NEW

Underground Parking Lots Smoke Extract Ventilation System

THRUVENT™ System

환기연구소 Ventilation Institute of Korea

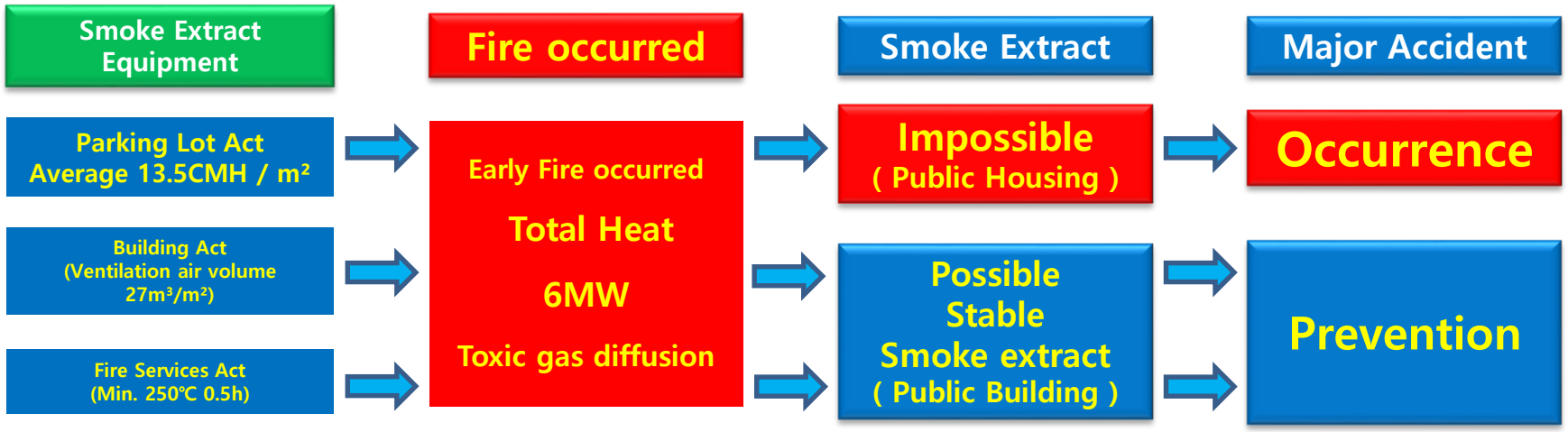
Ventopia

VIKorea Ventilation Institute of Korea

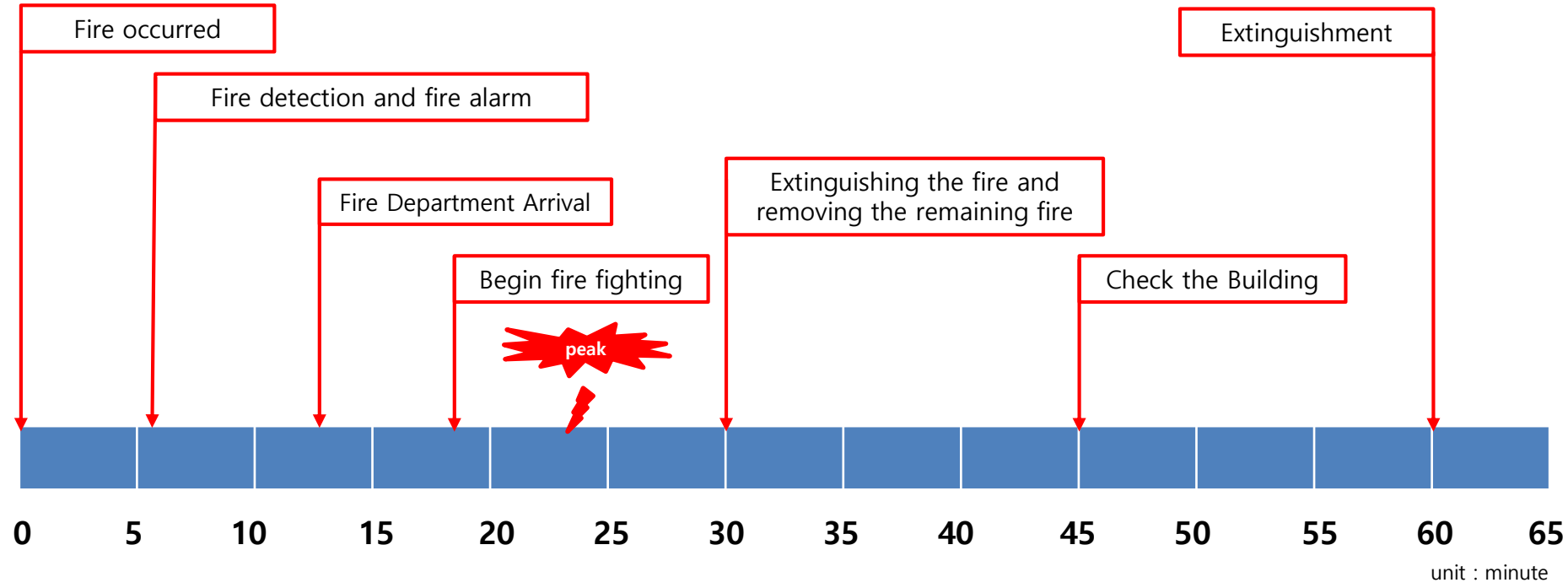
Contents

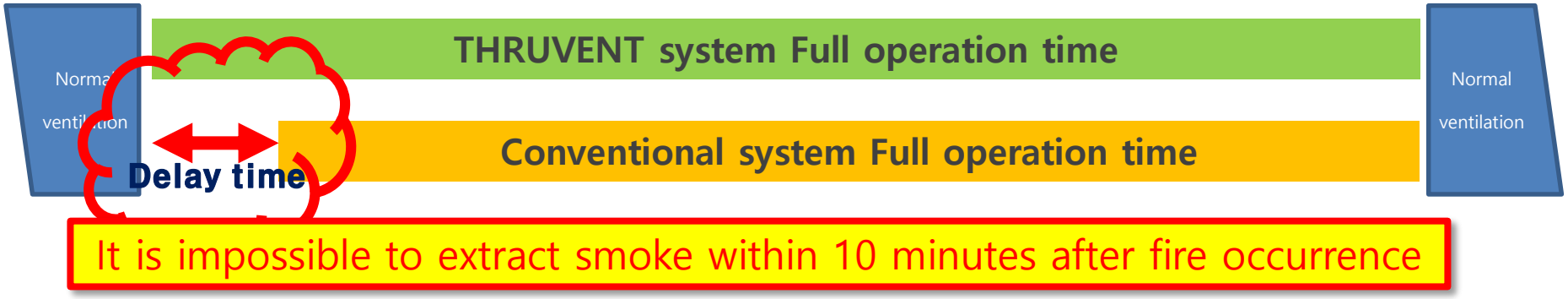
Law for Underground Parking Lot
Smoke Extract Ventilation Equipment

Description	Korean mandatory	Overseas mandatory					
		Country	Standard		Ventilation	Smoke Extract	Heat Resistance
Air Volume For Ventilation And Smoke Extract	Building Act / Equipment Standard [Publics Buildings] For Parking Lots over 2000m² : 27m³/h per area [Publics Housing] No legal standards / but must comply with building Act Parking Lot Act / Air Quality Standard [Publics Building] Carbon monoxide (CO) concentration kept below 25ppm [Publics Housing] Carbon monoxide (CO) concentration kept below 50ppm The technical standards to the Rule / smoke control system To install the smoke control system likely to be a target of HVAC system of the usual air conditioning functions and the criteria on the smoke control systems facilities immediately automatically fire. Smoke control function can be converted smoke control systems in HVAC system by the inspector indicates that if you can.	UK	BS7346-7:2006	ADF (ventilation) ADB (smoke Extract)	6ACH	10ACH	300℃ / 1h
		Saudi Arabia	Civil Defense		6ACH	15ACH	300℃ / 2.0h
		Australia New Zealand	AS/NZS 1668	Part1 (ventilation)	calculation	Ventilation air volume	200℃ / 2.0h
				Part3 (smoke extract)			300℃ / 0.5h
		Singapore	Green Building Design Guide CP 13:1999		CO 25ppm	9ACH	250℃ / 2.0h
		China	GB 50067-2014		CO 25ppm	6ACH	280℃ / 0.5h
		Malaysia	Uniform Building By-Law		8ACH	12ACH	300℃ / 2.0h
		Philippines	National Building Code		6ACH	9ACH	150℃ / 2.0h
		India	National Building Code		6ACH	12ACH	300℃ / 2.0h
		USA	**National Fire Code**	**NFPA 88 A**	-	**18CMH / m²**	-
			ANSI/ASHRAE	**Standard 62.1**	**13.5CMH / m²**	-	-
Heat Resistance	0.5h at 250℃ for Smoke Extract Equipment	EN 121001					



