

# Building Services



## ASSIGNMENT 01: Services in High-rise Buildings (BLD61904)

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# 1.0 PROJECT INTRODUCTION

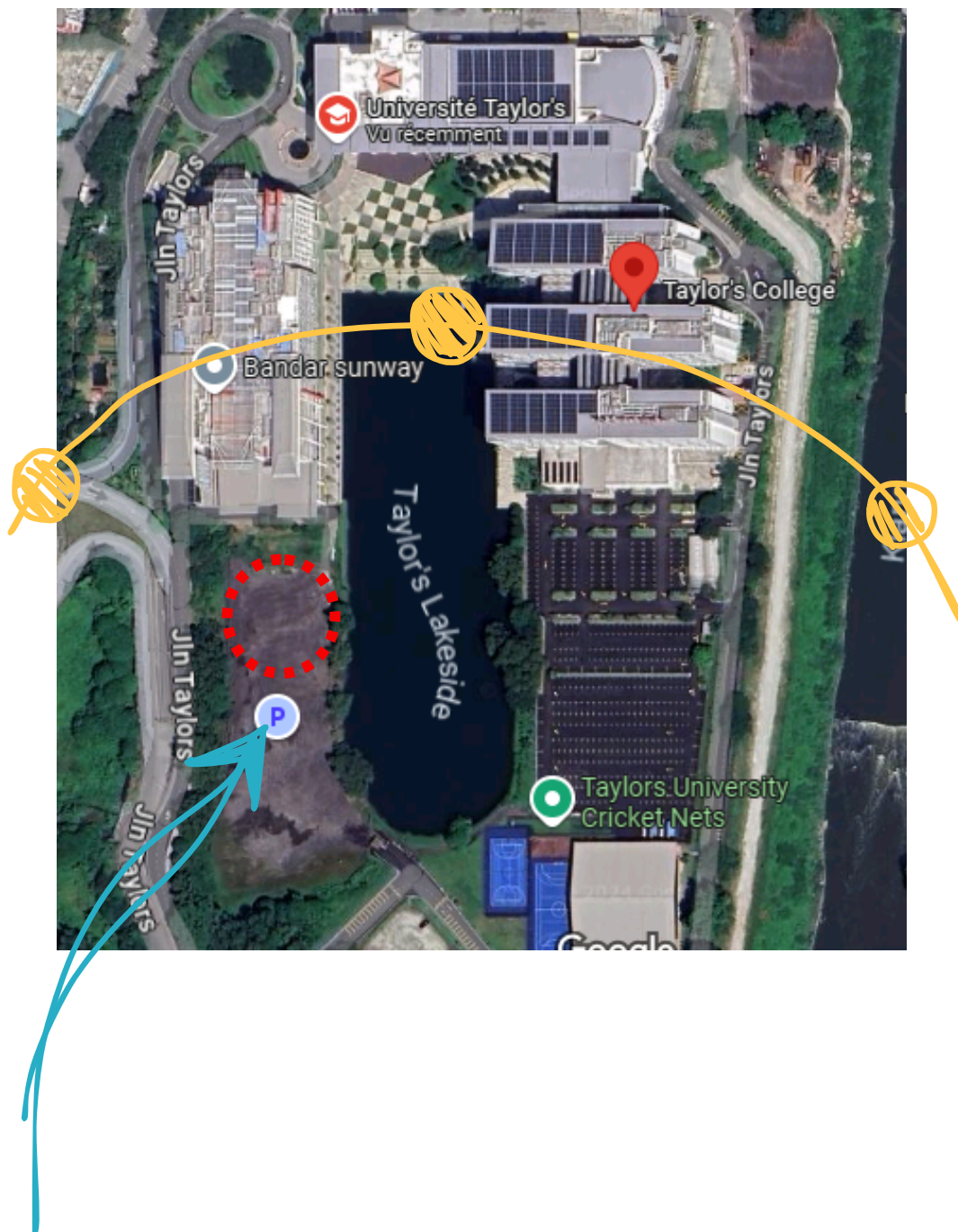
Aishath Hanaan Ibrahim (0356681)

# 1.1 PROJECT OVERVIEW

The project involves the planning of a tall building to be constructed for Taylor's University to meet the increased needs of students and staff. The structure will consist of basement car park, class rooms, lecture halls, and hostels for students, which would be backed by all the necessary building services systems such as mechanical heating systems, centralized air conditioning systems, active and passive fire systems, and vertical transportation (lifts). The scope of work includes the provision of security, solace, and convenience to all the users while maintaining the existing aesthetics of the campus buildings. It would be supplemented with the provision of floor plans, system simple sketches and narration to demonstrate service provision and interdependence and operation of the proposed services.

# 1.2 SITE INFORMATION

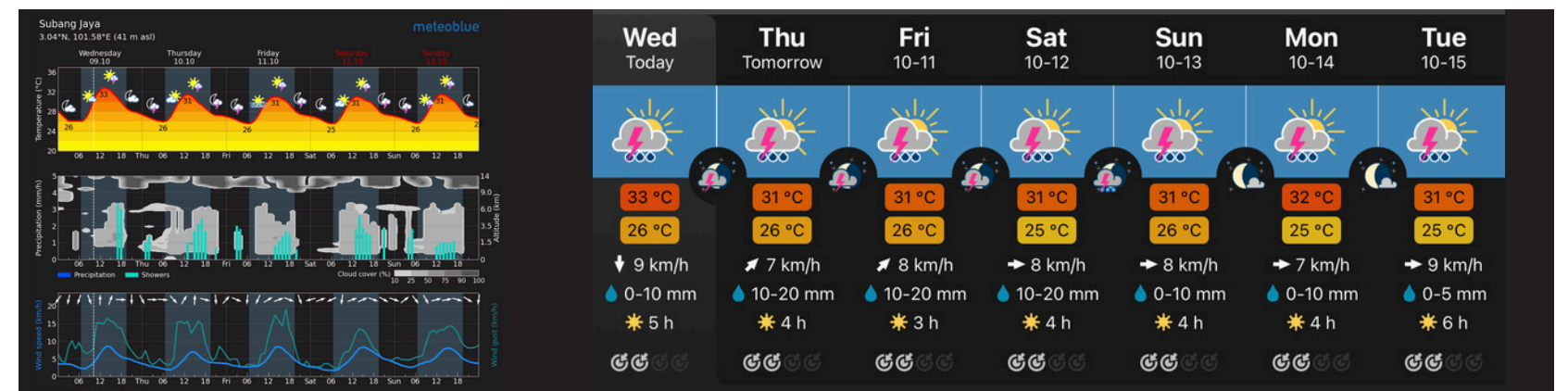
**Location:** 1, Jln Taylors, 47500 Subang Jaya, Selangor



Views



Climate Conditions

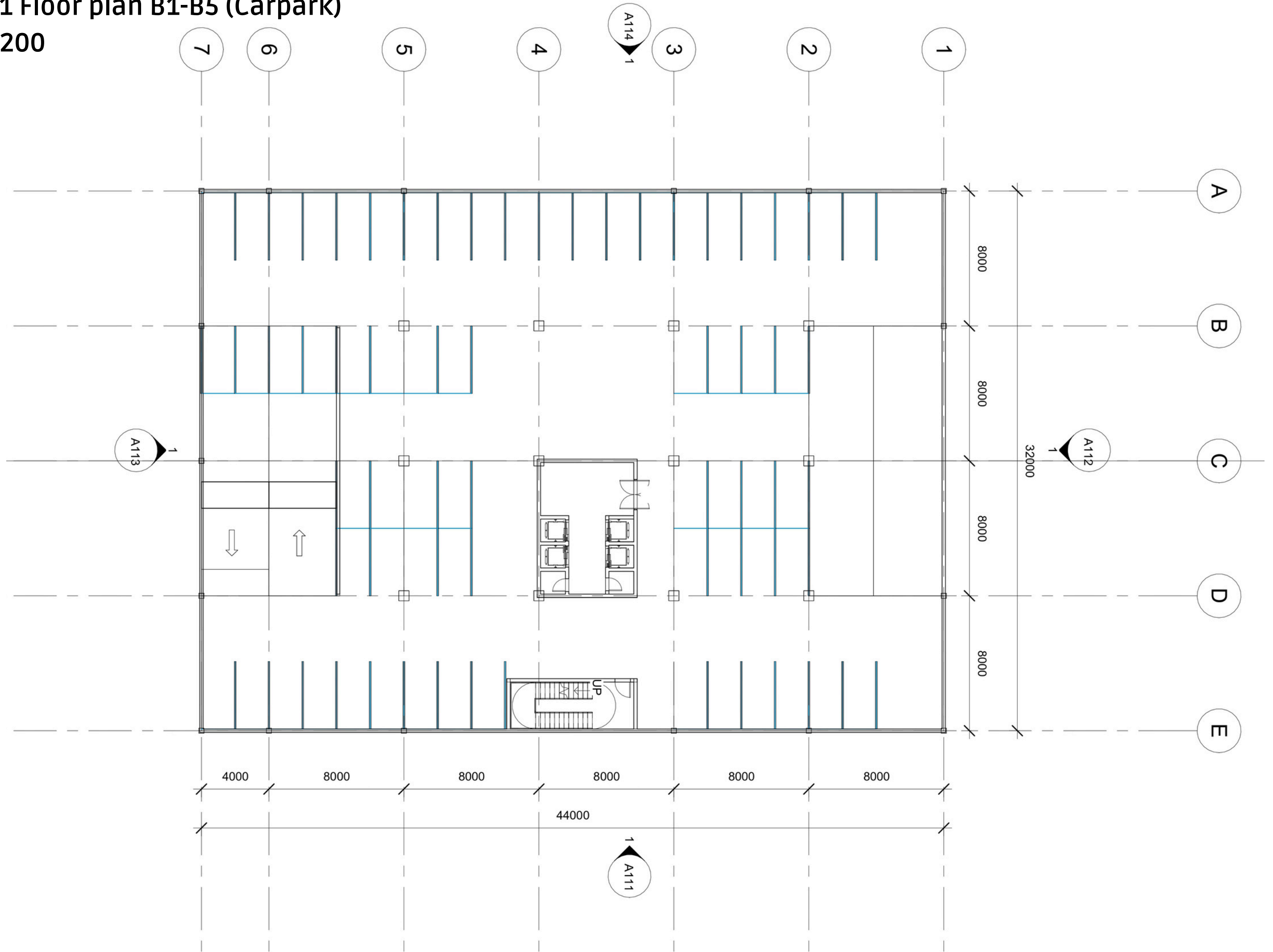


# 2.0 ORTHOGRAPHIC DRAWINGS

Zareen Tasnim Bushra (0351208)

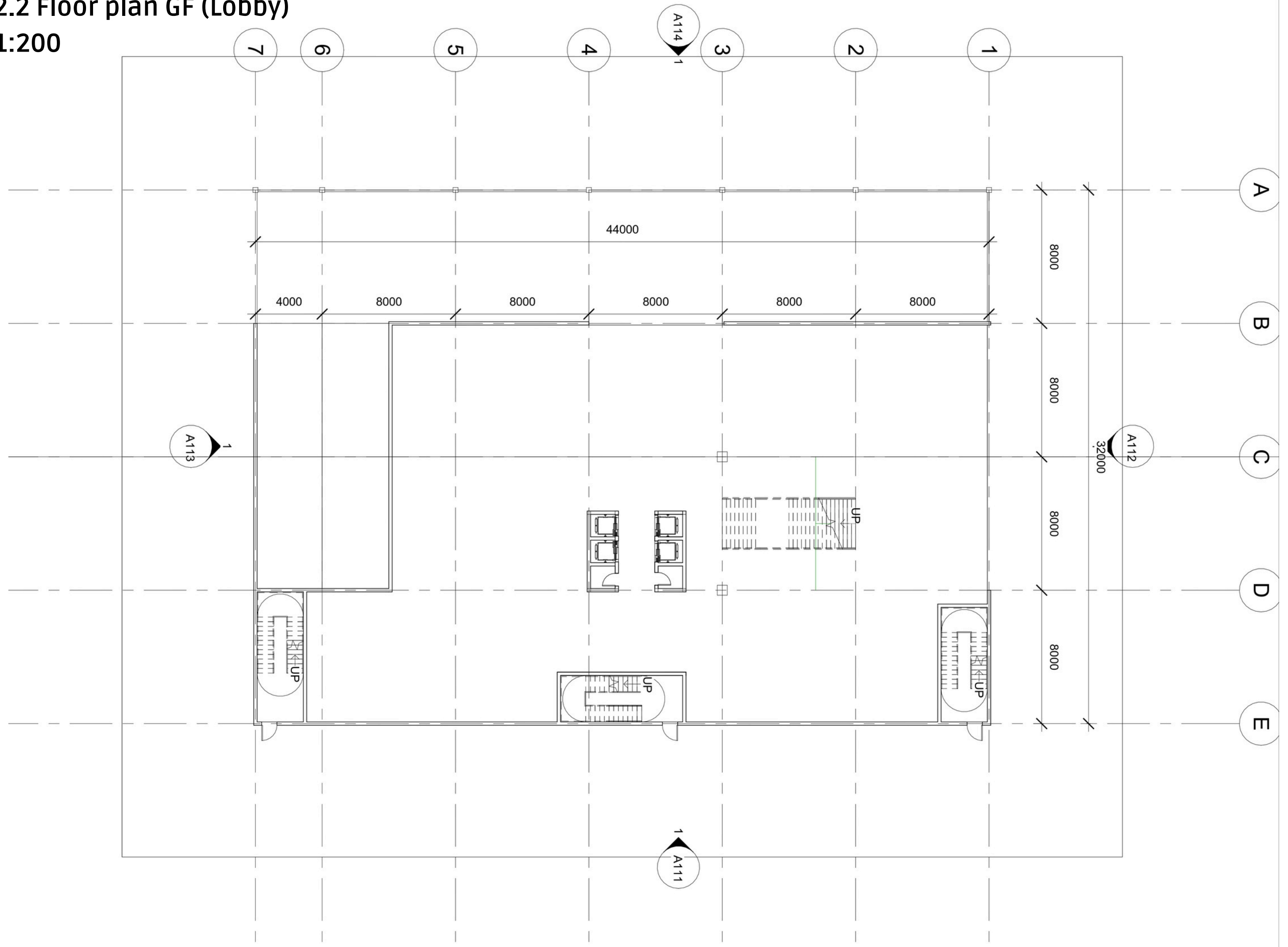
# 2.1 Floor plan B1-B5 (Carpark)

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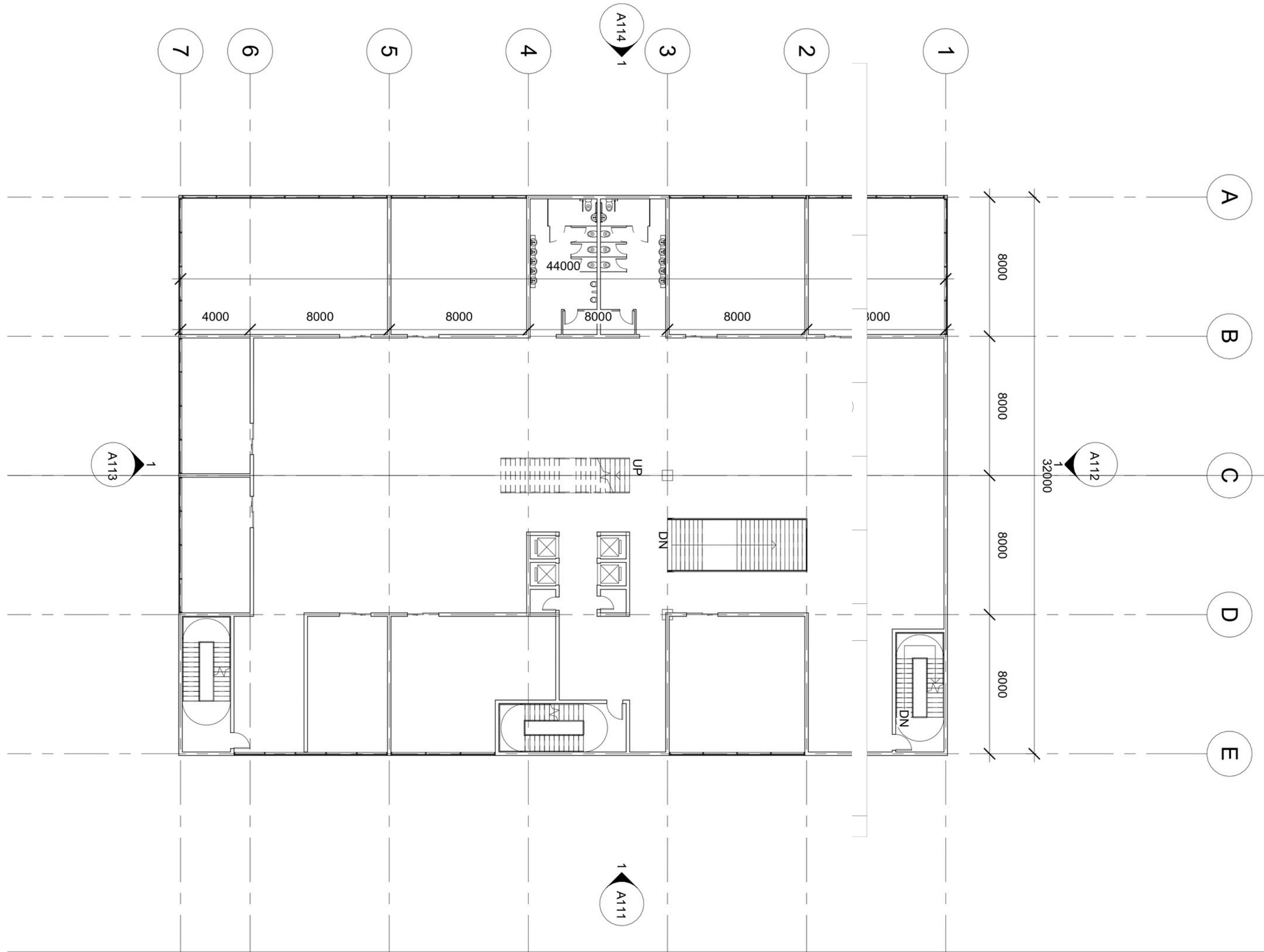
# 2.2 Floor plan GF (Lobby)

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# 2.3 Floor plan Mezzanine (Shoplots)

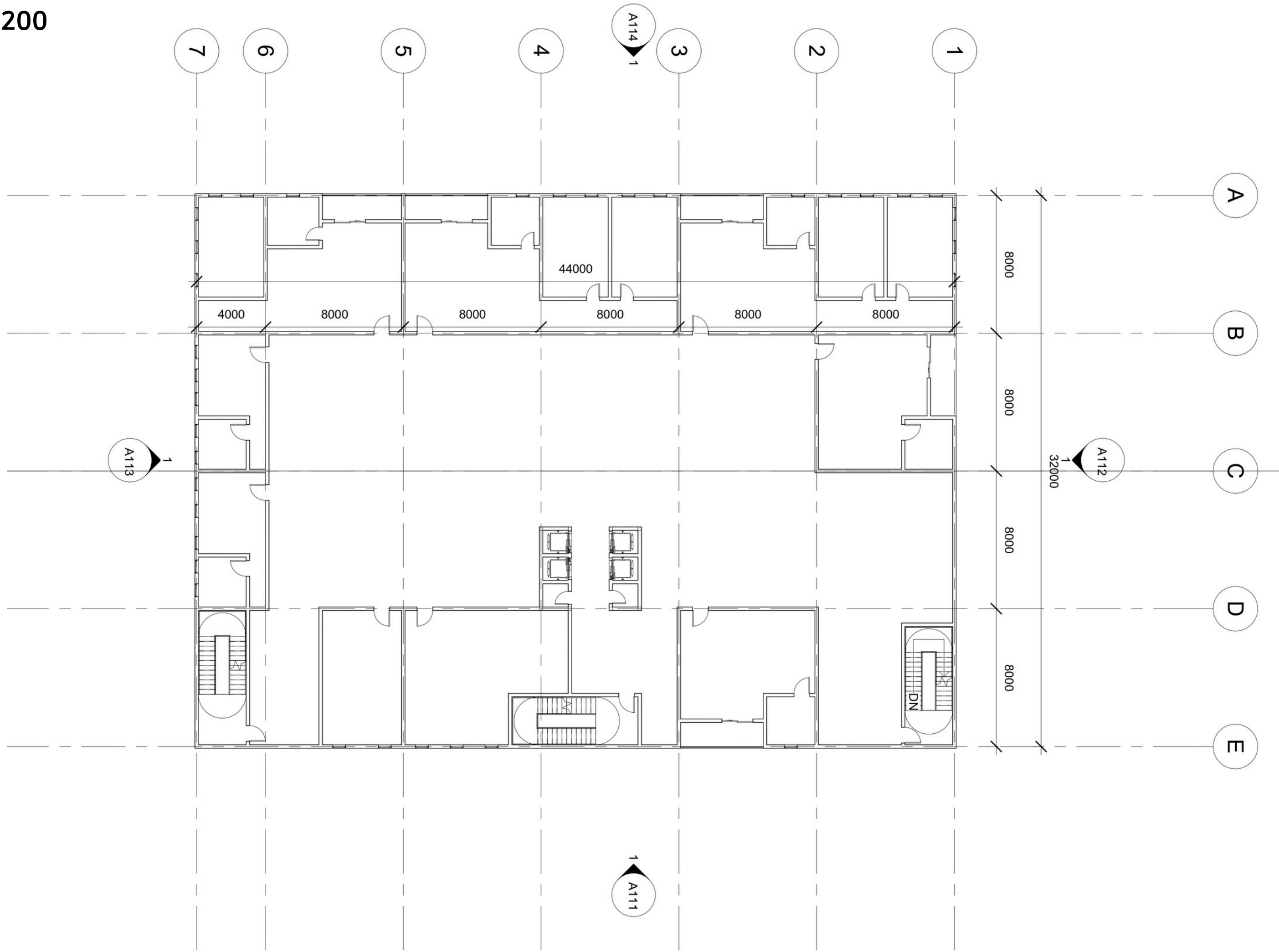
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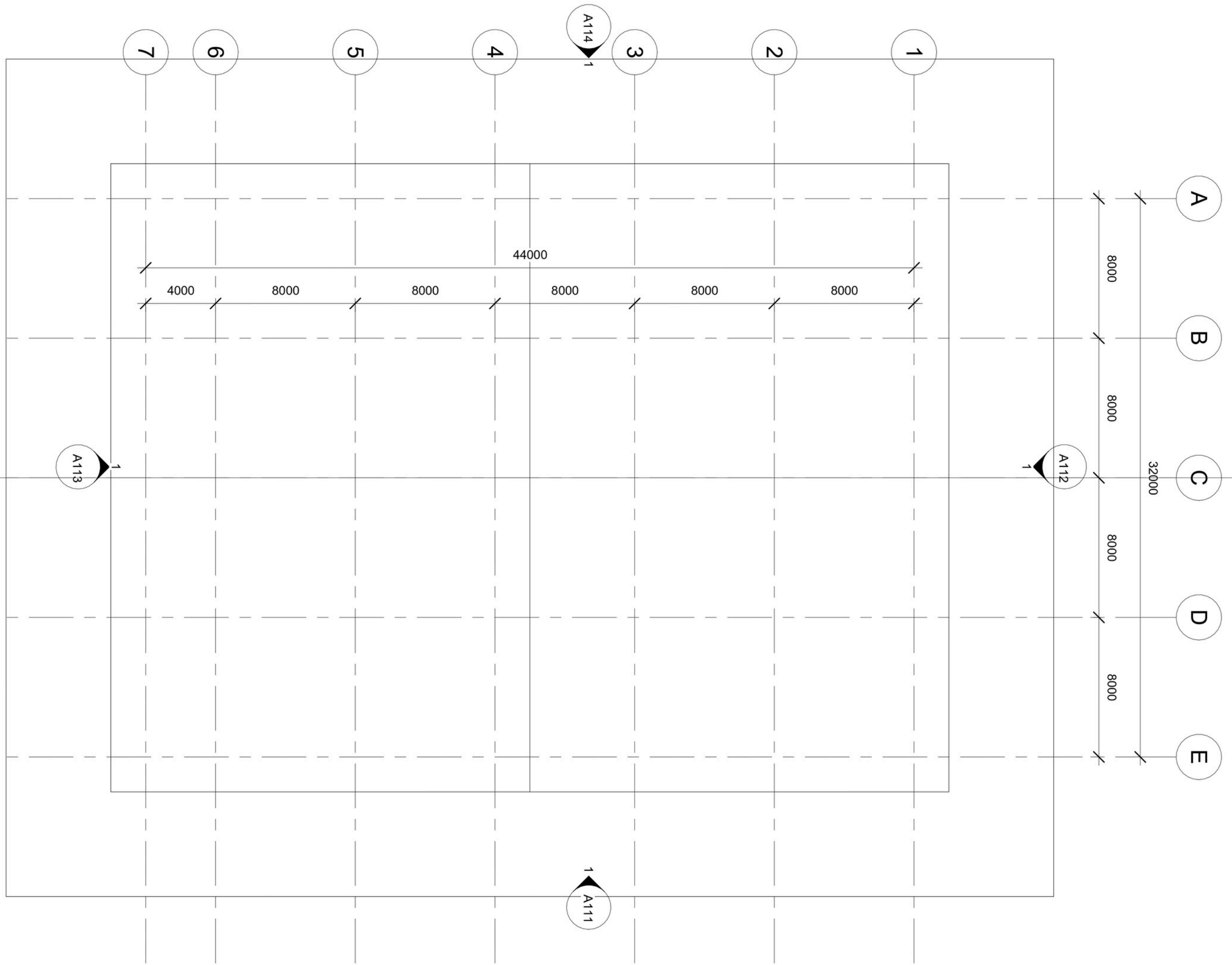
# 2.5 Floor plan L11-L18 (Hostel)

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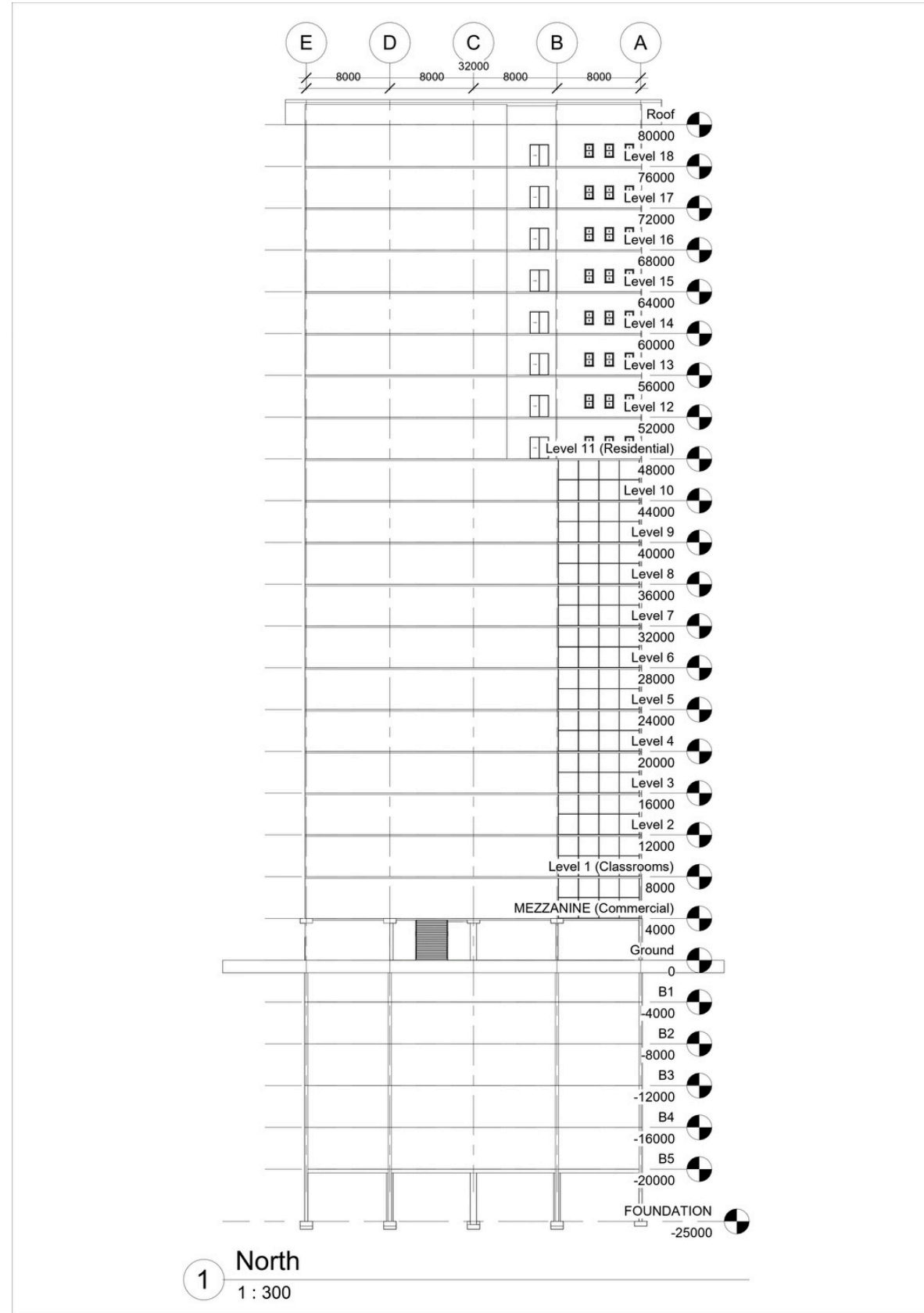
# 2.6 Roof plan

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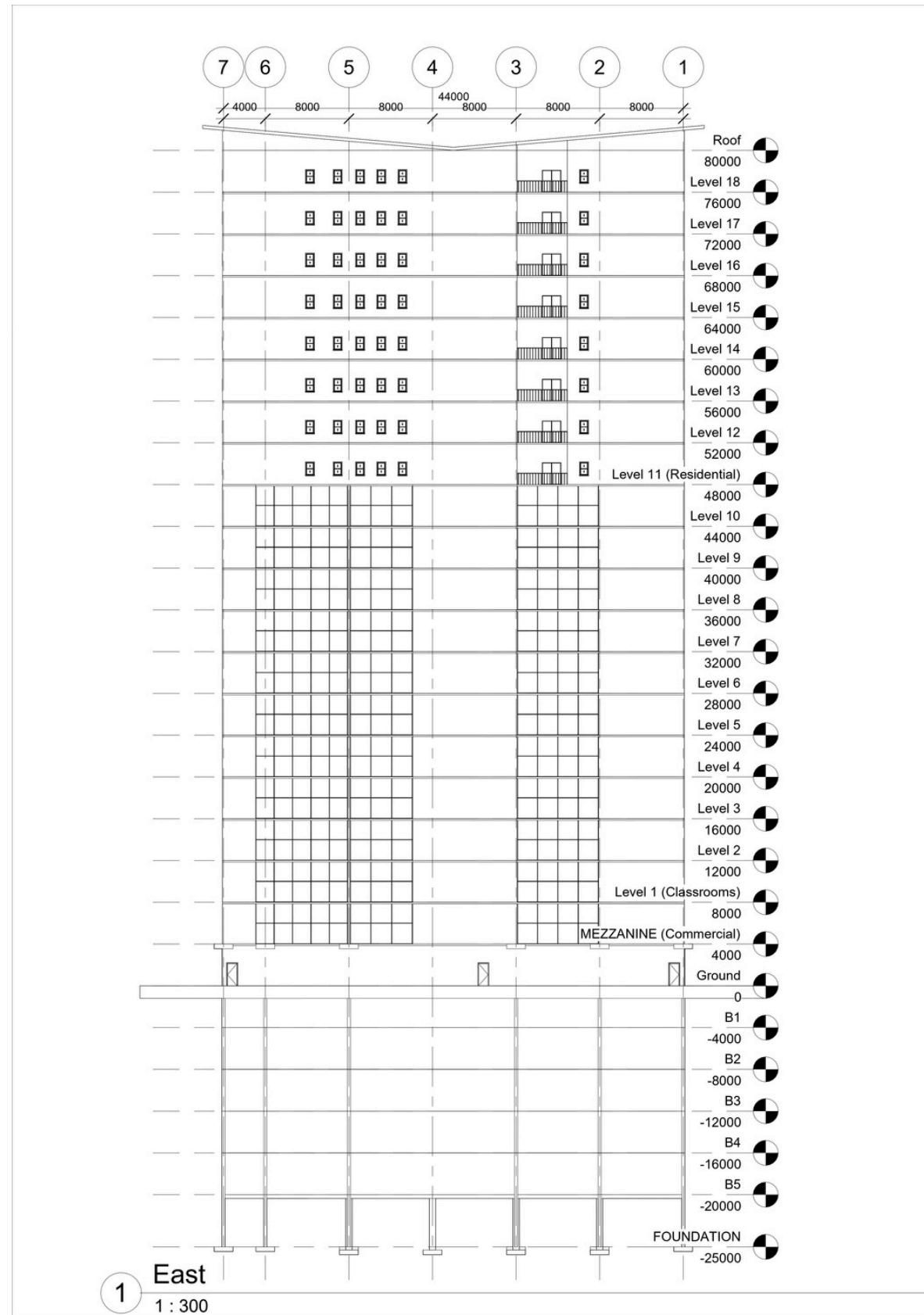
# 2.7 North elevation

N.T.S



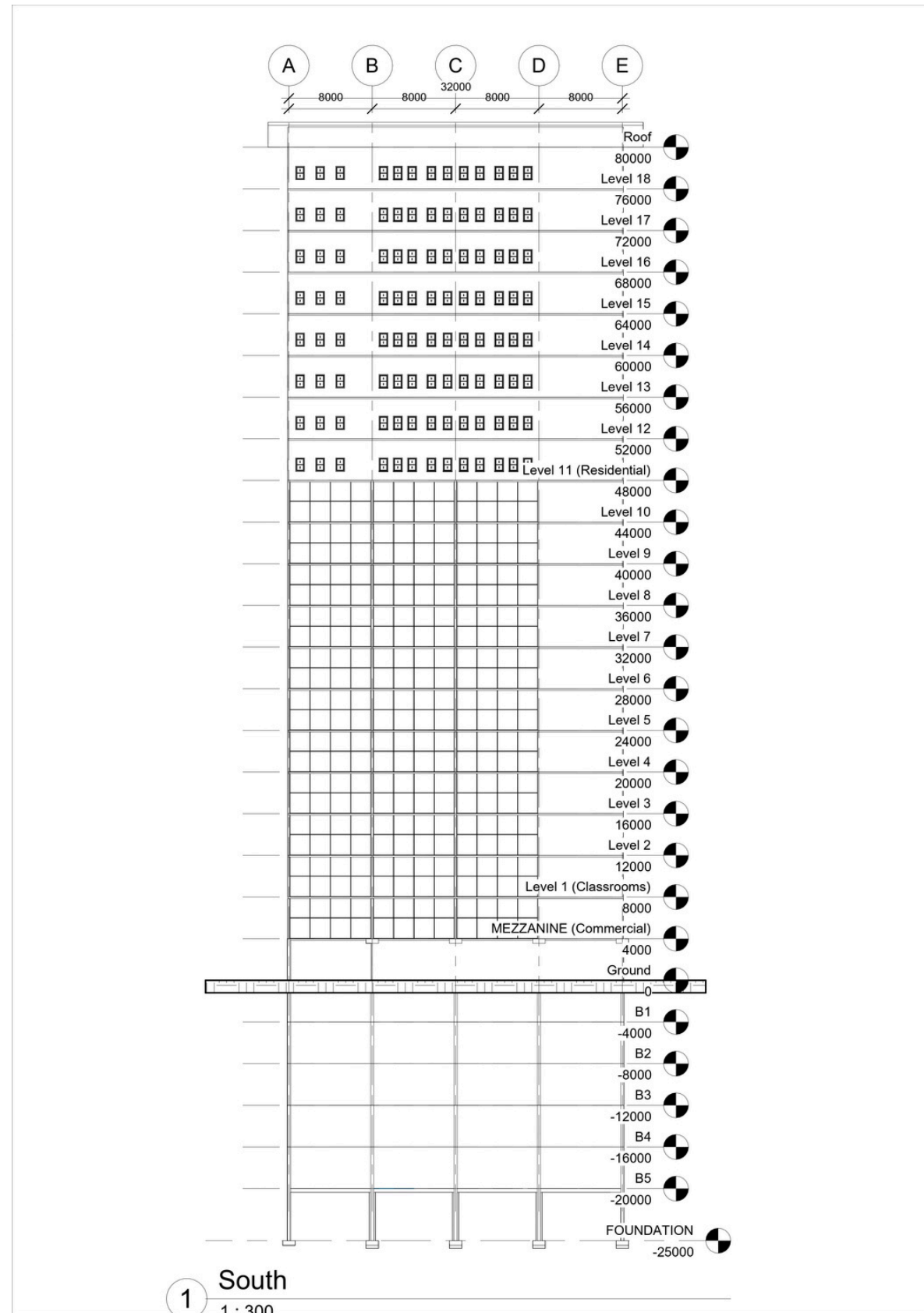
# 2.8 East elevation

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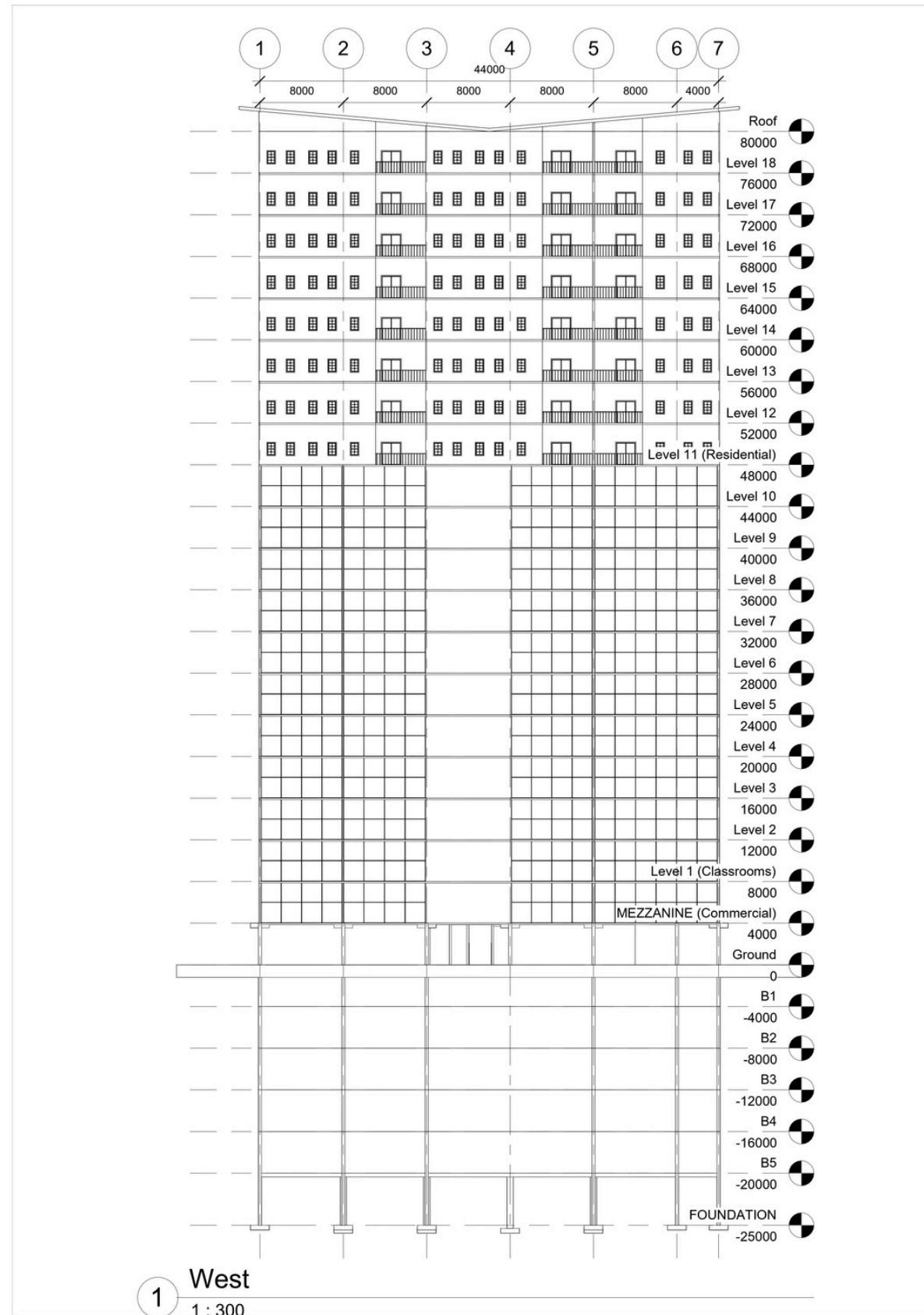
# 2.9 South elevation

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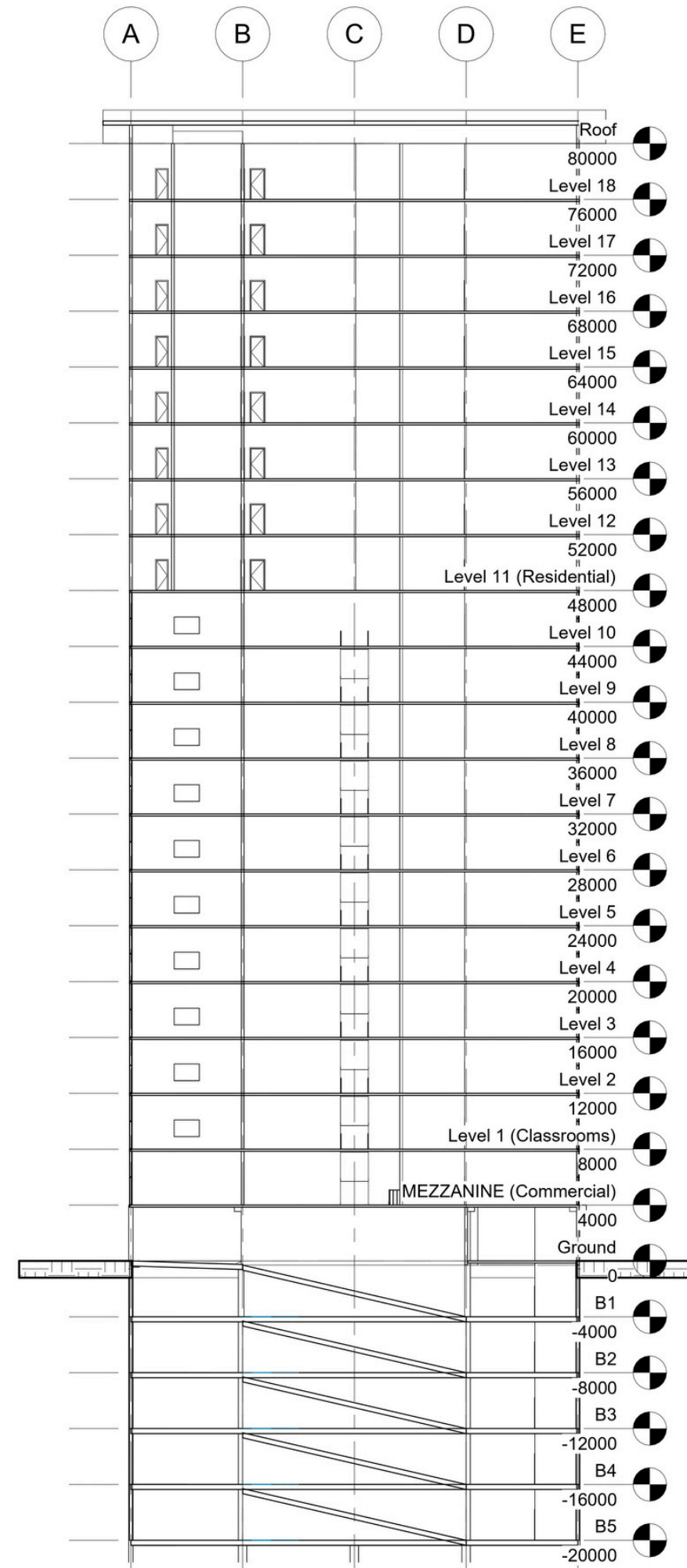
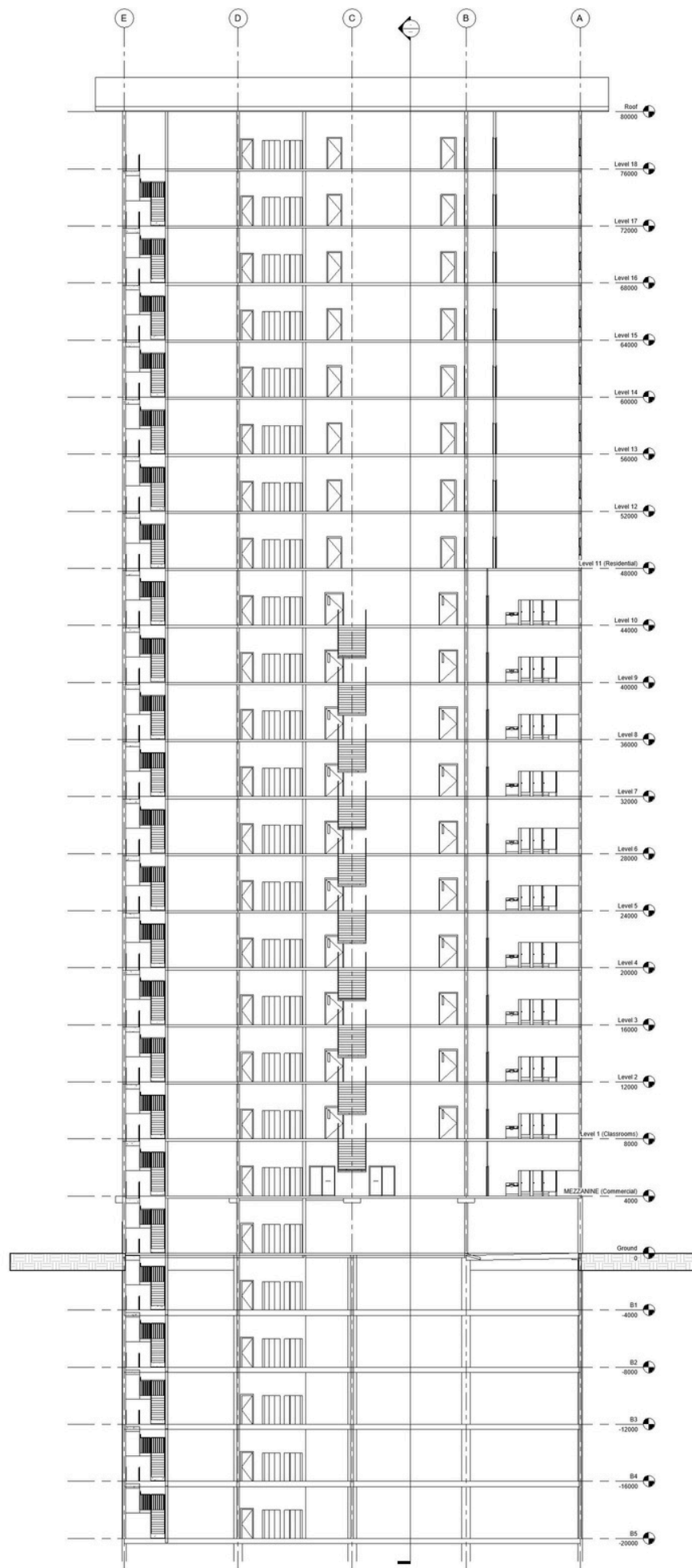


# 2.10 West elevation

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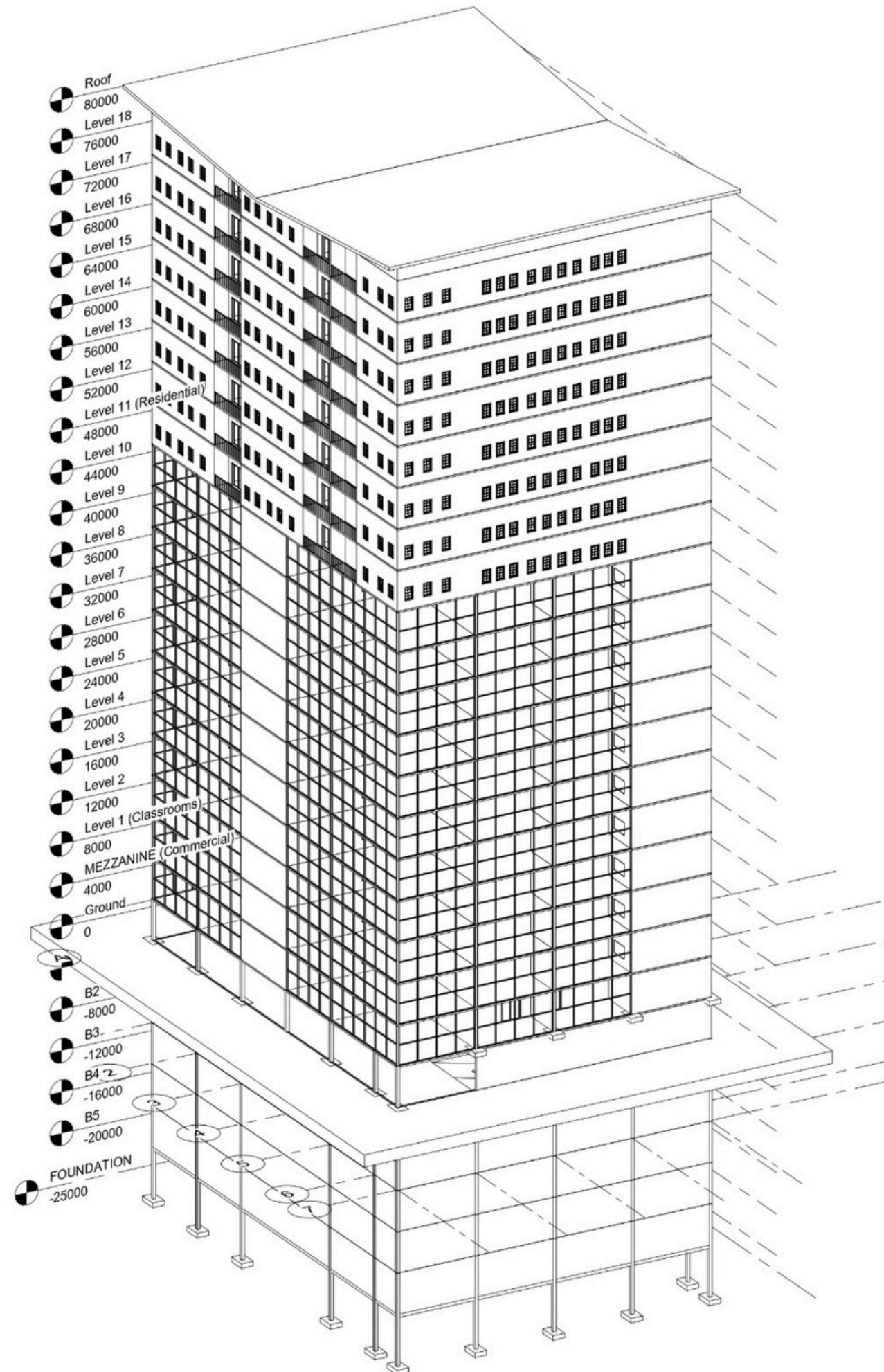


# 2.11 Sections N.T.S



## 2.12 3D View

N.T.S



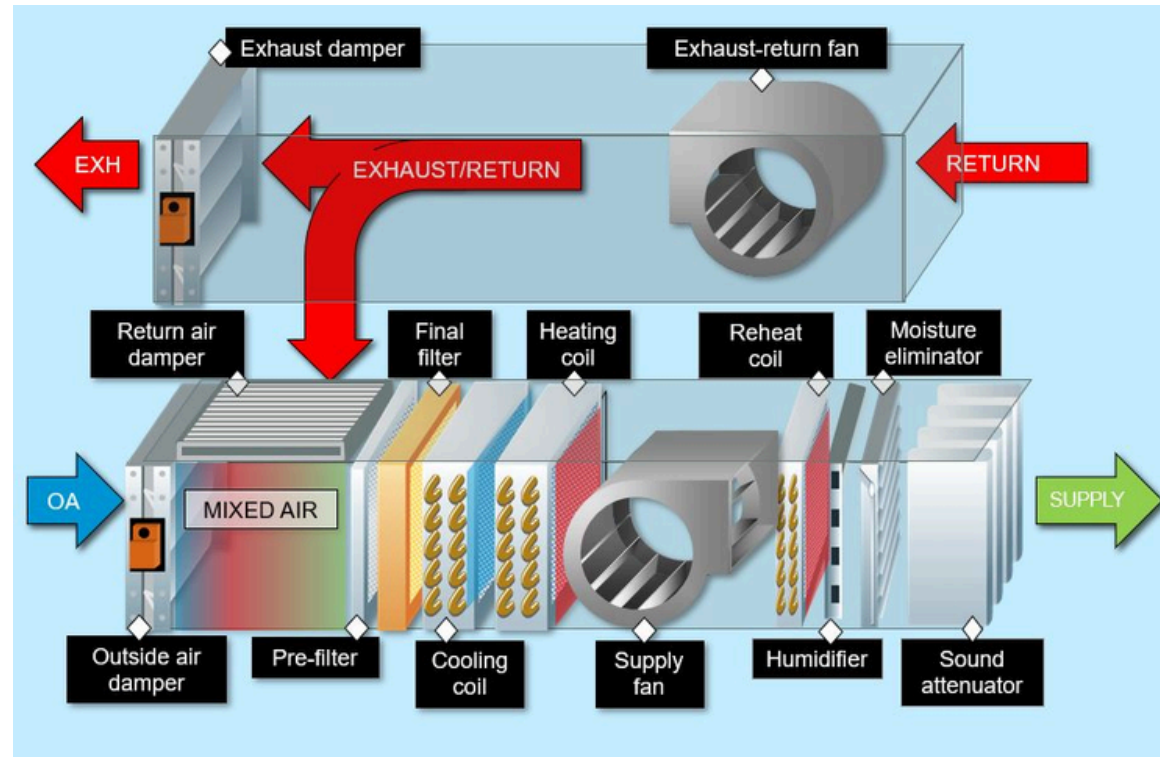
# 3.0 MECHANICAL VENTILATION SYSTEM

Siti Aiesya Goh (0355901)

## 3.1 Introduction

**Mechanical ventilation** within a building refers to systems that use fans, ducts and other mechanical devices to circulate air into and out of a building/space. It is mainly used in areas that need natural ventilation whose windows are not sufficient enough. By using this system, the overall building's natural ventilation improves, thereby improving the quality of air received and achieving thermal comfort within the spaces.

