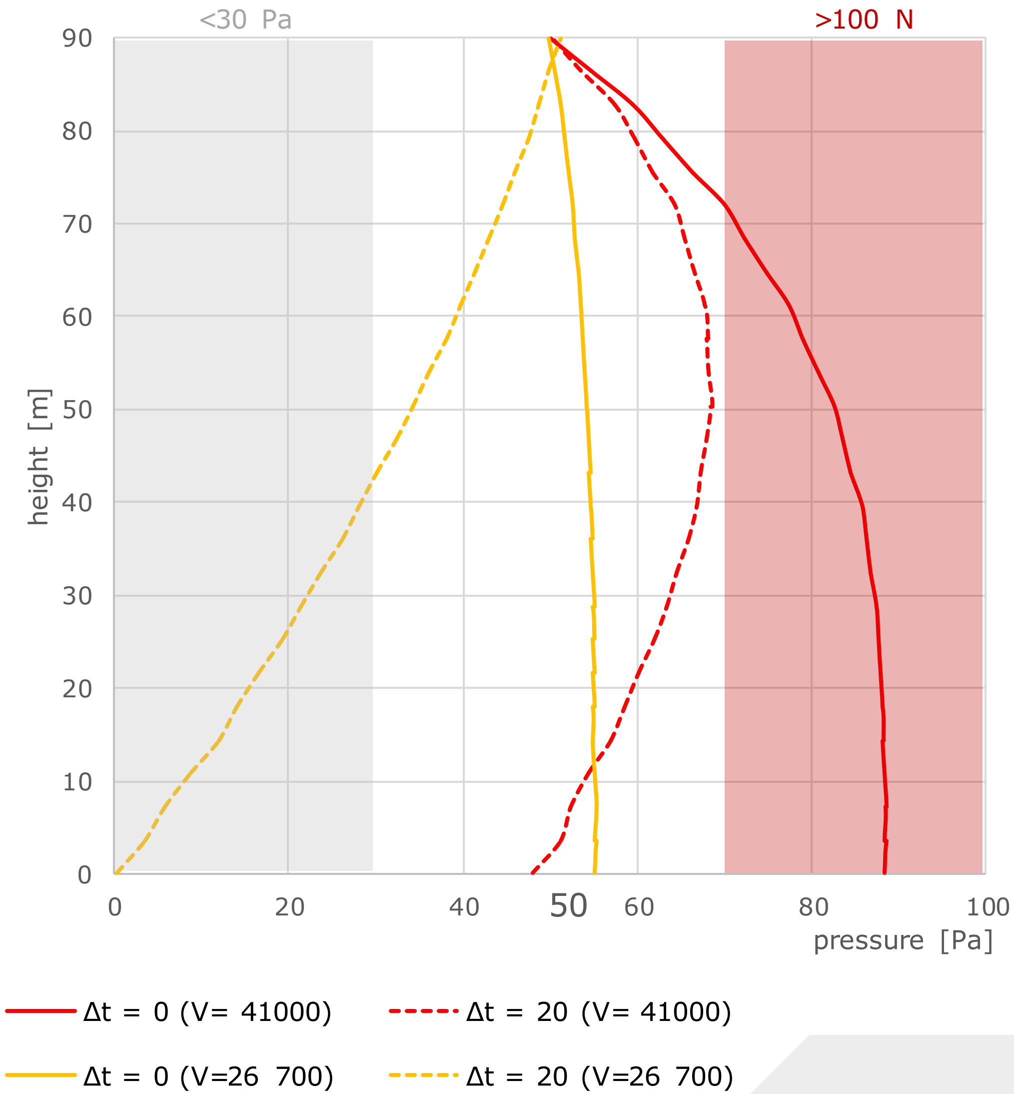


PRESSURE DISTRIBUTION
DIFFERENT PDS, 90m BUILDING



CONSTANT AIR VOLUME

V=26700 m³/h **V=41000 m³/h**



EN12101-6:2005

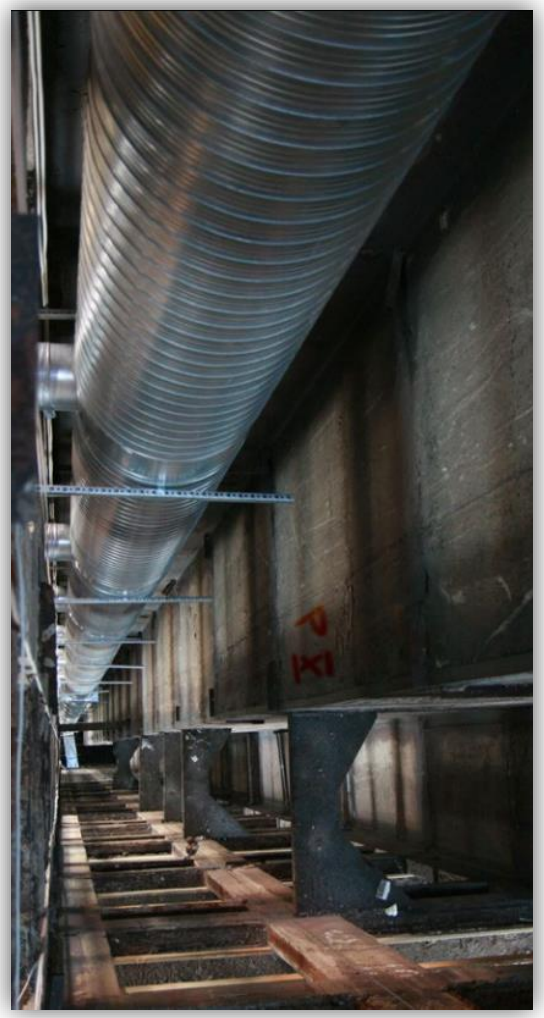
Annex B
(informative)

Solutions for inability to obtain design pressure differential

The following guidance relates specifically to pressurization systems. However, similar principles, suitably adapted, may also be applied to depressurization systems.

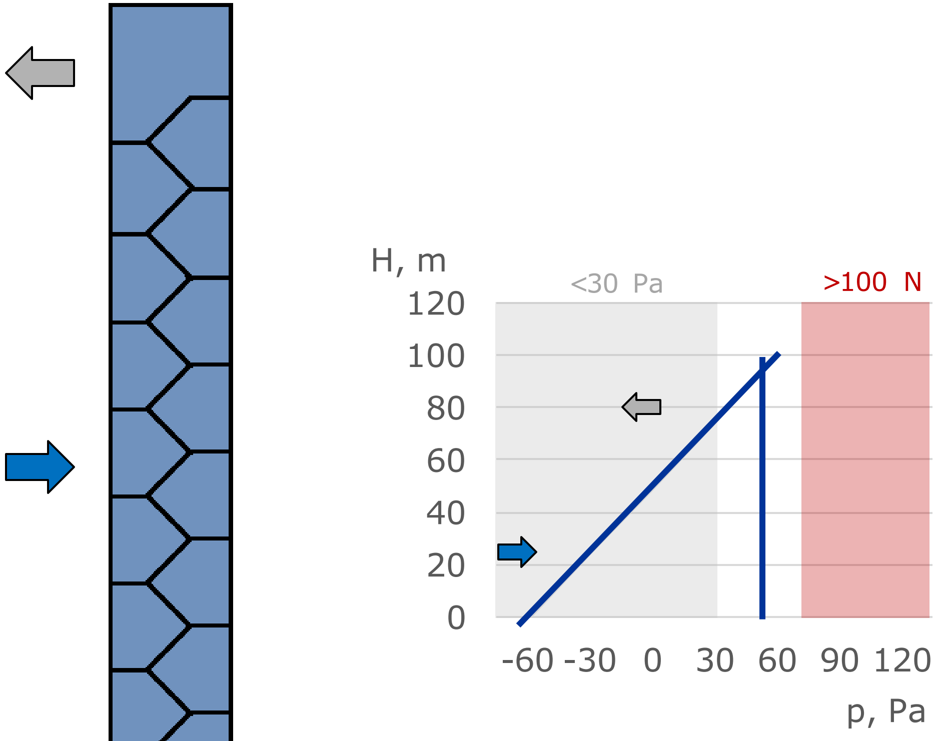
B.1 The pressure differentials recommended in this document are intended to take account of fire buoyancy and external wind conditions. If tests are carried out where external conditions give rise to high wind and gusts, it may not be possible to achieve the design pressure differential.

B.2 Where stack effect is likely to be a significant factor, this may be minimized by operating the pressure differential system for a period of one hour before testing so that the external air and shaft temperatures can equalize.

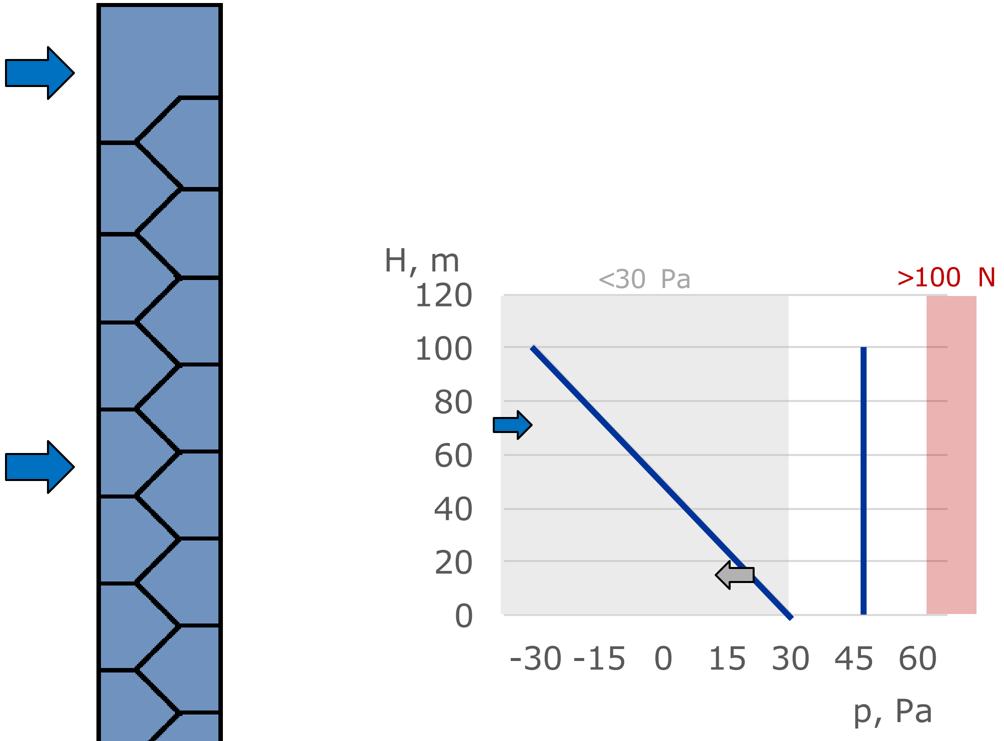


REAL SCALE TESTING	
LOCATION	CRACOW
BUILDING	23°, H=90 m
TIME	10.2008 – 09.2010

CASE STUDY ON RECONSTRUCTION:
SMAY.PL/PDS



WINTER



SUMMER

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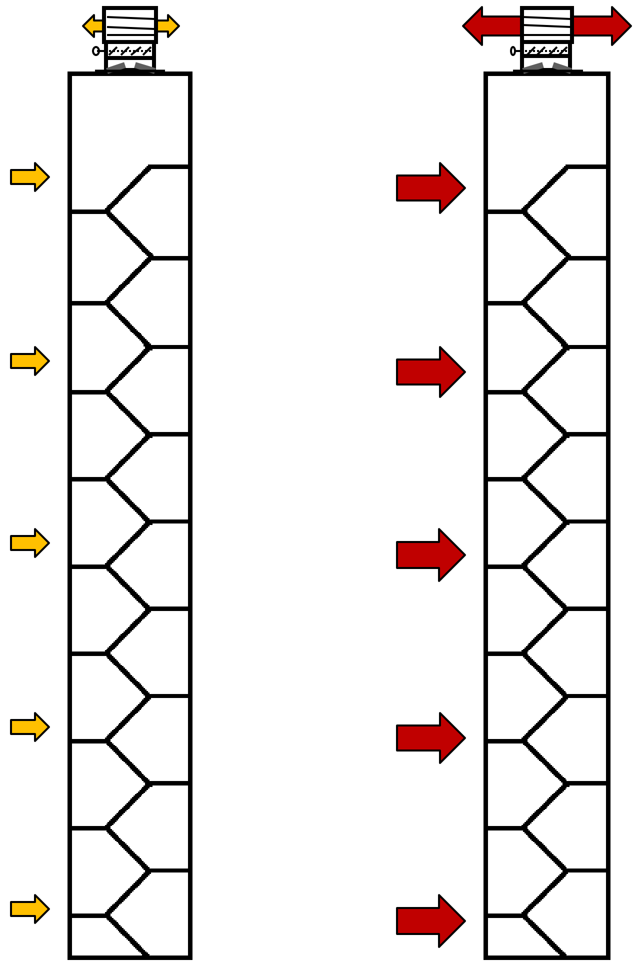
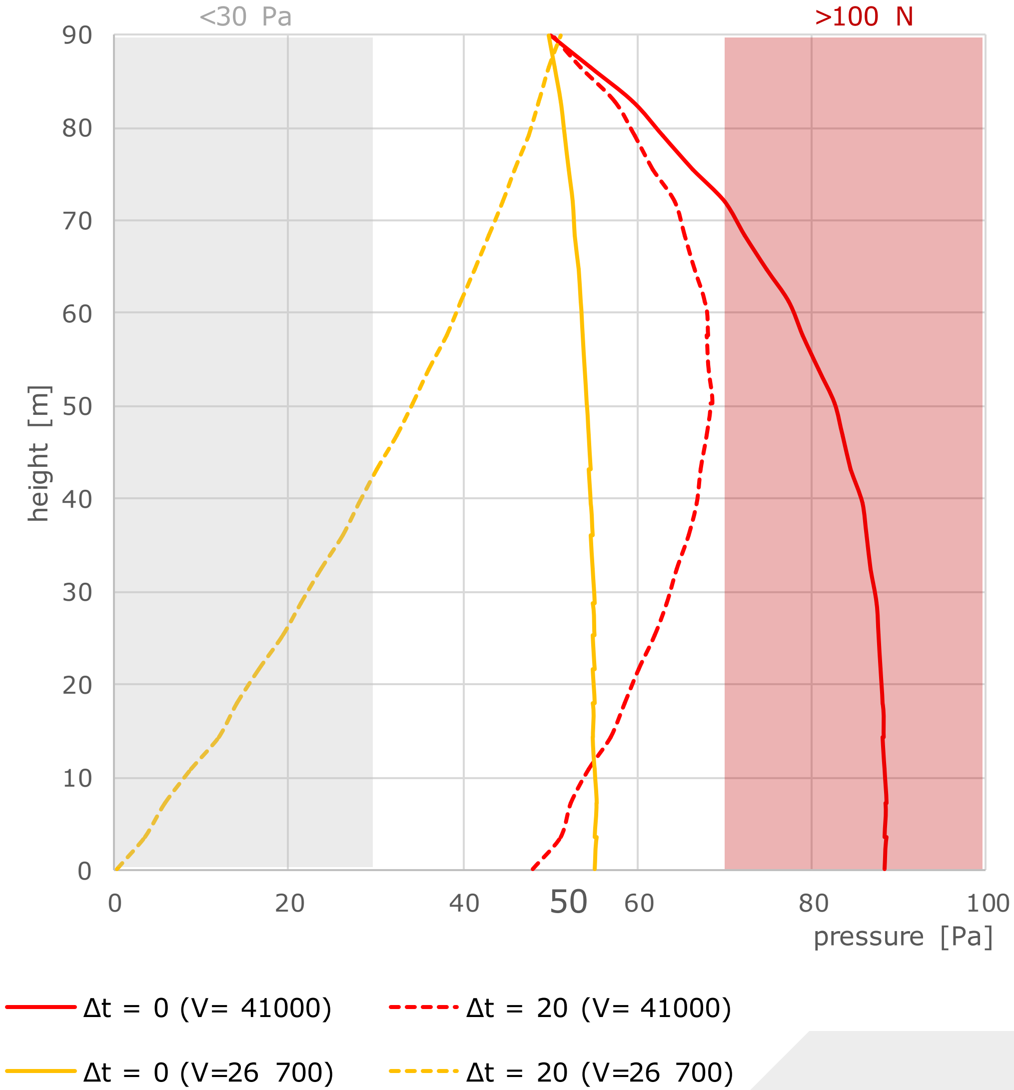
PRESSURE DISTRIBUTION
DIFFERENT PDS, 90m BUILDING



CONSTANT AIR VOLUME

V=26700 m³/h **V=41000 m³/h**



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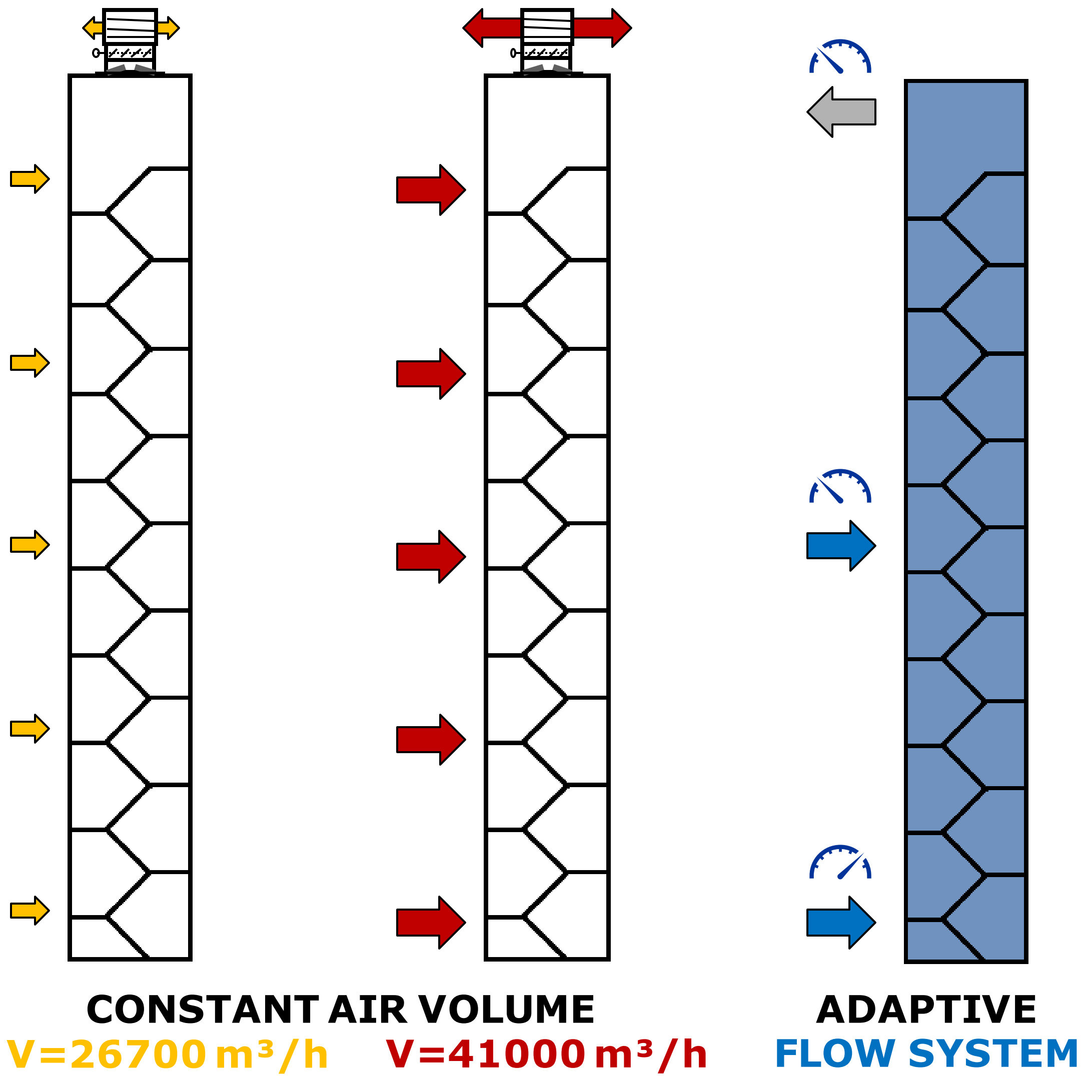
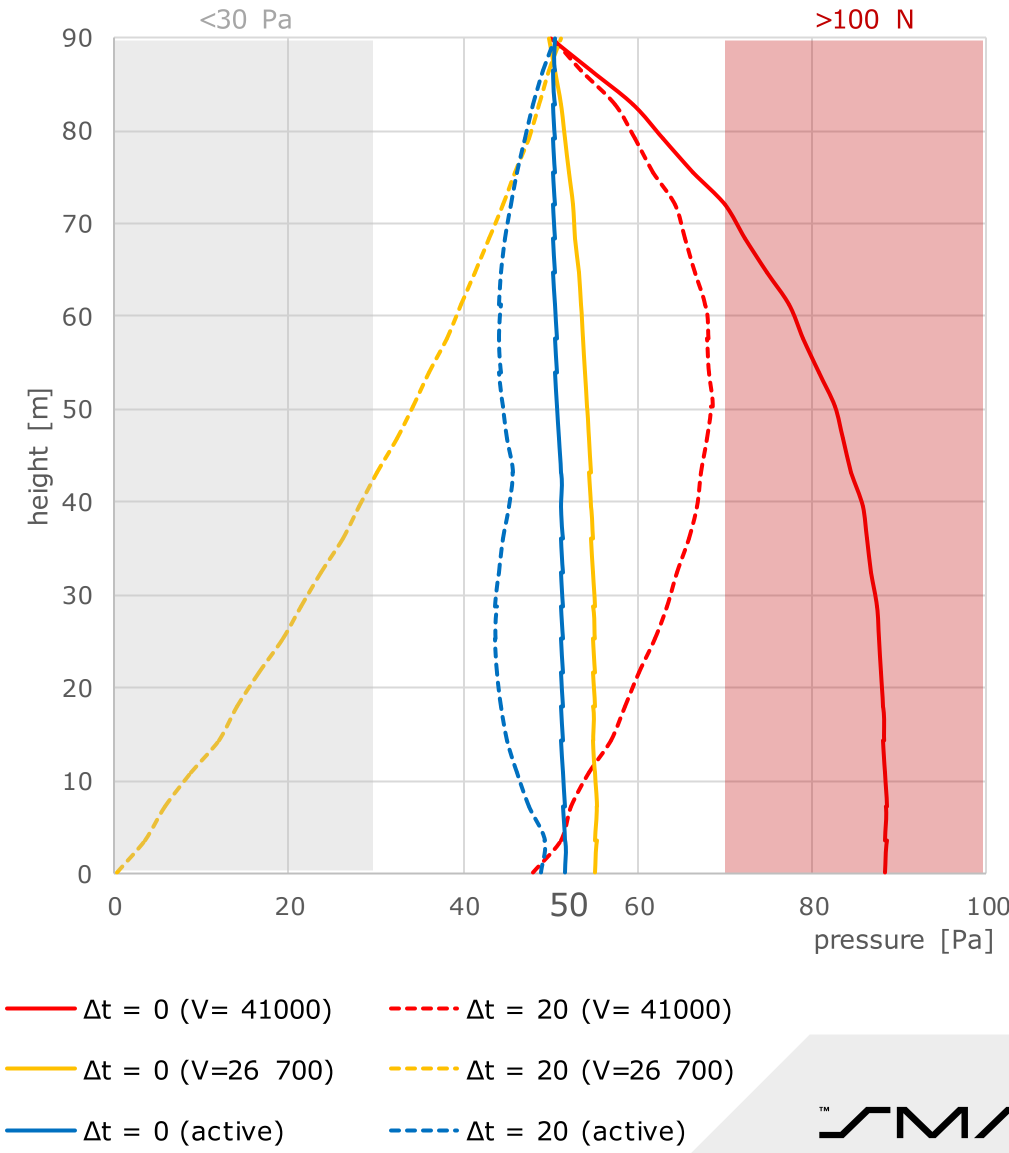
Ventilation
Systems

PRESSURE DISTRIBUTION
DIFFERENT PDS, 90m BUILDING





SUPPORT
ADDITIONAL MATHEMATICAL ANALYSIS

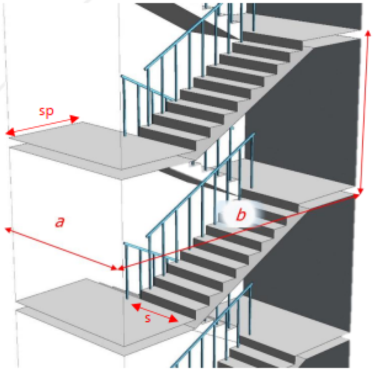
SMAY Sp. z o.o.
Podłęże 678
30-003 Podłęże,
POLAND

VAT UE: PL6782821888

smay.eu

DESCRIPTION AND ASSUMPTIONS FOR ANALYSIS:

- **Goal of the analysis**: determination of pressure distribution in the staircase during the operation of the pressure differentiation system
- Height of the staircase: 87,5 m (82,4 m above ground and 5,1 m underground)
- Tightness level: average in accordance to EN 12101-6
- Method of analysis: analytical calculations of pressure inside the staircase taking into account the stack effect, flow resistance, leakage
- All doors are closed
- The correct operation of the pressure differential system (PDS) requires pressure regulation within the corridors, which was not the subject of the analysis
- Location of air supply points:
  - Reversible top iSWAY unit: L23
  - Additional iSWAY unit: L06, L08, L10, L12, L14, L16, L18, L20
  - Reversible bottom iSWAY unit: LGround, L02, L04,
- the analysis was performed for summer, isothermal and winter conditions
- staircase geometry:
  - a = 3,0 m
  - b = 5,25 m
  - sp = 1,425 m
  - s = 1,40 m
  - h = 3,25 ÷ 4,11 m (above ground)
  - h = 2,95 ÷ 4,32 m (underground)



RESULTS OF THE ANALYSIS:

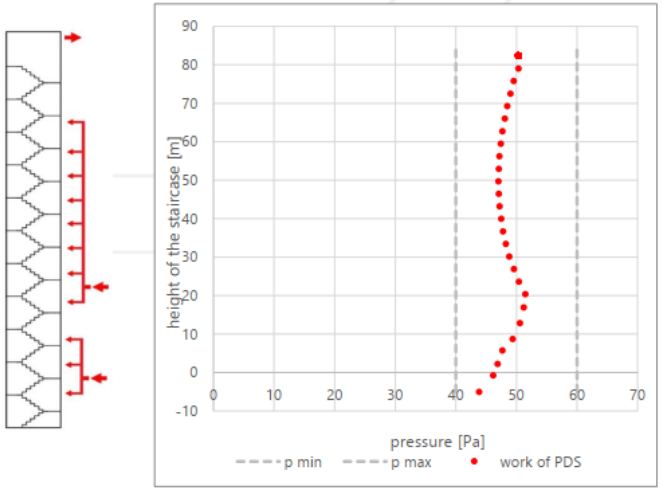
Winter conditions

Pressure differences between staircase and outside

Temperature **outside** in winter	T_{out}	0	[°C]
Temperature **inside** in winter	T_{inn}	18	[°C]

Outlet volume flow (top)	V_{out}	- 12 600	[m³/h]
Additional volume flow (middle)	V_{add}	5 000	[m³/h]
Inlet volume flow (down)	V_{inn}	21 200	[m³/h]

Figure 01. Pressure differences between staircase and outside due to work of Pressure Differential System (PDS) in winter conditions



Smay
Ventilation
Systems

SUPPORT

ADDITIONAL MATHEMATICAL ANALYSIS

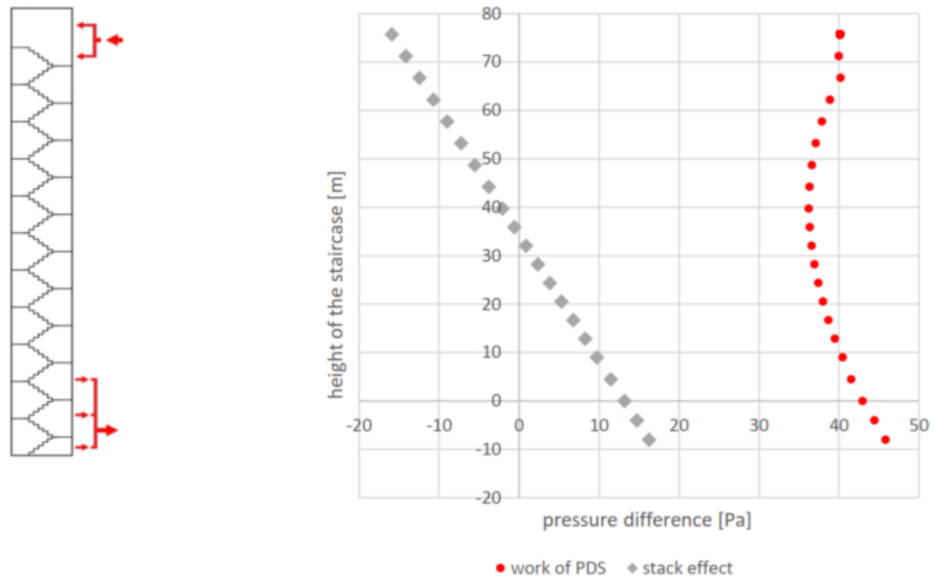
Summer conditions - staircase

Pressure differences between staircase and outside

Temperature **outside** in summer	$T_{out,s}$	32	[°C]
Temperature **inside** in summer	$T_{ins,s}$	22	[°C]

Outlet volume flow (down)	V_{out}	-9 700	[m³/h]
Inlet volume flow (top)	V_{inn}	40 000	[m³/h]

Figure 03. Pressure differences between staircase and outside due to stack effect and due to work of Pressure Differential System (PDS) in summer conditions



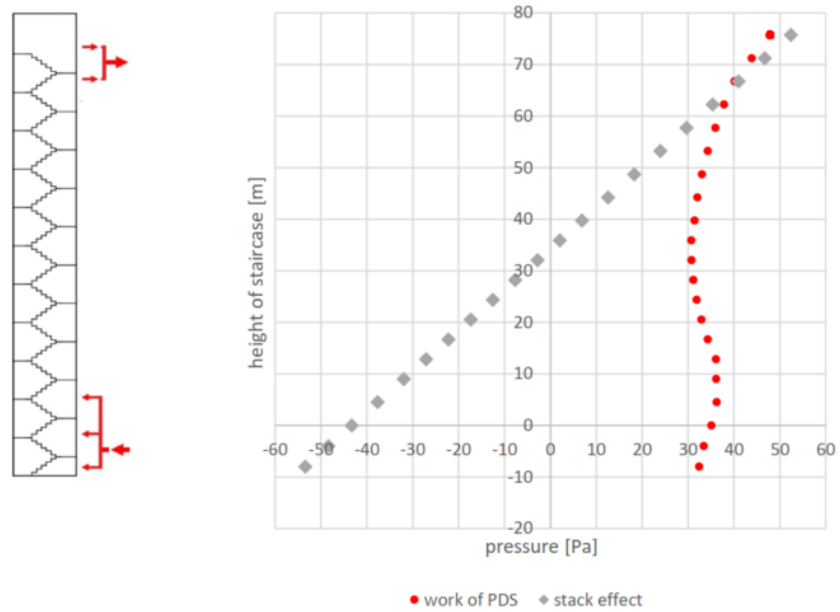
Winter conditions - staircase

Pressure differences between staircase and outside

Temperature **outside** in winter	$T_{out,w}$	-10	[°C]
Temperature **inside** in winter	$T_{ins,w}$	18	[°C]

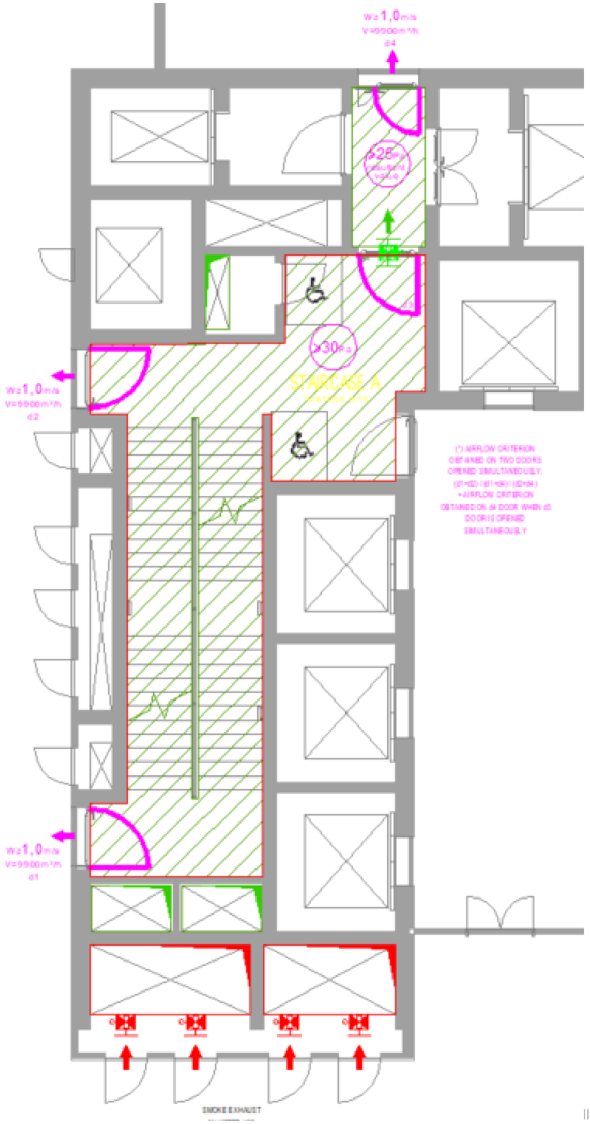
Outlet volume flow (top)	V_{out}	-32 500	[m³/h]
Inlet volume flow (down)	V_{inn}	61 000	[m³/h]

