

Use of Evacuation Simulation to Develop a Disaster Management Plan in Super Tall Buildings

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9. Evacuation Training/Drill/Education
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1. Introduction

- Speaker: Mr. Doo Chan Choi
- ✓ 2005 : Graduated from Worcester Polytechnic Institute (MS Fire Protection Engineering)
- ✓ ~ 2012 : Rolf Jensen Association (=>Jensen Hughes)
- ✓ ~ 2016(Present) : KF UBIS Co., Ltd (Korea)
- ✓ ~ 2016(Present) : Adjunct Professor – Gachon University Fire Protection Engineering Department (Korea)

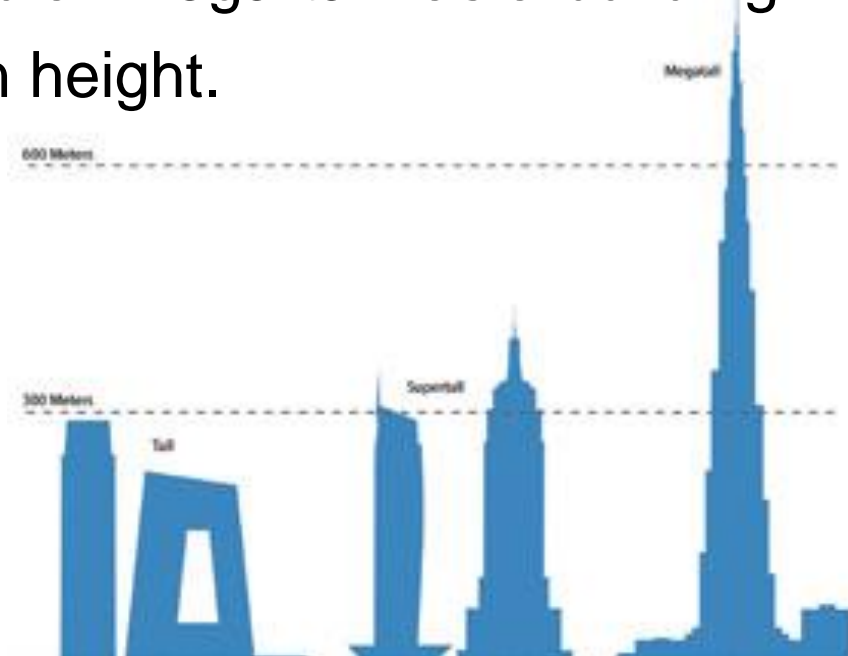


1. Introduction

- 1) **Disaster Management** in a Super Tall Building
- 2) How Computer **Simulation** Can be Utilized and Applied to Support Well-Defined Disaster Management Plan Development for a Super Tall Building Project from Design Phase to After Construction Phase.

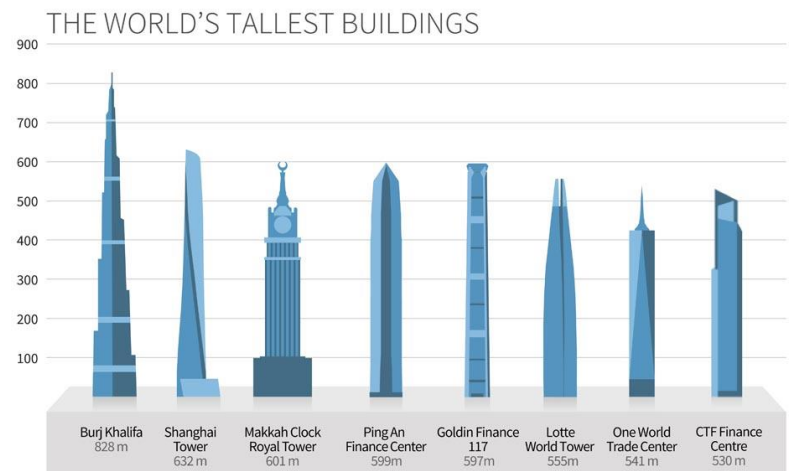
2. Super Tall Building

- What are Super tall and Mega tall Buildings?
 - There is no absolute definition of what constitutes a “tall building.”
 - The CTBUH defines “super-tall” as a building over 300 meters (984 feet) in height, and a “mega-tall” as a building over 600 meters (1,968 feet) in height.



2. Super Tall Building

- ✓ Multi / Mixed Occupancy Type
- ✓ Various Occupants
- ✓ Small/Mid Size Town or **City**
- ✓ Minor Probability of Disaster Scenarios
- ✓ The Severity of the Disaster Will be Greatly Amplified.
= Unique, Innovative and Well-Engineered Management and Planning is required.

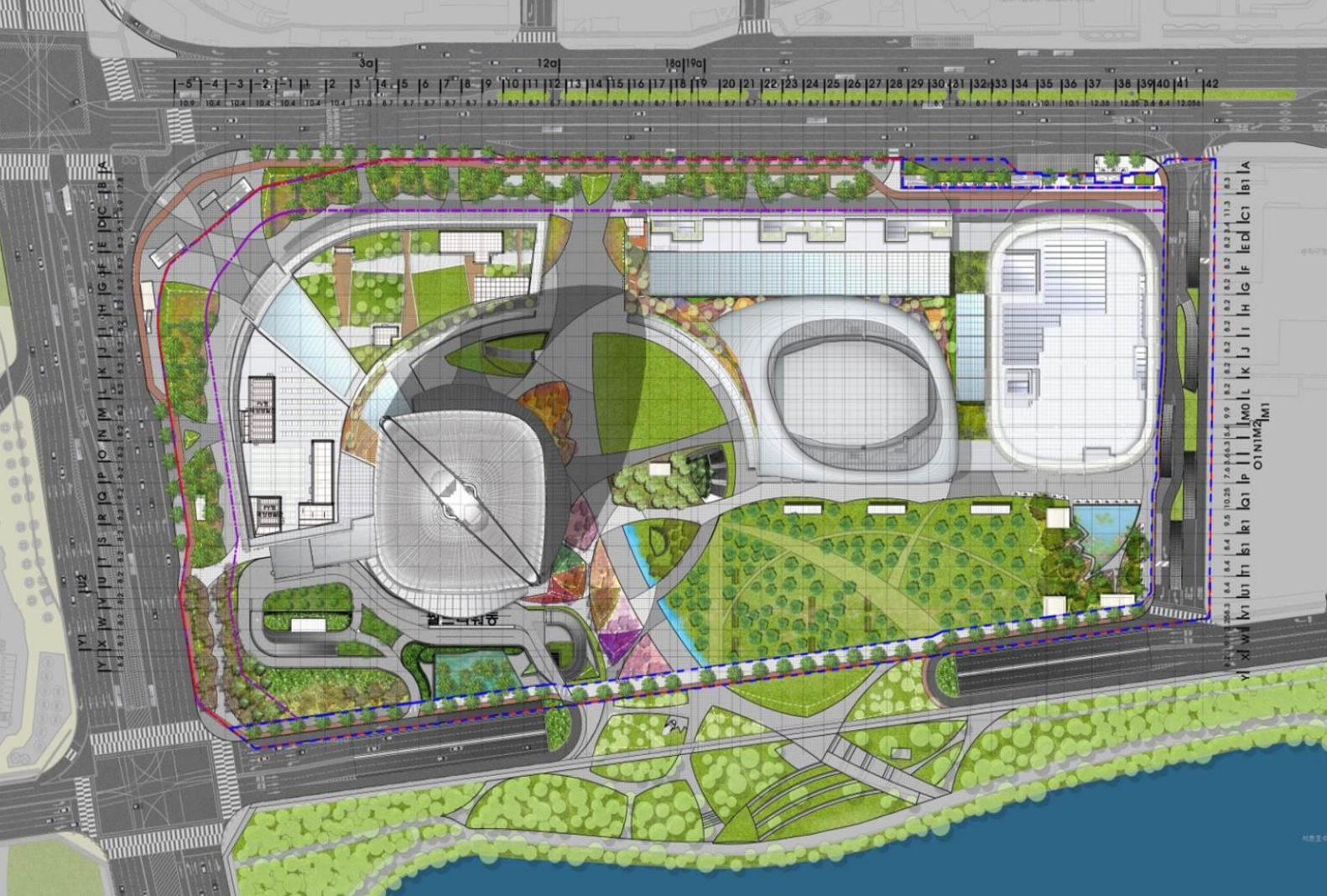


3. Project Building

- **Lotte World Tower**
- Seoul, Korea
- 555m Height
- 123 Floors
- Total Floor Area:
807,613m²



Site Plan



LANDMARK OF KOREA



117-123F

OBSERVATION DECK

World's Tallest
Observation Deck



OBSERVATION
DECK

SKY CAFE



108-114F

PRIVATE OFFICE

Office Space for VVIP

76-101F

HOTEL

World-class 6 Star Hotel



42-71F

RESIDENCE

Business Space
for Creativity & Innovation

14-38F

PRIME OFFICE

Global Business Hub



5-12F

PODIUM

One-stop Lifestyle
with Arts & Culture



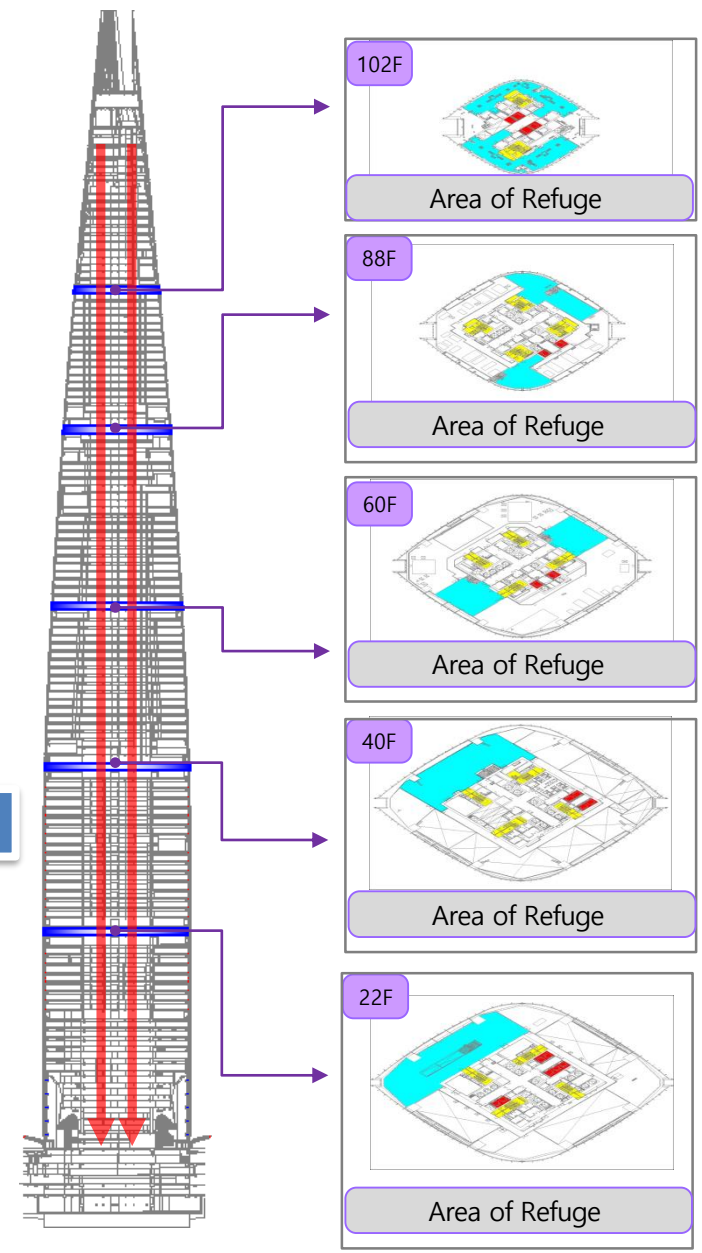
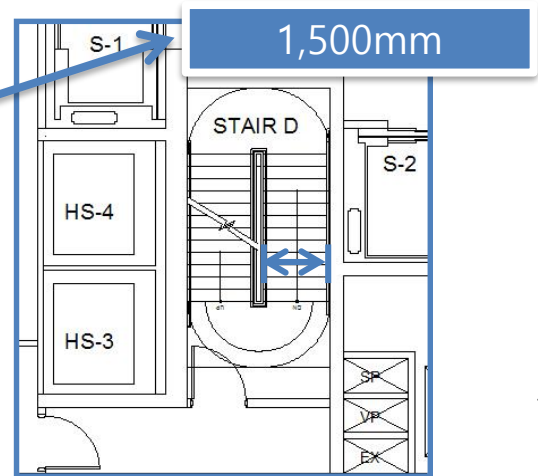
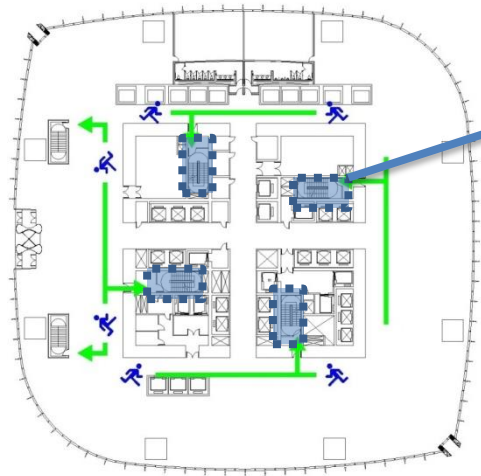
- Number of Occupants
: over 15,000
- Construction Completion
: End of 2016



at 555m

- Building the Most Safe Building

- ✓ Defend in Place
 - ✓ Area of Refuge
 - ✓ Safety Enhancement
 - ✓ Redundancy
- : Active/Passive Systems,
Exit Capacity



4. Disaster Management Overview

In general, a disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources.