### AHU System



The AHU (Air Handling Unit) is the central component of a ventilation system by drawing in outside and inside air, filtering it, regulating temperature and humidity, and circulating the fresh air via ductworks.

### Components of an AHU system

- **Air intake** - draws in fresh outside air via vents, and takes in return air from the building
- **Mixed air box** - combines fresh outdoor air with return air
- **Filtration** - air passes through pre-filter first for large particles, and then to the main filters (eg. HEPA) to finely filter it
- **Cooling Coils** - air passes through to be chilled via water or refrigerant
- **Fans** - supply fans blow air through the ductwork to distribute air; return fans pull air back from building to AHU for reconditioning
- **Humidifiers** - Adds moisture to the air via steam/evaporative methods
- **Dampers** - dampers with multiple sheets of metal at different angles to control amount of intake/outtake air

### UBBL 1986 PART III - Space, Light and Ventilation, Mechanical Ventilation and Air Conditioning

#### Clause 41. Mechanical ventilation and air-conditioning

1. Where permanent mechanical ventilation or air conditioning is intended, the relevant building by-laws relating to natural ventilation, natural lighting and heights of rooms shall not apply.
3. The provisions of the Third Schedule to these By-laws shall apply to buildings which are mechanically ventilated or air conditioned.

2. A permanent air conditioning system shall be provided with alternate means of ventilating the air conditioned enclosure, such that within half an hour of the air conditioning system failing, not less than the stipulated volume of fresh air specified hereinafter shall be introduced into the enclosure during the period when the air conditioning system is not functioning.

4. Where permanent mechanical ventilation in respect of lavatories, water closets, bathrooms or corridors is provided for and maintained in accordance with the requirements of the Third Schedule to these By-laws, the provisions of these By-laws relating to natural ventilation and natural lighting shall not apply to such lavatories, water closets, bathrooms or corridors.

## 3.2 Application of Mechanical Ventilation System- Precedent Studies

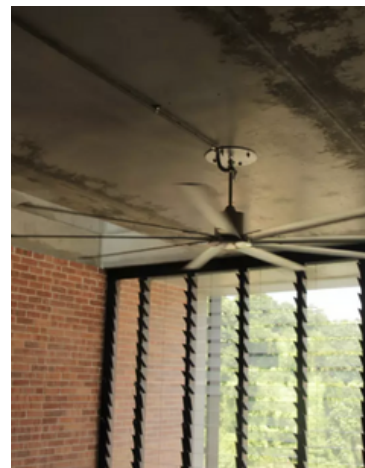
Taking a look at the precedents studies of two buildings, it is investigated on how the mechanical ventilation systems implemented are used and why

### 1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur

In terms of mechanical ventilation, PAM Centre utilises a **spot ventilation system**. This system requires the use of **localised exhaust fans** to exchange, dehumidify and filter air, but its only localised to a specific area of the building only, as it does not incorporate ductworks that transport air throughout the entire building; a similar fashion to fans in kitchens. By removing indoor air pollution and/or moisture at its source, spot ventilation improves the natural and whole-building ventilation, alongside thermal and user comfort.



**Spot ventilation systems** are used mainly within spaces like prayer area and the cafe's kitchen, as these small cramped areas does not allow for good ventilation, dehumidifying the air as well.



Using big **propellor fans** placed at every open space gives a wind-chill effect on the users, where the air is pushed down forcing cooling upon the space.



**AHU** distributes cool/hot air within the building, located on level 8 of the PAM building, allowing air to be distributed down via ducts with the axial fan within it ensuring proper cooling.

### 2 Tamarind Square, Cyberjaya

Tamarind Square itself is already a widely naturally ventilated structure, therefore the mechanical ventilation within its grounds focuses more on the interior spaces to ensure user comfort. **Retail-wise**, to go with the industrial style of the building, the ventilation comes with exposed ductworks and pipes, making it clear where fresh air is directed towards.



**Ductworks** can be seen scaling the building from the AC unit to inside of the retail spaces, which supports the ventilation within said retail space as even though Tamarind Square is an open-concept mall, its retail spaces still lack ventilation.



**Vents and ducts** being exposed in such a way allows for easy access during regulatory maintenance, and to be aware and monitor its condition should it break or leak.



**Ductworks** are often used more-so on the ground floor than others, due to the heat and gas/smoke from cars passing by, allowing air to be filtered properly before reaching a space used by many.

## 3.3 Mechanical Ventilation System Components / Strategies

There are many different types of mechanical ventilation strategies, and much more components that assist each strategy.

### 3.3.1 Different types of mechanical ventilation:

#### 1. Exhaust Ventilation

- Works by **depressurizing** the structure; where exhausting air causes pressure to pull in air from outside via passive vents
- Simple and inexpensive to install (single fan connected to a single exhaust in the building)
- Passive vents require **larger pressure differences** than fan induced pressure
- Most suitable for COLD climates; prone to moisture damage in warm climates

#### 2. Supply Ventilation

- **Forces outside air in** while inside air leaks out of the building via holes, cracks and international vents
- Simple and inexpensive to install, several fan and duct systems
- Pressurising the house minimises outdoor pollutant and avoids backdrafts of combustion gases
- **Filters outside air** to remove impurities or dehumidified for thermal comfort
- Most suitable for HOT or MIXED climates; moisture problem in cold climates

#### 3. Balanced Ventilation

- Instead of (de)pressurising, it introduces an **equal amount** of outside and inside air
- Typically consists of **two fans and two duct systems**, supplying frequent areas and exhausting more humid areas
- Appropriate for ALL climates
- **HRV (Heat Recovery Ventilators)**
  - Has heat exchanger
  - one/more fans to push air through machine
  - Only transfers heat

#### 4. Energy Recovery System

- Controls ventilation whilst **minimising energy costs** as it transforms the air taken in, adjusting it for optimum thermal comfort rather than cooling/heating it.  
  
There are two types of energy recovery systems that are used
- **ERV (Energy Recovery Ventilators)**
  - Has heat exchanger
  - one/more fans to push air through machine
  - Humidity of the house stays constant, minimising freezing

### 3.3.2 Components of the system:

#### 1. Fans



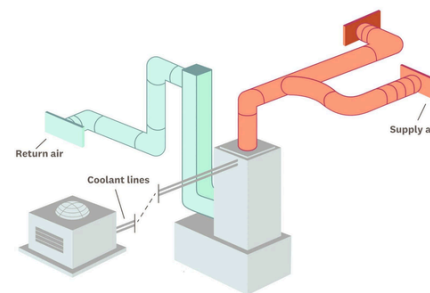
Moves air through ducts, creating air flow and pressure for circulation

#### 2. Filters



Removes contaminants, improving air quality

#### 3. Ducts



Transports air throughout a building

#### 4. Fire Dampers



Safety devices that prevent the spread of fire and smoke

#### 4. Diffusers

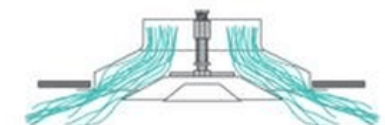


Figure 1. Air supply, cooling.



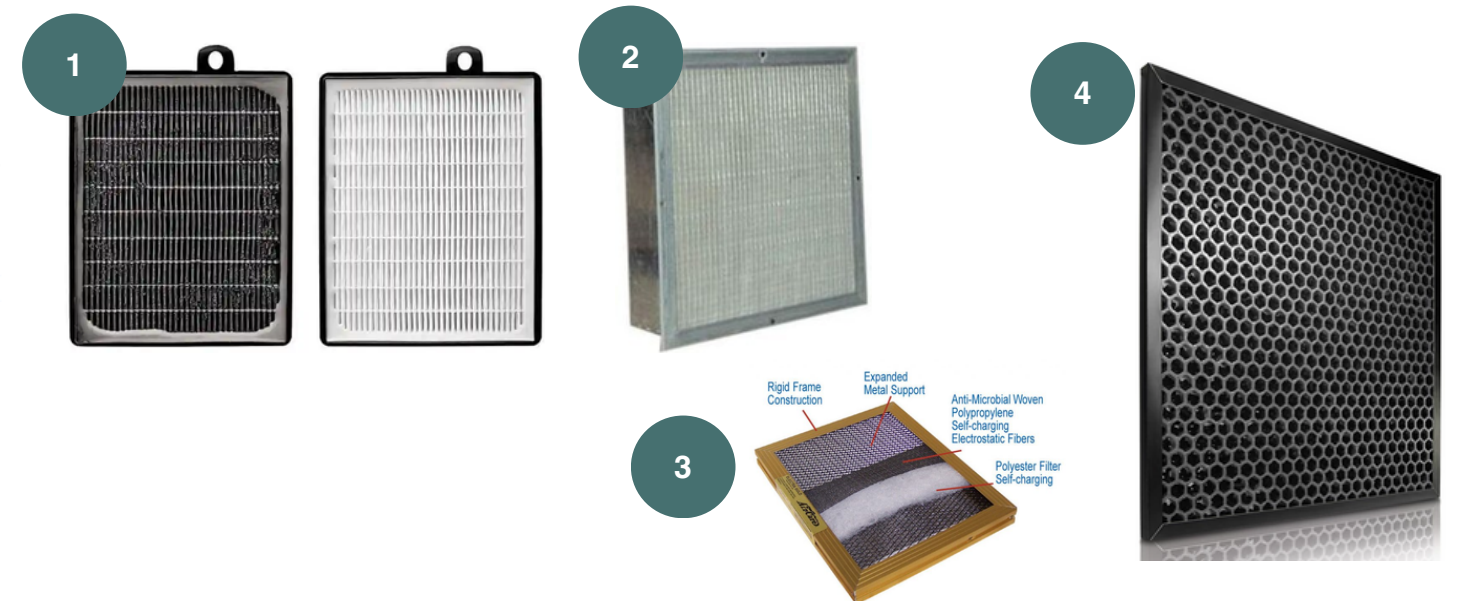
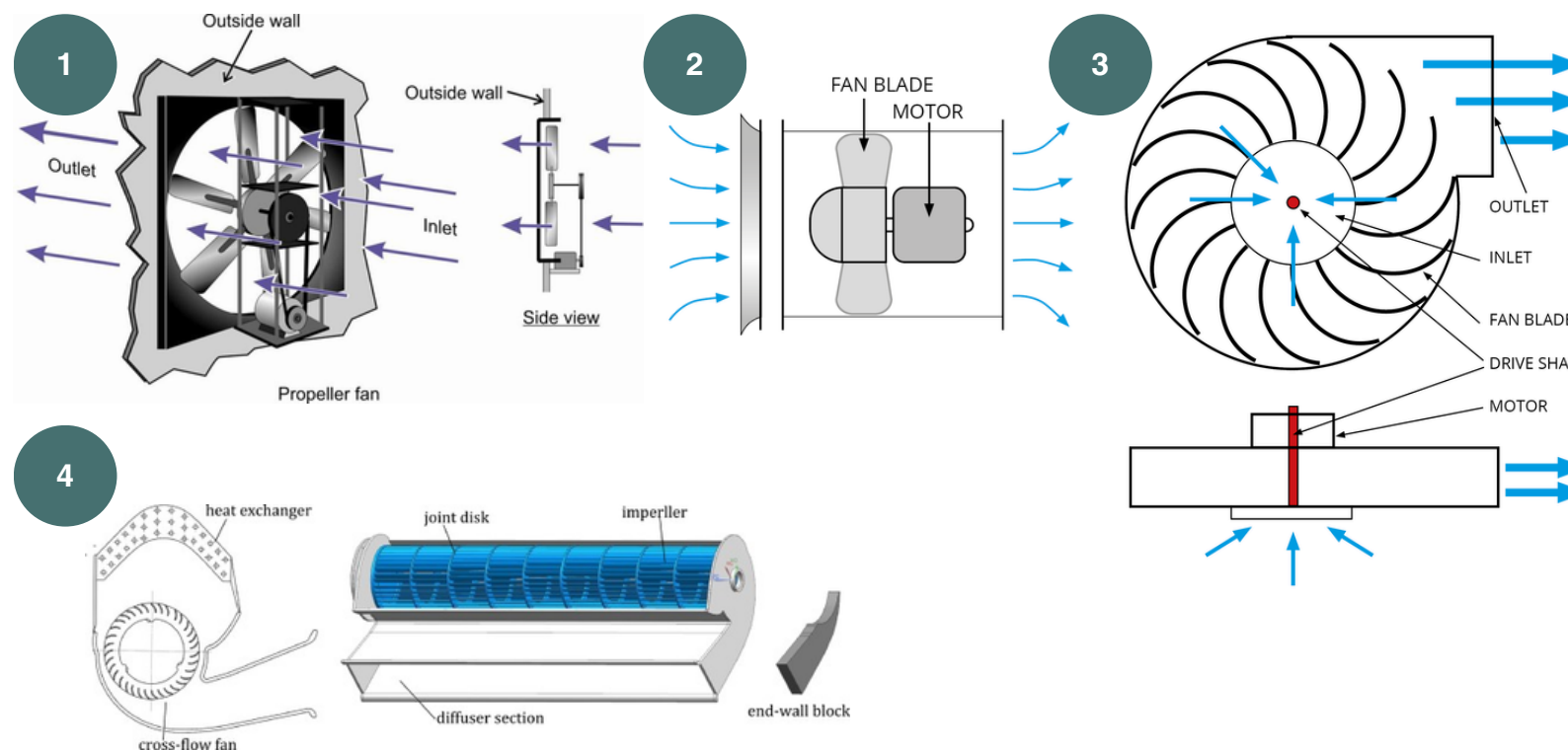
Figure 2. Air supply, heating.

Regulate ventilation system's operation using thermostats, sensors and timers

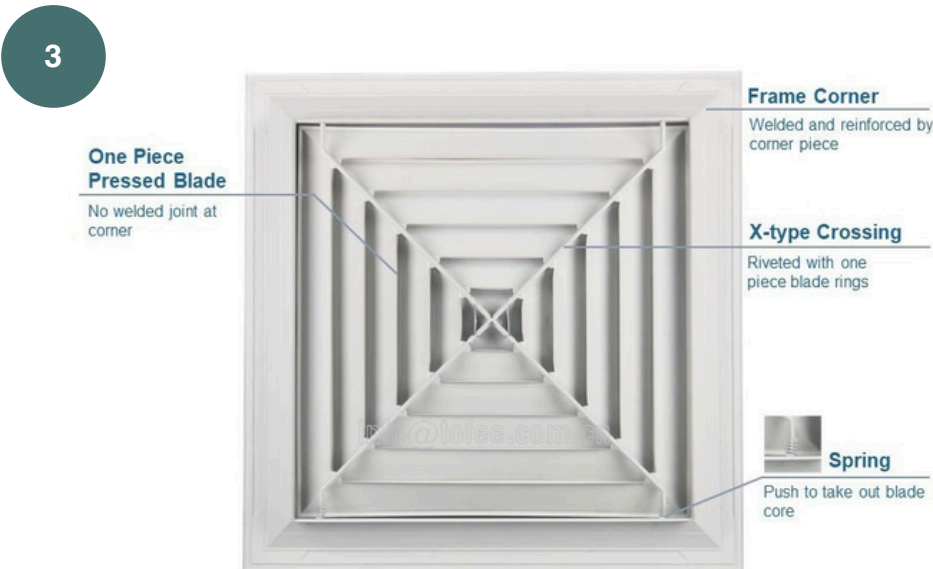
### 3.4.1 SCHEDULE OF MECHANINCAL VENTILATION

NO	COMPONENT NAME	DESCRIPTION
1	Propellor Fan	Works by <b>spinning angled blades</b> that pull outside air in; efficient for moving large amounts of air
2	Axial Fan	<b>Blades mounted on a rotating shaft</b> propels air into it, pulling air from one side and pushing out the other, creating constant air flow
3	Centrifugal Fan	Using power from <b>rotation of impellers</b> , it moves air in a circular motion, flow of air changing direction when entering/exiting the fan
4	Cross-flow / Tangential Fan	Draws air in <b>along the blade length</b> of a cylinder, expelling it perpendicularly, creating an even spread of air

NO	COMPONENT NAME	DESCRIPTION
1	Dry Filter	<b>Removes dust, pollen, and unwanted particles</b> ; the filter uses fibreglass or pleated paper. Easy to maintain, cost-effective, but requires regular replacement/cleaning.
2	Viscous Filter	Referring to wet, it uses a <b>sticky substances to filter air</b> where the contaminants get stuck onto the filter. Regular maintenance or cleaning required.
3	Electrostatic Filter	Has a <b>self-generated electrical charge to trap contaminants</b> ; charged particles are attracted to oppositely charged plates, capturing debris. Highly efficient, reusable and need regular maintenance.
4	Activated Carbon Filter	Contains <b>activated carbon</b> , which has a highly porous surface that <b>absorbs contaminants</b> , making the air fresher and cleaner. Regular replacement of the filter is required.



### 3.4.1 SCHEDULE OF MECHANICAL VENTILATION

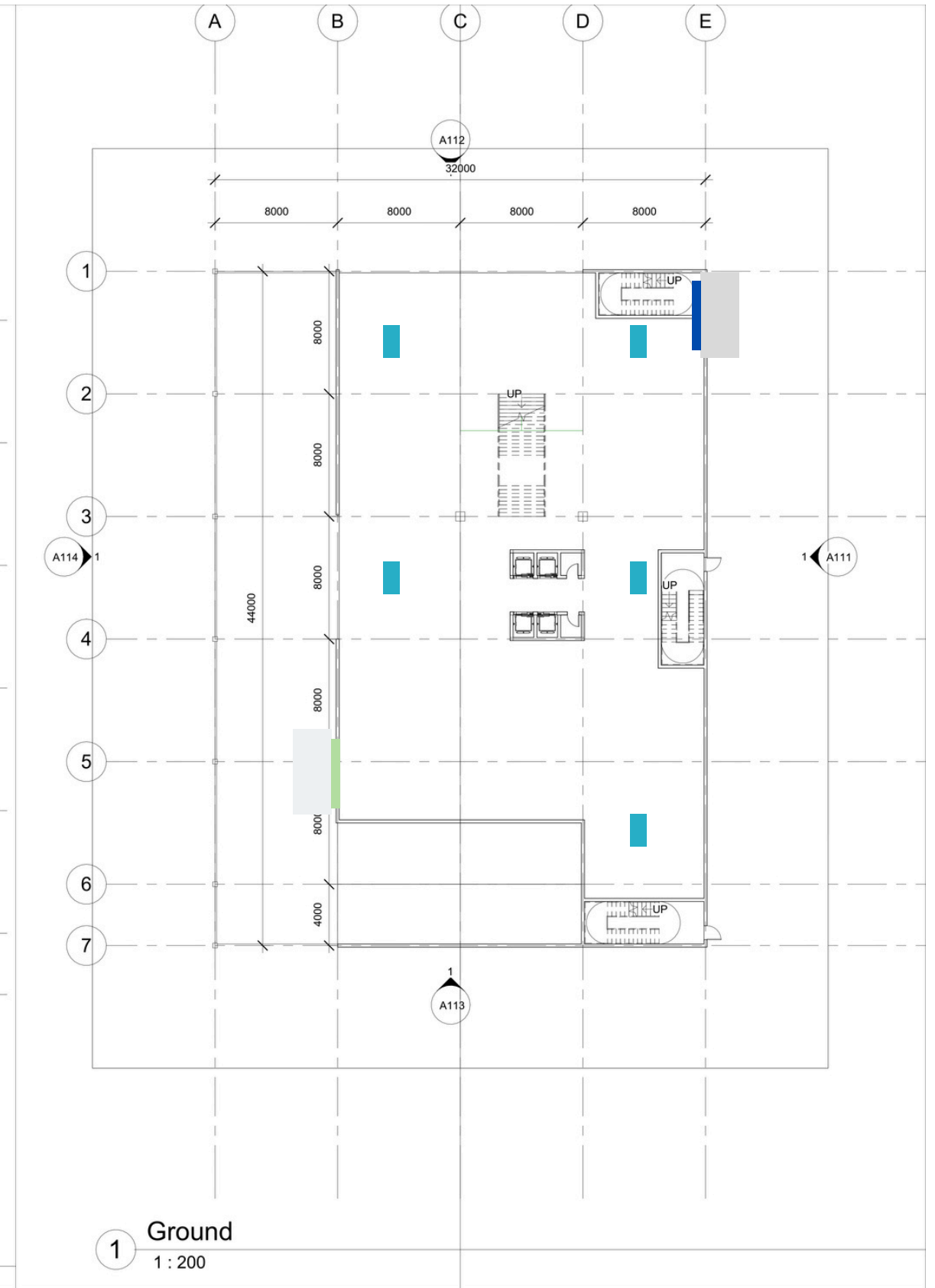
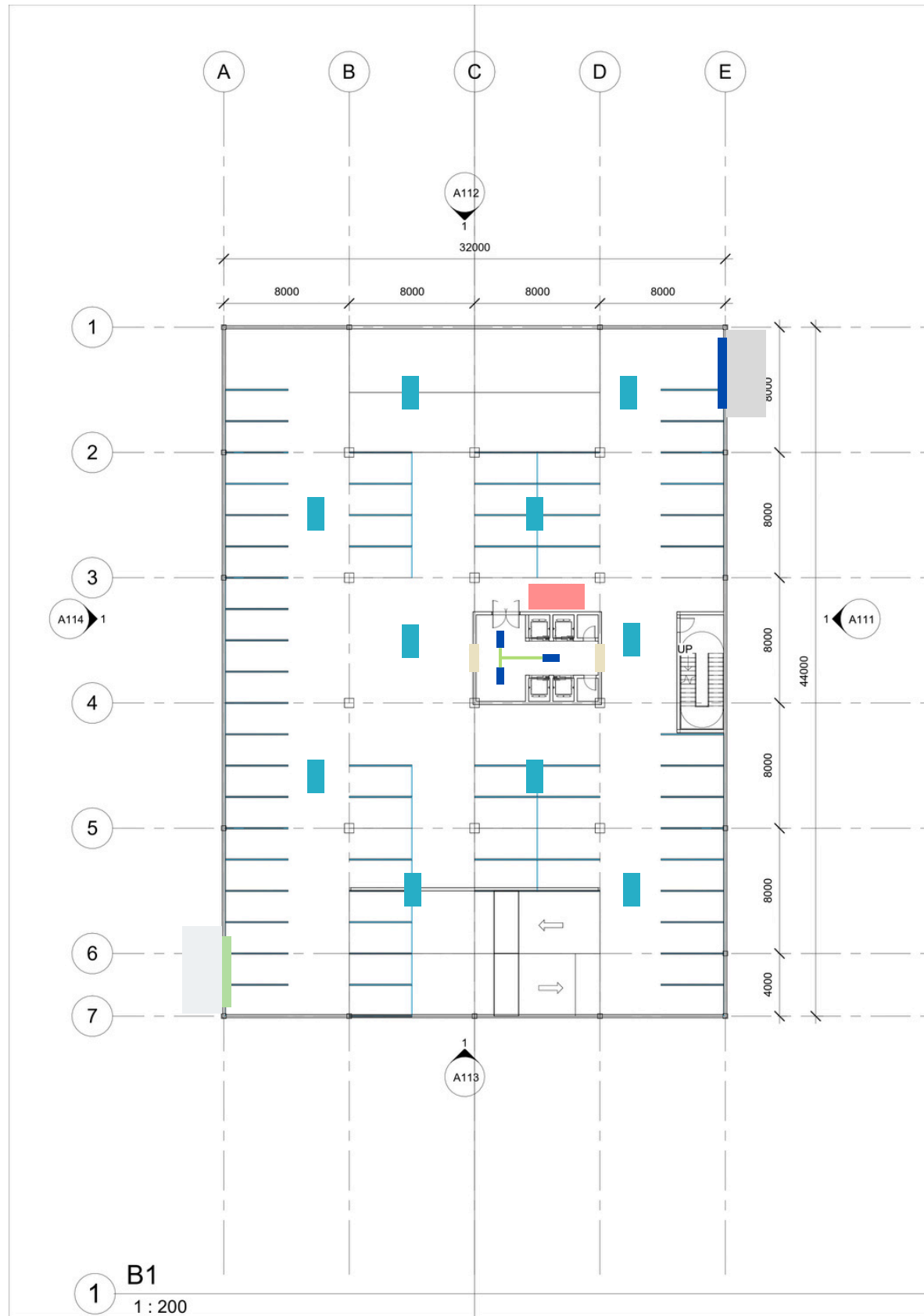


NO	COMPONENT NAME	DESCRIPTION
1	Ductwork	A <b>network of tubes and channels</b> , allowing air to flow throughout a building. Usually made of metal, fibreglass, flexible plastic; taking fresh air from the main vent system to different spaces within a building. Efficient airflow is achieved through good design and planning of ductworks, with regular maintenance is required to keep it clean and free from leaks and for optimal performance.
2	Fire Dampers	Main function as a <b>safety device</b> as when it senses a <b>fire</b> (rise of temperature), it automatically closes, preventing the spread of fire and smoke within said ducts.
3	Diffusers	Function of <b>distributing air from the ductwork</b> into a room at the end of the duct, with a series of fins, slots, and vents to help direct airflow. Diffusers create a comfortable environment with evenly distributed air, with regular maintenance.

### 3.4.2 Mechanical Ventilation System Proposal

LEGEND

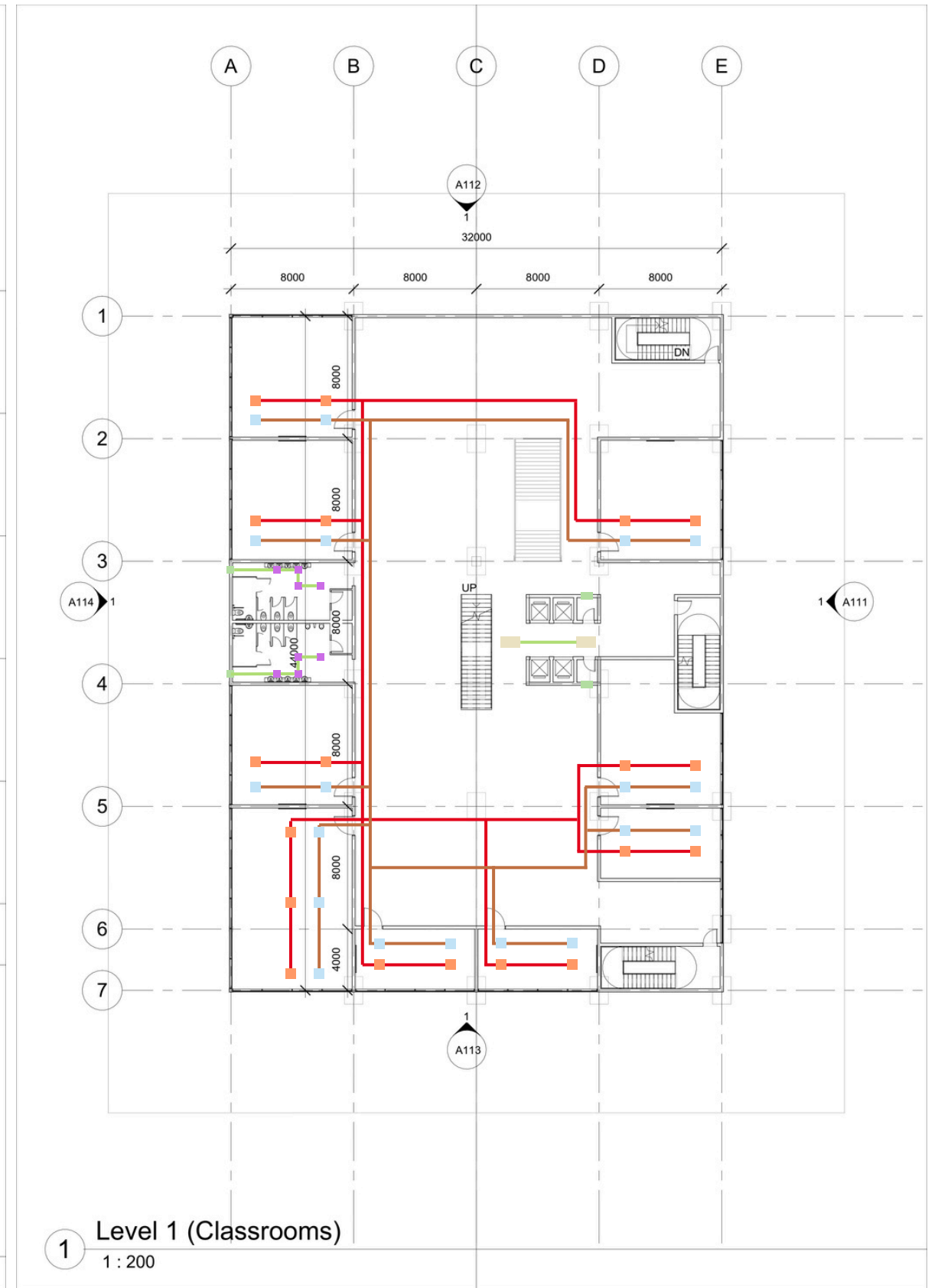
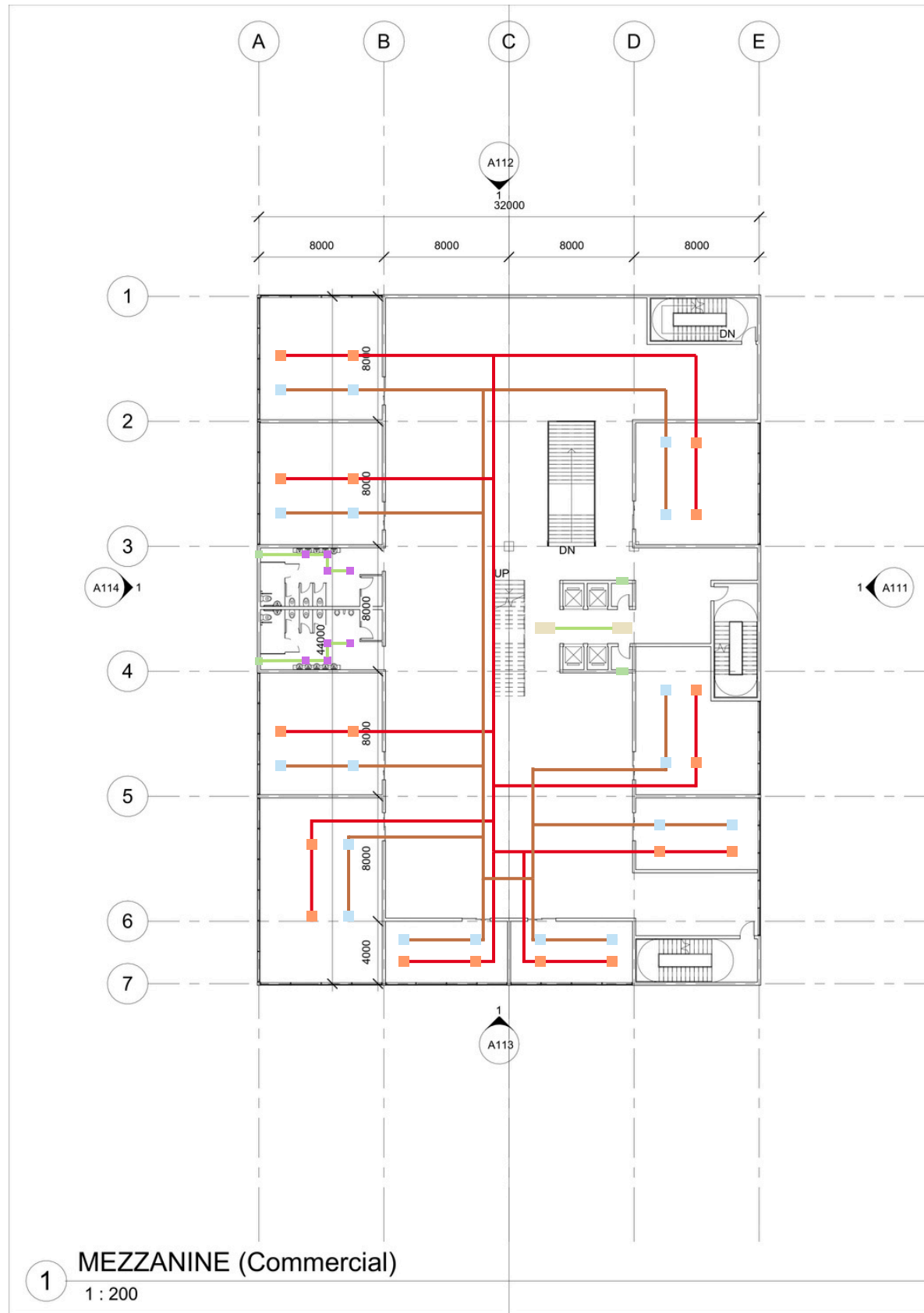
-  Supply propellor fan
-  Cast aluminum axial fan
-  Supply air shaft
-  Exhaust air shaft
-  Ceiling diffusers
-  Exhaust propellor fan
-  Sheet metal ductwork
-  AHU
-  Conditioned air supply pipe from AHU
-  Return air duct
-  Supply air diffuser



### 3.4.2 Mechanical Ventilation System Proposal

LEGEND

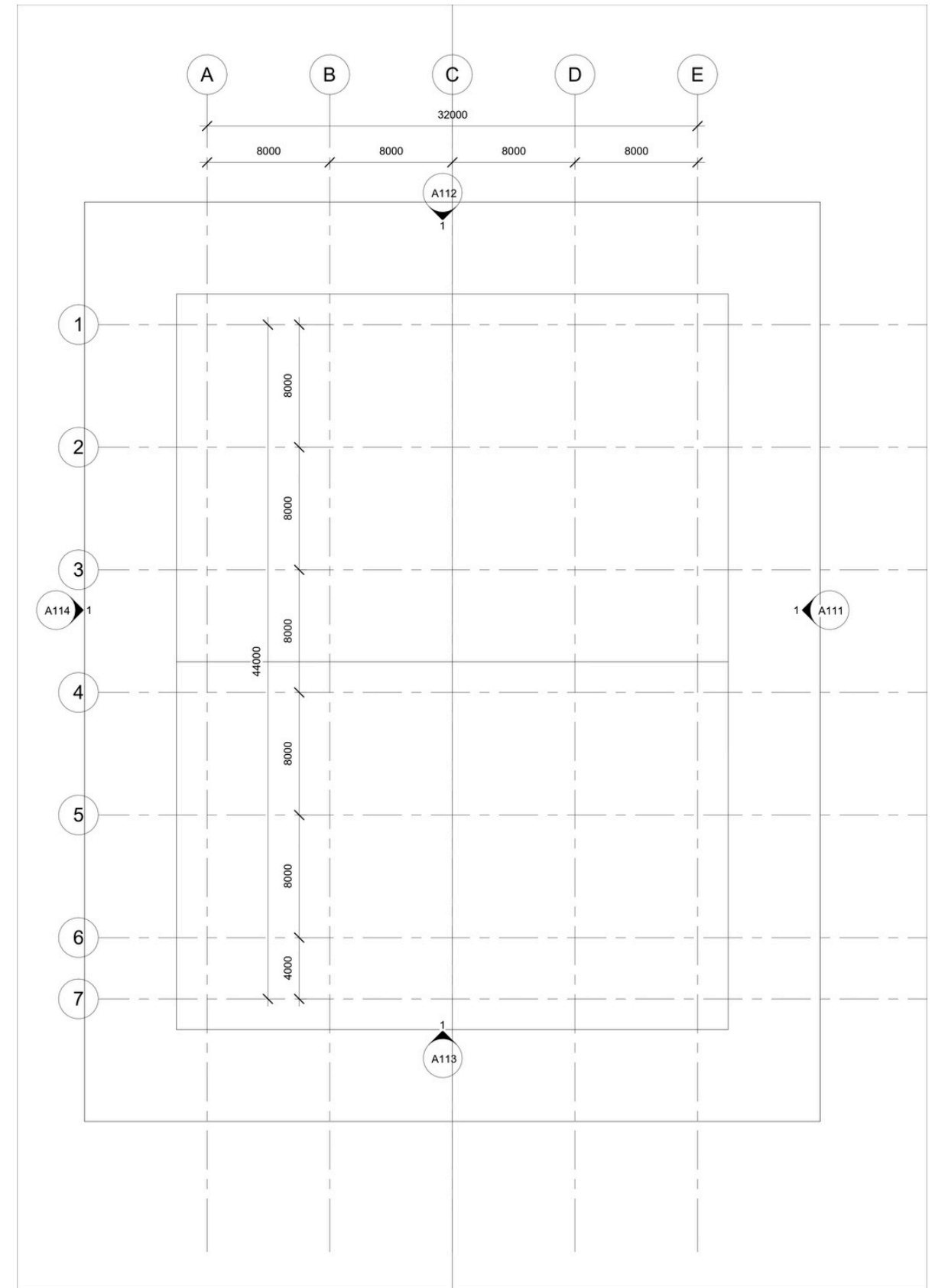
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- AHU
- Conditioned air supply pipe from AHU
- Return air duct
- Supply air diffuser
- Return air grille
- Exhaust grille



# 3.4.2 Mechanical Ventilation System Proposal

## LEGEND

- Supply propellor fan
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# 3.4.2 Mechanical Ventilation System Proposal

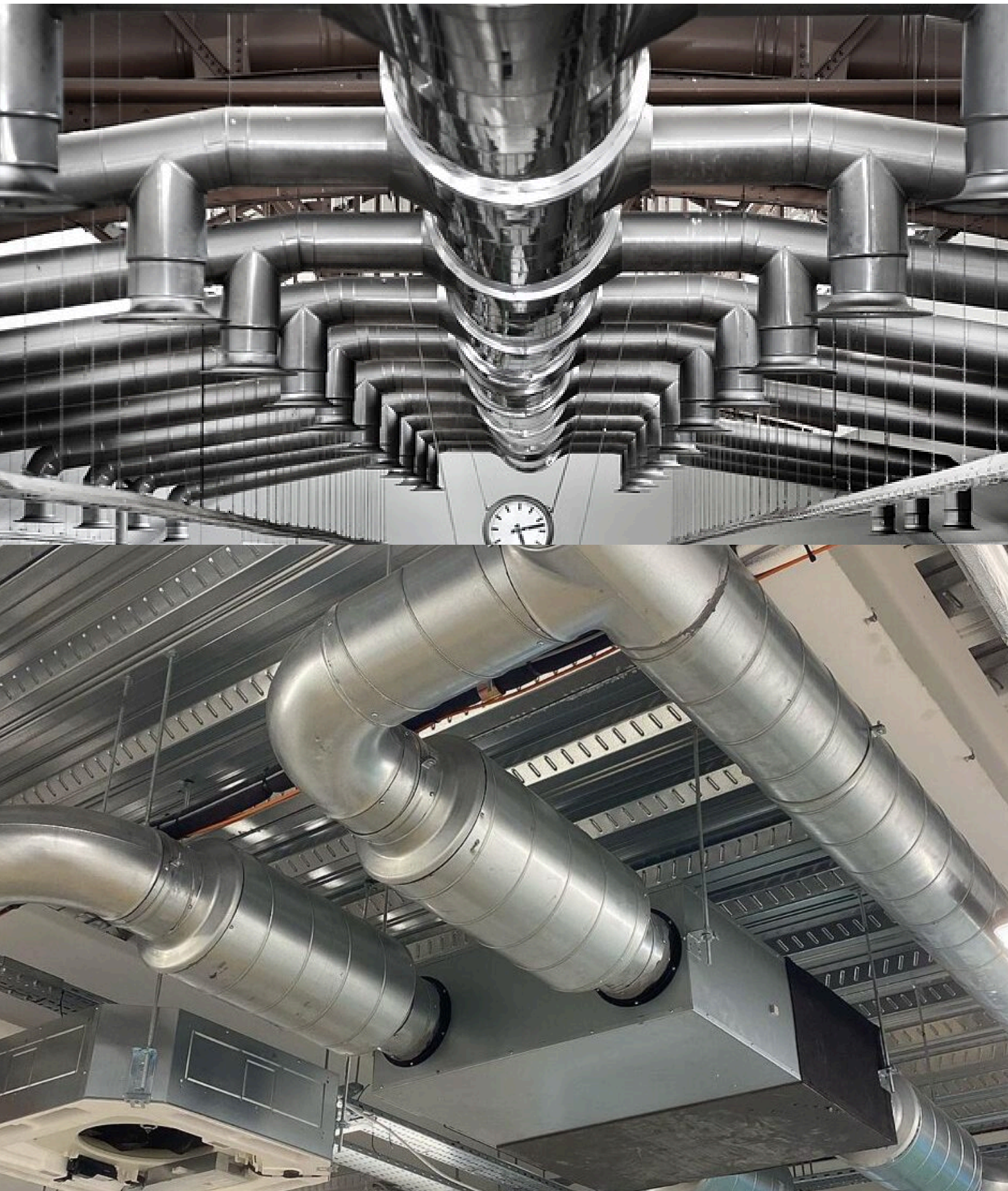
## LEGEND

- Supply propellor fan
- Cast aluminum axial fan
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- Ceiling diffusers
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- Sheet metal ductwork
- AHU
- Conditioned air supply pipe from AHU
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- Supply air diffuser
- Return air grille
- Exhaust grille



1 Section 2  
1 : 300

## 3.5 Conclusion



From learning via lectures, research and self-reading, we as a group have gained a deeper understanding about the importance of mechanical ventilation is in relation to not just thermal comfort, but also building sustainability and air quality for the users/occupants.

Mechanical ventilation systems keep up with the circulation and filtration of fresh and clean air, improving indoor air quality, thermal comfort, and overall user comfort. Aiding in humidity and temperature control also benefits the building in reducing running the risk of mold growth and damage to building.

Essential to the building's design and general operation with its many listed benefits, from health to energy efficiency, mechanical ventilation is no little matter.

# 4.0 AIR CONDITIONING SYSTEM

Fiqqa Ezzathul Alliya (0357043)

## 4.1 Introduction

An air conditioning system in a building is a **set of mechanical and electrical components designed to regulate indoor air quality by controlling temperature, humidity, air circulation, and purification**. It is a critical part of a building's HVAC (Heating, Ventilation, and Air Conditioning) infrastructure, ensuring optimal comfort and environmental control.

In mechanically ventilated commercial developments, air conditioning is often **provided by air handling units (AHU) connected to ductwork that supplies air to and extracts air from internal spaces**. Alternatively, **air handling units can be used to supply and extract air direct to a space**.

Air handling units typically comprise an **insulated box that might include some, or all of the following components; filter racks or chambers, a fan (or blower), heating, cooling and dehumidification, sound attenuators and dampers**. Air handling units that consist of only a fan and a heating or cooling element, located within the space they are serving, may be referred to as fan coil units (FCU).

Cooling itself can be generated either within the unit itself, or can be provided by connection to central chillers.

### UBBL 1984 Clause 41. Mechanical Ventilation and Air-Conditioning

1. The place where the everlasting air-conditioning or mechanical ventilation is deliberated, the applicable fabricating by-laws identifying with the natural lighting, natural ventilation and the height of spaces or rooms might make waived in those carefulness of the neighborhood power.
2. Whatever provision for the waiver of the pertinent by-laws should be a chance to be considered if what's more of the permanency air-conditioning framework there is given elective affirmed method for ventilating those ventilated enclosure, such-and-such inside half an hour of the air-conditioning framework failing, not under those stipulated volume from claiming new air specified hereinafter should be acquainted under those nook Throughout those time At the air-conditioning framework is not working.
3. Those procurements of The 3rd Schedule to all these By-laws might apply to edifices which air-conditioned or mechanically ventilated.
4. The place permanency mechanical ventilation On appreciation of lavatories, bathrooms, corridors or water-closets, will be furnished for what's more supported over understanding for those prerequisites of The 3rd Schedule to these By-laws, the procurements about these By-laws identifying with regular ventilation. Furthermore, regular lighting ought not apply should such water-closets, corridors, bathrooms or lavatories.

## 4.2 Application of Air Conditioning System- Precedent Studies

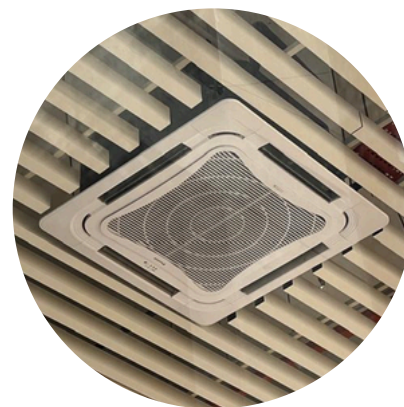
### 1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur

- **Energy Efficiency:** Uses energy-saving systems like VRV or split units, reducing energy consumption.
- **Zoned Cooling:** Provides cooling only where needed, enhancing flexibility and minimizing waste.
- **Sustainability:** Combines passive cooling (ventilation, shading) with air conditioning for efficiency.
- **Indoor Air Quality:** Incorporates filtration and fresh air intake for a healthy environment.
- **Design Integration:** Concealed units align with the minimalist architecture.
- **Maintenance:** Systems designed for easy accessibility and longevity.



### 2 Tamarind Square, Cyberjaya

- **Air Conditioning at Tamarind Square:** Limited to enclosed and retail spaces, using split unit systems.
- **Office spaces:** Concealed ceiling-mounted cassettes for aesthetics.
- **Retail spaces:** Exposed ductwork for easier maintenance near kitchens.
- **Outdoor Units:** Initially hidden or covered, but some exposed due to space constraints.
- **Insights:** Split systems are flexible and ideal for small spaces, balancing aesthetics and functionality.
- **Planning Needs:** Early consideration of future expansion and maintenance is crucial to avoid design compromises.



## 4.3 Air Conditioning System Components / Strategies

1

### Split System

Split-unit air conditioning systems are popular for residential and commercial cooling due to efficiency, versatility, and quiet operation. They consist of separate outdoor and indoor units for quieter operation and more flexibility in installation.

- **Outdoor Unit:**
  - **Condenser and Compressor:** Compressor raises refrigerant gas temperature, condenser dissipates heat.
  - **Expansion Valve:** Regulates refrigerant flow to indoor unit.
  - **Propeller Fan:** Cools condenser coil and compressor by blowing ambient air.
- **Indoor Unit:**
  - **Evaporator and Air Handling Unit (AHU):** Evaporator absorbs heat, AHU c

### Types of Split Systems:

#### Ductless Split:

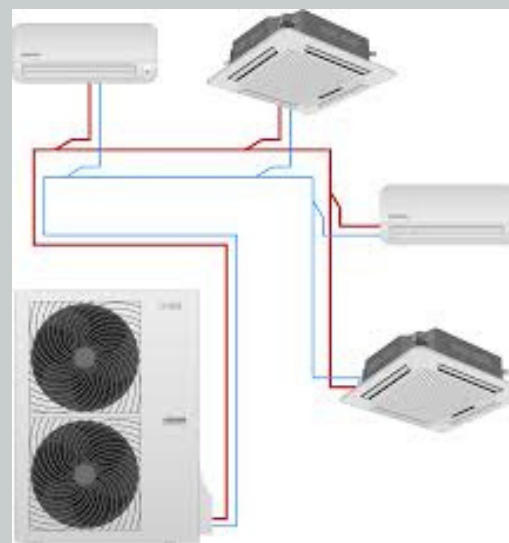
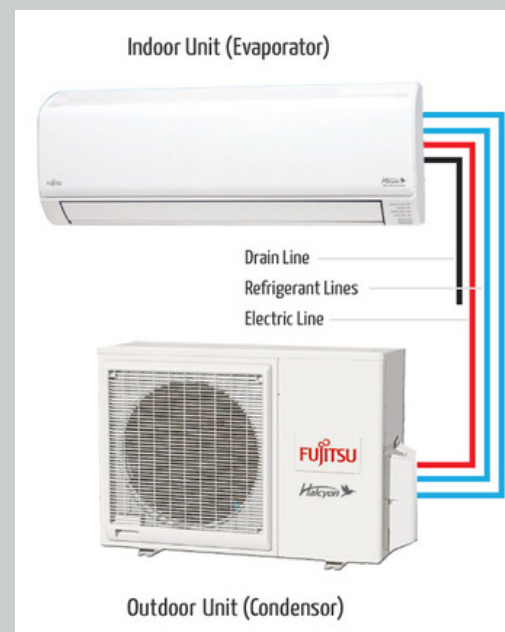
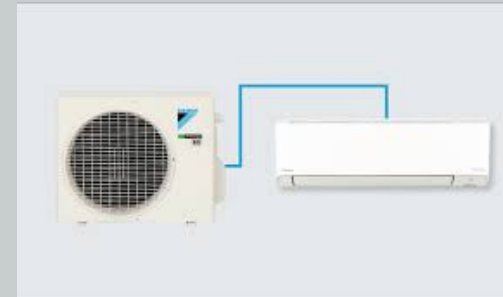
- **Wall Mounted:** Cools individual rooms, placed high on wall.
- **Cassette:** Ideal for limited wall space, indoor unit in ceiling.