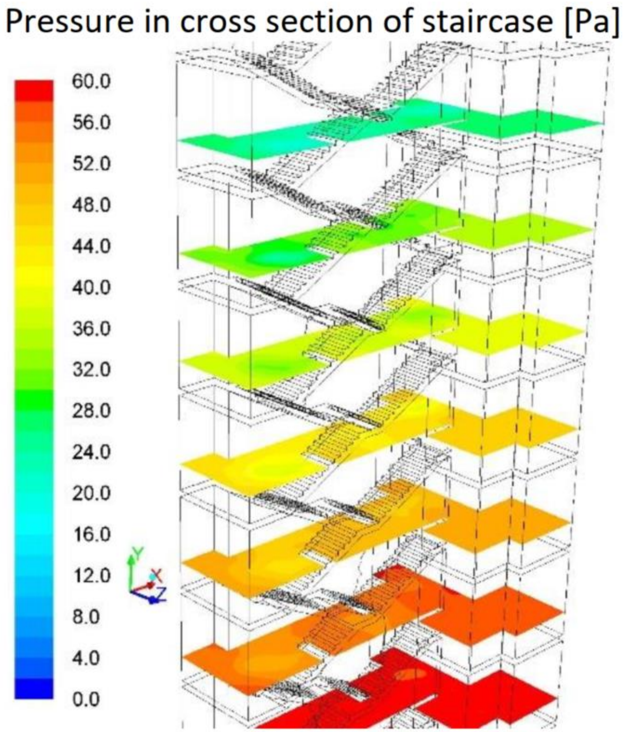
Figure 02. Pressure differences between staircase and outside due to stack effect and due to work of Pressure Differential System (PDS) in winter conditions

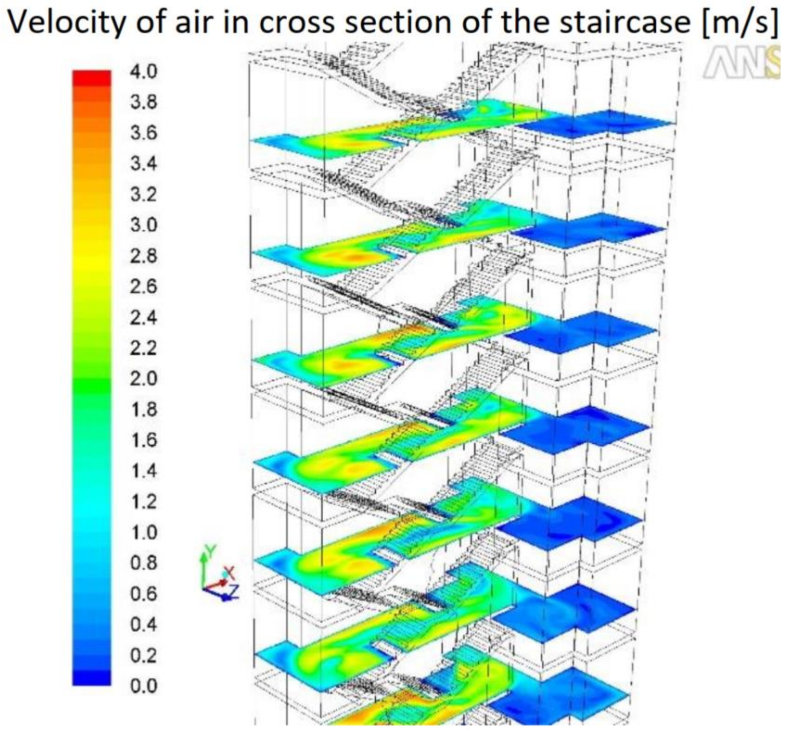


SUPPORT

ADDITIONAL MATHEMATICAL ANALYSIS

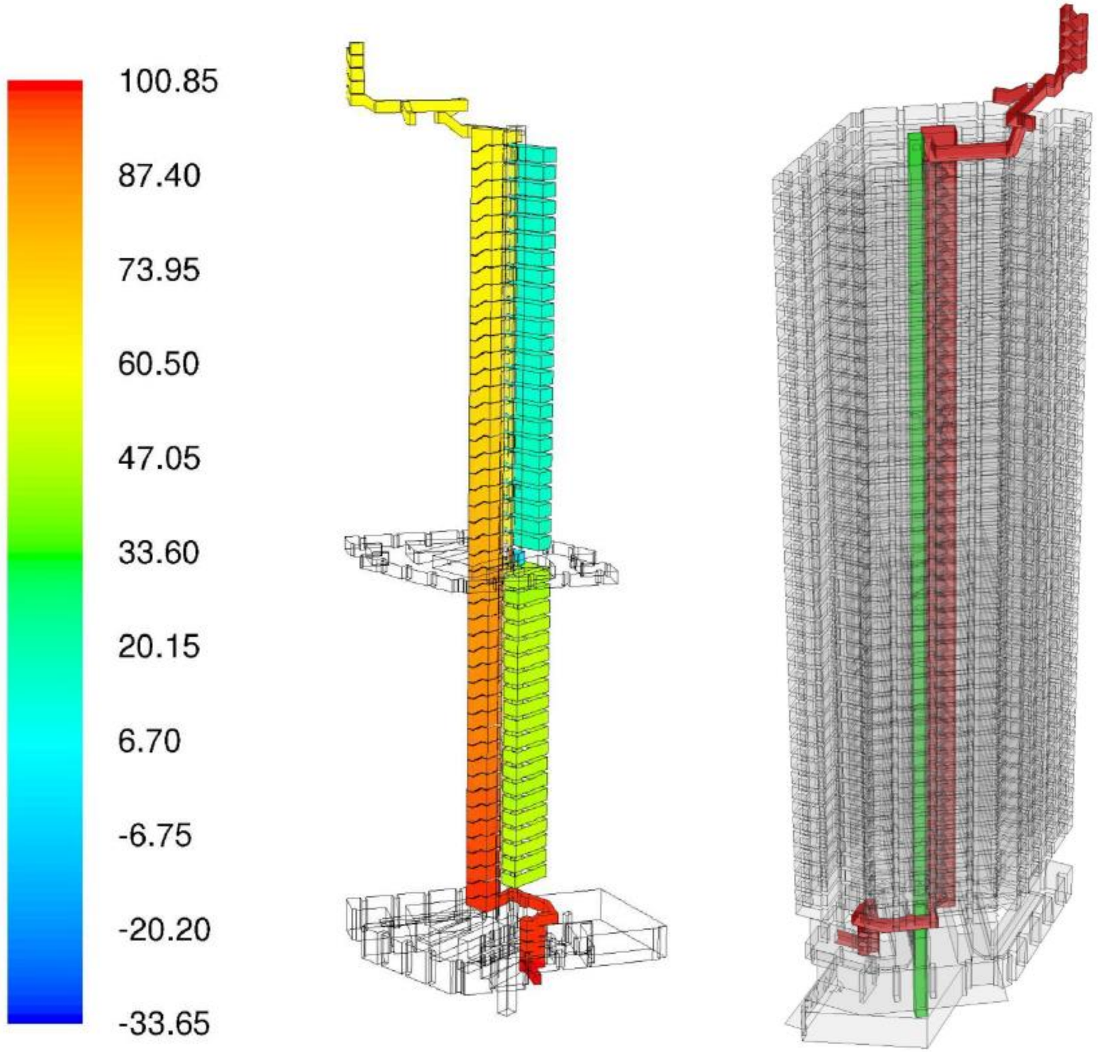


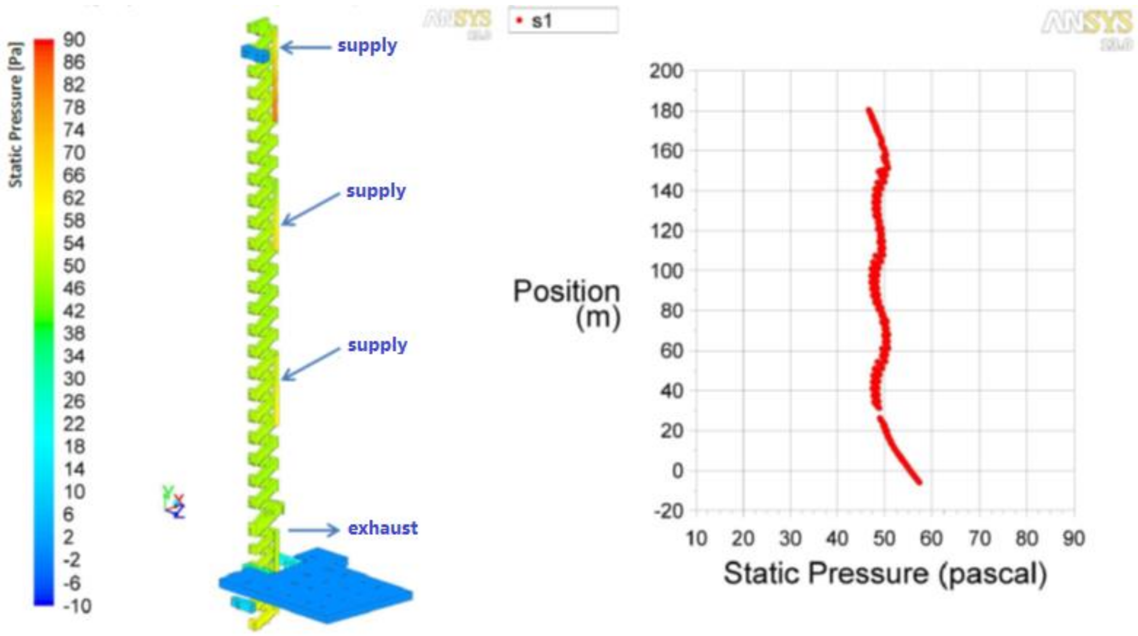




Smay
Ventilation
Systems

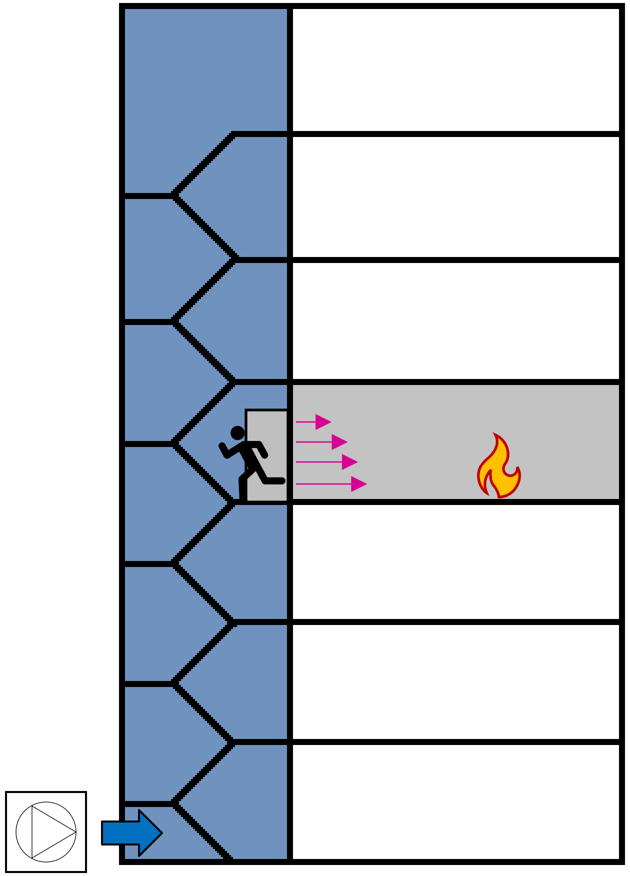
SUPPORT
CFD SIMULATIONS



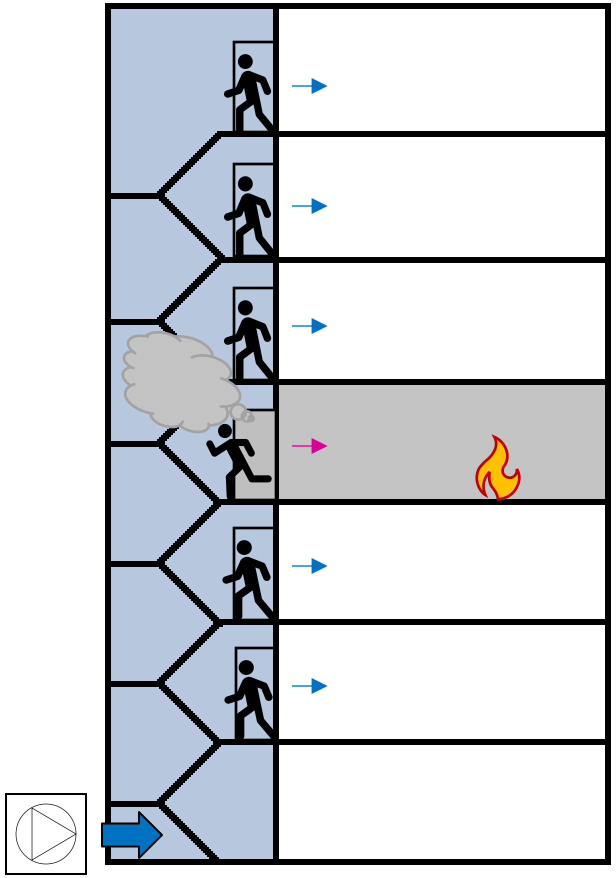


Smay
Ventilation
Systems

DOES PRESSURISATION WORK
DURING **SIMULTANEOUS EVACUATION**?



STAIRCASE PROTECTED
ONE DOOR OPEN
6 Pa ➔ 2 m/s



STAIRCASE PROTECTED
ALL DOORS OPEN
0 Pa ➔ 0 m/s

SMAY

DOES PRESSURISATION WORK DURING **SIMULTANEOUS EVACUATION**?

4.4 Class C pressurization system

4.4.1 General

The design conditions for Class C systems are based on the assumption that the occupants of the building will all be evacuated on the activation of the fire alarm signal that is simultaneous evacuation.

In the event of a simultaneous evacuation it is assumed that the stairways will be occupied for the nominal period of the evacuation, and thereafter will be clear of evacuees. Consequently, the evacuation will occur during the early stages of fire development, and some smoke leakage onto the stairway can be tolerated. The airflow due to the pressurization system shall clear the stairway of this smoke.

The occupants being evacuated are assumed to be alert and aware, and familiar with their surroundings, thus minimising the time they remain in the building.

EN 12101-6:2005

DOES PRESSURISATION WORK
DURING **SIMULTANEOUS EVACUATION**?

FLUSHING MODE

5.6.10 Requirements for pressure relief, controlled openings and flushing

National requirements may request continuous flushing of the protected space.

NOTE Consideration can be given to the application of flushing in any PDS design.

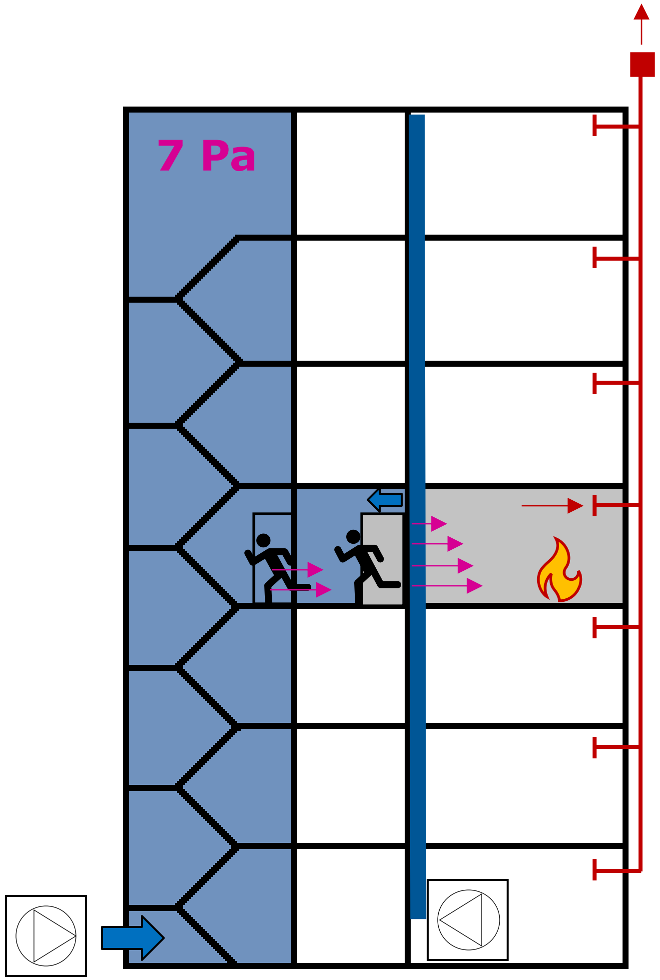
Where flushing is to be included, the protected space shall be flushed with a minimum airflow in accordance with national requirements, or a minimum of 7 500 m^3/h.

This may be achieved by using a simple opening, or an opening with a device fitted (e.g. pressure relief damper, control damper) selected to be capable of allowing the required minimum discharge rate, combined with the selection of the fan to achieve this, whilst maintaining the required design parameters of the PDS.

If the PDS is required to protect other spaces (e.g. lift shaft), the above shall be provided accordingly for those spaces.

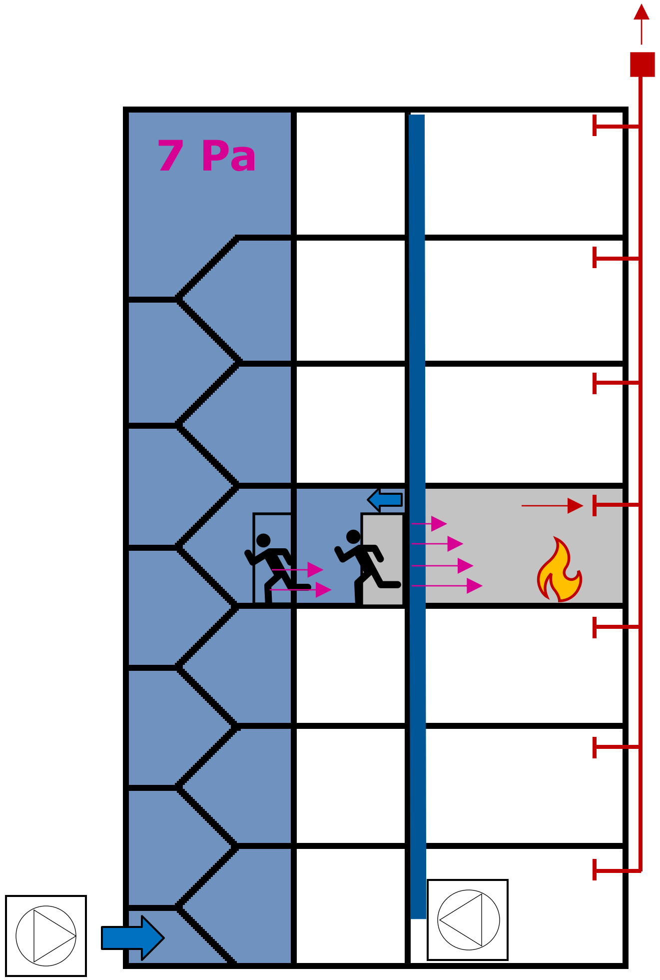
EN 12101-13:2022

DOES PRESSURISATION WORK
DURING **SIMULTANEOUS EVACUATION**?

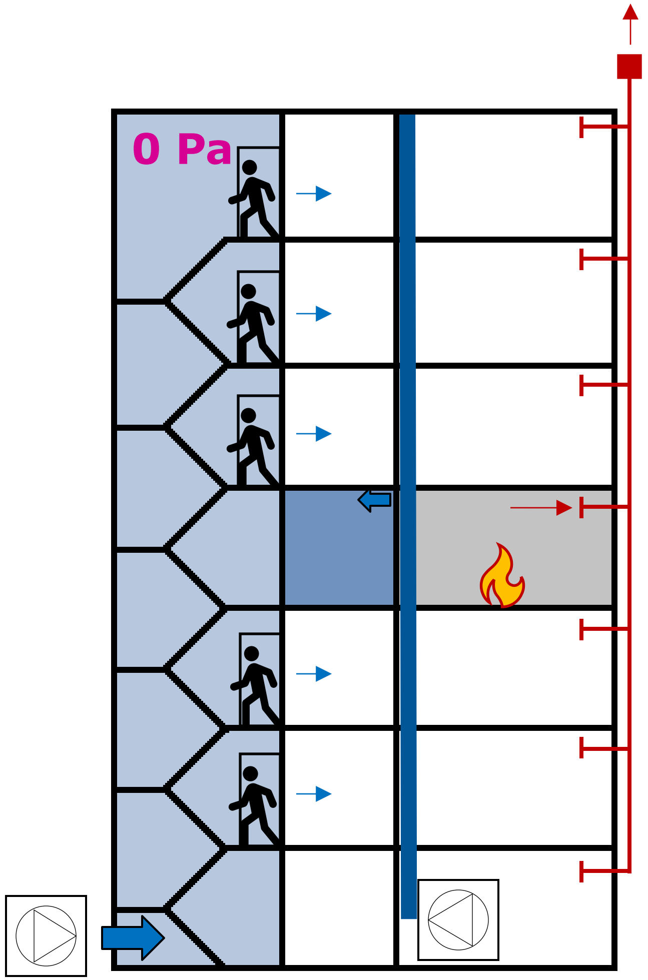


ONE DOOR OPEN
6 Pa ➔ 2 m/s
IN THE LOBBY

DOES PRESSURISATION WORK DURING **SIMULTANEOUS EVACUATION**?

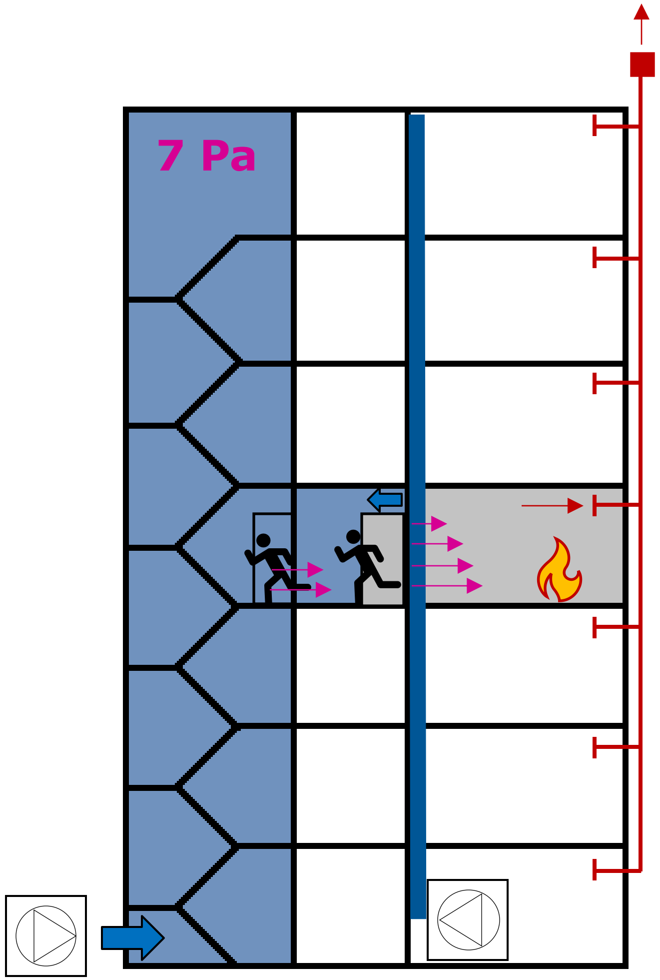


ONE DOOR OPEN
6 Pa ➔ 2 m/s
IN THE LOBBY

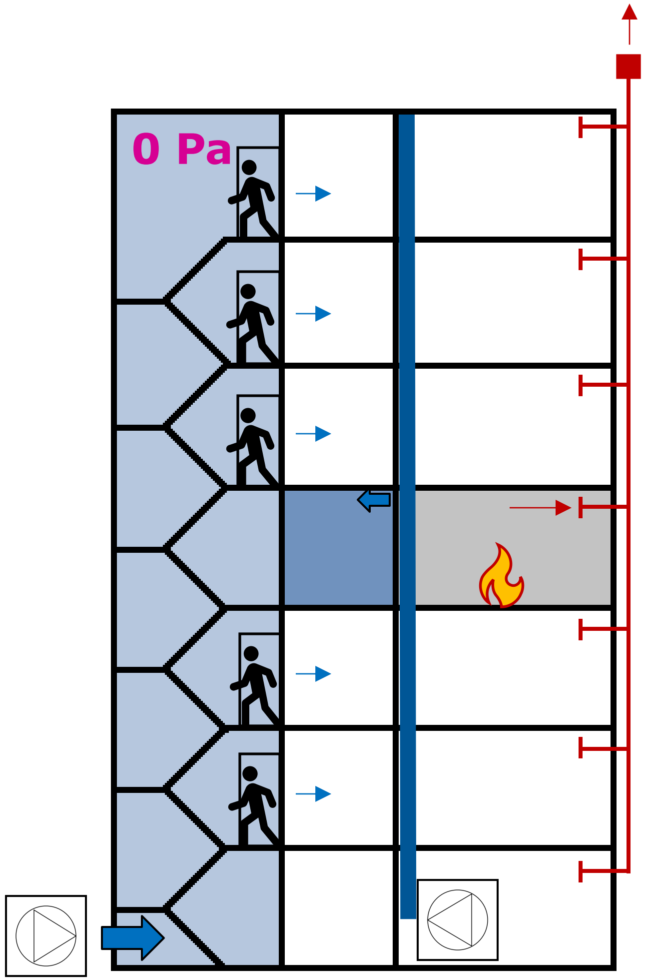


ALL OTHER DOORS OPEN
>30 Pa
IN THE LOBBY

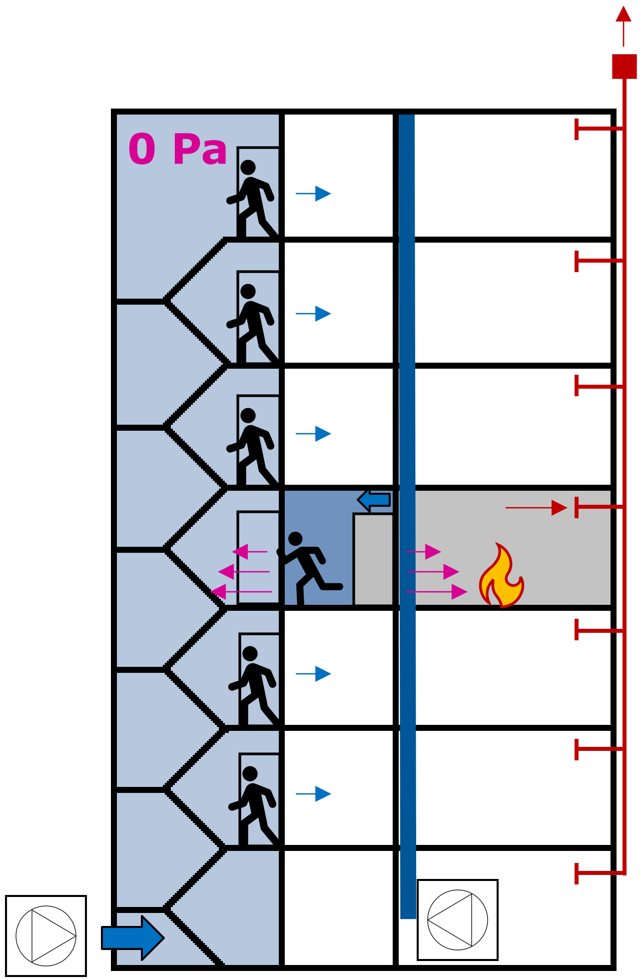
DOES PRESSURISATION WORK DURING **SIMULTANEOUS EVACUATION**?



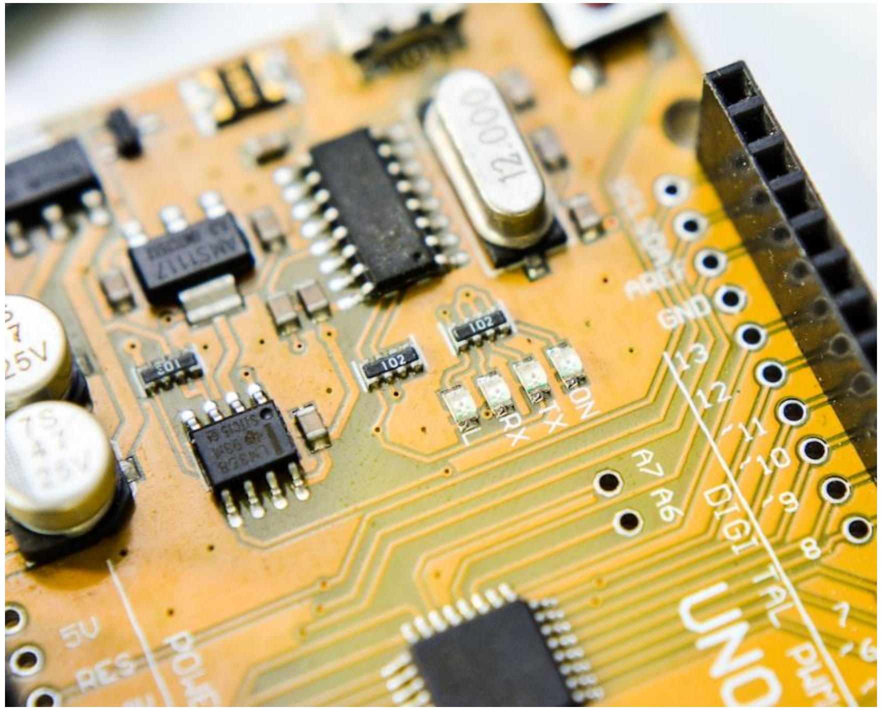
ONE DOOR OPEN
6 Pa → 2 m/s
IN THE LOBBY



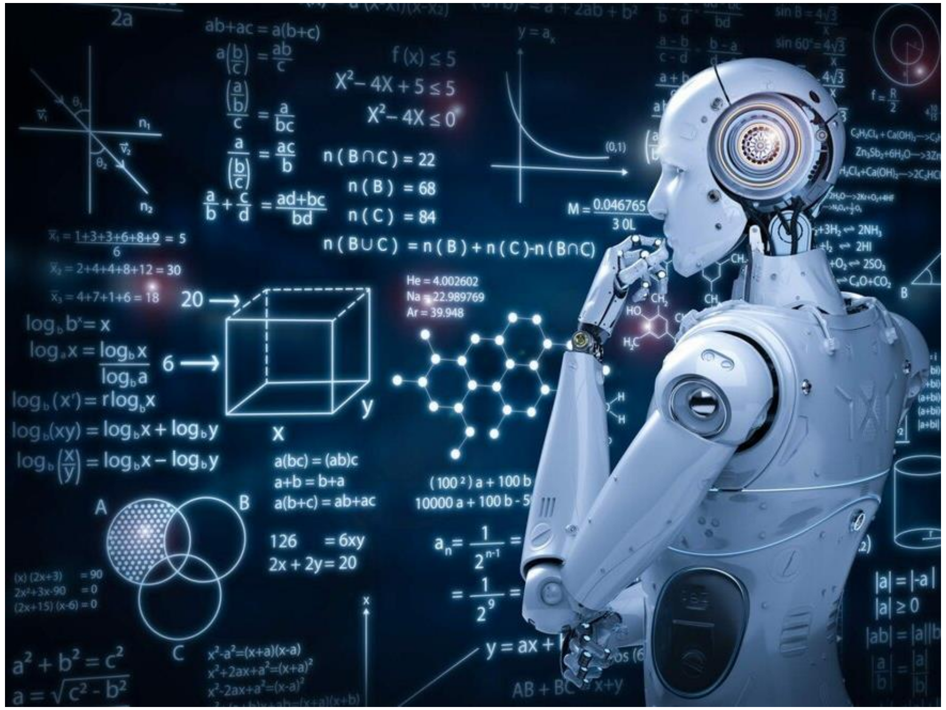
ALL OTHER DOORS OPEN
>30 Pa
IN THE LOBBY



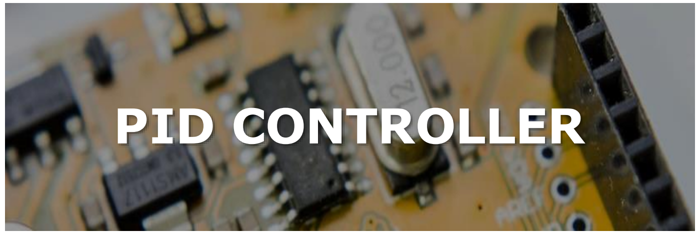
ALL DOORS OPEN
1 m/s ← 1 Pa → 1 m/s
IN THE LOBBY

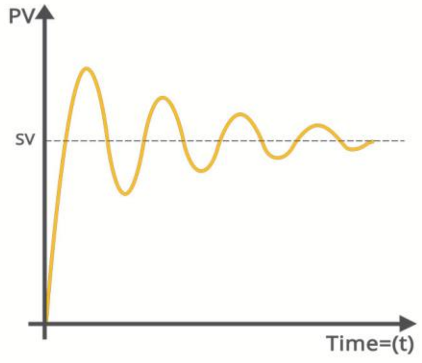


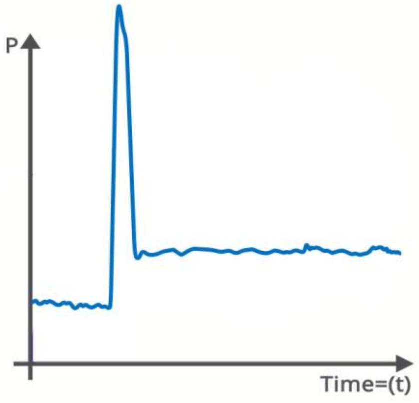
PID CONTROLLER
TRACKING SYSTEM



PREDICTIVE-ADAPTIVE CONTROLLER
BASED ON NEURAL NETWORK







PID CONTROLLER
PRESSURE-BASED
CONTROL ONLY

EXAMPLE RANGES, m³/h:
1300 – 9000
15 000 – 55 000

PREDICTIVE-ADAPTIVE CONTROLLER
BASED ON NEURAL NETWORK

EXAMPLE RANGES, m³/h:
200 – 50 500
1500 – 75 000

SELF-TEST ABILITY

iSWAY makes a brief test of its funcionality every 24h:

- Cut-off damper is opened
- Fan starts operation at low frequency (for few secs)
- Data is collected and recorded in the device memory

TM

Smay
Ventilation
Systems

BENEFITS:

- Potential failure can be quickly identified and eliminated
- Reports can be easily printed
- Allows to reduce the duration of periodic inspections
- Reduce operating costs

SMAY Sp. z o.o.
ul. Ciep łownic za 29

31-587 K raków
NIP: 6782821888

11.5.2 Testing frequency

11.5.2.1 General

In the absence of national requirements and supplier's recommendations, the test criteria outlined in 11.5.2.2, 11.5.2.3 and 11.5.2.4 shall apply.