Current Status
during fire occurrence in an underground parking lot

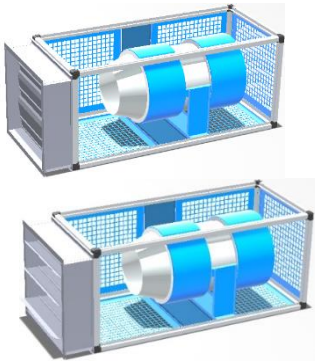


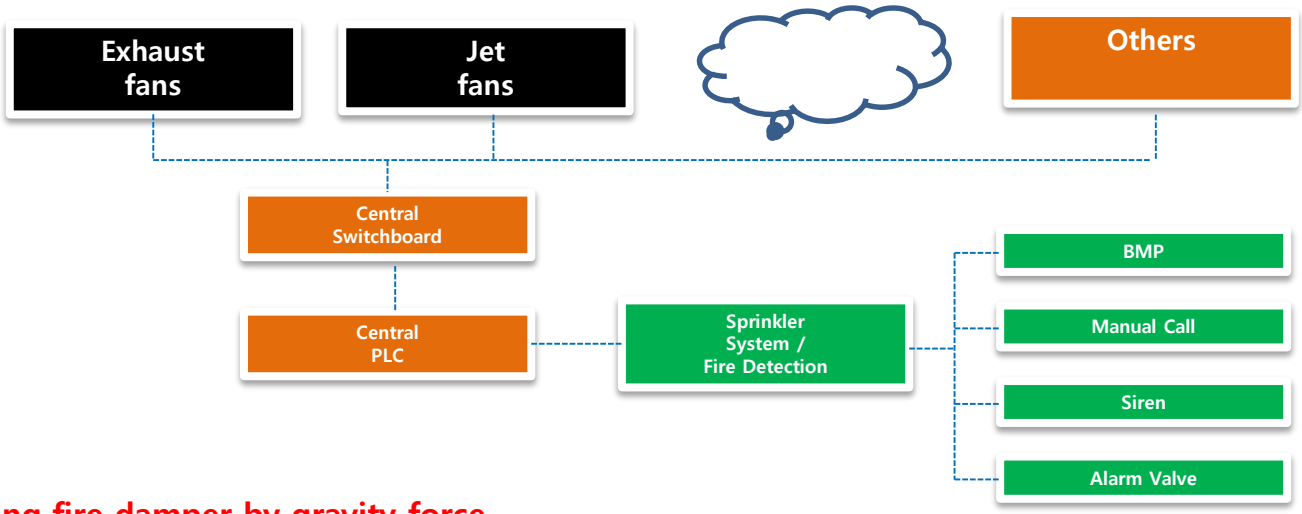


It is impossible to extract smoke within 10 minutes after fire occurrence

Technique to eliminate the time delay factor of Smoke Extract ventilation Equipment

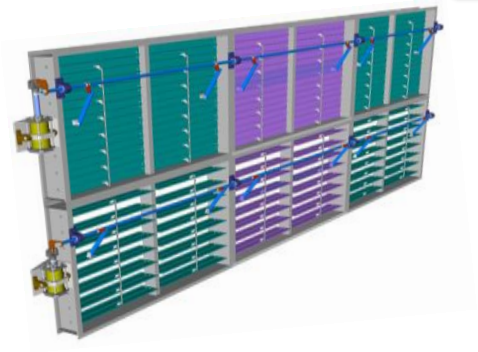
THRUVENT™

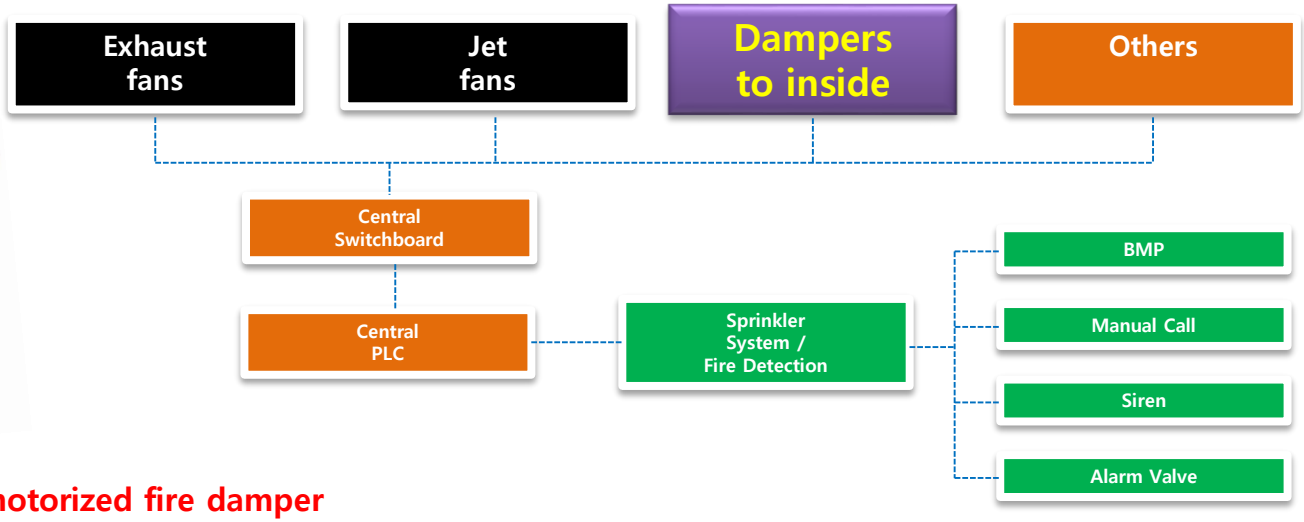




Self-opening and closing fire damper by gravity force
(Exclusion of sources of delayed smoke extract)

Conventional Equipment

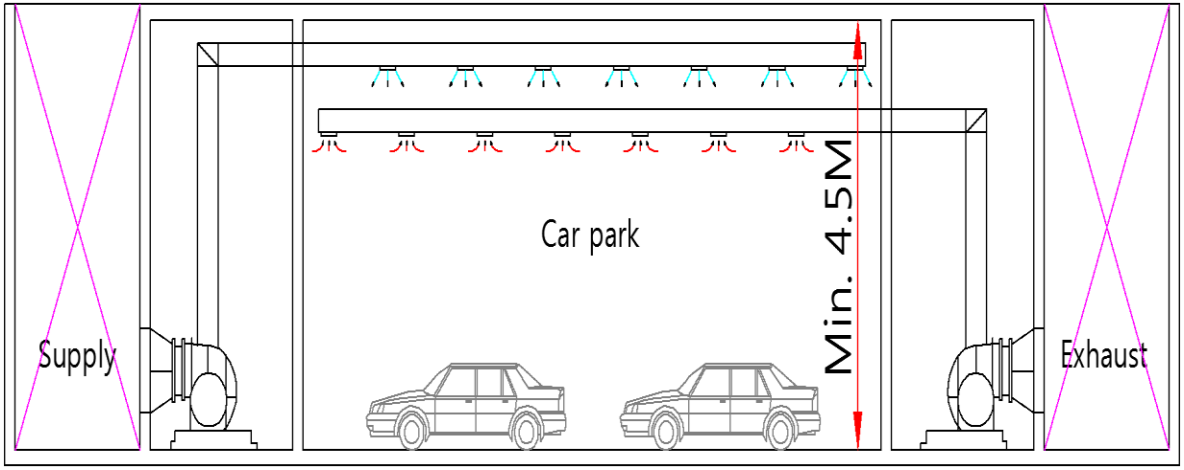




Opening and Closing by motorized fire damper
(Main cause of delayed smoke extract)

Current Status
CASE - 1

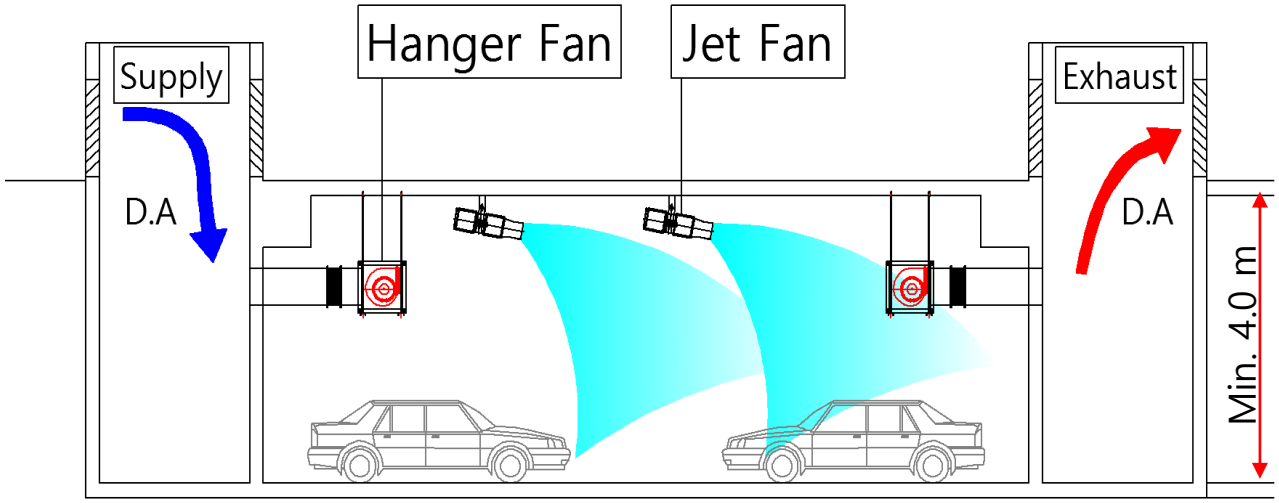
1. SIROCCO FAN type



Description	Comment	Problem
Smoke Extract (Time delay)	Fire Damper, Back Draft Damper installed separately	**Time delay occurred**
Fire damper	Separate operation	**Main cause of Time delay**
Fan room installation	Large space requirement	Construction cost increases
Noise level	**Lousy noise**	Independent silencer is required
Power consumption	Enormous power consumption	Overuse of energy
Maintenance	Indirect drive method and Complex	Periodic management required
Static pressure	Stable	