#### Ducted Split:

- **Ducted:** Hidden indoor unit, connected to ducts for larger spaces.

#### Variable Refrigerant Volume (VRV):

- **VRV (VRF):** Single outdoor unit, multiple indoor units, individual zone temperature control, energy-saving benefits.



2

### VRV System

In the realm of technology, Variable Refrigerant Volume (VRV) air conditioning systems, heralded as the sophisticated frontrunners in HVAC technology associated with Daikin.

#### Key Components:

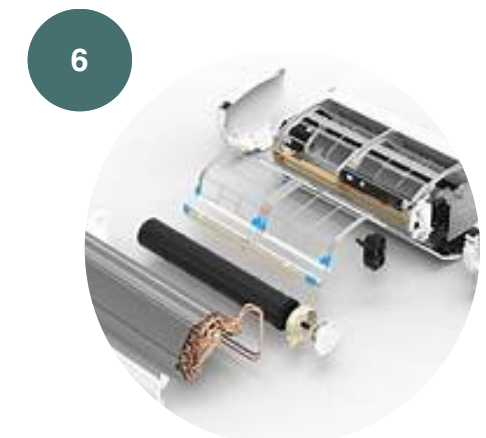
- **Outdoor Units**
- **Indoor Units**
- **Refrigerant Circulation:** High-caliber piping facilitates seamless refrigerant distribution between outdoor and indoor units, ensuring uniform climate control.
- **Intelligent Controls:** Daikin's VRV systems are equipped with advanced controls for meticulous monitoring and personalized temperature adjustments in each zone, offering unparalleled comfort customization.
- **Heat Transfer Capability:** Certain VRV systems possess the capability to redistribute warmth, transferring heat from warmer areas to cooler spaces, thereby enhancing energy efficiency significantly.



## 4.3 Air Conditioning System Components / Strategies

### 4.3.1 Components of an Air Conditioning System:

1	Thermostat	A device that regulates and maintains the desired indoor temperature by controlling the system's operation based on preset temperature settings.
2	Indoor Unit (Evaporator)	An air conditioning system cools and circulates air by absorbing heat from the indoor environment through the evaporator coil.
3	Outdoor Unit (Condenser)	Houses the condenser coil, compressor, and fan, working together to release heat absorbed from indoor air by the refrigerant, cooling it for recirculation.
4	Refrigerant	A chemical compound used in air conditioning systems to transfer heat. It absorbs heat from indoor air at the evaporator, cools the air, and then releases the absorbed heat at the condenser, enabling the cooling cycle.
5	Compressor	The core of the refrigeration cycle, pressurizing the refrigerant, raising its temperature and transforming it into a high-pressure gas.
6	Expansion valve	Regulates the flow of refrigerant into the evaporator coil, hence managing the cooling process by lowering refrigerant pressure and temperature levels.
7	Evaporator Coil	Located in the indoor unit, is where the refrigerant absorbs heat from the inside air, causing it to evaporate and cool the air that passes over it.
8	Condensor Coil	Housed in the outdoor unit, causes the refrigerant to condense back into a liquid condition by releasing heat that has been absorbed from the indoor air to the outside.



## 4.3 Air Conditioning System Components / Strategies

### 4.3.2 Air Conditioning Strategies:

#### 1 Zoning

Divide the building into zones with independent controls to optimize cooling and energy use.

#### 2 Energy Efficiency

- Use variable speed or inverter-driven systems (e.g., VRV/VRF) to adjust cooling output based on demand.
- Implement programmable thermostats to manage temperature and reduce energy waste.

#### 3 Sustainability

- Combine passive cooling methods (natural ventilation, shading) to reduce reliance on mechanical cooling.
- Use eco-friendly refrigerants to lower environmental impact.

#### 4

#### Flexibility in Design

Design systems for both aesthetic and functional needs (concealed or exposed units), depending on the space.

#### 5

#### Maintenance Access

Ensure easy access for regular maintenance to prolong system lifespan and improve efficiency.

#### 6

#### Indoor Air Quality

Integrate fresh air intake and filtration systems to ensure clean and healthy air indoors.

# 4.4 Air Conditioning System Proposal

## STUDENT HOSTEL : SPLIT SYSTEM



**INDOOR UNIT (WALL-MOUNTED)**

- FTKP28AV1MF
- 288 x 770 x 246



**OUTDOOR UNIT**

- RKP28AV1M
- 418 x 695 x 244

## CLASSROOMS : SPLIT SYSTEM



**INDOOR UNIT (CASSETTE)**

- FCF50CVM
- 256 x 840 x 840



**OUTDOOR UNIT**

- RZF50CVM
- 595 x 845 x 300



**INDOOR UNIT (CASSETTE)**

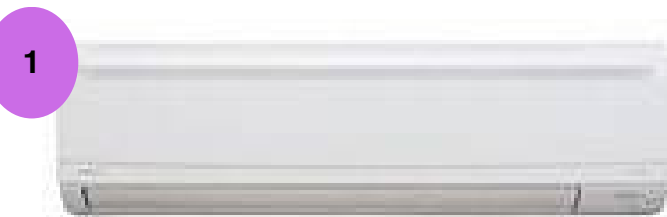
- FCF100CVM
- 298 x 840 x 840



**OUTDOOR UNIT**

- RZF100CVM
- 695 x 930 x 350

## COMMERSIALS : VRV SYSTEM



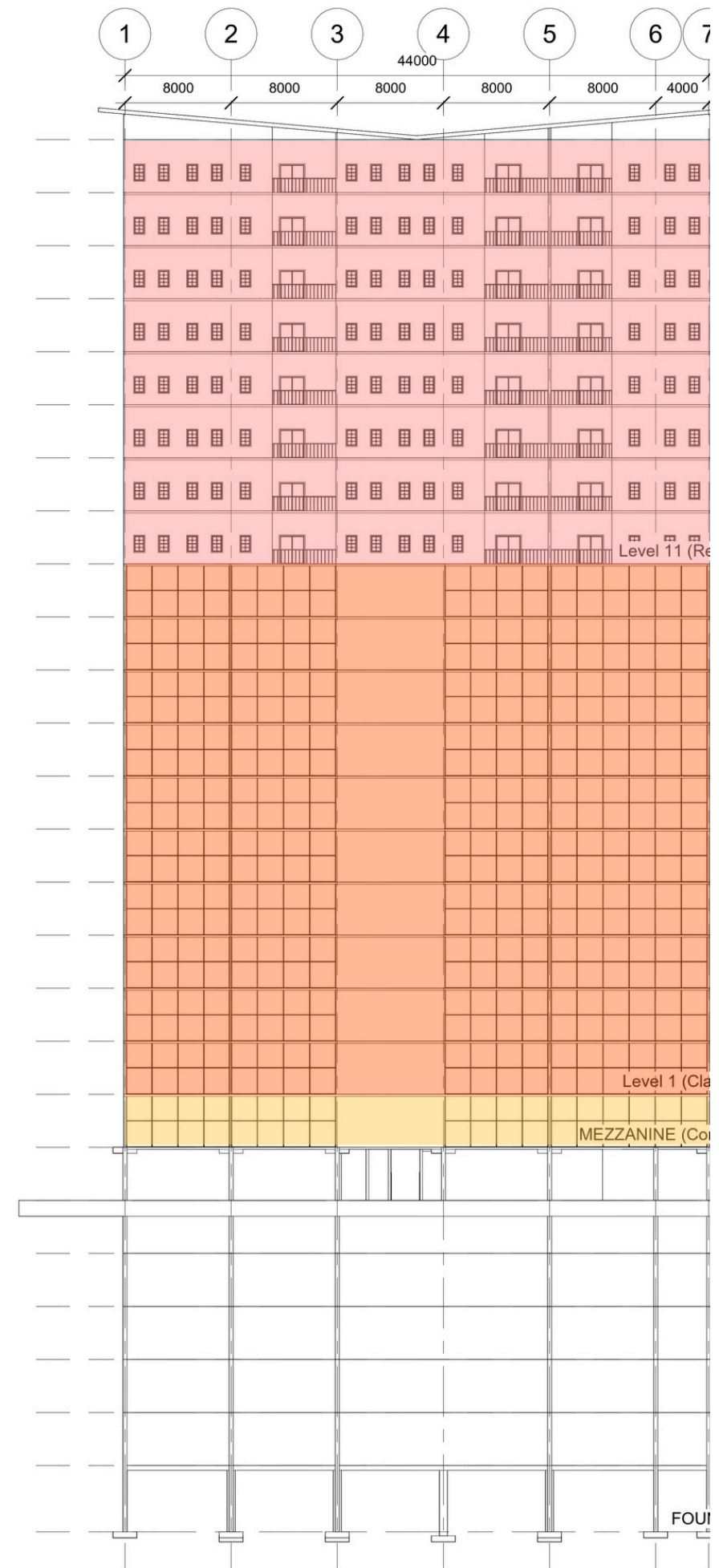
**INDOOR UNIT (CASSETTE)**

- FTXS09LVJU
- 295x 798x 189



**OUTDOOR UNIT (3 INDOOR TO 1 OUTDOOR)**

- RXYMQ36PVJU
- 940x950x330



# 4.4 Air Conditioning System Proposal

## 4.4.1 SPLIT SYSTEM (RESIDENTIAL)

**KEY**

**INDOOR UNIT (WALL-MOUNTED)**

- FTKP28AV1MF
- 288 x 770 x 246

**OUTDOOR UNIT**

- RKP28AV1M
- 418 x 695 x 244

**CALCULATIONS**

BTU = Area (sq. ft) × 25

**ROOM 1**  
 Area: 8x4 (32m<sup>2</sup>)  
 BTU: 344×25=8,600 BTUs

**ROOM 2**  
 Area: 16x4 (64m<sup>2</sup>)  
 BTU: 689×25=17,225 BTUs

**ROOM 3**  
 Area: 12x4 (48m<sup>2</sup>)  
 BTU: 517×25=12,925 BTUs

8600 + 17,225 + 12,925  
 = 38,750 BTUs

$$\text{Total HP} = \frac{\text{Total BTUs}}{\text{BTU per HP}} = \frac{38,750}{9,000} \approx 4.3 \text{ HP}$$





HOSTEL FLOORS

# 4.4 Air Conditioning System Proposal



## 4.4.2 SPLIT SYSTEM (CLASSROOM)

**KEY**

**CLASSROOMS (1HP)**

-  INDOOR UNIT (CASSETTE)
  - FCF50CVM
  - 256 x 840 x 840
-  OUTDOOR UNIT
  - RZF50CVM
  - 595 x 845 x 300

**LECTURE HALLS (4HP)**

-  INDOOR UNIT (CASSETTE)
  - FCF100CVM
  - 298 x 840 x 840
-  OUTDOOR UNIT
  - RZF100CVM
  - 695 x 930 x 350

**CALCULATIONS**

BTU = Area (sq. ft) x 25

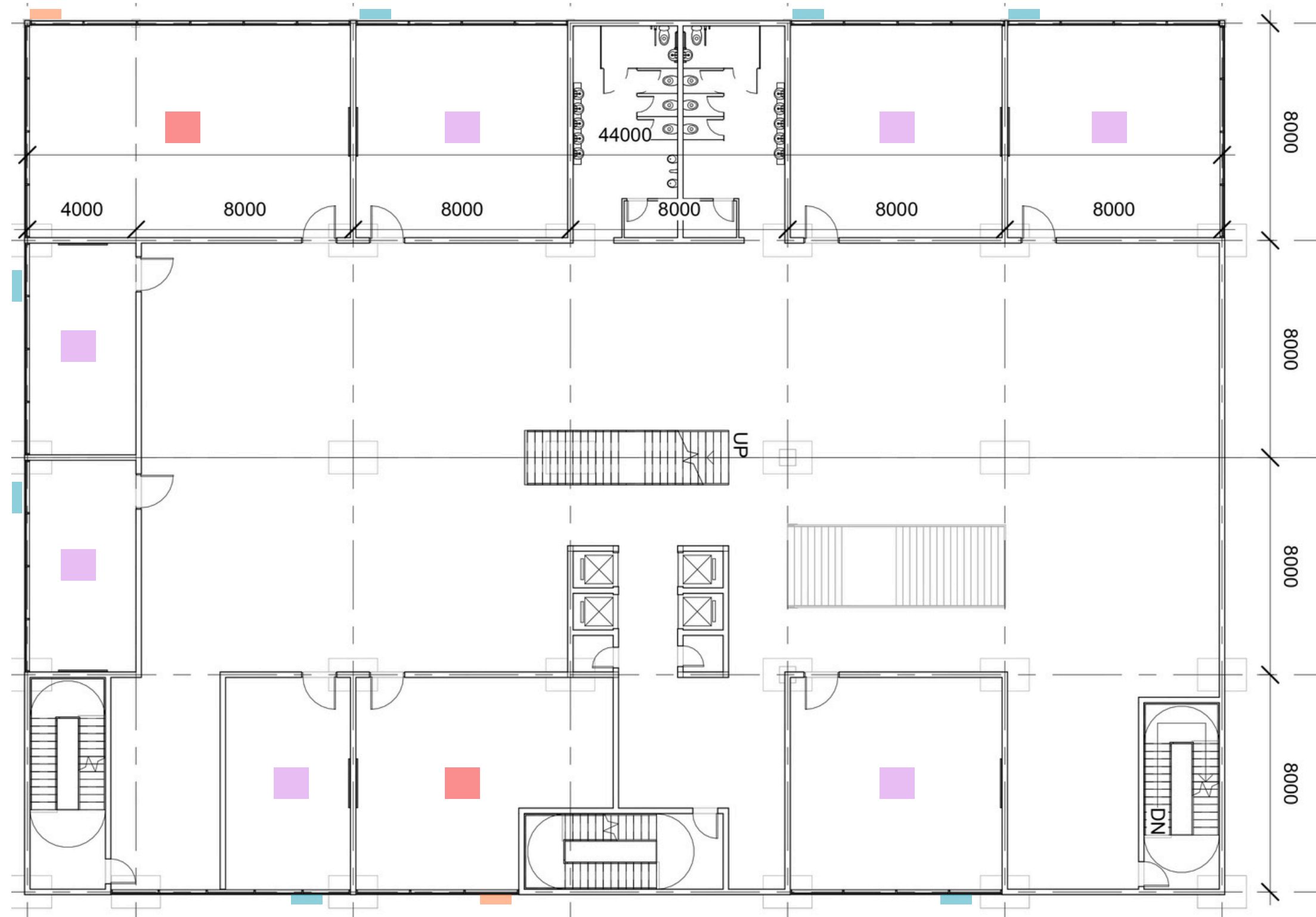
**CLASSROOM 1**  
 Area: 8X4 (32m<sup>2</sup>)  
 BTU: 344X25 = 8,600 BTUs

**CLASSROOM 2**  
 Area: 4X4 (16m<sup>2</sup>)  
 BTU: 172X25 = 4,300 BTUs

**LECTURE HALLS**  
 Area: 12X4 (48m<sup>2</sup>)  
 BTU: 517X25 = 12,925 BTUs

8,600 + 4,300 + 12,925  
 =25,825 BTUs

$$\text{Total HP} = \frac{\text{Total BTUs}}{\text{BTU per HP}} = \frac{25,825}{9,000} \approx 2.87 \text{ HP}$$




CLASSROOM FLOORS


# 4.4 Air Conditioning System Proposal

## 4.4.3 VRV SYSTEM (COMMERSIAL)

**KEY**

 INDOOR UNIT (WALL-MOUNTED)

- FTXS09LVJU
- 295x 798x 189

 OUTDOOR UNIT

- RXYMQ36PVJU
- 940x950x330

**CALCULATIONS**

BTU = Area (sq. ft) × 25

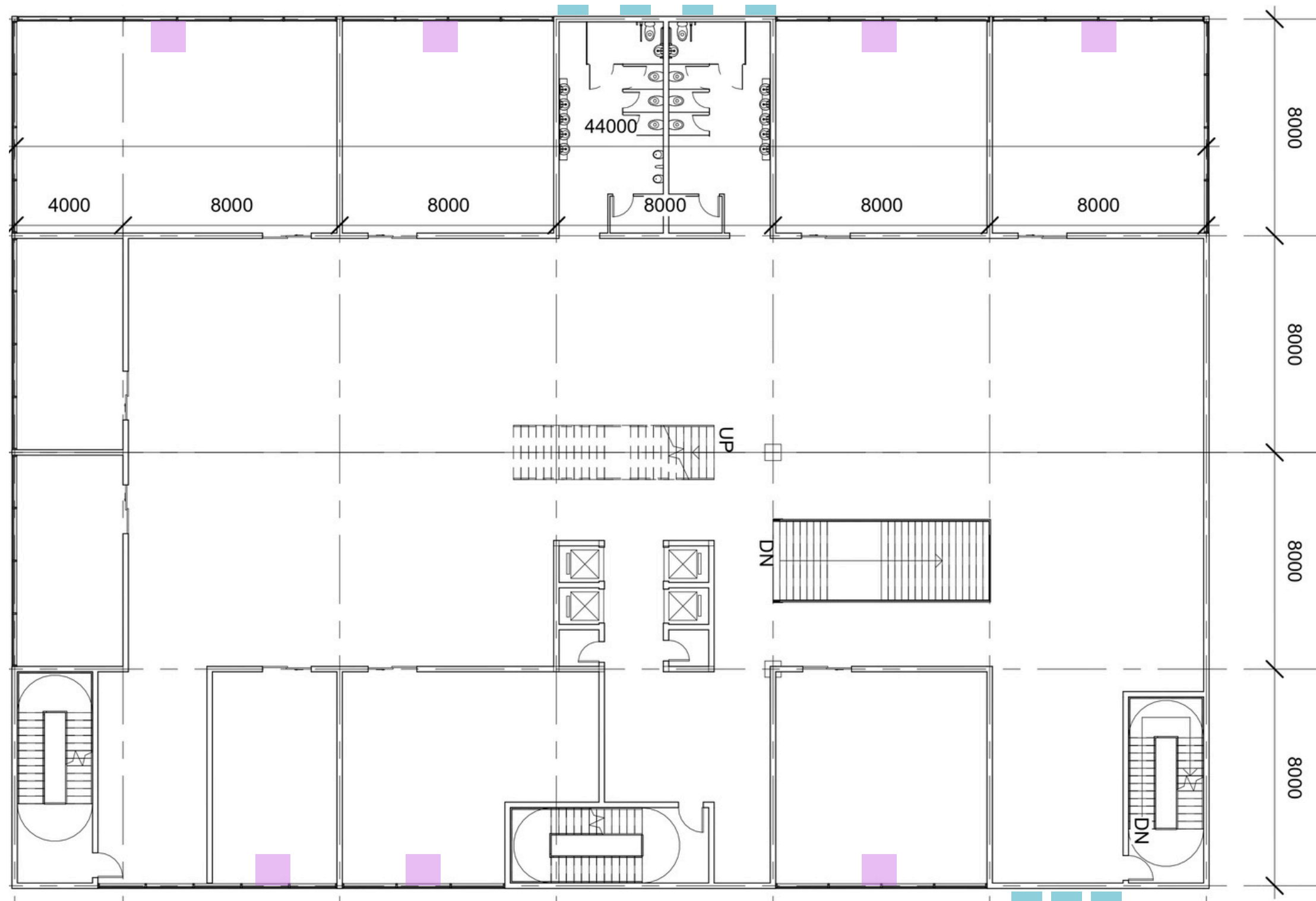
**STORE 1**  
 Area: 8X4 (32m²)  
 BTU: 344X25 = 8,600 BTUs

**STORE 2**  
 Area: 4X4 (16m²)  
 BTU: 172X25 = 4,300 BTUs

**STORE 3**  
 Area: 12X4 (48m²)  
 BTU: 517X25 = 12,925 BTUs

8,600 + 4,300 + 12,925  
 =25,825 BTUs

Total HP =  $\frac{\text{Total BTUs}}{\text{BTU per HP}} = \frac{25,825}{9,000} \approx 2.87 \text{ HP}$



SHOPLOTS

# 5.0 PASSIVE FIRE PROTECTION SYSTEM

Arushee Ramen (0345128)

## 5.1 Introduction

**Passive Fire Protection (PFP)** is a key aspect of structural fire safety, designed to contain fires and slow their spread through **compartmentalisation**. This involves using **fire-rated walls, doors, floors, and shutters** to divide buildings into cells, minimising smoke spread and ensuring **safe evacuation routes and firefighter access**. PFP functions passively without activating during a fire, complementing **Active Fire Protection (AFP) systems**. Both are regulated under UBBL 1984, which ensures compliance through strict testing and fire resistance ratings, typically ranging from 30 minutes to 4 hours. **Fire evacuation paths** must remain **unobstructed with consistent width**, as specified in Sections 166 and 169 of the UBBL.

**Fire-rated materials**, such as **reinforced concrete, masonry, and fireproofed steel**, are essential for PFP. Steel, due to its high thermal conductivity, is fireproofed using dense concrete, cementitious coatings, or intumescent coatings. These materials ensure longer evacuation times and help prevent fire spread, particularly in larger or high-occupancy buildings.

The main PFP strategies are:

1. Purpose Group

2. Fire Retardant Materials

3. Compartmentalisation

4. Means of Escape

## 5.2 Application of Passive Fire Protection - Precedent Studies

1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur

### Means of Escape & Firefighters' Access

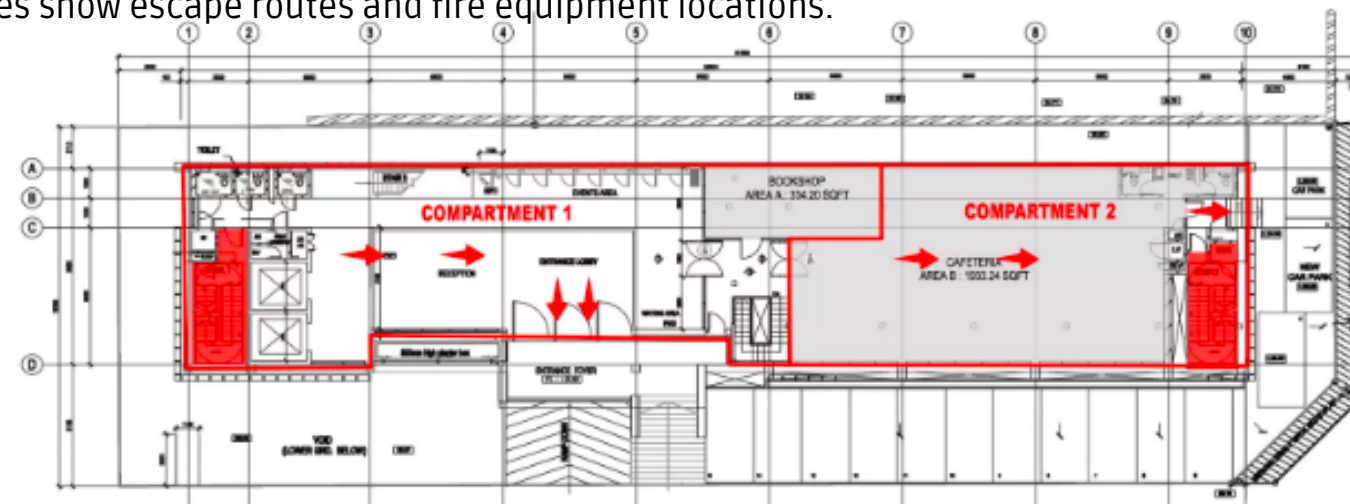
**Fire Escape Staircase:** Protected staircases ensure safe evacuation and firefighter access, with regulated dimensions and natural ventilation in the New PAM Centre, avoiding pressurisation systems.

**Fire Doors:** Swing doors with a fire-resistance rating, commonly made of durable materials, prevent fire spread. New PAM Centre uses solid hardwood core doors with safety features like automatic closers and fire-resistant glass.

**Door Release Mechanism:** Magnetic locks with pass card access, deactivatable via emergency buttons for safe egress.

**Exit Signs:** Glow-in-the-dark signs guide occupants to fire exits as per ISO and local regulations.

**Fire Escape Plan:** Floor plans at lift lobbies show escape routes and fire equipment locations.



( Ground floor plan of New PAM Centre showing the two compartments, escape route directions as well as the enclosed fire escape staircases. )

### Compartmentalisation

A fire safety strategy that uses barriers, such as walls and floors, to divide a building into sections. It slows fire and smoke spread, protecting escape routes and providing time for safe evacuation. New PAM Centre has two compartments with **fire-resistant walls in high-risk areas**. Ducting systems include **fire dampers** for added safety.

## 5.2 Application of Passive Fire Protection - Precedent Studies

1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur

### Fire-Rated Building Materials

Materials designed to **resist fire for a specific duration**, slowing flame spread and maintaining structural integrity.

**Precast Concrete:** Main structural material with a 4-hour fire resistance rating, using non-combustible aggregates.

**Masonry:** Fireproof clay bricks with thickness-based fire resistance (2-4 hours).

**Steel Elements:** Fire-resistant coatings or concrete encasement protect steel structures.

**Aluminium Cladding:** Lightweight material with fire-resistant coatings prevents rapid fire spread.

2 Tamarind Square, Cyberjaya

### Fire Doors and Exit Sign

Building compartmentalisation is achieved through the strategic placement of **fire doors** made of **fire-resistant materials**. When a fire breaks out, they automatically close to stop the spread of smoke and flames, safeguarding escape routes and giving residents more time to safely leave.

**Exit signs** are placed conspicuously in the building's common rooms, stairwells, and hallways. These signs are well marked, illuminated, and frequently have arrows pointing in the direction of the closest exit. Even in low-visibility situations brought on by smoke, these signs are essential for directing residents toward the safest and most straightforward paths to departure points during an emergency.

Tamarind Square's **exit signs and fire doors** work together to provide a coordinated and effective evacuation procedure, greatly improving occupant safety and lowering possible dangers during fire emergencies.

### Fire Staircase

The purpose of these **fire staircases** is to serve as **secure escape routes** in the event of a fire. They keep smoke and flames from spreading since they are enclosed with **fire-resistant materials**, giving residents a safe route.

Because the fire staircases are **well-lit and prominently marked**, residents can locate and utilise them to swiftly and safely leave the building. By **strategically integrating fire staircases**, occupant safety is greatly improved and possible risks during fire emergencies are decreased.

### Roller shutters

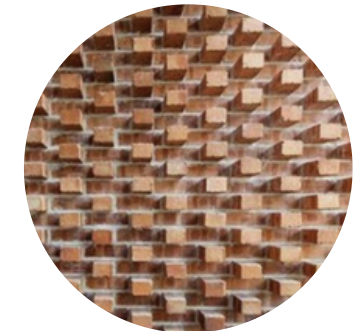
In the case of a fire, these shutters automatically close to protect residents and limit damage by stopping smoke and flames from spreading.



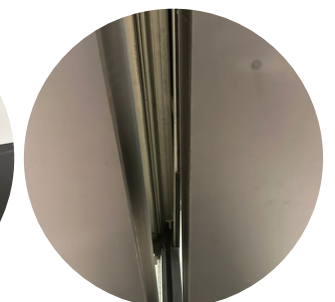
Precast Concrete Wall



Fire rated escape door



Masonry brick wall



## 5.3 Passive Fire Protection Components / Strategies

### 5.3.1 Purpose Group

A "Purpose Group" is a classification system for buildings, designed to define the appropriate fire safety requirements based on their specific use or function. They are categorised according to the **Fifth Schedule (UBBL 1986-Clause 134)**. When a building is divided into separate compartments with different purposes, each compartment is assessed individually to assign its respective purpose group.

However, if a building or a compartment serves multiple functions, the primary or dominant use is taken into account to determine its purpose group. This approach ensures that the fire safety measures align with the primary risks and requirements associated with the building's main function while accommodating variations within its compartments.

#### PURPOSE GROUP UBBL (2012)

I : Small Residential	V : Shop
II : Institutional	VI : Factory
III : Other Residential	VII : Place of Assembly
IV : Office	VIII : Storage and general

130. Fifth Schedule of the principle By-Laws is amended—

(a) by substituting for paragraph (I) the following paragraph:  
"I. Small residential  
Private dwelling house detached or semidetached or terraced.";

(b) in paragraph (II)—

(i) by substituting for the words "Hospital, school" the words "Hospitals, schools, colleges, libraries, nursing homes";  
and

(ii) by inserting after the word "used" the words "for education or";

(c) in paragraph (III), by inserting after the words "I and II" the words ", including hotels, hostels, dormitories, apartments, flats, old folks homes and orphanages.";

(d) in paragraph (V), by substituting for the words "meaning thereby premises not being a shop but" the words "shopping complexes, food courts, wet and dry markets, premises"; and

(e) in paragraph (VII), by inserting after the words "I to VI" the words ", including convention centres, museums, art galleries, cinemas, theatres, auditoriums, places of worship, transportation passenger terminals".

#### UBBL 1986-Clause 140 Fire Appliance Access

Fire appliance access shall be provided within the site of a building to enable fire appliance to gain access to the building. Access openings shall also be provided along the external walls of buildings fronting the fire access way to provide access into the building for firefighting and rescue operations.

The requirements of the fire access way shall be as follows:

- The access way shall have the minimum width of 6 metres throughout its entire length and shall be able to accommodate the entry and manoeuvring of a fire engine, extended ladders pumping appliances, turntable and hydraulic platforms;
- The access way shall be metalled, paved and laid with strengthened perforated slabs to withstand the loading capacity of a stationary 30 tonnes fire appliance;
- The access way shall be positioned so that the nearer edge shall not be less than 2 metres and more than 10 metres from the centre position of the access opening, measured horizontally;
- The access way shall be laid on a level platform or if on an incline, the gradient shall not exceed 1:15. The access road shall be laid on an incline of not exceeding a gradient of 1:8.3

## 5.3 Passive Fire Protection Components / Strategies

### 5.3.2 Fire Retardant Materials

Designing structural elements for fire resistance involves two main considerations: **heat transmission and structural integrity**.

The **heat transmission endpoint** ensures that the temperature rise on the side opposite the fire is limited. This depends on the **type of concrete** used and the **thickness of the element**, which act together to slow heat transfer.

The **structural endpoint** ensures that the element **retains its strength and resists collapse** under fire conditions. This is influenced by the temperature of the reinforcement at the end of the fire resistance duration, which is controlled by the **thickness of the concrete cover between the fire-exposed surface and the reinforcement**.

Both considerations work together to ensure structural elements perform effectively during a fire.

In accordance with **UBBL 1986-Clause 224**, the notional fire resistance period for specific concrete construction elements is determined by their thickness. To achieve maximum fire resistance, the structure incorporates **load-bearing precast concrete walls with thicknesses of 200mm and 300mm**. These dimensions provide the structure with a fire resistance period of **up to 4 hours**, ensuring enhanced safety and durability under fire conditions.

#### UBBL 1986-Clause 224 Fire resistance for any element of structure

Any element of structure shall be deemed to have the requisite fire resistant if:

(a) it is constructed in accordance with the specifications given in the Ninth Schedule to these Bylaws and the notional period of fire resistance given in that Schedule as being appropriate to that type of construction and other relevant factors is not less than requisite fire resistance; or

(b) a similar part made to the same specification as the element is proved to have the requisite fire resistance under the conditions of test prescribed in the foregoing By-laws.

WALLS					
A. Masonry construction					
Construction and materials	Minimum thickness ex for period of fi				
	Loadbearing				
	4 hrs.	2 hrs.	1½ hrs.	1 hr.	½ hr.
1. Reinforced concrete, minimum concrete cover to main reinforcement of 25 mm:					
(a) unplastered	180	100	100	75	75
(b) 12.5 mm cement-sand plaster	180	100	100	75	75
(c) 12.5 mm gypsum-sand plaster	180	100	100	75	75
(d) 12.5 mm vermiculite-gypsum plaster	125	75	75	63	63
2. No-fines concrete of Class 2 aggregate:					
(a) 12.5 mm cement-sand plaster					
(b) 12.5 mm gypsum-sand plaster					
(c) 12.5 mm vermiculite-gypsum plaster					
3. Bricks of clay, concrete or sand-lime:					
(a) unplastered	200	100	100	100	100
(b) 12.5 mm cement-sand plaster	200	100	100	100	100
(c) 12.5 mm gypsum-sand plaster	200	100	100	100	100
(d) 12.5 mm vermiculite-gypsum plaster or perlitegypsum* plaster	100	100	100	100	100

PART III					
REINFORCED CONCRETE BEAMS					
Construction and materials	Minimum concrete over without finish to main reinforcement (in mm) for a fire resistance of--				
	4 hrs.	2 hrs.	1½ hrs.	1 hr.	½ hr.
	(a) without plaster	63	45	35	25
(b) finished with 12.5 mm vermiculite-gypsum plaster	25	12.5	12.5	12.5	12.5
(c) with 2.5 mm cement-sand or gypsum-sand plaster on mesh reinforcement fixed around beam	50	30	20	12.5	12.5

PART II					
REINFORCED CONCRETE COLUMNS					
Construction and materials	Minimum dimension of concrete column* without finish (in mm) for a fire resistance of--				
	4 hrs.	2 hrs.	1½ hrs.	1 hr.	½ hr.
	1. (a) without plaster	450	300	250	200
(b) with 12.5 mm cement-sand or gypsum-sand plaster on mesh reinforcement fixed around column	300	225	150	150	150

## 5.3 Passive Fire Protection Components / Strategies

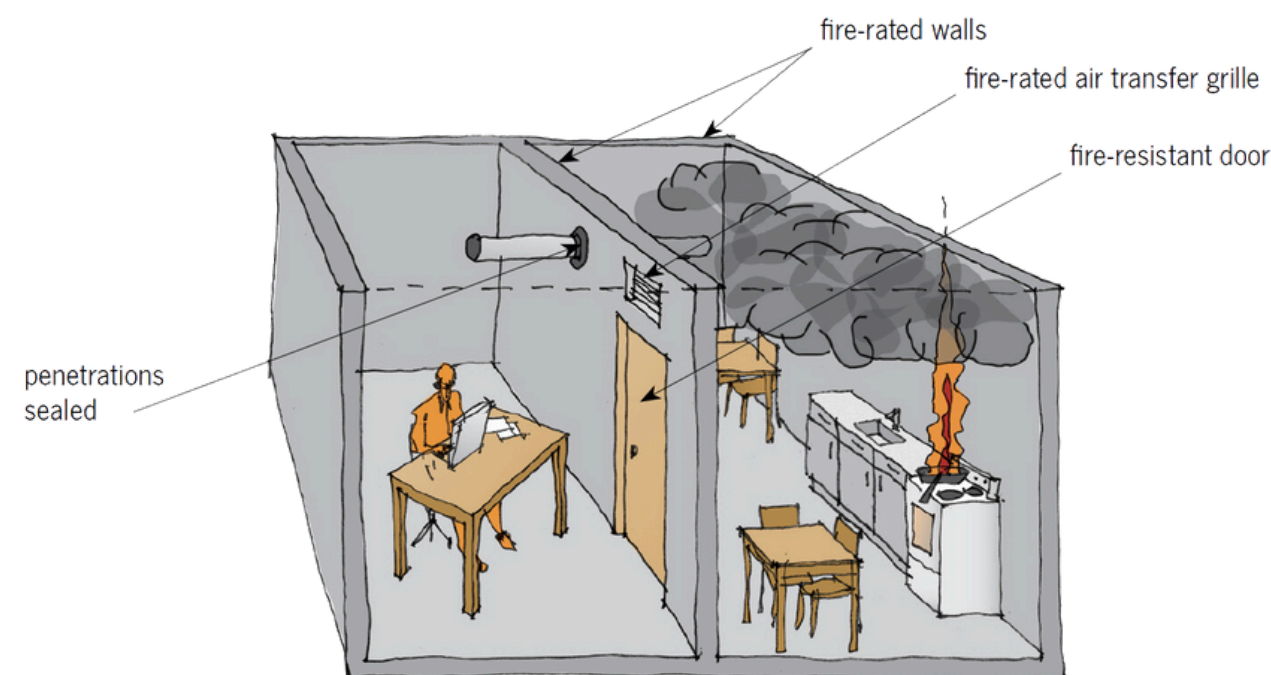
### 5.3.3 Compartmentalisation

Compartmentalisation involves dividing a building into distinct sections, or 'compartments,' as part of an effective fire risk management strategy. The primary aim of this approach is to **confine a fire to a specific area**, limiting its spread and minimising overall damage. This containment strategy provides additional time for occupants to evacuate safely and for fire services to manage and extinguish the fire. Each compartment is designed with **fire-resistant materials and protective features** such as **fire doors and cavity barriers**. By creating fire-resistant compartments within a building, the likelihood of successfully controlling and suppressing a fire is significantly increased.

**UBBL 1986-Clause 138 Other walls and floors to be constructed as compartment walls or compartment floor.**

The following walls and floors in buildings shall be constructed as compartment walls or compartment floors:

- (a) any floor in a building of Purpose Group II (Institutional);
- (b) any wall or floor separating a flat or maisonette from any other part of the same building;
- (c) any wall or floor separating part of a building from any other part of the same building which is used or intended to be used mainly for a purpose falling within a different purpose group as set out in the Fifth Schedule to these By-laws; and
- (d) any floor immediately over a basement storey if such basement storeys has an area exceeding 100 square metres.



#### DIMENSIONS OF BUILDINGS AND COMPARTMENTS

(By-law 136)

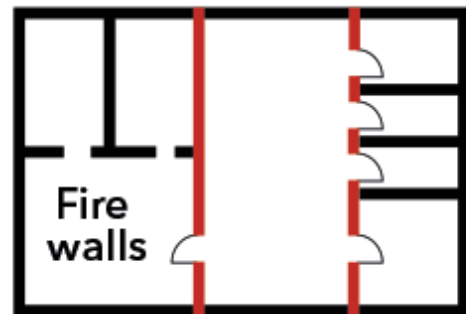
Purpose group (1)	Height of buildings (2)	Limit of dimensions	
		Floor are of storey in building or compartment (in m <sup>2</sup> ) (3)	Cubic capacity of building or compartment (in m <sup>3</sup> ) (4)
<i>Part 1 --- Building other than single storey buildings</i>			
II (Institutional)	Any height	2 000	No limit
III (Other residential)	Not exceeding 28 m	3 000	8 500
III (Other residential)	Exceeding 28 m	2 000	5 500
V (Shop)	Any height	2 000	7 000
VI (Factory)	Not exceeding 28 m	No limit	28 000
VI (Factory)	Exceeding 28 m	2 000	5 500
VIII (Storage and general)	Not exceeding 28 m	No limit	21 000
VIII (Storage and general)	Exceeding 28 m	1 000	No limit

Figure 2. Fire spread control using passive fire protection

## 5.3 Passive Fire Protection Components / Strategies

### 5.3.3 Compartmentalisation

#### Compartment walls



#### Compartment floors / ceilings



DIMENSIONS OF BUILDINGS AND COMPARTMENTS [By-law 136]				
Purpose group (1)	Height of a building in metre (m) (2)	Limit of a dimension		
		Floor area of a storey in a building or compartment in square metre (m <sup>2</sup> ) (3)	Cubic capacity of a building or compartment in cubic metre (m <sup>3</sup> ) (4)	
<i>Part 1 --- Building other than a single storey building</i>				
II	Institutional— Note: Hospital (patient accommodation ward)	Any height	2, 000	No limit
		Any height	750	No limit
III	Other residential	Not exceeding 28	3, 000	8, 500
III	Other residential	Exceeding 28	2, 000	5, 500
V	Shop	Any height	2, 000	7, 000
VI	Factory	Not exceeding 28	No limit	28, 000
VI	Factory	Exceeding 28	2, 000	5, 500
VIII	Storage and general	Not exceeding 28	No limit	21, 000
VIII	Storage and general	Exceeding 28	1, 000	No limit
<i>Part 2 -- Single storey building</i>				
II	Institutional Note 1: Hospital (patient accommodation ward)	Any height	3, 000	No limit
		Any height	750	No limit
III	Other residential	Any height	3, 000	No limit

SUSPENDED CEILINGS [By-law 148(6), 219]			
Height of building (1)	Types of floor (2)	Required fire resistance of floor (3)	Description of suspended ceiling (4)
Less than 15 m	Non-compartment	1 hour or less	Surface of ceiling exposed within the cavity not lower than Class 1 (as to surface spread of flame).
	Compartment	Less than 1 hour	
	Compartment	1 hour	Surface of ceiling exposed within the cavity not lower than Class O (as to surface spread of flame); supports and fixings for the ceiling non-combustible.
15 m or more	Any	1 hour or less	Surface of ceiling exposed within the cavity not lower than Class O (as to surface spread of flame) and jointless; supports and fixings for the ceiling non-combustible.
Any	Any	more than 1 hour	Ceiling of non-combustible construction and jointless; supports and fixings for the ceiling non-combustible.

UBBL 1986-Clause 148(6) Special requirements as to compartment walls and compartment floors.

Any compartment wall or compartment floor which is required by these By-laws to have FRP hour or more shall, excluding-

(a) any floor finish;

(b) any surface finish to a wall or ceiling which complies with the requirements of by-laws 204 shall; or

(c) any ceiling which complies with the description specified in the Ninth Schedule to these Bylaws,

be constructed wholly of non-combustible materials and, apart from any ceiling, the required FRP of the wall or floor shall be obtained without assistance from any non-combustible material.

## 5.3 Passive Fire Protection Components / Strategies

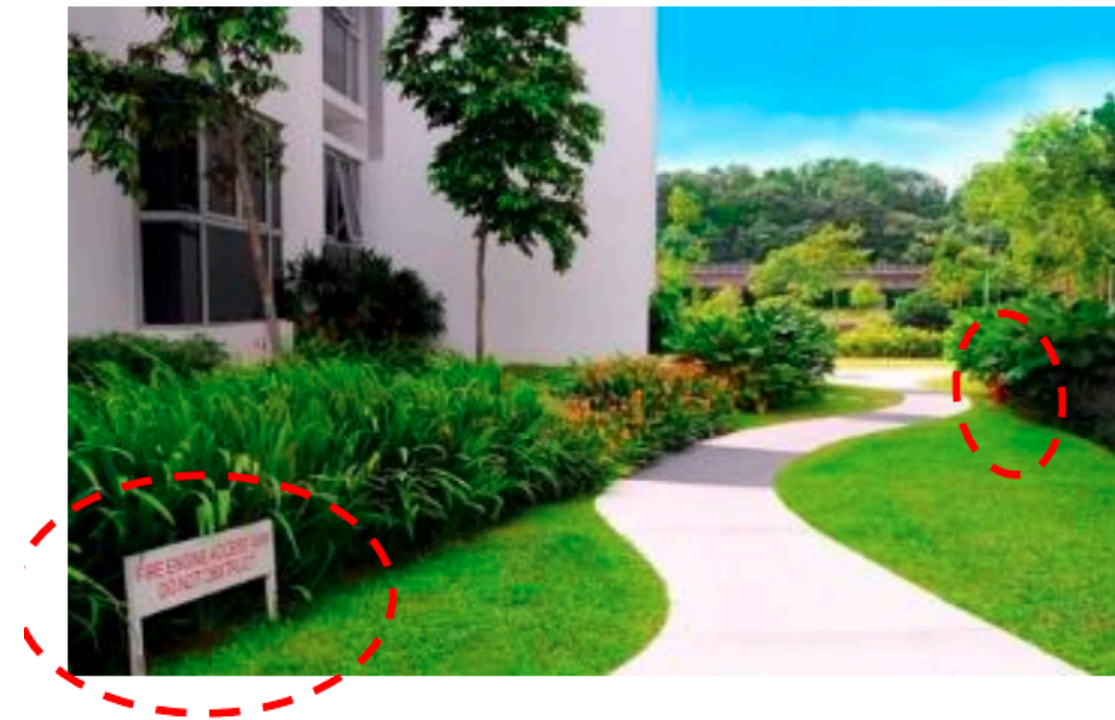
### 5.3.4 Means of Escape

The Fire and Rescue Department of Malaysia (Bomba) typically advises that **fire escape plans** be displayed at strategic locations such as **lift lobbies, main corridors, and near staircases**. These plans should be positioned at **eye level or slightly above** to ensure they are easily visible to all occupants. Additionally, they are best placed in high-traffic areas like **entrances, exits, and common gathering points** to maximise awareness and accessibility during emergencies.

It is recommended to ensure that they are **illuminated or made of photoluminescent material** to remain visible during power outages. Fire escape plans should be posted on **every floor**, particularly in public areas and **near fire exits**, to enhance accessibility. Additionally, it is crucial to regularly maintain and update these plans to reflect any changes in the building's layout, ensuring their accuracy and effectiveness in emergencies.

**Assembly points** are recommended to be placed in **open, easily accessible, and safe locations** away from potential fire hazards. Assembly points should be clearly marked with **visible signage** and situated at a **sufficient distance from the building** to ensure the safety of evacuees. Additionally, these points should accommodate the expected number of occupants and allow for smooth movement without causing congestion. **Regular drills and inspections** can help ensure that assembly points remain effective and meet safety standards.

**Fire Drills** are recommended to be carried out **at least once a year** for libraries, hospitals, hotels, hostels, offices and government buildings.



## 5.3 Passive Fire Protection Components / Strategies

### 5.3.4 Means of Escape

**Fire-rated doors** are specially designed using materials that work together to slow or prevent the spread of flames, smoke, and, in some cases, radiant and conductive heat transfer. These doors play a vital role in protecting building occupants during a fire emergency by maintaining fire safety barriers.

The selection of **fire-rated doors** is based on the **Fire Resistance Period (FRP)** and their placement within the building, particularly in relation to compartment walls and openings. These doors are strategically located on each floor, providing access to fire staircases that guide occupants to safety during an emergency. To ensure effectiveness, **door closers** are installed to automatically shut the doors after they have been opened, reducing the risk of fire and smoke spreading.

**Fire-rated doors** are typically constructed from steel, a non-combustible material known for its cost efficiency and higher fire-resistance rating compared to wooden doors. These doors are an essential part of fire safety regulations, ensuring that they are never left open in a way that could compromise the safety of the building's occupants or accelerate the development of a fire.

#### UBBL 1986-Clause 162 Fire doors in compartment walls and separating walls.

- (1) Fire doors of a appropriate FRP shall be provided.
- (2) Openings in compartment walls and separating walls shall be protected by a fire door having a FRP in accordance with the requirements for that wall specified in the Ninth Schedule to these By-laws.
- (3) Openings in protecting structures shall be protected by fire doors having FRP of not less than half the requirement for the surrounding wall specified in the Ninth Schedule to these By-laws but in no case less than half hour.
- (4) Openings in partitions enclosing a protected corridor or lobby shall be protected by fire doors having FRP of half-hour.

#### UBBL 1986-Clause 164 Door closers for fire doors.

- (1) All fire doors shall be fitted with automatic door closers of the hydraulically spring operated type in the case of swing doors and of wire rope and weight type in the case of sliding doors.
- (2) Double doors with rabbeted meeting stiles shall be provided with co-ordinating device to ensure that leafs close in the proper sequence.
- (3) Fire doors may be held open provided the hold open device incorporates a heat actuated device to release the door. Heat actuated devices shall not be permitted on fire doors protecting openings to protected corridors or protected staircases.

Doors with a **Fire Protection Rating (FPR) of 120 minutes** are proposed for the design of the building to enhance fire safety. These doors provide a certified two hours of fire resistance, ensuring that flames and smoke are effectively contained within specific areas for an extended period. This duration is crucial as it allows sufficient time for occupants to evacuate the building safely during an emergency, minimising potential risks and enhancing overall safety measures.



## 5.3 Passive Fire Protection Components / Strategies

### 5.3.4 Means of Escape

An **fire escape staircase** is a staircase specifically designed and constructed using **non-combustible materials** to ensure safety during a fire emergency. These staircases are protected from fire through the **use of fire-rated construction** or **by being strategically located in external spaces**. Their primary purpose is to provide a secure and reliable route for occupants to evacuate to an external area in the event of a fire.

#### UBBL 1986-Clause 168. Staircases.

(1) Except as provided for in by-laws 194 every upper floor shall have means of egress via at least two separate staircases.

(2) Staircases shall be of such width that in the event of any one staircase not being available for escape purpose the remaining staircases shall accommodate the highest occupancy load of any one floor discharging into it calculated in accordance with provisions in the Seventh Schedule to these By-laws.

(3) The required width of staircase shall be the clear width between walls but handrails may be permitted to encroach on this width to a maximum of 80 millimetres. [(3) Am.Sel.P.U.142/2012]

(4) The required width of a staircase shall be maintained throughout its length including at landings.

(5) Doors giving access to staircases shall be so positioned that their swing shall at no point encroach on the required width of the staircase or landing.

#### UBBL 1986-Clause 106. Dimensions of staircases.

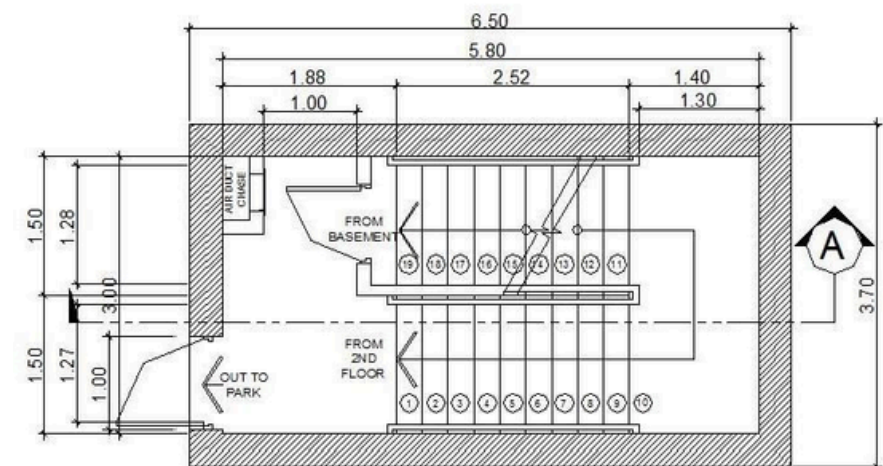
(1) In any staircase, the rise of any staircase shall be not more than 180 millimetres and the tread shall not less than 255 millimetres and the dimensions of the rise and the tread of the staircase so chosen shall be uniform and consistent throughout.

(2) The widths of staircases shall be in accordance with by-law 168.

(3) The depths of landings shall be not less than the width of the staircases.



In compliance with the **UBBL**, fire escape staircases have been strategically positioned to ensure that they are within a **maximum travel distance of 45 meters** from all compartments on each floor. This placement is designed to facilitate efficient and safe evacuation during emergencies.



## 5.3 Passive Fire Protection Components / Strategies

### 5.3.4 Means of Escape

Fire exit doors and exit signs play an essential role in a building's **emergency evacuation system**. Designed to ensure a quick and safe exit during fire incidents or other emergencies, these features work together to guide occupants efficiently toward escape routes. Their combined functionality significantly enhances the overall safety and preparedness of the building in critical situations.

#### UBBL 1984-Clause 172. Emergency exit signs.

- 1) Storey exits and access to such exits shall be marked by readily visible signs and shall not be obscured by any decorations, furnishings or other equipment.
- (2) A sign reading "KELUAR" with an arrow indicating the direction shall be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent.
- (3) Every exit sign shall have the word "KELUAR" in plainly legible letters not less than 150 millimetres high with the principal strokes of the letters not less than 18 millimetres wide. The lettering shall be in red against a black background.
- (4) All exit signs shall be illuminated continuously during periods of occupancy.
- (5) Illuminated signs shall be provided with two electric lamps of not less than fifteen watts each.