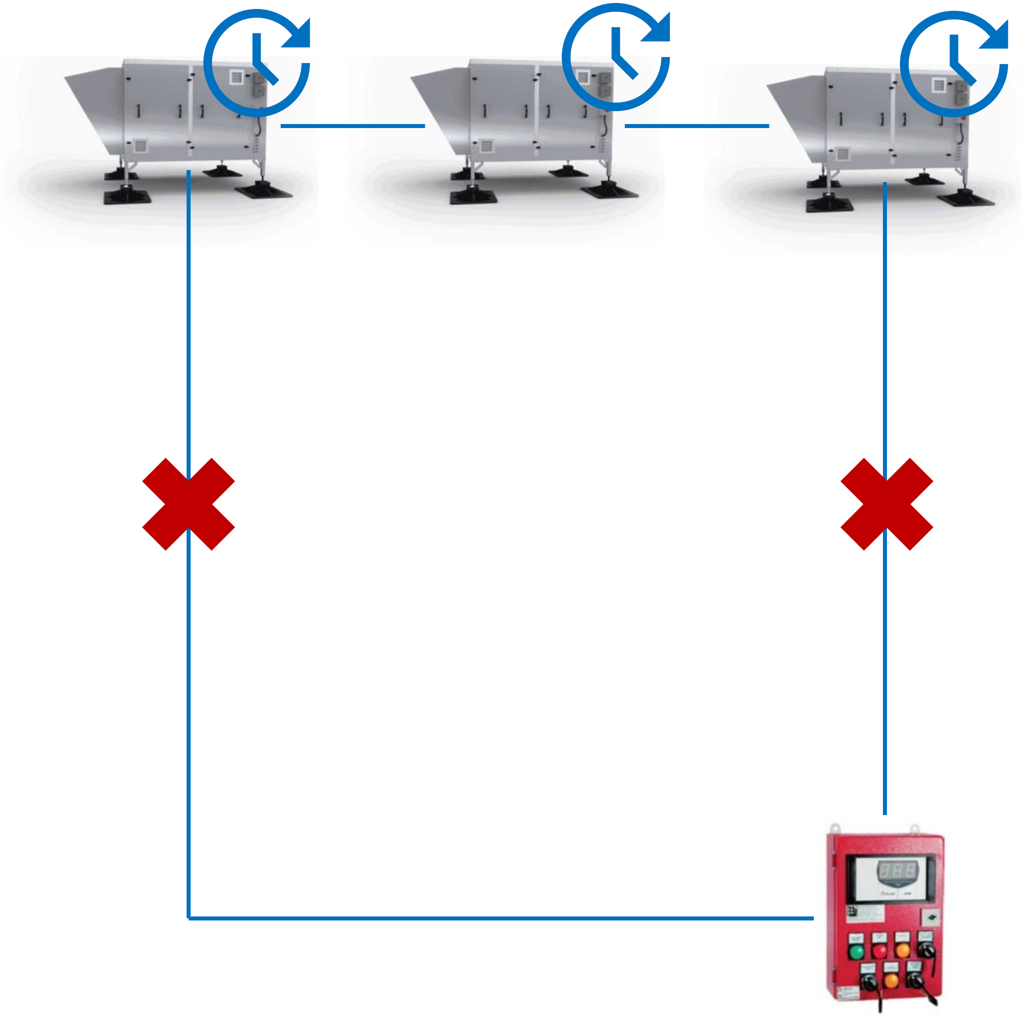
11.5.2.2 Daily testing

a) Check for faults – make a record of any faults or no faults – see Clause 11.4;

b) Check that faults from the previous day have been cleared – check records.

RELIABILITY

MALFUNCTIONS



❶ **RING TOPOLOGY: CABLING SAVINGS**

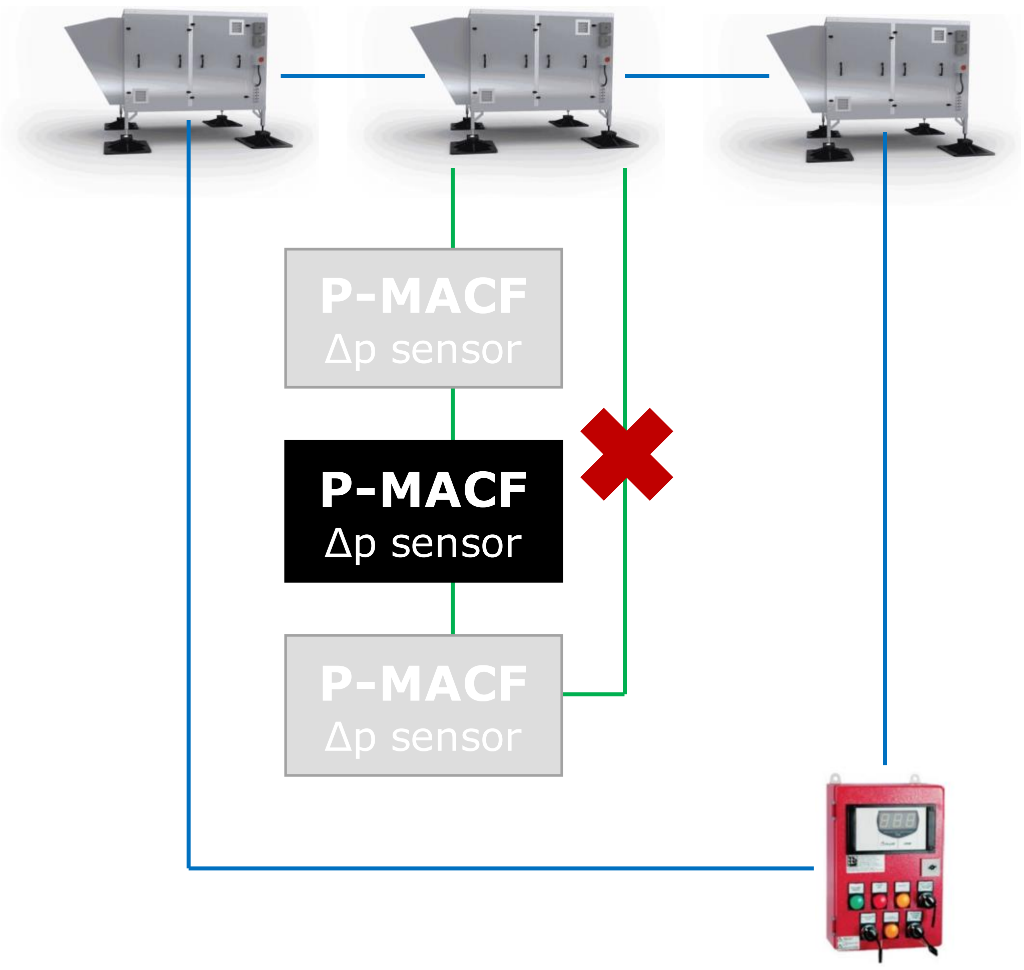
❷ **TWO-WAY COMMUNICATION**

❸ **STAND-ALONE OPERATION**

❹ **SELF-TEST EVERY 24h**

RELIABILITY

MALFUNCTIONS

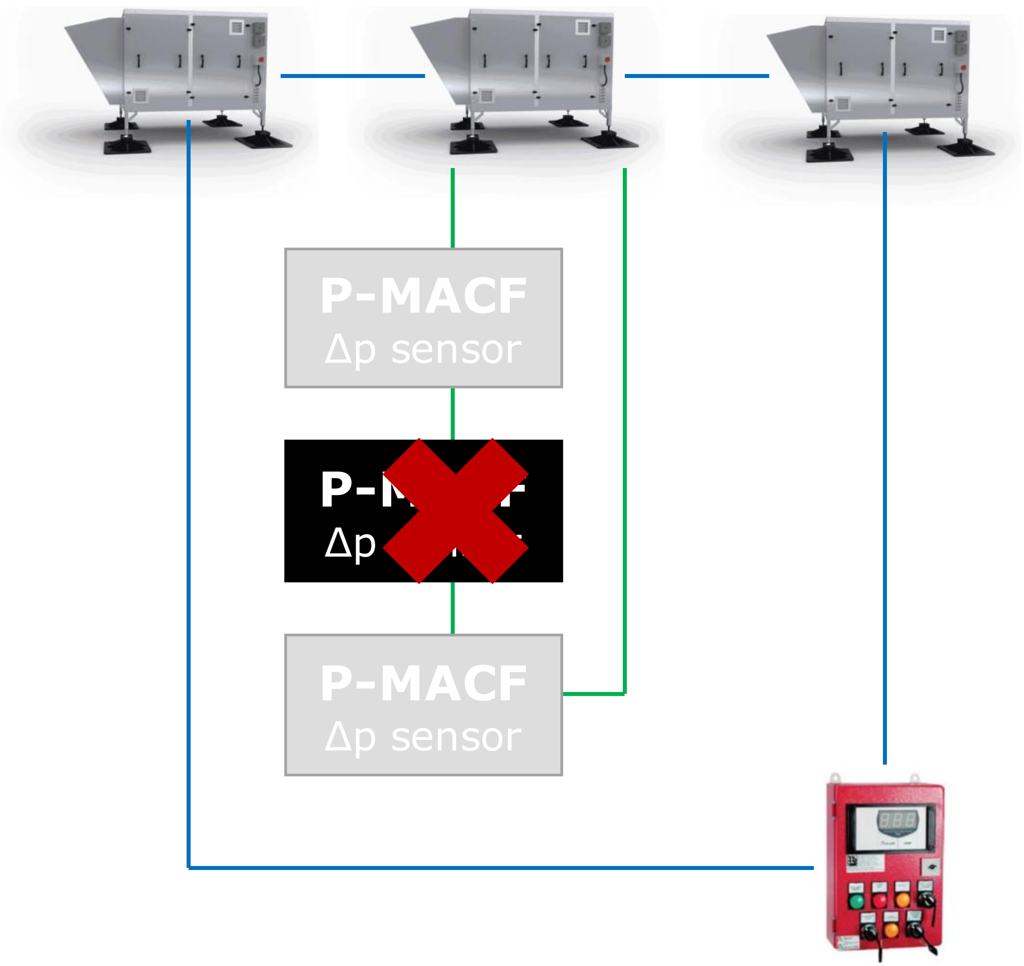


❶ **RING TOPOLOGY: CABLING SAVINGS**

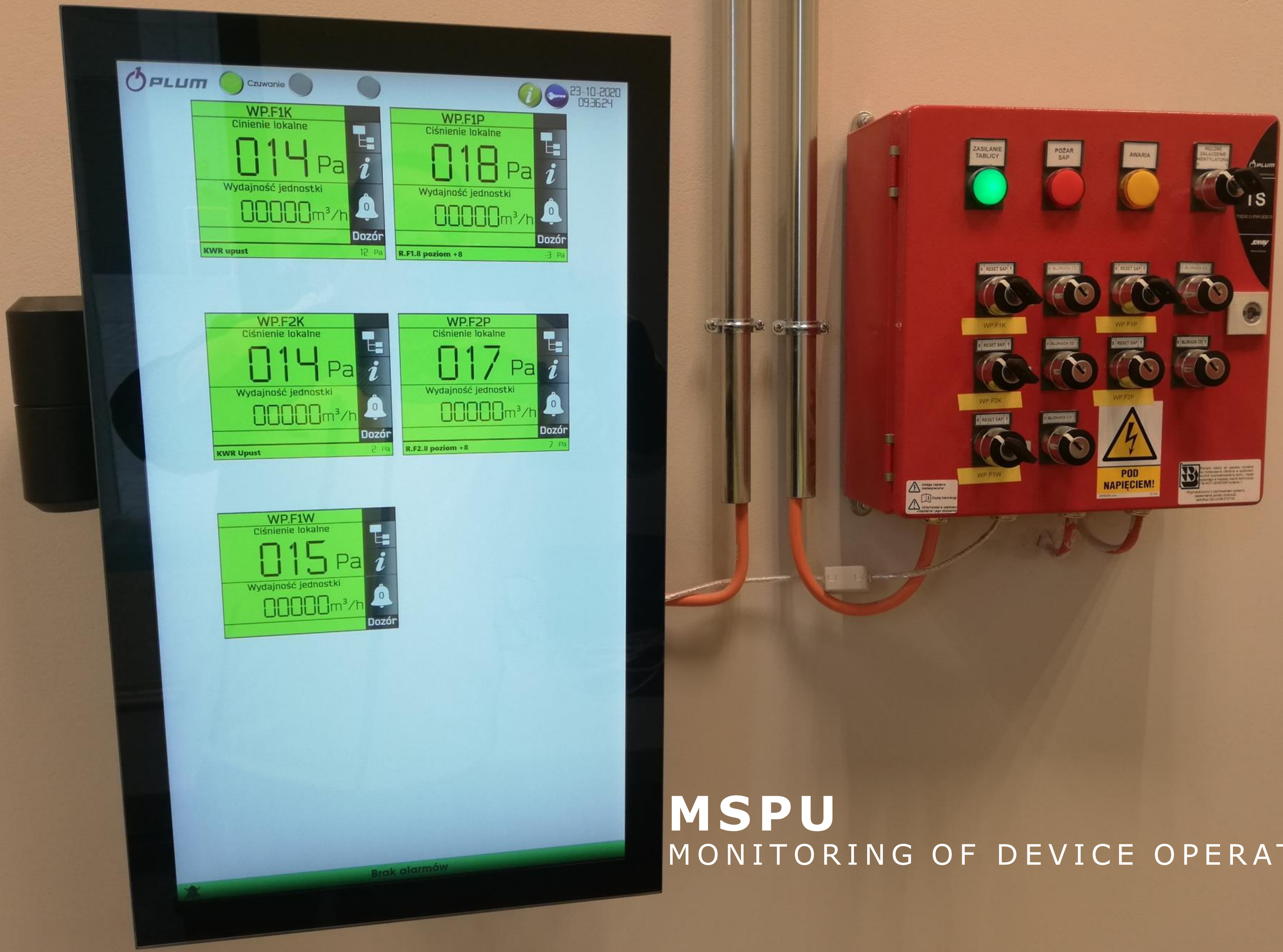
❷ **TWO-WAY COMMUNICATION**

RELIABILITY

MALFUNCTIONS



1. RING TOPOLOGY: CABLING SAVINGS
2. TWO-WAY COMMUNICATION
3. MOST FREQUENT SETTING IN CASE OF NO SENSOR SIGNAL



TS
CONTROL BOARD

MSPU
MONITORING OF DEVICE OPERATING CONDITIONS

ZD
REMOTE ACCESS SYSTEM

Table 1. Connection to SMAY devices

System	USB connector
SafetyWay	USB typ B
CSUP Łoś	USB typ B
SmayLab	micro USB
iFlow	micro USB
ZODIC-M	USB typ B
CSUP N-0200	USB typ B
SR-300 Ryś	micro USB


CHMIELNA 89*
SKYLINER
VARSO TOWER
GENERATION PARK*
WARSAW SPIRE
ZŁOTA 44
MENNICA LEGACY TOWER*
WIDOK TOWER
ASTORIA PREMIUM OFFICE*
CENTRAL POINT*
* - covered

KEY TAKEAWAYS:

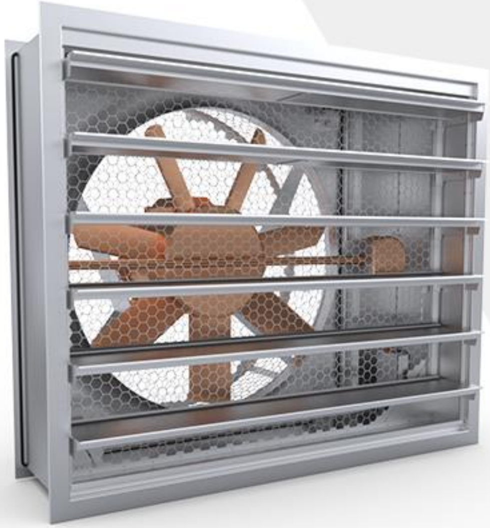
1. PRESSURE-CONTROLLED FAN
   DYNAMIC RESPONSE TO THE
   CURRENT CONDITIONS,
   SELF-ADAPTATION

2. FLOW SYSTEM FOR HIGH-RISE BUILDINGS
   STACK EFFECT MITIGATION

3. FLEXIBILITY IN DESIGN
   LOBBY PROTECTION,
   COOPERATION WITH OTHER SYSTEMS,
   EXPERIENCED TEAM READY TO HELP

4. PREDICTIVE-ADAPTIVE REGULATOR
   FASTEST RESPONSE,
   OSCILLATION RESISTANCE

5. RELIABILITY
   SELF-TEST EVERY 24h
   KIT'S OF DEVICES TEST

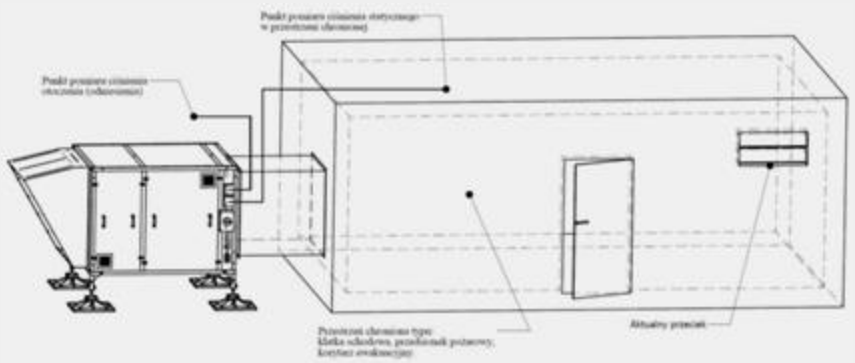


iSWAY-WFC®

iSWAY-RFC®

iSWAY-FC®

SAFETY WAY



DESIGN
SOLUTIONS

SWAY SAFETY WAY

CASE STUDY

UNITY TOWER

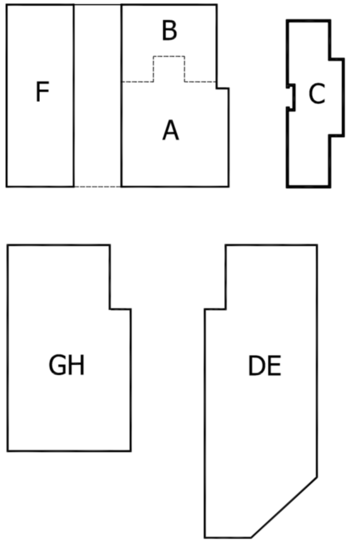
CONSTRUCTION: 2016-2020

CASE STUDY

UNITY TOWER

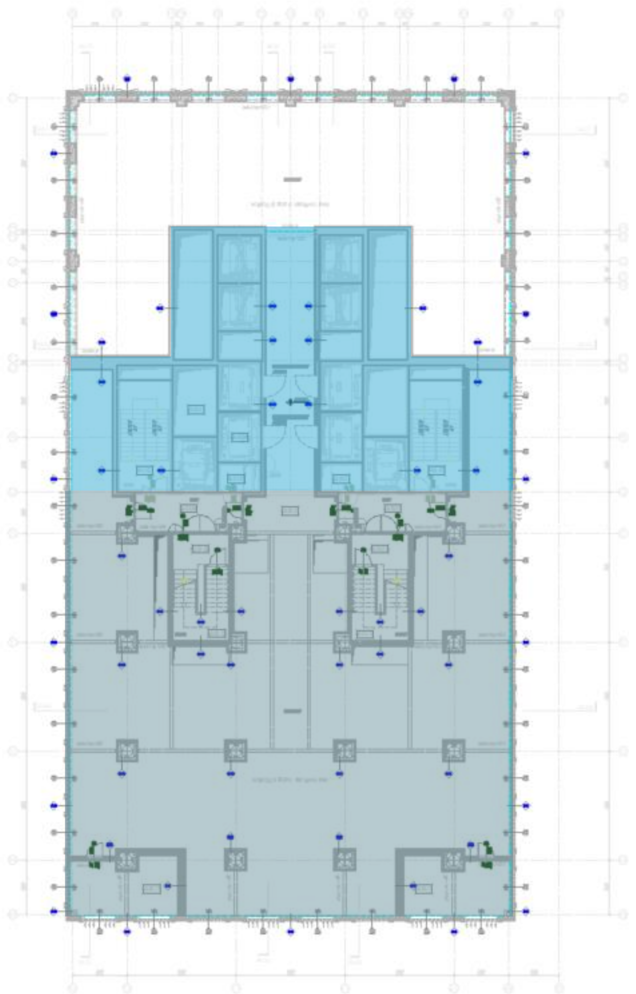
CONSTRUCTION: 2016-2020

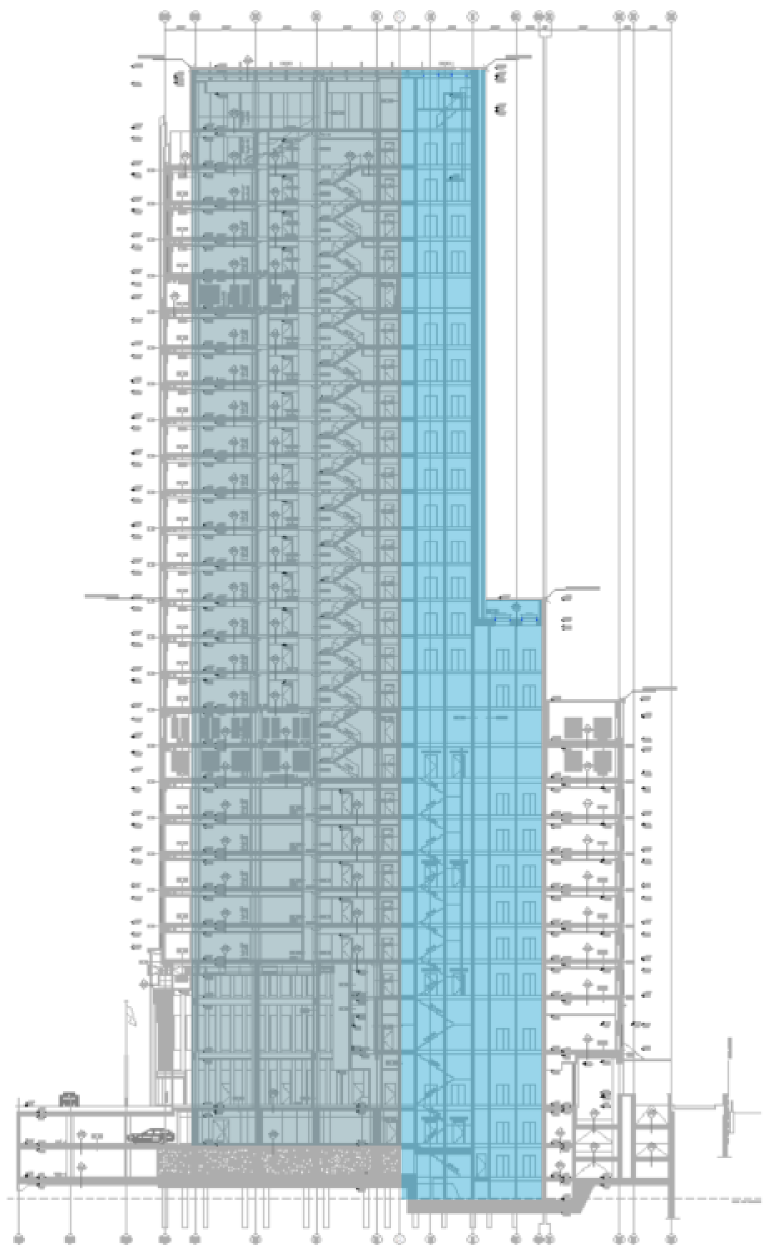
BUILDING COMPLEX:
- AB: 102m (27 storeys),
- C: 25m
- DE: 25m
- F: 40m
- GH: 40m



CASE STUDY

floor plan of level +9
and cross-section B-B



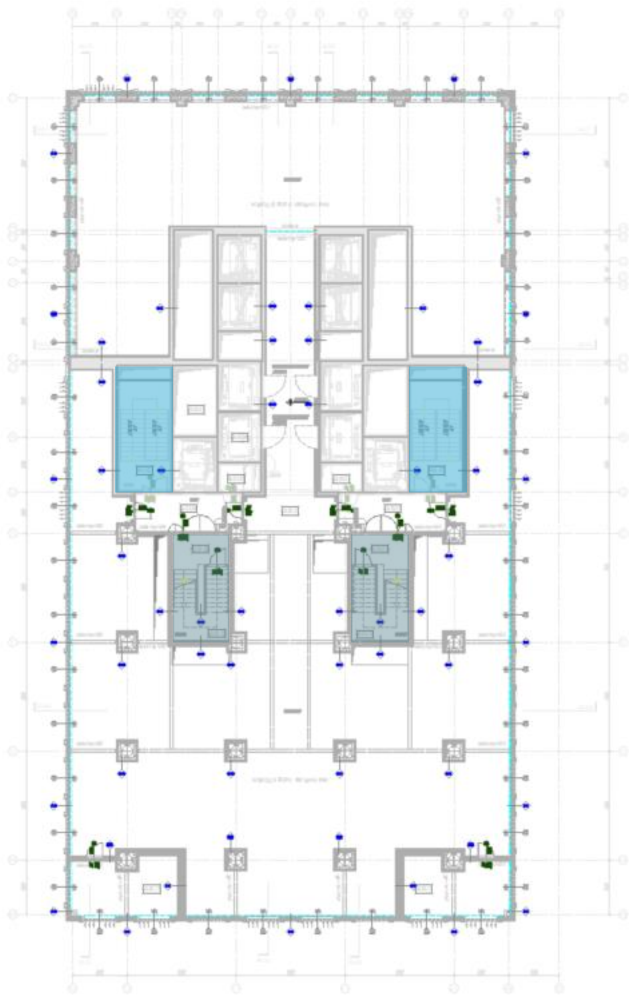


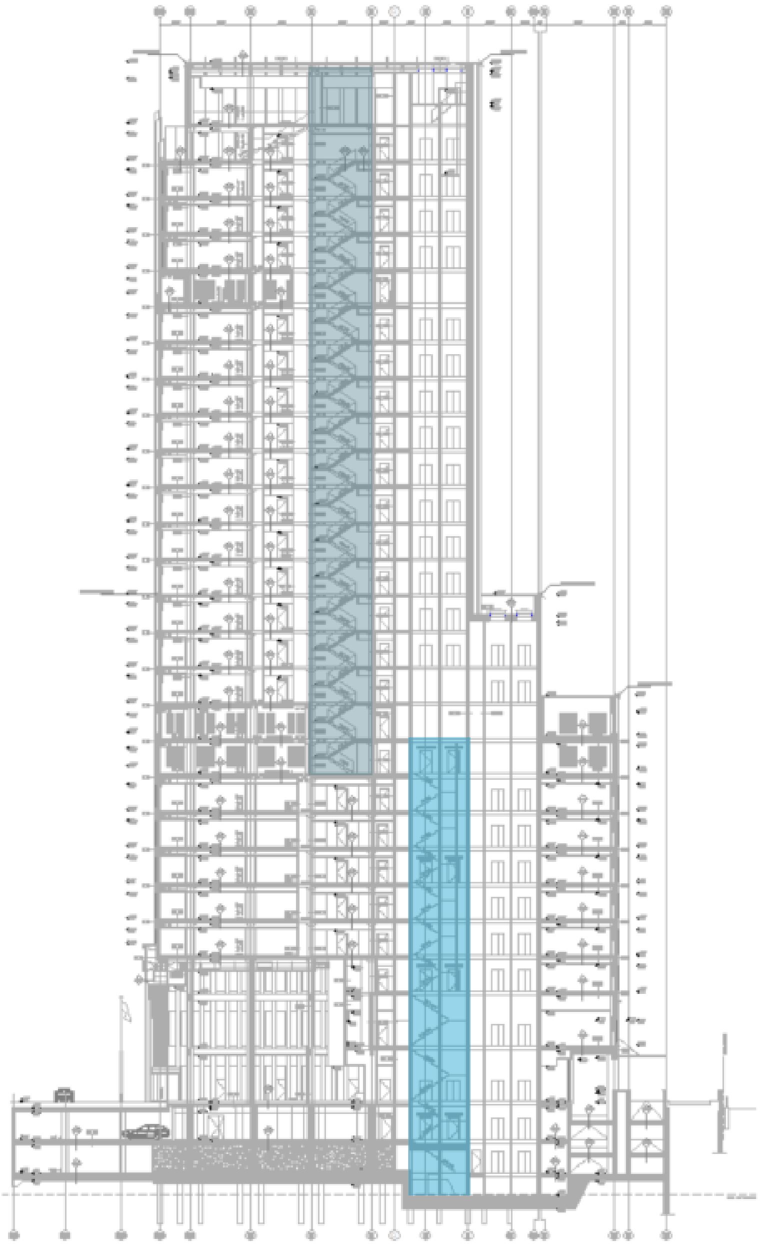
CASE STUDY

floor plan of level +9
and cross-section B-B

upper staircase: **64m**

lower staircase: **54 m**



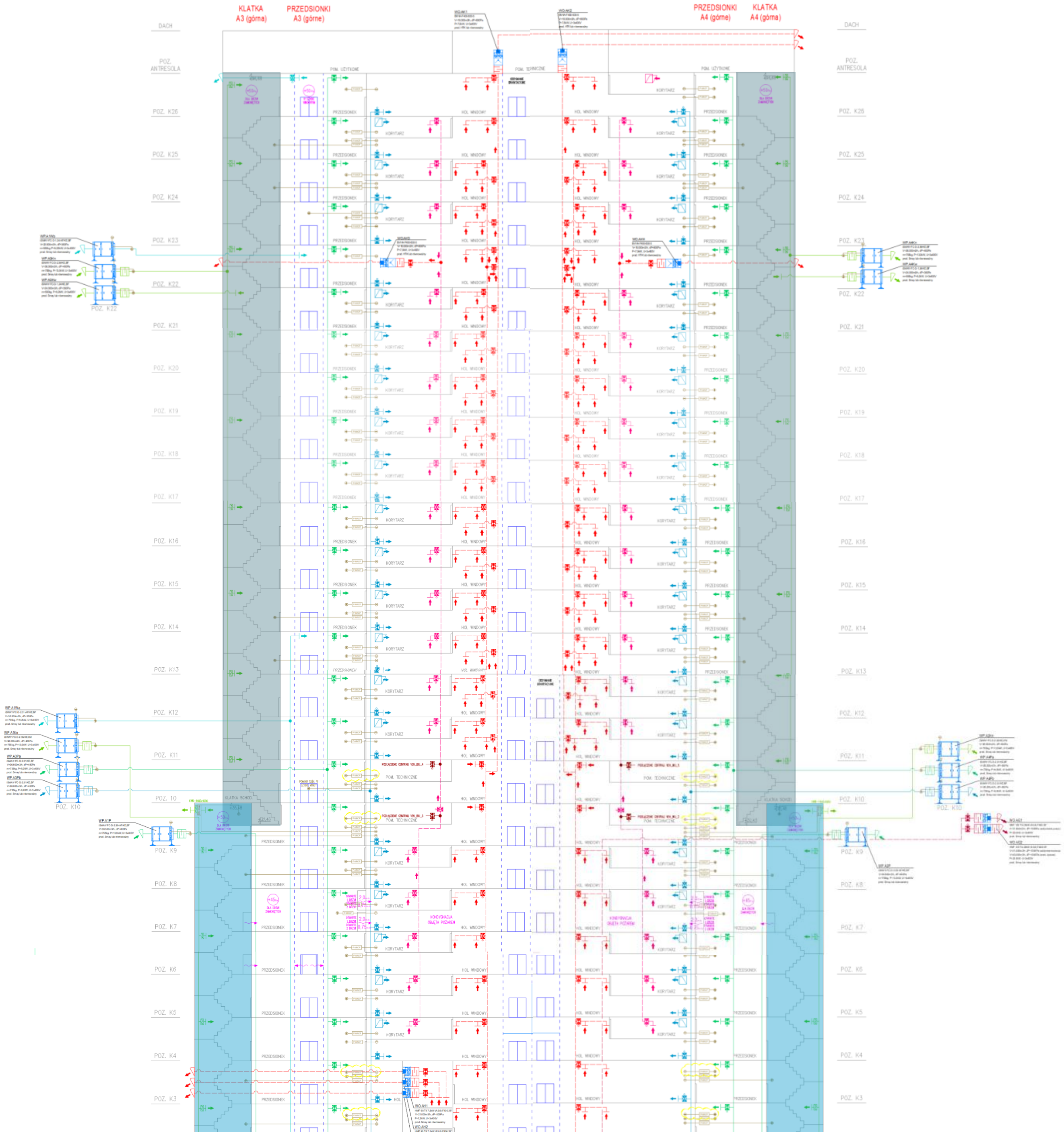


CASE STUDY

pressurization system scheme

upper staircase: **64m**

lower staircase: **54 m**



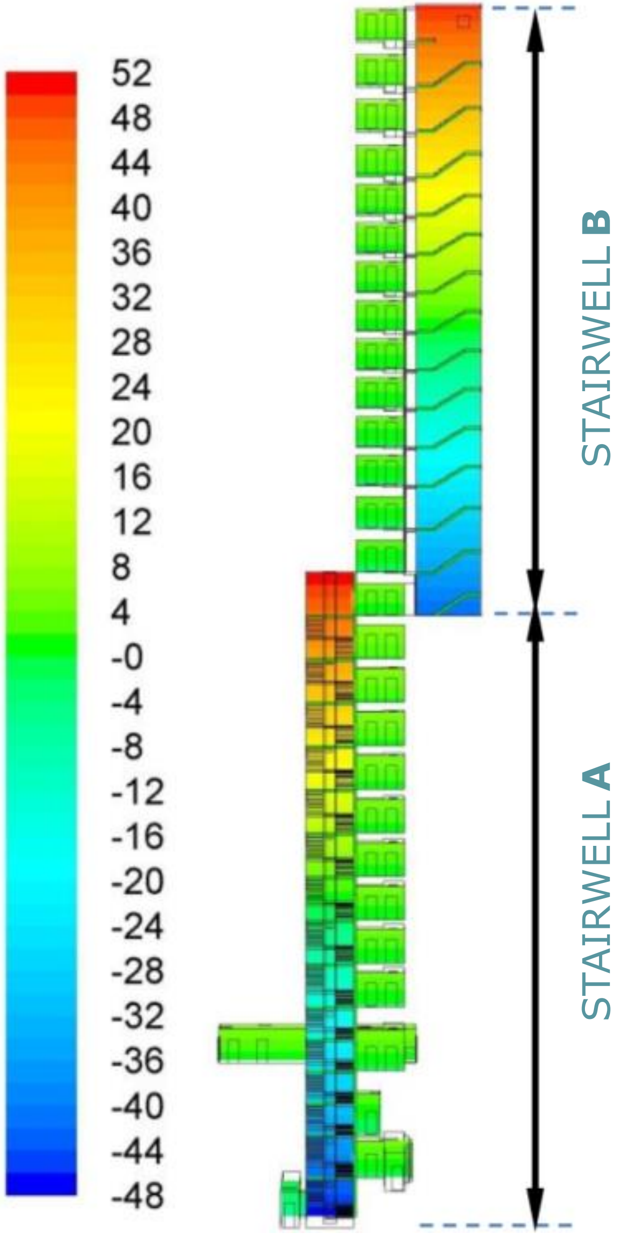
SMAY

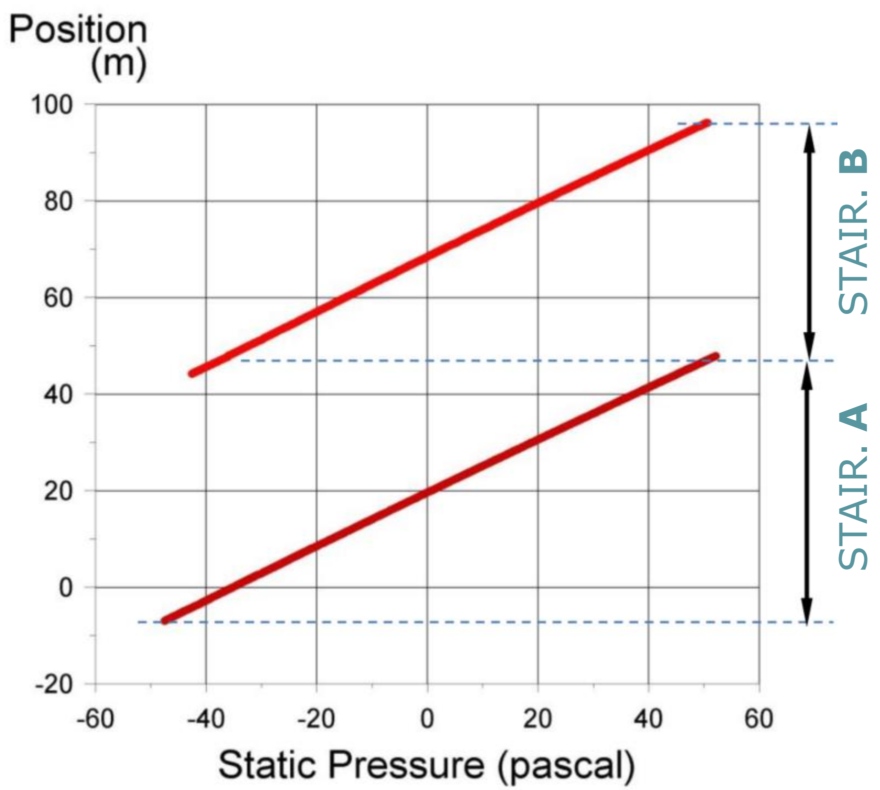
CASE STUDY

CFD simulation results:

Natural pressure distribution

in winter conditions
(Te=-20°C;Ti=20°C)



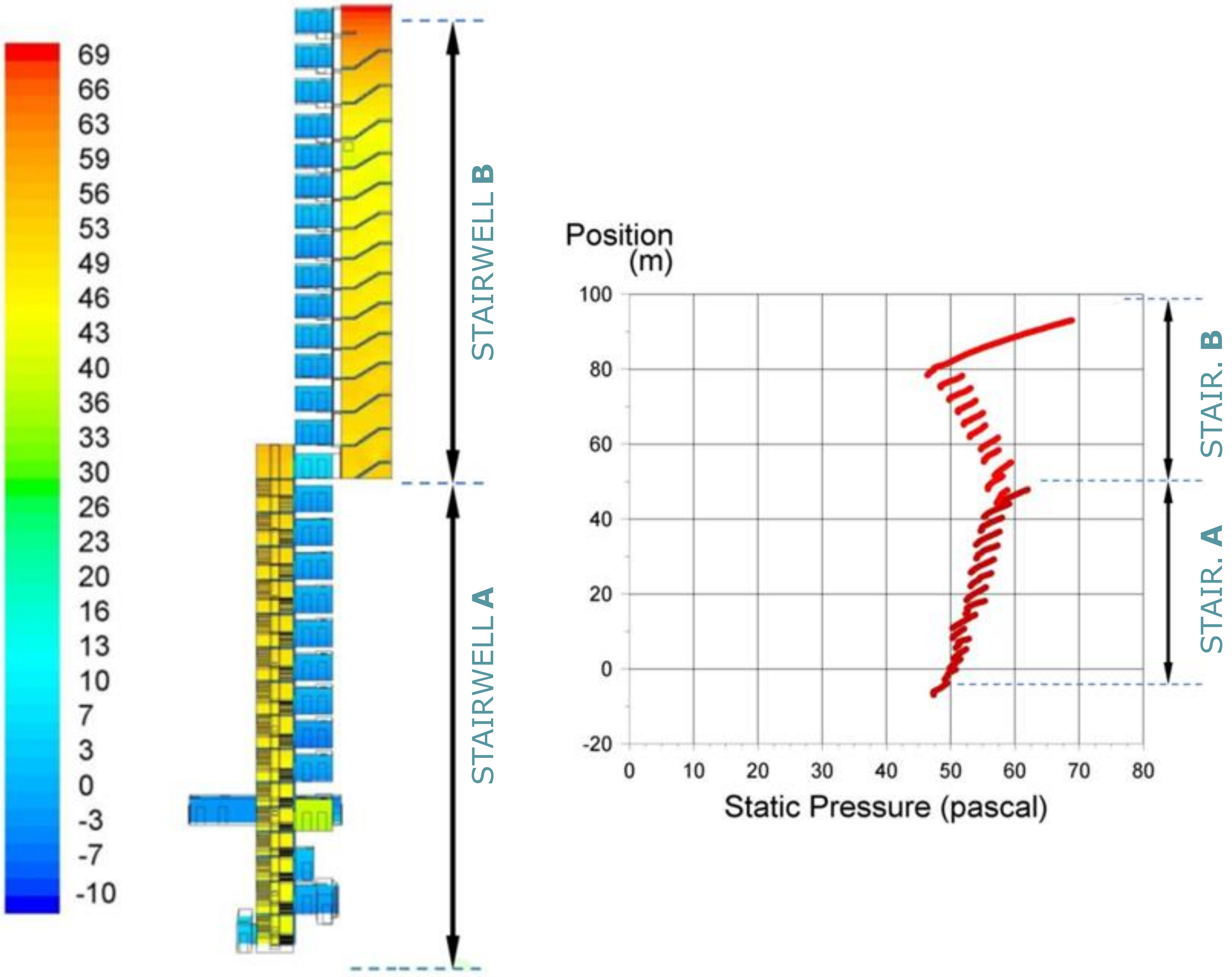


CASE STUDY

CFD simulation results:

Pressurization system operation

in winter conditions
(Te=-20°C;Ti=20°C)

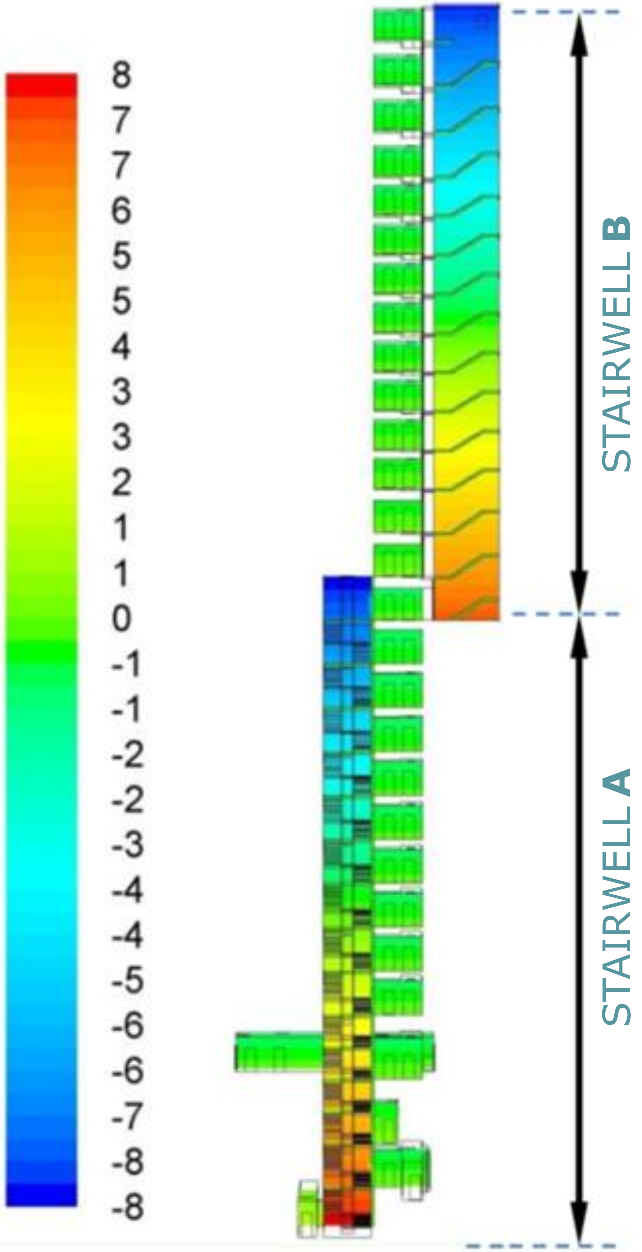


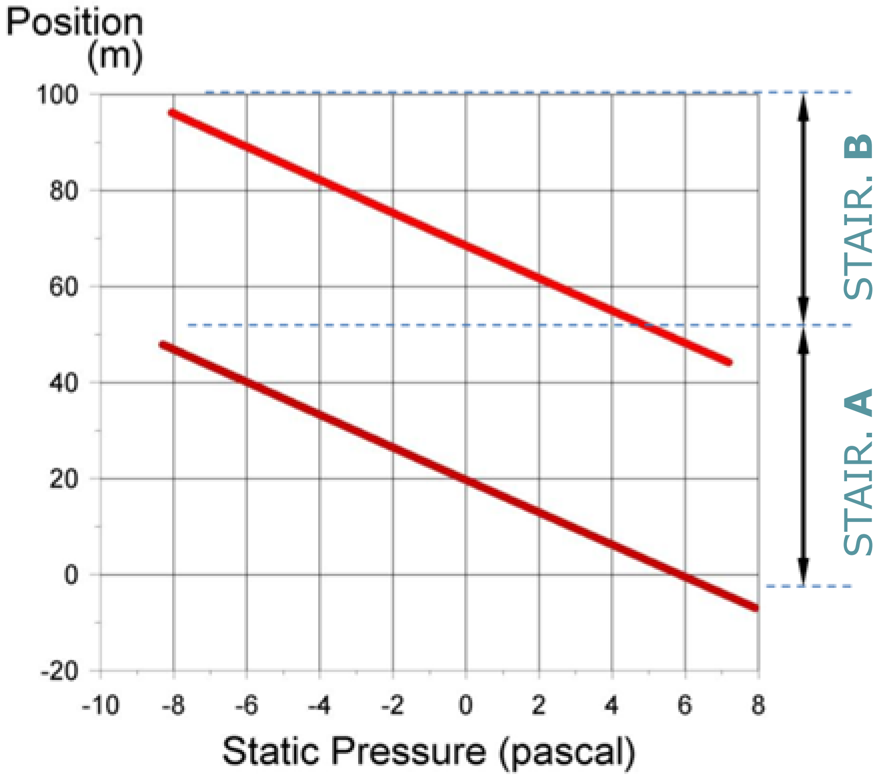
CASE STUDY

CFD simulation results:

Natural pressure distribution

in summer conditions
(Te=32°C;Ti=24°C)



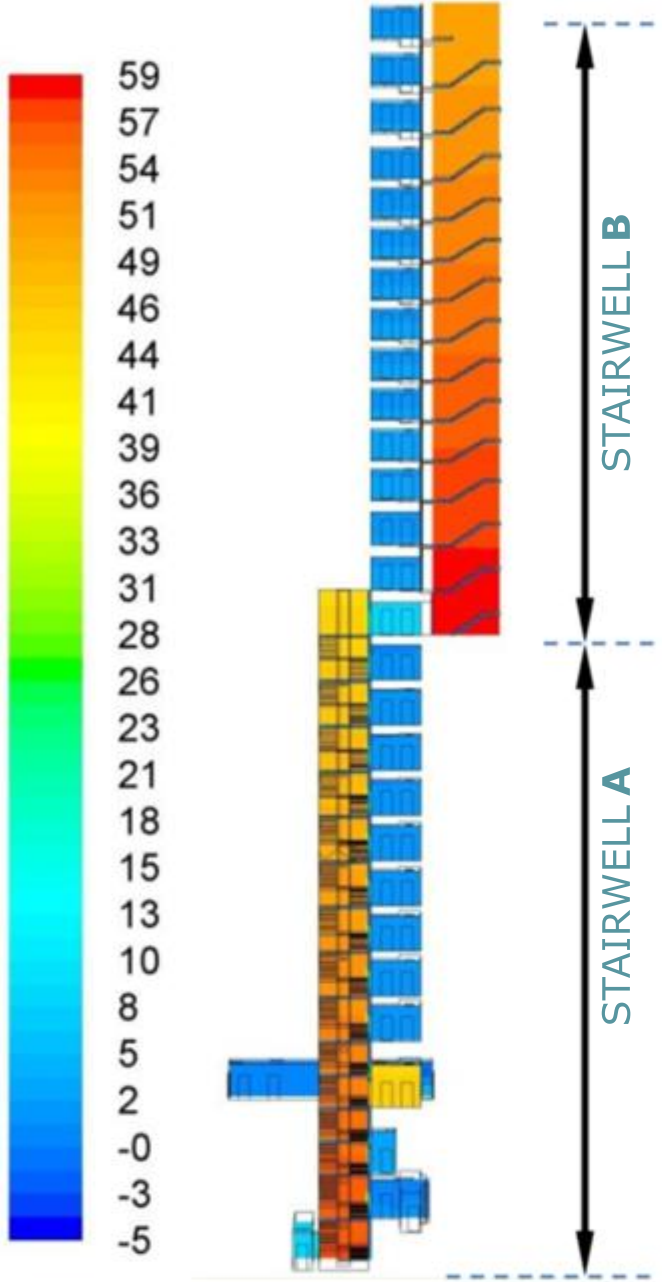


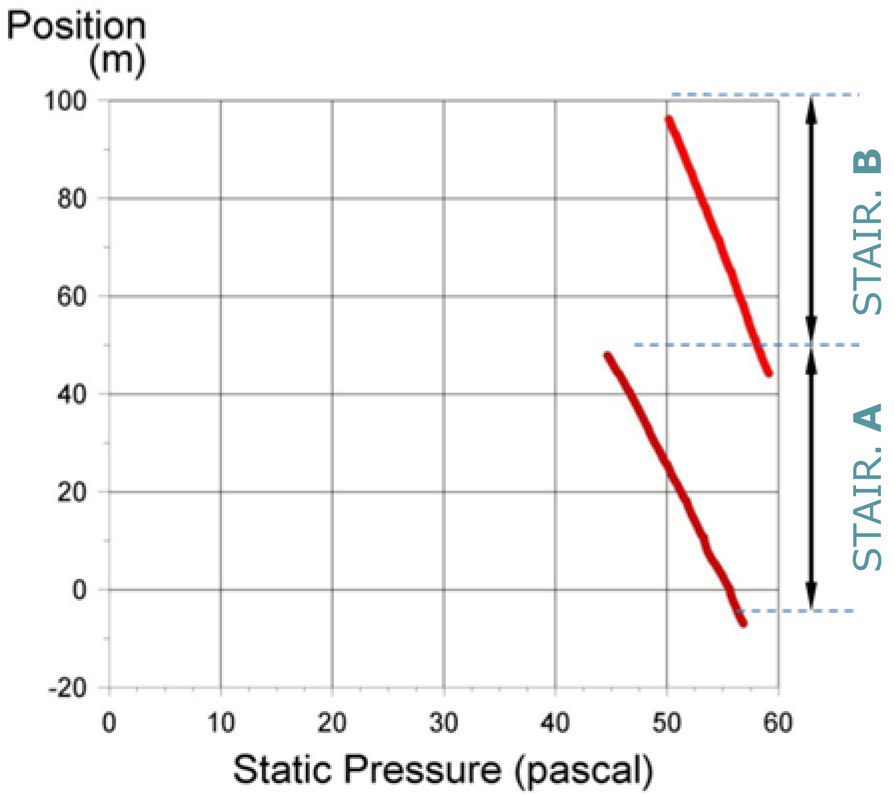
CASE STUDY

CFD simulation results:

Pressurization system operation

in winter conditions
(Te=32°C;Ti=24°C)

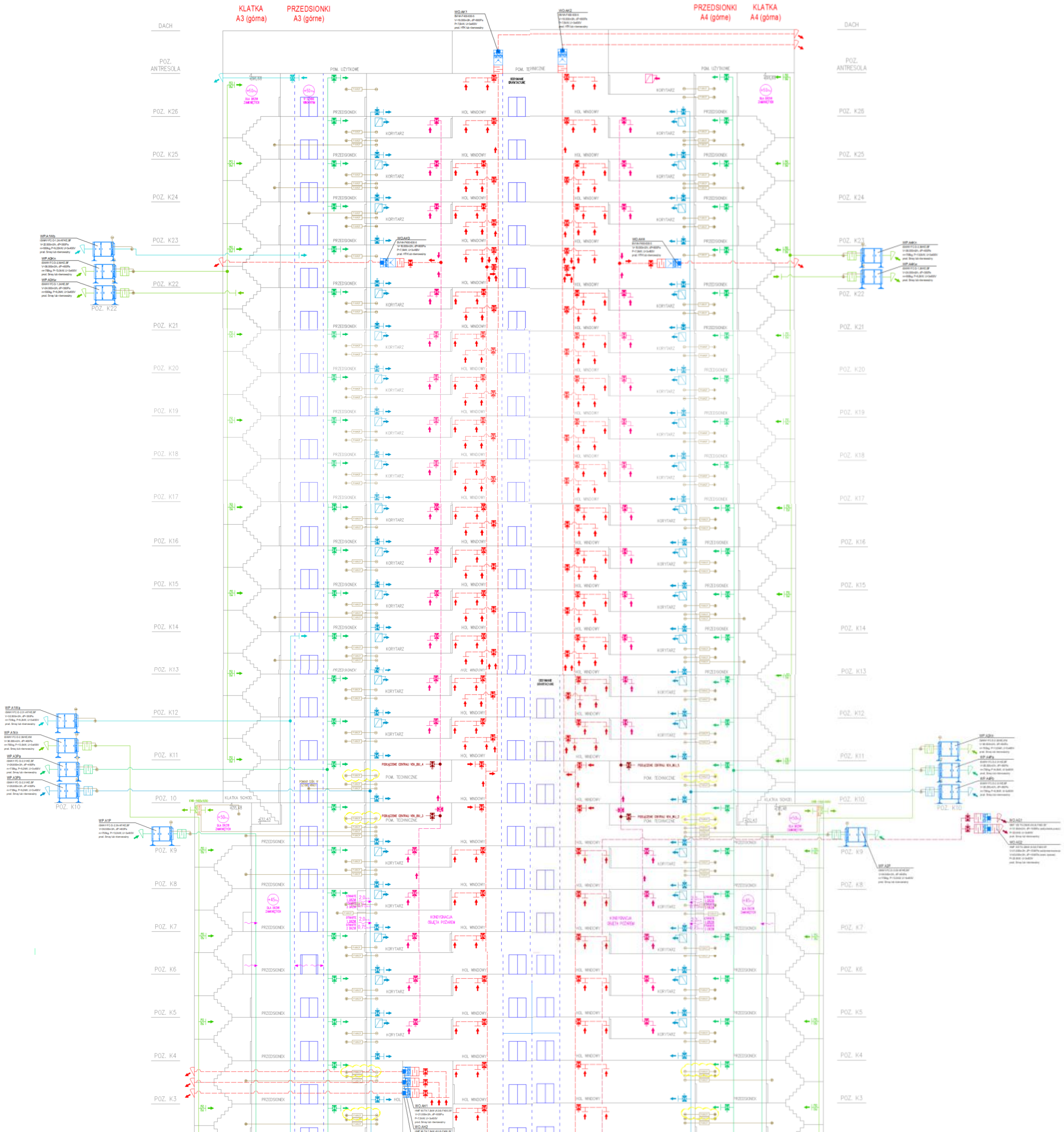




SMAY

CASE STUDY

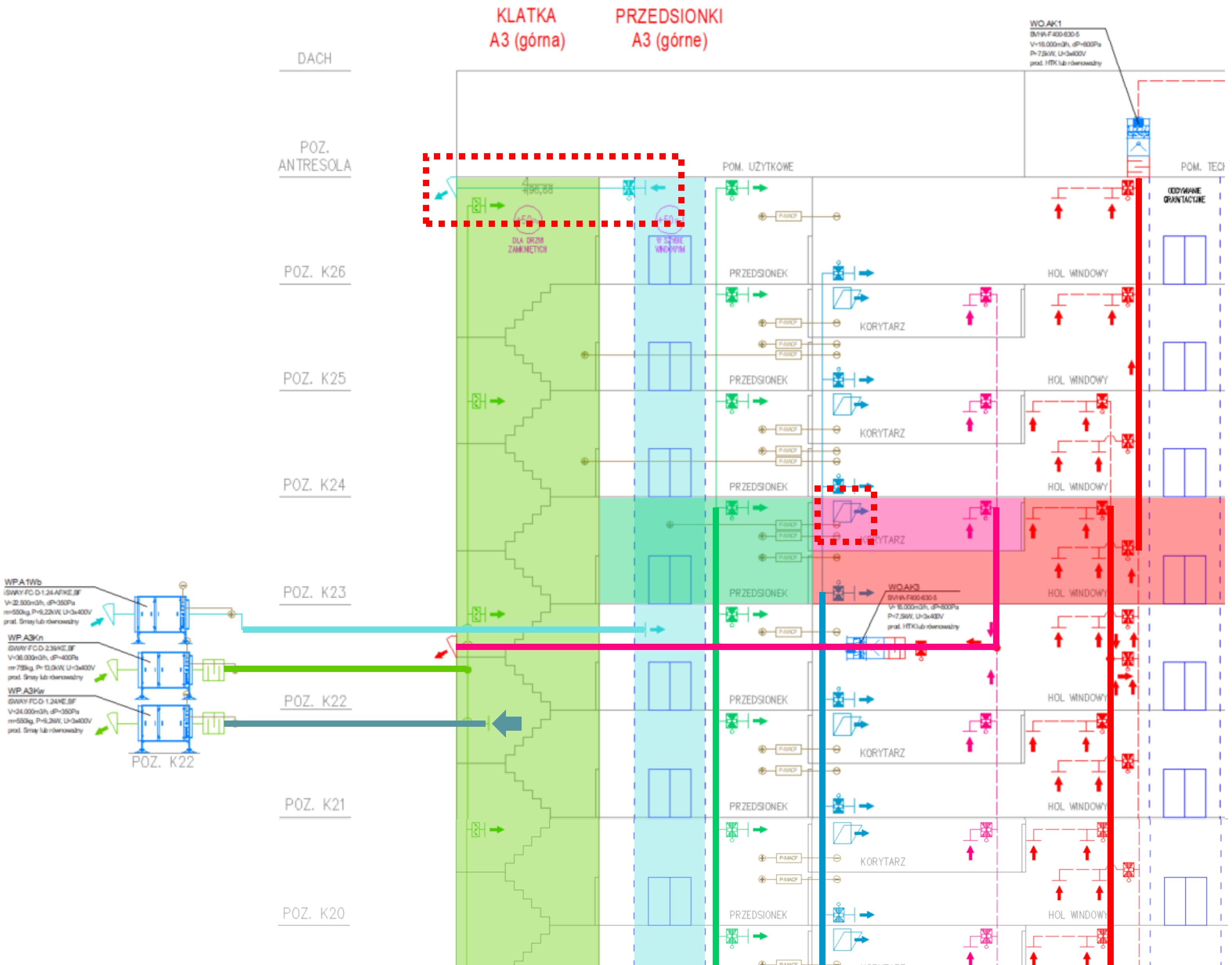
pressurization system scheme



CASE STUDY

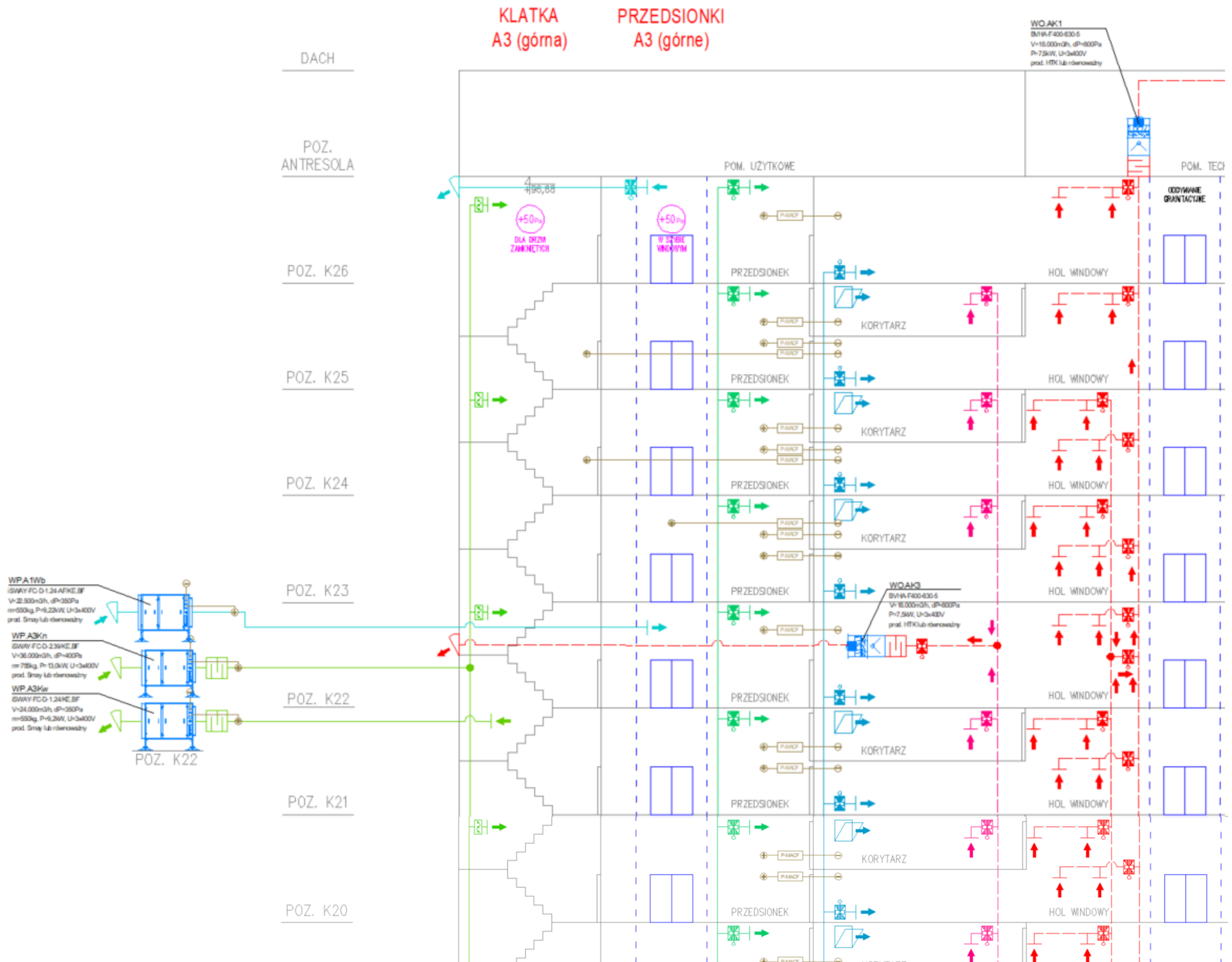
pressurization system scheme:

- protected spaces,
- systems cooperation,
- air compensation methods



CASE STUDY

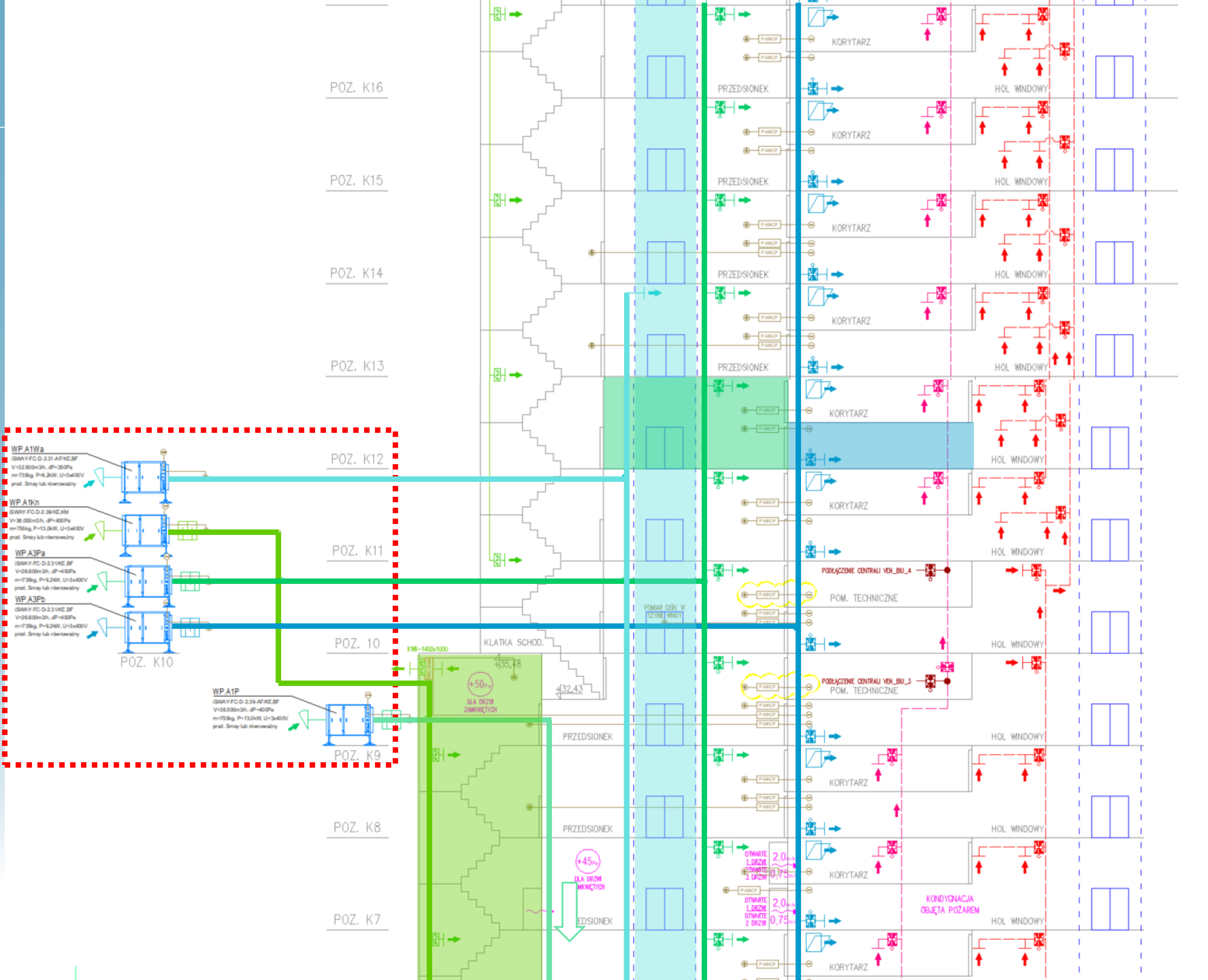
pressurization system scheme



CASE STUDY

pressurization system scheme:

- staircase separation,
- iSWAYs location

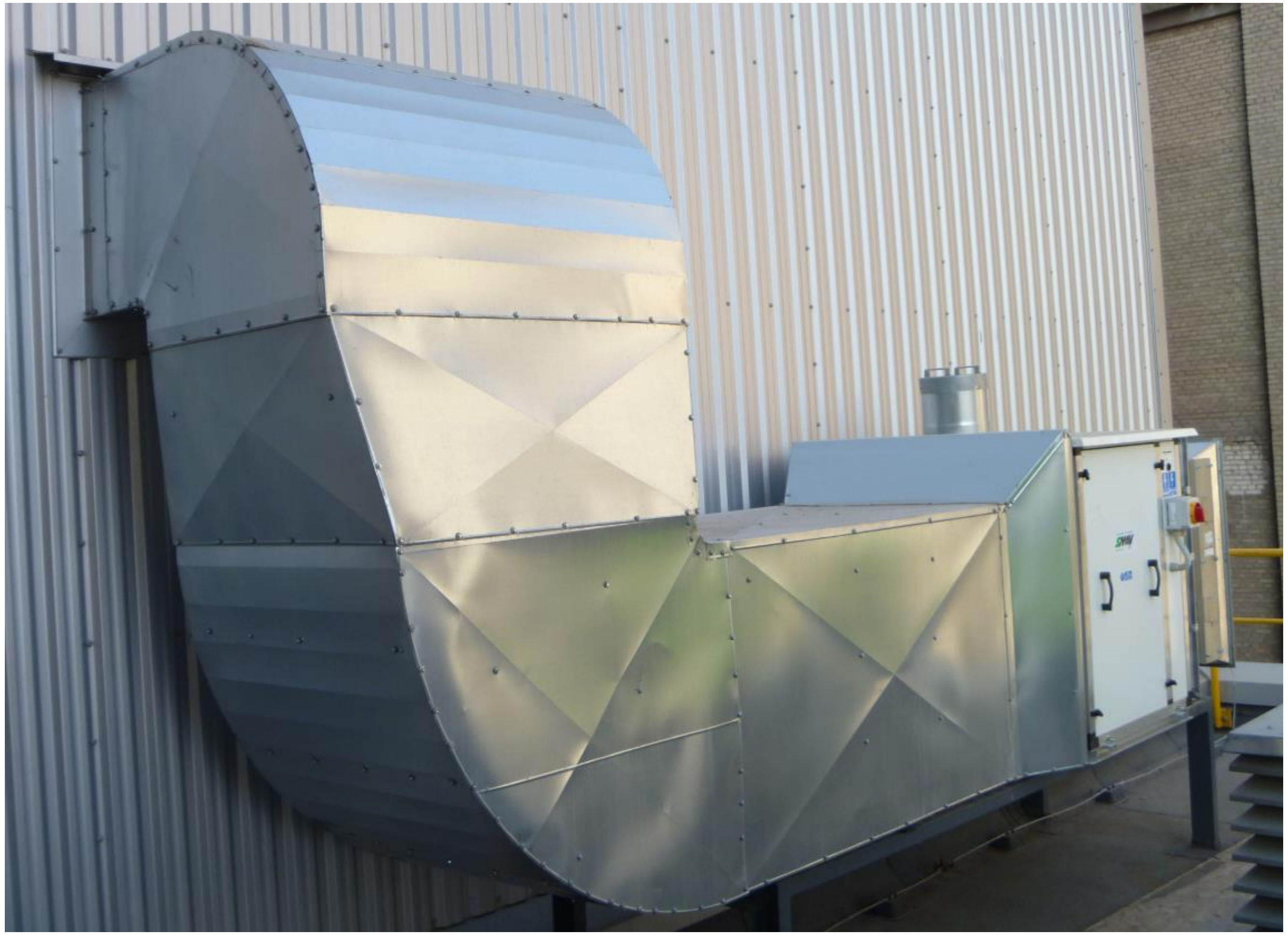


CASE STUDY

implementation phase:

- iSWAYs location,
- supply points

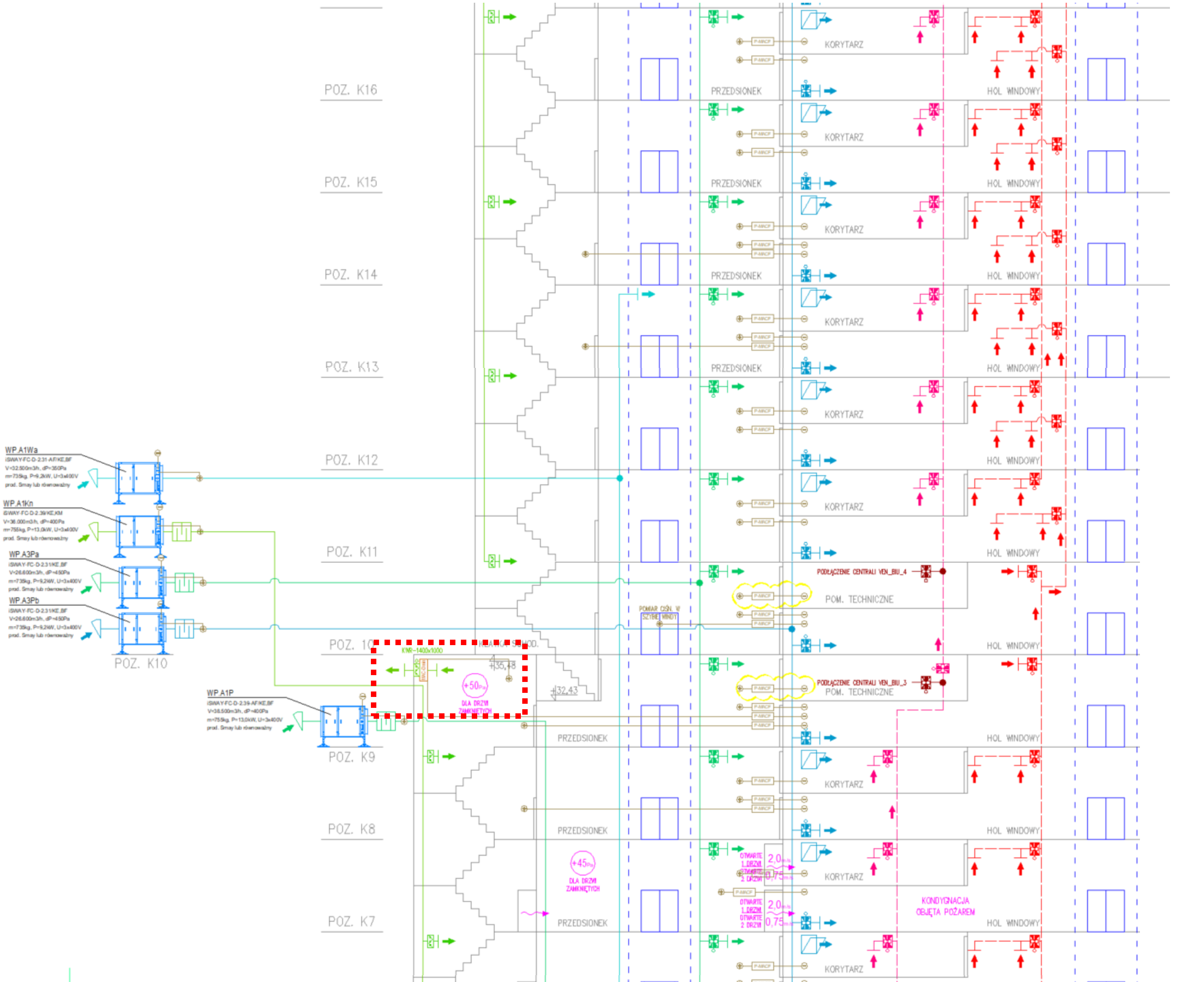
IMPLEMENTATION EXAMPLES



IMPLEMENTATION EXAMPLES

CASE STUDY

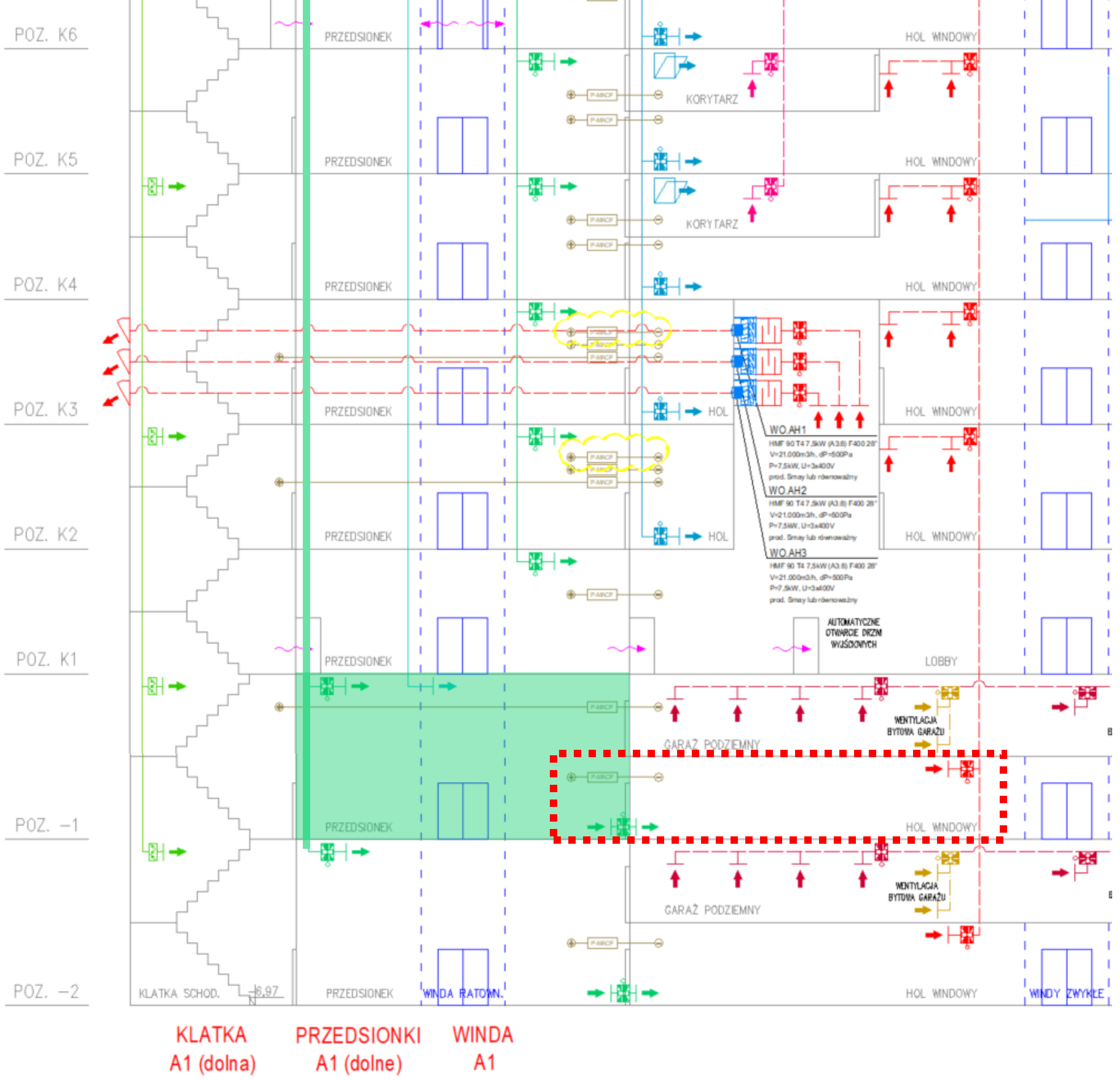
pressurization system scheme



CASE STUDY

pressurization system scheme:

- transfer damper for make-up air



DESIGN SOLUTIONS
FIRE-FIGHTING LOBBIES
TRADITIONAL AIR TRANSFER

CASE STUDY

pressurization system scheme:

- Electronically-controlled transfer

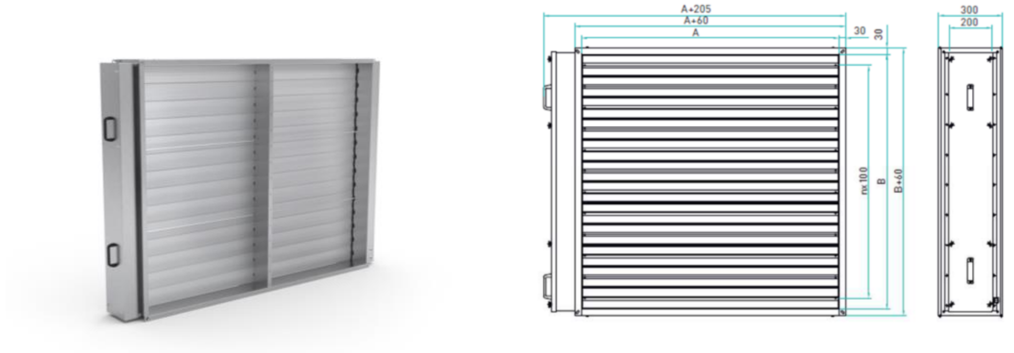
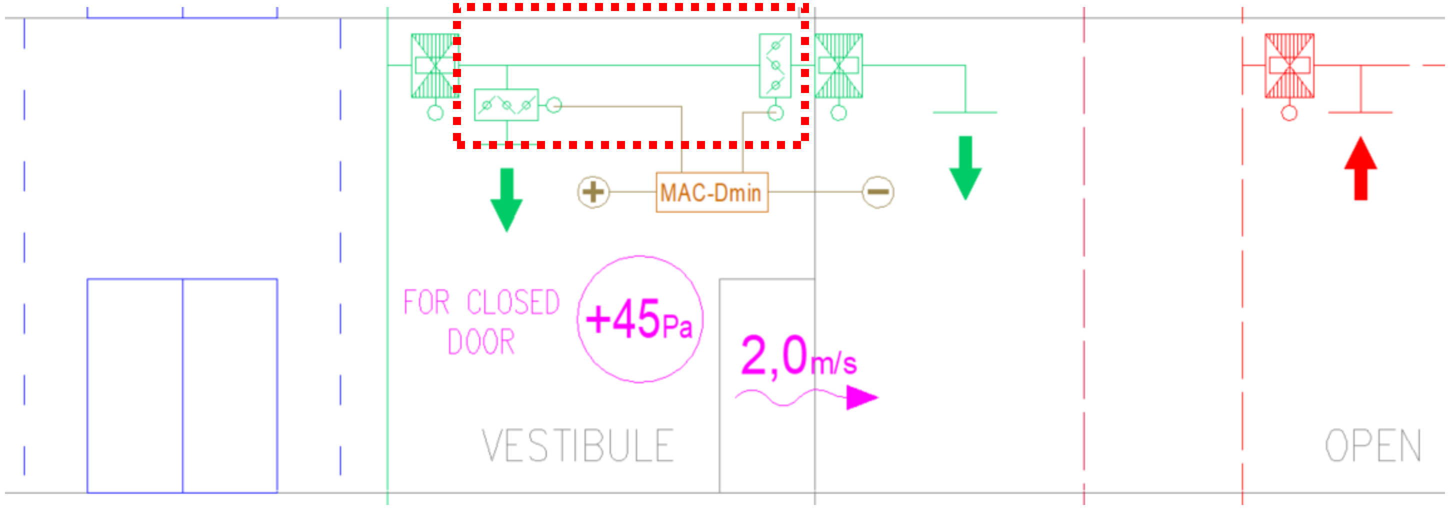


Figure 3. SRC-Z-R, SRC-Z-O and SRC-Z-U damper dimensions.

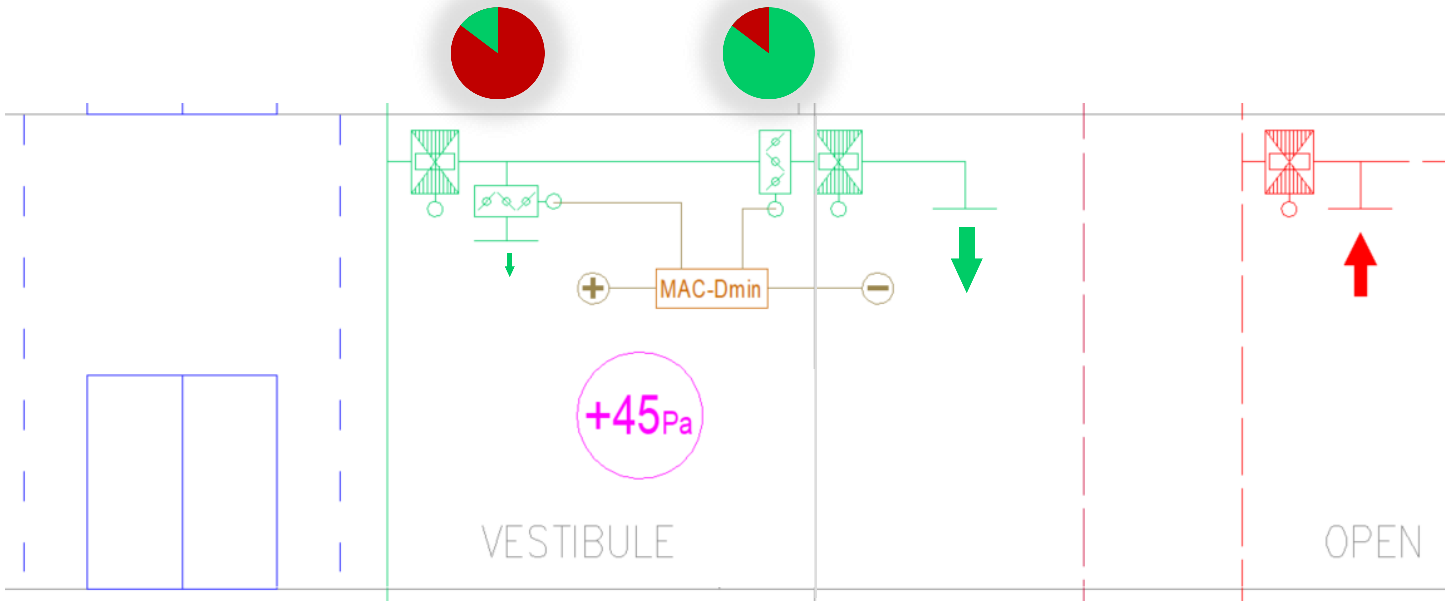


CASE STUDY

pressurization system scheme:

- Electronically-controlled transfer

PRESSURE DIFFERENCE CRITERION

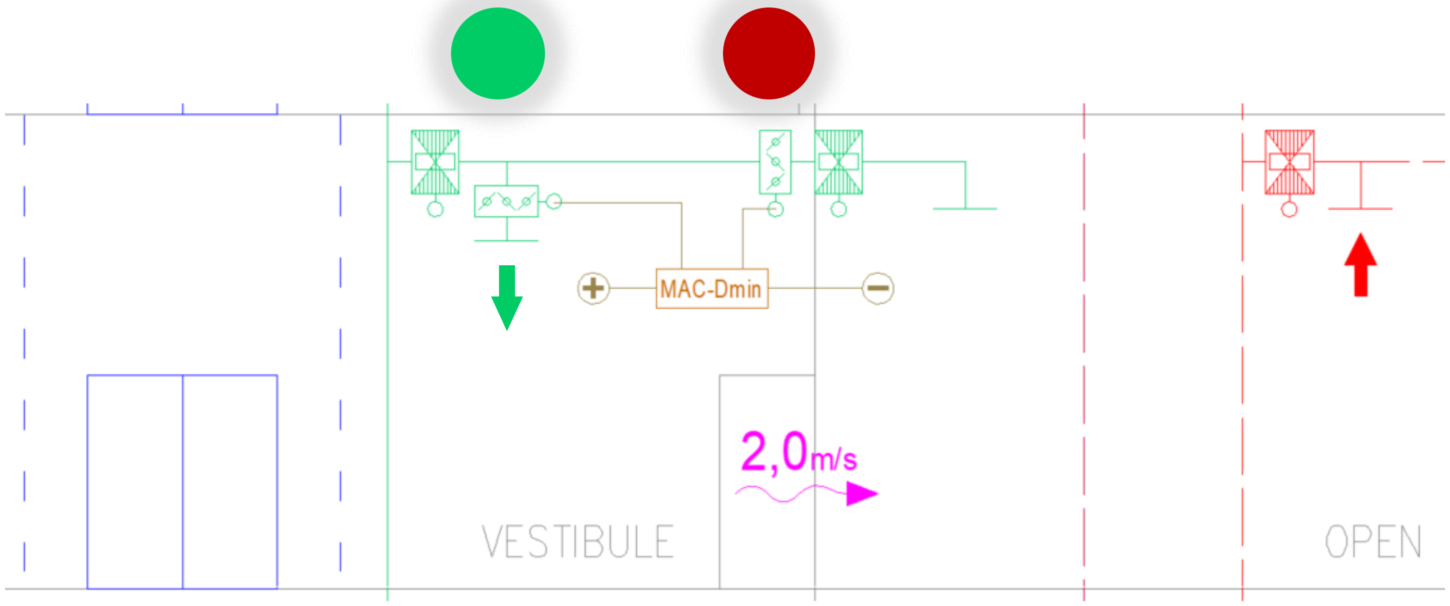


CASE STUDY

pressurization system scheme:

- Electronically-controlled transfer

AIRFLOW
CRITERION



DESIGN SUPPORT

ALL STAGE SUPPORT

CONCEPT OF THE SYSTEM

TECHNICAL CONSULTING

CALCULATIONS

SELECTION OF EQUIPMENT

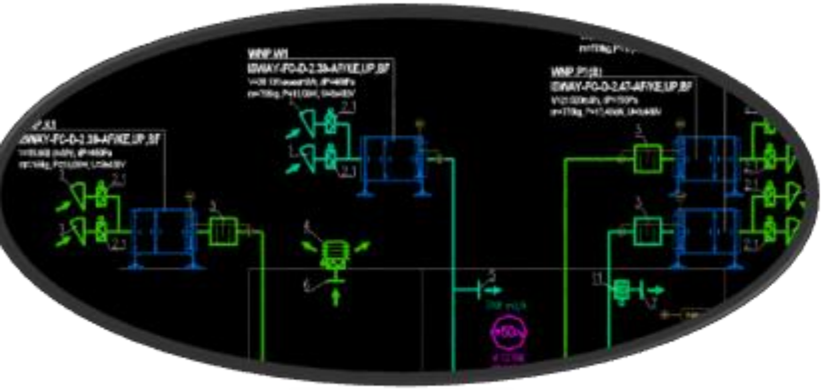
CFD &

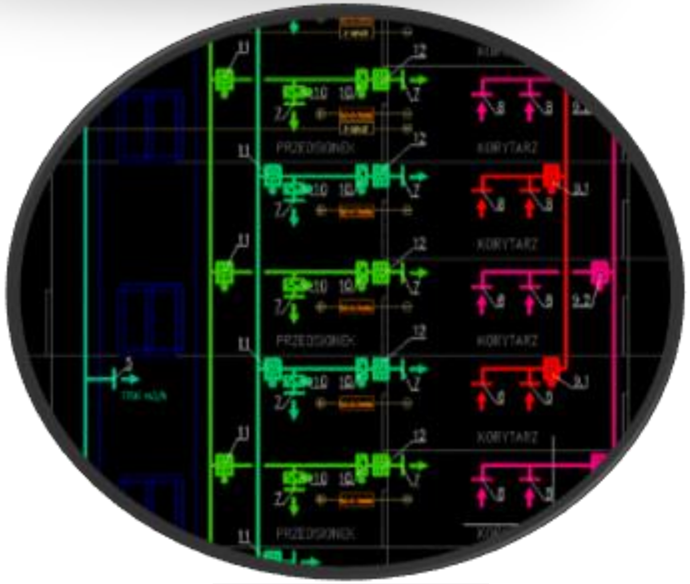
MATHEMATICAL ANALYSIS

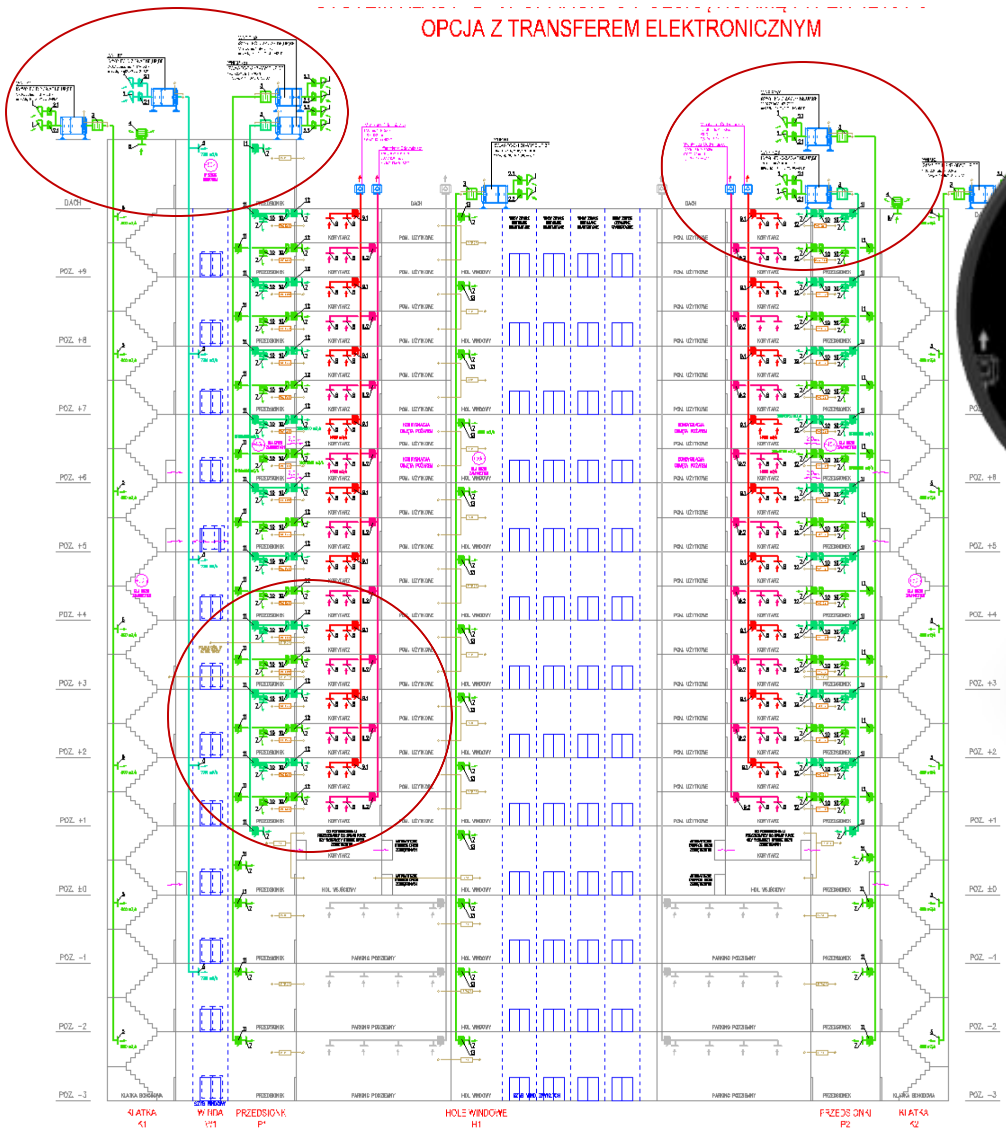
START-UP

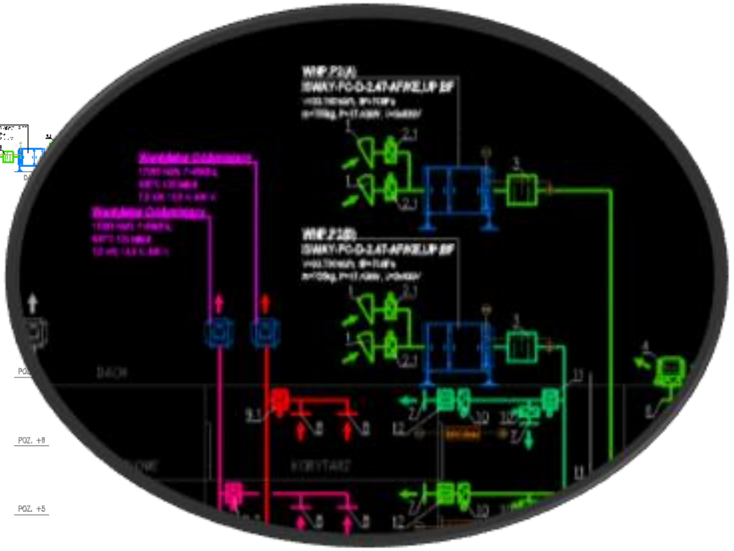
COMMISSIONING SUPPORT

SUPPORT
CONCEPT OF SYSTEM









SUPPORT
CALCULATIONS

STAIRCASE: C   SYSTEM: C
2021-11-02

STAIRCASE C

OVERPRESSURE CRITERION	ΔP = 50 Pa		
Type of LEAK:		leakage unit:	air volume:
- DOORS - single, opening to overpressure	n = 12 pcs.	A_E = 0,01 m^2	Q_D = 2 535 m^3/h
- DOORS - single, opening from overpressure	n = 1 pcs.	A_E = 0,02 m^2	Q_D = 423 m^3/h
- DOORS - double	n = 0 pcs.	A_E = 0,03 m^2	Q_D = 0 m^3/h
- LIFT SHAFT - doors to lift	n = 12 pcs.	A_d = 0,06 m^2	Q_{Ld} = 15 212 m^3/h
- CEILING and FLOOR	A_{FLOOR} = 90,0 m^2	A_{LF}/A_{WALL} 0,052 $*10^{-3}$	Q_{LF} = 99 m^3/h
- WALLS internal (average)	A_{WALL} = 1 045,0 m^2	A_{LW}/A_{WALL} 0,210 $*10^{-3}$	Q_{LW} = 4 637 m^3/h
- WALLS external (average)	A_{WALL} = 0,0 m^2	A_{LW}/A_{WALL} 0,110 $*10^{-3}$	Q_{LW} = 0 m^3/h
- WINDOWS (swing, with seal)	L = 0,0 m	A_{WINDOW}/L 0,036 $*10^{-3}$	Q_{WINDOW} = 0 m^3/h
- Other leakages		A = 0,00 m^2	Q_{OTHER} = 0 m^3/h
Summary LEAKAGES			Q_{DC} = 22 906 m^3/h
AMOUNT OF AIR THROUGH LEAKINESS with addition	addition:	d_{NN} = 50 %	Q = 34 360 m^3/h
TRANSFER	none	Anetto ≥ 0,23 m^2	Q = 0 m^3/h
RELIEF ON ROOF	none	A = - m^2	Q = 0 m^3/h
AIR VOLUME FOR CRITERION ΔP = 50 Pa			Q_{S50} = 34 360 m^3/h

AIR VELOCITY CRITERION	W ≥ 0,75 m/s		
OPEN DOORS ON FIRE LEVEL:	D_A = 2,26 m^2		Q_{DO} = 6 110 m^3/h
Air exhaust method	gravitational relief	pUP ≤ 20 Pa	Awind ≥ 0,48 m²
Overpressure in stairway while opened doors		p = 21 Pa	Ashaft ≥ 0,85 m²
Type of LEAK:		leakage unit:	air volume:
- DOORS - single, opening to overpressure	n = 11 pcs.	A_E = 0,01 m^2	Q_D = 1 500 m^3/h
- DOORS - single, opening from overpressure	n = 1 pcs.	A_E = 0,02 m^2	Q_D = 273 m^3/h
- DOORS - double	n = 0 pcs.	A_E = 0,03 m^2	Q_D = 0 m^3/h
- LIFT SHAFT - doors to lift	n = 12 pcs.	A_d = 0,06 m^2	Q_{Ld} = 9 816 m^3/h
- CEILING and FLOOR	A_{FLOOR} = 90,0 m^2	A_{LF}/A_{WALL} 0,052 $*10^{-3}$	Q_{LF} = 64 m^3/h
- WALLS internal (average)	A_{WALL} = 1 045,0 m^2	A_{LW}/A_{WALL} 0,21 $*10^{-3}$	Q_{LW} = 2 992 m^3/h
- WALLS external (average)	A_{WALL} = 0,0 m^2	A_{LW}/A_{WALL} 0,11 $*10^{-3}$	Q_{LW} = 0 m^3/h
- WINDOWS (swing, with seal)	L = 0,0 m	A_{WINDOW}/L 0,036 $*10^{-3}$	Q_{WINDOW} = 0 m^3/h
- Other leakages		A = 0,00 m^2	Q_{OTHER} = 0 m^3/h
Summary LEAKAGES			Q_{FR} = 14 650 m^3/h
OPEN DOORS on other floors (series flow)	D_A = 1,89 m^2	DA = 2,10 m^2	Q_{DO} = 0 m^3/h
OPEN DOORS on other floors (direct)	D_A = 1,89 m^2	2,10	Q_{DO} = 0 m^3/h
TRANSFER	none	Anetto ≥ 0,23 m^2	Q = 0 m^3/h
RELIEF ON ROOF	none	A = - m^2	Q = 0 m^3/h
AIR VOLUME FOR CRITERION W ≥ 0,75 m/s			Q_{LOB} = 20 760 m^3/h

OVERPRESSURE CRITERION WITH OPEN DOOR	ΔP = 10 Pa		
Type of LEAK:		leakage unit:	air volume:
- DOORS - single, opening to overpressure	n = 12 pcs.	A_E = 0,01 m^2	Q_D = 1 134 m^3/h
- DOORS - single, opening from overpressure	n = 0 pcs.	A_E = 0,02 m^2	Q_D = 0 m^3/h
- DOORS - double	n = 0 pcs.	A_E = 0,03 m^2	Q_D = 0 m^3/h
- LIFT SHAFT - doors to lift	n = 12 pcs.	A_d = 0,06 m^2	Q_{Ld} = 6 803 m^3/h
- CEILING and FLOOR	A_{FLOOR} = 90,0 m^2	A_{LF}/A_{WALL} 0,052 $*10^{-3}$	Q_{LF} = 44 m^3/h
- WALLS internal (average)	A_{WALL} = 1 045,0 m^2	A_{LW}/A_{WALL} 0,21 $*10^{-3}$	Q_{LW} = 2 074 m^3/h
- WALLS external (average)	A_{WALL} = 0,0 m^2	A_{LW}/A_{WALL} 0,11 $*10^{-3}$	Q_{LW} = 0 m^3/h
- WINDOWS (swing, with seal)	L = 0,0 m	A_{WINDOW}/L 0,036 $*10^{-3}$	Q_{WINDOW} = 0 m^3/h
- Other leakages		A = 0,00 m^2	Q_{OTHER} = 0 m^3/h
Summary LEAKAGES			Q_{DC} = 10 060 m^3/h
OPEN DOORS on other floors (direct)	D_A = 2,64 m^2	0,00	Q_{DO} = 24 950 m^3/h
OPEN DOORS on other floors (direct)	D_A = 1,89 m^2	2,10	Q_{DO} = 0 m^3/h
TRANSFER	none	Anetto ≥ 0,23 m^2	Q = 0 m^3/h
RELIEF ON ROOF	none	A = - m^2	Q = 0 m^3/h
AIR VOLUME FOR CRITERION ΔP = 10 Pa			Q_{S10} = 35 010 m^3/h

FAN SELECTION			
Required air volume for the criterion ΔP = 50 Pa			Q_{S50} = 34 360 m^3/h
Required air volume for the criterion W ≥ 0,75 m/s			Q_{LOB} = 20 760 m^3/h
Required air volume for the criterion ΔP = 10 Pa			Q_{S10} = 35 010 m^3/h
Calculated air volume for stack effect elimination	don't include		Q_{CK} = 0 m^3/h
Safety factor	addition for leaks of ducts:	d_{NN} = 15 %	
TOTAL SUPPLY AIR VOLUME			Q_P = 40 270 m^3/h
Available pressure of the air supply fan			P_{FAN} = 408 Pa
SELECTED FAN	WP.C	iSWAY-FC-D- 2.31-J	

SELECTION CARDS

2023-05-09

Pressurization unit: A.E(floor).6-L2
Protected space: firefighting lobby

iSWAY-FC-D-2.47-AF-Z/KE,SS,UP

The iSWAY-FC® unit series is designed to create a specified value of overpressure in a staircase space, fire-fighting vestibule, fire-fighting elevator shaft, or other space covered by a pressure differential system. They can be located in the machine room on any floor, on the roof or next to the building at ground level.