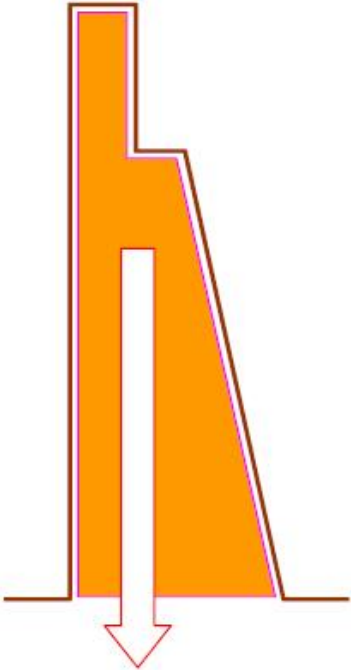
There can be various emergency situations from a minimal accident or fire case to major hazard impact on the building and occupants. If fail to response, a disaster can arise from these hazard events in super tall buildings and the severity of the disaster will be greatly amplified.

Disaster Scenario

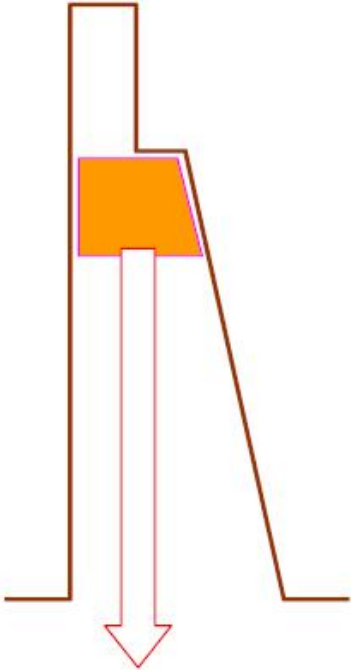


Building / Service	Human Related	War / Terrorism	Nature (Weather)
	Active Shooter	Biological	Typhoon
Cooling	Bomb	Chemical	Earthquake
Chiller	Fire	IED Terror	Major Flood
House Water	Kidnaping	Redioactive	
Electrical	Medical		
Fire Safety	Lost Child		
Elevator	Security		
Security	Violence		
Public Water			
Structure			

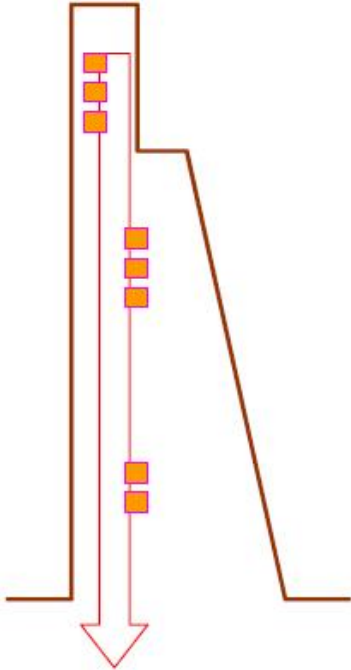
Emergency Evacuation Concept (CTBUH)



Total emergency evacuation means that the total building population is evacuated immediately.



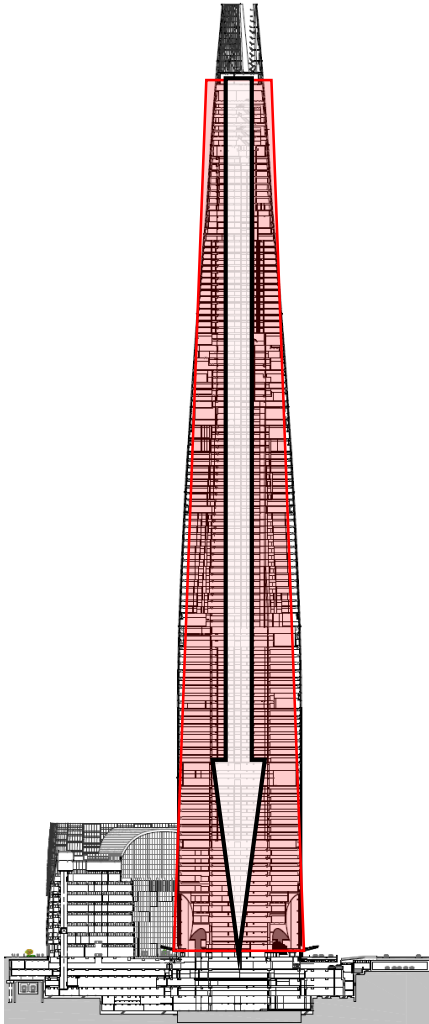
Staged emergency evacuation means that a part of the building population is immediately evacuated.



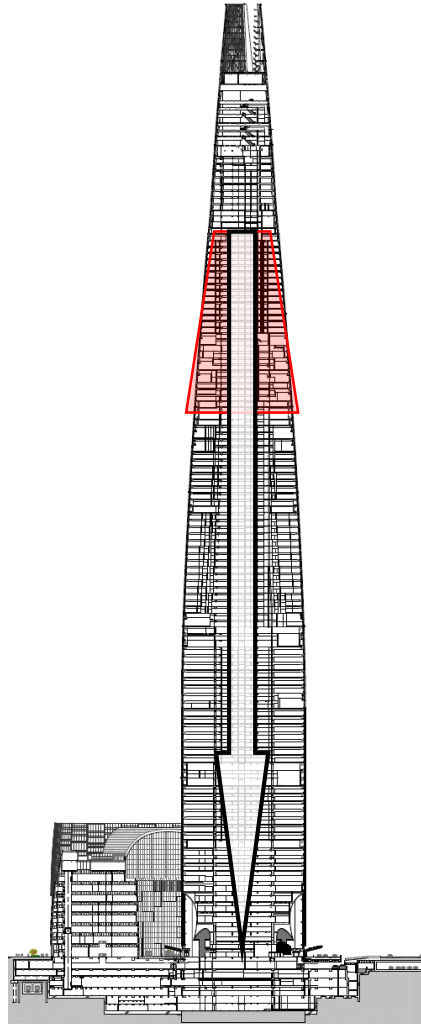
Fractional emergency evacuation means that only a very small group or fraction of the building population is evacuated/rescued.

Super Tall Building Evacuation Concept

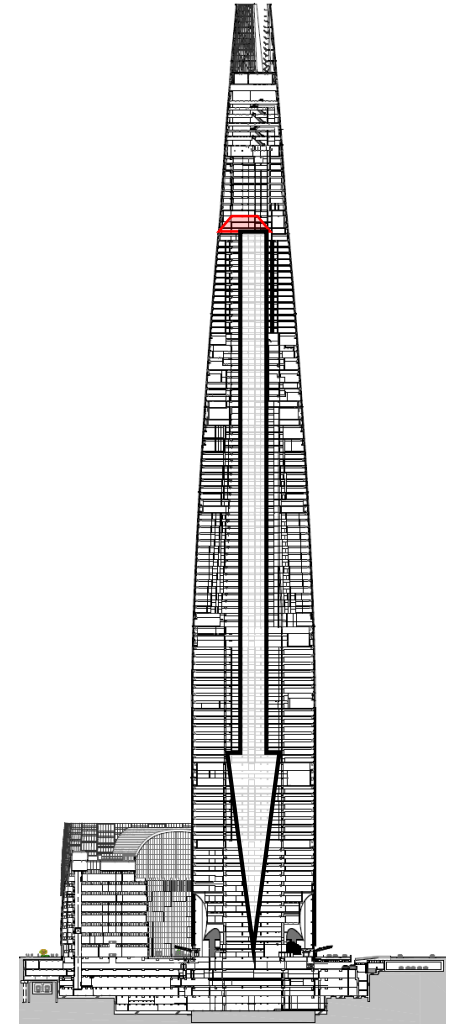
Total/Full Evacuation



Staged Evacuation



Fractional Evacuation



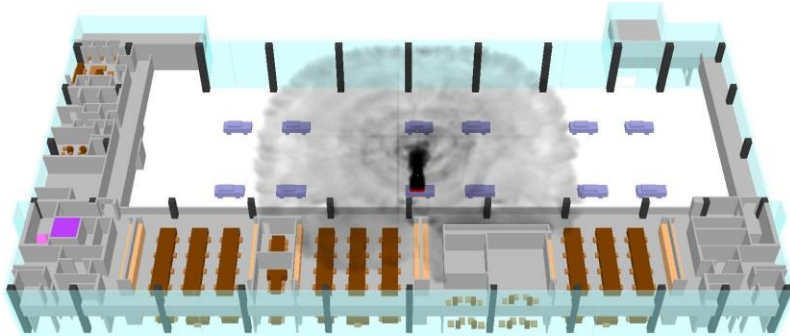
4. Disaster Management Overview

5 Features Using Simulation Study

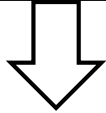
- 1) Fire Life Safety Engineering Analysis and **Performance Based Assessment**
- 2) **Elevator Assisted Evacuation**
(Life Boat Evacuation) Study
- 3) Major Focus of **Disaster Management** with
Evacuation Simulation Study
- 4) Disaster Management **Response Plan/Procedure**
- 5) Evacuation **Training/Drill/Education**

5. Fire Life Safety Engineering Analysis and Performance Based Assessment

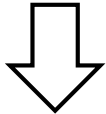
- Original Purpose of Fire / Egress Simulation
- ASET VS REST -> Life Safety Assessment based on PBD



Fire Simulation



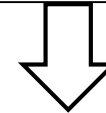
ASET (Available Safety Egress Time)



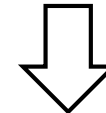
X Sec



Egress Simulation



RSET (Required Safety Egress Time)

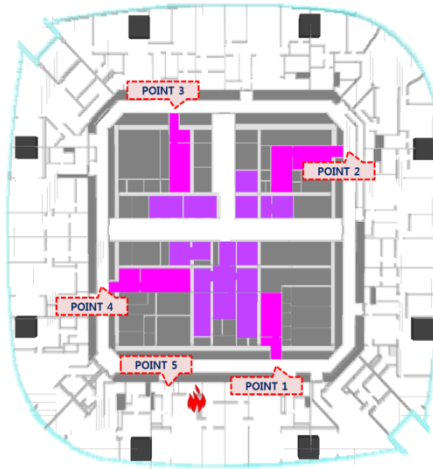
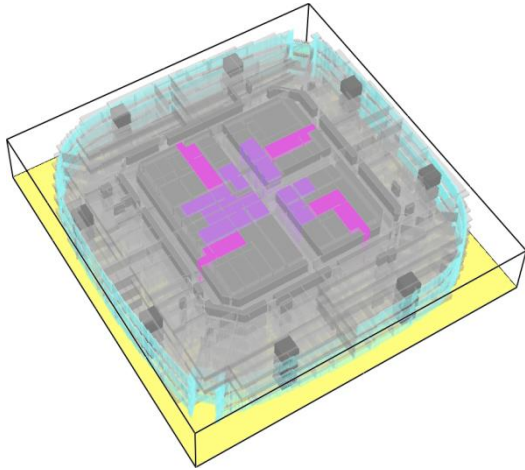