#### UBBL 1986-Clause 173. Exit doors.

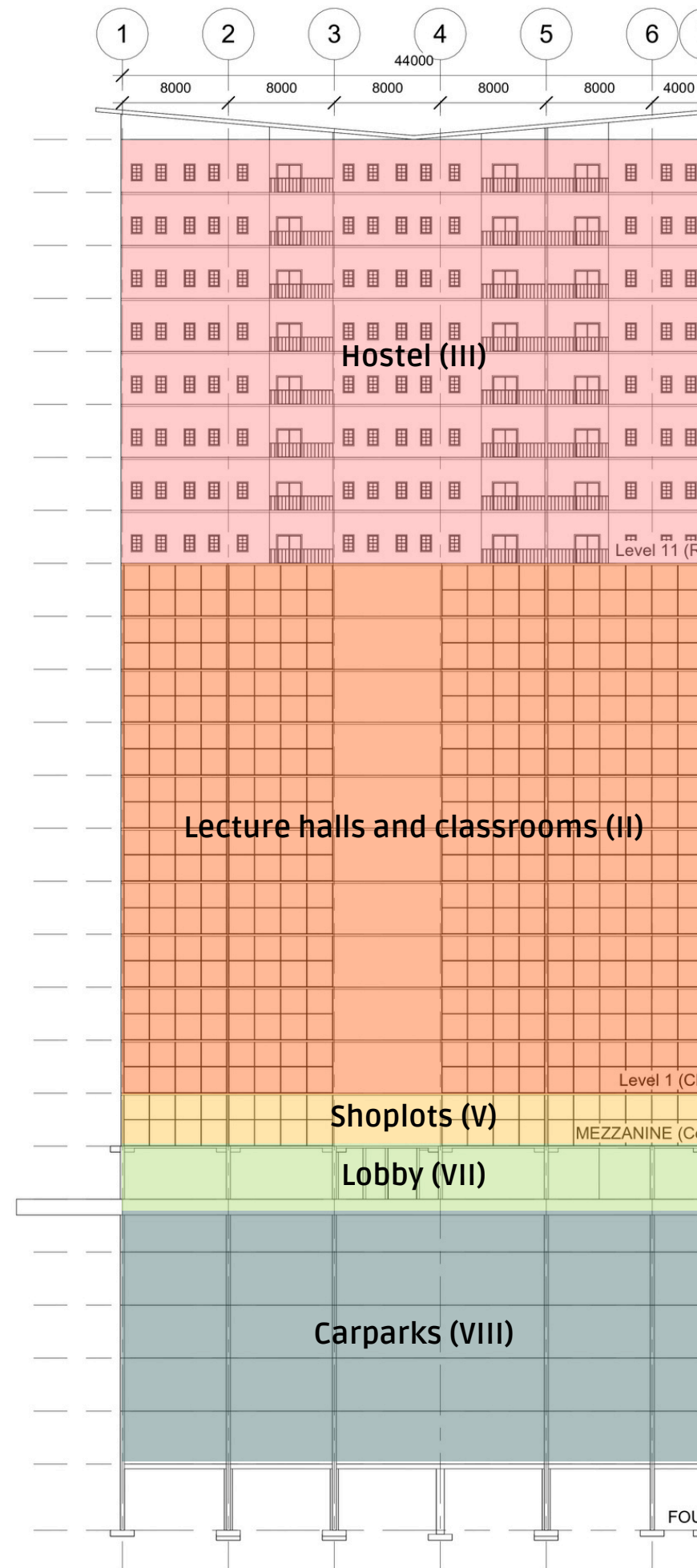
- (1) All exit door should be openable from the inside without the use of a key or any special knowledge or effort.
- (2) Exit doors shall close automatically when released and all door devices including magnetic door holders, shall release the doors upon power failure or actuation of the fire alarm.



The fire door and the certification of the fire door

# 5.4 PFP Proposal

## 5.4.1 Purpose Group



### PURPOSE GROUP UBBL (2012)





- I : Small Residential
- II : Institutional
- III : Other Residential
- IV : Office
- V : Shop
- VI : Factory
- VII : Place of Assembly
- VIII : Storage and general

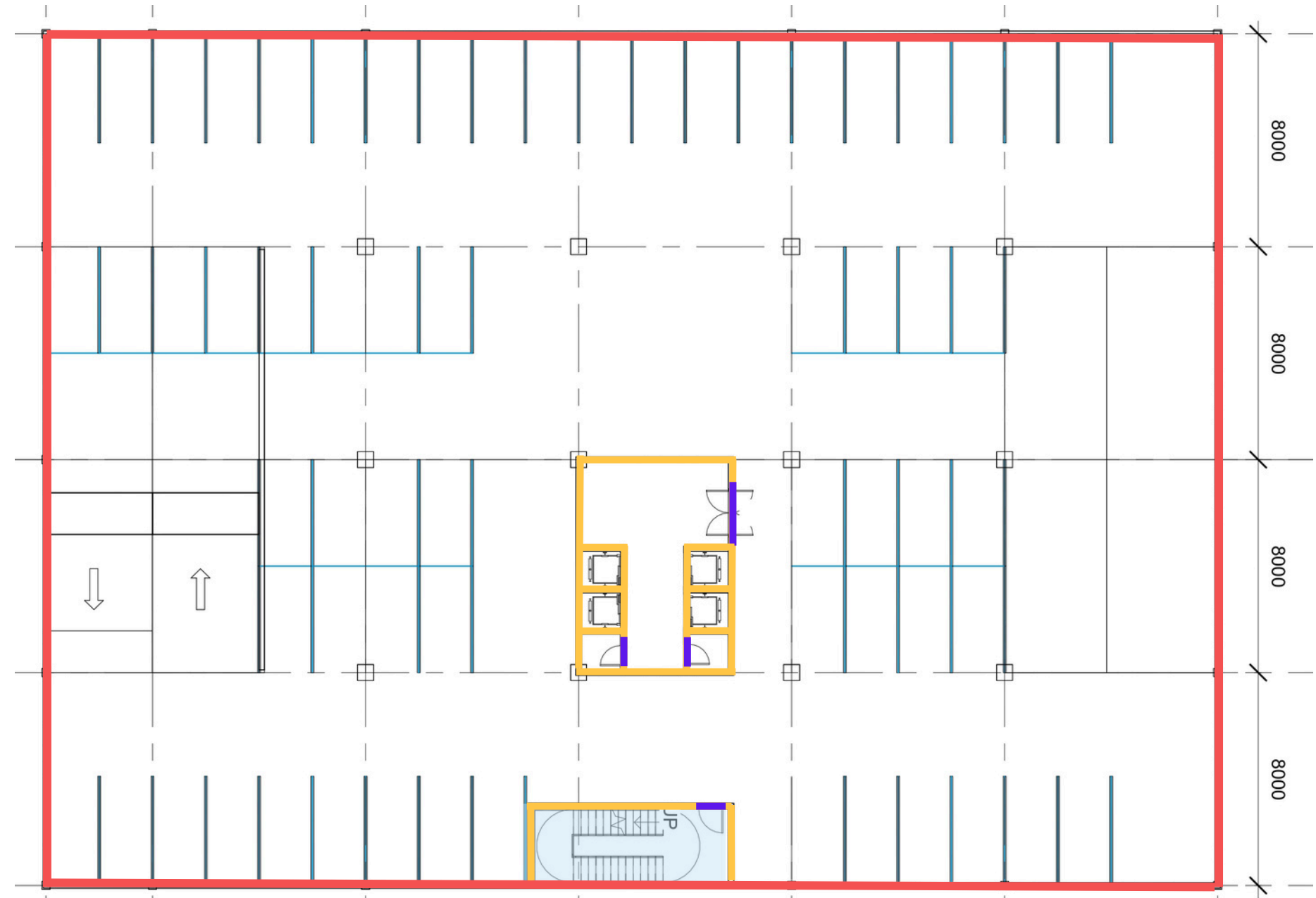
# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (B1-B5)

1:200

**KEY**

-  FIRE ESCAPE STAIRWELL B1-B5
-  300MM PRECAST CONCRETE WALL +4 HOURS FIRE PROTECTION
-  200MM PRECAST CONCRETE WALL 4 HOURS FIRE PROTECTION
-  FIRE RATED DOOR 120MIN FIRE PROTECTION

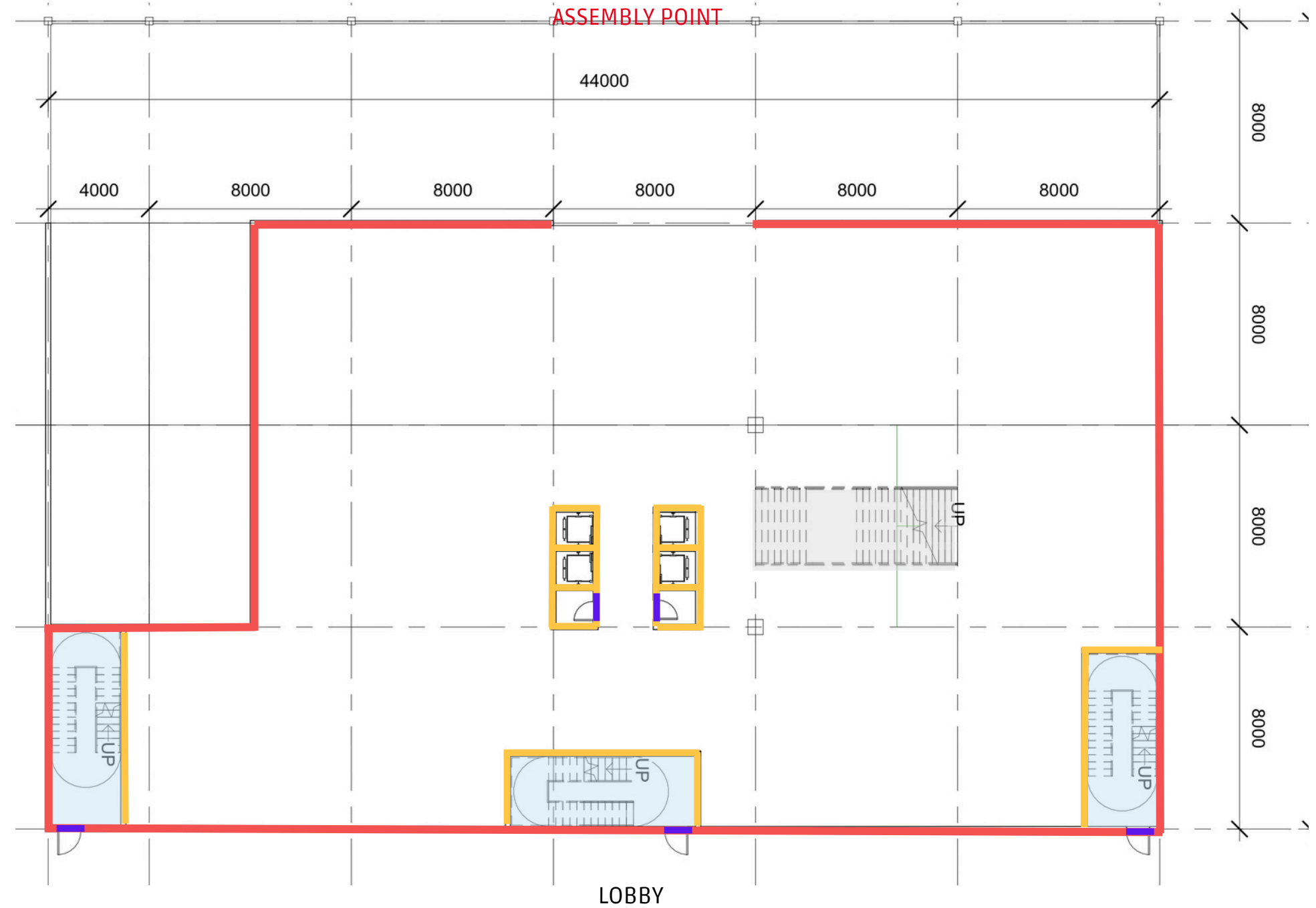
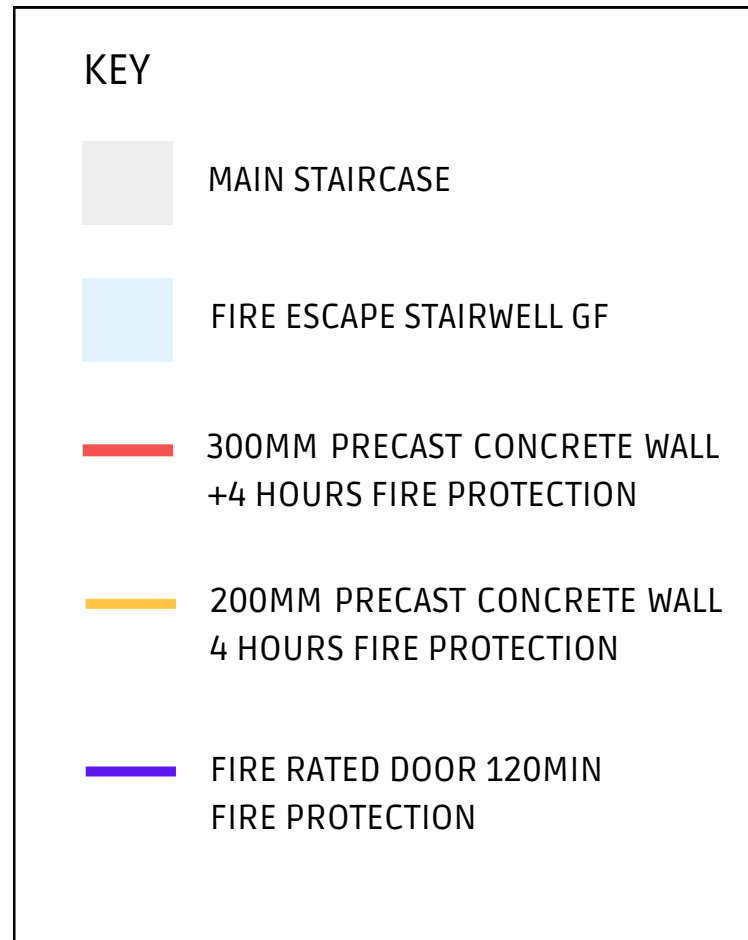


CARPARK

# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (GF)

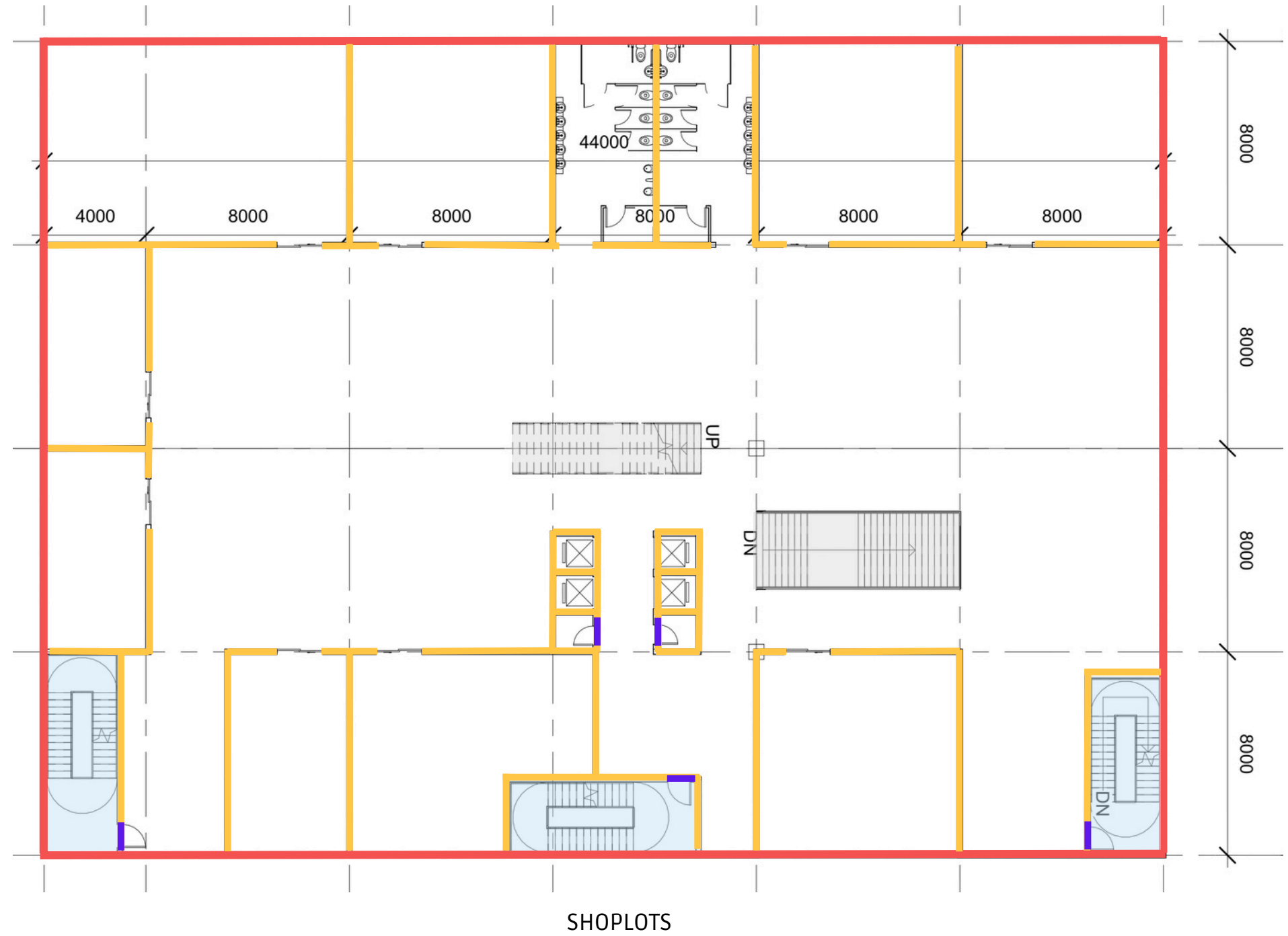
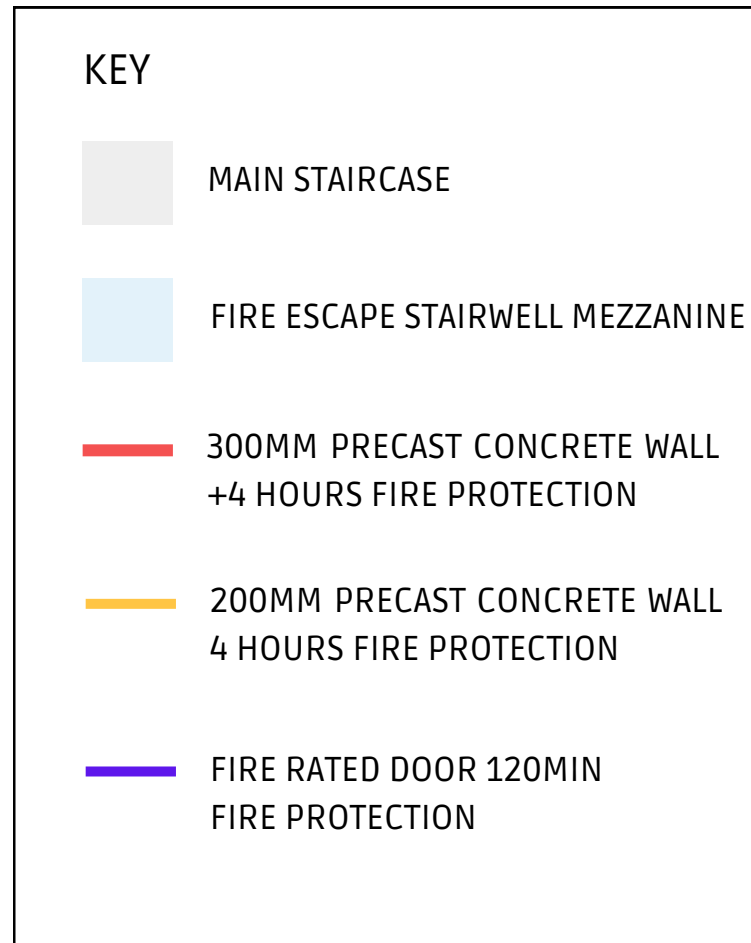
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# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (MEZZANINE)

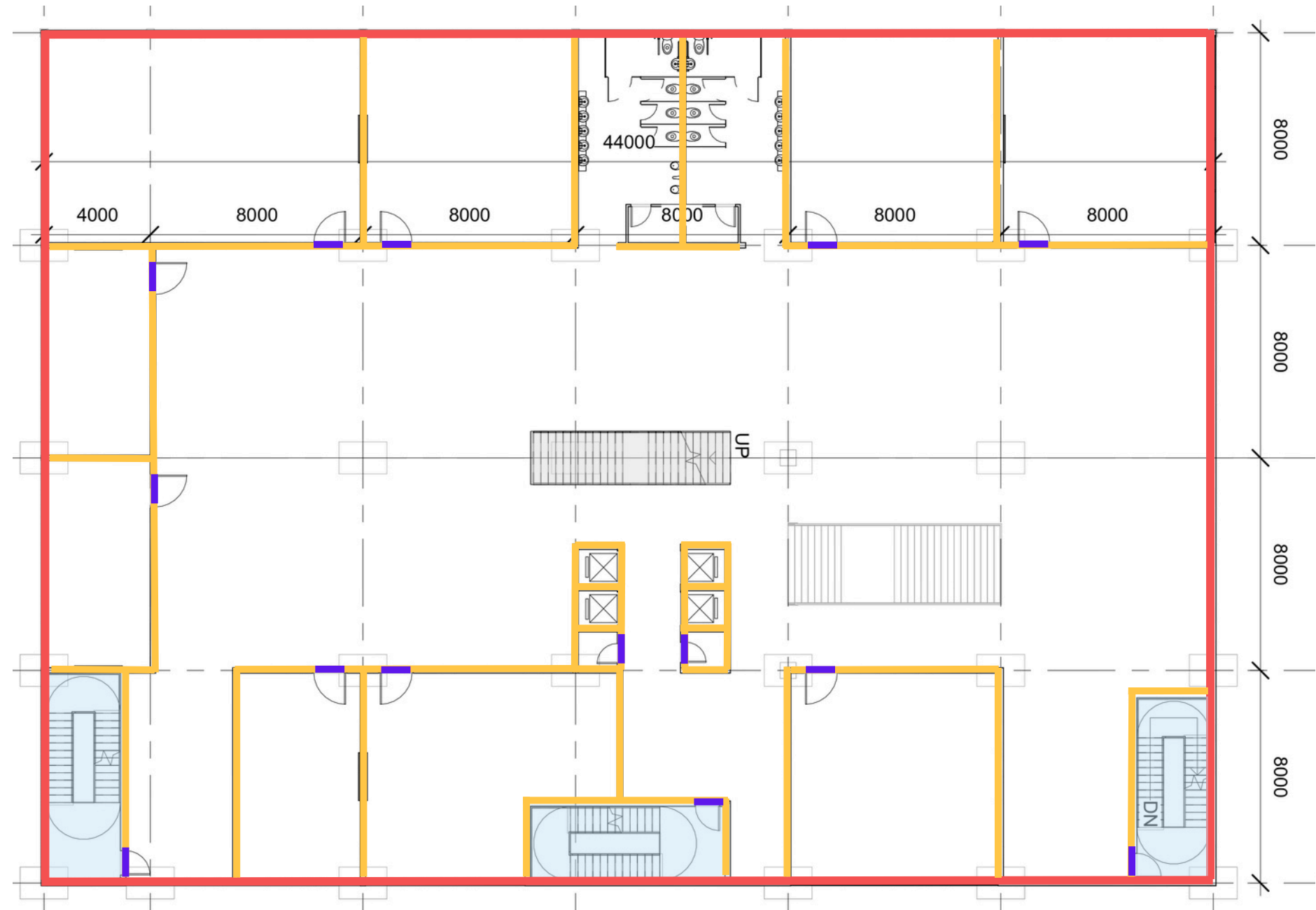
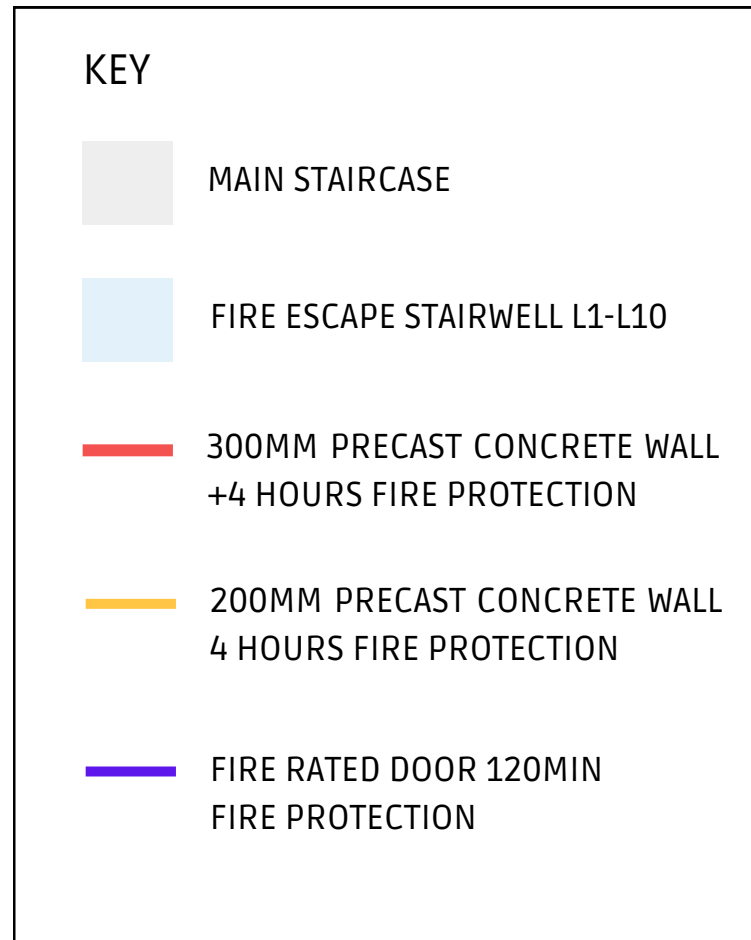
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# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (L1-L10)

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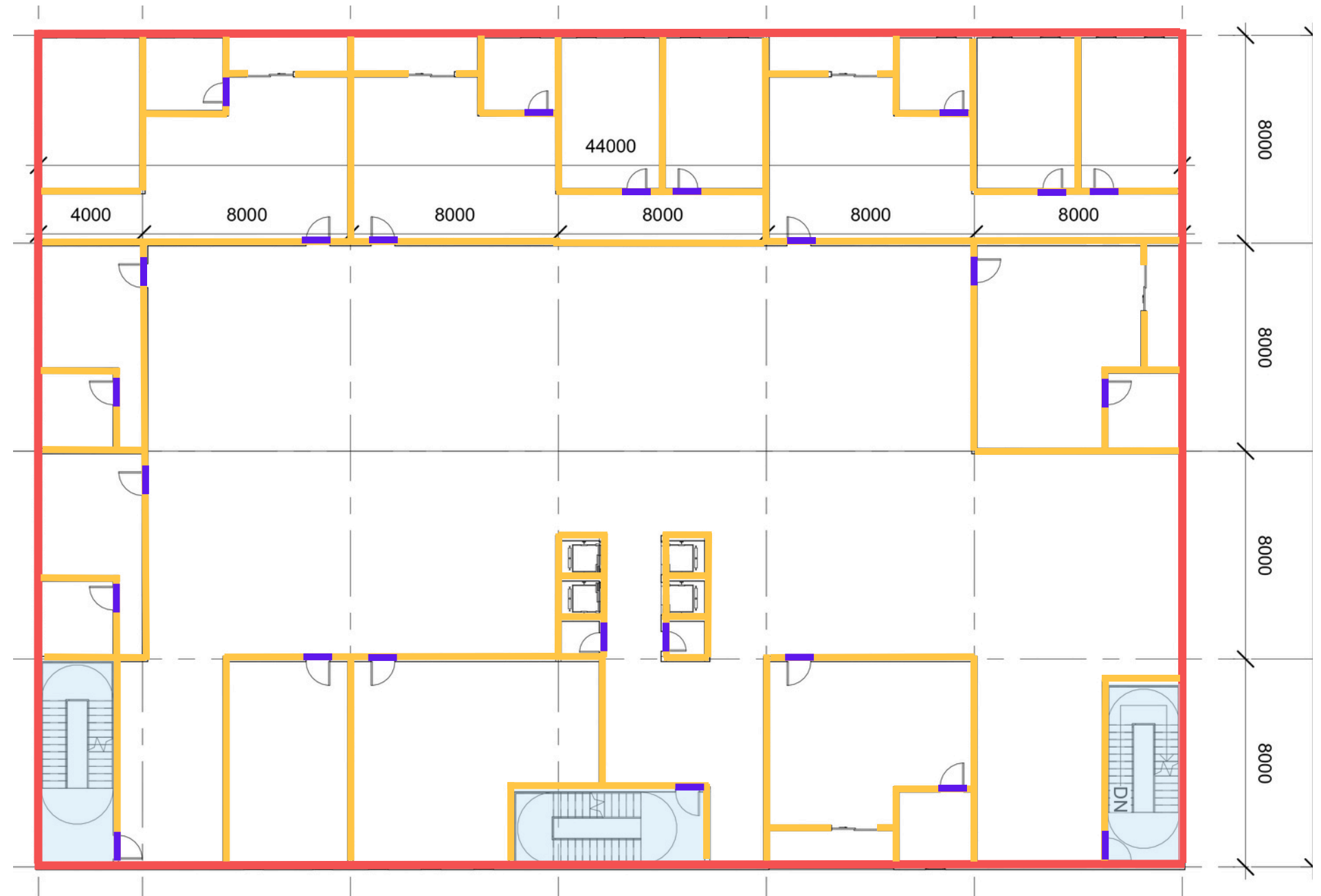
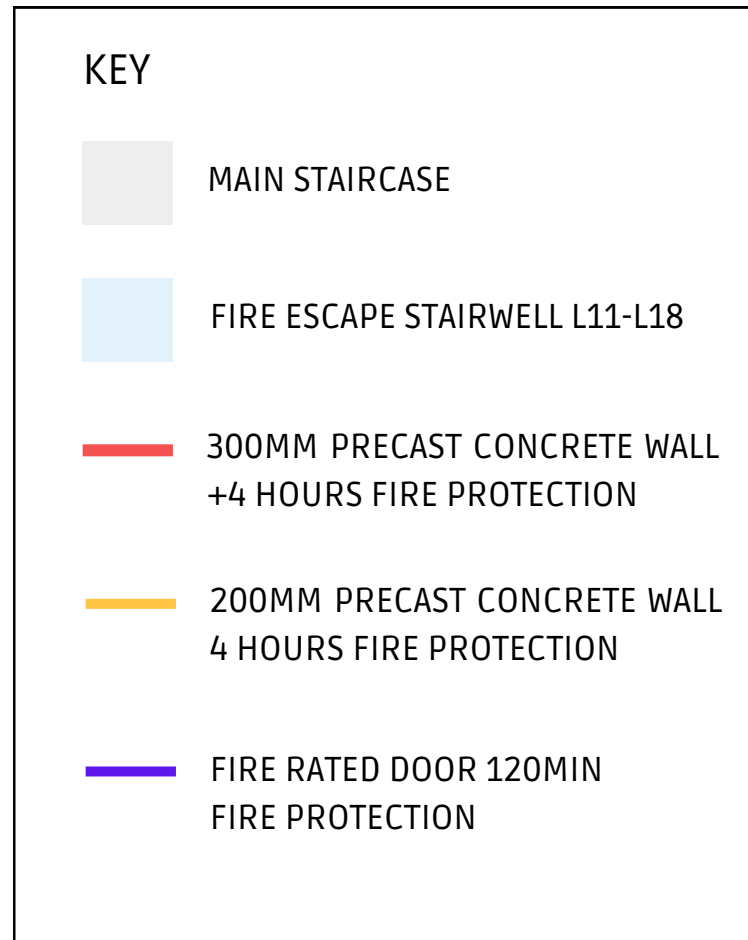


CLASSROOM FLOORS

# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (L11-L18)

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





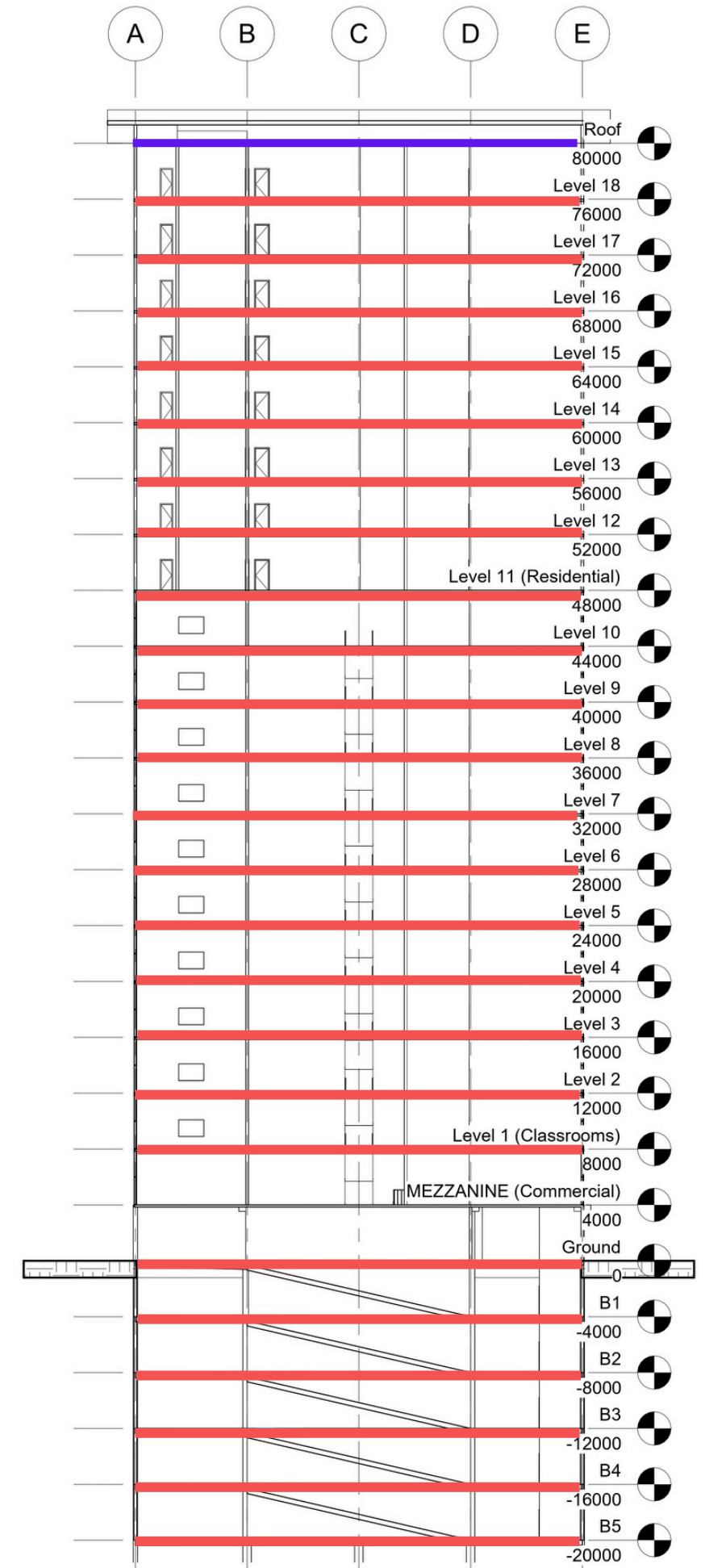
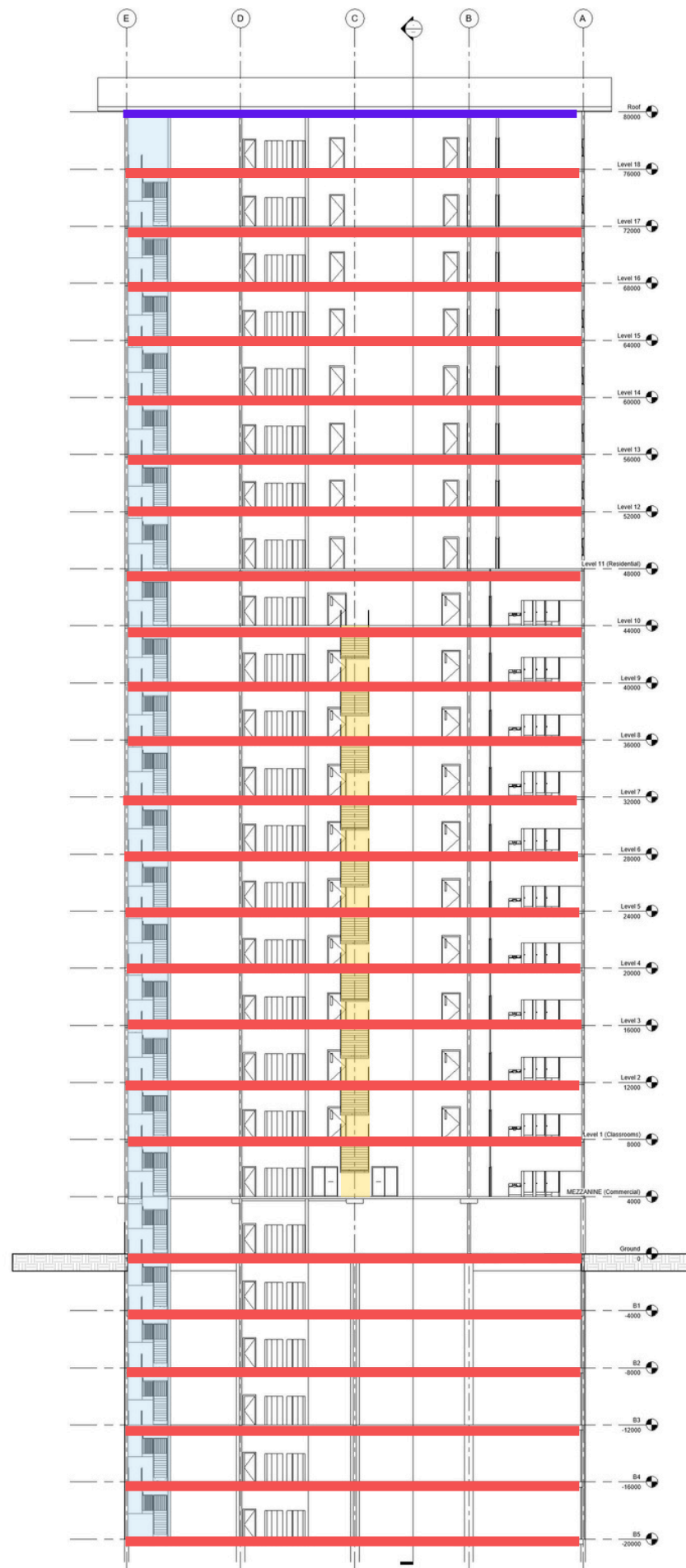
HOSTEL FLOORS

# 5.4 PFP Proposal

## 5.4.2 Compartmentalisation (Section)

**KEY**

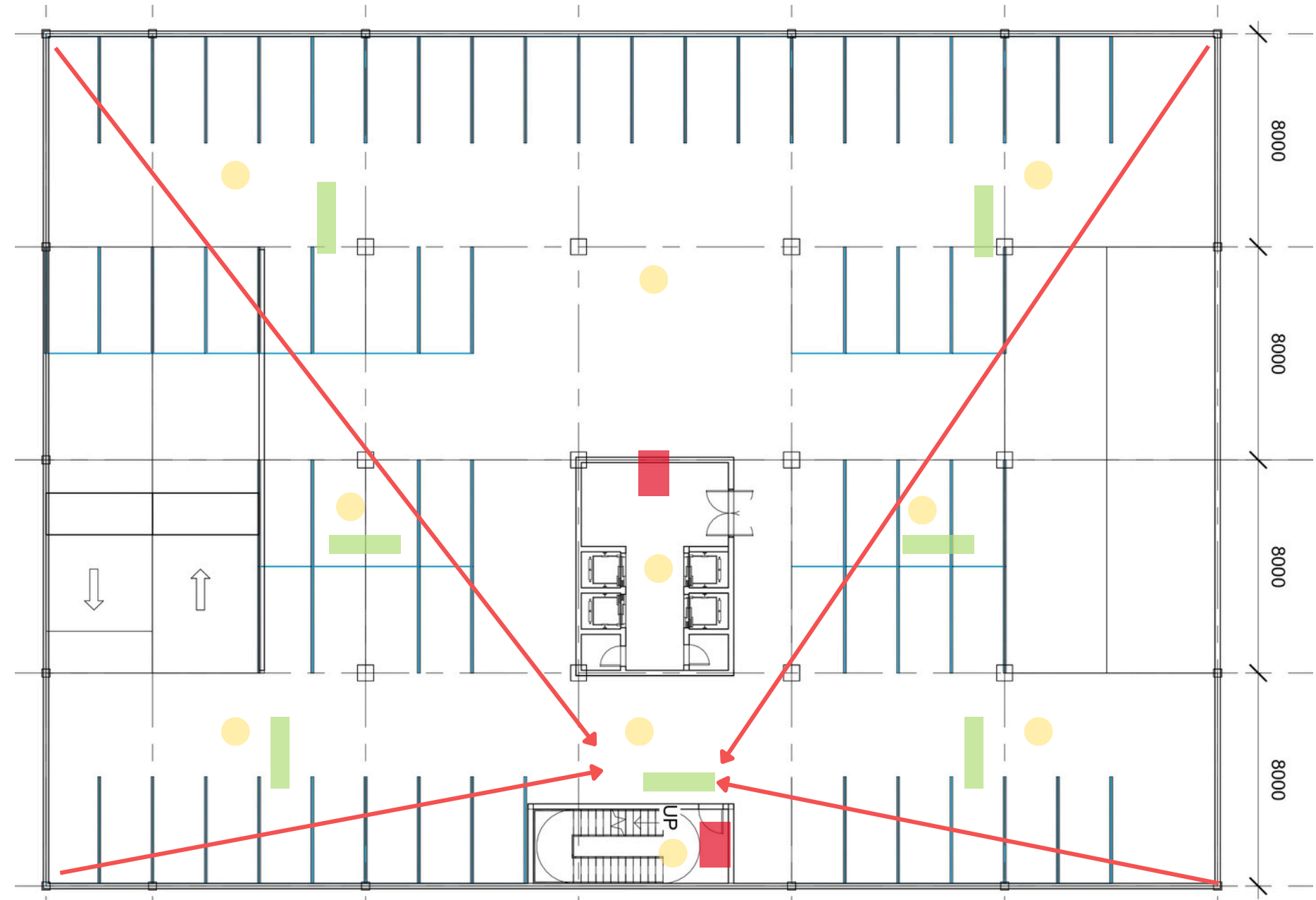
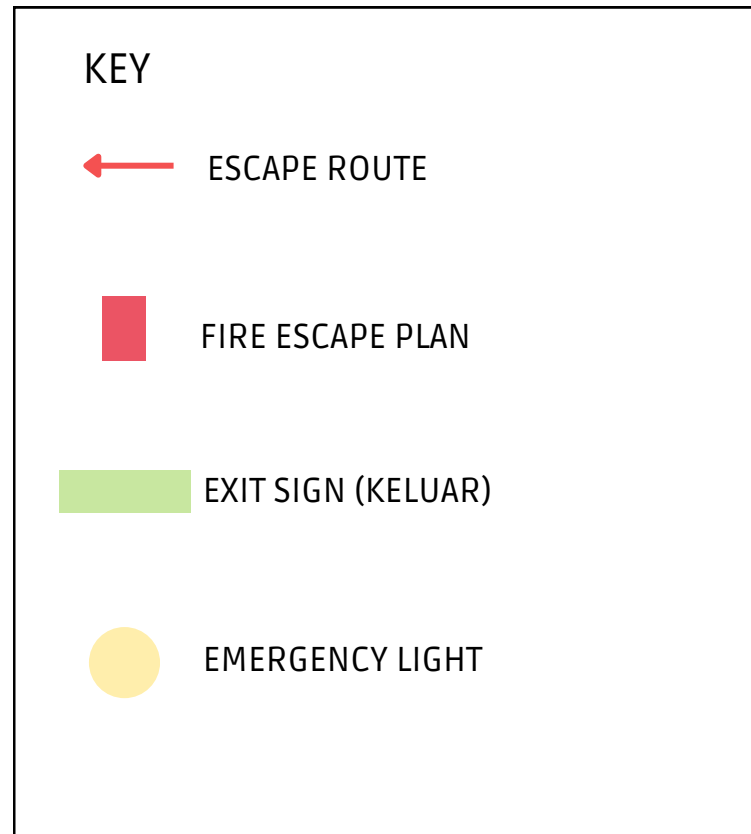
-  FIRE ESCAPE STAIRWELL B5-L18
-  MAIN STAIRWELL MEZZANINE-L10
-  250MM PRECAST CONCRETE FLOOR SLAB +4 HOURS FIRE PROTECTION
-  250MM PRECAST CONCRETE ROOF +4 HOURS FIRE PROTECTION



# 5.4 PFP Proposal

## 5.4.3 Means of Escape (B1-B5)

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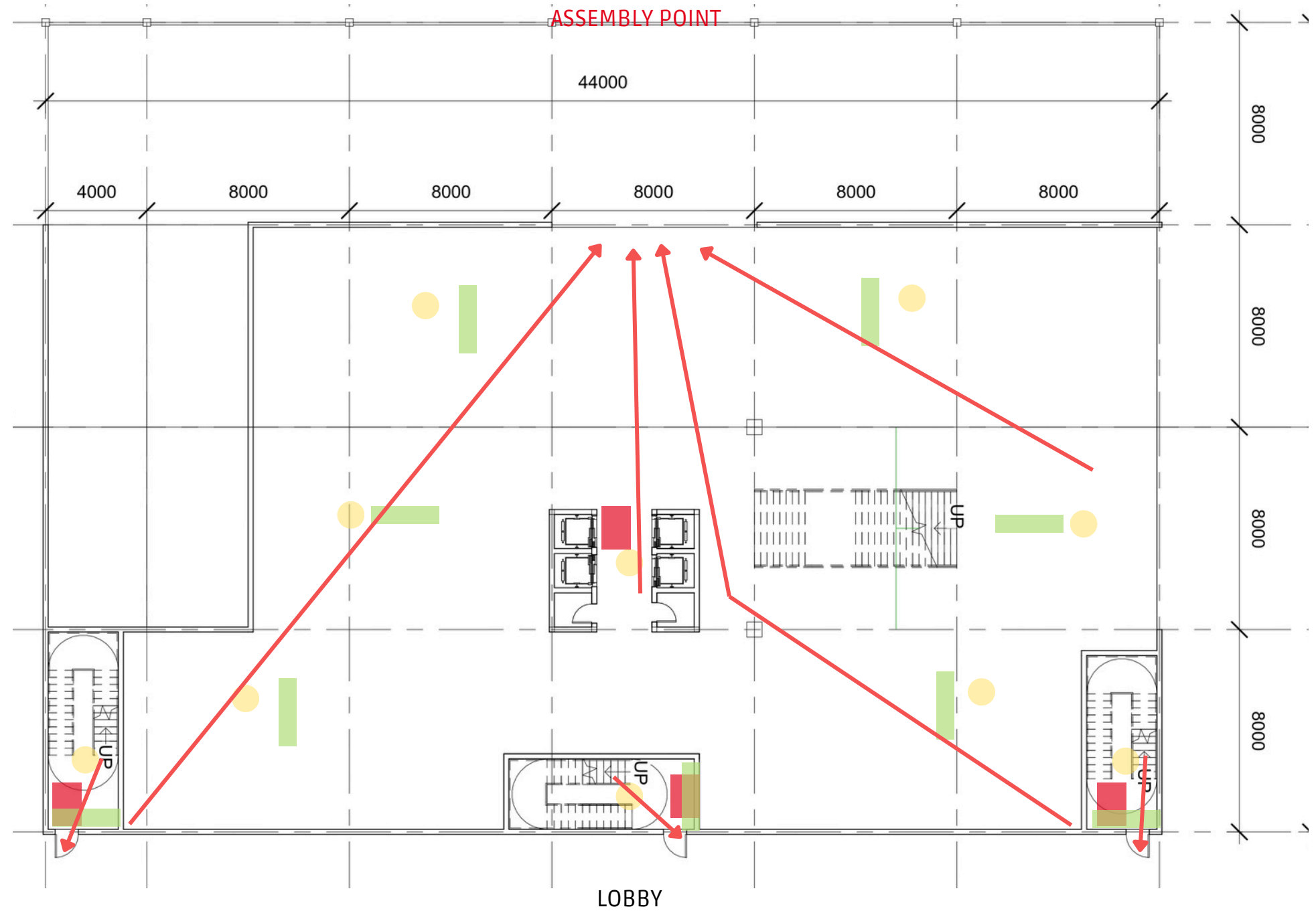
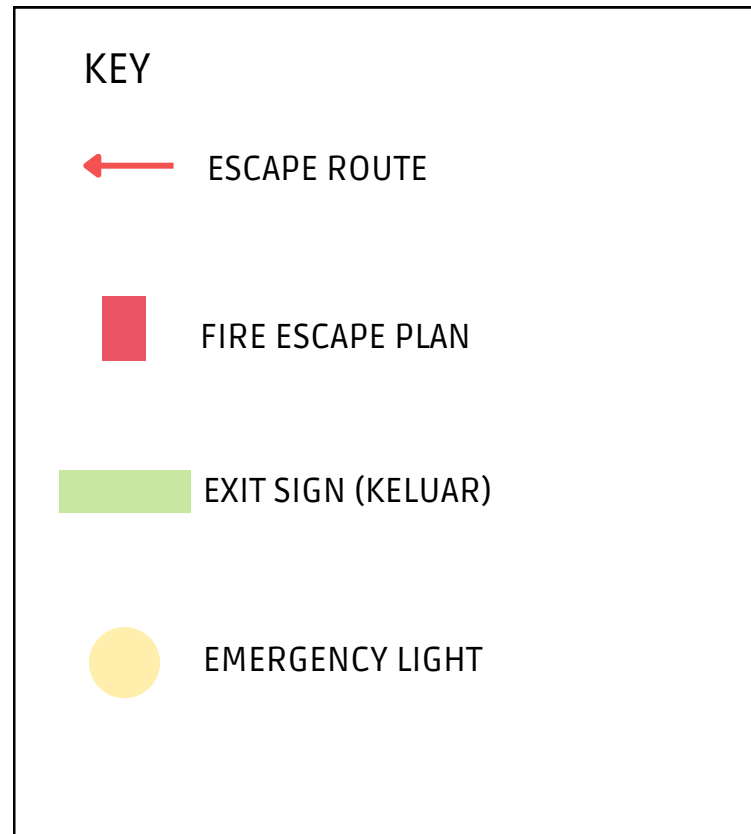