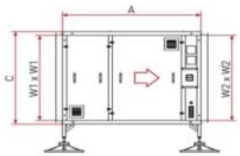
TYPE AND SIZE

Type	iSWAY-FC-D
Size	2.47
Operating direction	supply
Location	outside the building
Operating side	-

iSWAY-FC-D pressurisation unit

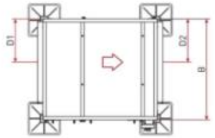
DEVICE PARAMETERS

Fan capacity	V =	16 800	m^3/h
Static pressure	ΔP =	1100	Pa
Active power	P =	17,40	kW
Apparent power	S =	17,75	kVA
Supply voltage	U =	3x 400	V
Sound power level	Lwa =	95	dB(A)
Total weight	m =	571	kg



BASIC EQUIPMENT

- Inverter controlled fan
- Automation cabinet (with inverter, regulator, 24 VDC power supply)
- Shut-off damper with servomotor
- Smoke detector;
- Housing insulated with sandwich slabs;
- Main switch;
- Braking resistor.



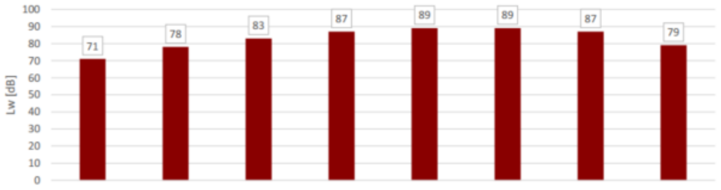
ADDITIONAL EQUIPMENT

- Additional outputs 24V DC	-
- Additional pressure sensor	-
- Suction-side connection	KE - flexible connector
- Support system	SS - welded feet
- Dual intake system	SRC multi-blade dampers
- Air volume measurement	-
- Anti-Frost system	infrared heater
- Roof	-

iSWAY-FC-D DIMENSIONS

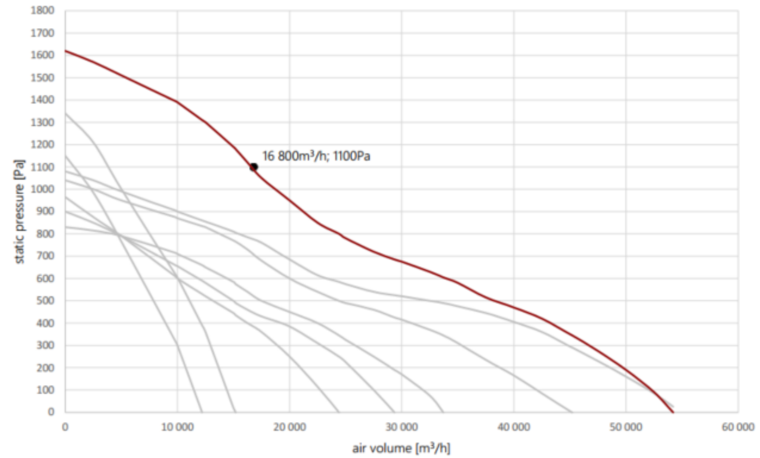
Width:	B =	1520	mm
Height:	C =	1300	mm
Length:	A =	1720	mm
Connectors size:	W1,W2 =	1200x1200	mm
Connect. length:	D1,D2 =	650	mm

ACOUSTIC DATA



Sound power level in frequency bands, Lw [dB]

OPERATING POINT



The operating point for type iSWAY-FC-D-2.47 unit with A.E(floor).6-L2 symbol serving: the firefighting lobby.
The unit characteristics show the dependence of the flow rate on the available compression (taking into account the pressure loss of the shut-off damper and the unit-mounted air intake).

DOCUMENTATION:

https://www.smay.pl/en/product/isway-fc-compact-unit-for-pressure-differential-systems/

SUPPORT
ADDITIONAL MATHEMATICAL ANALYSIS

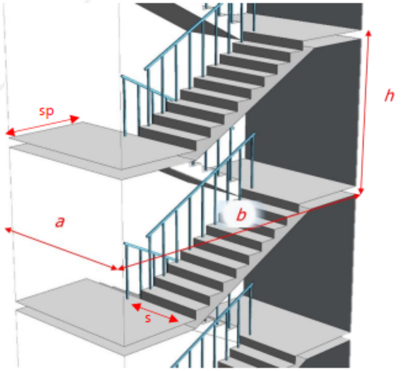
SMAY Sp. z o.o.
Podłęże 678
30-003 Podłęże,
POLAND

VAT UE: PL6782821888

smay.eu

DESCRIPTION AND ASSUMPTIONS FOR ANALYSIS:

- **Goal of the analysis**: determination of pressure distribution in the staircase during the operation of the pressure differentiation system
- Height of the staircase: 87,5 m (82,4 m above ground and 5,1 m underground)
- Tightness level: average in accordance to EN 12101-6
- Method of analysis: analytical calculations of pressure inside the staircase taking into account the stack effect, flow resistance, leakage
- All doors are closed
- The correct operation of the pressure differential system (PDS) requires pressure regulation within the corridors, which was not the subject of the analysis
- Location of air supply points:
  - Reversible top iSWAY unit: L23
  - Additional iSWAY unit: L06, L08, L10, L12, L14, L16, L18, L20
  - Reversible bottom iSWAY unit: LGround, L02, L04,
- the analysis was performed for summer, isothermal and winter conditions
- staircase geometry:
  - a = 3,0 m
  - b = 5,25 m
  - sp = 1,425 m
  - s = 1,40 m
  - h = 3,25 ÷ 4,11 m (above ground)
  - h = 2,95 ÷ 4,32 m (underground)



RESULTS OF THE ANALYSIS:

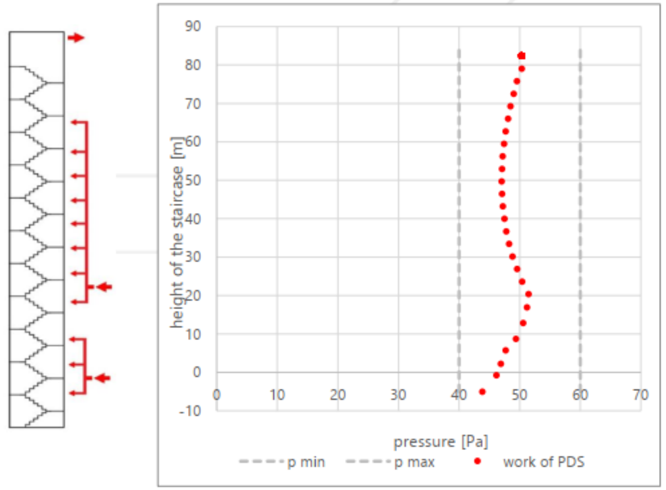
Winter conditions

Pressure differences between staircase and outside

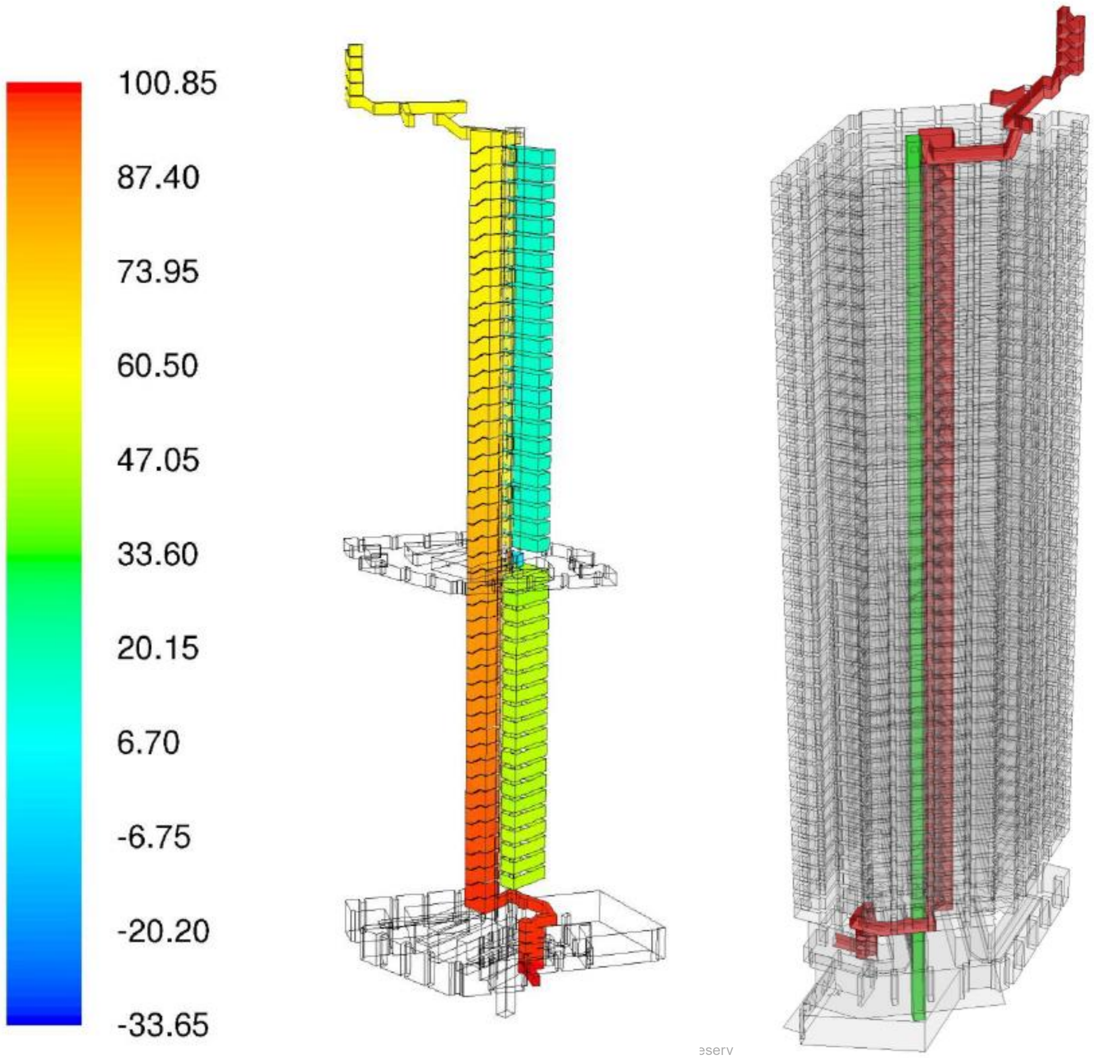
Temperature **outside** in winter	T_{out}	0	[°C]
Temperature **inside** in winter	T_{inn}	18	[°C]

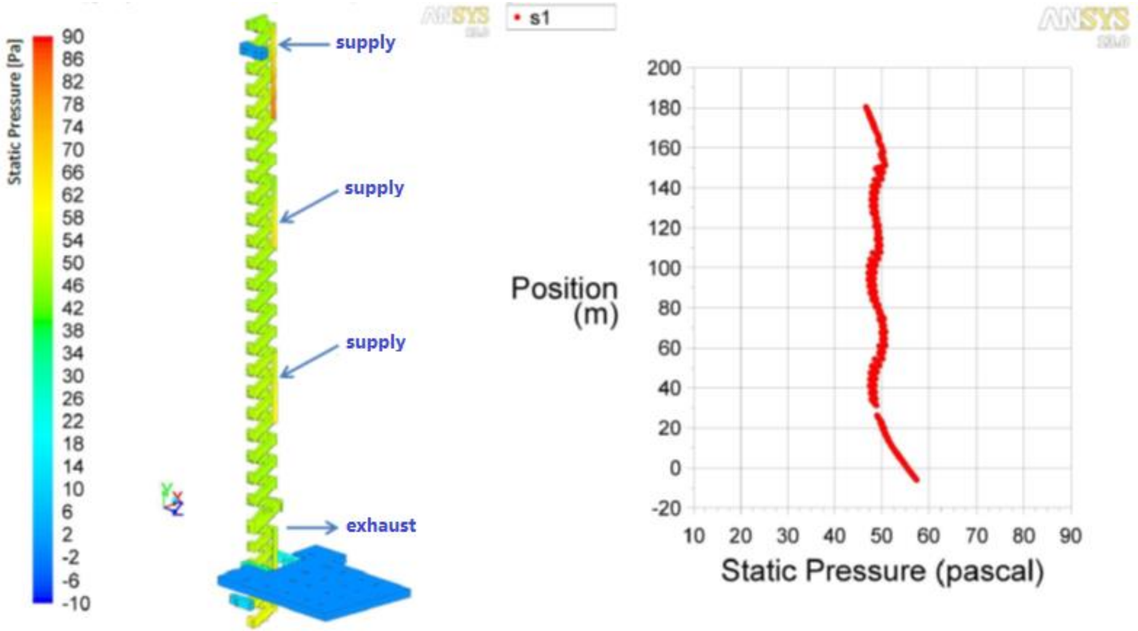
Outlet volume flow (top)	V_{out}	- 12 600	[m³/h]
Additional volume flow (middle)	V_{add}	5 000	[m³/h]
Inlet volume flow (down)	V_{inn}	21 200	[m³/h]

Figure 01. Pressure differences between staircase and outside due to work of Pressure Differential System (PDS) in winter conditions



SUPPORT
CFD SIMULATIONS





SUPPORT
SPECIFICATION

Symbol	Type	Description	Qty
PRESSURE DIFFERENTIAL SYSTEM			
	REVERSIBLE SAFETY WAY SYSTEM	SAFETY WAY PRESSURE DIFFERENTIAL SYSTEM WITH REVERSIBLE UNITS for space pressurization according to design criteria, with stack effect counteracting in high-rise buildings. Certified complete system including all units and accessories. Meets all the requirements of Standard EN 12101-6 as a smoke prevention system. The reversible Safety Way system is protected under the PATENTS PL218694 "System of positive pressure protection of vertical escape routes" and PL218095 "Method of pressure regulation in vertical escape routes". The devices provide 90% of nominal capacity in less than 3 seconds, at any pressure change. Communication and control of the units in a bidirectional loop ensuring full operation of the system and all fans with a single wiring fault. Optional dual pressure measurement system to ensure full system operation with a single pressure sensor failure. System provides automatic 24-hour testing to verify system and fan readiness every 24 hours on a programmable schedule.	1
EQUIPMENT FOR STAIRCASES			
S-A_T	**iSWAY-FC-R-2.31-J-AF-Z / KE, UP, BF**	REVERSIBLE PRESSURIZATION UNIT for outdoor installation, with right-side service access. The unit has all components built and fully wired in a compact housing. It ensures pressure generation and regulation by continuous measurement and by changing the fan capacity by means of a frequency converter. Equipment: fan with variable output, insulated housing with inspection panel, shut-off damper with actuator, automation cabinet with frequency converter, controller and 24V DC power supply, braking resistor, smoke detector and differential pressure sensor in the device, anti-freeze damper system, a pair of dampers with actuators for double inlet system, two flexible inlet and outlet connectors, BigFoot supports, main switch. Parameters: Capacity 1500÷36000 m3/h (88% of capacity in reverse), available pressure 260 Pa (for max airflow), active electric power 9,22 kW, supply voltage 3x 400 V, weight 412 kg, dimensions BxCxA= 1520x1300x1720 mm.	2
S-A_B	**iSWAY-FC-R-2.47-J-AF / KE, KM**	REVERSIBLE PRESSURIZATION UNIT for indoor installation, with right-side service access. The unit has all components built and fully wired in a compact housing. It ensures pressure generation and regulation by continuous measurement and by changing the fan capacity by means of a frequency converter. Equipment: fan with variable output, insulated housing with inspection panel, shut-off damper with actuator, automation cabinet with frequency converter, controller and 24V DC power supply, braking resistor, smoke detector and differential pressure sensor in the device, anti-freeze damper system, two flexible inlet and outlet connectors, mounting brackets, main switch. Parameters: Capacity 1500÷46000 m3/h (88% of capacity in reverse), available pressure 316 Pa (for max airflow), active electric power 17,4 kW, supply voltage 3x 400 V, weight 515 kg, dimensions BxCxA= 1520x1300x1720 mm.	2

S-B	**iSWAY-FC-D-2.31-J-AF / KE, KM**	PRESSURIZATION UNIT for indoor installation, with right-side service access. The unit has all components built and fully wired in a compact housing. It ensures pressure generation and regulation by continuous measurement and by changing the fan capacity by means of a frequency converter. Equipment: fan with variable output, insulated housing with inspection panel, shut-off damper with actuator, automation cabinet with frequency converter, controller and 24V DC power supply, braking resistor, smoke detector and differential pressure sensor in the device, anti-freeze damper system, two flexible inlet and outlet connectors, mounting brackets, main switch.Parameters: Capacity 1500÷29400 m3/h, available pressure 506 Pa (for max flow), active electric power 9,22 kW, supply voltage 3x 400 V, weight 412 kg, dimensions BxCxA= 1520x1300x1720 mm.	1
PRESSURIZATION SYSTEM ACCESSORIES			
	P-MACF	PRESSURE DIFFERENCE SENSOR, with LEDs indicating operating status. Pressure range 0÷500Pa, power supply 24V DC, protection degree IP54, operating temperature -25÷55°C	5
	T-MACF	TEMPERATURE SENSOR, with LEDs indicating operating status. Measurement range -25÷55°C, power supply 24V DC, protection degree IP65, operating temperature -25÷55°C, measurement error ±2,5°C.	8
	KWR-1205x1205-	COMPACT EXHAUST VENT including roof outlet type B, damper with 3 actuators, digital regulator with a differential pressure sensor, roof base. Dimensions AxBxH= 1205x1205x1210+ mm.	1
AUTOMATION COMPONENTS			
	TSS-5	INDICATOR-SIGNAL BOARD with display, for 5 iSWAY unit Degree of protection IP65, key-operated security switch, dimensions SxWxG= 313x640x188 mm.	1
	Start-up	COMMISSIONING OF THE PRESSURIZATION SYSTEM Commissioning of equipment, measurement of required design criteria and calibration of the pressure differential	1

Smay
Ventilation
Systems

SUPPORT
TECHNICAL DESCRIPTION

1. Reference standard

Subject pressure differential system (PDS) *heat control systems. Specification for pre* knowledge has been applied.

2. Design objectives and assumpti

2.1. Design objectives

Major design objective is to keep vertical means of escape and facilitate firefighting

Secondary design objective is to provide system) serving as mechanical air release

2.2. Design assumptions

- stairwells ST1 and ST2 (over- and
  - design pressure difference in
  - design airflow velocity from th
  - maximum door opening force
- firefighting lobbies FL1 and FL2 (
  - design pressure difference in
  - design airflow velocity from th
  - maximum door opening force

Note: it is assumed that only lobbies at th

3. Fire scenario

It is assumed that:

- building is fitted with an automati pressure differential system (PDS) one storey only at the time),

In case of a fire:

- stairwells are pressurized (overgro

Note: it is necessary to pressurize bo simultaneously regardless of the fire locat

- firefighting lobbies only at the ove
- smoke extraction from the corrido
- passenger lifts are automatically b
- evacuation will be carried out as p separately),
- capacities of the pressure differen in the stairwell can be open at the
- design parameters of the pressure moment when system has been tr

4. Overall description of the pressure

Note: Entire pressure differential system systems and certified in accordance wit performance, reliability and durability of one supplier (one responsible party).

SMAY Sp. z o.o.
Podłęże 678
32-003 Podłęże

VAT UE: PL6782821888

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4.1. List of key components of the pressure differential system (PDS)

4.1.1. Pressure differential kits type SMAY iSWAY-FC® (CE in accordance with prEN 12101-6),

Use: pressurization of the stairwells, lobbies and lift shafts, compensation of the corridors

Kit of predefined components enclosed in single self-carrying thermally insulated casing with air supply fan, frequency inverter, pressure regulator, pressure differential sensor, breaking resistor, battery power supply, ducted smoke detector. Confirmed response time (<3 s within the range of airflows from 200 up to 50 500 m^3/h), reliability 10 000 cycles, durability and immunity to oscillations.

List of key components:

1 - Casing (steel sheet insulated with PIR foam)

2 - Infrared heater AF (option).

3 - Airflow measurement probe

4 – Axial fan

5 - Breaking resistor

6 - Shut-off damper (air intake)

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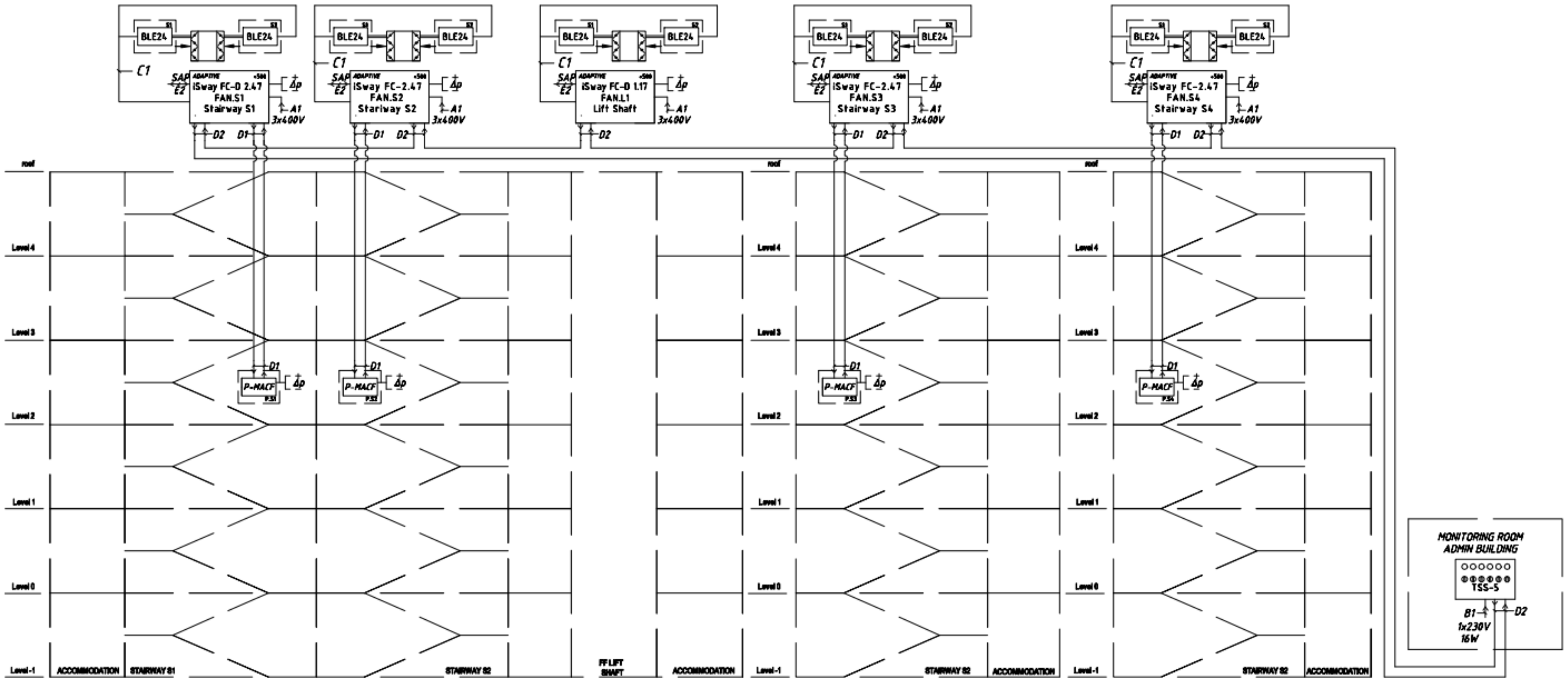
Ventilation
Systems

SUPPORT
ELECTRICAL GUIDELINES



WIRING		
Designation in Scheme	Connections of automation's components	Cable type
A1	Guaranterd supply line 3x400V for iSWAY FC	TABLE 2
B1	Guaranted supply line 1x230VAC MSPU, TS, TSS	NHXH FE180/PH90 3x1,5
C1	Power/control cable 24VDC (double air intake)	HDGs FE180/PH90 3x1,5 mm²
D1	Local FireBus loop	HTKSH FE180/PH90 ekw 2x2x0,8
D2	Global FireBus loop	HTKSH FE180/PH90 ekw 2x2x0,8
E2	Cable. Fire alarm (FAS) (NC, parameterization required with two 4k7 resistors in a configuration in accordance with the DTR) Confirmation of work (NO) Failure (NC)	HTKSH FE180/PH90 3x2x0,8

The dimensions of automation's components SAFETY WAY SMAY	
Device	Dimension DxHxS [mm]
TSS-5	313x640x188
P-MACF	180x122x90

TABELE 1 Power and overcurrent protection circuit in device and in distribution board for equipment							TABLE 2 Cable A1
Device	Active power P[kW]	Apparent power S[kVA]	cos φ	A	Overcurrent protection circuit in equipment	Required overcurrent protection circuit in distribution board	Cross section
iSWAY FC 1.17	5,26	5,36	0,98	0,9	B 16A	gG 20A	NHXH FE180/PH90 5x4 mm²
iSWAY FC 2.47	17,40	17,75	0,98	0,9	B 40A	gG 50A	NHXH FE180/PH90 5x16 mm²

Operation panel	Active power P[W]	Apparent power S[VA]	Overcurrent protection circuit in equipment	Required overcurrent protection circuit in distribution board
TSS-5	16	20	1,25 time delay	B6

Important note:

1. Power supply out of scope SMAY sp. z o.o. (guaranteed 24 VDC, 230VAC, 3x400VAC)
2. Low- and high-current installation out of scope SMAY sp. z o.o.
3. Power cables and control cables raceways performed as E90
4. Additional steering of actuators controlling doors, windows, skylights, smoke dampers, fire dampers and transfer dampers out of scope SMAY sp. z o.o.
5. Power, control and monitoring cables:
   - assumed that length of power supply cables (3x400VAC) is less than 70m while 20% of that length might be threatened by fire at once and voltage drop is less than 3%. For other conditions it is necessary to calculate size of the cables again.
   - assumed that length of power supply cables (1x230VAC) is less than 60m while 20% of that length might be threatened by fire at once and voltage drop is less than 5%. For other conditions it is necessary to calculate size of the cables again.
   - assumed that length of power supply cables (1x24VAC) for MAC-D-MIN controllers, and PZ boxes (C2-C6) is less than 40m while 20% of that length might be threatened by fire at once and voltage drop is less than 10%. For other conditions it is necessary to calculate size of the cables again.
   - assumed that length of power supply cables (1x24VAC) for P-MACF sensors, is less than 100m while 20% of that length might be threatened by fire at once and voltage drop is less than 10%. For other conditions it is necessary to calculate size of the cables again.
   - length of bus communication loop cannot exceed 250m between devices.
   - length of F2 and F7 cable together should not exceed 50m while 20% of that length might be threatened by fire at once. For other conditions it is necessary to calculate size of the cables again.
   - bus communication loop wires must be laid in a least 0,4m interspace from power cables (230VAC, 400VAC)

6. Static pressure measurement points located in air supply ductwork or protected spaces and ambient pressure measurement points shall be defined in mechanical design. The way of performing measurement points and leading of pulse tubes according to SMAY guidelines. Pneumatic signals „Δp" lead to iSWAY-FC type devices, P-MACF sensors and MAC-D-MIN controllers according to mechanical design guidelines.
7. Pneumatic installation (wires, pulse tubes, measurement points, connections) out of scope SMAY sp. z o.o.
8. TSS, TS, MSPU shall be located nearby the entrance of the building, on the fire and rescue brigades access level.
9. ŻUBR power supplies, if they are located at the schematic diagram, are powering only smoke exhaust fans located on the schematic diagram.
10. ŻUBR power supplies for smoke exhaust fans, shall be installed in fire separated technical rooms (indoor versions) or on the roof nearby the powered fans (outdoor versions).
11. MAC-D-MIN controller, P-MACF pressure transducer shall be mounted within the protected space (lobby, staircase, elevator duct).
12. Grounding of MAC-D-MIN and P-MACF shall be made with use of wiring from the casing of the power supply to the grounding point inside the device.
13. It is required to use separate overcurrent protection (short-circuit) for each of power supply outputs. This applies to every power supply line (24VDC, 230VAC and 3x400VAC. Overcurrent protection shall be mounted directly after the power supply branching point. It is required to ensure the selectivity of used protection.
14. This drawing is not a design according to law and it cannot be used as a substitute of the appropriate design - it is a guideline for electric and control design of SAFETY WAY/iSWAY
15. If required, manufacturer reserves the right to introduce all necessary changes both in the components and comlete systems.
16. It is highly recommended to contact the manufacturer or it's official representative at the conceptual design stage in order to execute the design

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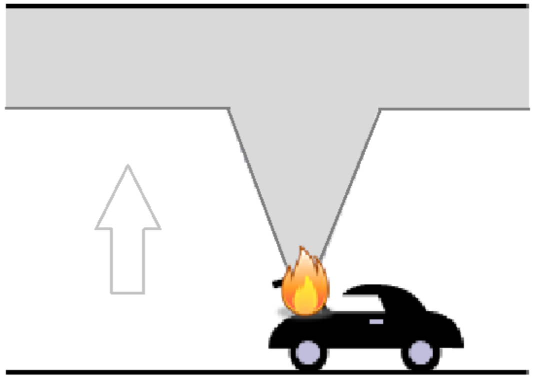
SAFETY CARPARK

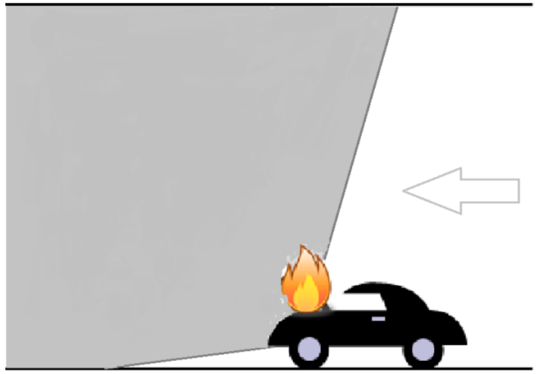
JET FAN VENTILATION

DUCT SYSTEM



Horizontal layers separation
SMOKE UNDER THE CEILING

JET FAN SYSTEM



Vertical layers separation
SMOKE BETWEEN FIRE AND EXHAUST SHAFT

Smoke extraction	Smoke control	
High carparks	**Low carparks**	
Its application can be the basis for extending escape routes	Its use cannot be the basis for extending escape routes due to local drops in visibility	
Complex geometry	**Simple garage geometry** allowing large volumes of air to be pushed from the supply point to the exhaust point	
Duct installation	Jet fans	
Air volumes ca. **100 000 m³/h**	Air volumes **160 000 m³/h – 240 000 m³/h**	

Smoke extraction	Smoke control	Smoke clearance
High carparks	**Low carparks**	**Where allowed by a law**
Its application can be the basis for extending escape routes	Its use cannot be the basis for extending escape routes due to local drops in visibility	N/A
Complex geometry	**Simple garage geometry** allowing large volumes of air to be pushed from the supply point to the exhaust point	**Where allowed by a law**
Duct installation	Jet fans	Duct/jets
Air volumes ca. **100 000 m^3/h**	Air volumes **160 000 m^3/h – 240 000 m^3/h**	**10 exchanges/hour**

§ 207. The building and related facilities **shall be designed and constructed** so as to ensure, in the event of fire:

4) the possibility of **evacuating people** or rescuing them by other means;

5) the **safety of rescue teams** is taken into account.

§ 270.1 The smoke ventilation system should:

1) remove smoke with an intensity that ensures that **in the time required to evacuate people** on protected escape routes and passages, there will be no **temperature or smoke that prevents safe evacuation**,

2) have a constant supply of outside air to make up for any shortfall in that air as a result of its escape with the smoke.