Y Sec

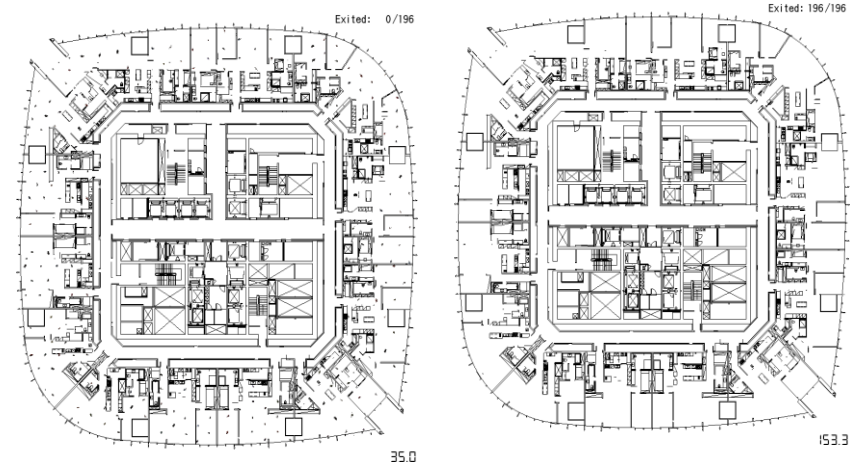


‘ Safety Building ’

• Fire Simulation (FDS)

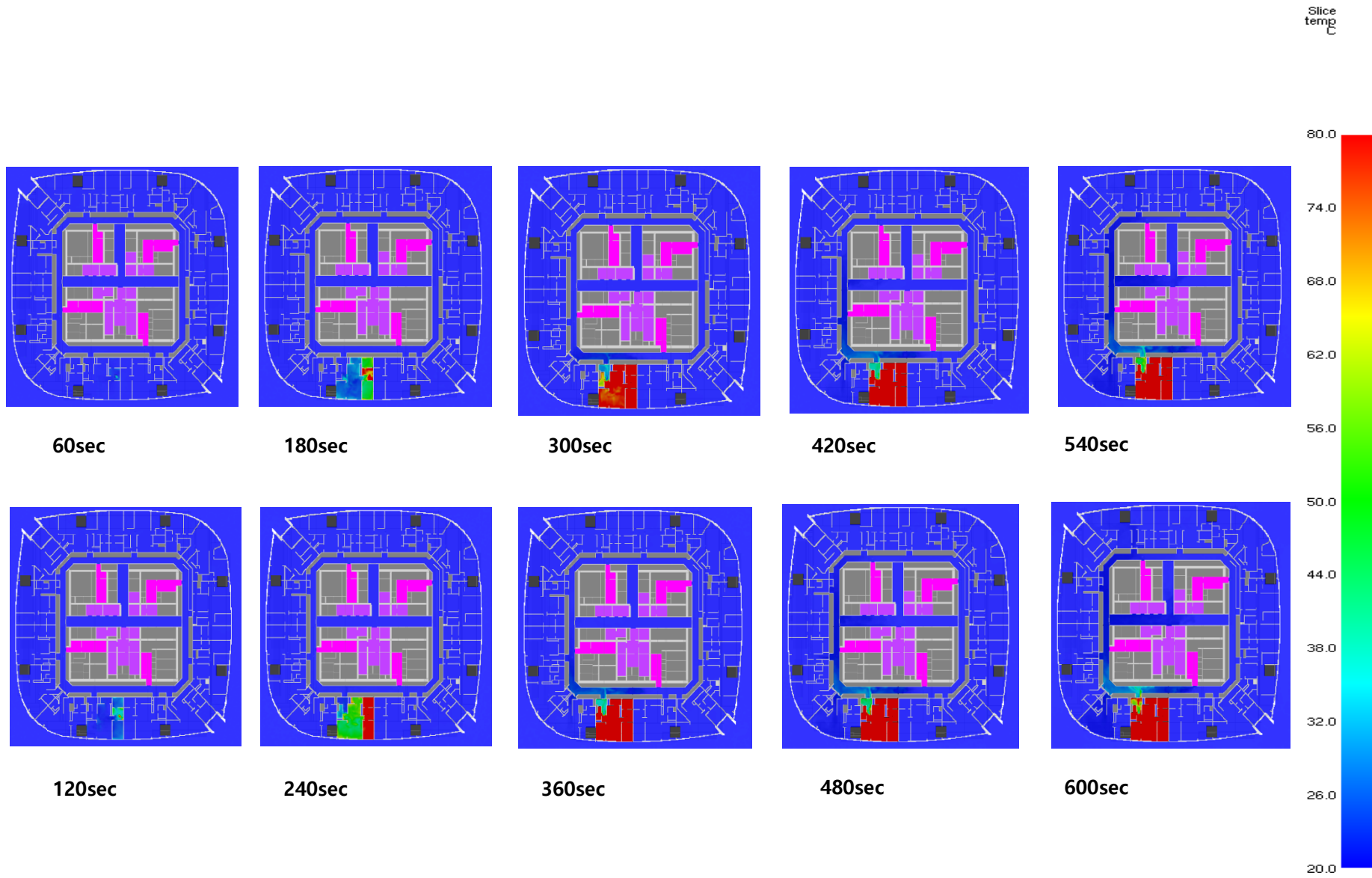


Egress Simulation (Pathfinder)



• Result

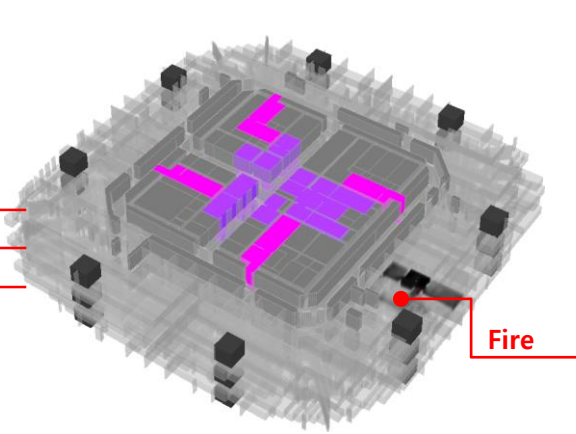
		Fire Simulation (ASET)	Egress Simulation (RSET)	Pass/Fail
45f (Officetel)	POINT 1	12 min	2 min	Pass
	POINT 2	12 min	2 min	Pass
	POINT 3	12 min	2 min	Pass
	POINT 4	7 min	2 min	Pass
	POINT 5	4 min	50 sec	Pass



46F

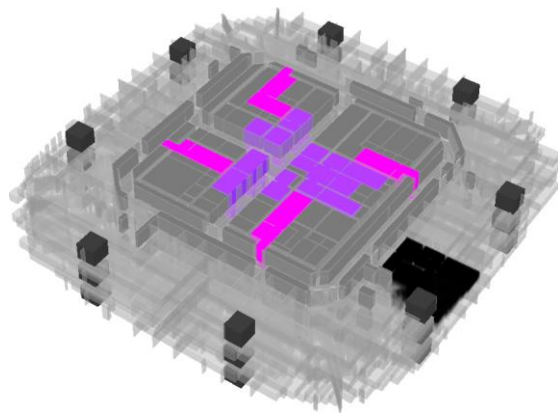
45F

44F

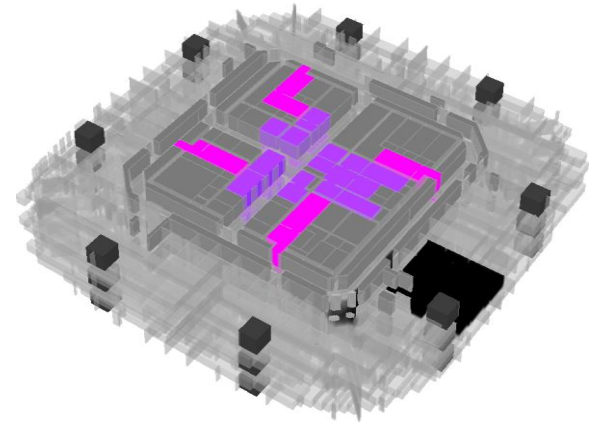


Fire

100sec



200sec

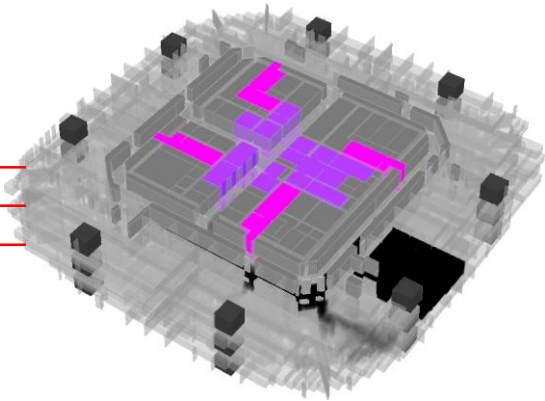


300sec

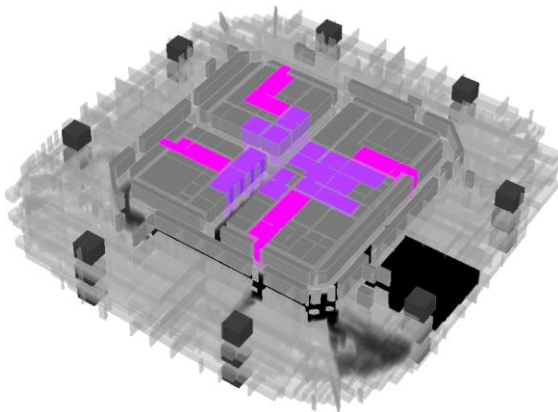
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45F