Current Status
CASE- 2

2. Wall hung FAN type

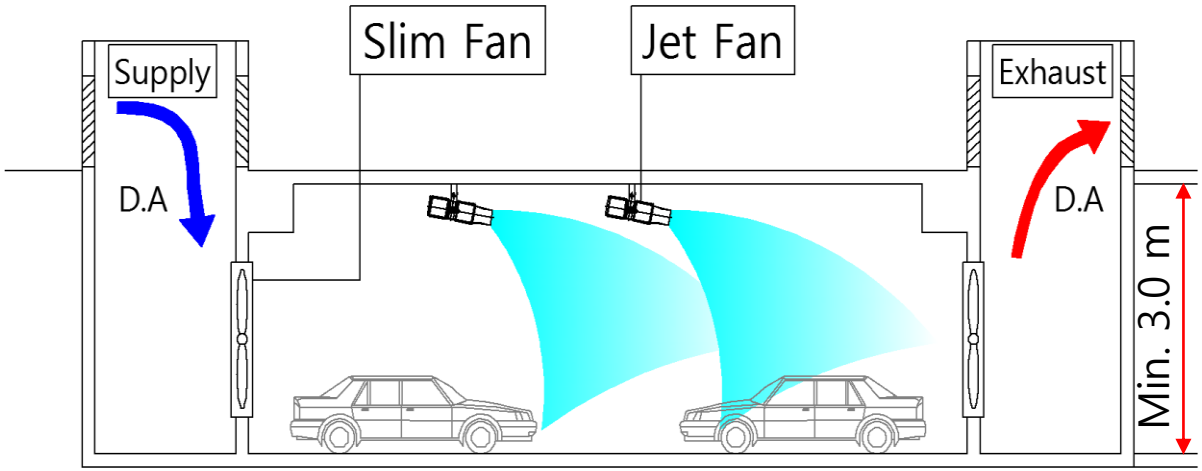


Axial Fan

Description	Comment	Problem
Smoke Extract (Time delay)	Fire Damper, Back Draft Damper installed separately	**Time delay occurred**
Fan room installation	Not essential	Limited air volume & installation
Variable air volume	No adjustable air volume	Addition of inverter construction
Power consumption	Enormous power consumption	Overuse of energy
Noise level	**Roaring noise**	Back & Forth silencer is required
Maintenance	Indirect drive method and Complex	Periodic management required
Static pressure	Stable	

Current Status
CASE - 3

3. Wall FAN type



Description	Comment	Problem
Smoke Extract (Time delay)	Fire Damper, Back Draft Damper installed separately	**Impossible**
Fan room installation	Not essential	Low resistance to fire
Variable air volume	No adjustable air volume	Inverter construction extension
Power consumption	Enormous power consumption	Overuse of energy
Noise level	Low noise	Silencer not required
Maintenance	Indirect drive method and Complex	Periodic management required
Static pressure	**Low**	Smoke extract is infeasible

Advanced Smoke Extract System

- THRUVENT™ SYSTEM -

Existing Problems

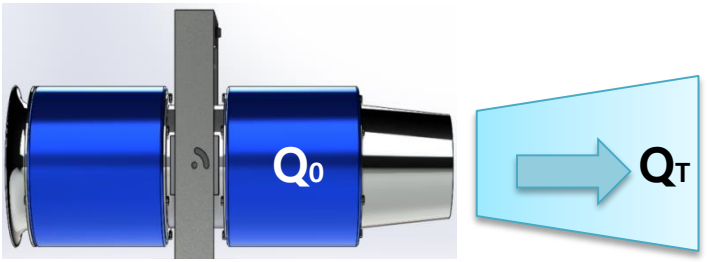
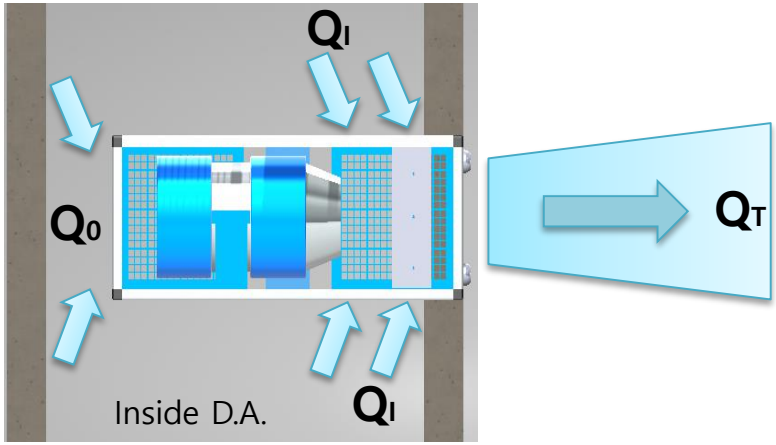
- Fire occurrence
  : Time delay occurs
- Normal
  : Poor ventilation
- Lack of parking lot
  : One more parking
- Operating big fan
  : overuse of energy
- Operating big fan
  : Excessive noise

Improvement Effect

- Time delay zero
  Ensure stable smoke extract
- Maintain comfortable indoor air quality without particular dust
- Fanroomless
  Can deliver more parking space
- Energy savings of more than 80%
  (saving on building maintenance costs)
- More comfortable indoor sound

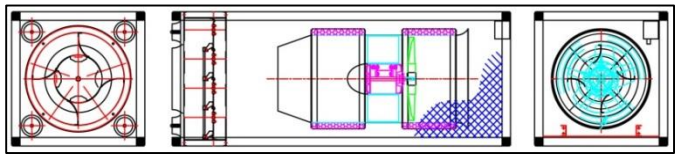
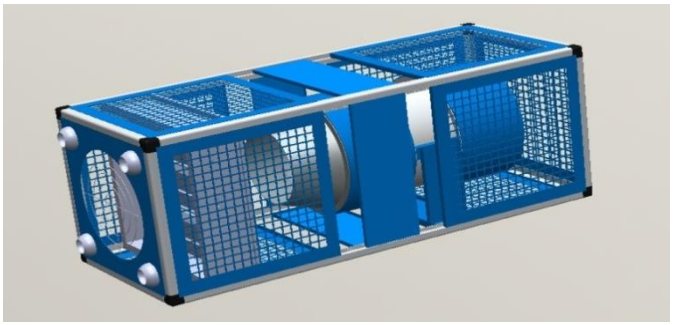
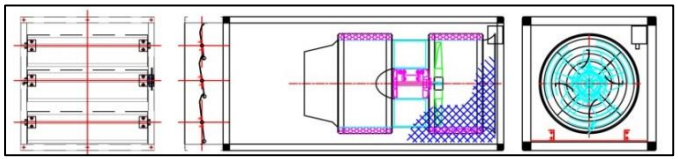
Energy Saving Principles
- THRUVENT™ SYSTEM -

The same principles as applied by UK Dyson, applied in our system since 2001

Air volume in free space	Air volume when installed inside shaft
	
4,000 CMH (Q_0)	5,500 CMH (Q_T)
100% (0.43kW)	137% (0.43kW)
$Q_0 = Q_T$	$Q_0 + Q_I = Q_T$

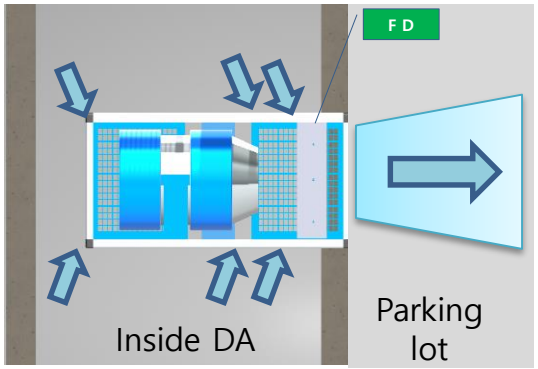
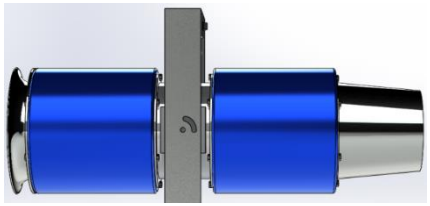
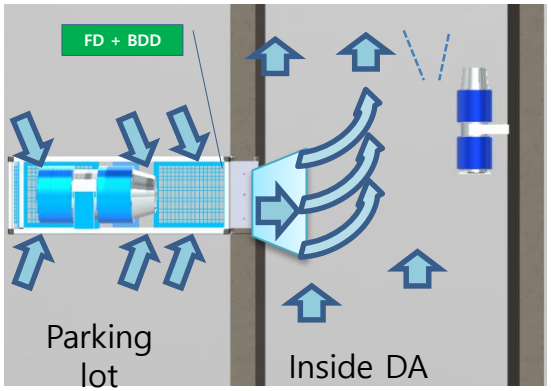
World Standards
- THRUVENT™ SYSTEM -

THRUVENT™ fan Globalization / Standardization / Modularization

Description	Supply air fan	Exhaust air fan
Dimension 630 * 630 * 1600(L) Globalization Standardization Modularization	 	 
Feature	1. Modularization : 630*630*1600mm 2. Standardization : EN12101-3 F300 class (300℃, 2h) 3. Static pressure : over 20mmAq 4. FD integrated type : opening and closing by non-power 5. Minimal fan power consumption : under 0.5kW	1. Modularization : 630*630*1600mm 2. Standardization : EN12101-3 F300 class (300℃, 2h) 3. Static pressure : over 20mmAq 4. FD, BDD integrated type : opening and closing by non-power 5. Minimal fan power consumption : under 0.5kW