OBJECTIVES FOR SMOKE VENTILATION

1. Preventing the spread of smoke and hot fire gases outside the smoke zone.
2. Ensuring the evacuation of people from the smoke zone.
3. To assist the rescue and firefighting operation through effective smoke and heat extraction.
4. Reduce property damage caused by smoke and heat.

<table>
<tr><th>Criterion</th><th>Smoke extraction ventilation
(DUCT SYSTEM)</th><th>Smoke and heat propagation control
(JET FANS SYSTEM)</th><th>Smoke clearance system
(10 EX/H)</th></tr>
<tr><td colspan="4">During evacuation</td></tr>
<tr><td>Temperature</td><td colspan="3">under the ceiling - 200 °C
at a height of 1.8m - 60 °C</td></tr>
<tr><td>Smokiness</td><td colspan="3">smoke accumulated under the storey ceiling,
at a height of ≤ 1,8 m - 0,105 g/m³
(range of visibility of self-luminous escape route signs - 10 m)</td></tr>
<tr><td>Radiation</td><td colspan="3">less than 2.5 kW/m² towards the floor</td></tr>
<tr><td colspan="4">During fire-fighting operation</td></tr>
<tr><td>Temperature</td><td colspan="3">at a height of 1.5 m less than 120 °C
at a distance of more than 15 m from the source of fire</td></tr>
<tr><td>Smokiness</td><td colspan="2">at a height of ≤ 1,5 m - 0,105 g/m³
(range of visibility of self-luminous escape route signs - 10 m)
at a distance of 15 m from the source of fire</td><td>zone can be
smoke-filled</td></tr>
<tr><td>Radiation</td><td colspan="3">up to 15 kW/m² at a distance of 5 m from the fire source on the fire access side,
5 kW/m² at a distance of up to 15m from the source of fire</td></tr>
<tr><td>Access to fire source</td><td>smoke maintained in
the layer under the ceiling
- fire source is visible
and access to it is easy</td><td>fire source can be accessed
to 15m of its location
via a smoke-free route</td><td>the whole area is smoke-filled
- the fire area should be small enough
for the fire source to be quickly
found and located</td></tr>
</table>

DESIGN SOLUTIONS
METHODOLOGY

BS 7346-7:2013 (British standard)

Components for smoke and heat control systems. Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks.


BS 7346-7:2006

BRITISH STANDARD

Components for smoke and heat control systems –

Part 7: Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks

BSi British Standards

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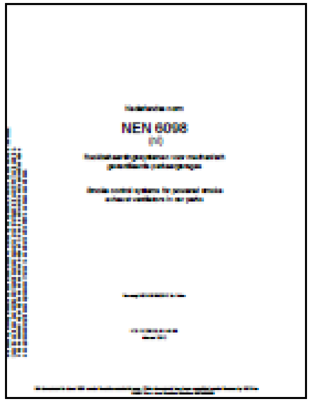
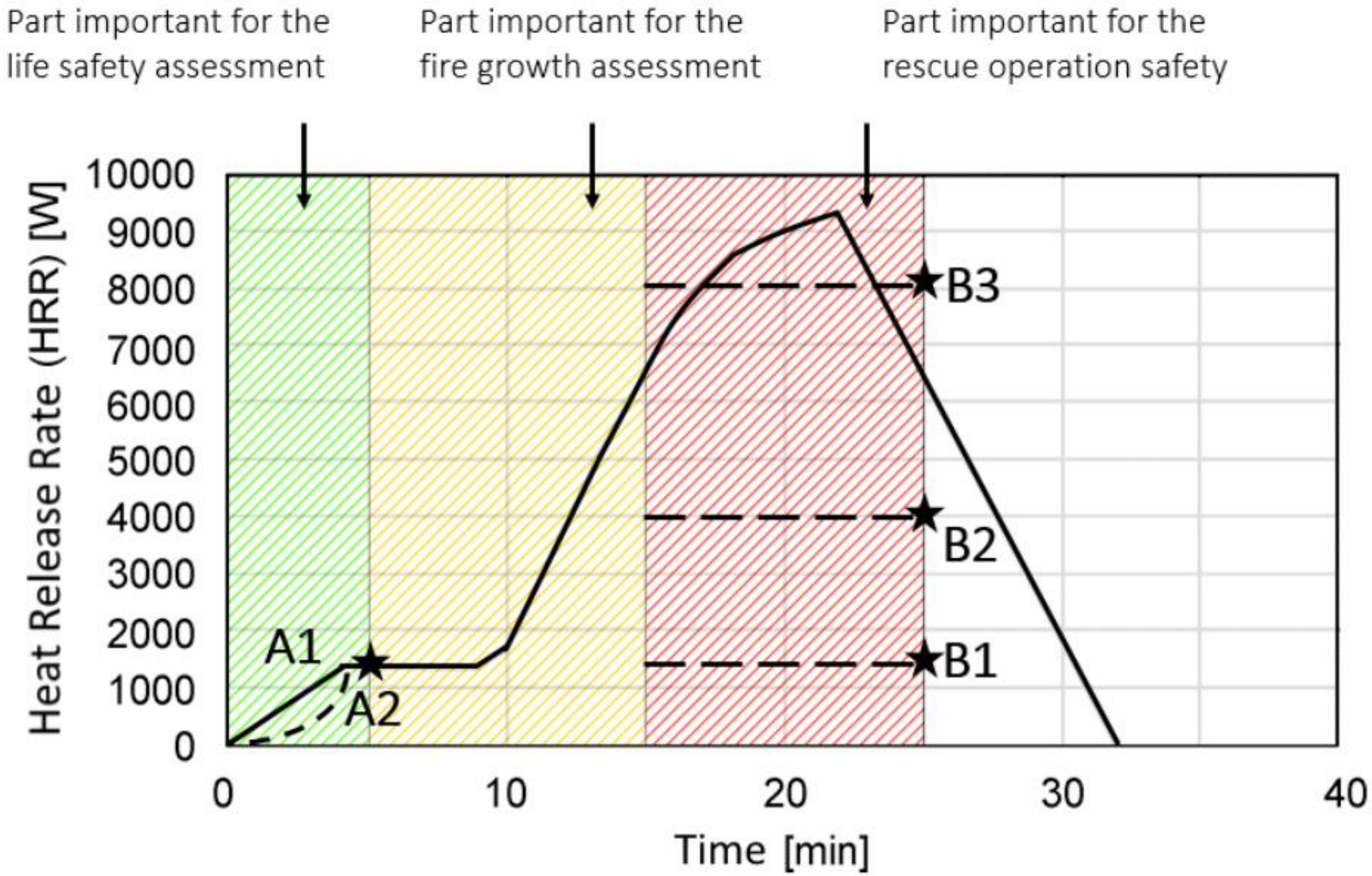

NEN 6098

(nl)

NEN 6098:2012 (Dutch standard)

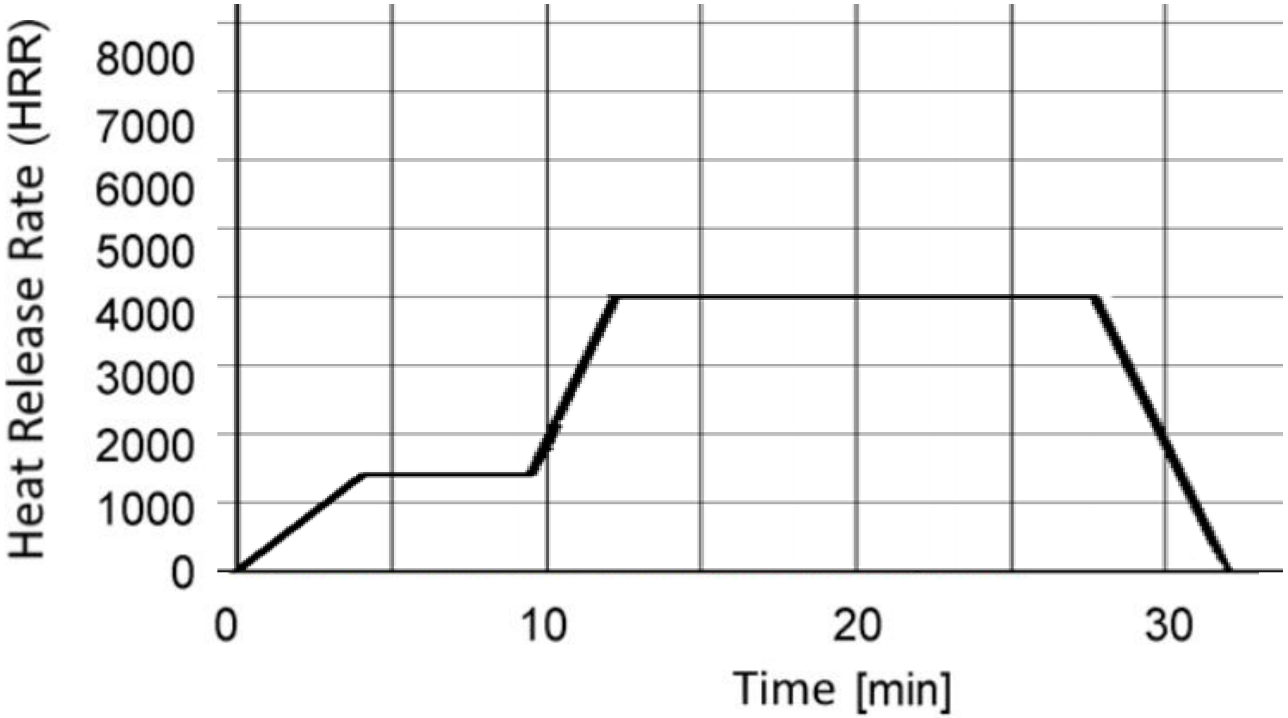
Smoke control systems in car parks.



✓garage not equipped with sprinkler system;

✓three-car fire (source of fire is one car);

✓maximum fire power 9.4 MW;



✓garage equipped with sprinkler system;

✓one-car fire;

✓maximum fire power 4 MW;

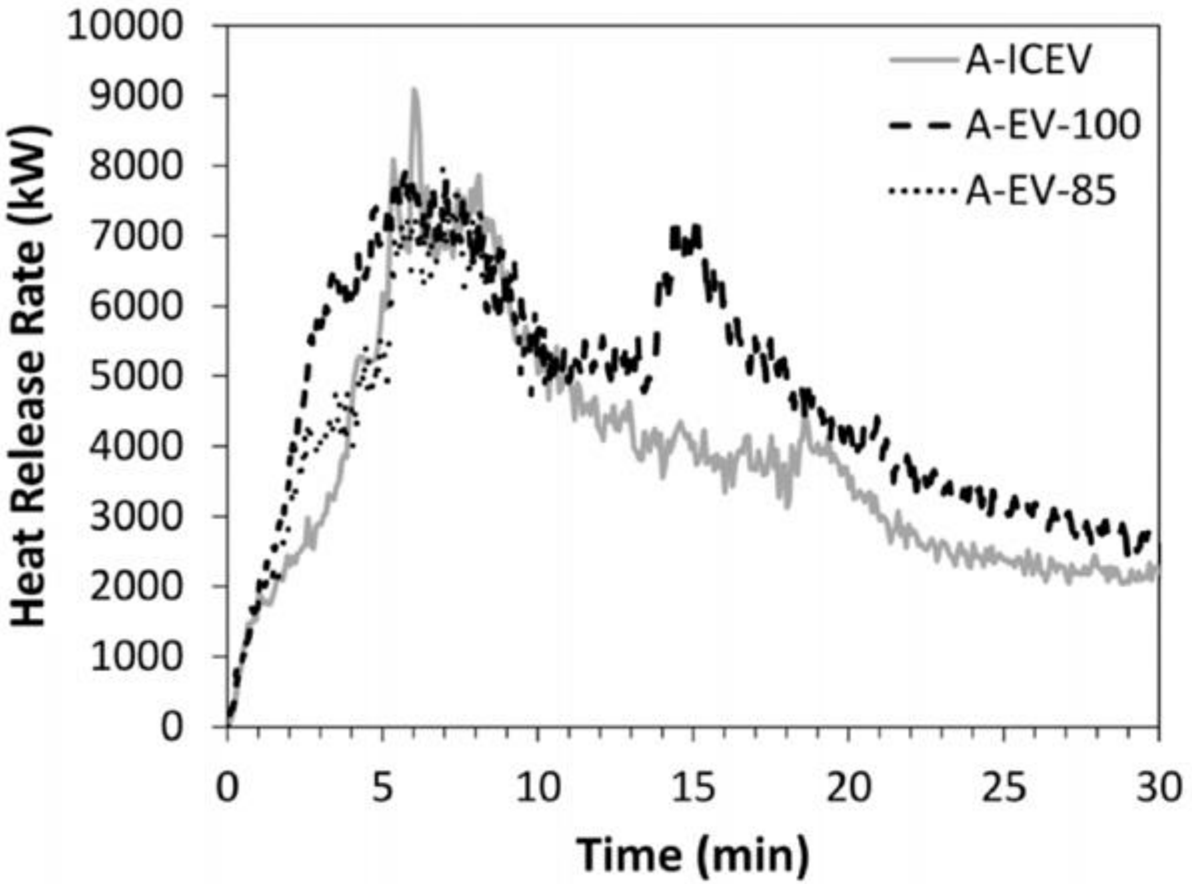


Figure 5: HRR for ICEV and EV fire tests (including a 2MW burner contribution) [source: ARUP]

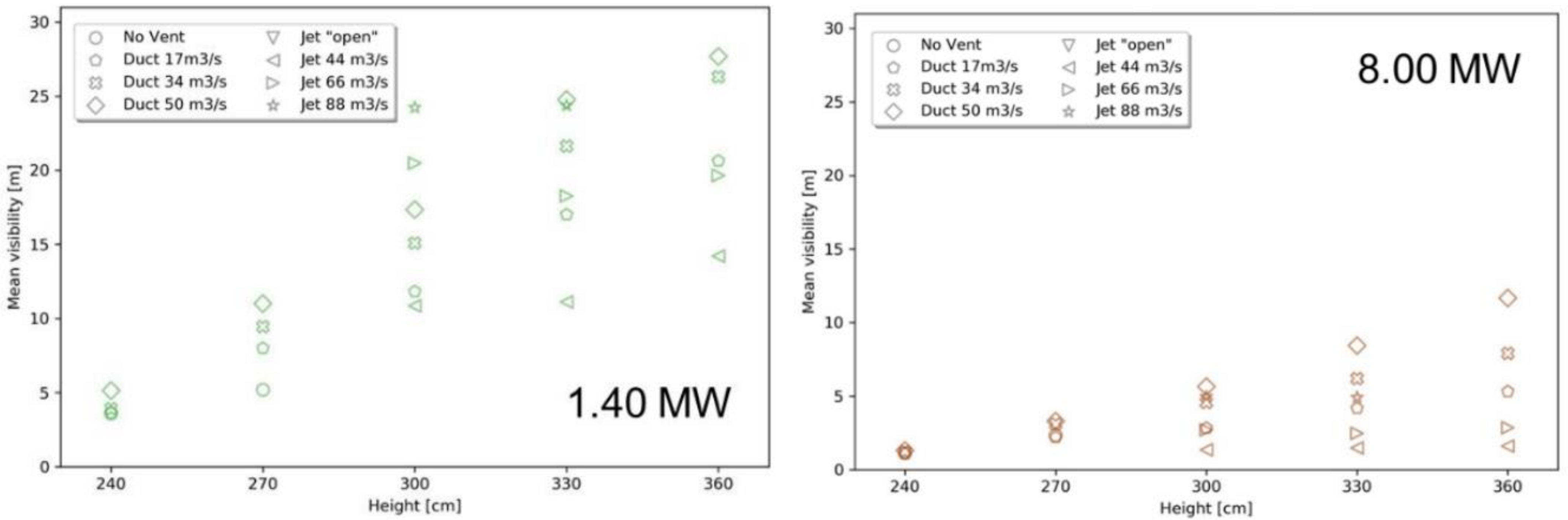


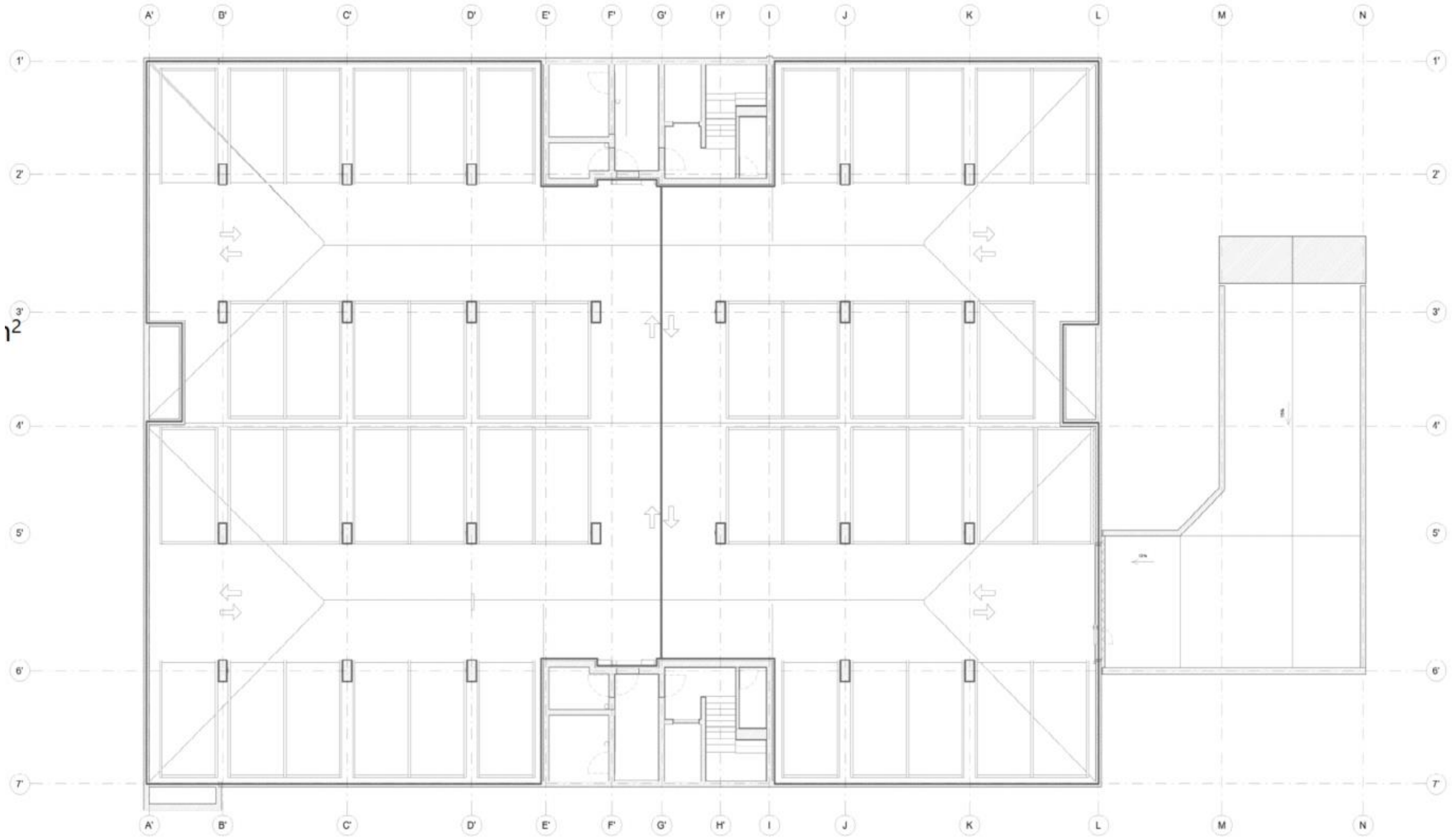
Figure 5. Mean visibility in smoke at the height of 1.80 m after 450 seconds of analysis for fires B1 (1.40 MW) and B3 (8.00 MW) for all tested systems and heights

Source: Multiparametric CFD to analyze the key variables in car park smoke control, Wojciech Węgrzyński, Building Research Institute (ITB)

CASE STUDY **LAYOUT**

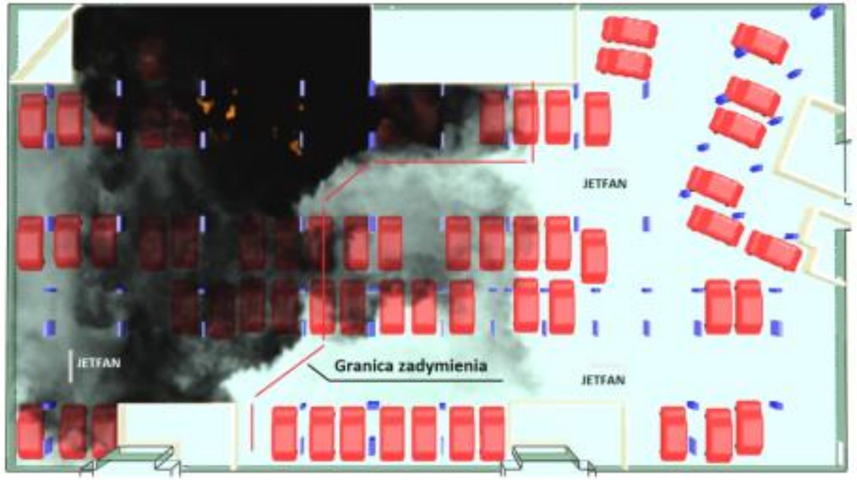
Area: 1600 m^2

System: reversible, jet fan

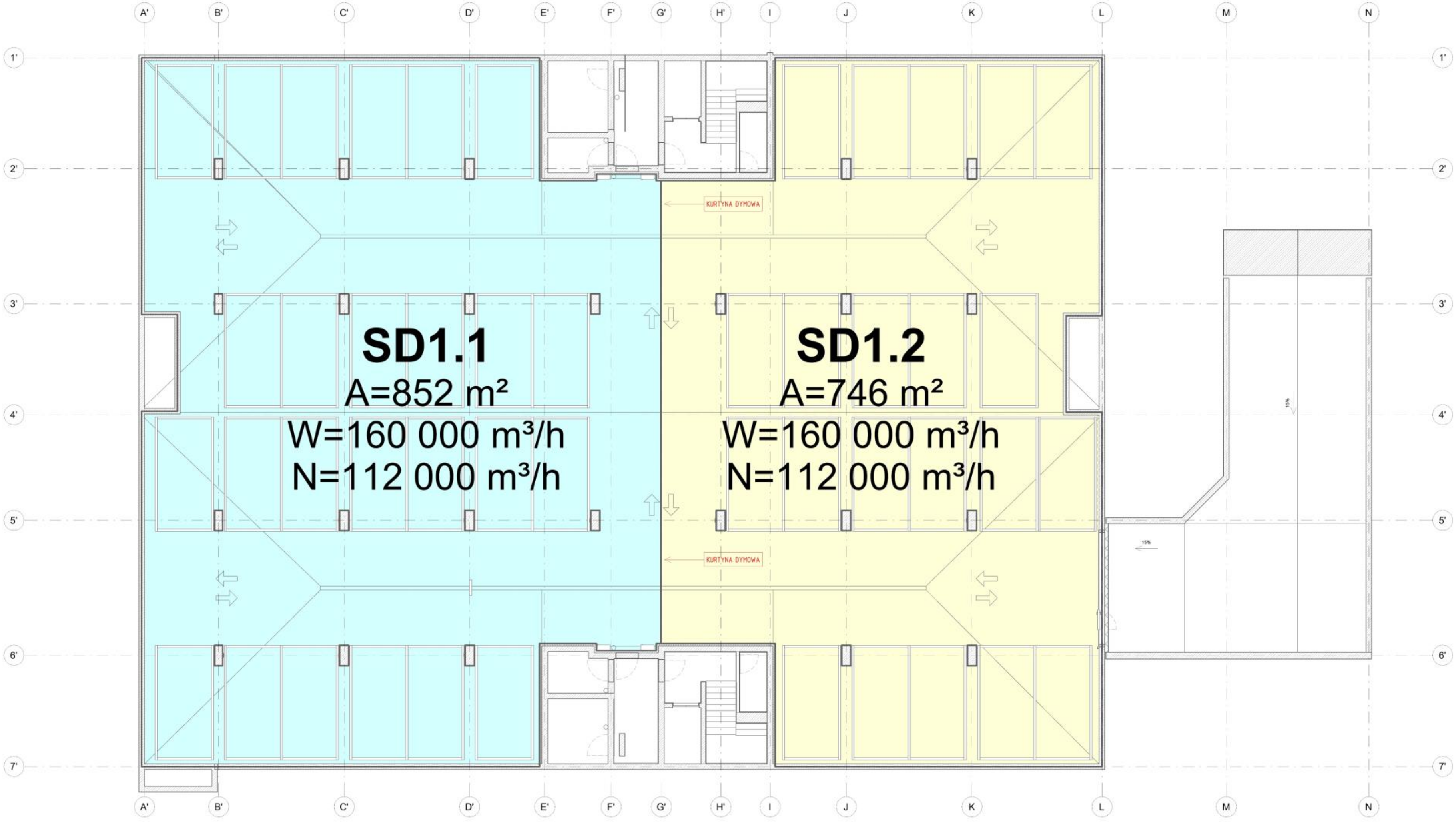


CASE STUDY
LAYOUT

1. All evacuating persons from the fire zone should be able to move in the smoke and heat free part of the garage for the time needed to evacuate them.
2. The smoke extraction system of the garage should maintain the smoke in one smoke zone where the fire has occurred.
3. The smoke zones should be arranged in such a way as to take maximum advantage of the architectural and geometrical shape of the car park.



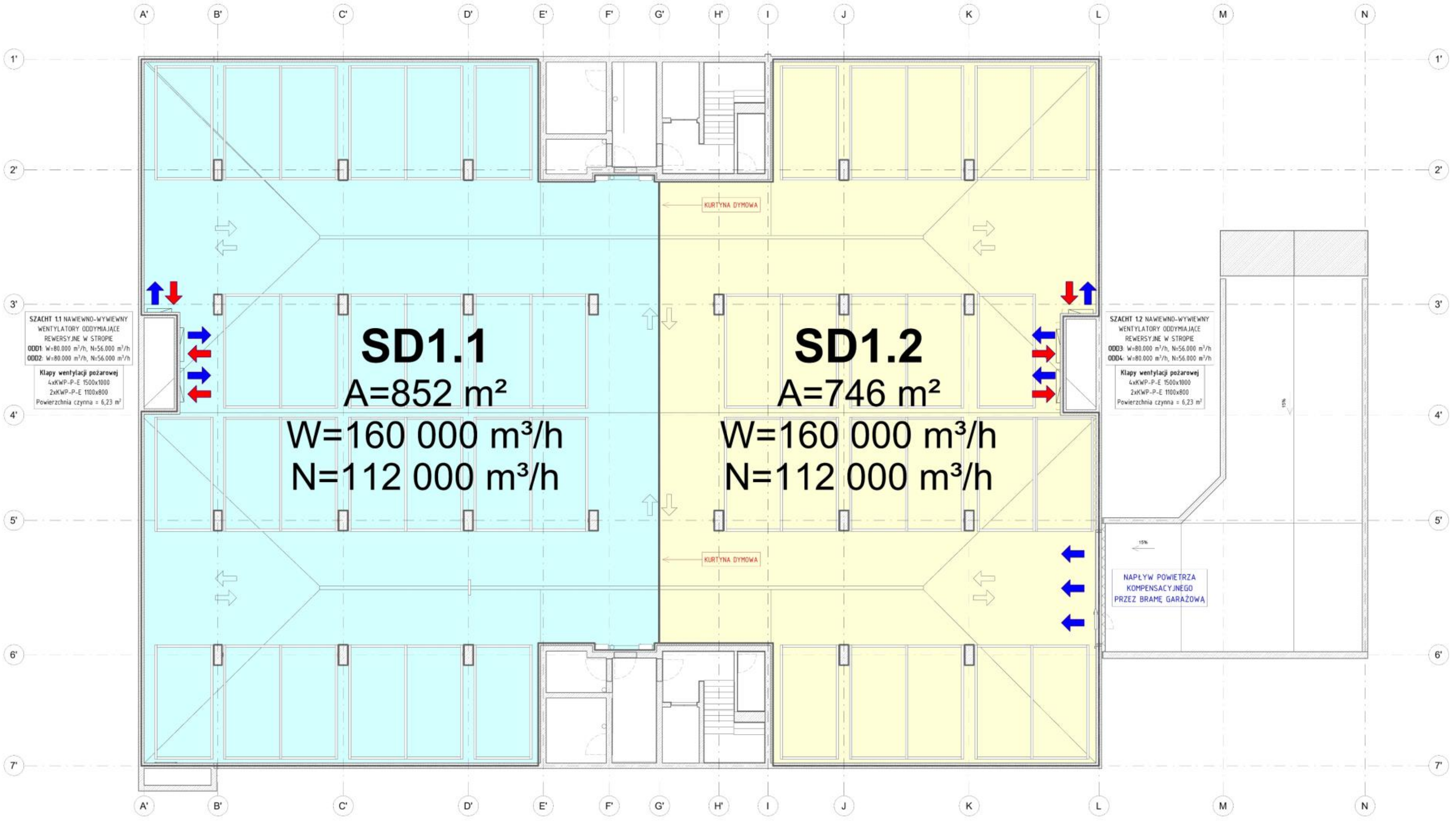
CASE STUDY
SMOKE ZONES



CASE STUDY
SMOKE ZONES

1. Each smoke zone should be served by at least 2 smoke extraction fans with a class of not less than F400 120 min.
2. Capacity in the range of 160,000 m³/h - 240,000 m³/h – to be confirmed by CFD simulation.`

CASE STUDY
SHAFTS

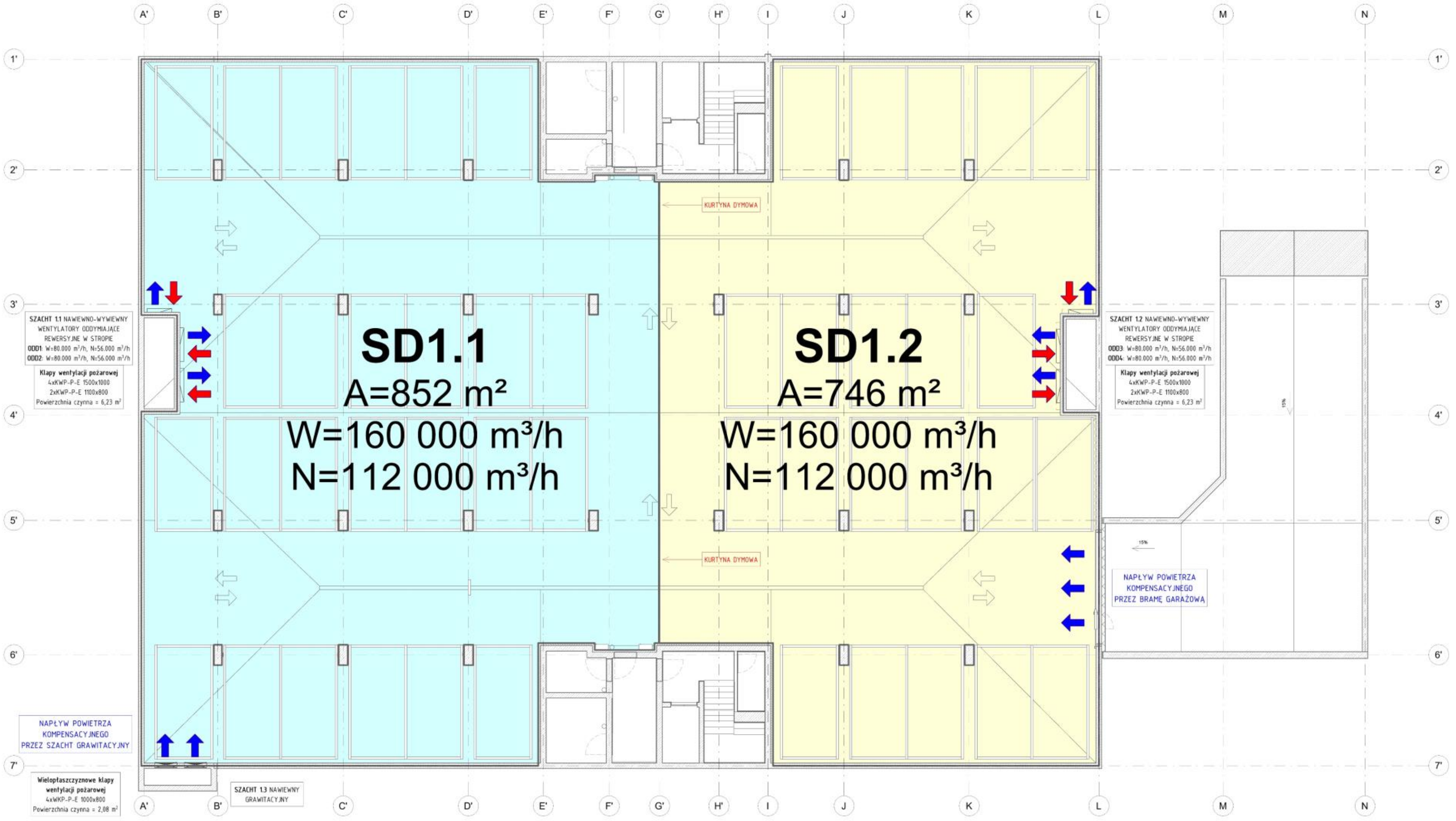


CASE STUDY
SHAFTS

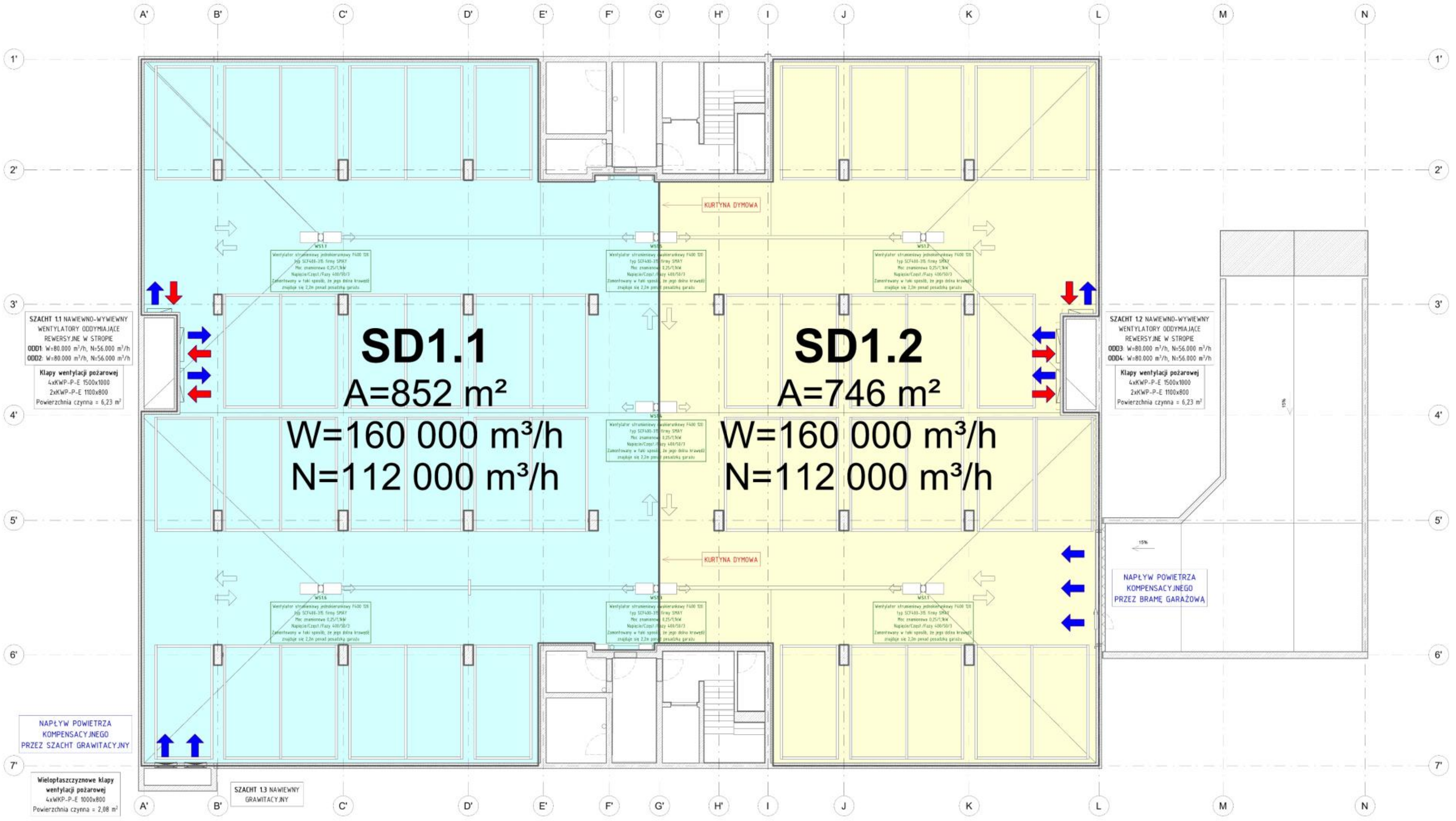
1. It is recommended that the total amount of air supplied to the garage by mechanical means should not exceed 80% of the amount of air removed from the garage.
2. The remaining missing air volume should be supplied to the garage by passive means.
3. In garages where the exit leads directly to the outside of the building, the recommended source of compensation air is open external gates. There should be no extraction points in the area around the gate which is a source of compensation air.
4. There should be a slight negative pressure in the garage during system operation, but the maximum force on the escape door (100 N), should not be exceeded.