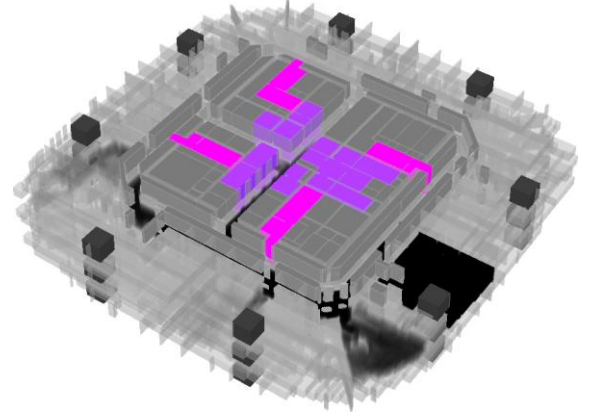
44F



400sec

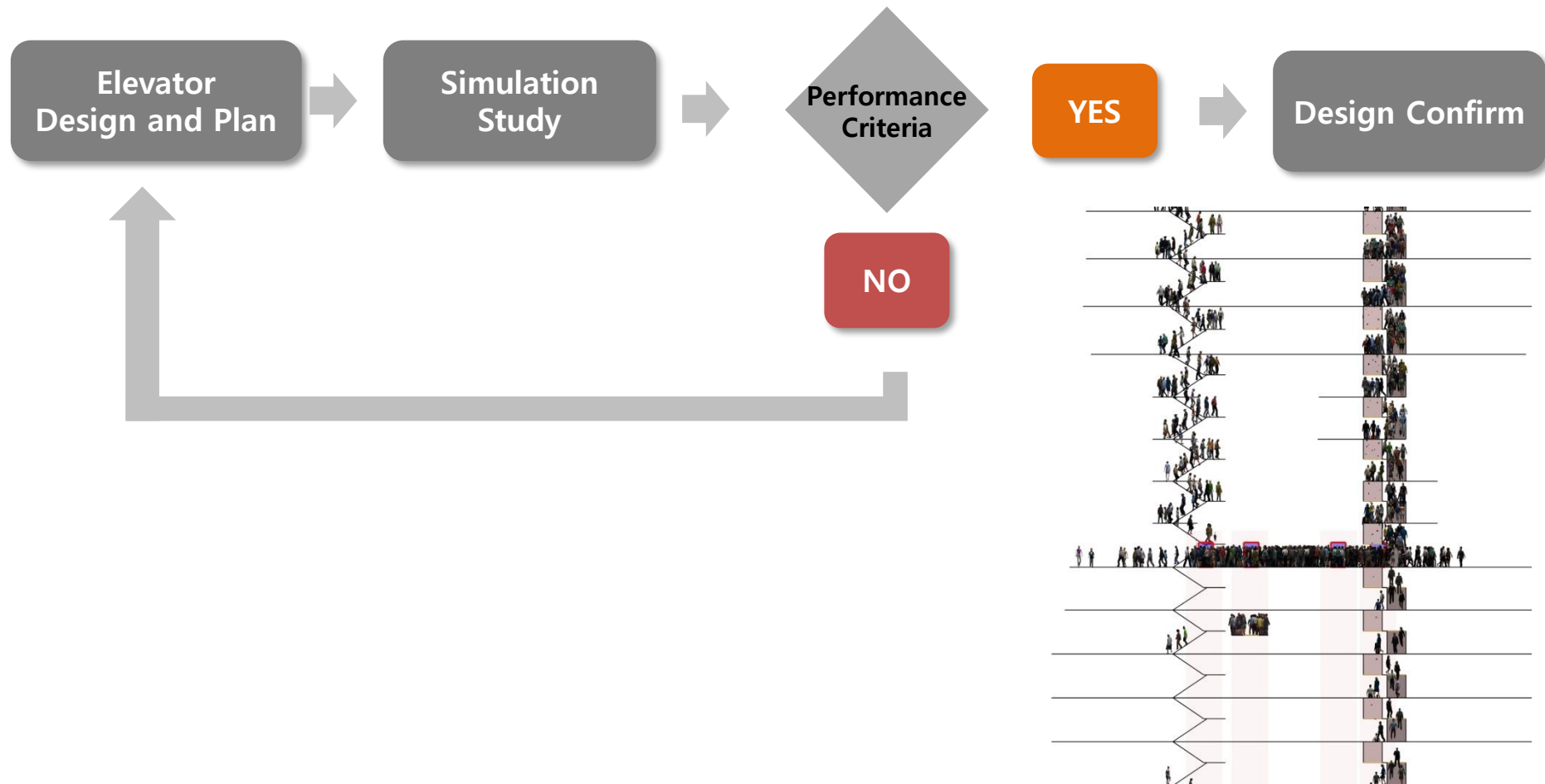


500sec

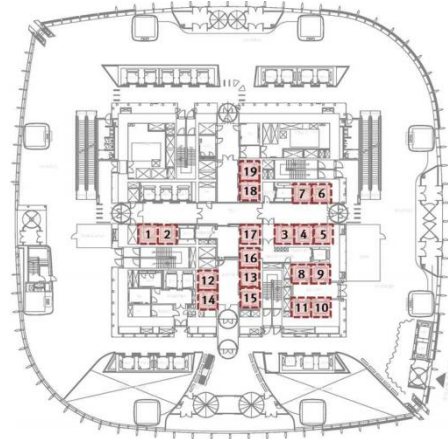
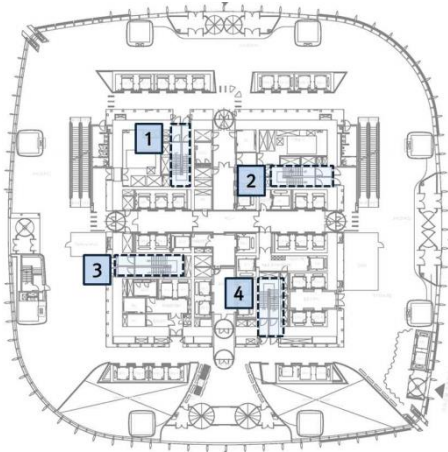


600sec

6. Elevator Assisted Evacuation (Life Boat Evacuation) Study



Stair/Elevator Design and Plan



Simulation Scenario

Scenario 1
(Stair Only)

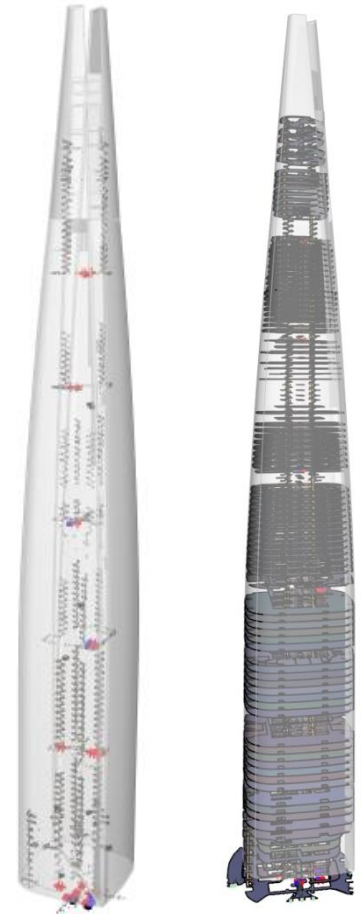
Scenario 2
(Stair XX% EV XX%)

Scenario 3
(Stair XX% EV XX%)

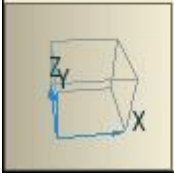
Scenario 4
(Stair XX% EV XX%)

Scenario 5
(Stair XX% EV XX%)

Simulation Study

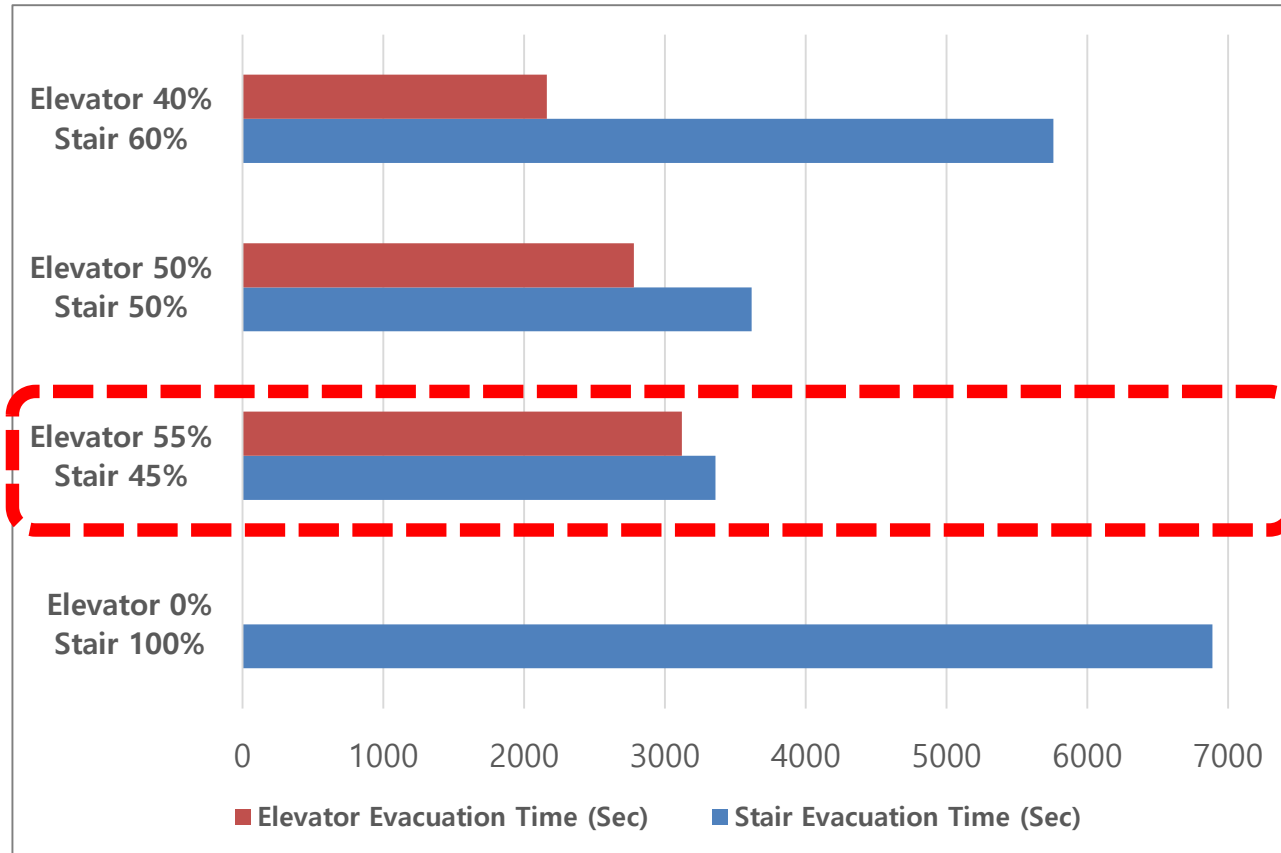


Exited: 0/15806



0.0

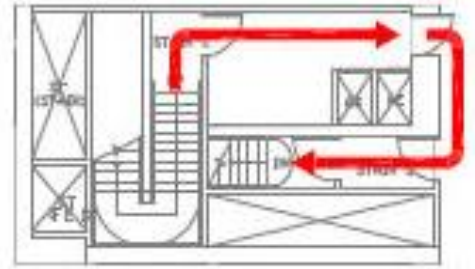
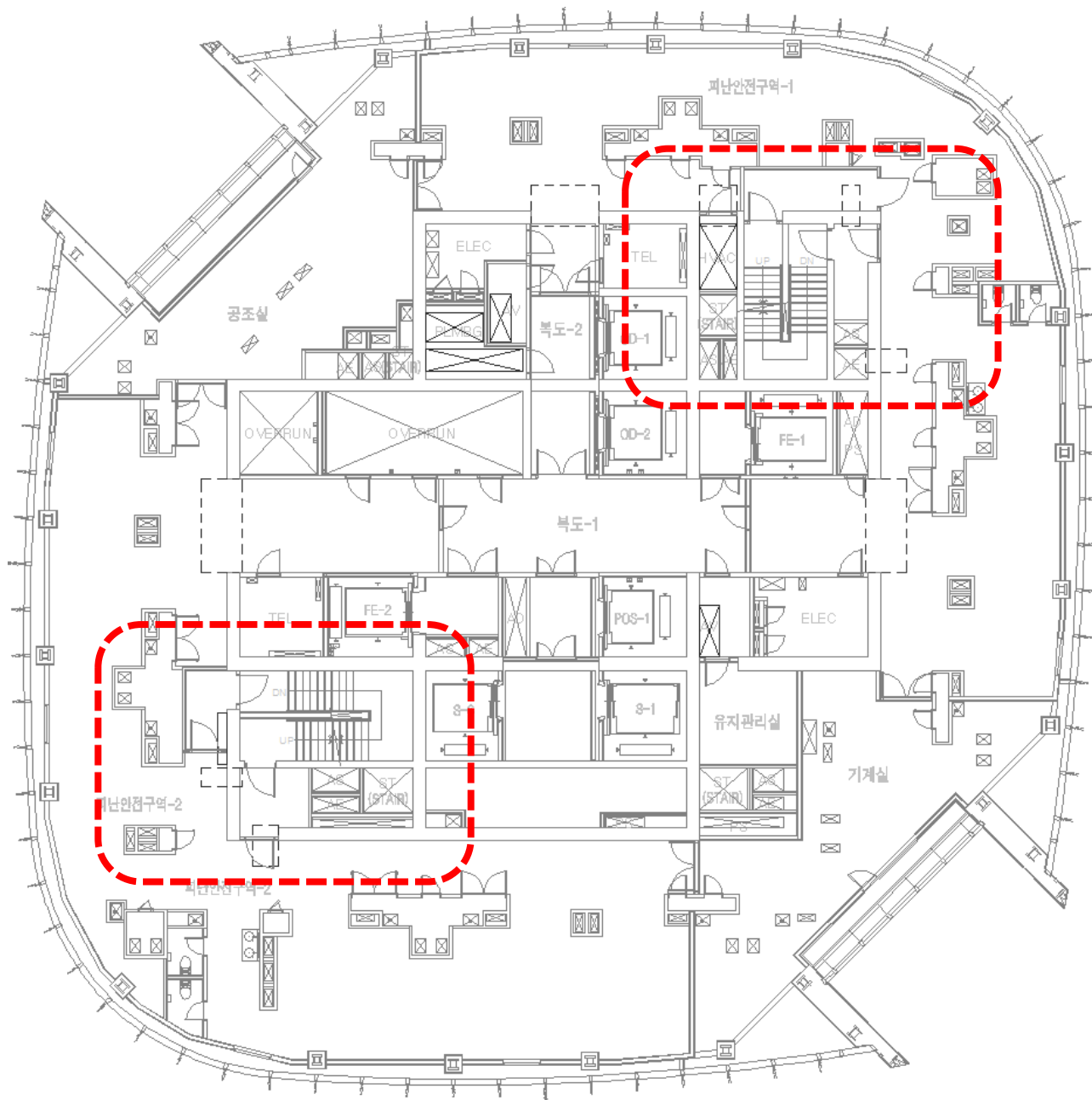
Exit Stair / Evacuation Elevator Using Ratio Analysis