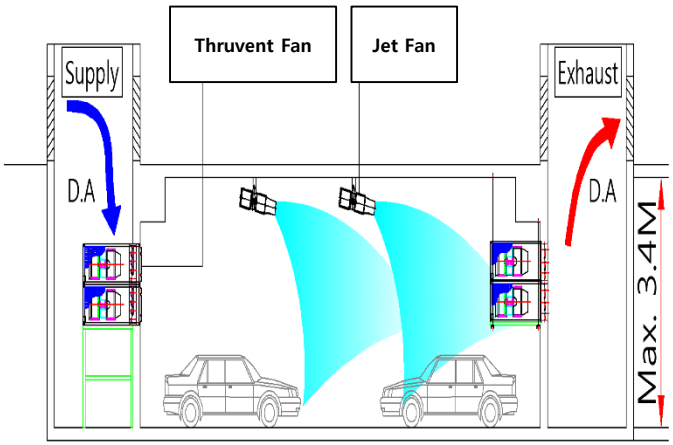
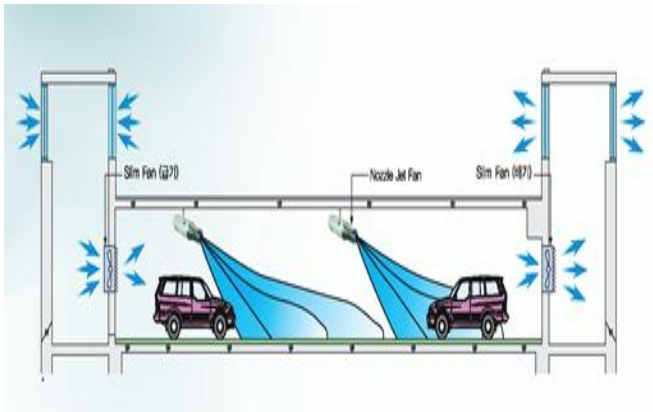
Simple, Dynamic, and Powerful Smoke Extract System
- THRUVENT™ SYSTEM -

THRUVENT™ system configuration

Supply air fan	Turbo jet fan	Exhaust fan
		
To fulfill the demand of air supply in underground parking lot	Captivate and dilute contaminated air in the underground parking lot with a powerful thrust	Extracted contaminated air in the parking lot quickly outside by static pressure regain technology

Underground Parking Lot Smoke Extract System
- THRUVENT™ SYSTEM -

System comparison

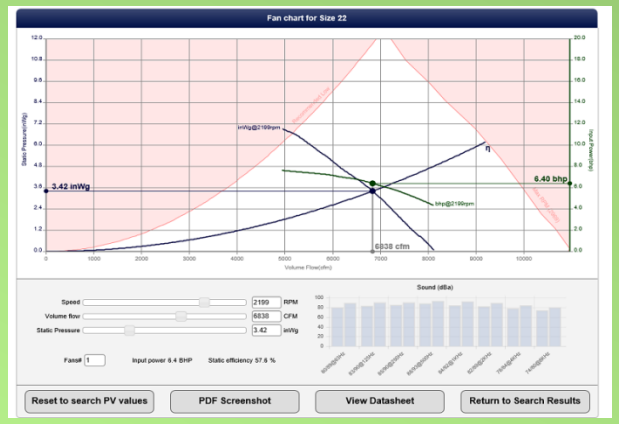
Description	Comment	
Type	Wall hung type, Axial fan + Jet fan	Wall type, Propeller fan + Jet fan
Image		
Feature	1. Modularization : 630*630*1600mm 2. Standardization : EN12101-3 F300 class (300℃, 2h) 3. Static pressure : over 20mmAq 4. FD, BDD integrated type : opening and closing by non-power 5. Minimal fan power consumption : under 0.5kW	**Impossible smoke extract due to low static pressure**

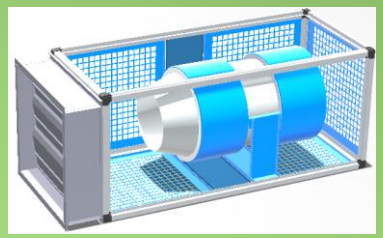
Fan Array Selection Software
- THRUVENT™ SYSTEM -

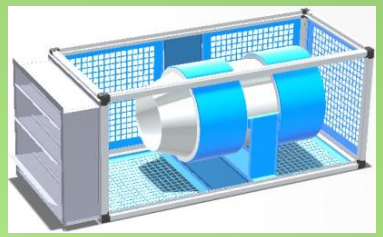
System Optimization Software

Maximize Energy Saving

COMPUTAIR
Specialist technical software
Accuracy, efficiency, dependability, - *the Computair package*





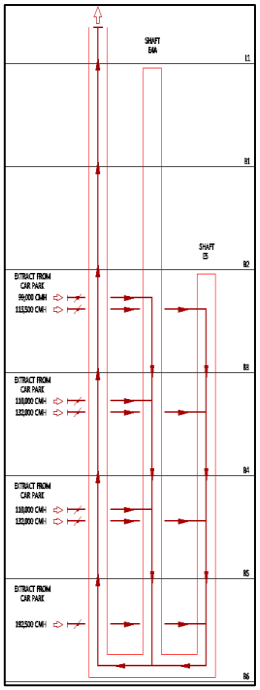


Co-developed "Fan Selection Software" with UK 'Computair' for globalization _ 2018

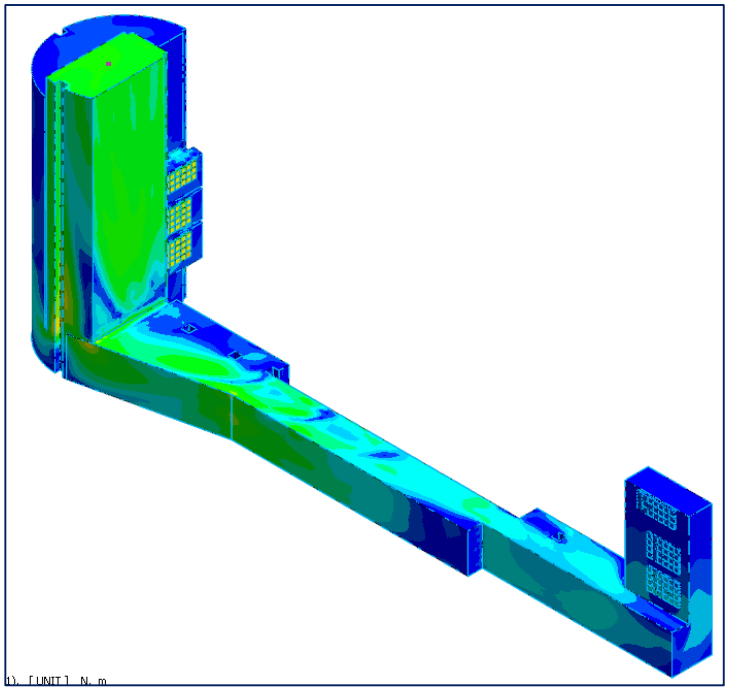
Green Building Better Living
- THRUVENT™ SYSTEM -