CASE STUDY

ADDITIONAL SUPPLY



CASE STUDY
JET FANS



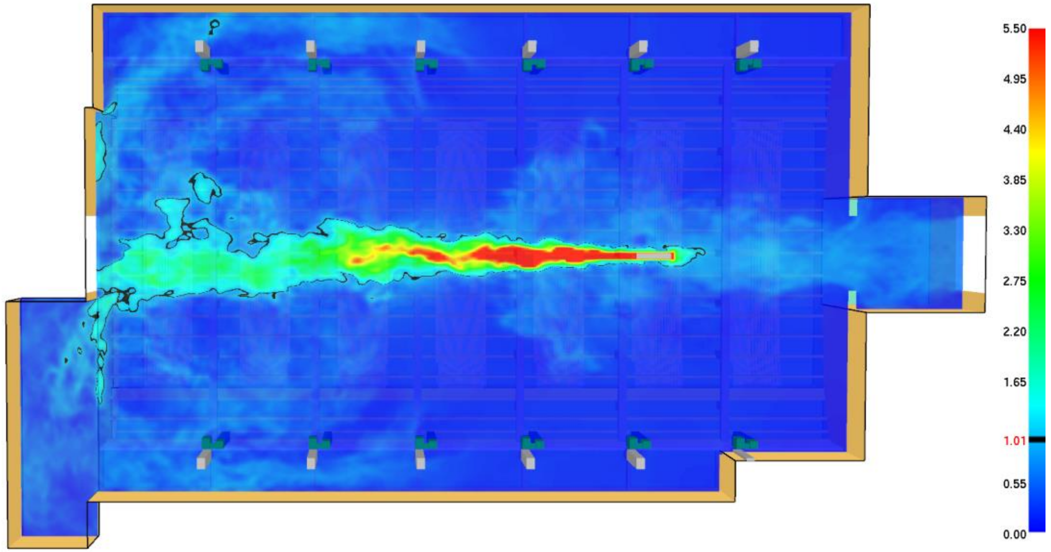
CASE STUDY
JET FANS

1. Jet fans should be distributed evenly throughout the garage space.
2. It is recommended not to locate jet fans above parking spaces.
3. Jet fans must not blow air into any escape doors, thereby obstructing their opening.
4. Jet fans shall be activated with an appropriate delay based on anticipated safe evacuation conditions.
5. Sprinkler heads should not be mounted in the axis of the stream generated by the jet fans.

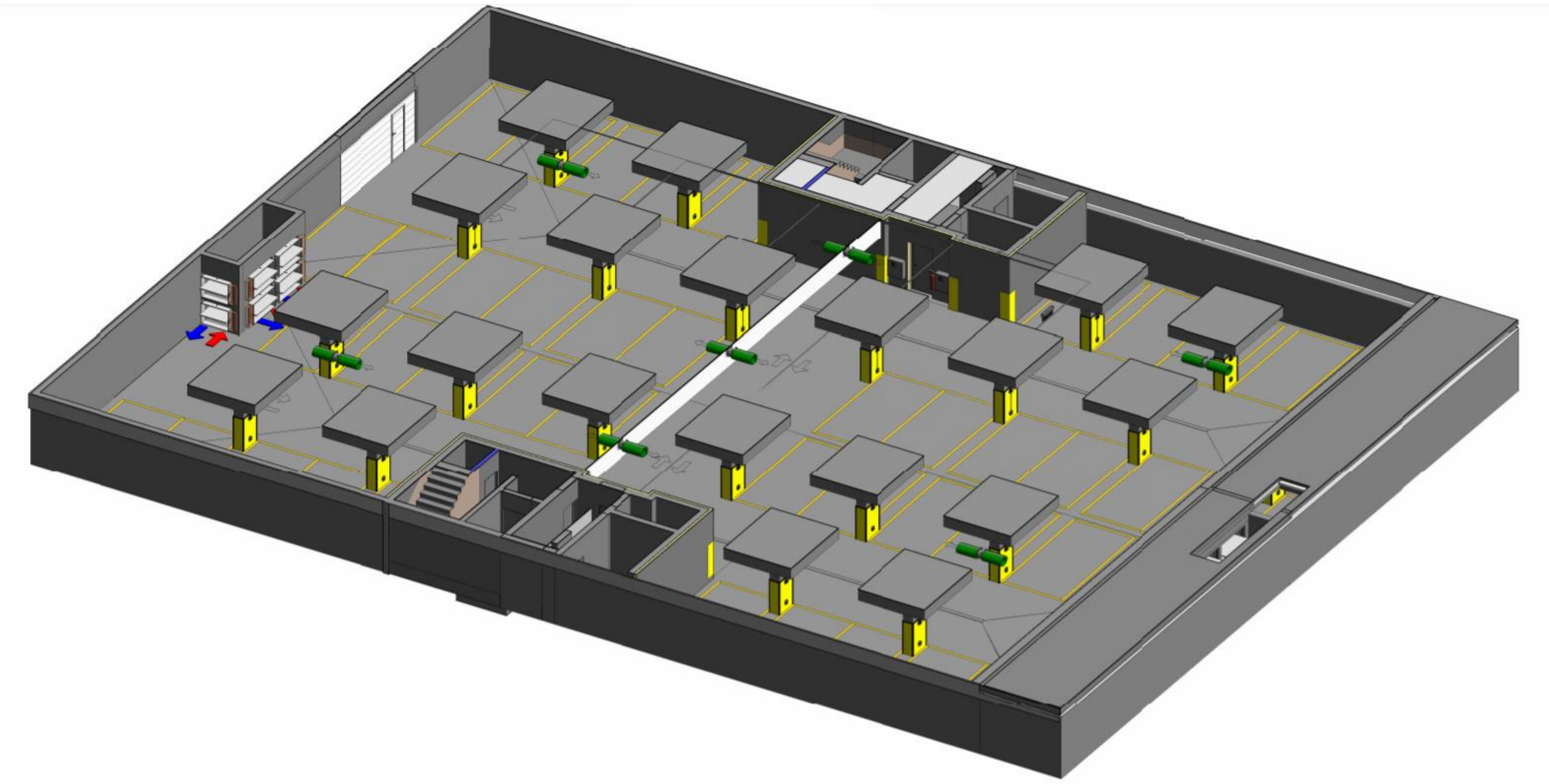
CASE STUDY
JET FANS

The selection and distribution of jet fans must ensure:

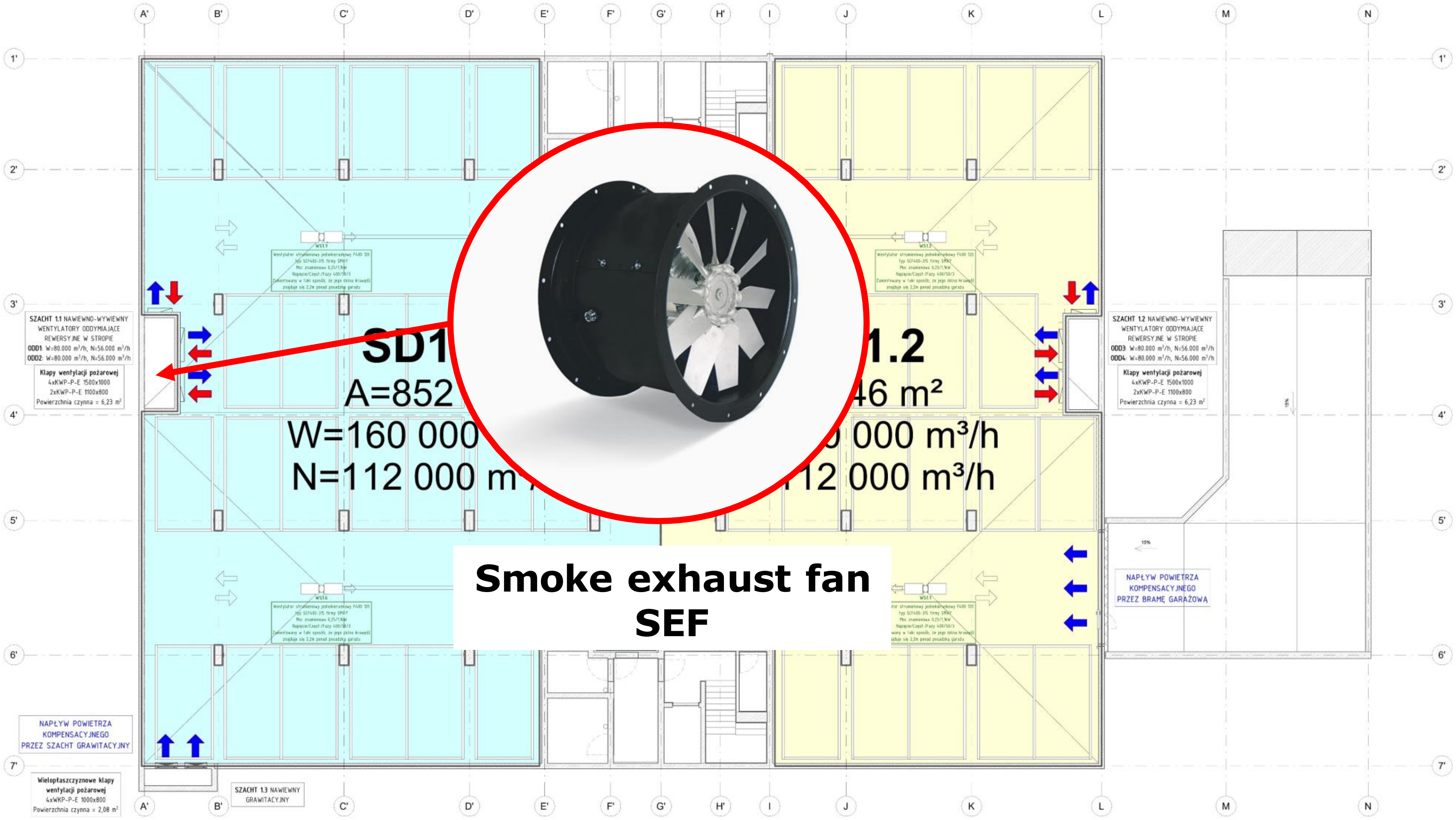
- ✓ stopping the spread of smoke in the direction of the inflow of compensating fresh air
- ✓ an even velocity distribution in the garage space from supply to extract air shafts.
- ✓ sufficiently turbulent air movement to reduce the temperature of the fire gases as close as possible to the fire.



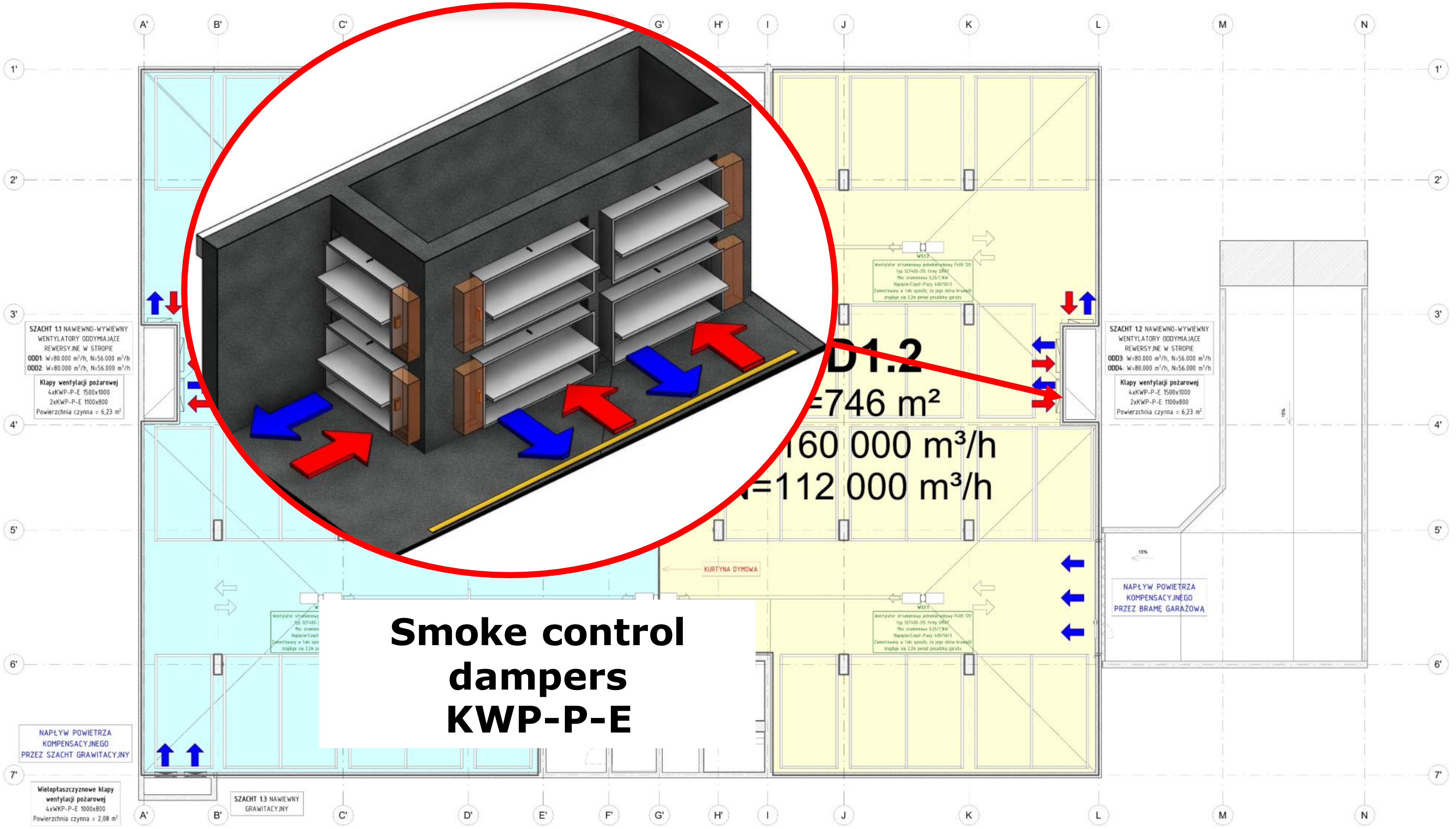
CASE STUDY
MODEL



CASE STUDY
EQUIPMENT



CASE STUDY
EQUIPMENT

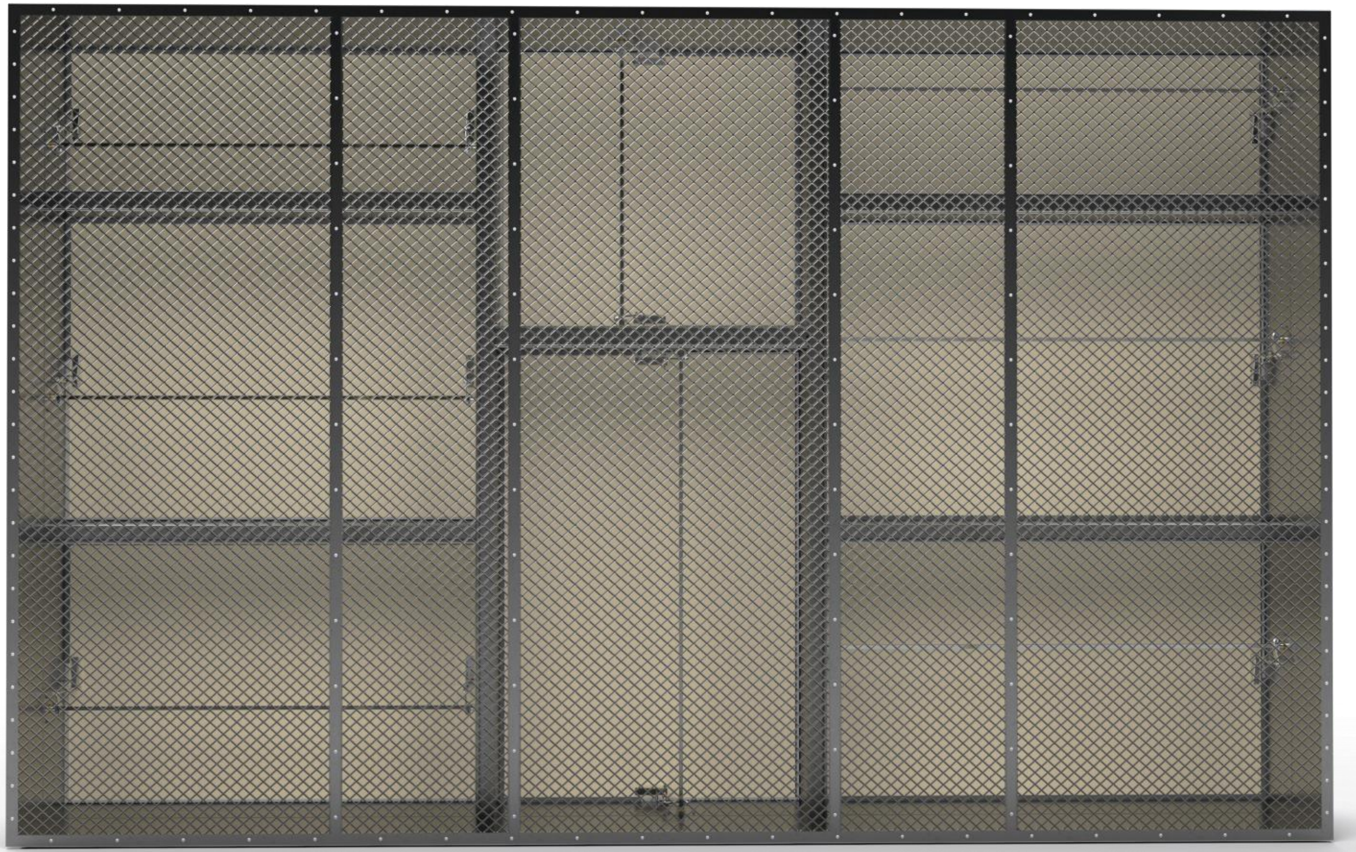


Smoke control dampers KWP-P-E

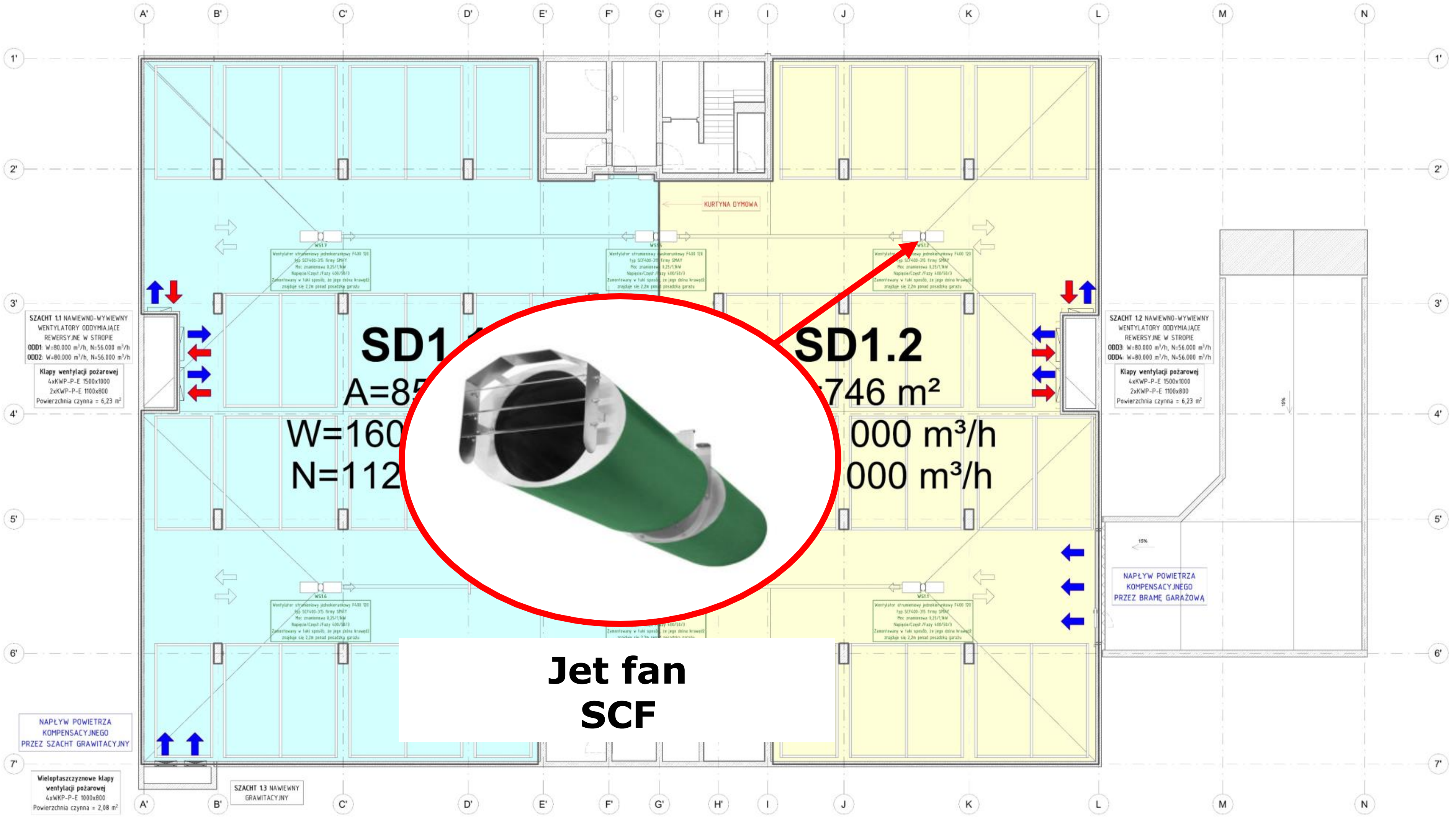
CASE STUDY
EQUIPMENT

Batteries of smoke control dampers KWP-P-E

UP TO 10 m²

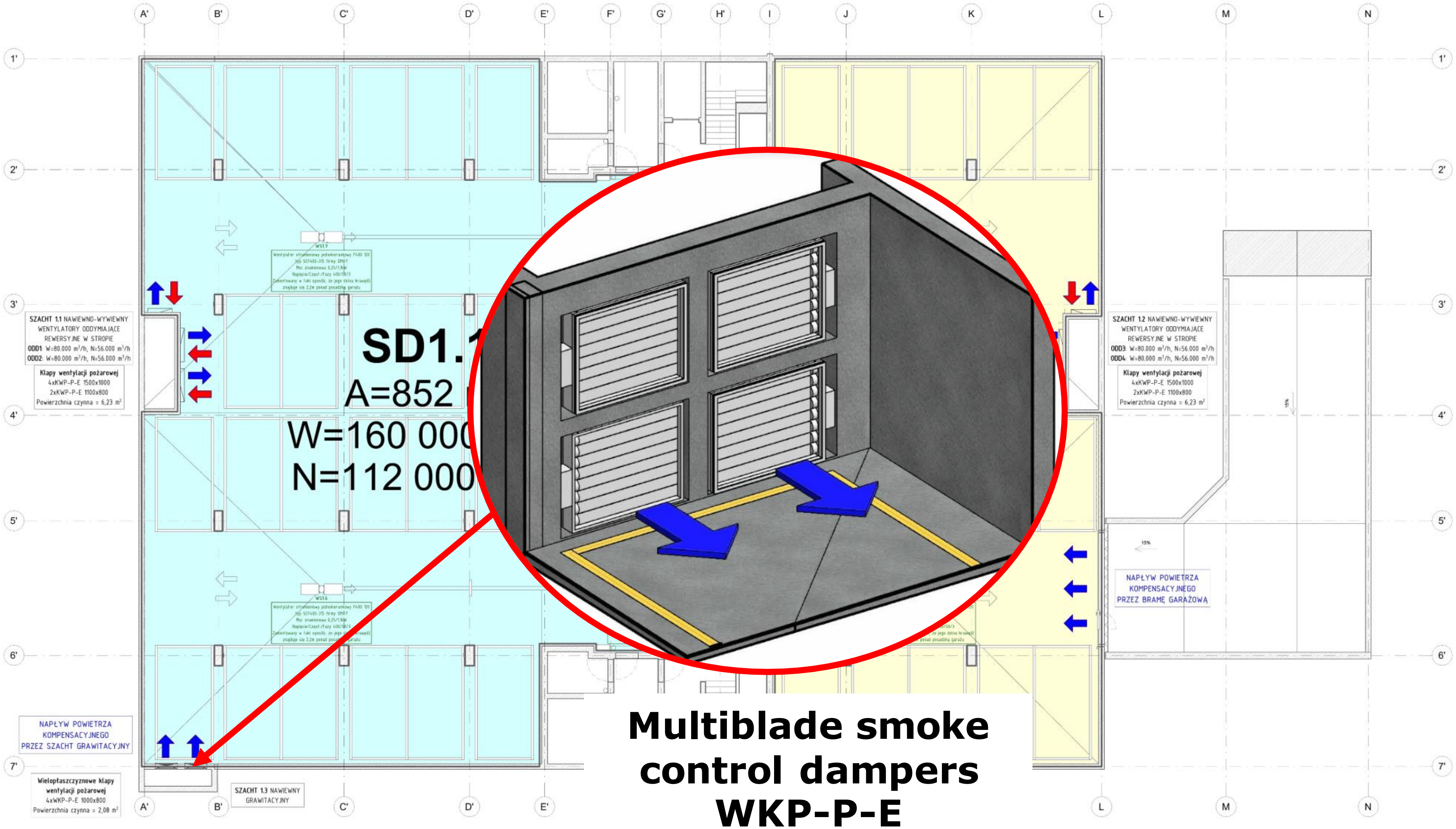


CASE STUDY
EQUIPMENT



Jet fan
SCF

CASE STUDY
EQUIPMENT



Multiblade smoke control dampers WKP-P-E

CASE STUDY
EQUIPMENT

View of the garage with CO/LPG sensors and warning signs

CASE STUDY
EQUIPMENT

ZUP
power supply for fire devices

Features:

- meets EN 12101-10 requirements
- ready for operation with fire control panels meeting requirements of EN12101-9 and others
- fire control panel CSUP can be installed inside ZUP
- supply power lines can be monitored
- optical status signalling
- IP54, made for class III enviroment

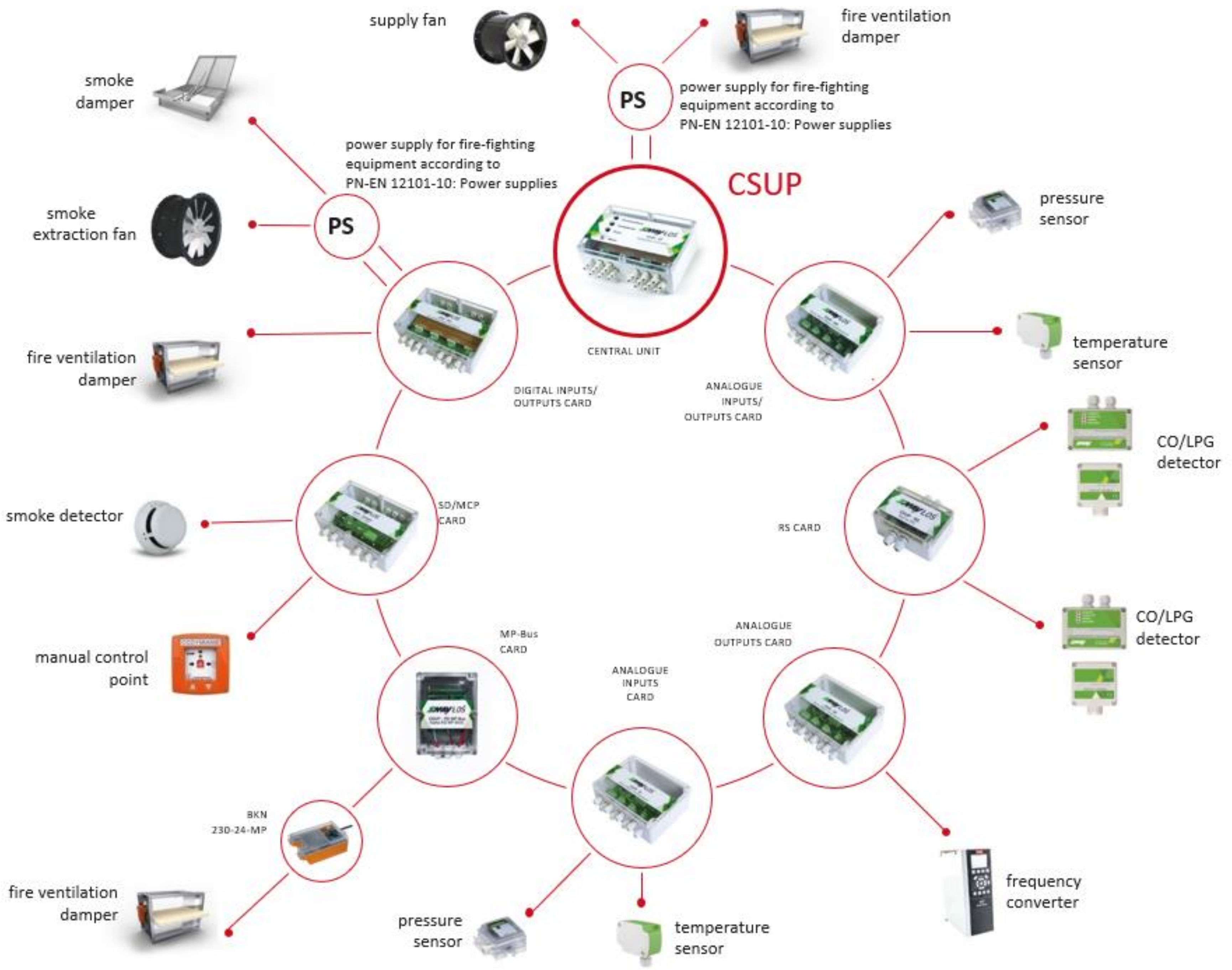
CASE STUDY
EQUIPMENT

CSUP
control panel for fire devices

Features:

- meets prEN 12101-9 requirements
- spread, module architecture, up to 64 modules in one communication bus, 2-directions loop communication
- ready for BACnet, IP and Modbus protocols
- analog and digital controlling
- optical status signalling
- IP54, made for class III enviroment

CASE STUDY
EQUIPMENT



Ευχαριστώ πολύ!

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