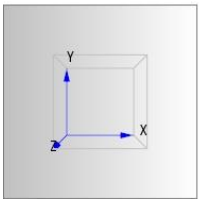
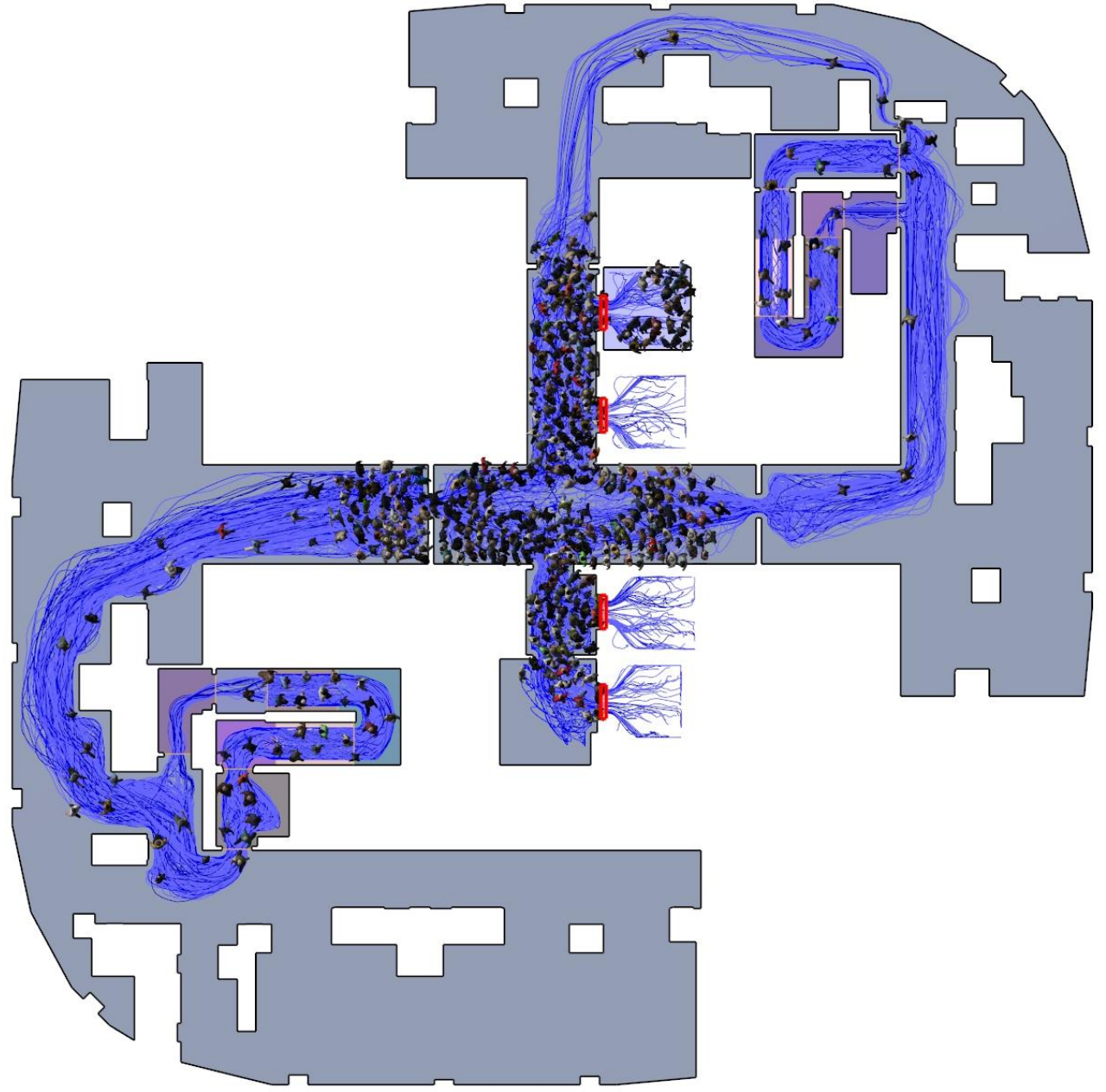
→ Evacuation Plan Optimization

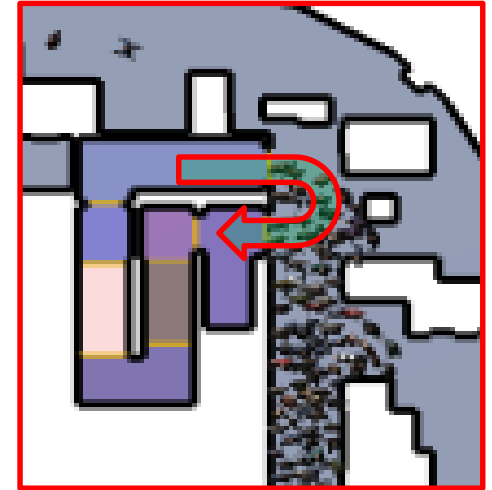
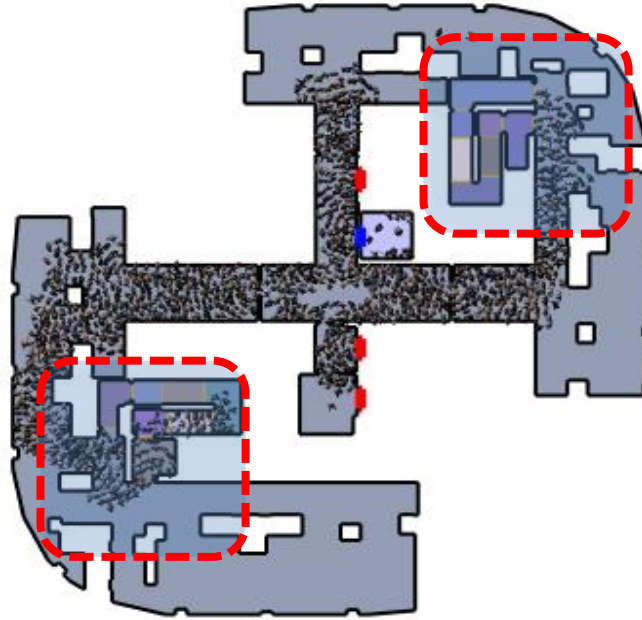
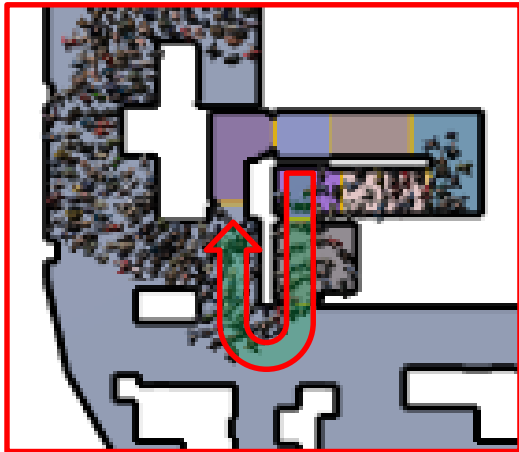
7. Major Focus of Disaster Management with Evacuation Simulation Study

- Ideal Design vs Real World
- Human Factor
- Disaster Management / Responder
 - Decision Making
 - Response During Emergency

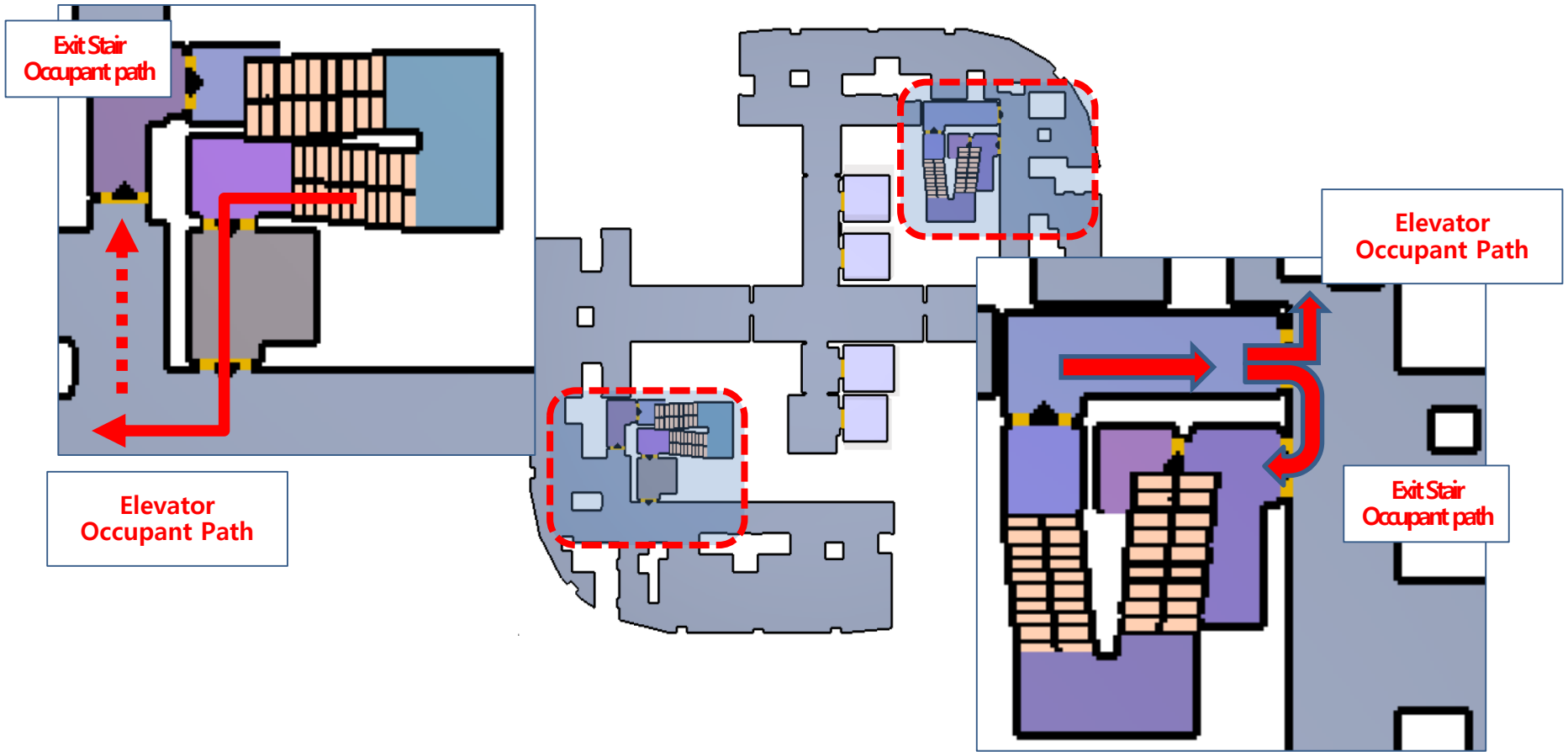


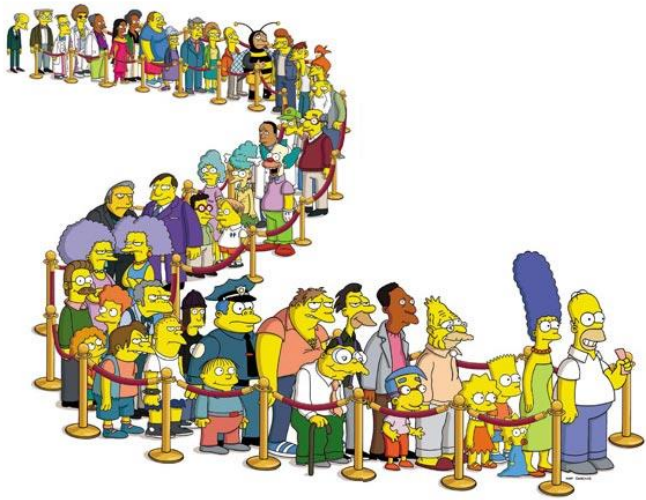


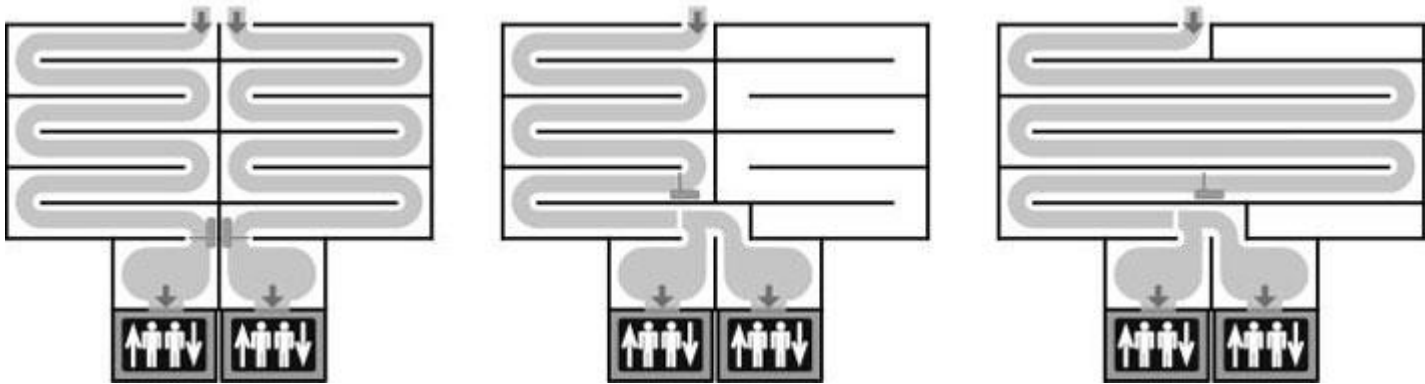




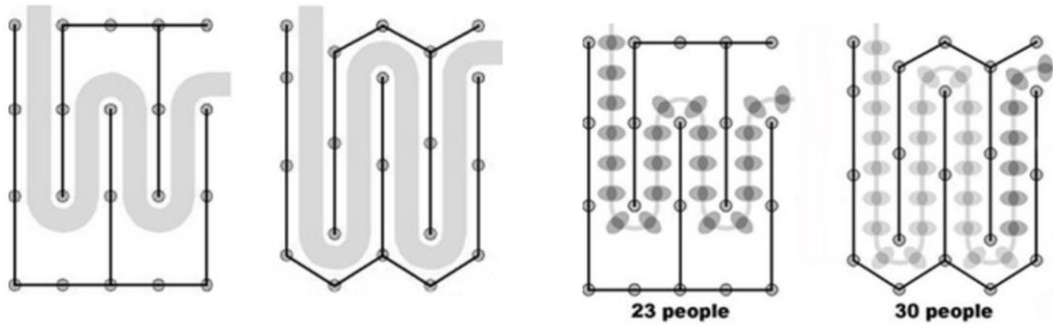
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'Normal' layout. Wasted space. Improved layout.