THRUVENT™ CFD verification conducted _ Midas NFX

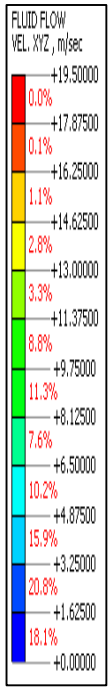
Site : Yeouido "P" construction

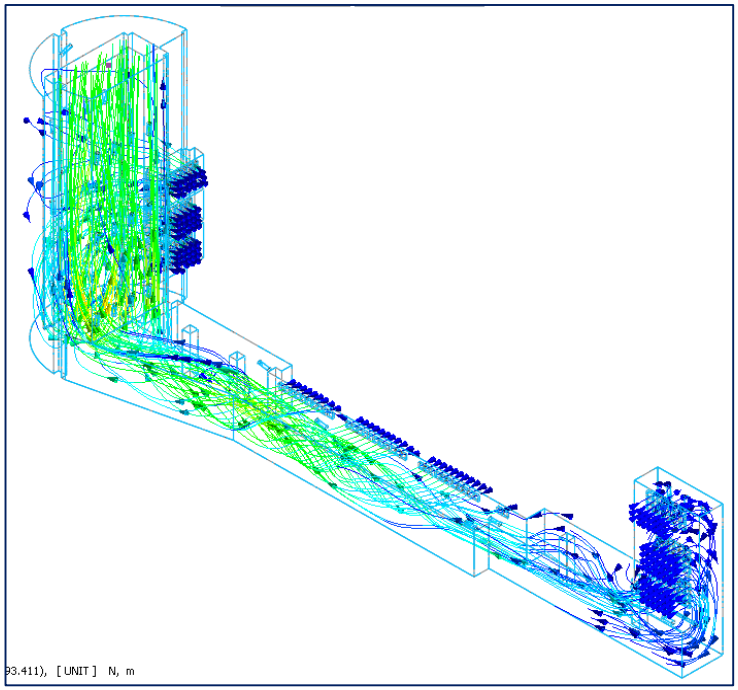


Diagram_E4-E5



Velocity distribution_E4-E5





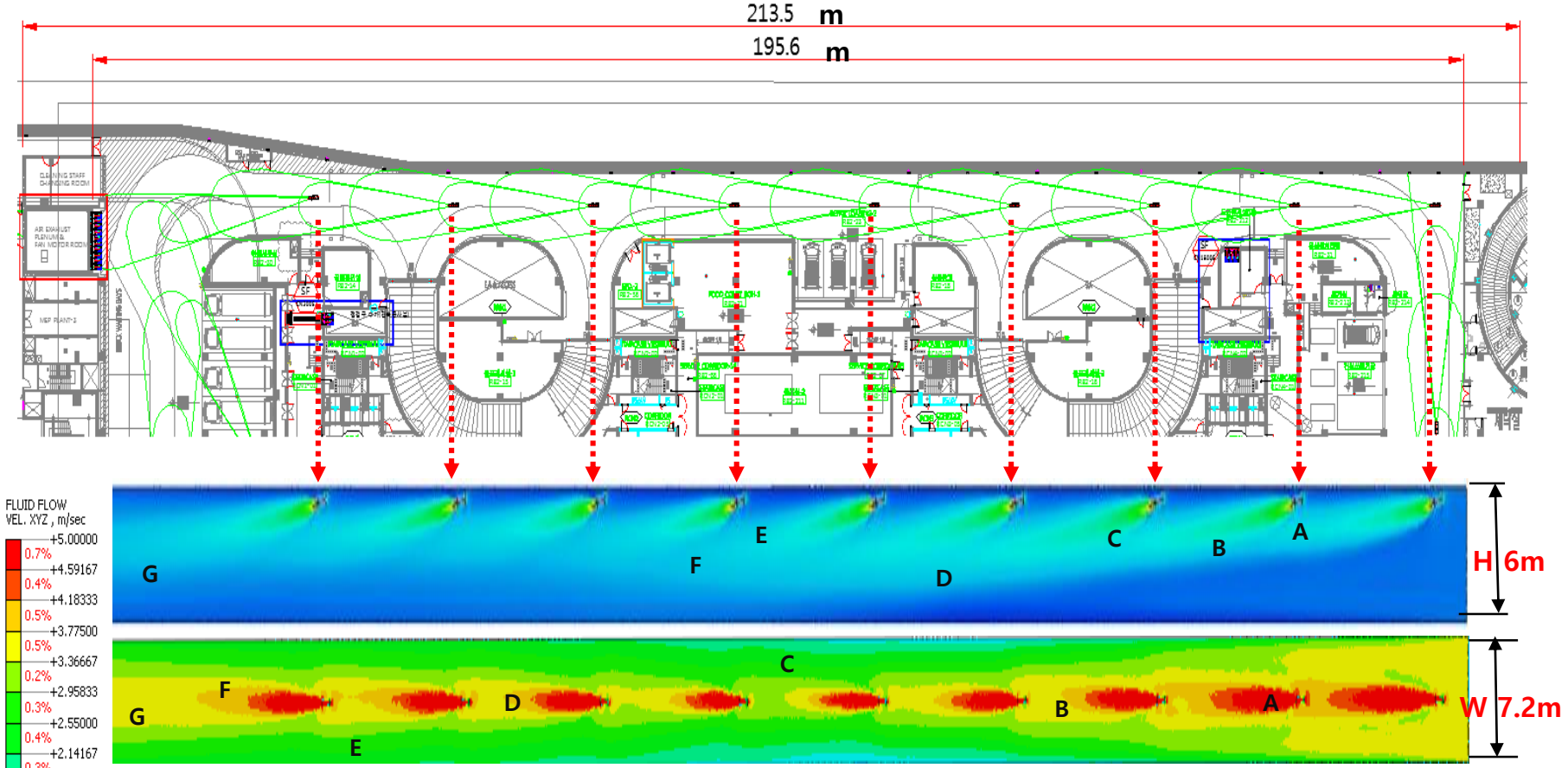
Speed streamline area_E4-E5

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

THRUVENT™ CFD verification conducted _ Midas NFX

Site : Yeouido "P" construction



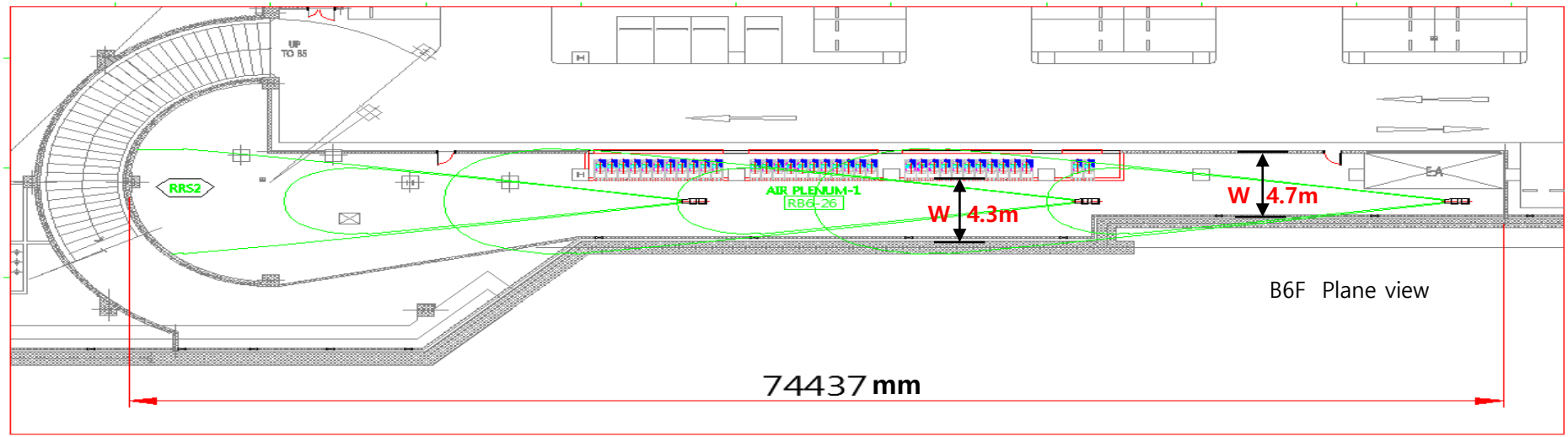
Location	Yeouido "p" construction	A	B	C	D	E	F	G
Air velocity	Section	7.7m/s	1.6m/s	1.9m/s	0.9m/s	1.0m/s	1.2m/s	1.0m/s
	Plan	4.2m/s	0.7m/s	0.5m/s	1.5m/s	0.6m/s	1.2m/s	0.8m/s

Underground Parking Lot Smoke Extract System

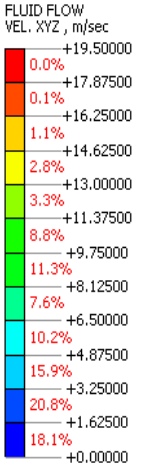
- THRUVENT™ SYSTEM -

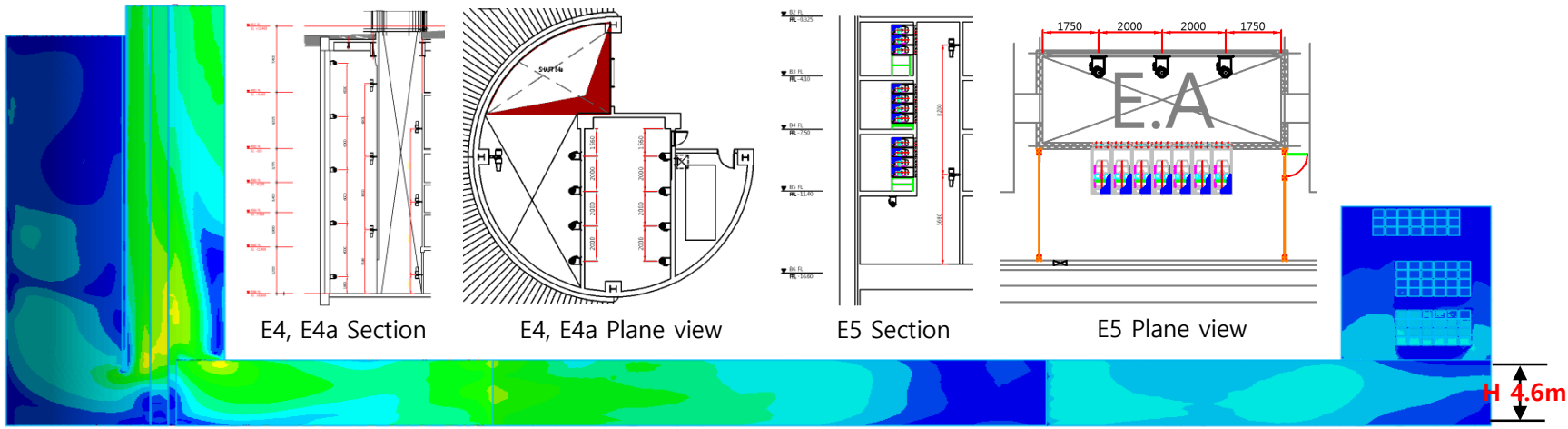
THRUVENT™ CFD verification conducted _ Midas NFX