CARPARK

# 5.4 PFP Proposal

## 5.4.3 Means of Escape (GF)

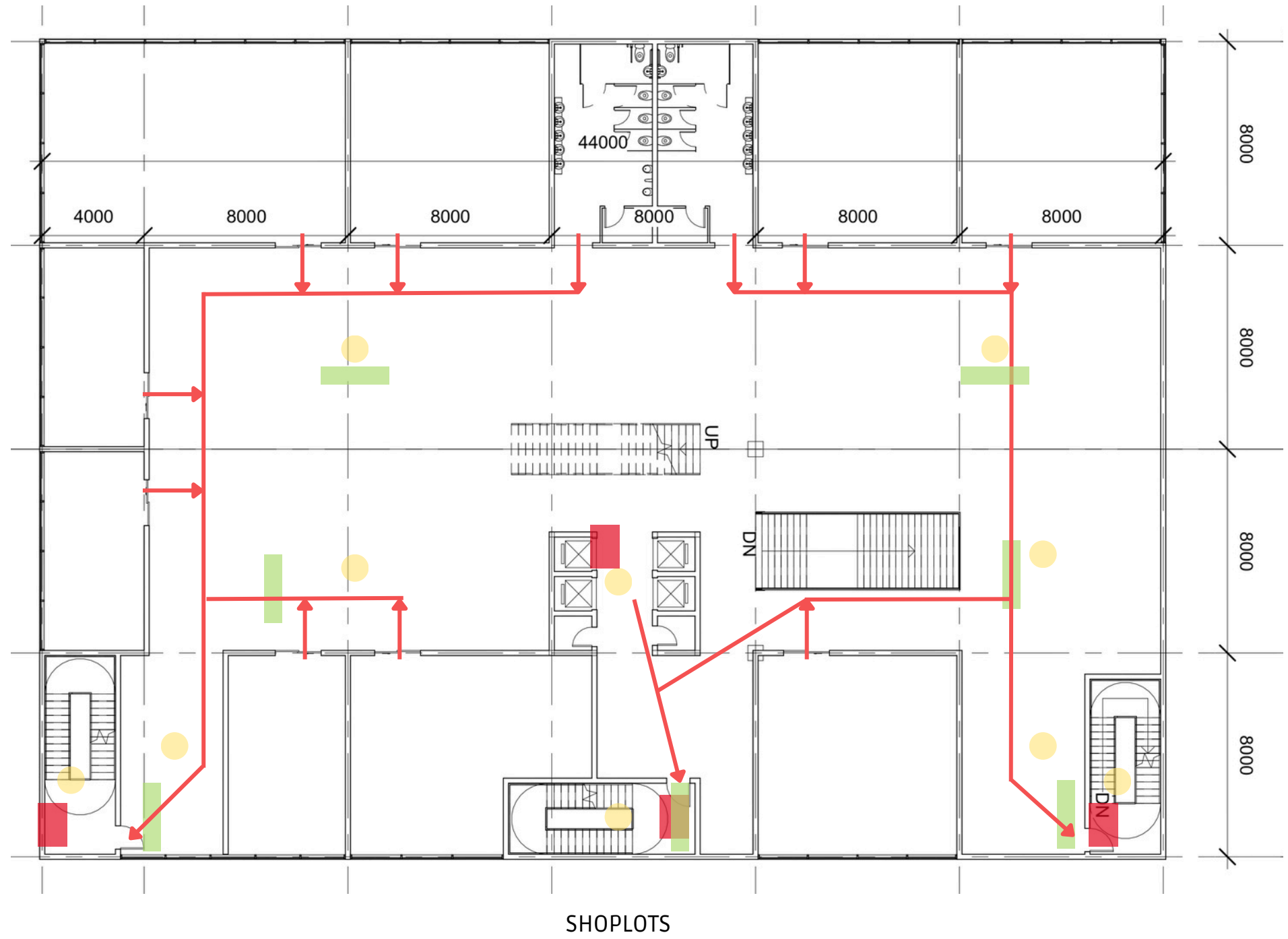
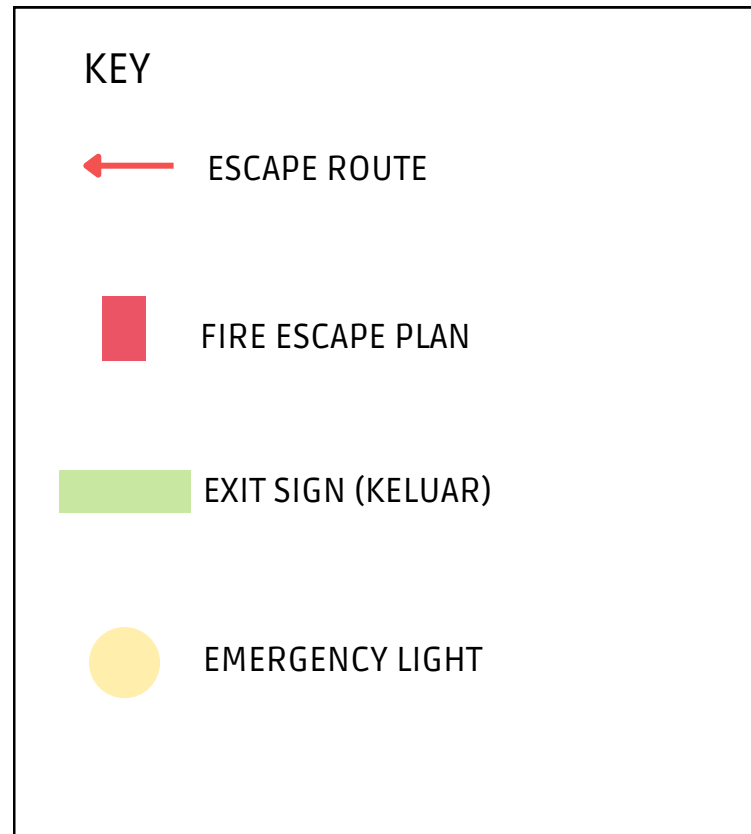
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# 5.4 PFP Proposal

## 5.4.3 Means of Escape (MEZZANINE)

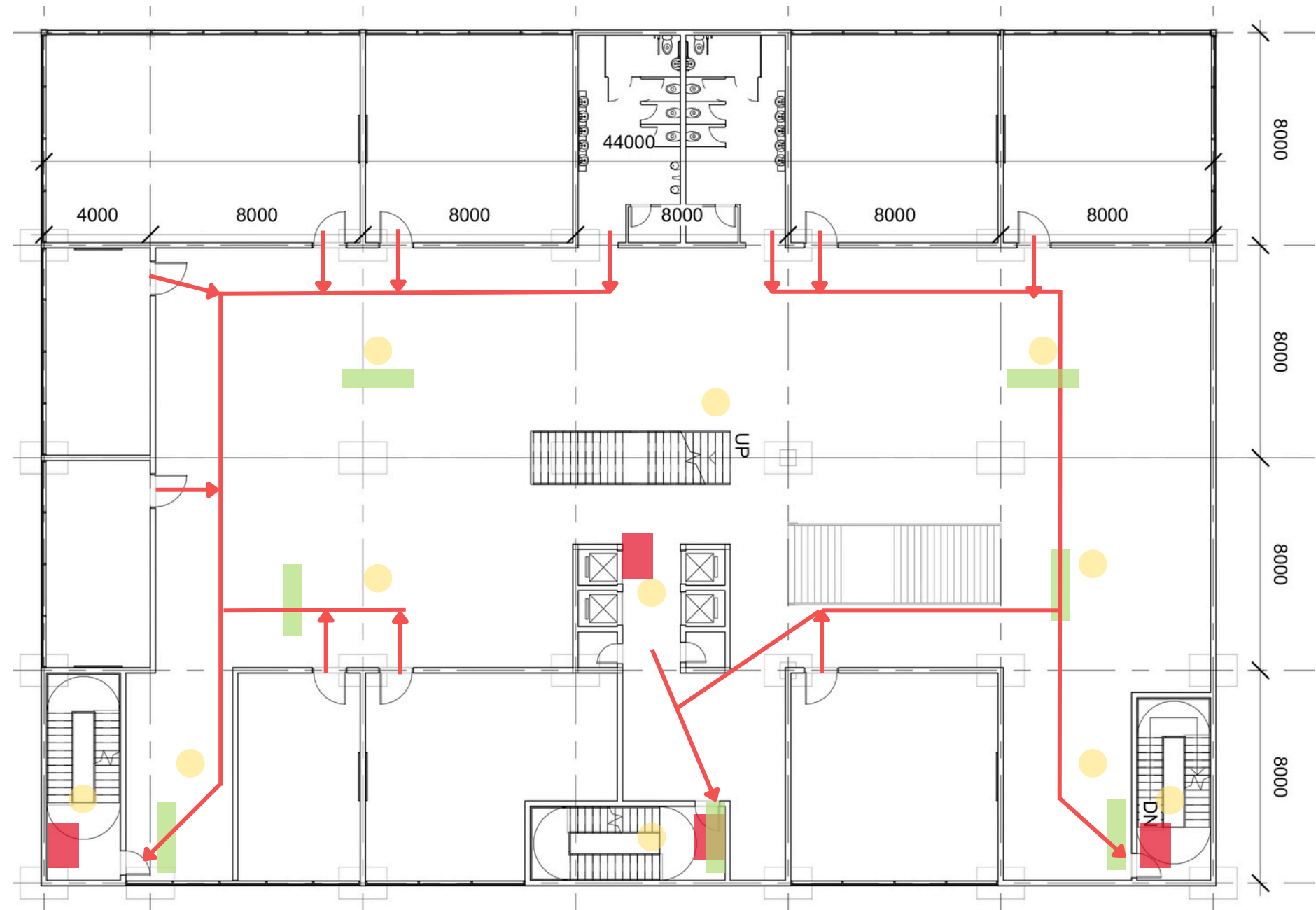
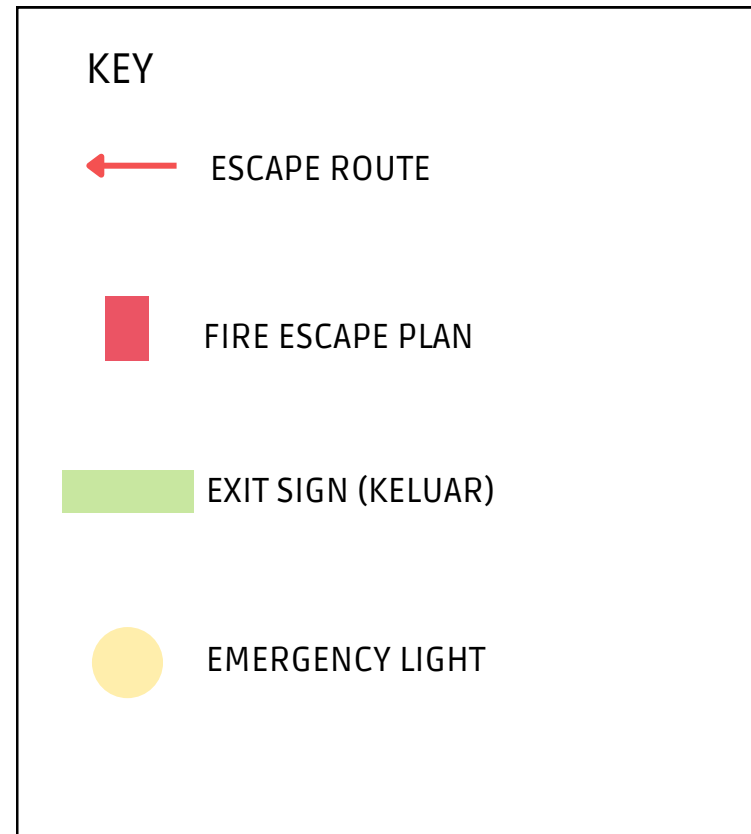
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# 5.4 PFP Proposal

## 5.4.3 Means of Escape (L1-L10)

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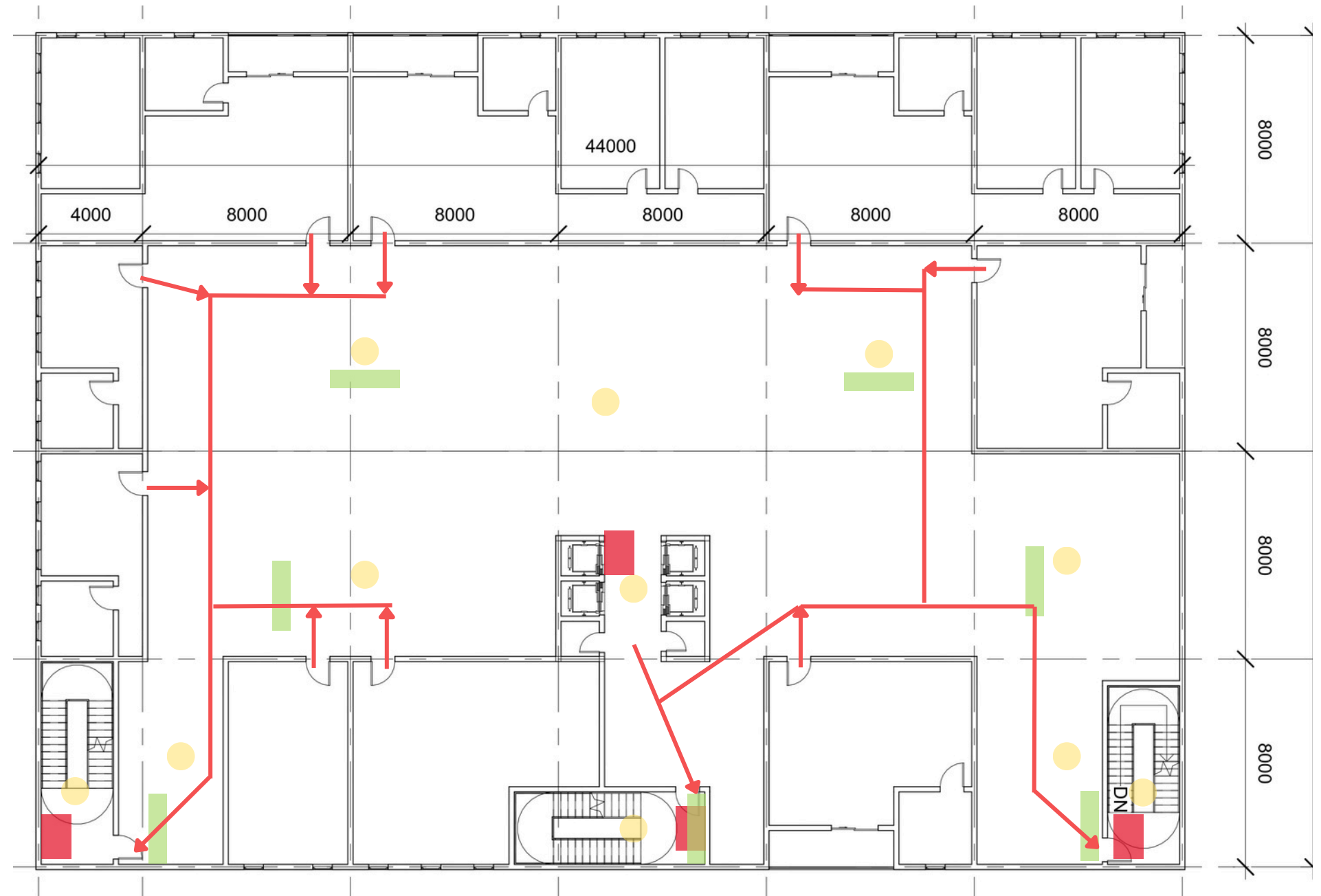
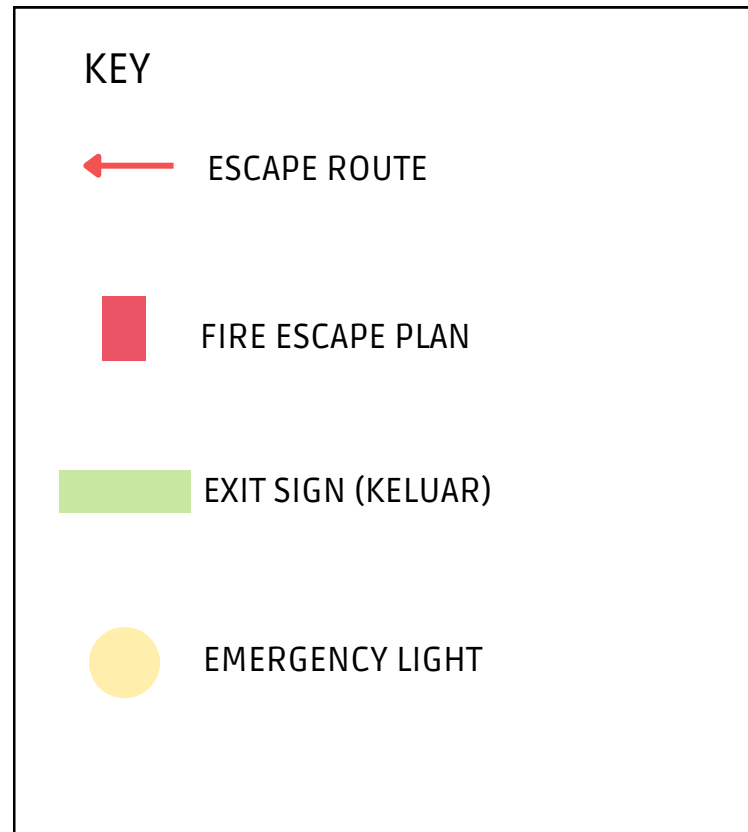


CLASSROOM FLOORS

# 5.4 PFP Proposal

## 5.4.3 Means of Escape (L11-L18)

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HOSTEL FLOORS

# 6.0 ACTIVE FIRE PROTECTION SYSTEM

Arushee Ramen (0345128)

## 6.1 Introduction

**Active fire protection (AFP)** involves measures that require action to detect, alert, suppress, or contain a fire. This action can be **manual**, such as using a **portable fire extinguisher**, or **automated**, like a **smoke detector** triggering an alarm or activating a sprinkler system. Systems that operate digitally or automatically are also classified as active fire protection methods, as they take direct steps to respond to a fire incident.

The main AFP categories are:

### Water based

- Water type portable fire extinguisher (for class A fires)
- External fire hydrants
- Hose reel systems
- Dry riser system
- Wet riser system
- Automatic sprinkler system

### Non-water based

- Carbon dioxide systems
- Dry chemical agents & application systems
- Argonite

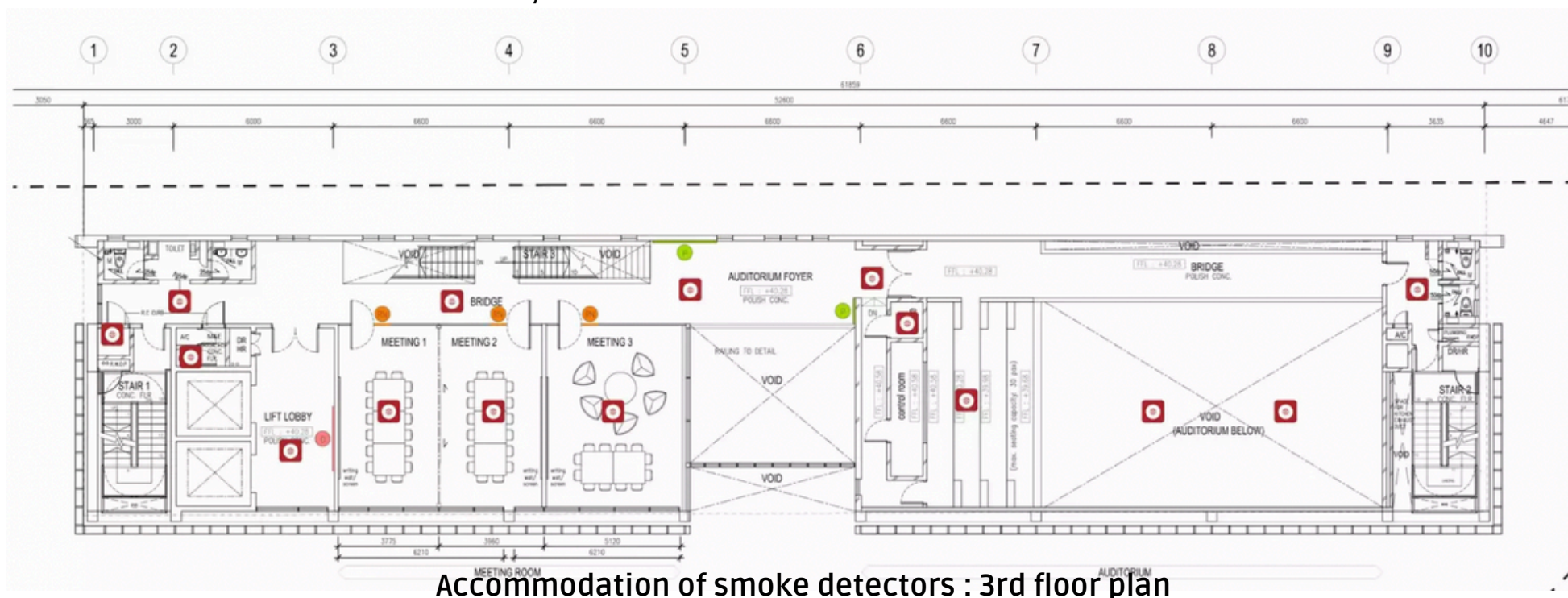
### Fire Detection & Alarm system

- Addressable
- Conventional
- Analogue addressable
- Air sampling

## 6.2 Application of Active Fire Protection - Precedent Studies

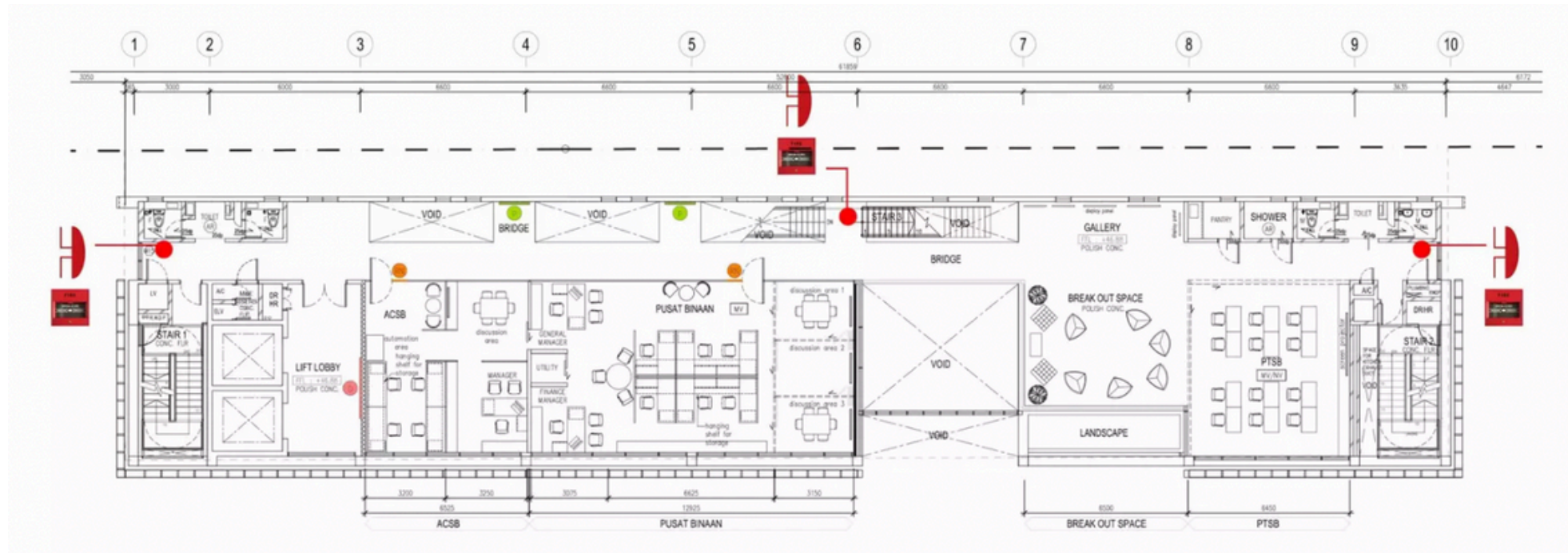
### 1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur

The PAM Center's **active fire protection system** emphasises **early fire detection and swift suppression** to safeguard occupants and property. **Advanced smoke and heat detectors** are strategically installed to ensure rapid response. The system integrates **automated sprinklers and fire suppression mechanisms** to promptly manage fires. **Fire alarms** work in tandem with **emergency lighting and communication systems** to facilitate organised evacuations. To ensure reliability during emergencies, **fail-safes and backup power supplies** are incorporated. Regular maintenance and strict adherence to local fire safety regulations are essential to maintain the system's effectiveness.

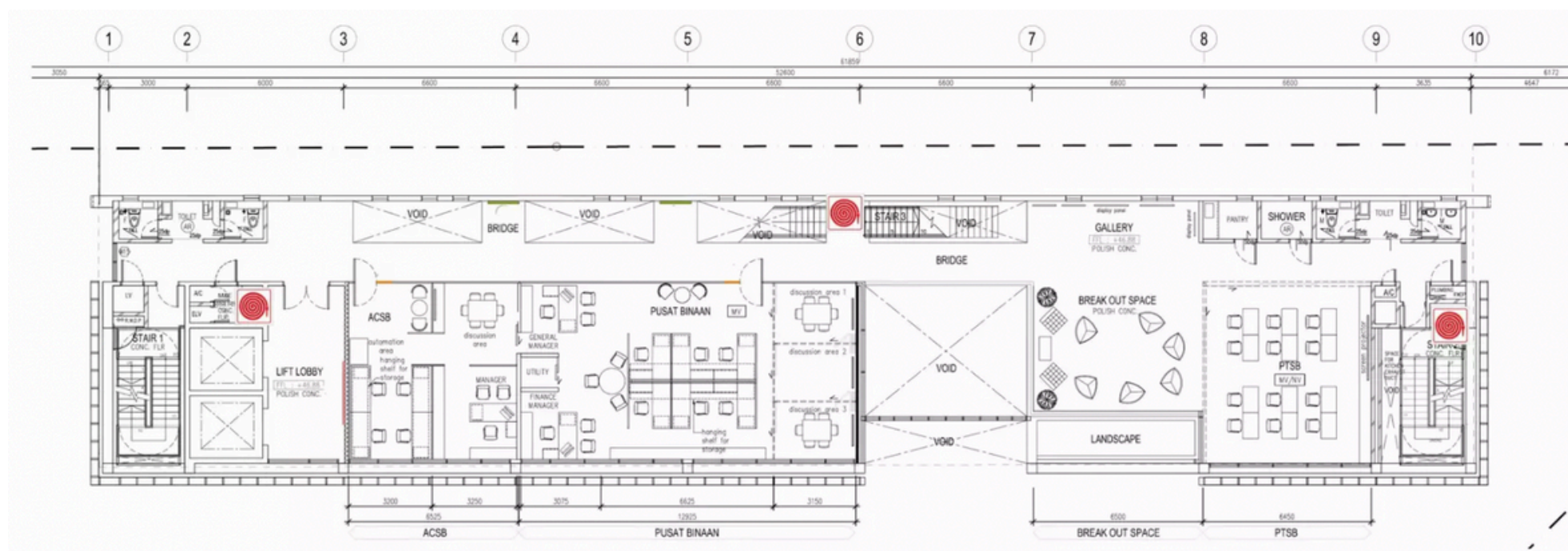


## 6.2 Application of Passive Fire Protection - Precedent Studies

### 1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur





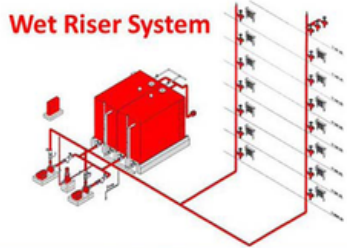


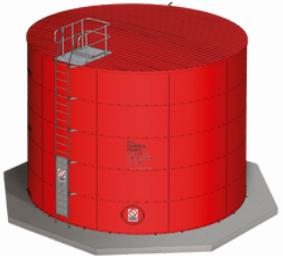
Placements of manual call point & alarm bell : 5th floor plan



Placements of hose reel : 5th floor plan

## 6.3 Active Fire Protection Components / Strategies

### 6.3.1 Water Based System

Element	Image	Function	Location
External Fire Hydrant		Serves as an immediate water supply for firefighters to control and extinguish fires.	Positioned around the building's exterior perimeter, typically on the ground floor.
SRI Fire Hose Reel		Provides a regulated water source for occupants to manage fires during their initial stages.	Commonly found near exits, within stairwells, or in shared areas like corridors.
Wet Riser System		Maintains a pressurised water-filled pipeline system to ensure rapid deployment for firefighting.	Wet risers are generally installed in staircases or specific service shafts across levels LG3 to L21.
Sprinkler Piping		Automatically identifies and combats fires by releasing water.	Sprinklers are mounted on ceilings in various spaces such as dormitories, classrooms, retail outlets, shared zones, and underground areas for optimal coverage and fire suppression.
Water Pump Room		Houses the pumping equipment responsible for maintaining water pressure in the sprinkler system.	Found in the basement or within a specialised mechanical room housing essential equipment.
Water Tank		Stores a dedicated water supply to sustain the sprinkler system during fire emergencies.	Located either in the building's basement or on the roof to ensure water pressure through gravity-fed systems.

## 6.3 Active Fire Protection Components / Strategies

### 6.3.1 Water Based System

#### UBBL 1986-Clause 225. Detecting, warning and extinguishing fire.

(1) Every building shall be provided with means of detecting, warning and extinguishing fire in accordance with the requirements as specified in the Tenth Schedule.

(2) Every building shall be served by at least one fire hydrant located not more than 45 metres from the fire brigade access, designed and installed in accordance with MS 1489. In any case, hydrants shall be located not more than 90 metres apart.

(3) Depending on the size and location of the building and the provision of access for fire appliances, additional fire hydrant shall be provided as may be required by the D.G.F.R.

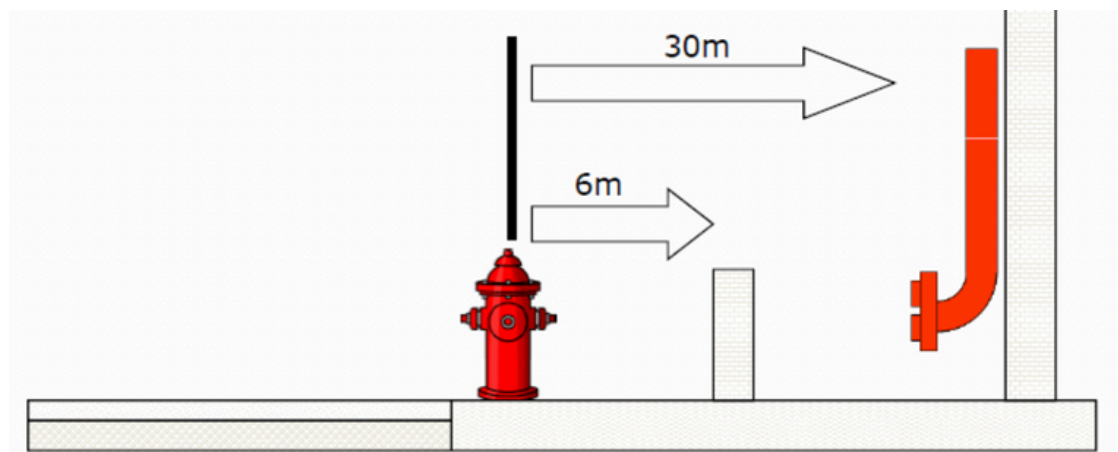
#### UBBL 1984-Clause 247.

(1) Water storage capacity and water flow rate for the fire fighting systems and installations shall be provided in accordance with the scale as set out in the Tenth Schedule to these By-laws.

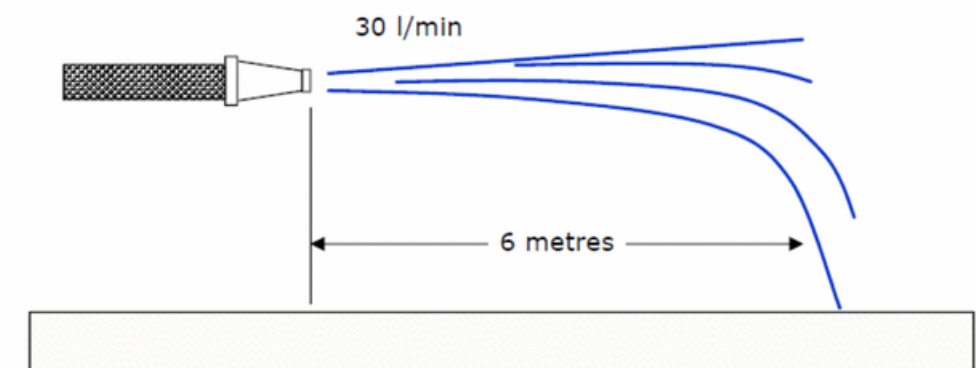
(2) Main water storage tanks within the building, other than for hose reel systems, shall be located at ground, first or second basement levels, with fire brigade pumping inlet connections accessible to fire appliances.

(3) Storage tanks for automatic sprinkler installations where full capacity is provided without need for replenishment shall be exempted from the restrictions in their location.

- The breeching inlet for the building must be located no farther than 30 metres.
- The breeching inlet must maintain a minimum distance of 6 metres from the building to ensure safety.
- Along the access road, breeching inlets should be spaced no more than 90 metres apart.
- The access road must have a minimum width of 6 metres to accommodate fire department vehicles and equipment.



- Each hose reel has a standard length of 30 metres, designed to cover every 800 square metres of usable floor space.
- Hose reels are typically installed on every floor along designated escape routes, often positioned beside exit doors or near staircases for convenient access during emergencies.



## 6.3 Active Fire Protection Components / Strategies

### 6.3.1 Water Based System

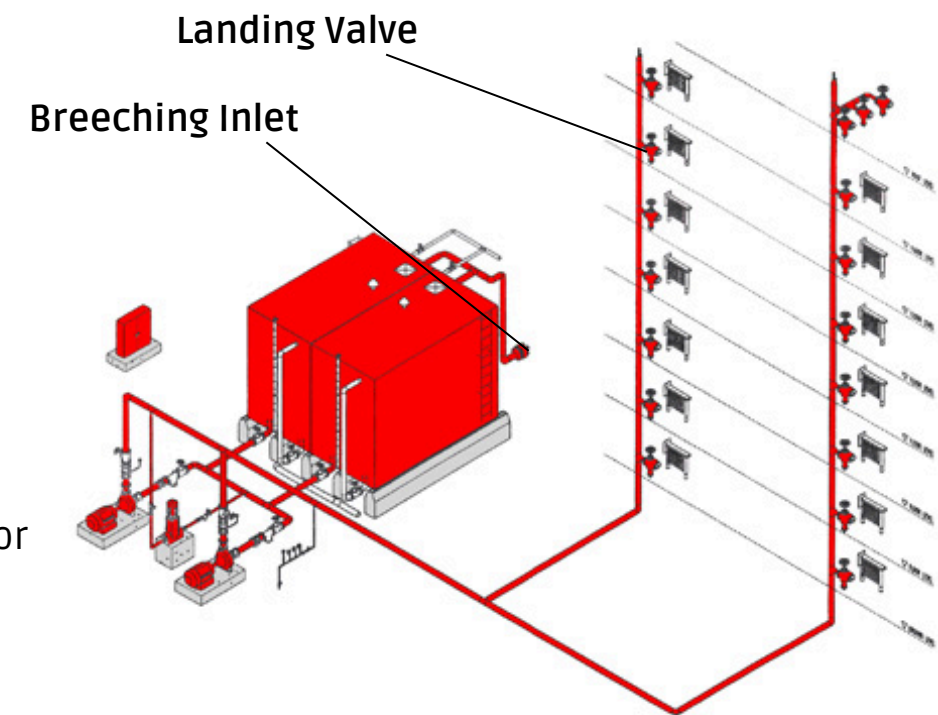
#### UBBL 1986-Clause 231. Wet riser systems.

(1) Wet rising systems shall be provided in every building in which the top most occupied floor is more than 30 metres above fire appliance access level.

(2) Wet riser systems shall be designed and installed in accordance with M.S. 1489 such that all parts of the floor are within 45 metres from a landing valve.

**Breeching Inlet:** A ground-floor connection allowing firefighters to pump water into dry risers for upper floors.

**Landing Valve:** A manual stop valve for controlling the water supply in firefighting hose systems.



#### UBBL 1986-Clause 228. Sprinkles systems.

Sprinkler systems shall be designed and installed in accordance with MS 1910.





- The sprinkler pump supplies water from the storage tank to the sprinkler system.
- A minimum of two pumps, one primary (duty) and one backup (standby), are mandatory.
- Standby pumps must be powered by an emergency generator or a diesel engine to ensure operation during outages.

Hazard class	Maximum area per sprinkler	Maximum distances as shown in Figure 8 m		
		Standard layout	Staggered layout	
	m <sup>2</sup>	S and D	S	D
LH	21,0	4,6	4,6	4,6
OH	12,0	4,0	4,6	4,0
HHP and HHS	9,0	3,7	3,7	3,7



# 6.3 Active Fire Protection Components / Strategies

## 6.3.2 Non-Water Based System

Element	Image	Function	Location
Carbon Dioxide Fire Extinguisher		Suppresses fires by removing oxygen, effectively suffocating the flames.	Positioned near high-use electrical areas or equipment.
ABC Powdered Fire Extinguisher		A versatile extinguisher using dry chemical powder to tackle Class A, B, and C fires.	Strategically placed throughout the building for comprehensive fire safety.
CO2 Fire System		Employs a clean, gaseous agent to extinguish fires without leaving residue.	Installed in spaces with delicate electronics or high-value assets.
FM-200 Fire Alarm Panel		Detects fires and activates the FM-200 suppression system for rapid response.	Located in control rooms or areas managing fire suppression systems.

## 6.3 Active Fire Protection Components / Strategies

### 6.3.2 Non-Water Based System

UBBL 1984-Clause 227. Portable extinguishers.

Portable extinguisher shall be designed and installed in accordance with MS 1539






Relevant MS 1539 Portable fire extinguishers:







Part 1 : Construction & Test Methodology

Part 3: Selection & Application - Code of Practice

Part 4: Maintenance of Portable Fire Extinguishers - Code of Practice




#### Types of fire extinguisher and their uses

WATER	FOAM	POWDER	CO <sub>2</sub>	WET CHEMICAL
Used on paper, wood, coal, cardboard and other solid fuel fires.	Used on solid fuel fires as well as flammable liquids.	Used on any kind of fire except for Class F cooking oils.	Used on flammable liquids and electrical fires.	Used on cooking oil fires as well as combustible solid materials.
				
Solid Red	Cream	Blue	Black	Yellow
Can be used on: Class A	Can be used on: Class A Class B	Can be used on: Class A Class B Class C Class D Electrical	Can be used on: Class B Electrical	Can be used on: Class A Class F

 <b>Class A</b> Combustible materials. These include paper, textiles, wood and similar materials.	 <b>Class B</b> Flammable liquids. These include petrol, oil and paint.	 <b>Class C</b> Flammable gases. These include butane and methane.
 <b>Class D</b> Flammable metals. These include potassium and uranium.	 <b>Electrical</b> Electrical goods. These include appliances in kitchens as well as computers, phones etc.	 <b>Class F</b> Cooking oils. These include chip pan fires and deep fat fryers.

# 6.3 Active Fire Protection Components / Strategies

## 6.3.3 Fire Detection & Alarm system

Element	Image	Function	Location
<p>Smoke Detector Photoelectric Smoke Detector (Model D-213)</p>		<p>Identifies smoke or heat from a fire, triggering an early warning system and activating fire alarms.</p>	<p>Mounted on ceilings across the building for optimal fire detection.</p>
<p>Heat Detector</p>		<p>Identifies smoke or heat from a fire, triggering an early warning system and activating fire alarms.</p>	<p>Mounted on ceilings across the building for optimal fire detection.</p>
<p>Fire Alarm Bell DOME Alarm Bell (Model D-102)</p>		<p>Emits a loud alert sound to notify occupants of a fire, prompting immediate evacuation.</p>	<p>Strategically placed throughout the building in areas where the alarm is clearly audible.</p>

## 6.3 Active Fire Protection Components / Strategies

### 6.3.3 Fire Detection & Alarm system

UBBL 1986-Clause 239. Voice communication system.

There shall be two separate approved continuously electrically supervised voice communications systems, one a fire brigade communications system and the other a public address system between the central control station and the following areas:

(a) lifts, lift lobbies, corridors and staircases;

(b) in every office area exceeding 100 square metres in area;

(c) in each dwelling unit and hotel guest where the fire brigade system may be combined with the public address system.

A **manual pull station** is designed to alert building occupants in the event of a fire. These devices are typically positioned near exits, enabling individuals to activate the **alarm** as they evacuate, thereby warning others in the building. The pull station is directly connected to the **fire alarm system**, triggering a local alarm to ensure prompt notification.



- Lifts, lift lobbies, corridors, and staircases;
- Within any office area larger than 92.9 square metres;
- Inside each dwelling unit and hotel guest room, where the fire brigade system can also be integrated with the public address system.

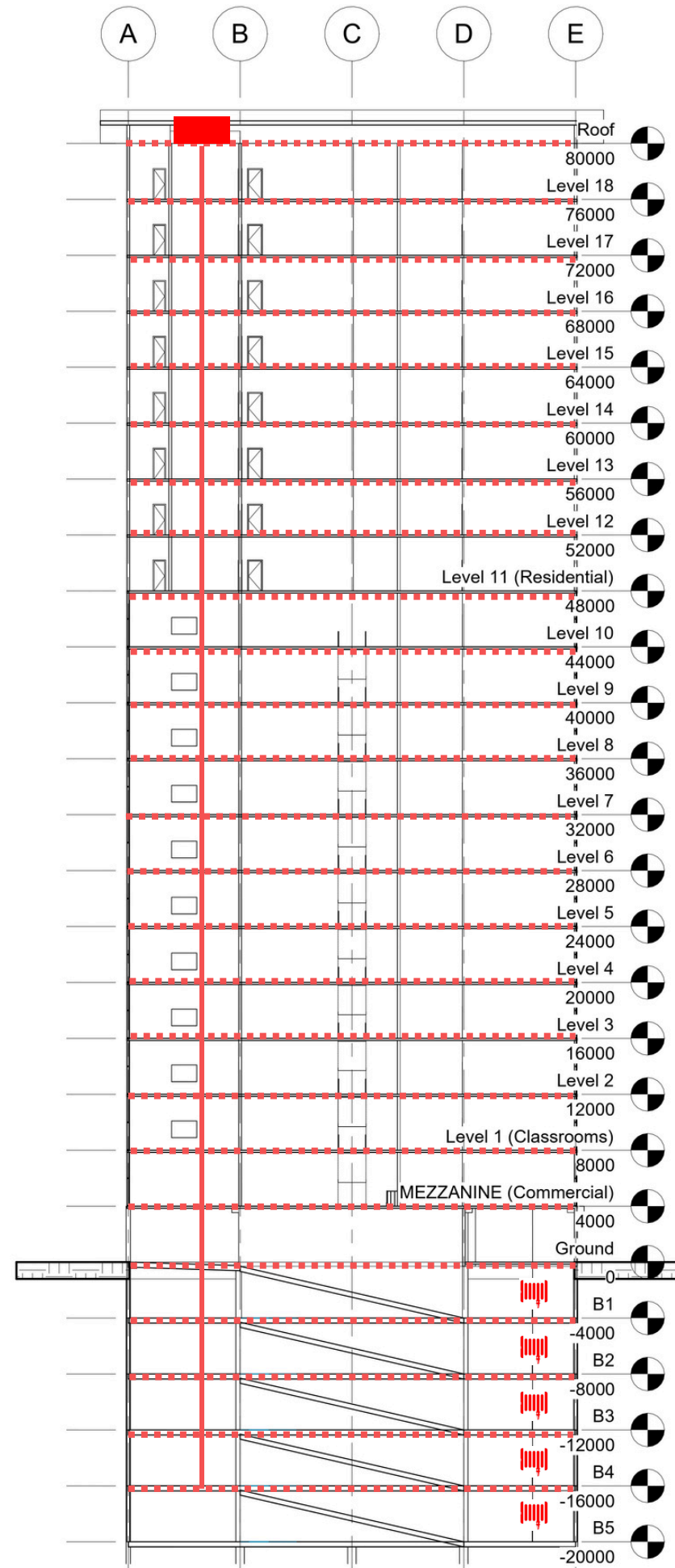
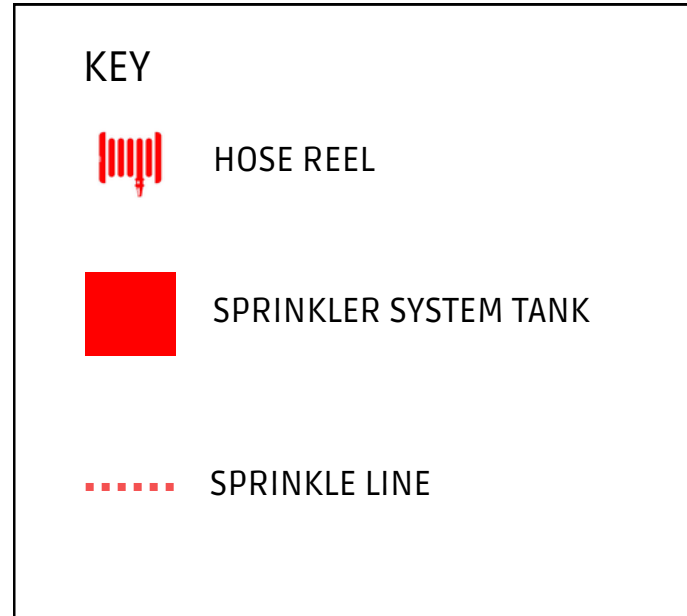
**Photoelectric smoke detectors** operate by directing a light beam onto a **photosensor**. The presence of smoke interrupts the beam, activating the alarm.