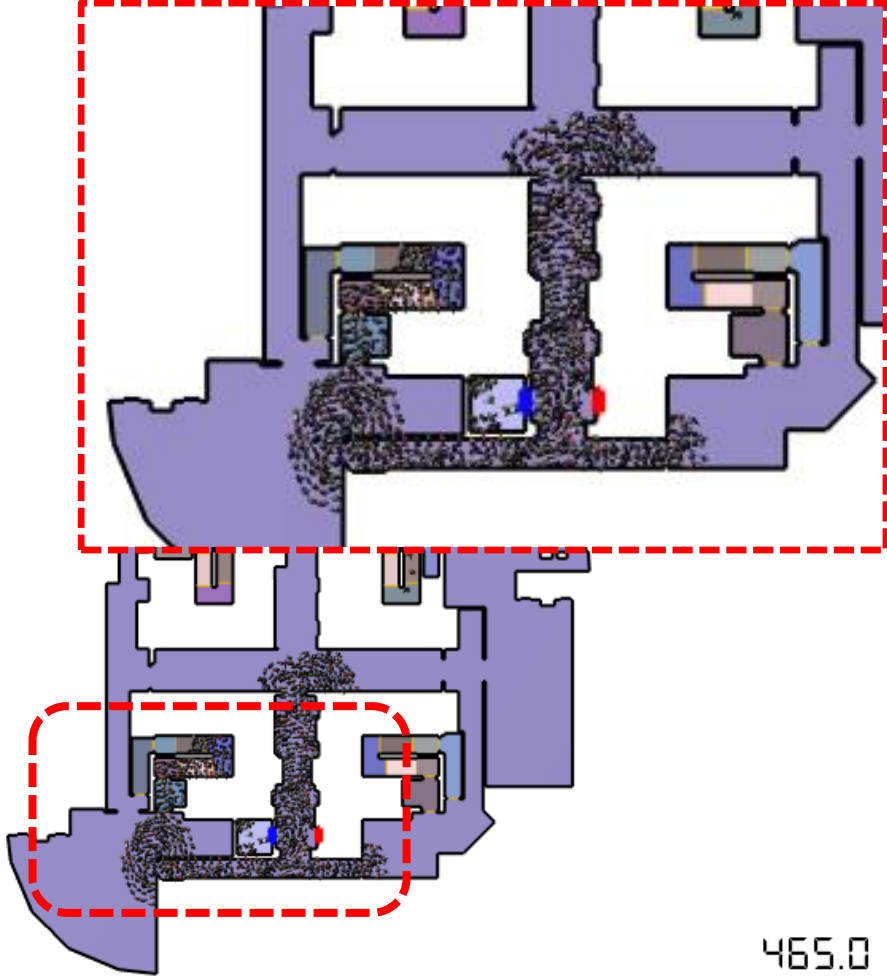


23 people

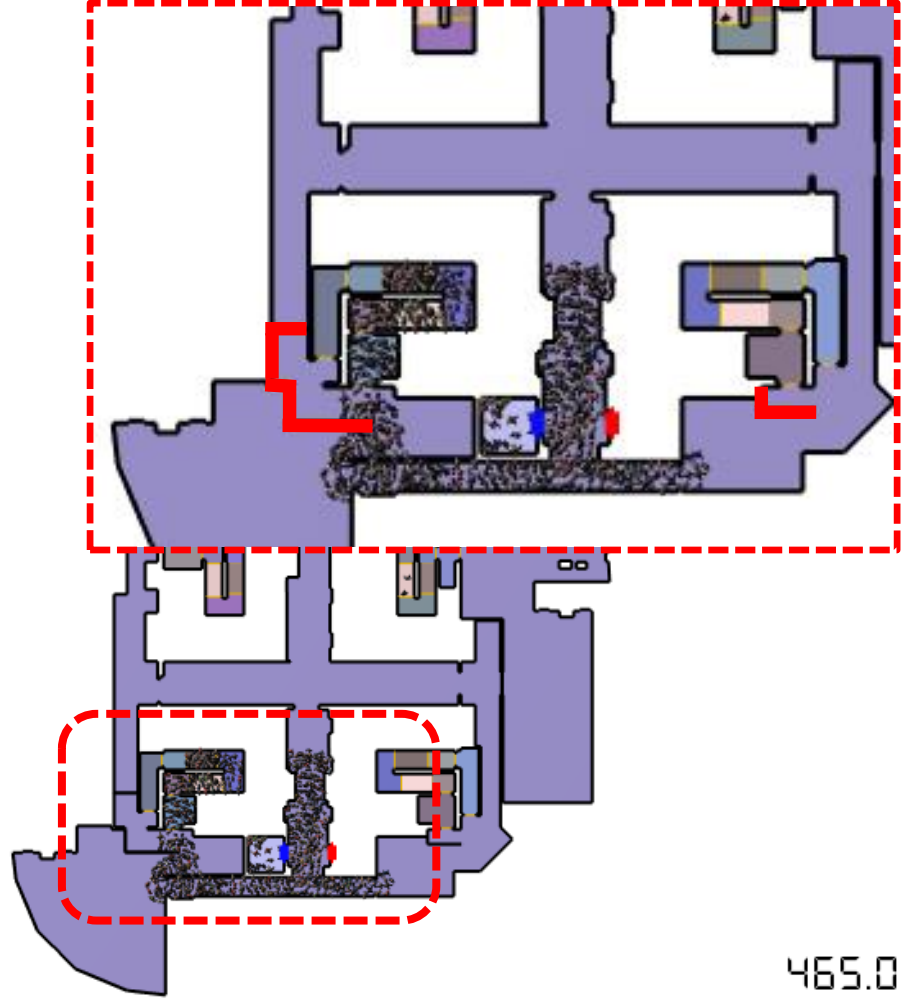
30 people







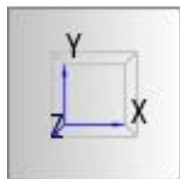
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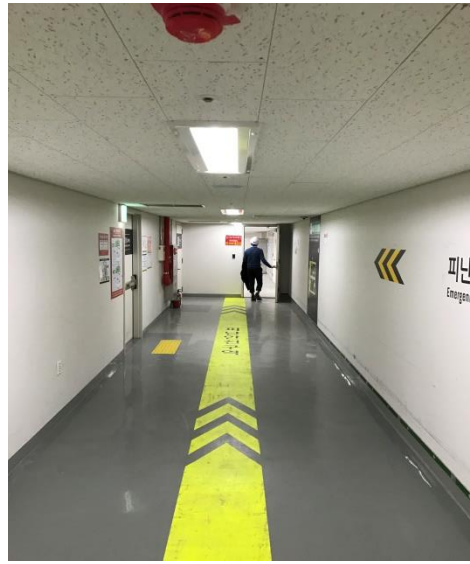
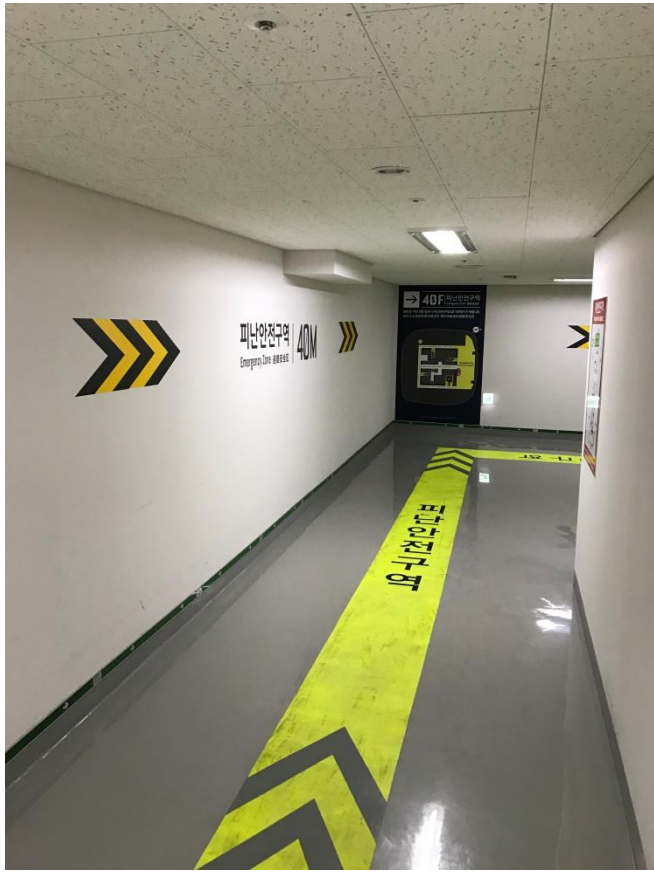


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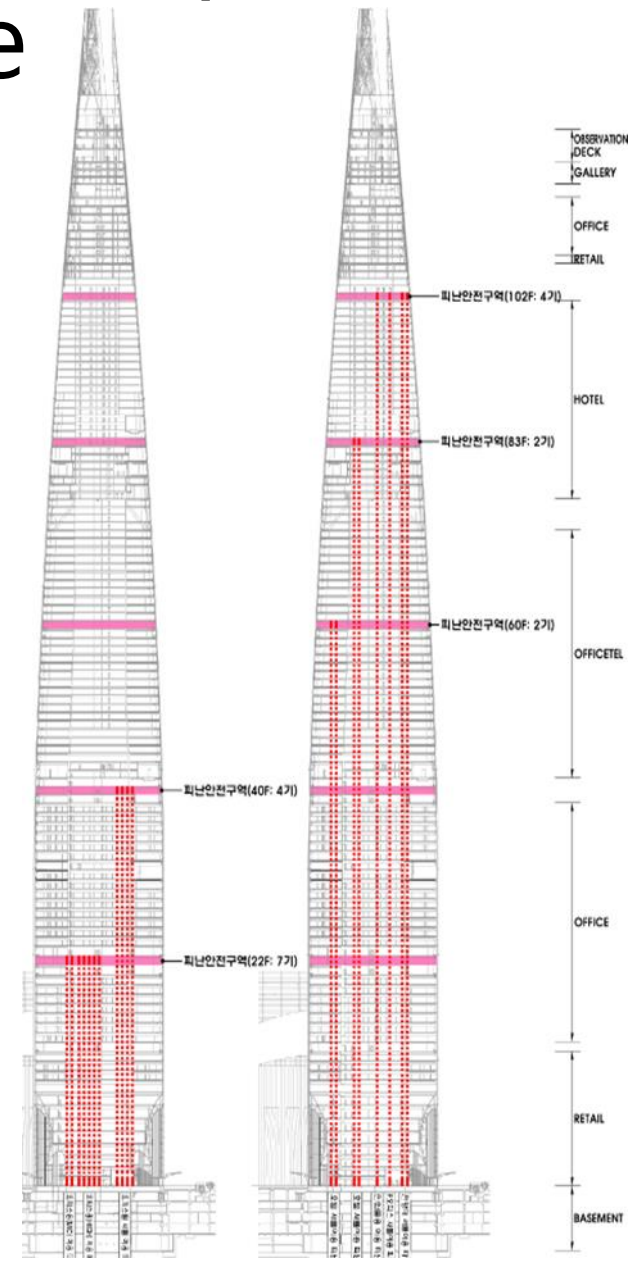
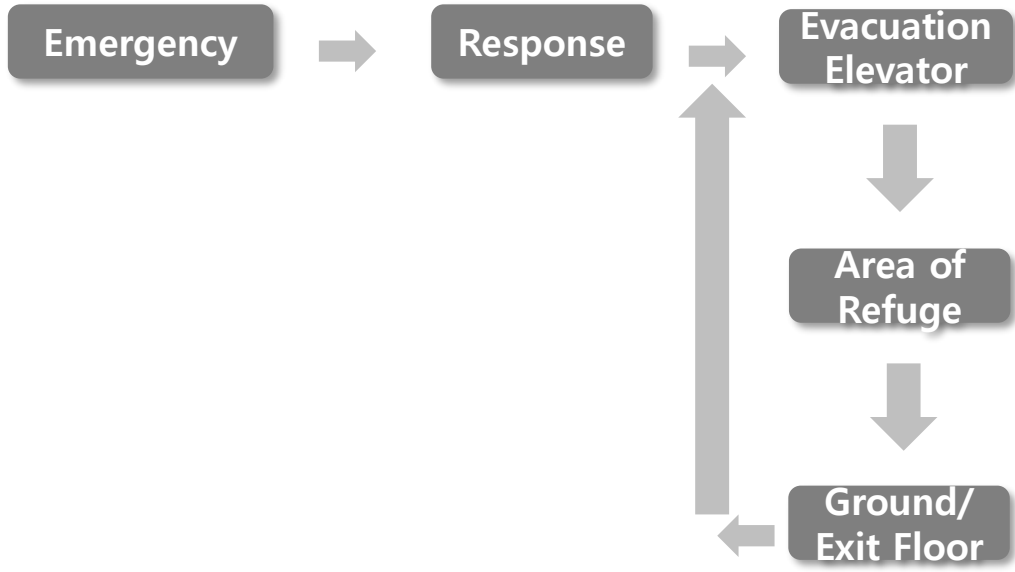