Site : Yeouido "P" construction



B6F Plane view





E4, E4a Section

E4, E4a Plane view

E5 Section

E5 Plane view

Underground Parking Lot Smoke Extract System

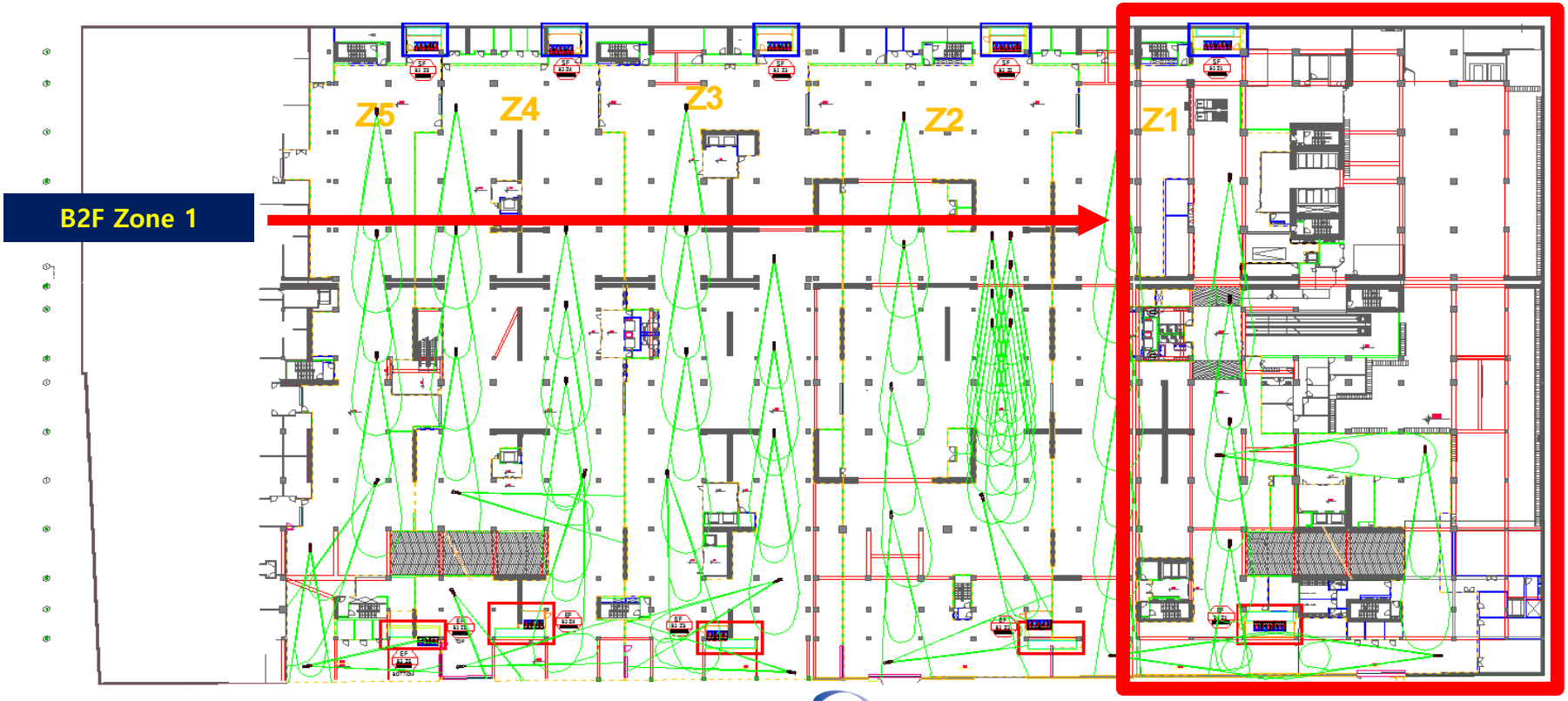
- THRUVENT™ SYSTEM -

THRUVENT™ CFD verification conducted _ Midas NFX

Site : IRAN "MP" construction

B 2 F Overview

Description	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total
Area (m²)	3,894	3,549	3,351	3,047	1,811	15,652
Height (m)	3.58	3.58	3.58	3.58	3.58	
Volume (m³)	13,941	12,705	11,997	10,908	6,483	56,034