The range between the transmitter and receiver is typically between 9 and 92 metres, with a spacing of 9–18 metres between individual units. Advanced options, such as air **sampling detection systems** and **laser-based photoelectric devices**, are also available for enhanced fire detection



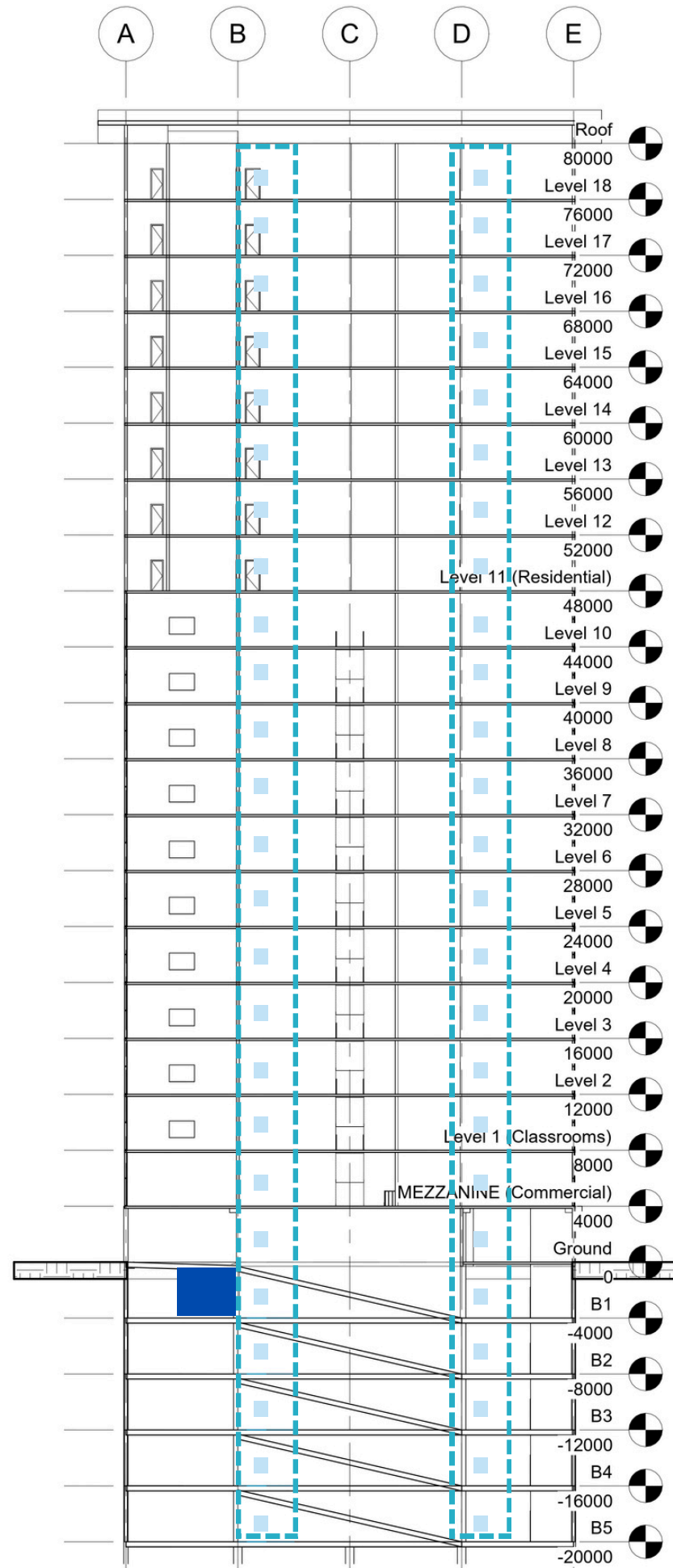
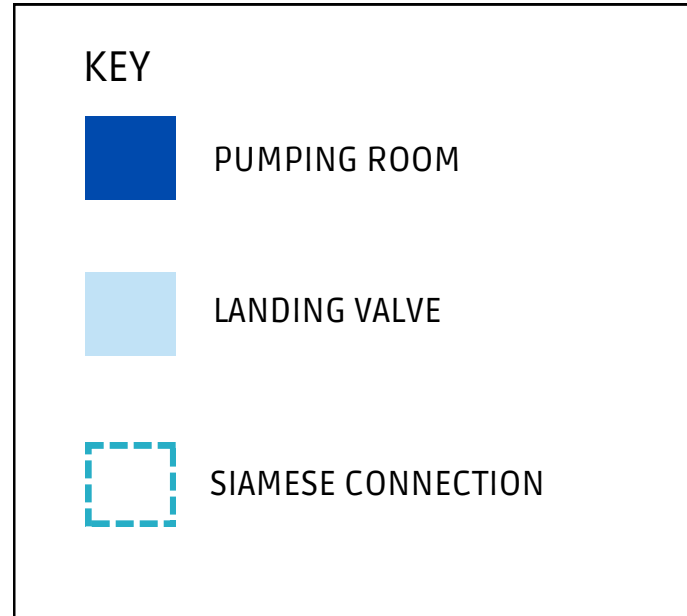
# 6.4 AFP Proposal

## 6.4.1 Vertical Planning- Automatic Sprinkler System and Hose Reel System



# 6.4 AFP Proposal

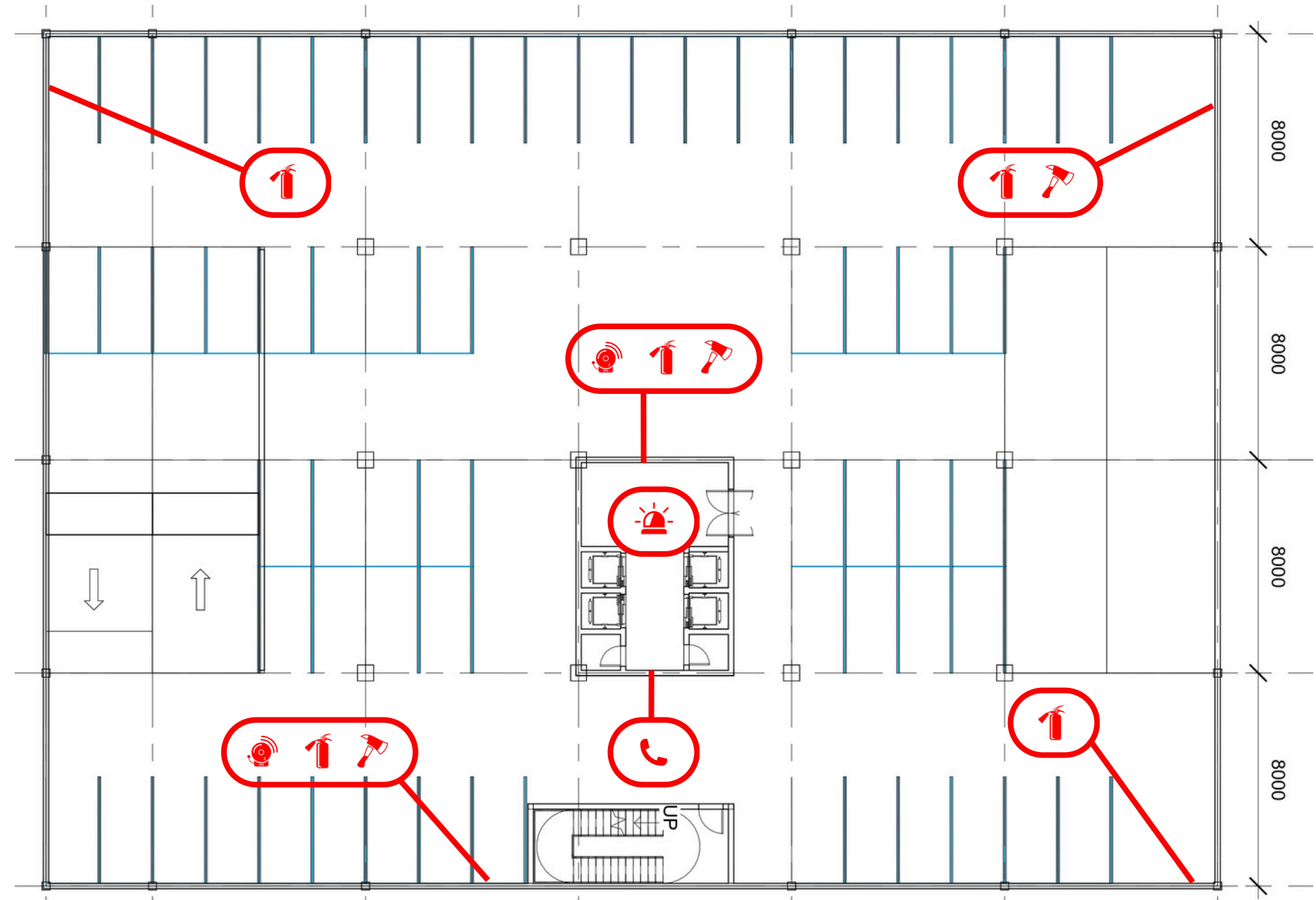
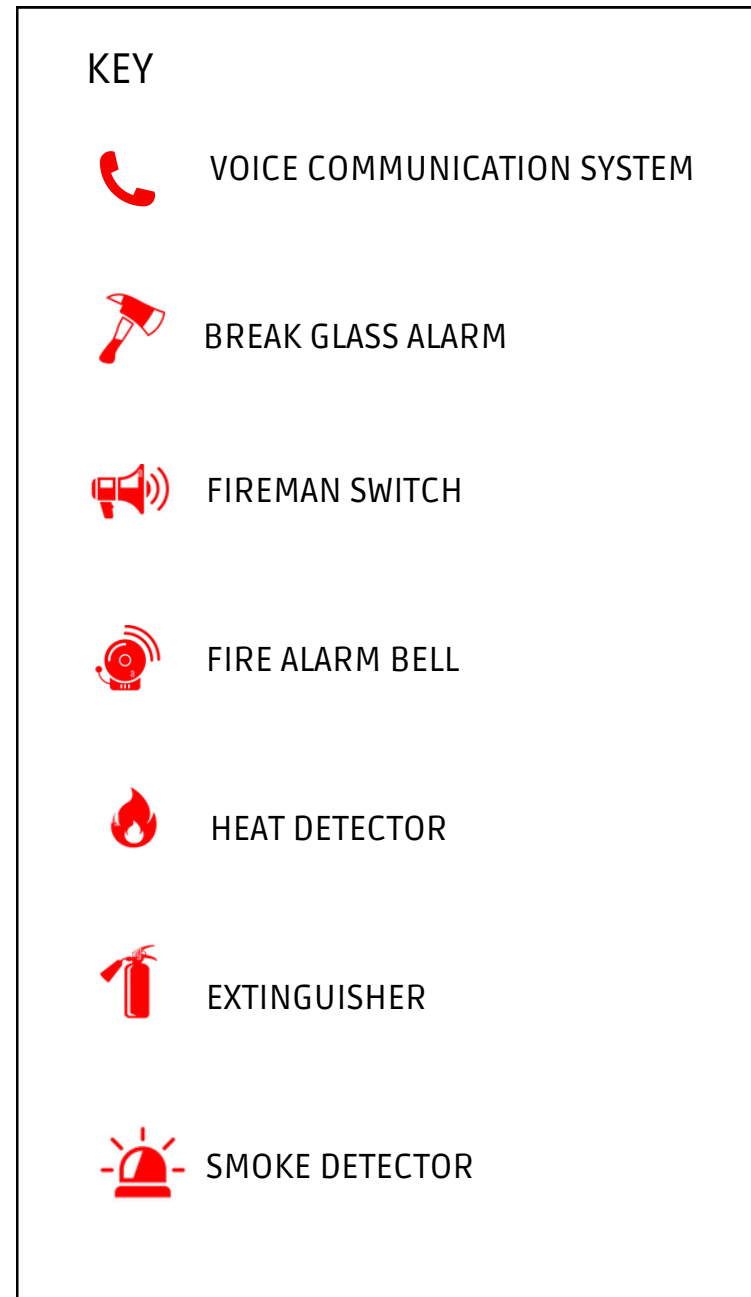
## 6.4.2 Vertical Planning-Wet Riser System



# 6.4 AFP Proposal

## 6.4.3 Horizontal Planning-Fire & Alarm System (B1-B5)

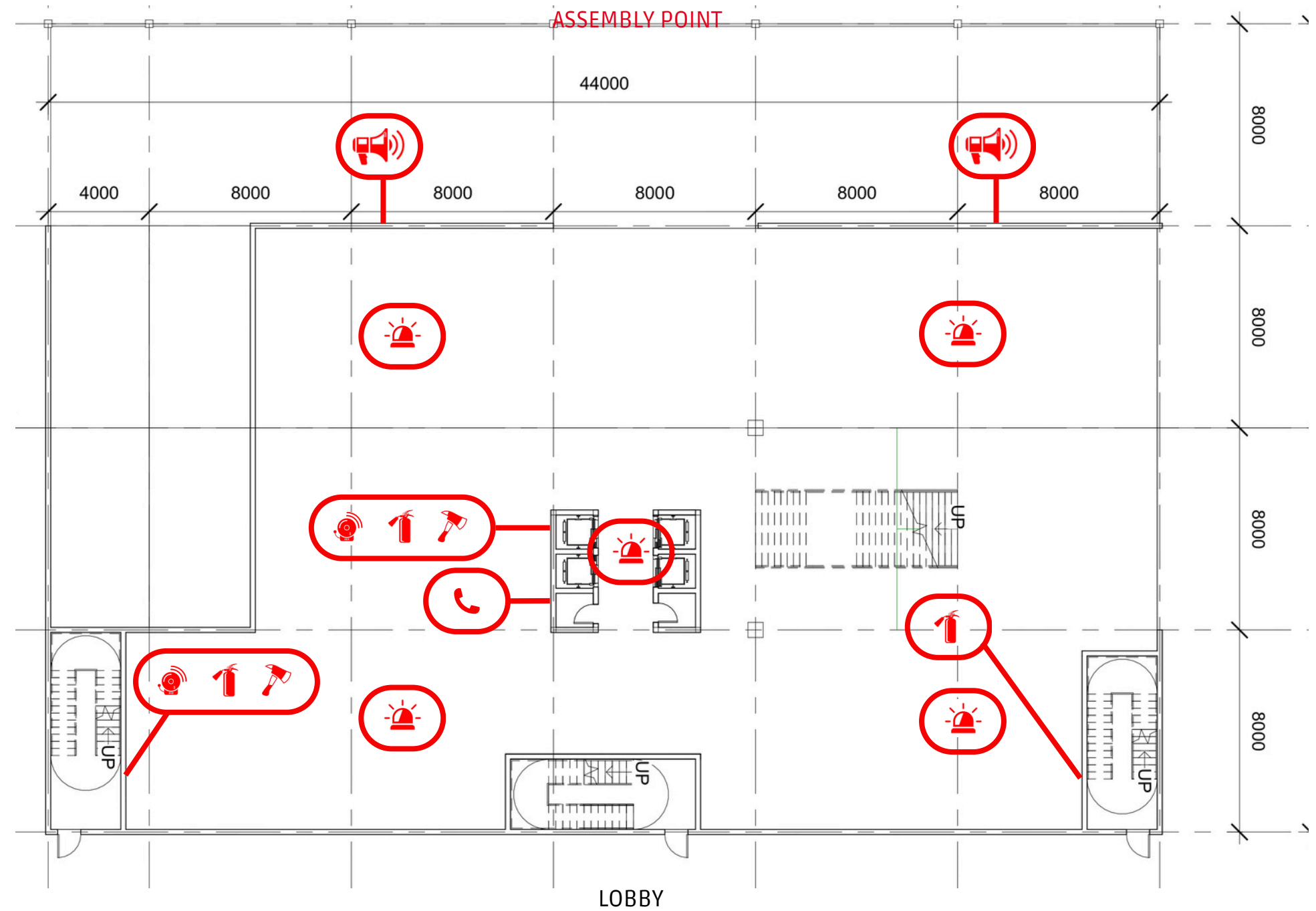
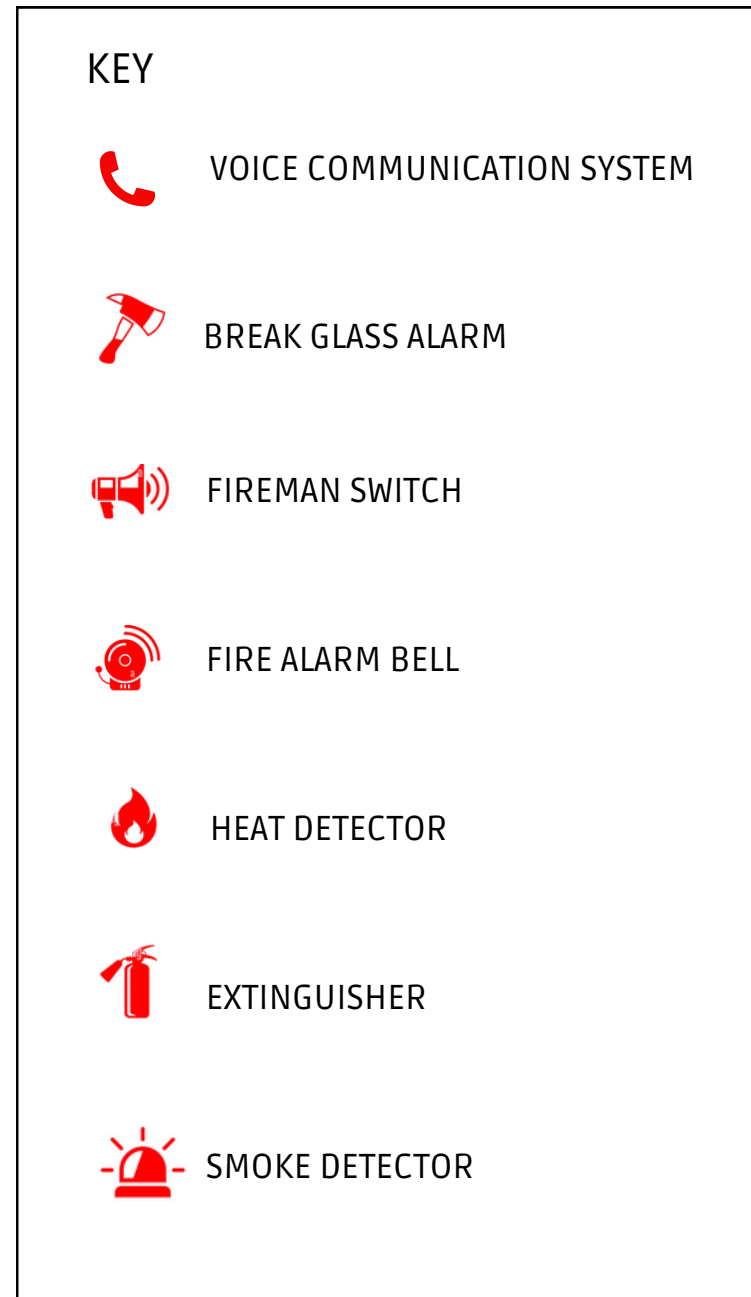
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# 6.4 AFP Proposal

## 6.4.3 Horizontal Planning-Fire & Alarm System (GF)

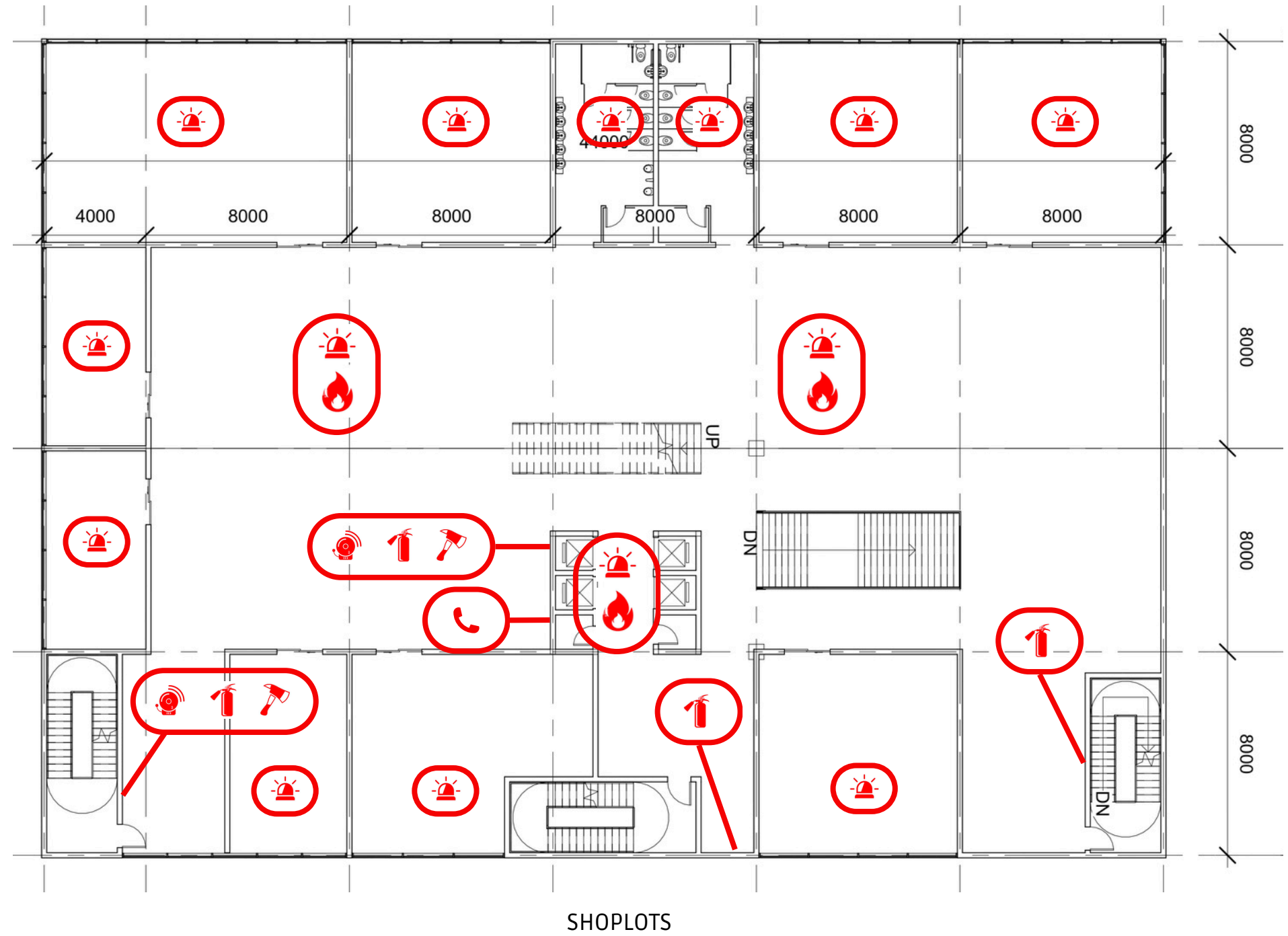
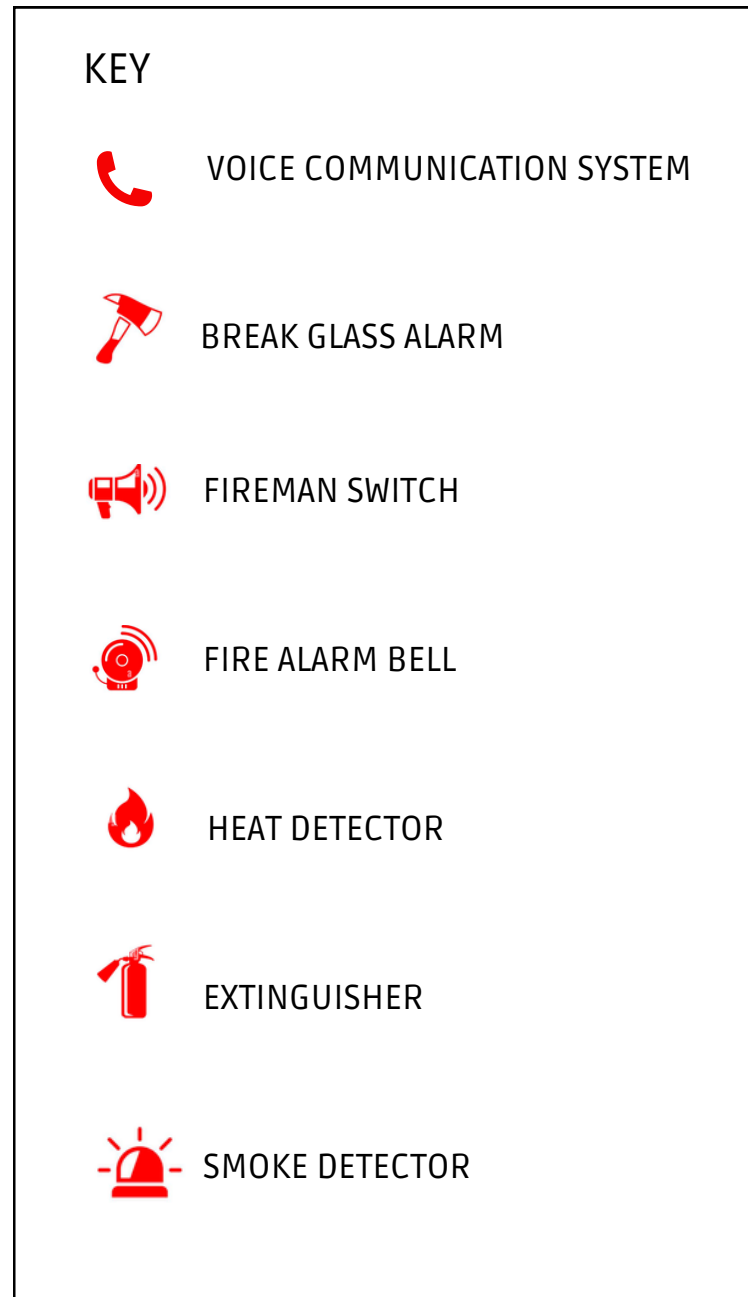
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# 6.4 AFP Proposal

## 6.4.3 Horizontal Planning-Fire & Alarm System (MEZZANINE)

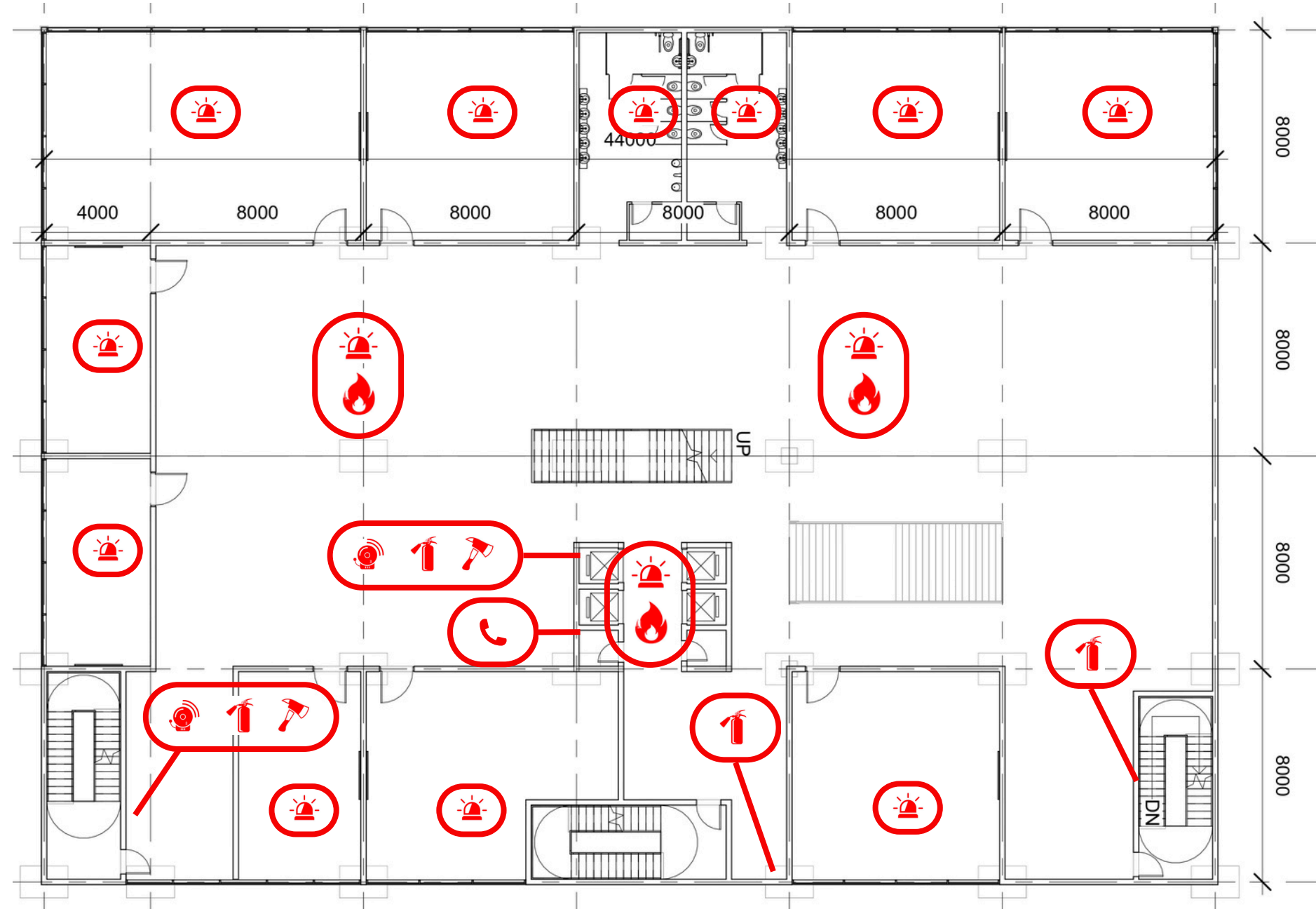
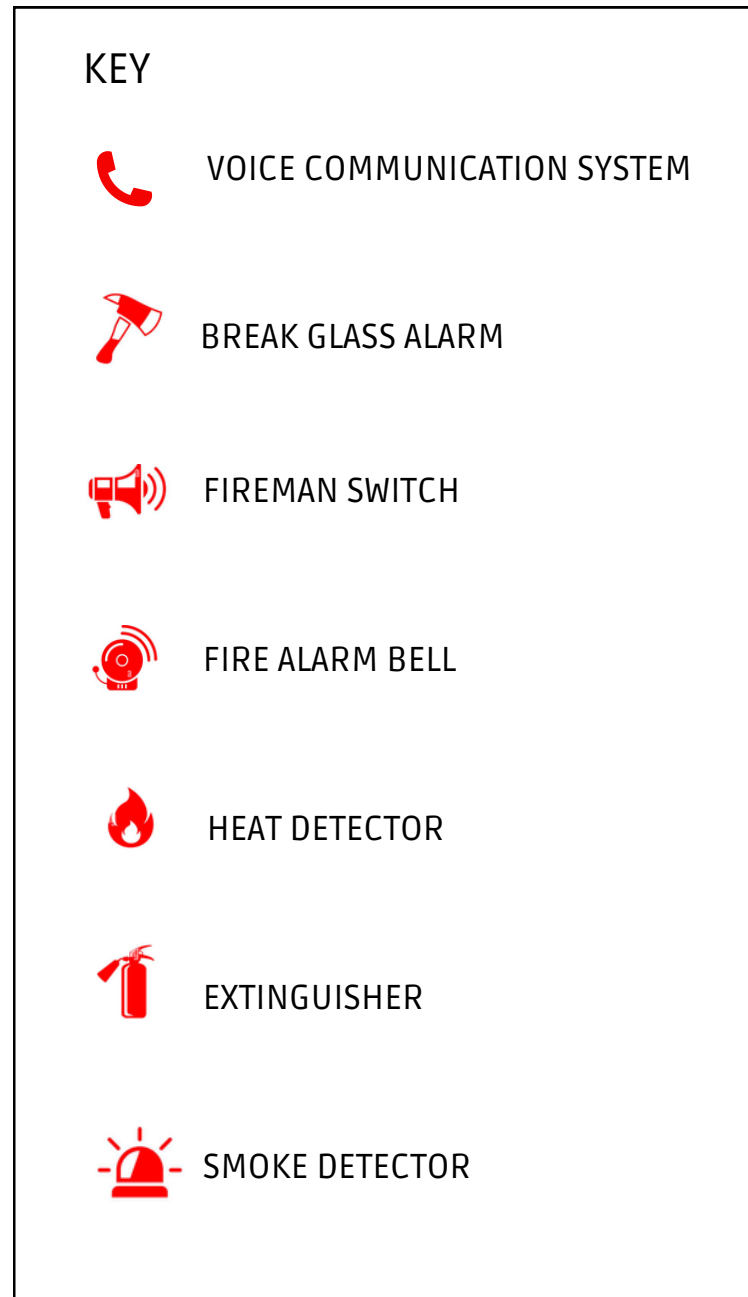
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# 6.4 AFP Proposal

## 6.4.3 Horizontal Planning-Fire & Alarm System (L1-L10)

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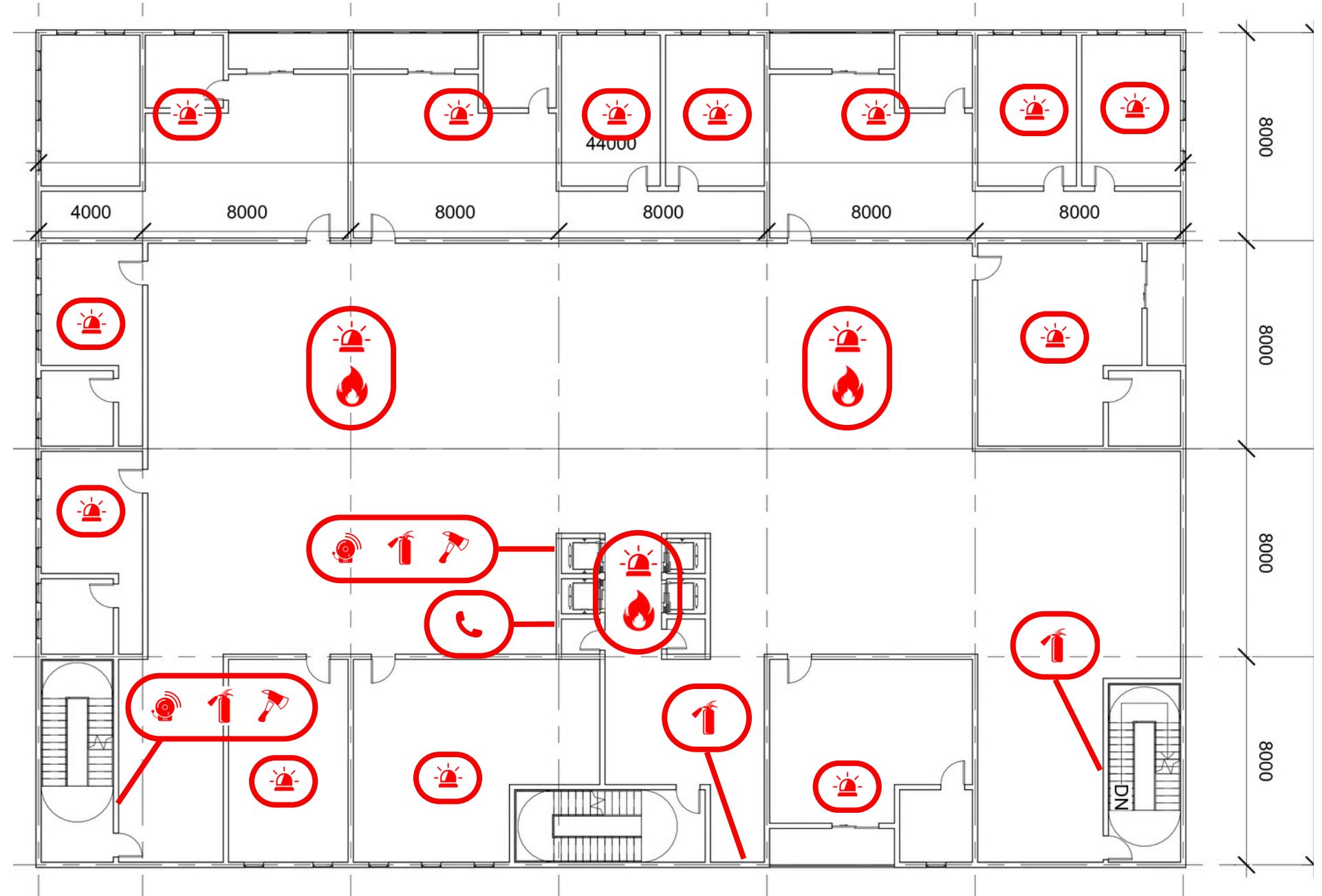
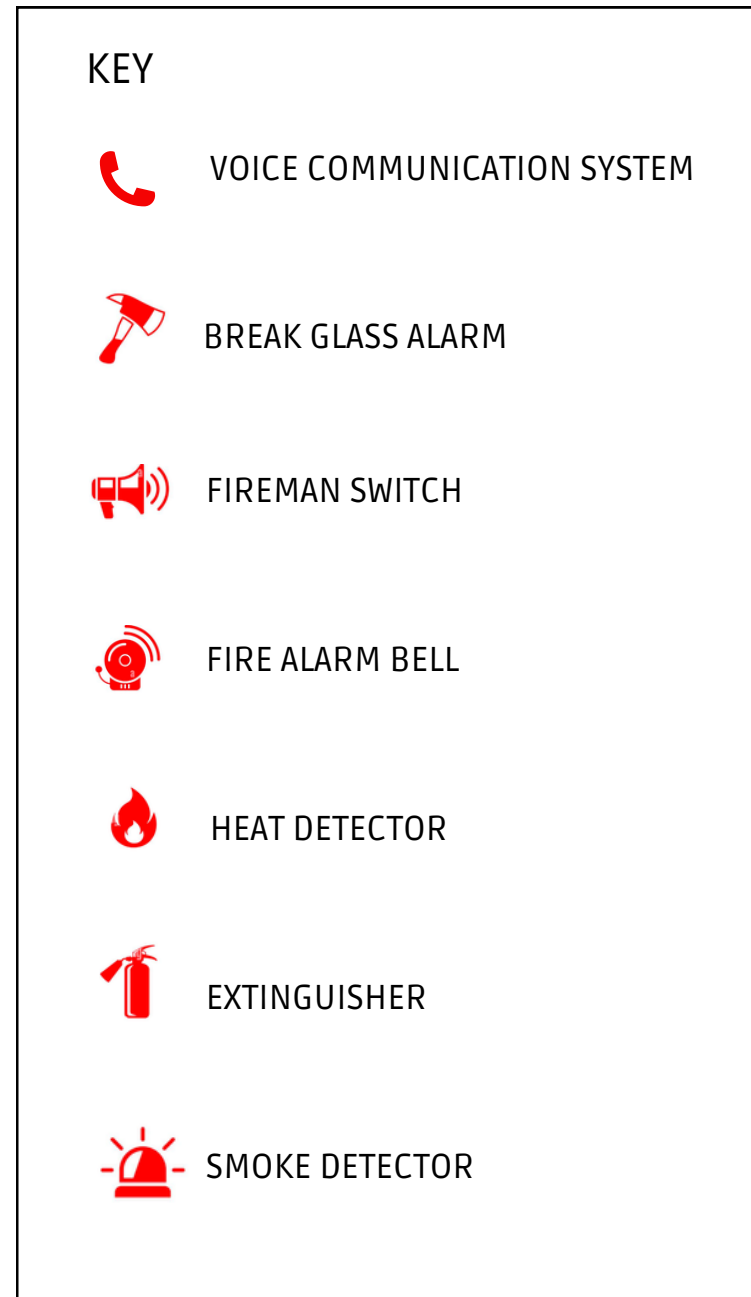


CLASSROOM FLOORS

# 6.4 AFP Proposal

## 6.4.3 Horizontal Planning-Fire & Alarm System (L11-L18)

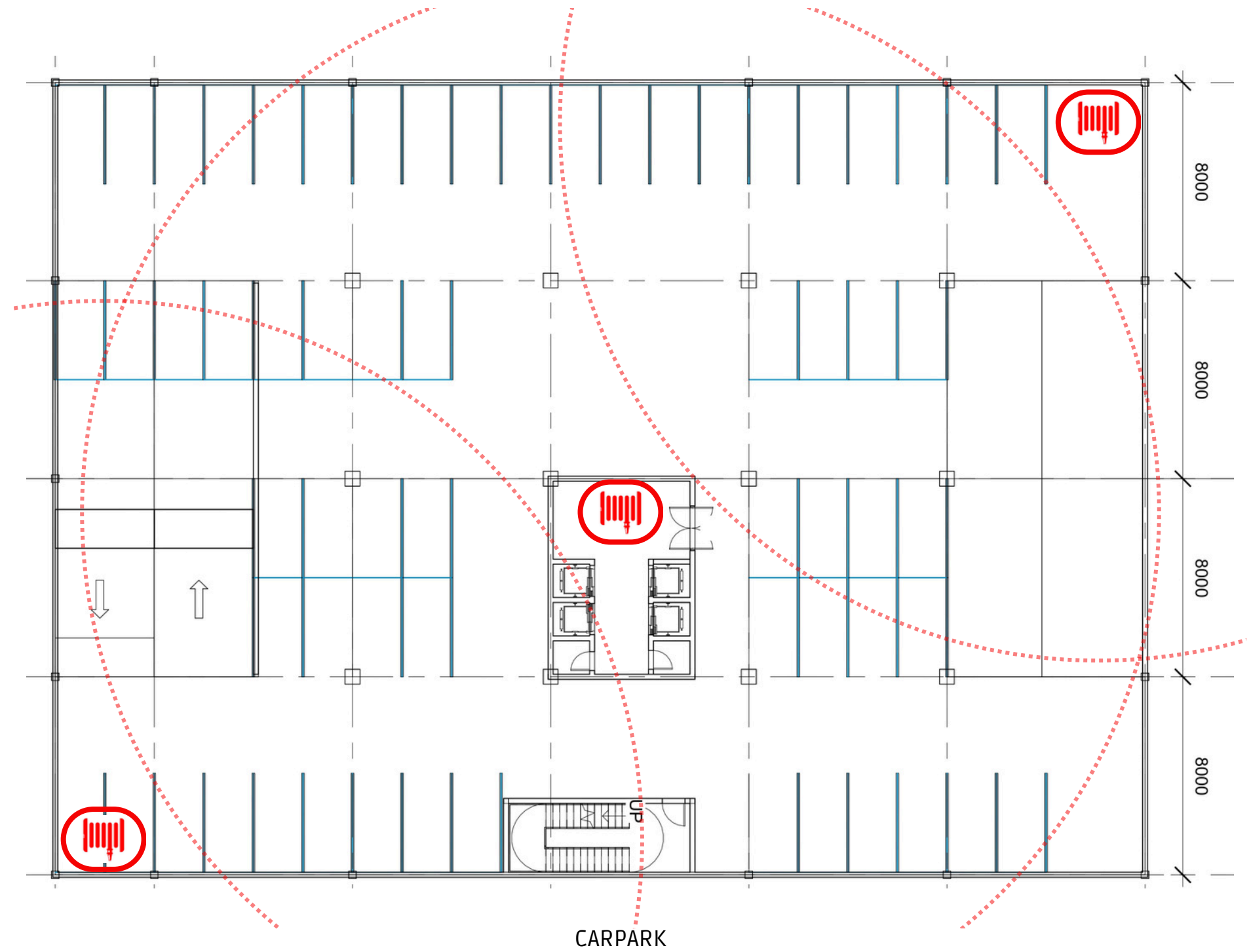
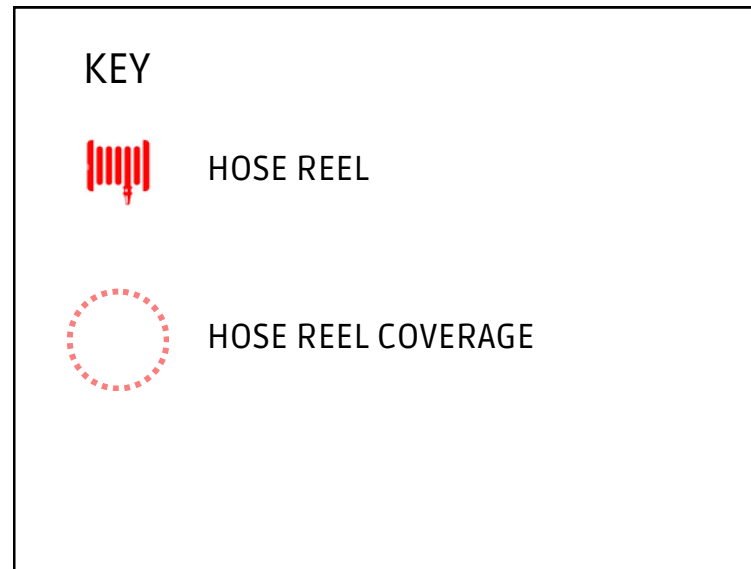
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# 6.4 AFP Proposal

## 6.4.4 Horizontal Planning-Hose Reel System (B1-B5)

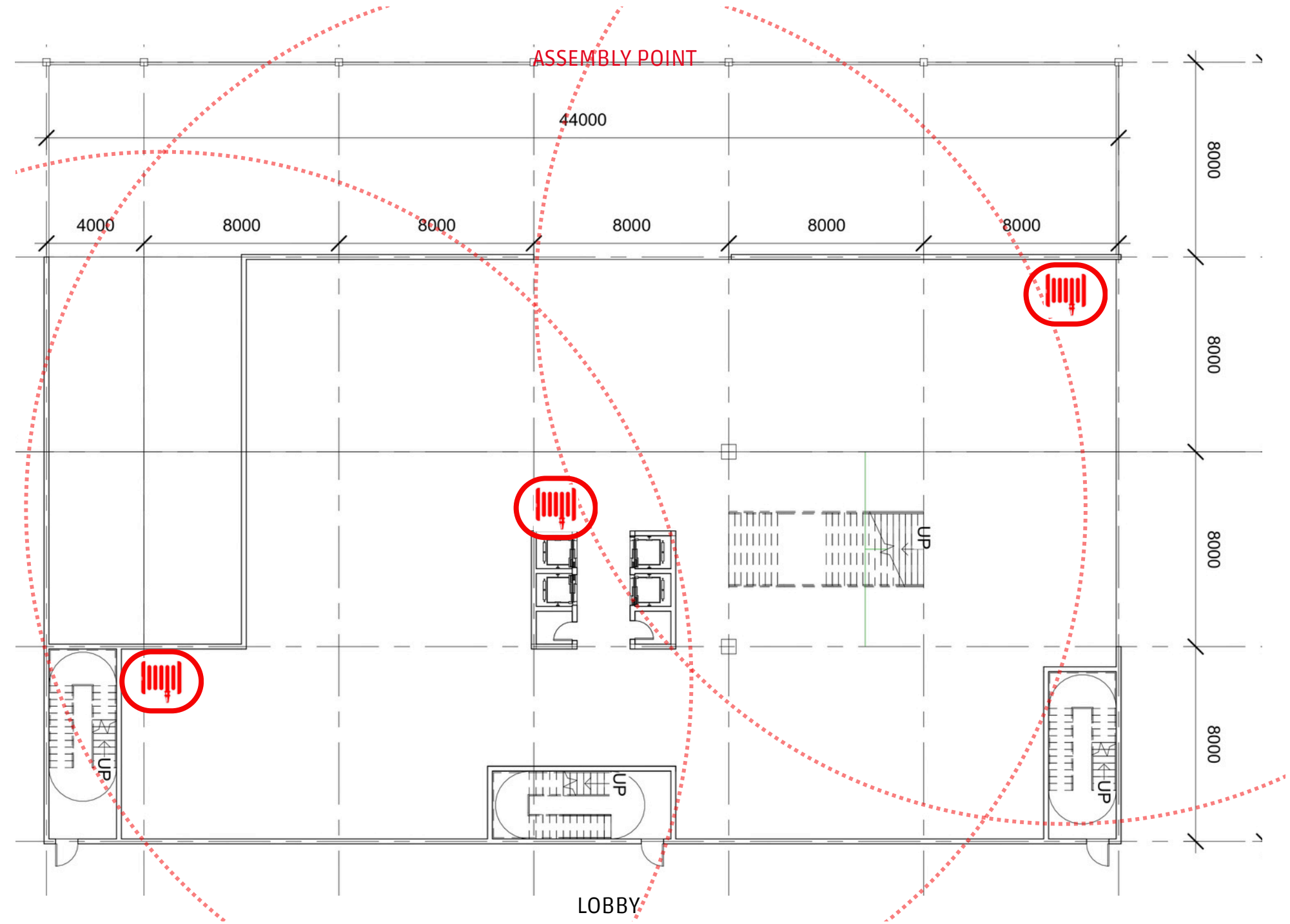
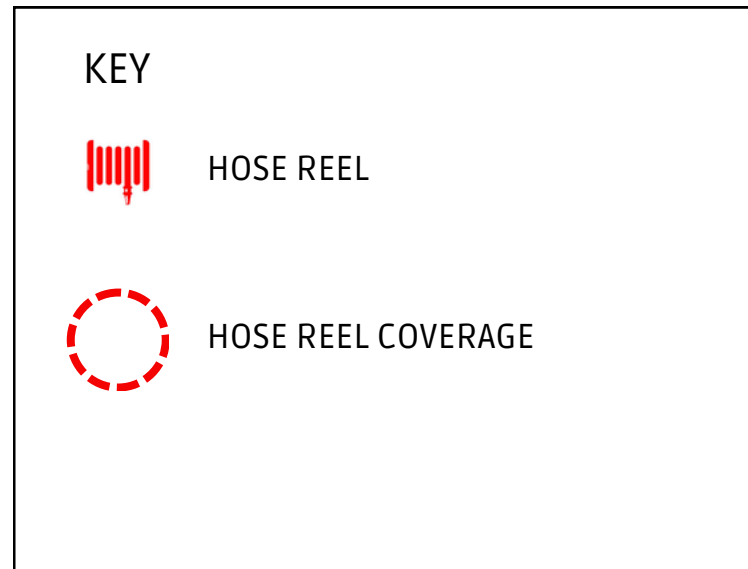
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# 6.4 AFP Proposal

## 6.4.4 Horizontal Planning-Hose Reel System (GF)

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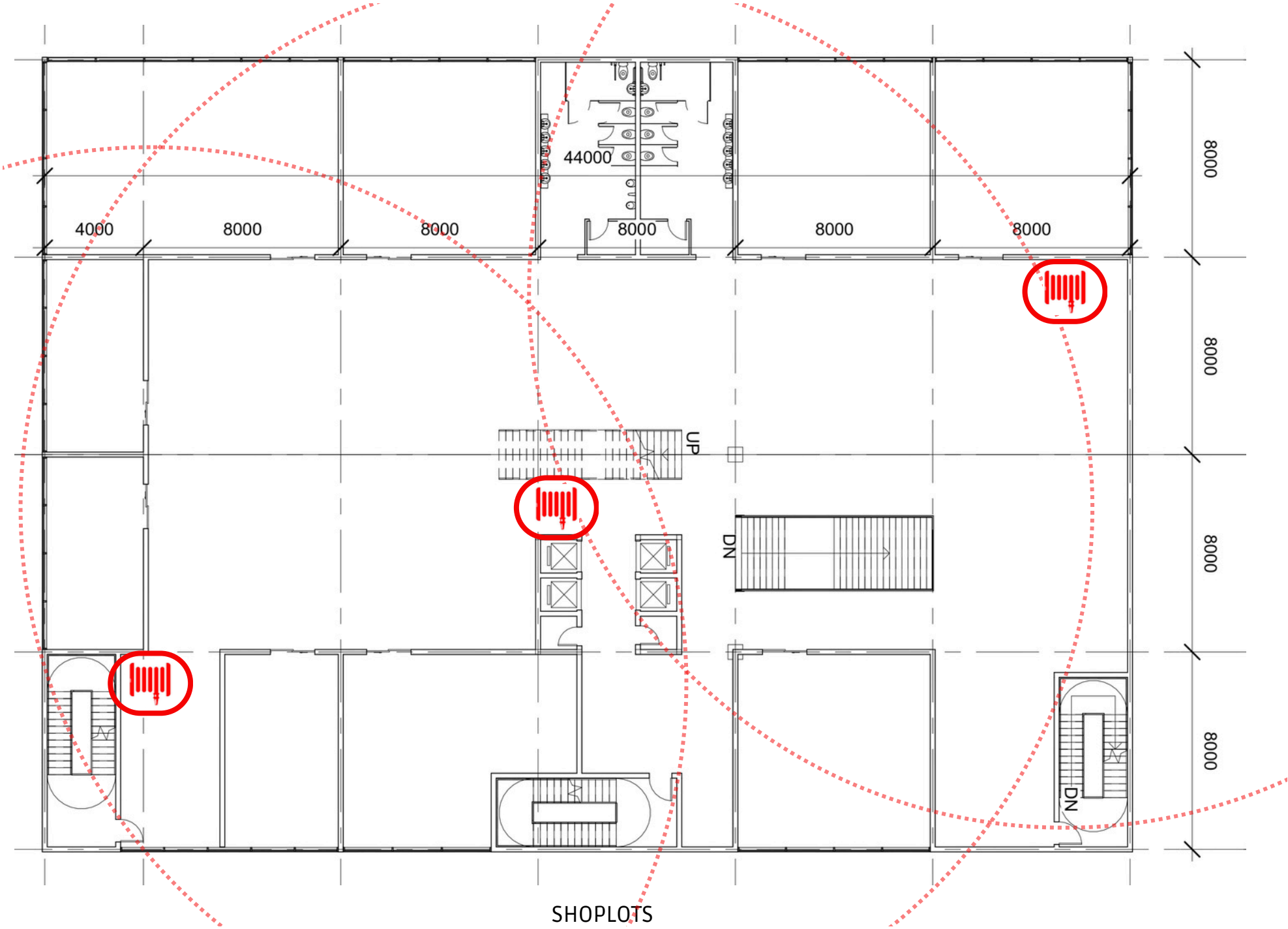
# 6.4 AFP Proposal

## 6.4.4 Horizontal Planning-Hose Reel System (MEZZANINE)

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**KEY**

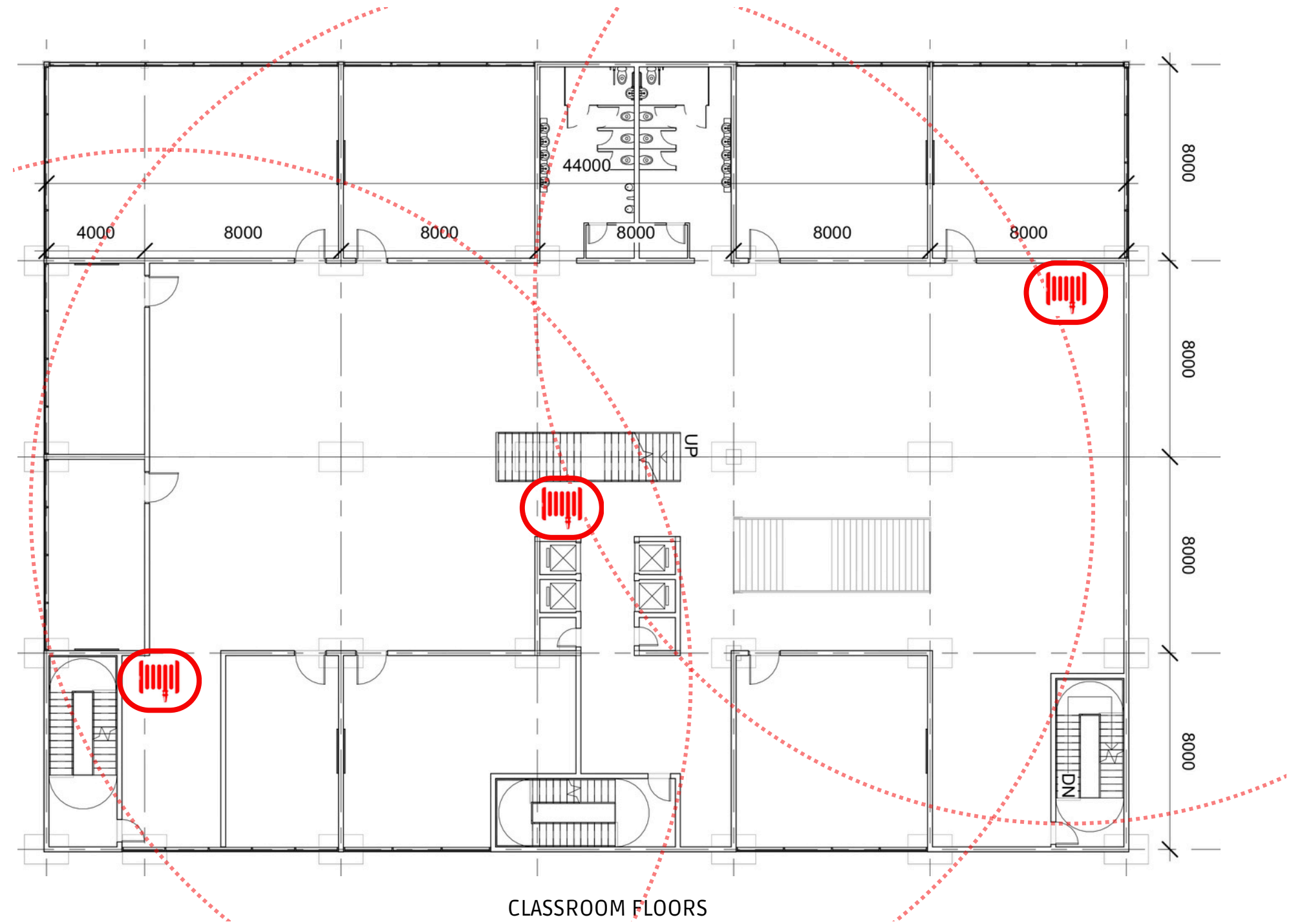
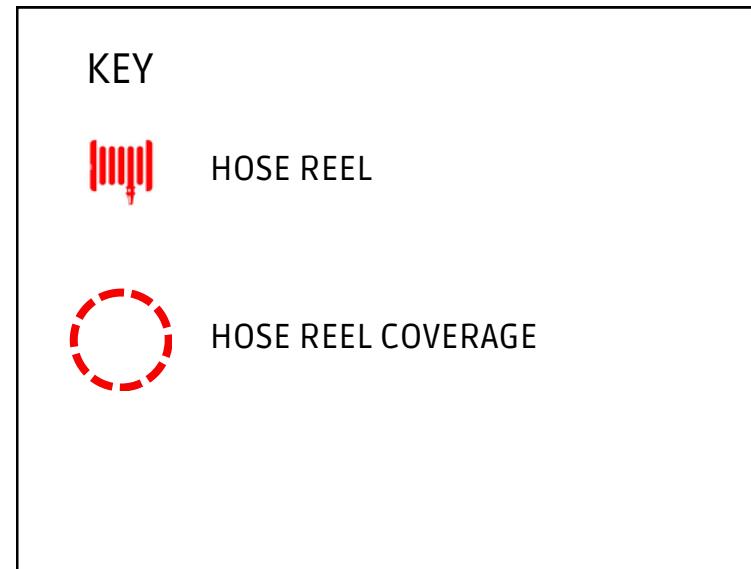
-  HOSE REEL
-  HOSE REEL COVERAGE