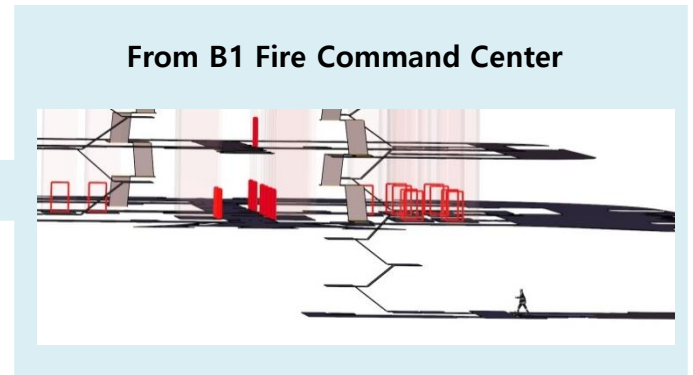
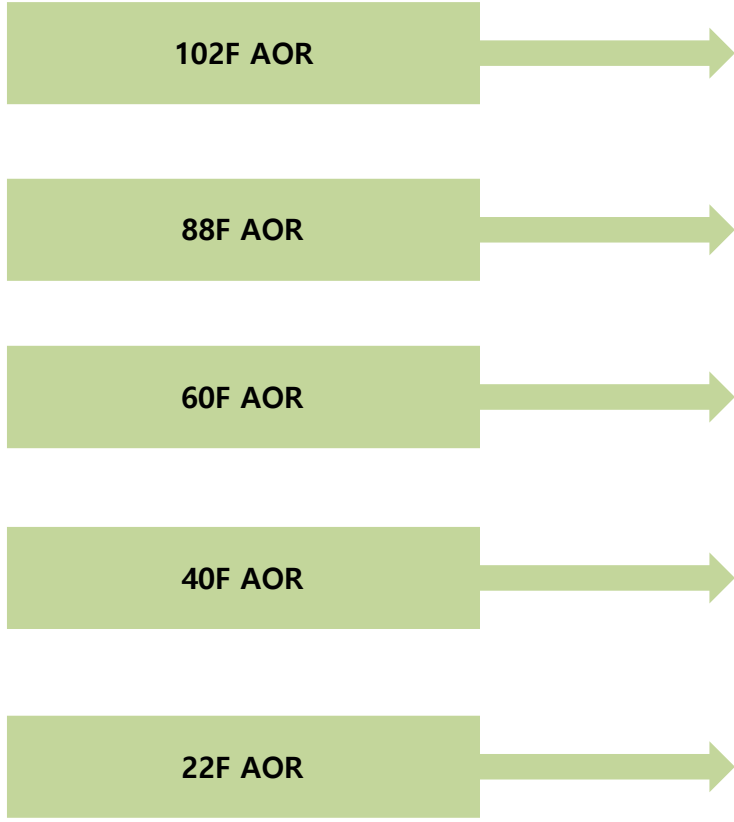
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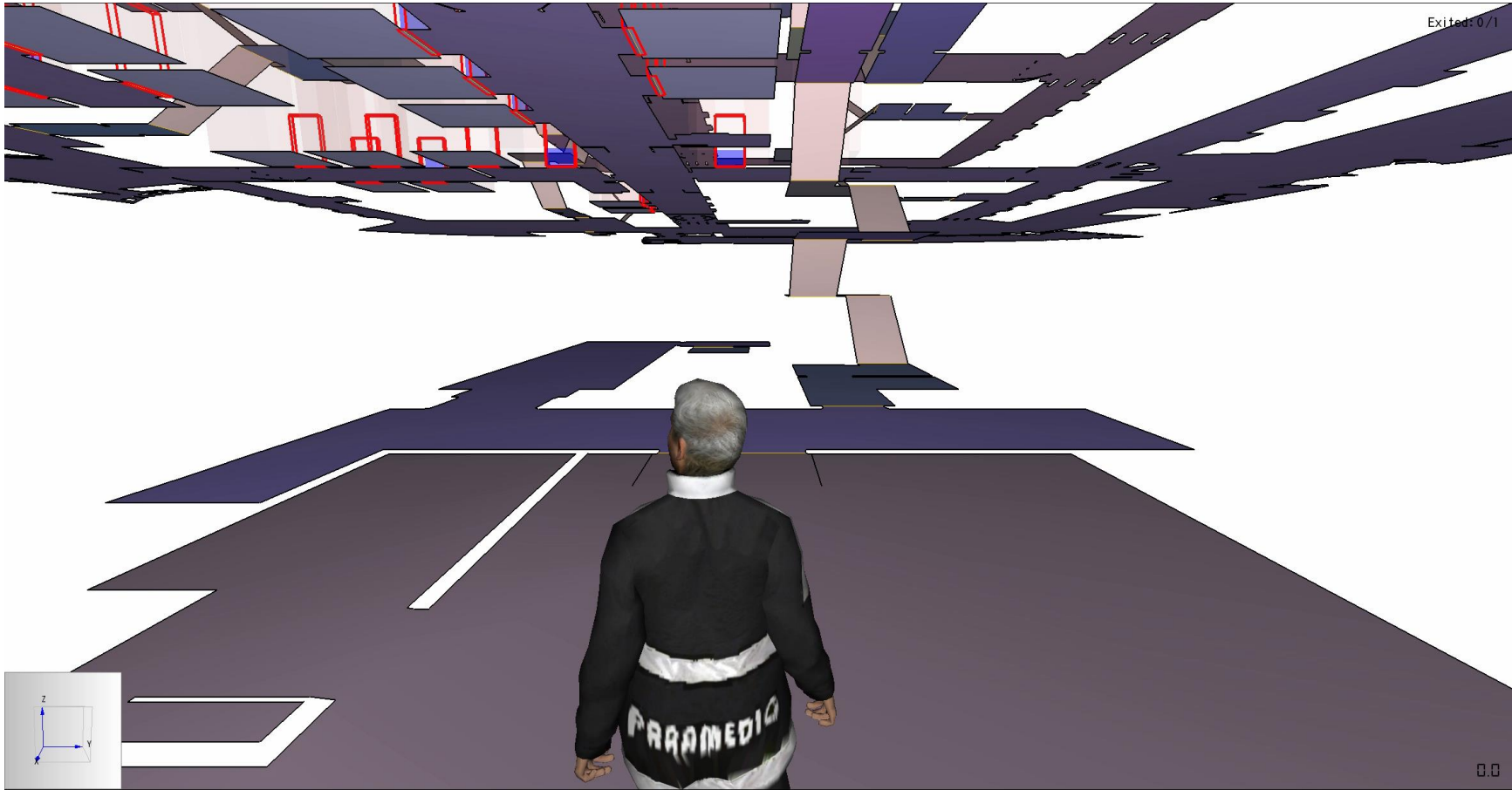




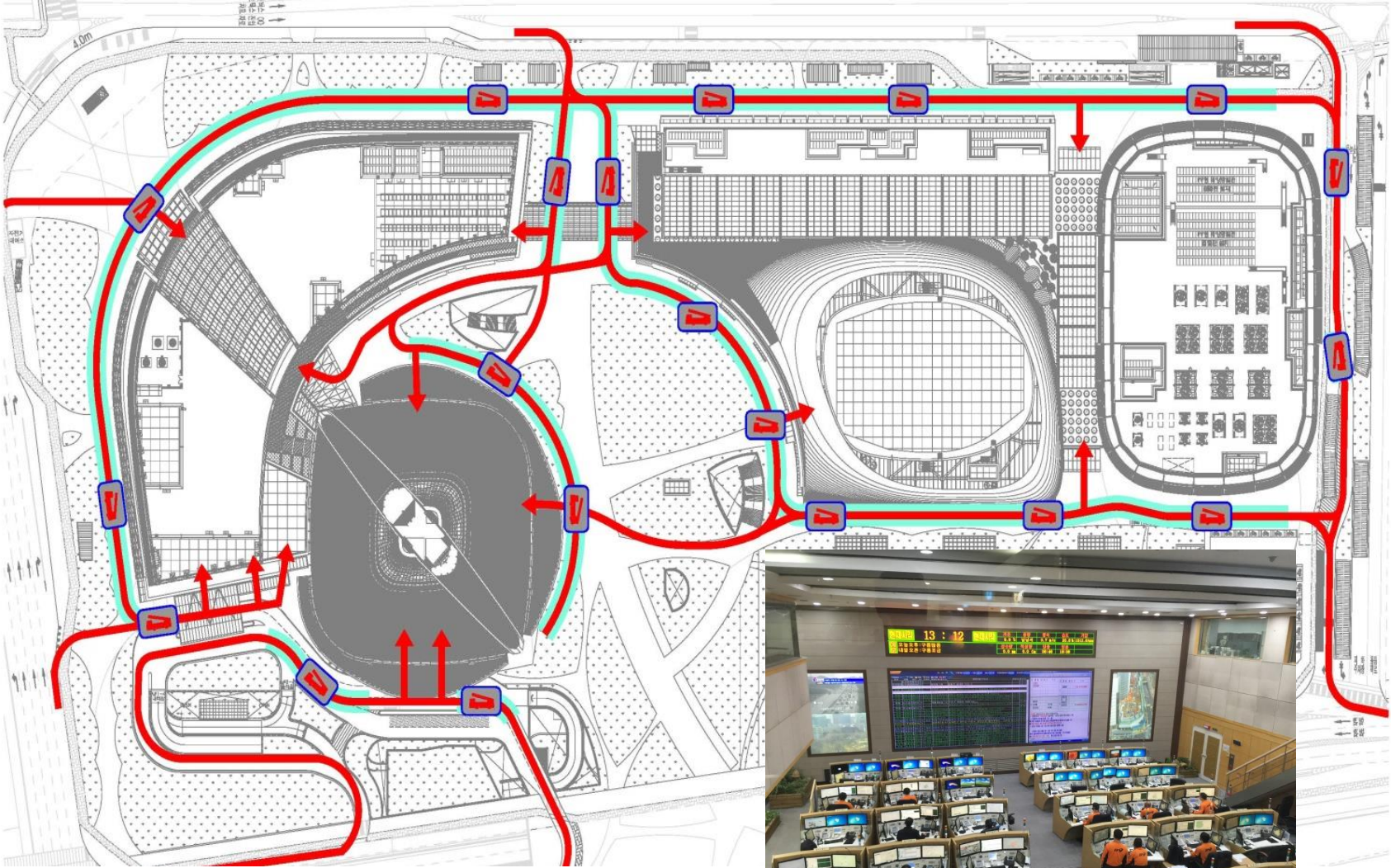
8. Disaster Management Response Plan/Procedure