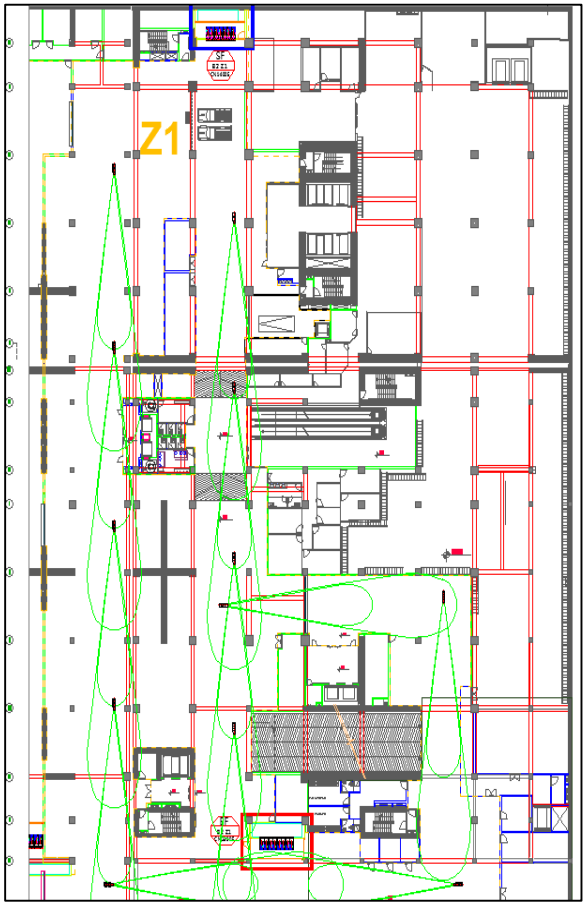


Underground Parking Lot Smoke Extract System

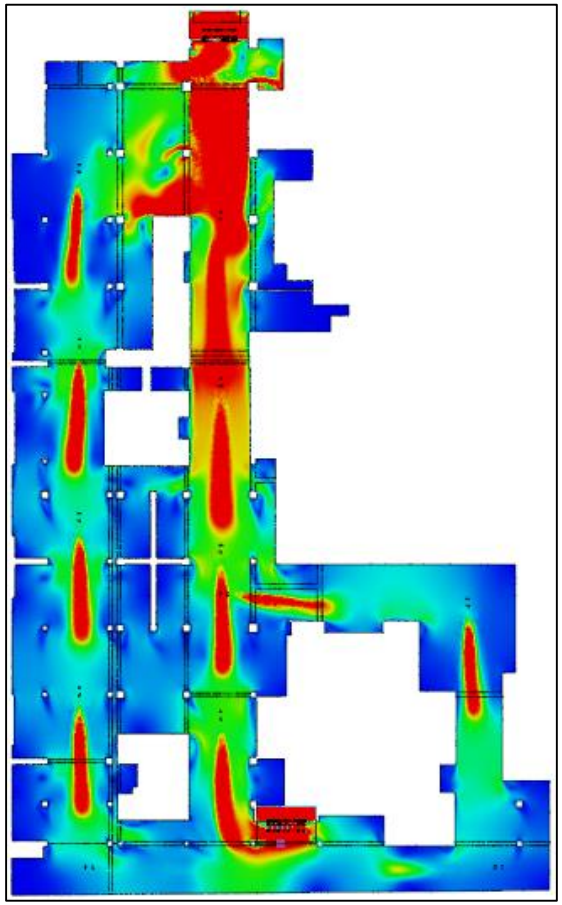
- THRUVENT™ SYSTEM -

THRUVENT™ CFD verification conducted _ Midas NFX

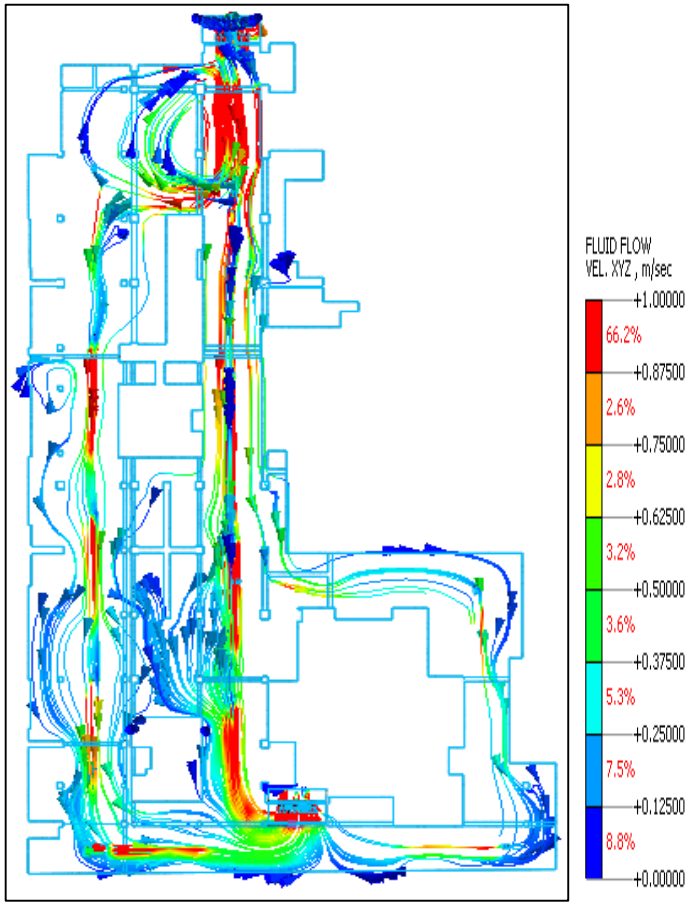
Site : IRAN "MP" construction



B2F _ zone 1



Velocity distribution _ zone 1



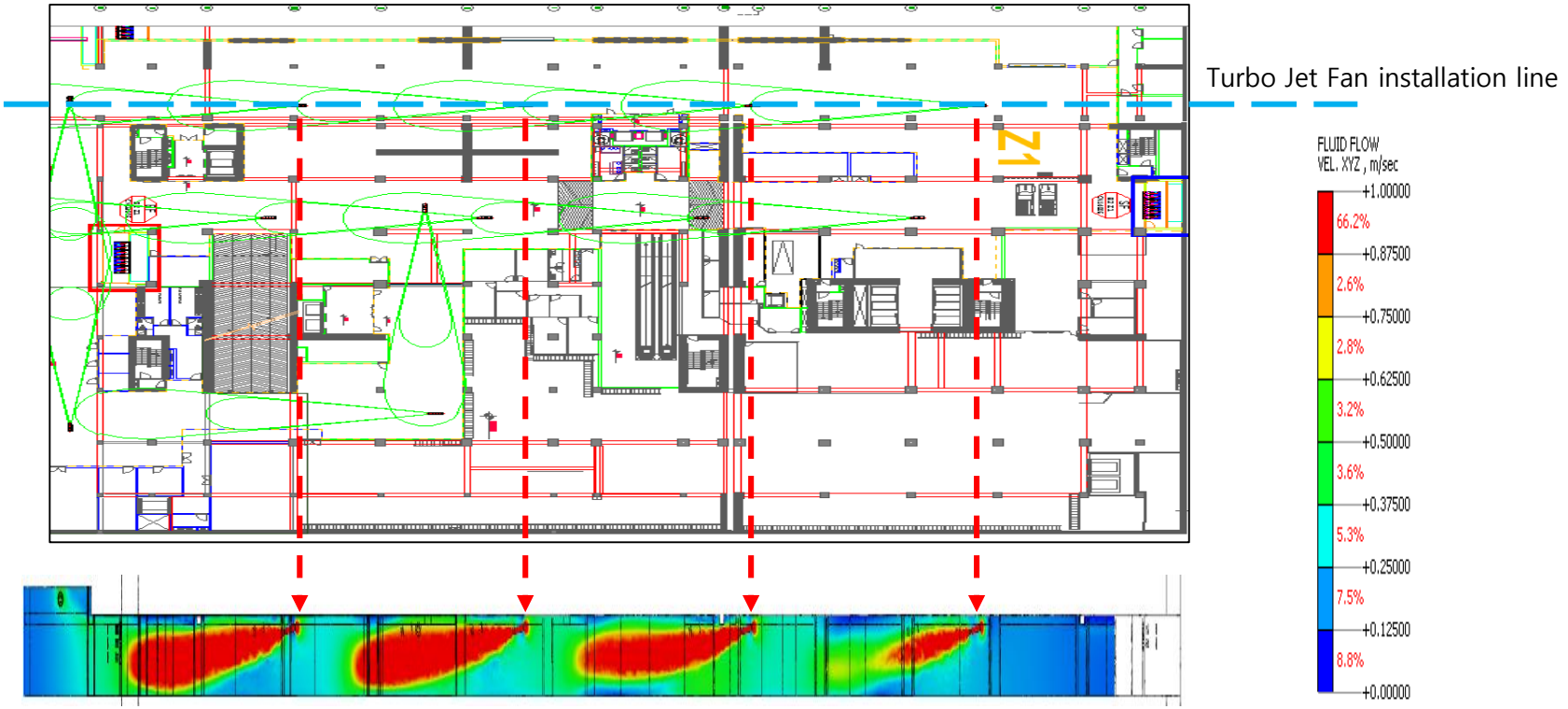
Velocity wired circulation _ Zone 1

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

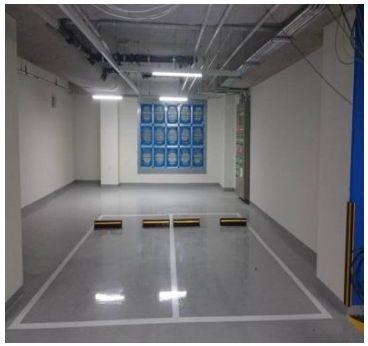
THRUVENT™ CFD verification conducted _ Midas NFX

Site : IRAN "MP" construction



Underground Parking Lot Smoke Extract System
- THRUVENT™ SYSTEM -

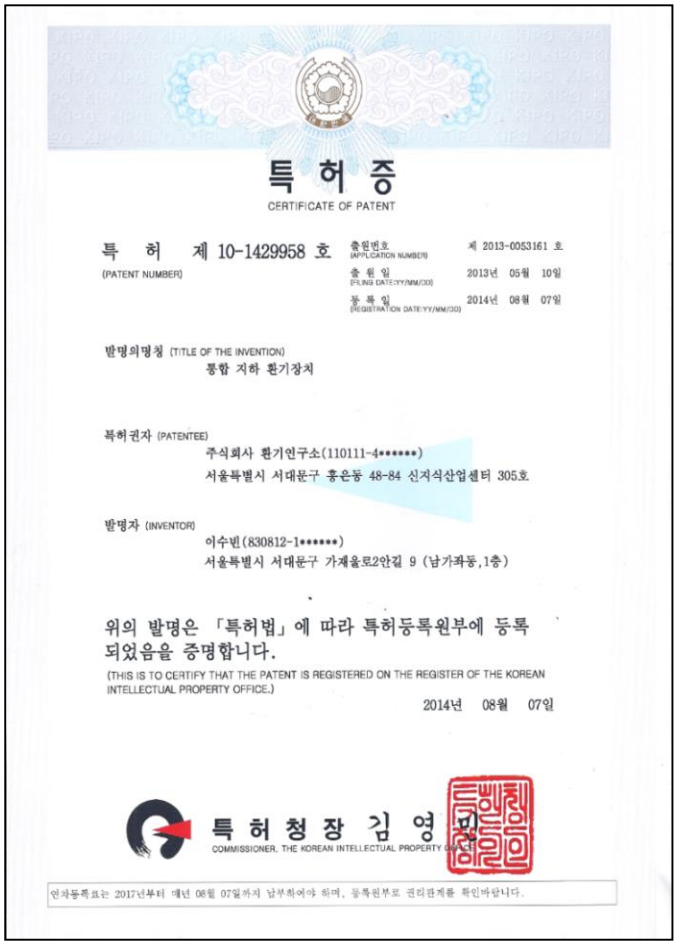
THRUVENT™ Fan Array diversification

Samsung SDS IT center (Seoul, Sangam)		Samsung Elec. Factory 2, Campus (Keongbuk, Gumi)	
			
			

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

Globalization / Patent registration and application in 59 countries



특 허 증

CERTIFICATE OF PATENT

특 허 제 10-1429958 호 (PATENT NUMBER)

출원번호 (APPLICATION NUMBER) 제 2013-0053161 호

출 원 일 (FILING DATE:YY/MM/DD) 2013년 05월 10일

등 록 일 (REGISTRATION DATE:YY/MM/DD) 2014년 08월 07일

발명의명칭 (TITLE OF THE INVENTION)
통합 지하 환기장치

특허권자 (PATENTEE)
주식회사 환기연구소(110111-4******)
서울특별시 서대문구 홍은동 48-84 신지식산업센터 305호

발명자 (INVENTOR)
이수빈(830812-1******)
서울특별시 서대문구 가재울로2안길 9 (남가좌동,1층)

위의 발명은 「특허법」에 따라 특허등록원부에 등록되었음을 증명합니다.

(THIS IS TO CERTIFY THAT THE PATENT IS REGISTERED ON THE REGISTER OF THE KOREAN INTELLECTUAL PROPERTY OFFICE.)

2014년 08월 07일

특허청장 김 영 (COMMISSIONER, THE KOREAN INTELLECTUAL PROPERTY OFFICE)

No	Country Name	Application number	Registered Number
1	EPC	14795235.2	
2	GCC	115370070	
3	America	14/787,459	US 6,953,395 B2
4	Australia	2014-263349	2014263349
5	Brazil	BR 11 2015 028305 5	
6	Canada		CA 2912177
7	China		ZL 2014 8 0024066.2
8	Colombia	32760	15 293514
9	India	10025/DELNP/2015	
10	Indonesia	P00201506787	IDP000054228
11	Japan	2016-512835	6490056
12	Malaysia	PI2015704050	
13	Mexico	MX/E/2015/082055	
14	Philippine	1-2015-502487	
15	Russia		2645648
16	Singapore	11201508909T	
17	South Africa	2015/07884	2015/07884
18	Thailand	1501006783	
19	Vietnam	1-2015-04195	