# 6.4 AFP Proposal

## 6.4.4 Horizontal Planning-Hose Reel System (L1-L10)

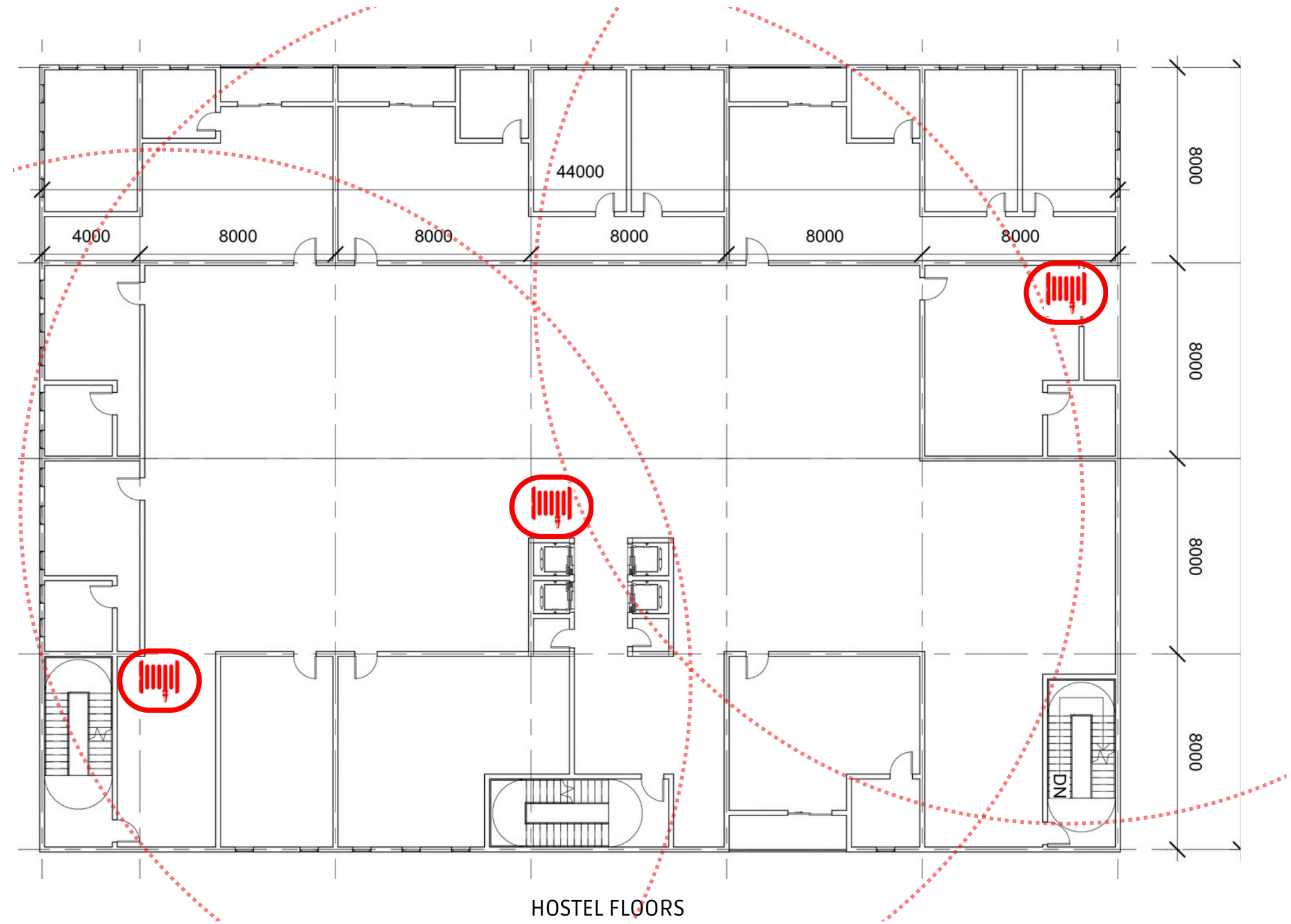
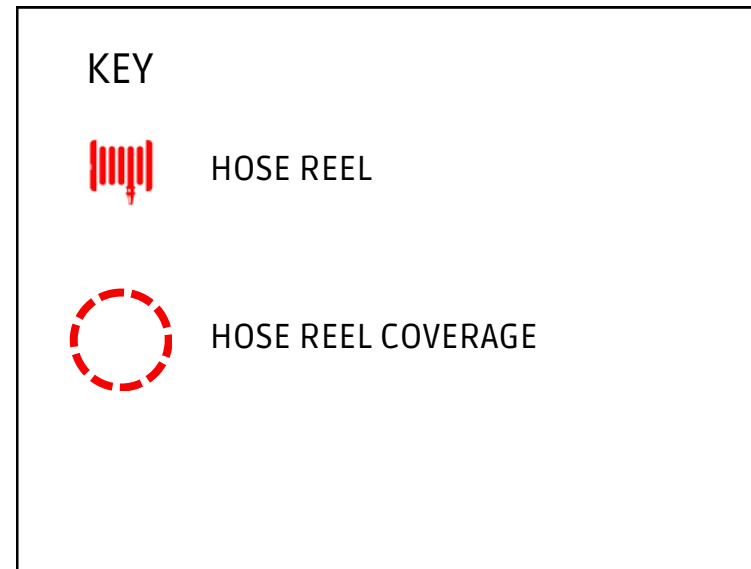
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# 6.4 AFP Proposal

## 6.4.4 Horizontal Planning-Hose Reel System (L11-L18)

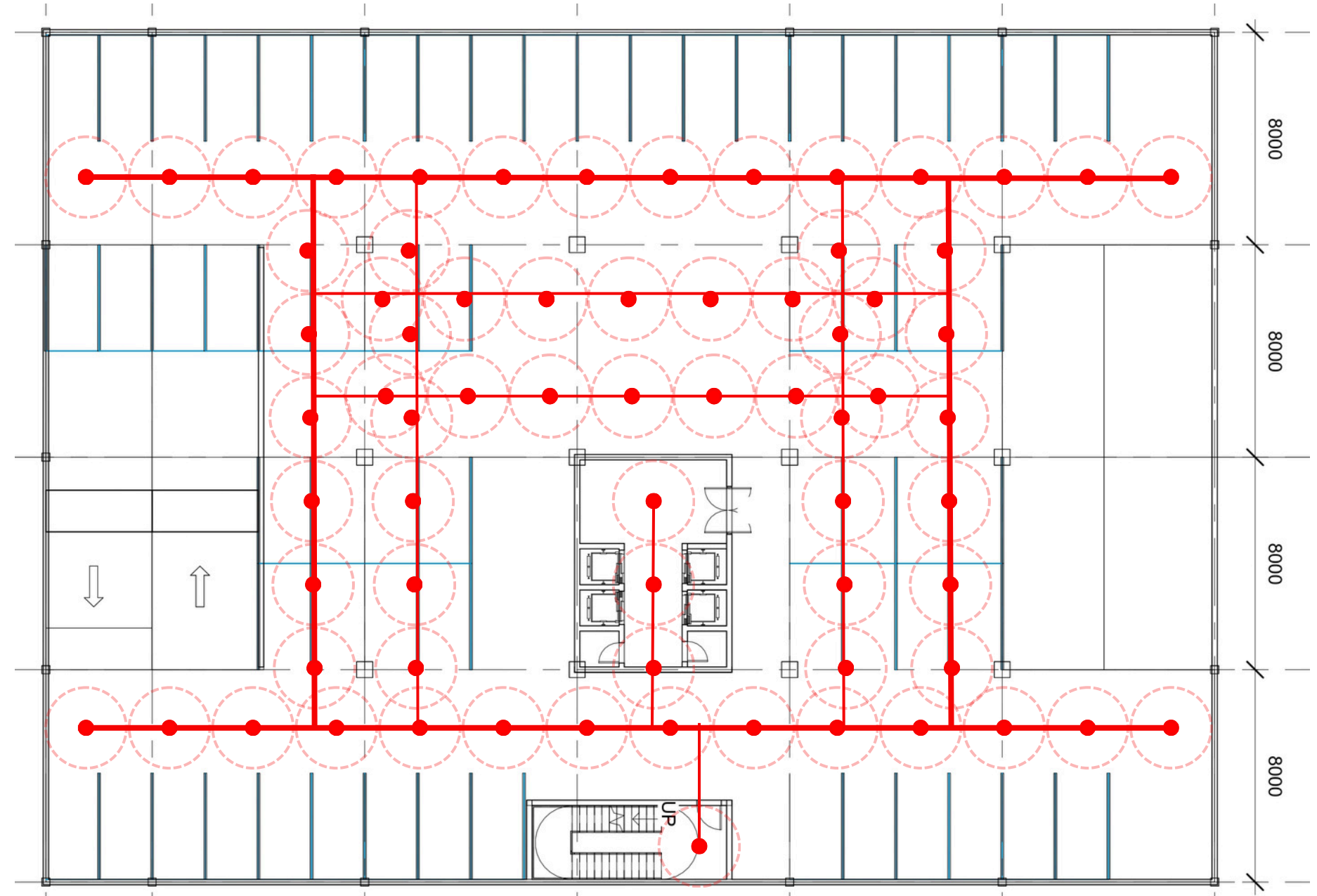
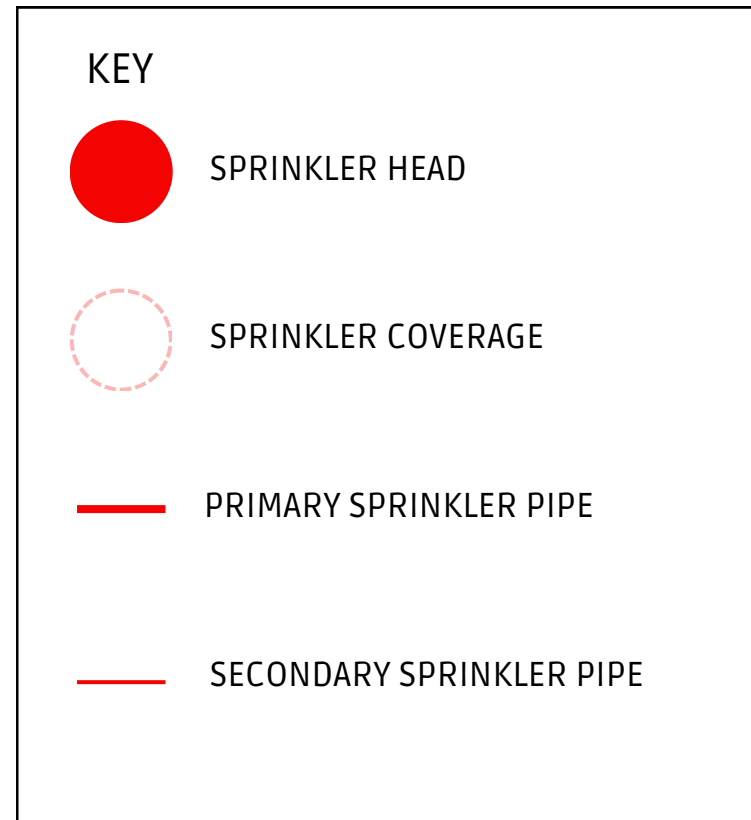
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# 6.4 AFP Proposal

## 6.4.5 Horizontal Planning-Automatic Sprinkler System (B1-B5)

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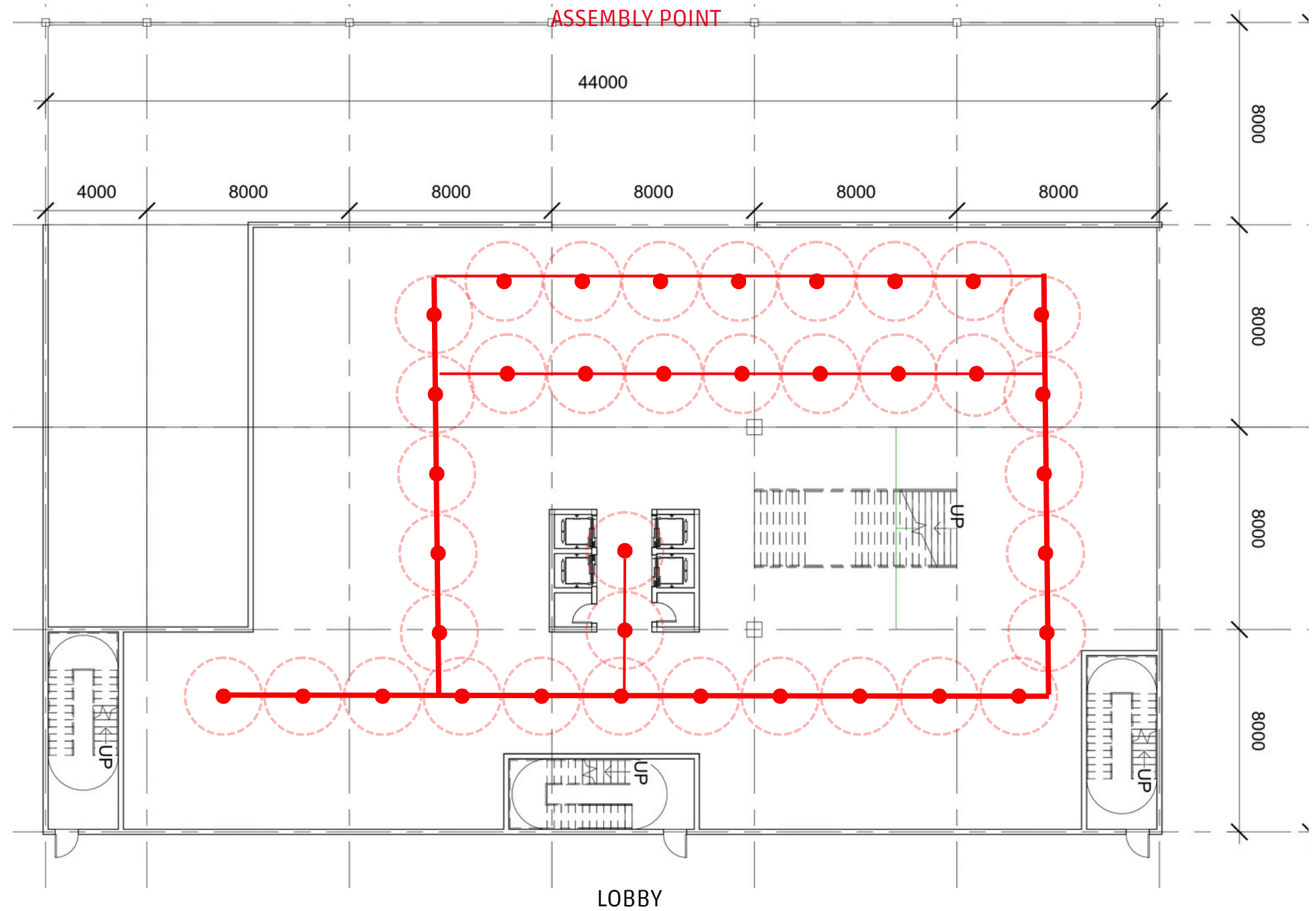
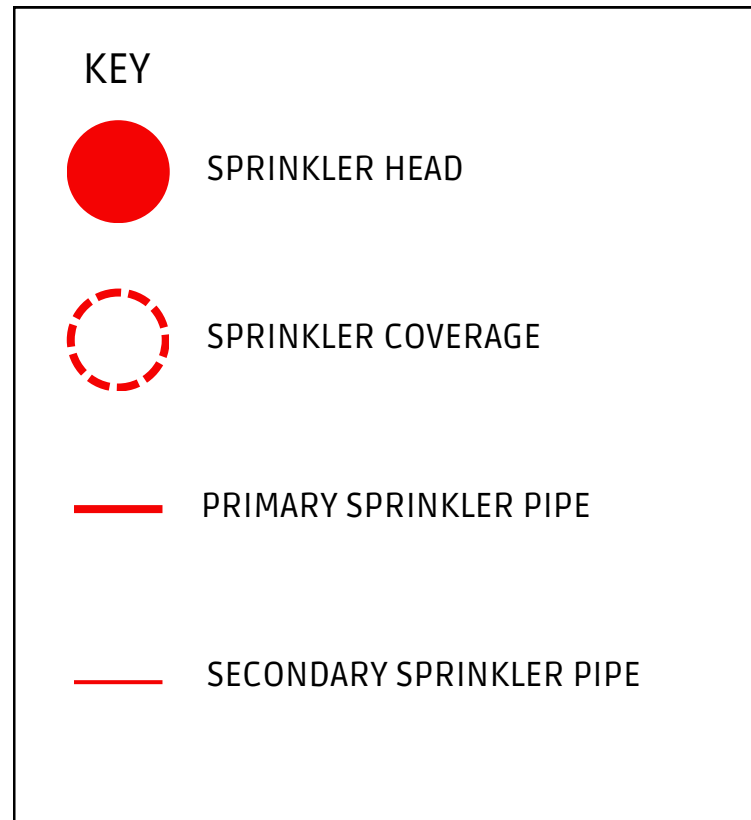


CARPARK

# 6.4 AFP Proposal

## 6.4.5 Horizontal Planning-Automatic Sprinkler System (GF)

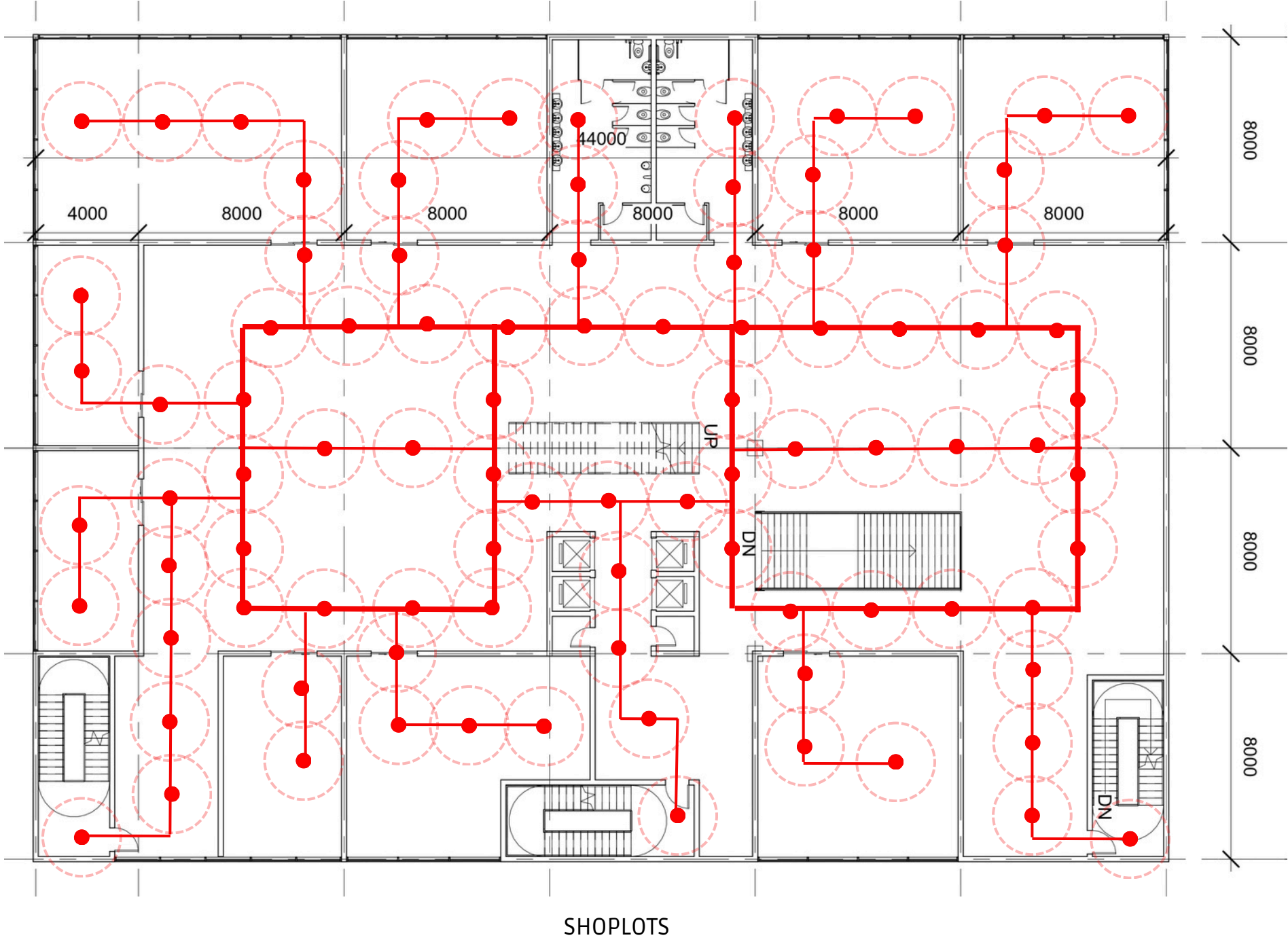
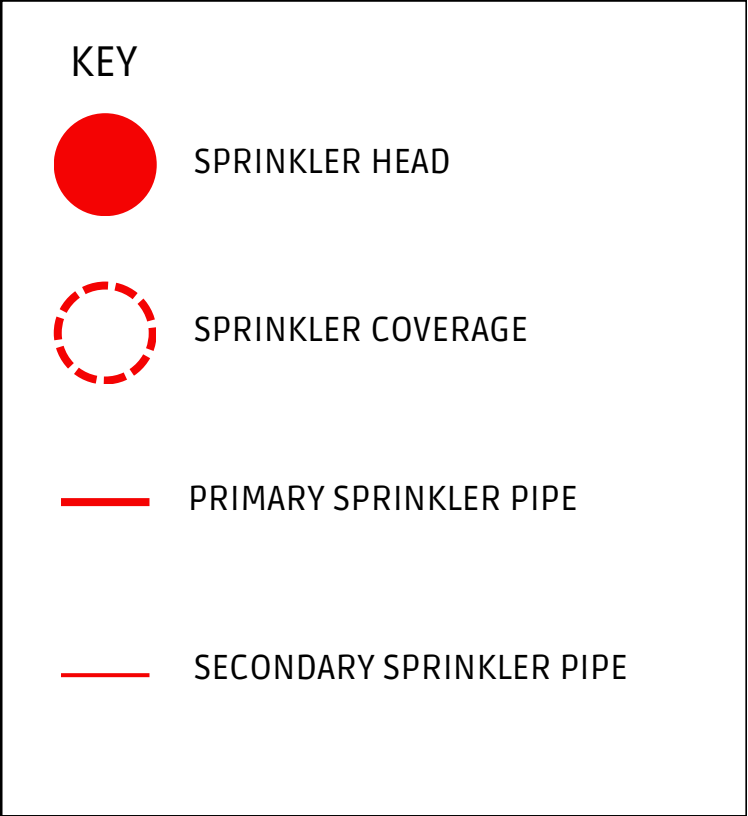
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# 6.4 AFP Proposal

## 6.4.5 Horizontal Planning-Automatic Sprinkler System (MEZZANINE)

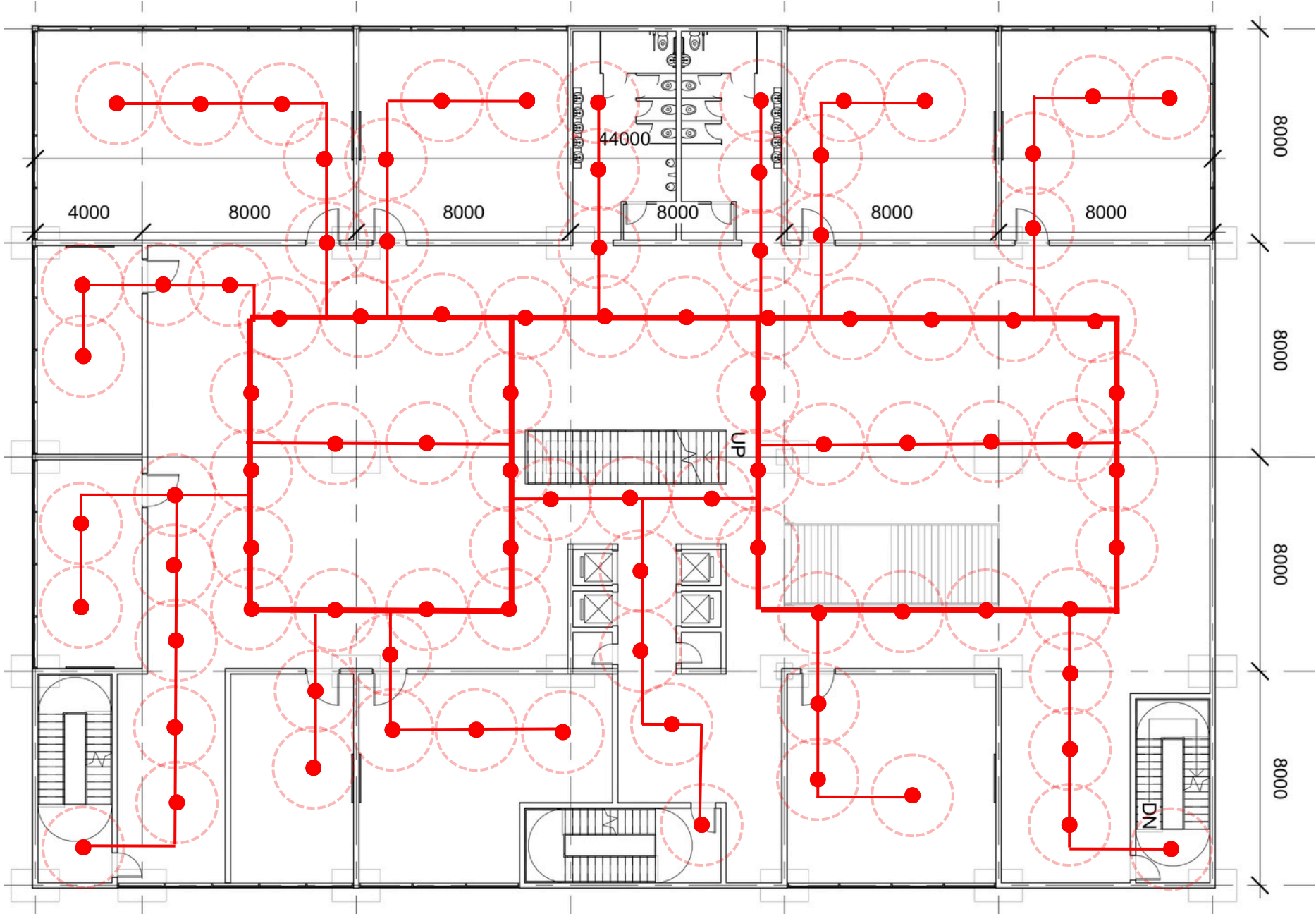
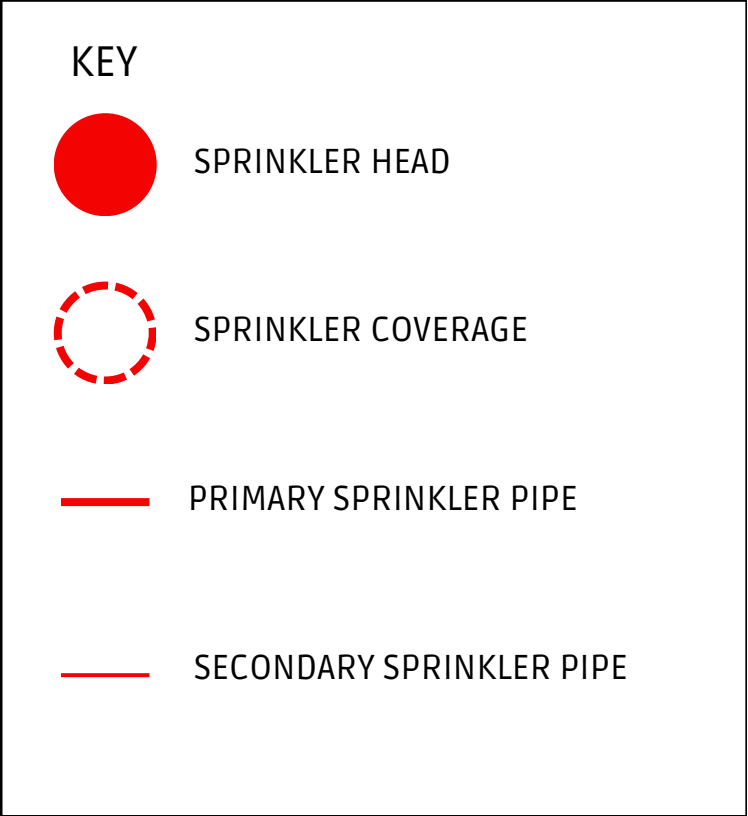
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# 6.4 AFP Proposal

## 6.4.5 Horizontal Planning-Automatic Sprinkler System (L1-L10)

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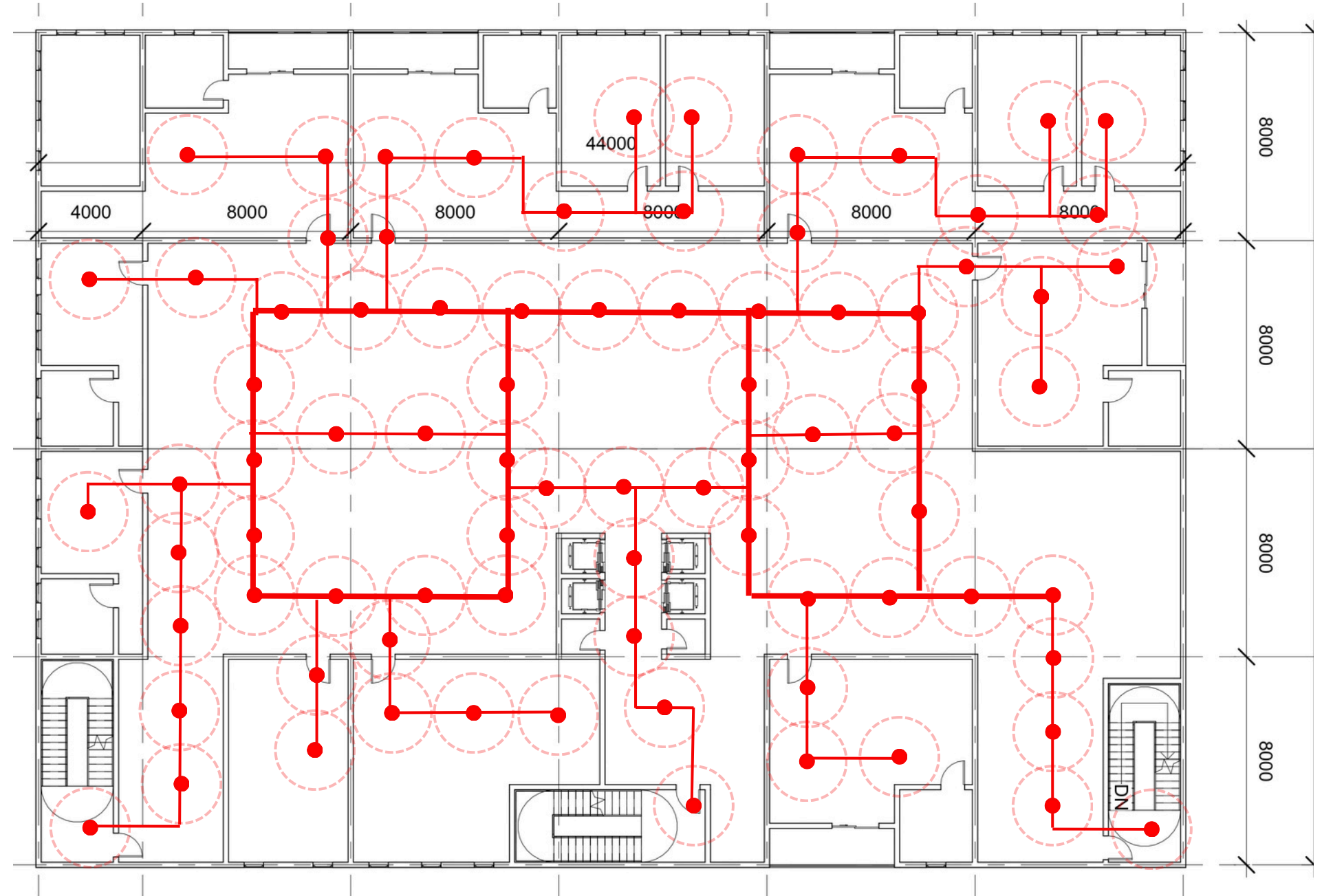
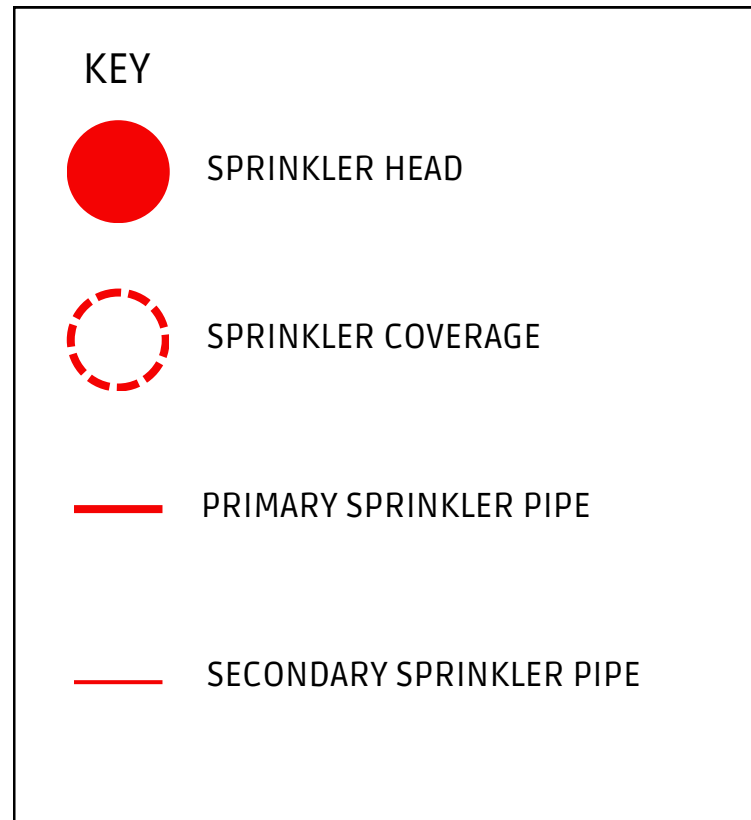


CLASSROOM FLOORS

# 6.4 AFP Proposal

## 6.4.5 Horizontal Planning-Automatic Sprinkler System (L11-L18)

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HOSTEL FLOORS

# 7.0 MECHANICAL TRANSPORTATION SYSTEM

Aishath Hanaan Ibrahim (0356681)

# 7.1 Introduction

Mechanical Transportation Systems are a crucial part of modern infrastructure. These systems encompass transportation devices such as **conveyors, escalators and elevators, as well as automated guided vehicles (AGVs)** which operate on mechanical components including belts, gears, pulleys and motors. MTS provides excellent accessibility, particularly for multi-story buildings, industrial facilities, and wide commercial spaces with their ability to create seamless transitions between floors and parts. You make them work, reliably and efficiently, thus reducing the human effort involved and maximizing productivity as a whole.

## 1 Vertical Transportation Systems



Elevators



Escalators



Stairs

## 2 Horizontal Transportation Systems



Travelators



Conveyor Belts

### 7.1.1 Laws pertaining to Mechanical Systems (UBBL 1984)

#### PART VI - CONSTRUCTIONAL REQUIREMENTS

##### UBBL 1986-Clause 124: Lifts

For all non-residential buildings exceeding 4 storeys above or below the main access level at least one lift shall be provided.

#### PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS

##### UBBL 1986-Clause 150: Protected Shafts

(5) There shall be no opening in any protecting structure other than any one or more of the following:

- (c) if the protected shaft contains a lift, an openings which complies with the provisions of bylaw 162; and
- (d) if the protected shaft serves as, or contains a ventilating duct, an inlet to or outlet from the duct or an opening for the duct.

#### PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS

##### BBL 1986-Clause 151 Ventilation to lift shafts.

Where openings to lift shafts are not connected to protected lobbies, such lift shafts shall be provided with vents of not less than 0.09 square metre per lift located at the top of the shafts. Where the vent does not discharge directly to the open air the lift shafts shall be vented to the interior through a duct of the required FRP as for the lift shafts.

#### PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS

##### B152. Openings in lift shafts.

(1) Every opening in a lift shaft or lift entrance shall open into protected lobby unless other suitable means of protection to the opening to the satisfaction of the local authority is provided. These requirements shall not apply to open type industrial and other special buildings as may be approved by the D.G.F.S.

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **B152. Openings in lift shafts.**

(2) Landing doors shall have a FRP of not less than half the FRP of the hoistway structure with a minimum FRP of half hour.

(3) No glass shall be used for in landing doors except for vision in which case any vision panel shall or be glazed with wired safety glass, and shall not be more than 0.0161 square metre and the total area of one or more vision panels in any landing door shall be not more than 0.0156 square metre.

(4) Each clear panel opening shall reject a sphere 150 millimetres in diameter.

(5) Provision shall be made for the opening of all landing doors by means of an emergency key irrespective of the position of the lift car.

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **153. Smoke detectors for lift lobbies.**

(1) All lift lobbies shall be provided with smoke detectors.

(2) Lift not opening into a smoke lobby shall not use door reopening devices controlled by light beam or photo-detectors unless incorporated with a force close feature which after thirty seconds of any interruption of the beam causes the door to close within a preset time.

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **154. Emergency mode of operation in the event of mains power failure.**

(1) On failure of mains power all lifts shall return in sequence directly to the designated floor, commencing with the fire lifts, without answering any car or landing calls and park with doors open.

(2) After all lifts are parked the lifts on emergency power shall resume normal operation: Provided that where sufficient emergency power is available for operation of all lifts, this mode of operation need not apply.

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **BBL 1986-Clause 155. Fire mode of operation**

(2) If mains power is available all lifts shall return in sequence directly to the designated floor, commencing with the fire lifts, without answering any car or landing calls, overriding the emergency stop button inside the car, but not any other emergency or safety devices, and park with doors open.

(3) The fire lifts shall then be available for use by the fire brigade on operation of the fireman's switch.

(4) Under this mode of operation, the fire lifts shall only operate in response to car calls but not to landing calls in a mode of operation in accordance with by-law 154.

(5) In the event of mains power failure, all lifts shall return in sequence directly to the designated floor and operate under emergency power as described under paragraphs (2) to (4).

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **BBL 1986-Clause 229. Means of access and fire fighting in buildings over 18.3 metres high.**

(5) A fire lift shall be provided to give access to each fire fighting access lobby or in the absence of a lobby to the fire fighting staircase at each floor level.

(6) The fire lift shall discharge directly into the fire fighting access lobby fire fighting staircase or shall be connected to it by a protected corridor.

## **PART VII - FIRE SAFETY INSTALLATION REQUIREMENTS**

### **BBL 1986-Clause 243. Fire lift.**

(1) In a building where the top occupied floor is over 18.5 metres above the fire appliance access level fire lifts shall be provided.

(3) The fire lifts shall be located within a separate protected shaft if it opens into a separate lobby.

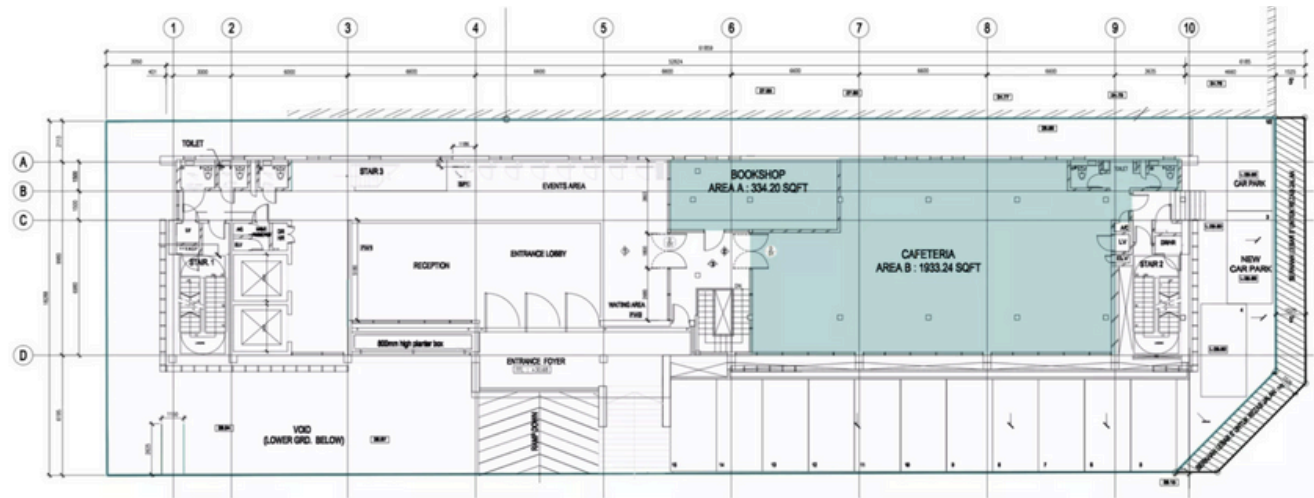
(4) Fire lifts shall be provided at the rate of one lift in every group of lifts which discharge into the same protected enclosure or smoke lobby containing the rising main, provided that the fire lifts are located not more than 61 metres travel distance from the furthest point of the floor.

## 7.2 Application of Mechanical Transportation System- Precedent Studies

The use of vertical transportation on the **PAM Building** is quite instrumental with its multiple elevators which in terms of movement but also accessibility as an office space. Tamarind Square, on the other hand, employs both horizontal and vertical systems in a way that reinforces its active mix-use character through seamless connections from retail to office to leisure.

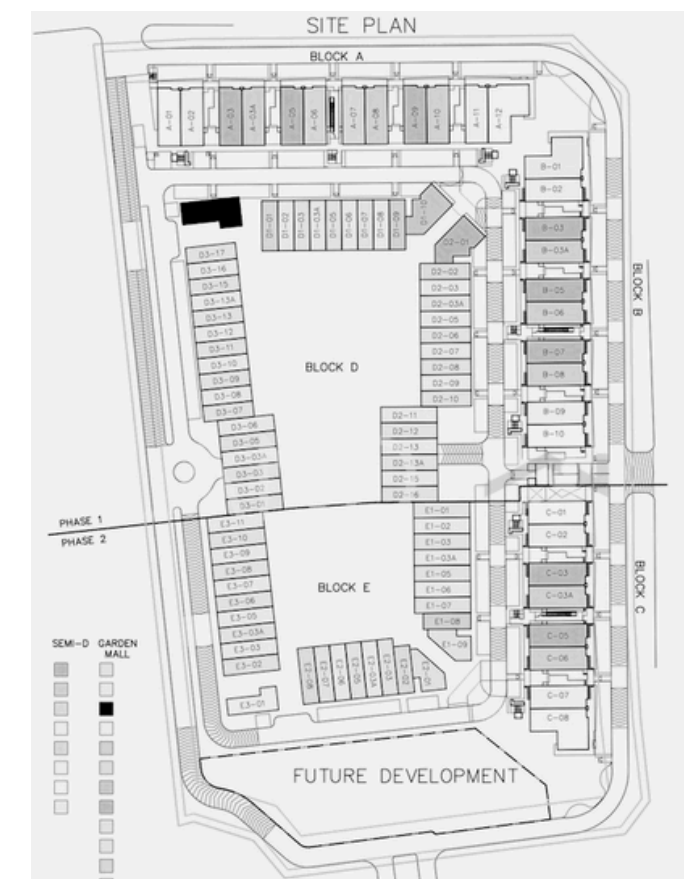
### 1 Pertubuhan Akitek Malaysia (PAM) Centre, Kuala Lumpur Machine Room-less Elevator (MRL)

- **Space Optimization:** The absence of a machine room is particularly beneficial in the PAM Building, where efficient use of space is essential for accommodating the needs of architects, designers, and events.
- **Reduced Structural Modifications:** MRL elevators simplify the building's infrastructure, minimizing the need for additional structural modifications, which helps maintain the building's architectural integrity.
- **Sustainability:** The energy-efficient design of MRL elevators aligns with the PAM Building's commitment to sustainable architecture, reducing energy consumption and contributing to green building practices.



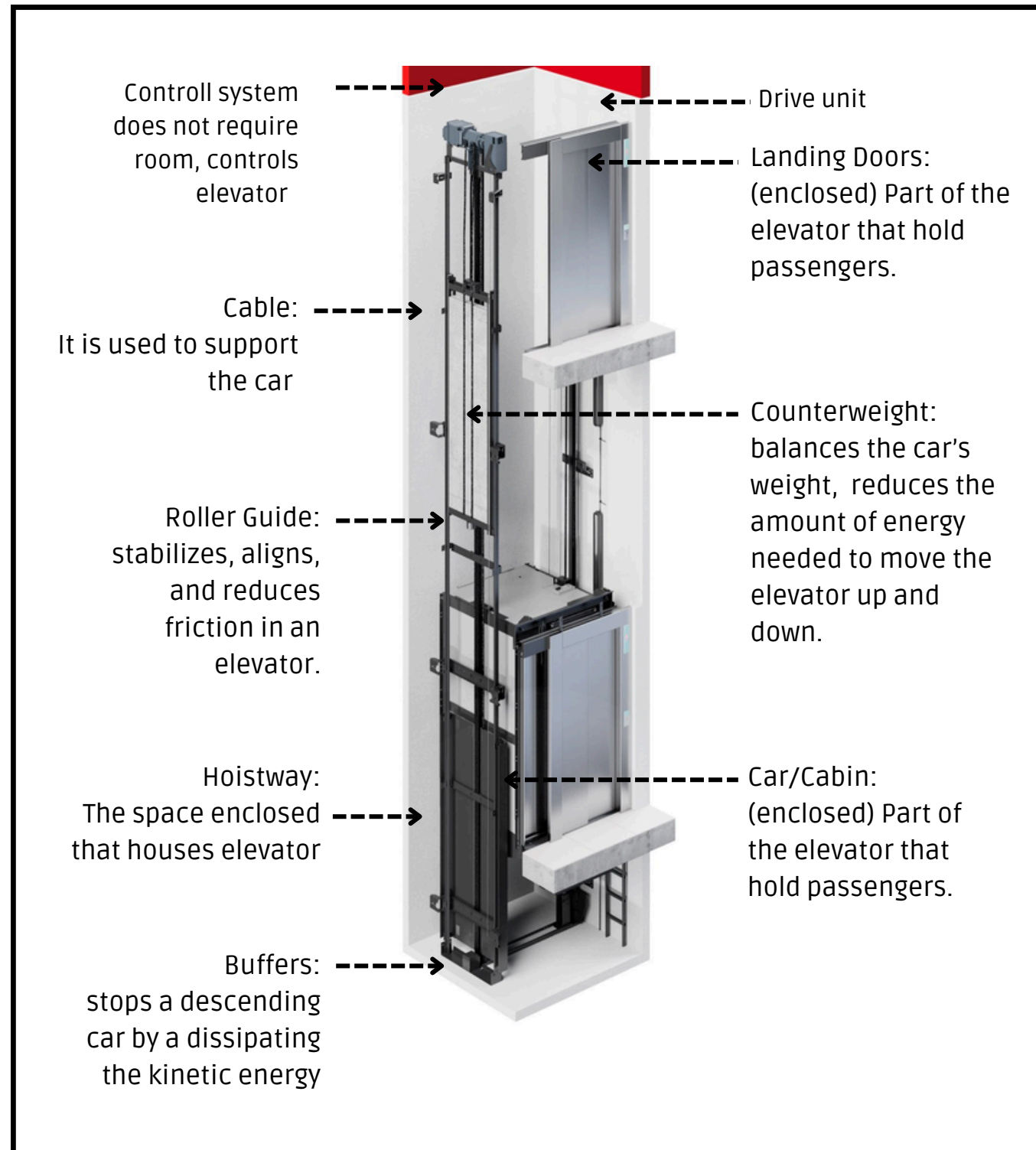
### 2 Tamarind Square, Cyberjaya OTIS Lift System- Machine Room-less Elevator (MRL)

- **Space Efficiency:** The absence of a machine room allows for more usable floor space, which is valuable in Tamarind Square's mixed-use design, where maximizing retail and office areas is essential.
- **Lower Energy Consumption:** MRL elevators are more energy-efficient, which aligns with the building's potential sustainability goals and helps reduce ongoing operational costs.
- **Quieter Operation:** The quieter operation of MRL elevators creates a more pleasant environment for both tenants and visitors, particularly in busy areas like retail zones and office spaces.
- **Cost-Effective:** Without the need for a dedicated machine room, construction and maintenance costs are reduced, allowing resources to be allocated to other important areas, such as building amenities.
- **Aesthetic Flexibility:** MRL elevators integrate well into the building's sleek, modern design, providing architects more flexibility in layout and aesthetic choices without sacrificing functionality..



## 7.3 Mechanical Transportation System Components / Strategies

The Mechanical transportation system components are these vital parts to run the whole design of a building or various other centre for reliable and correct people and items relocating. These components contribute in a very different way to the accessibility, efficiency and overall usability of a building.