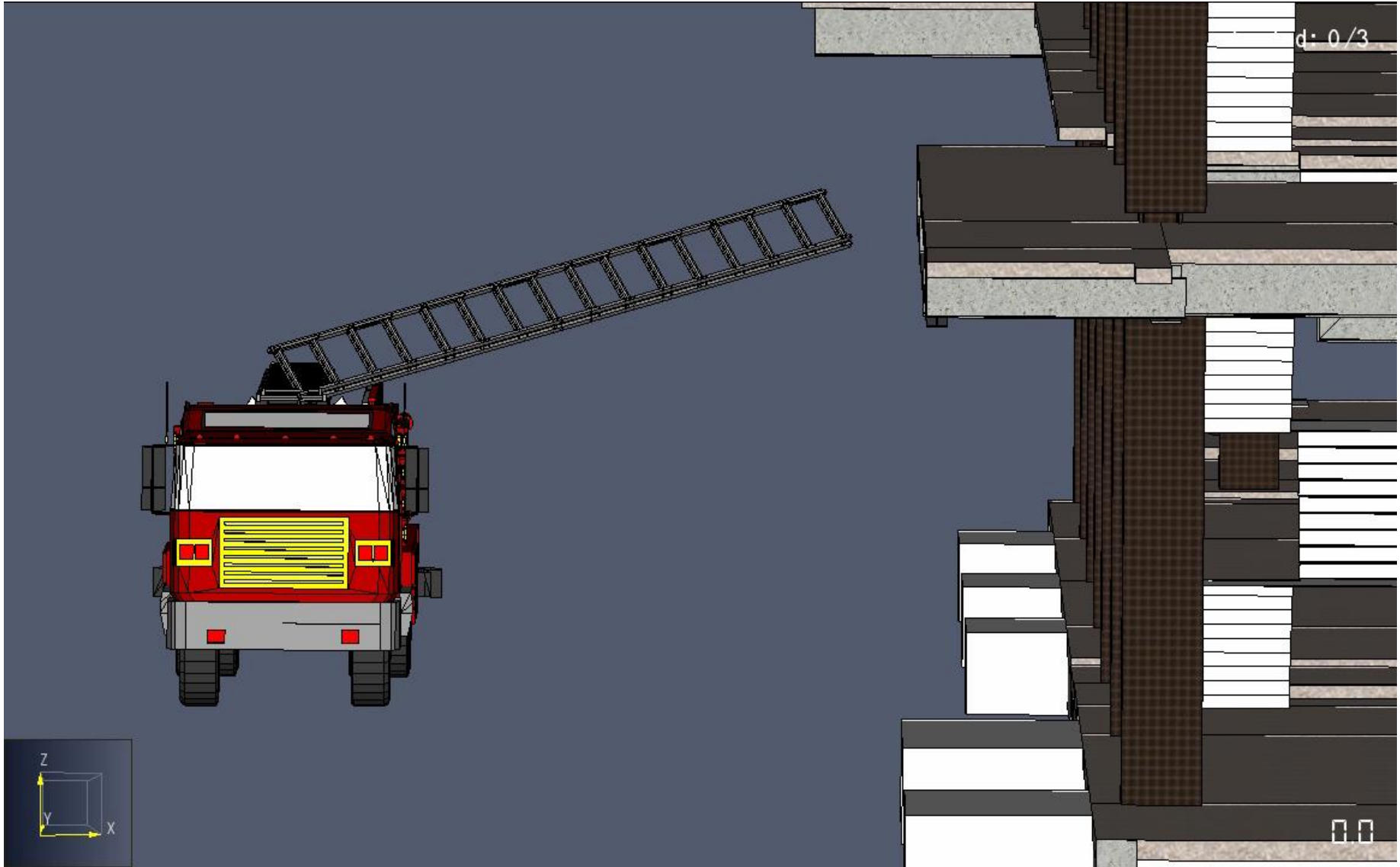




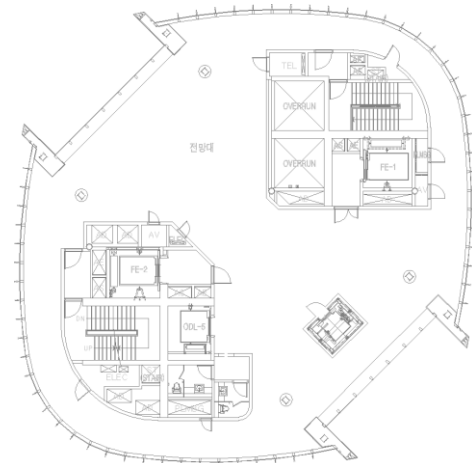
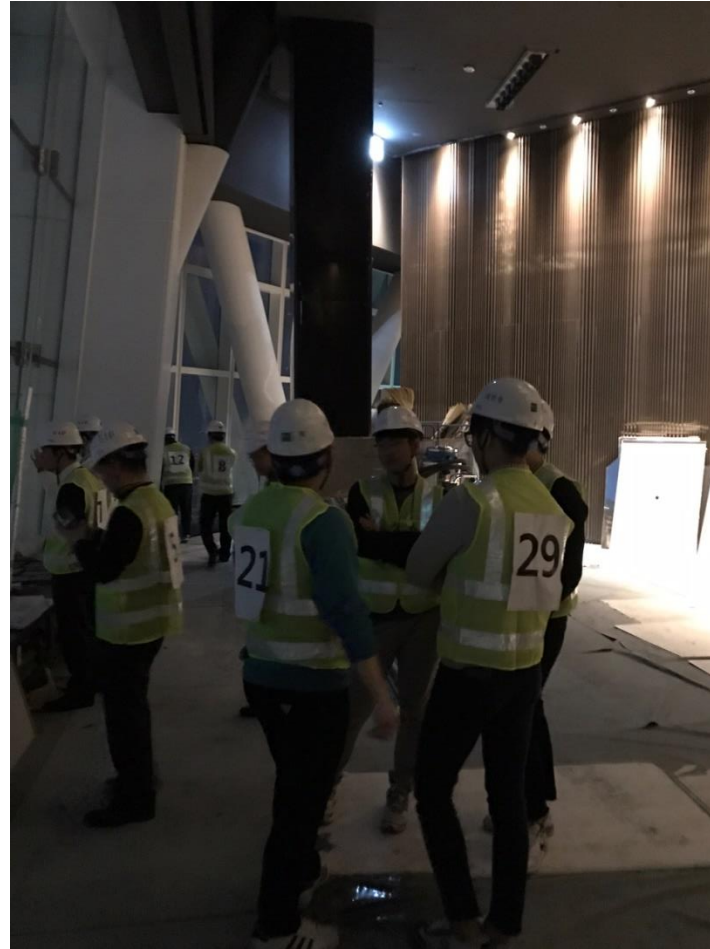


Fire Department Access Plan

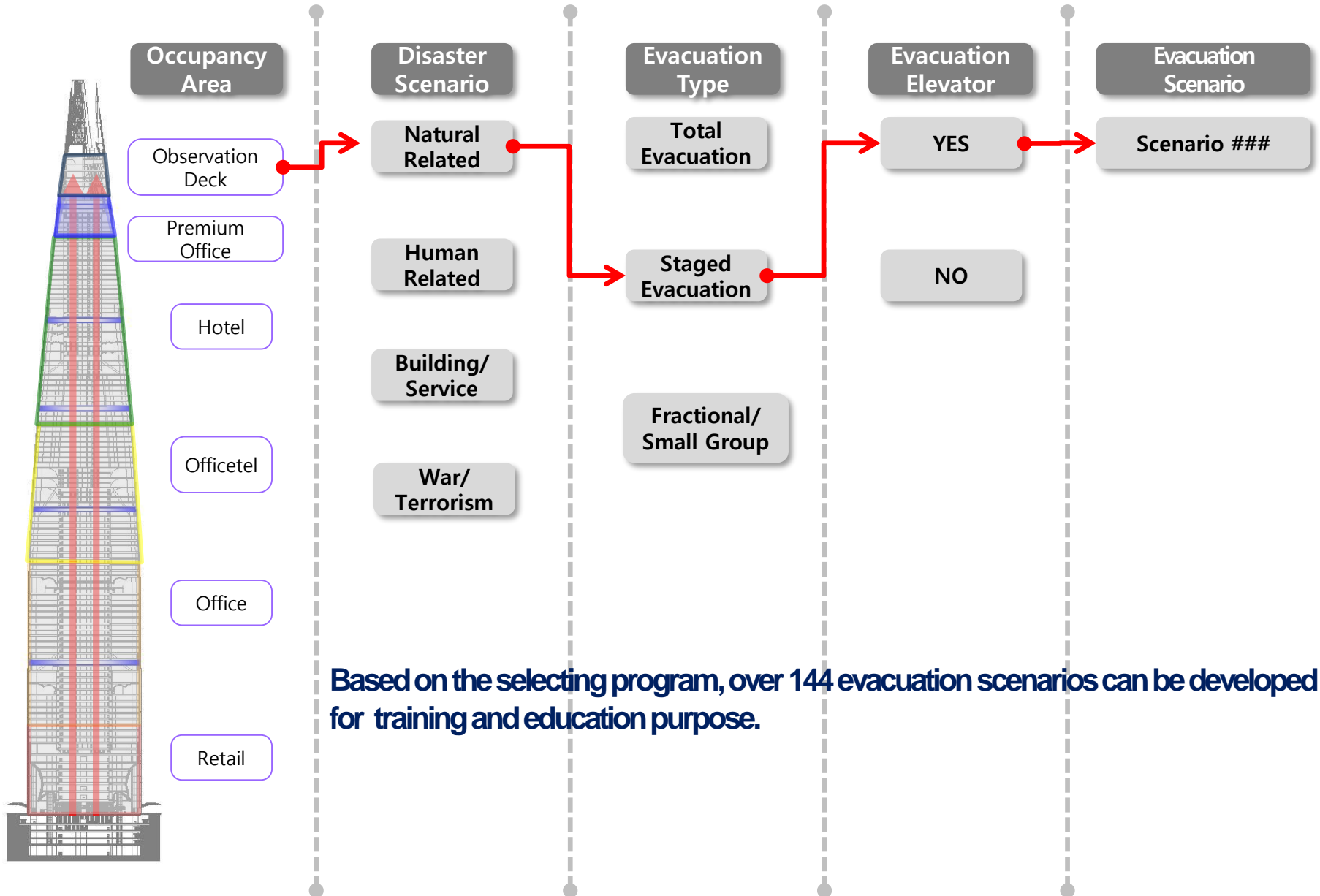


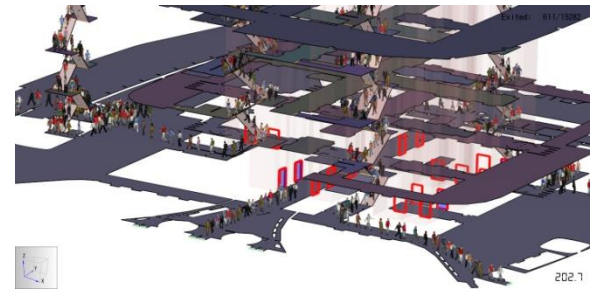
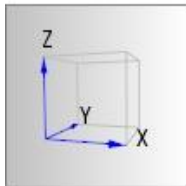


9. Fire Evacuation Training / Drill / Education



Super Tall Building Evacuation Scenario Module Selecting Program





10. Conclusion

- Simulation can be used to develop detail of Disaster Management and Emergency Response Procedure/Process
- Establish Goals
- Save Cost and Time vs Actual Training / Drill
- Training, Education and Practice Reference / Back-up Data

Thank You!

Q&A

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Innovative technology
Safety service

70TH
SINCE 1947

“
고객의 재산과 생명을
지키는 우리의 도전은
계속됩니다
”

주요업무

- 전문소방시설 설계, 감리, 점검, 공사 · 소방시설 내진설계 · 정보통신 감리업
- 화재안전진단 · PDB(성능위주설계) · 사전재난 영향평가 · 화재, 피난 시뮬레이션
- 재난대응 매뉴얼 · 4개 원자력 발전본부 및 제주, 인천공항 소방대 운영

주요인증

- ISO9001(품질경영시스템) · ISO14001(환경경영시스템)
- KOSHA18001(안전보건경영시스템) · 한국서비스품질 우수기업 인증
- 경영혁신 중소기업(MAIN-BIZ) 인증 · 소방시설 점검 능력평가 1위 (2012~2014)

 **한방유비스(주)**
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