Underground Parking Lot Smoke Extract System
- THRUVENT™ SYSTEM -

Essential patent registered by other countries

Korea

U.S.A

China

Australia

Indonesia

Colombia

Canada

Russia

Japan

South Africa

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

Results : Value Engineering

Country	Site name	Description	Existing system	Thruvent system	Different
KOREA	Dongtan Meta police	Power consumption(kW)	828.75	282.22	**-546.53 (-65.9%)**
		Increased parking lot(space)	-	18	+18
	Tehran-ro 237 re-development	Power consumption(kW)	288.20	97.98	-190.22 (-66.0%)
	Garak Housing re-development	Power consumption(kW)	631.60	247.20	-384.40 (60.1%)
		Increased parking space	-	**370**	+370
	Yeouido Parc.1	Power consumption(kW)	2,300.00	430.50	**-1,869.50 (-81.3%)**
	Seonreung B/D	Power consumption(kW)	30.34	18.32	-12.02 (-39.6%)
		Increased parking lot(space)	-	5	+5
CHINA	YLY	Power consumption(kW)	930.00	222.90	**-707.1 (-76.0%)**
		Increased parking lot(space)	-	18	+18
INDIA	Commercial B/D	Power consumption(kW)	270.00	130.90	-139.1 (-51.5%)
		Increased parking lot(space)	-	40	+40
	The Park	Power consumption(kW)	3,102.50	1,049.3.	**-2,053.2 (-66.2%)**
		Increased parking space	-	**58**	+58
	NCP Wadala	**Increased parking space**	-	**556**	+556
MALAYSIA	Star Residence	Power consumption(kW)	1,282.40	280.90	**-1,000.50 (78.1%)**
		Increased parking space	-	**72**	+72
IRAN	Mega Pars	Power consumption(kW)	1,716.25	386.10	**-1,330.15 (77.5%)**

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

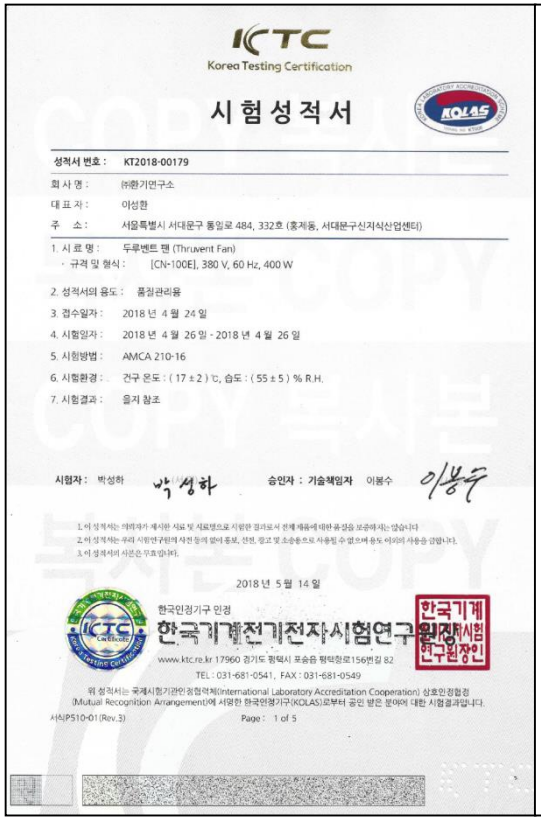
ENERGY Globe Award 2015

Contract with South Korean Brand "THRUVENT" Signed.

Description	Area (m^2)	Car Parking Lots (spaces)	Air volume (CMH)	Power consumption (kW)		Energy saving	
						kW	%
Mega Pars	**86,550**	**2,632**	**2,736,000**	**1,716.25**	**386.10**	**-1,330.15**	**-77.5**

Underground Parking Lot Smoke Extract System
- THRUVENT™ SYSTEM -

Turbo Jet Fan



KTC
Korea Testing Certification

시 험 성 적 서

성적서 번호 : KT2018-00179
회 사 명 : (주)환기연구소
대 표 자 : 이성환
주 소 : 서울특별시 서대문구 통일로 484, 332호 (홍제동, 서대문구신지식산업센터)
1. 시 료 명 : 두루벤트 팬 (Thruvent Fan)
· 규격 및 형식 : [CN-100E], 380 V, 60 Hz, 400 W
2. 성적서의 용도 : 품질관리용
3. 접수일자 : 2018 년 4 월 24 일
4. 시험일자 : 2018 년 4 월 26 일 - 2018 년 4 월 26 일
5. 시험방법 : AMCA 210-16
6. 시험환경 : 건구 온도 : (17 ± 2) ℃, 습도 : (55 ± 5) % R.H.
7. 시험결과 : 을지 참조

시험자 : 박성하 승인자 : 기술책임자 이봉수

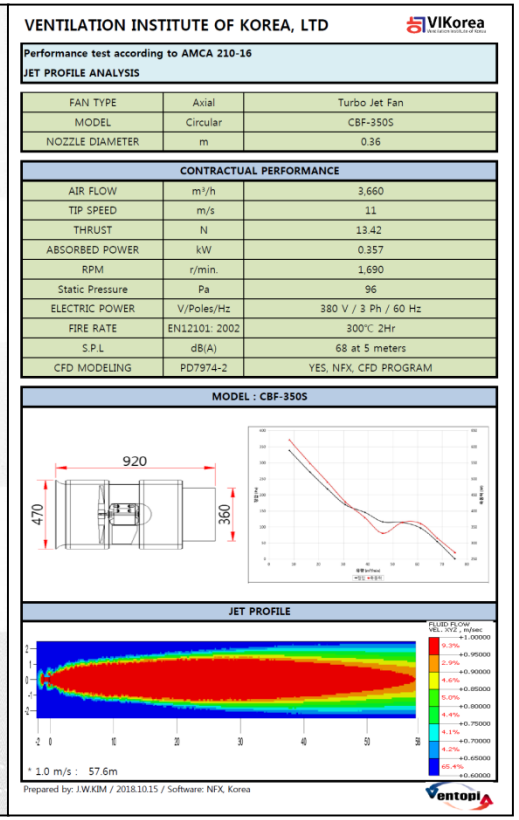
2018 년 5 월 14 일

한국인정기구 인정
한국기계전기전자시험연구원장인

www.ktc.re.kr 17960 경기도 평택시 포승읍 평택항로156번길 82
TEL : 031-681-0541, FAX : 031-681-0549

위 성적서는 국제시험기관인정협력체(International Laboratory Accreditation Cooperation) 상호인정협정 (Mutual Recognition Arrangement)에 서명한 한국인정기구(KOLAS)로부터 공인 받은 분야에 대한 시험결과입니다.

서식(P510-01(Rev.3) Page : 1 of 5



VENTILATION INSTITUTE OF KOREA, LTD
VIKorea

Performance test according to AMCA 210-16
JET PROFILE ANALYSIS

FAN TYPE	Axial	Turbo Jet Fan
MODEL	Circular	CBF-350S
NOZZLE DIAMETER	m	0.36

CONTRACTUAL PERFORMANCE		
AIR FLOW	m³/h	3,660
TIP SPEED	m/s	11
THRUST	N	13.42
ABSORBED POWER	kW	0.357
RPM	r/min.	1,690
Static Pressure	Pa	96
ELECTRIC POWER	V/Poles/Hz	380 V / 3 Ph / 60 Hz
FIRE RATE	EN12101: 2002	300℃ 2Hr
S.P.L	dB(A)	68 at 5 meters
CFD MODELING	PD7974-2	YES, NFX, CFD PROGRAM

MODEL : CBF-350S

JET PROFILE

Prepared by: J.W.KIM / 2018.10.15 / Software: NFX, Korea

Ventopia

Test Report (KTC)

Jet Profile

Performance test according to AMCA 210-16

CONTRACTUAL PERFORMANCE		
AIR FLOW	m³/h	3,660
TIP SPEED	m/s	11
THRUST	N	13.42
ABSORBED POWER	kW	0.357
RPM	r/min.	1,690
Static Pressure	Pa	96
ELECTRIC POWER	V/Poles/Hz	380 V / 3 Ph / 60 Hz
FIRE RATE	EN12101	300℃ 2h
S.P.L	dB(A)	68 at 5 meters
CFD MODELING	PD7974-2	YES, NFX, CFD PROGRAM

Underground Parking Lot Smoke Extract System
- THRUVENT™ SYSTEM -

Clean Underground Parking Lot without particular dust
THRUVENT™ + VENTOMATIC™

Combining IoT technology with Thruvent™ system
The user of the underground parking lot can use the mobile phone app or the outside installed board, smart solution considering the next users while, maintaining a clean underground parking lot without particular dust

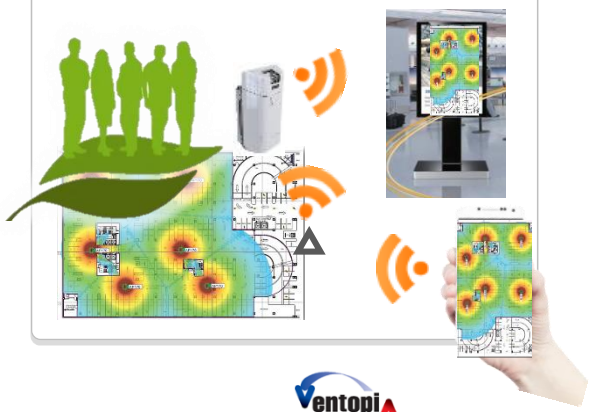
Consider the next users

Using IoT for Consideration

Smart solution that considers the next users and maintains a clean underground parking lot without particular dust

Maintain real-time clean environment

The air quality remains optimal at all times.
Remote control according to user instructions
Adjustment by automatic operation



Improving the quality of life

Underground Parking Lot Smoke Extract System

- THRUVENT™ SYSTEM -

Overseas subsidiaries and partners

Overseas Subsidiaries

Ventopia USA, Inc.

Ventopia India,Pvt., Ltd.

Ventopia Colombia, Ltd.

Distributors

YMAGE Trading & Construction Corp.

SADAD Engineering & Trading Co.

OEM Manufacturers

COOLEX (Kuwait)