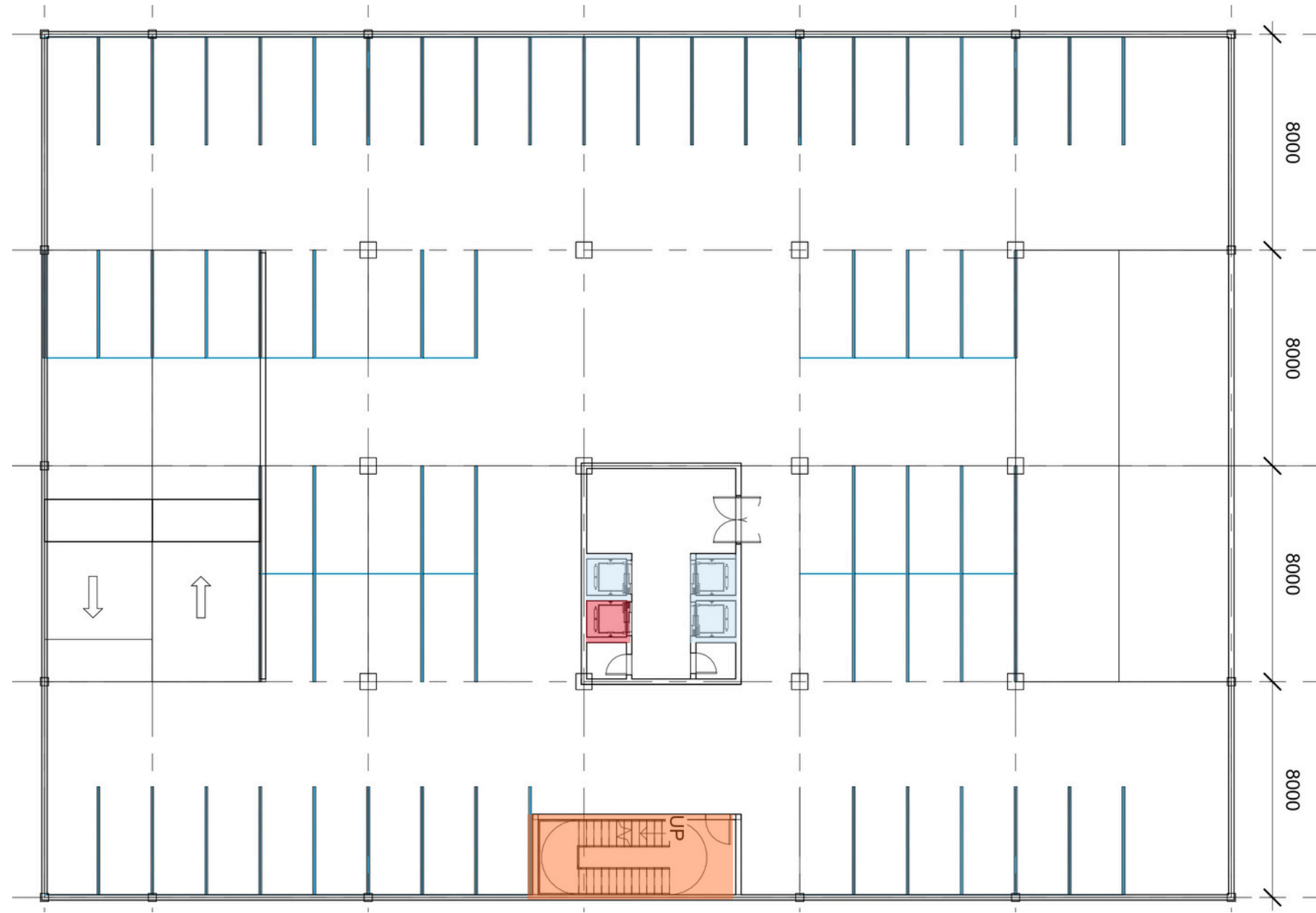


### 7.3.1 Elevator Specifications





Type	Passenger Lift	Bomba Lift
Name	Schindler 3300	Schindler 3000
Capacity	400-1125 kg	320 - 1350 kg
Travel Height	Up to 80 m	Up to 125 m
Stops	-	Max 35 stops
Speed	1.0 - 1.6 m/s	1.0 - 2.5 m/s
Drive System	machine room-less	machine room-less
Group Size	Up to 6 cars	Up to 6 cars
Entrances	One or two-sided	One or two-sided
Interior	customizable-wide range of fixtures	customizable- fixtures fireproof doors
Applicable Segments	High to mid-rise residential and commercial buildings	High to mid-rise residential and commercial buildings

# 7.4 Mechanical Transportation System Proposal

## 7.4.1 Location of Mechanical Transportation Systems

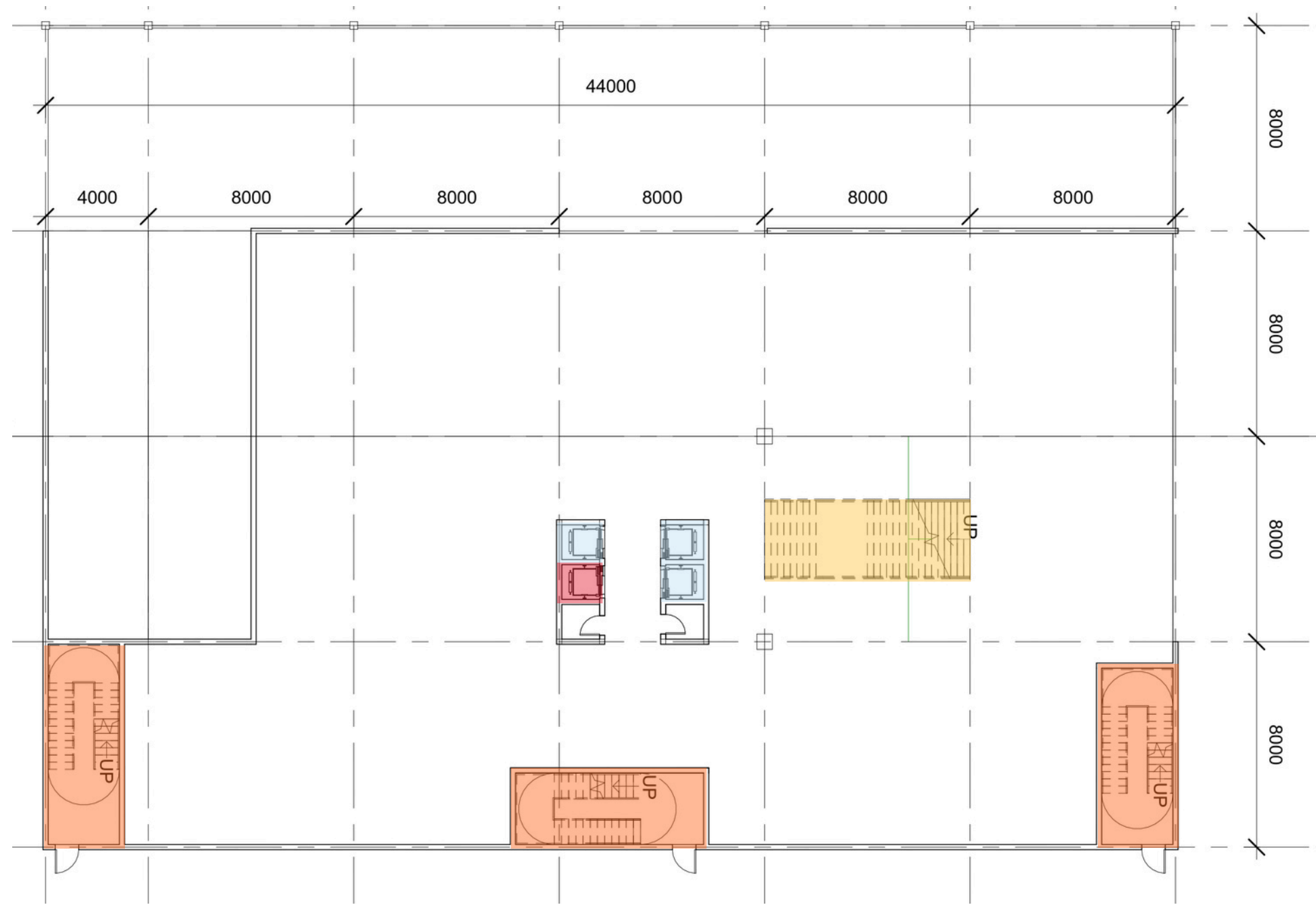


BASEMENT FLOORS





KEY	
	MAIN STAIRCASE
	PASSENGER LIFT
	FIRE ESCAPE STAIRWELL
	BOMBA LIFT

# 7.4 Mechanical Transportation System Proposal

## 7.4.2 Location of Mechanical Transportation Systems



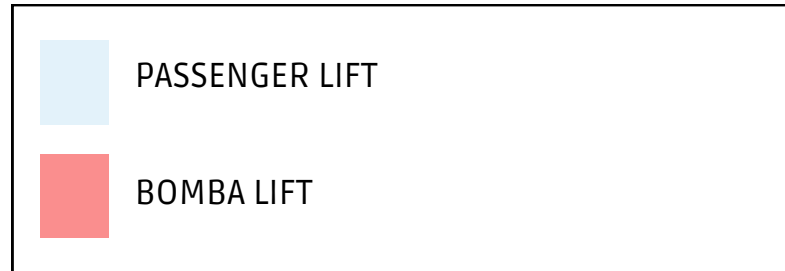
GROUND FLOOR to RESIDENTIAL FLOOR

KEY		MAIN STAIRCASE		PASSENGER LIFT
		FIRE ESCAPE STAIRWELL		BOMBA LIFT

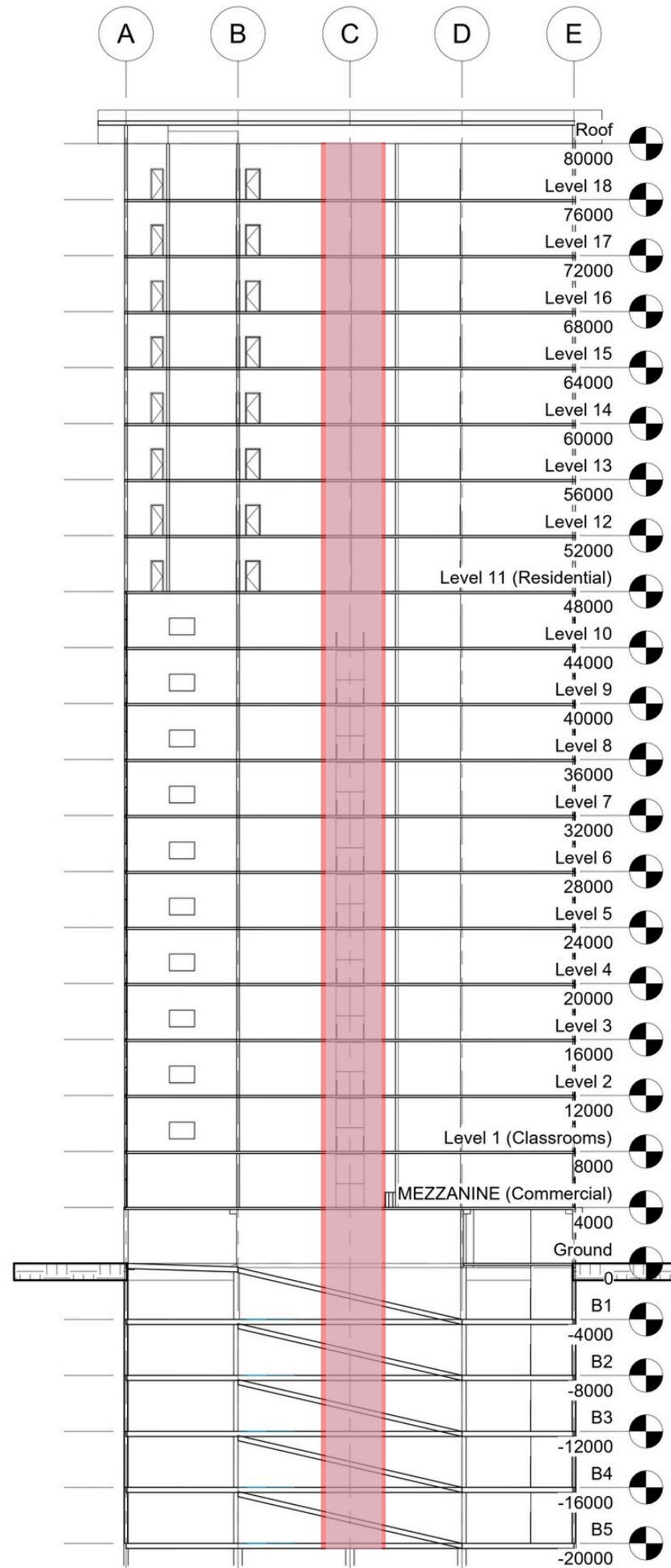
# 7.4 Mechanical Transportation System Proposal

## 7.4.3 Vertical Location of Mechanical Transportation Systems

### KEY



In a high rise building lifts operate vertically, between floors using a shaft. Distributed in key locations, they enable fast access on different floors and contain sophisticated systems that control speed and safety while stopping at a targeted level height.



SECTION

# 7.4 Mechanical Transportation System Proposal

## 7.4.4 Vertical Planning







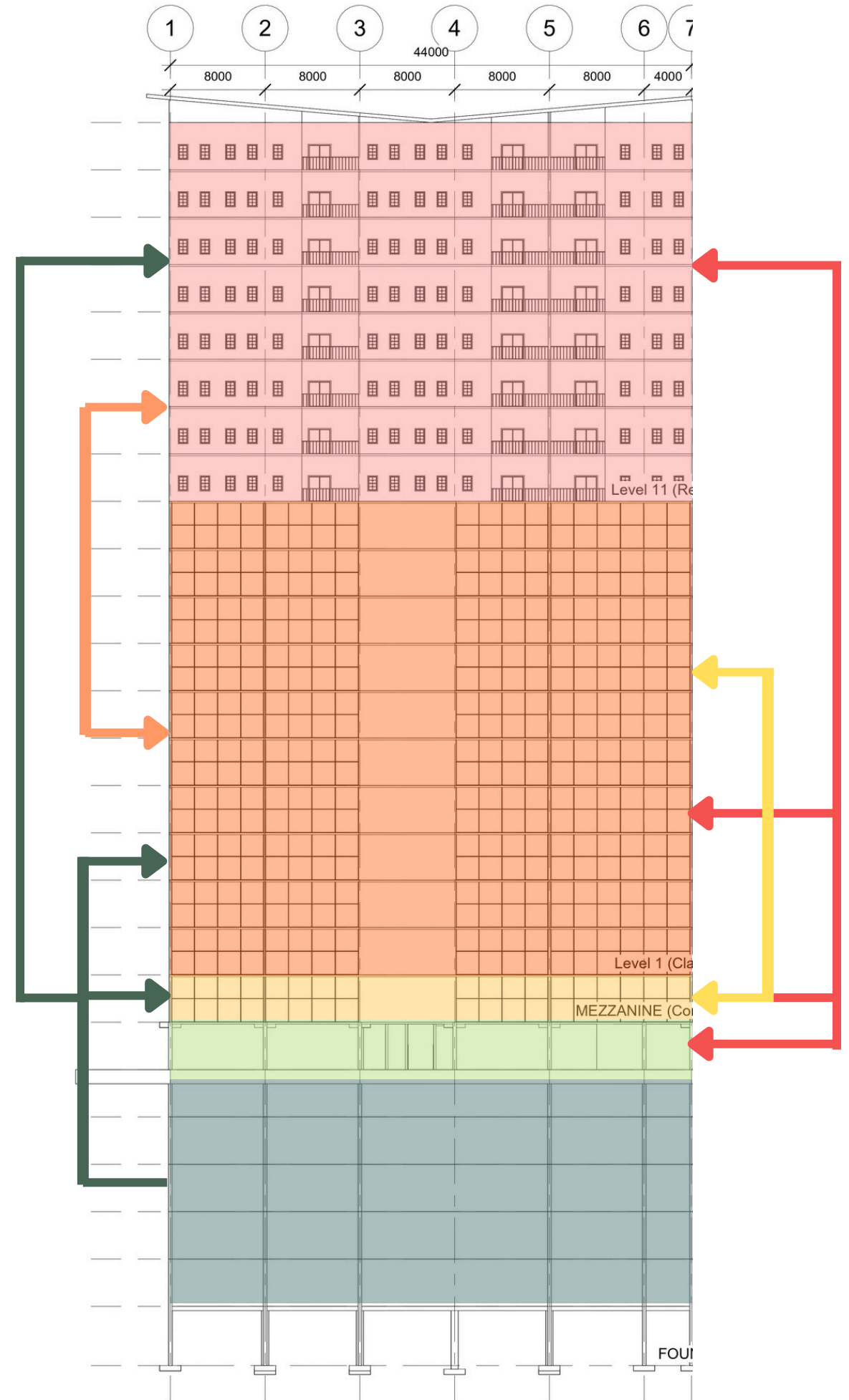
The garage, (parking) which is underground consists of five floors, an ideal amount for an educational building. the added parking space will help the flow of jam as well as match the student capacity.

the classrooms consist of 10 floors each with large halls for lectures for the students.

The residential section of the building directly connected to the floors below, increasing ease and efficiency.

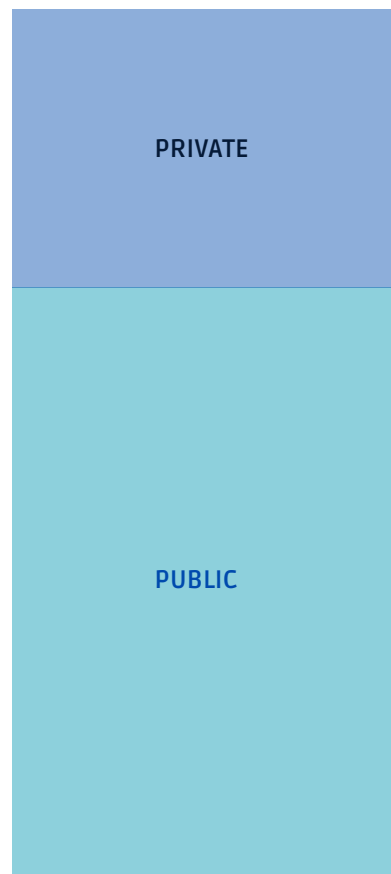
The lobby is fully connected. this means that from the lobby you can access all floor levels and vice versa.

-  RESIDENTIAL - CLASSROOMS - COMMERCIAL
-  CLASSROOMS - RESIDENTIAL
-  COMMERCIAL - CLASSROOMS
-  PARKING TO CLASSROOMS AND RESIDENTIAL AND LOBBY



## 7.4 Mechanical Transportation System Proposal

### 7.4.5 Vertical Zoning



1

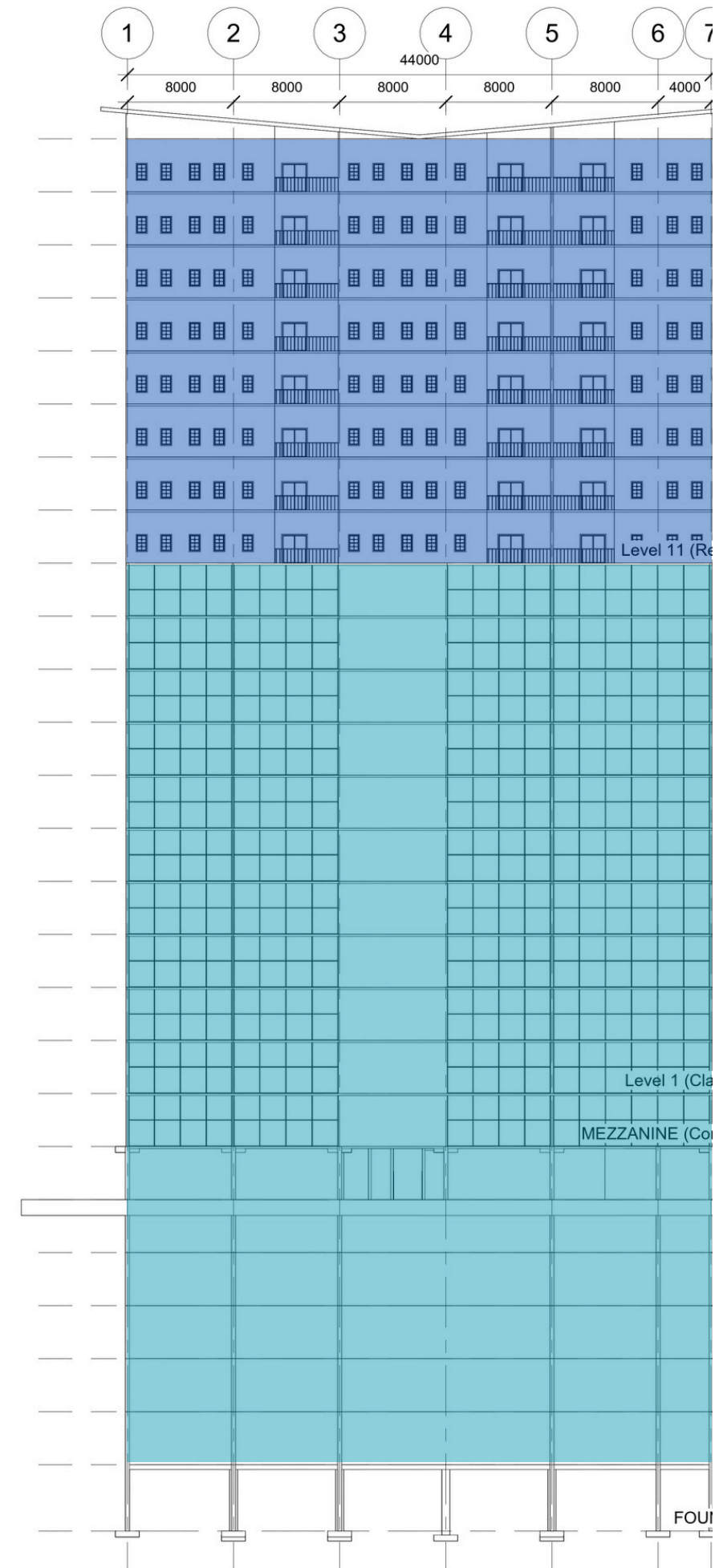
#### PRIVATE

The private floors consists of the residential area, creating privacy and security for the sttudents living in the building. It can only be access via access card that is verified by building staff.

2

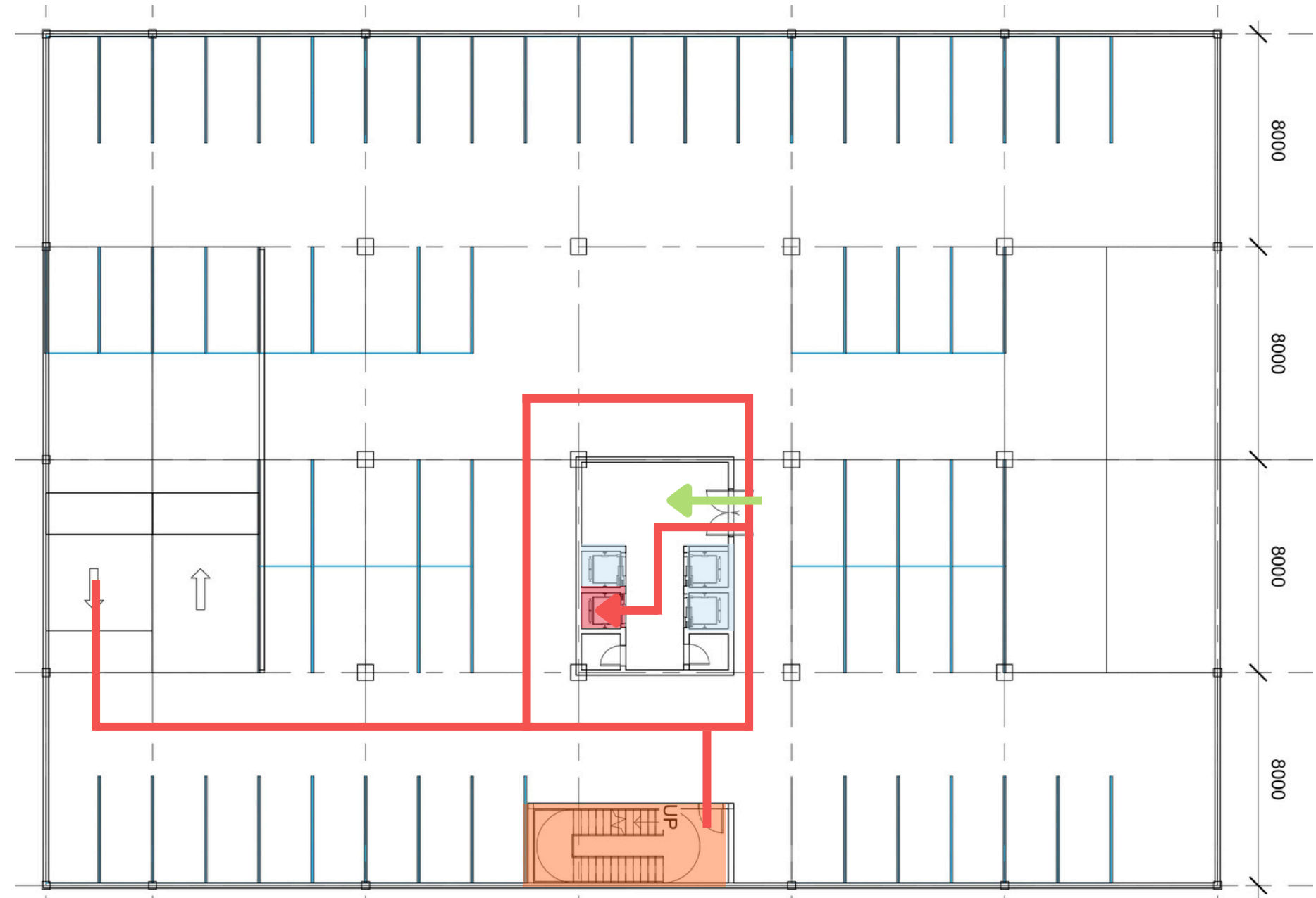
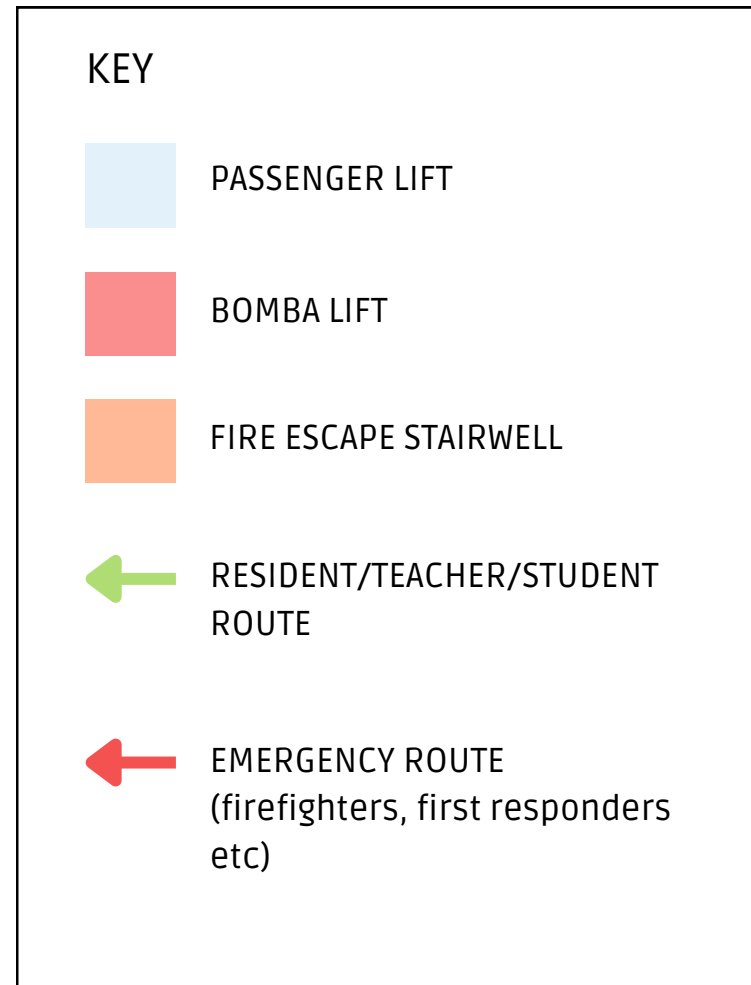
#### PUBLIC

The public floors consist of the parking floors, lobby, the mezzanine floor and the classrooms. This is so that all users within the building has easy access to the buildings facilities.



# 7.4 Mechanical Transportation System Proposal

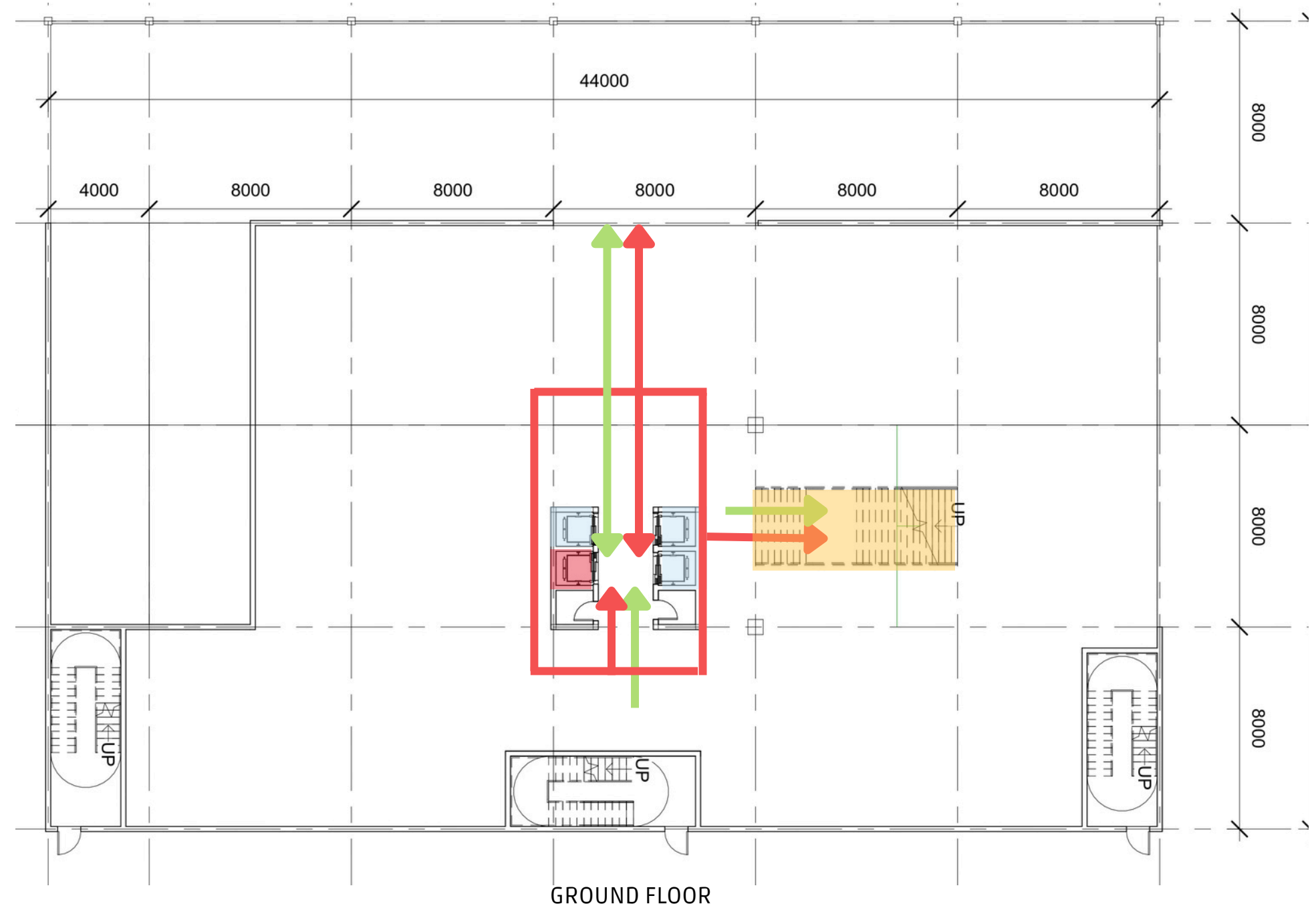
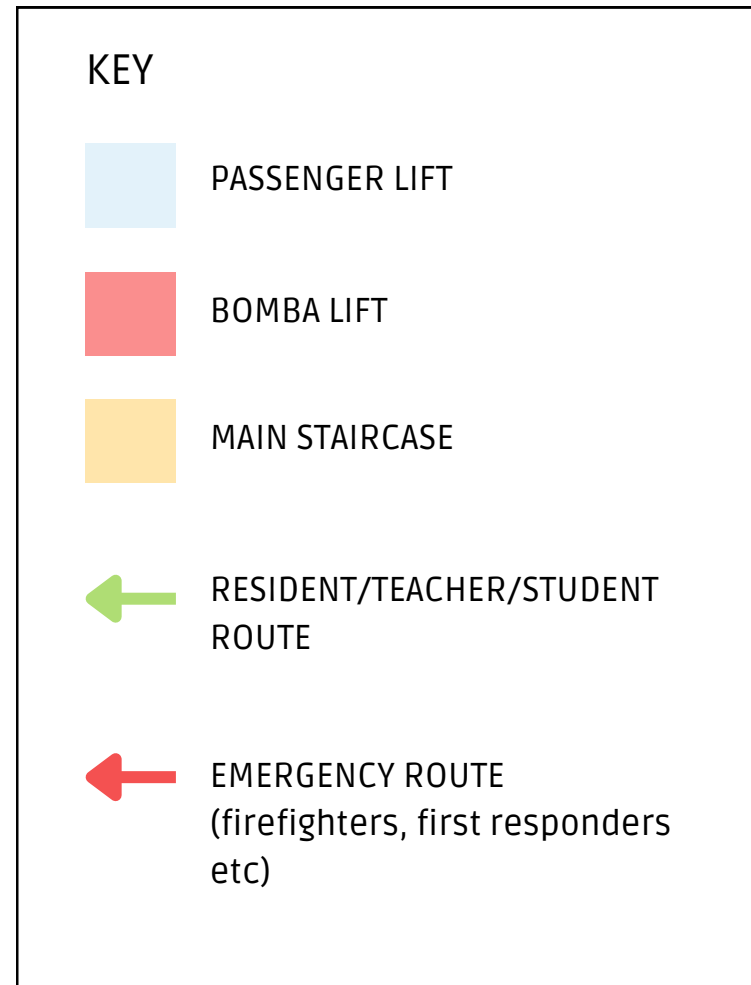
## 7.4.6 Location of Mechanical Transportation Systems



BASEMENT FLOORS

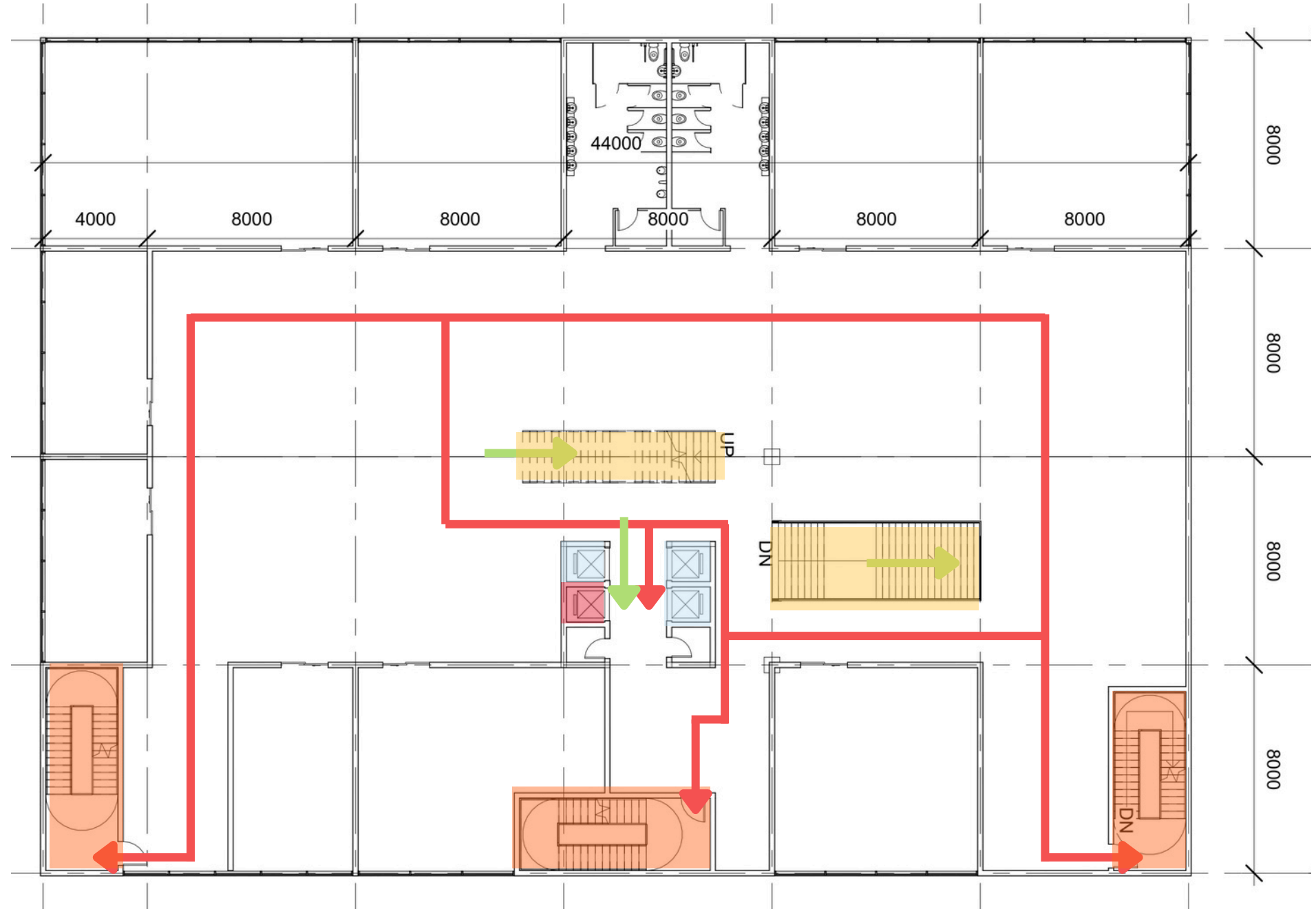
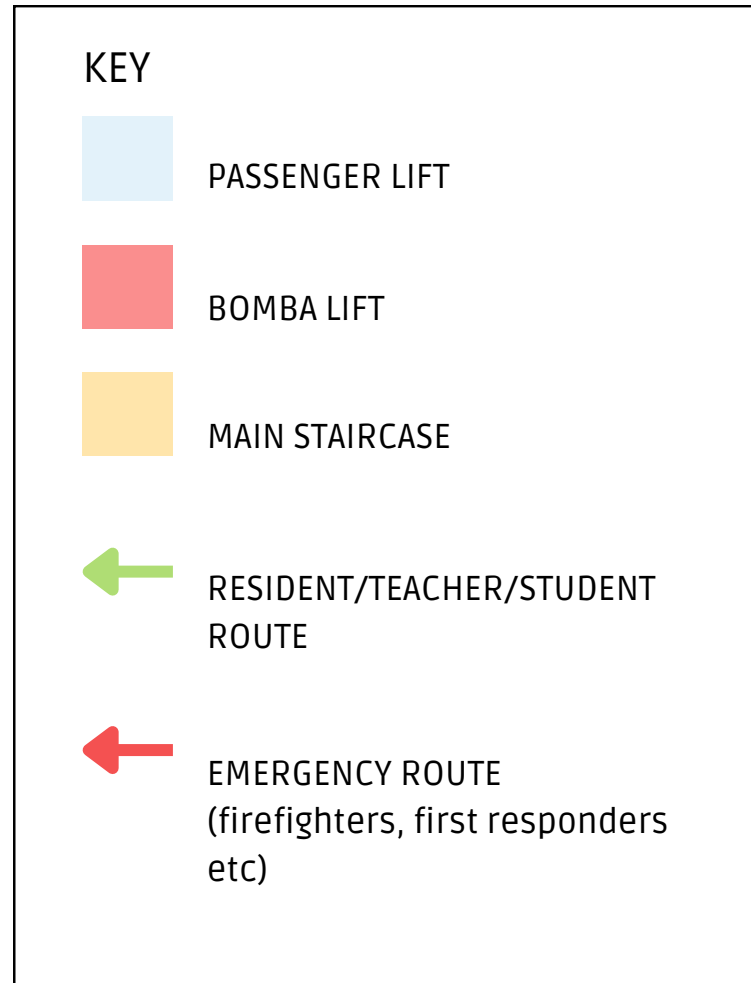
# 7.4 Mechanical Transportation System Proposal

## 7.4.7 Location of Mechanical Transportation Systems



# 7.4 Mechanical Transportation System Proposal

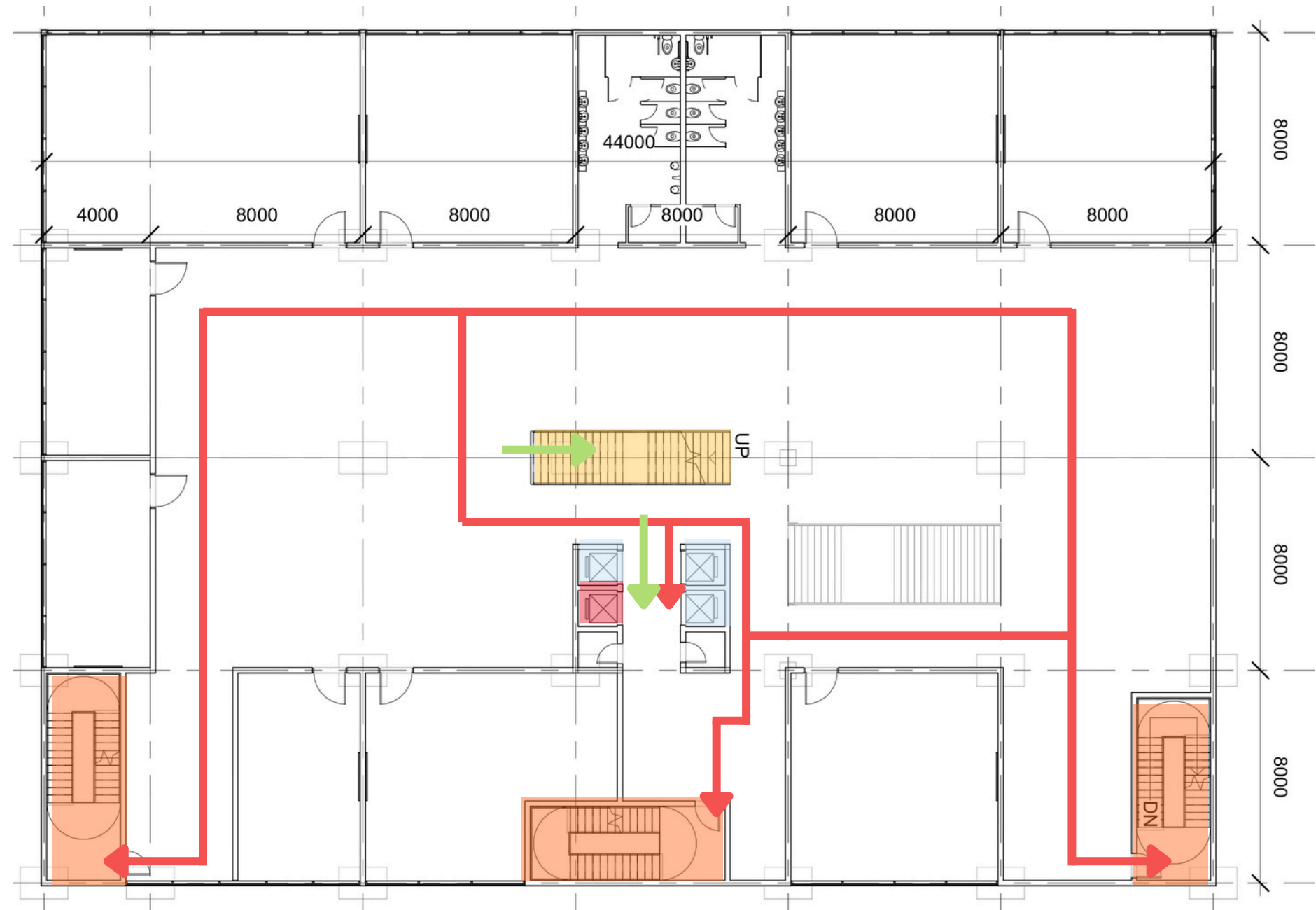
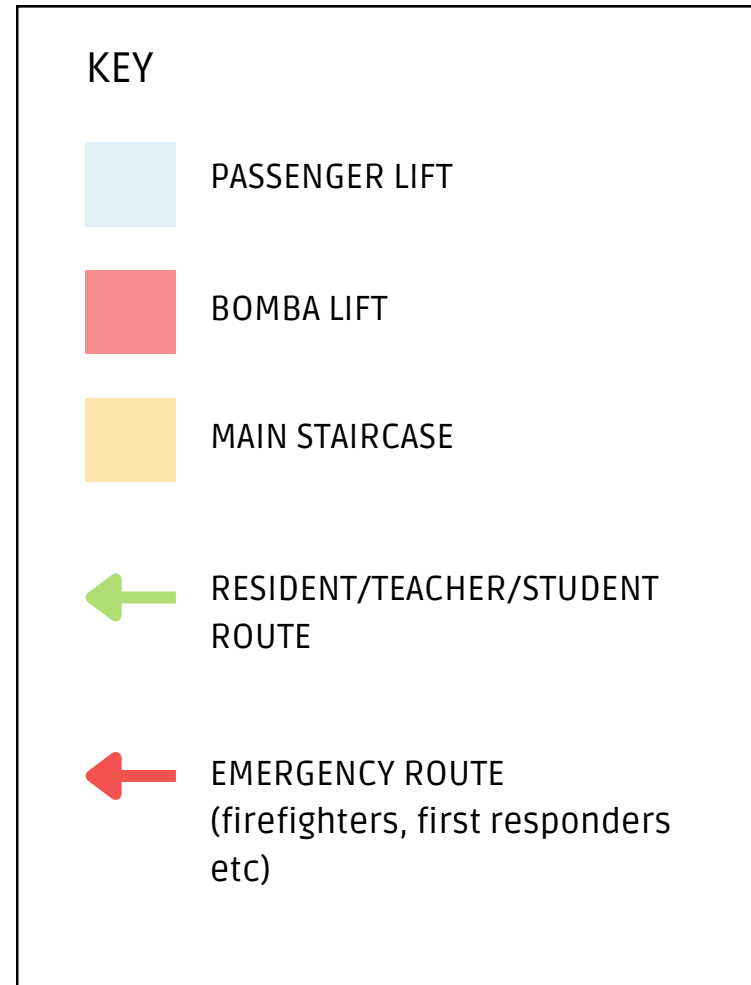
## 7.4.8 Location of Mechanical Transportation Systems



MEZZANINE FLOOR (COMMERCIAL)

# 7.4 Mechanical Transportation System Proposal

## 7.4.9 Location of Mechanical Transportation Systems



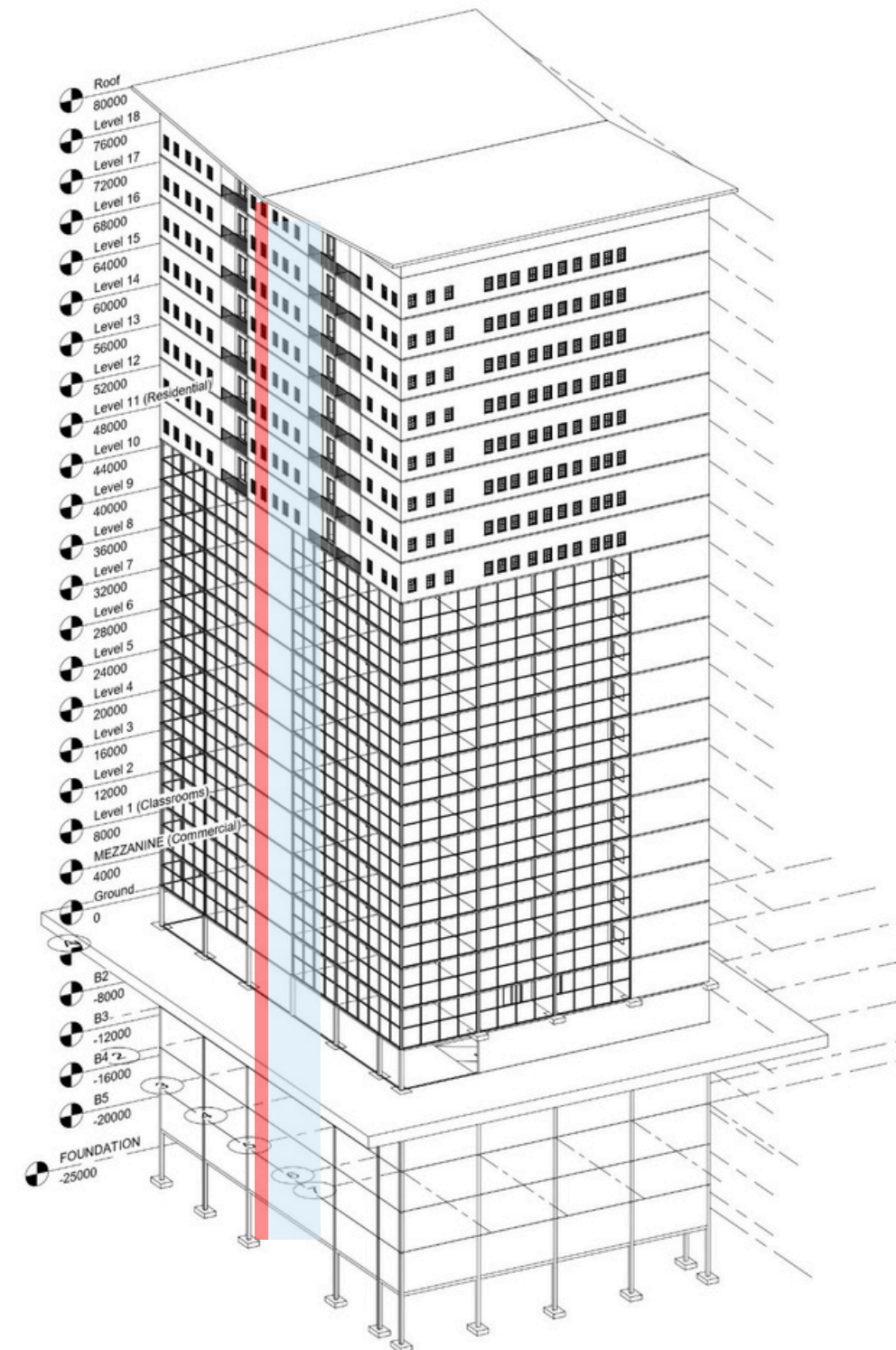
CLASSROOM FLOORS



## 7.5 CONCLUSION

Mechanical ventilation systems are essential to supporting indoor air quality and thermal comfort within a building envelope. It constitutes to be one of the most important elements which regulates the airflow system, extracts contaminants, and manages humidity in dwellings making plenty of sense as a means through which good environments can be achieved. But there are difficulties in using mechanical ventilation. It can be challenging to create a system that optimizes air quality, energy efficiency, and noise. Furthermore, it needs regular servicing to prevent problems like obstruction or reduced functioning which will increase running expenses or discomfort.

However, the proper installation and management of mechanical ventilation systems pay off in many ways despite these challenges. It guarantees the desired quality of air, minimizes chances of airborne diseases, thereby improving the health and well-being of residents. Moreover, technology such as heat recovery in a modern system offers improved energy efficiency and lowers utility costs. Integrating these systems successfully can also be used to enhance the performance and sustainability of a building. Thus, despite the challenges, the rewards of a well-designed and maintained mechanical ventilation system are substantial and contribute to long-term building performance.



# 8.0 REFERENCES

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