RESPONDING TO EMERGENCY

Research article

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GRADUATION STUDIO

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SALAM
Emergency Station

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COMPLEX PROJECTS
Beirut studio
AR3CP100

student
Rik Sijbrandij
5227331

chair
Kees Kaan

CP coordinator
Manuela Triggianese

lab coordinator
Hrvoje Smidihen

group tutors
Eline Blom
Hrvoje Smidihen

research tutors
Dan Baciu
Hrvoje Smidihen

email
infocpstudios@gmail.com

Instagram
https://www.instagram.com/
cp.complexprojects/

website
https://www.tudelft.nl/bk/over-faculteit/
afdelingen/architecture/organisatie/disciplines/
complex-projects/

facebook
https://www.facebook.com/CP_Complex-
Projects-422914291241447

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RESEARCH PLAN

01

04-08-2020 | DISASTER STRIKES

It's August 4 when Lebanon's capital, Beirut, is hit by one of the largest non-nuclear explosions the world has ever seen (Rincon, 2020). Unfortunately, this explosion that damaged and/or demolished more than half of the city (Fakih, 2021) is not the first crisis it has to deal with. Several catastrophes have already plagued Lebanon and its capital during the last century such as (civil) wars, financial, health and other crises and a corrupt government (Center for Disaster Philantrophy, 2021).

However, Beirut is not the first or the last city dealing with these types of problems. There are multiple cities around the world that are dealing with different disasters or are at risk of being struck by them, be it natural (see figure 1) or man-made. This research investigates how architecture can make a positive contribution to cities that regularly have to deal with emergency situations. In order to improve the lives of people living in areas affected by these emergency situations, it is being investigated whether an emergency station can be successfully implemented in the context of crisis-stricken Beirut. This emergency station will consist of an ambulance post, police station and a fire station combined into one overarching building.

BEIRUT'S SECURITY CONCERNS

This paragraph gives an insight in the problems each emergency service (healthcare, law enforcement and fire brigade) encounters in the context of Beirut. Subsequently, these problems will be related to architectural topics that can be addressed, leading to the problem statement of this research.

First of all, the health system in Beirut has been severely damaged by the explosion, limiting the care that can be provided to those in need (Meyers, 2020). Additionally, due to the financial crisis, there is little money in the country to rehabilitate hospitals. Furthermore, the country is struggling with a medicine crisis, which could cause several people to die from minor health complications that could normally be resolved with medicine (Devi, 2020). On top of that, countries worldwide are currently battling the COVID-19 pandemic and Lebanon is no exception (McCaffrey, 2021). These are all reasons why there is a strain on the healthcare system in Beirut, so serious health complications are best prevented or treated early. Nonetheless, response time to emergencies in Beirut is slow due to the lack of departure points for ambulances, congestion in the city and a general lack of staff (El Itani et al., 2019). However, the healthcare sector is not the only emergency service where the pressure is mounting.

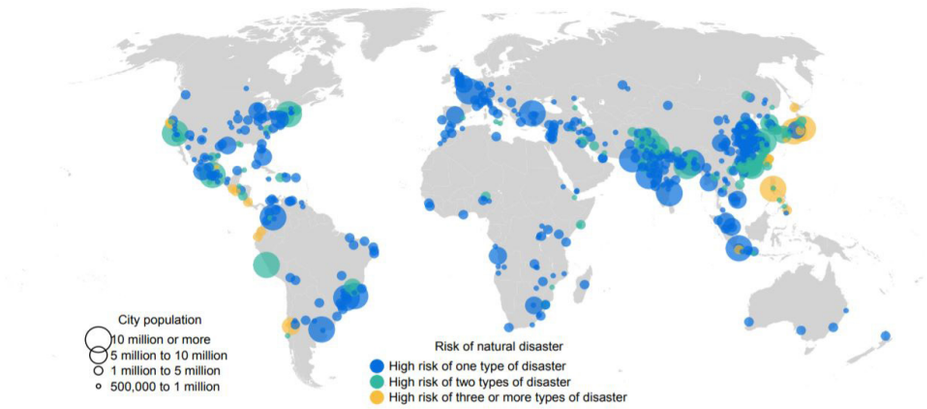


Fig. 1: Cities with a high risk of natural disaster (United Nations, Department of Economic and Social Affairs, 2018)

Secondly, there is an increase in the usage and mistrust of the Lebanese police, the Internal Security Forces (ISF). Since the explosion hit the port of Beirut, crime rates in Beirut have risen significantly (see figure 2). As a result of public unrest due to the financial and fuel crisis, among other things, there have been several incidents. These include explosions and shootings that have killed several people and police officers (Reuters, 2021). Moreover, this public unrest and mistrust in the government has led to many protests that regularly turn violent. These protesters clash with the police due to the lack of confidence they have in the ISF, significantly less than in the army for example (Geha, 2015). This is a consequence of the strong ties that the ISF has with politicians, a majority of citizens would like to see less political interference within the security forces (Geha, 2015). The closed and secured appearance of the police stations in Beirut (see figure 3) don't help the relations with the citizens.

Crime	2019	2020	Percentage Increase/Decrease
Total car thefts	514	1094	+ 112.8%
Total car robberies	44	89	+ 102.2%
Pickpocketing	678	503	– 25.8%
Aggravated robberies	1610	2534	+ 57.3%
Robberies without taking cars	247	610	+ 146.9%
Murders	100	183	+ 38%

Fig. 2: Increase in crime rates (شيباني , 2021)

Thirdly, there are problems within the fire brigade of Beirut, the Civil Defense. As with the ambulance services, the efficiency of the emergency response is limited by the slow response time of the fire brigades' services as well. The congestion that Beirut has also plays a role here, but there are also other causes, namely uncertainty in authority and poor coordination (Anderson, 1969). For example, the Civil Defense should take the leading role in the event of disasters, but their authority is often questioned by other agencies, because of their large base of volunteers (Anderson, 1969). Subsequently, this leads to poor overall coordination in dealing with these emergency situations and slower response times as a consequence.

When these issues are linked to approachable architectural topics, they become design challenges. The problem that arises in healthcare and the fire department, which can be researched architecturally, is the response time, as it is linked to the location and infrastructure (traffic flows & congestion) in the city. In addition, research into the security, approachability and identity of the building is important to the ISF. Due to the conflicts with the population and the terrorist threat in Beirut, the building and the site must be safe, without discouraging citizens from using the police station. Moreover, the coordination challenge facing the Civil Defense can be explored by studying how the services can work together integrally in one overarching building.

Fig. 3: Tayouneh Police Station in Beirut

PROBLEM STATEMENT

In an ideal safe city, everyone has sufficient access to rapid emergency services that work together integrally and efficiently. In Beirut, however, there is a lack of capacity in emergency services and mutual coordination to respond in time to all emergencies due to the various crises that have hit the city. Unfortunately, as a result of these crises, emergency situations are becoming more common. As a consequence, citizens in need do not receive timely and/or insufficient help, making the city significantly less safe. By accommodating the emergency services in one overarching building, an attempt is made to improve the safety situation in Beirut.

RESEARCH QUESTION

How can security concerns in crisis-stricken Beirut be generated architecturally in a building typology that unifies the emergency services and contributes to the safety of the city?

Sub-questions

1. What layers of the urban fabric are important in the choice of the site of the emergency station and how do they play a role in shaping this site and the building?

2. What architectural design strategies can be used to make a building as safe as possible, without reducing its approachability to the public?

2.1 How can architectural design strategies be used to make a building as safe as possible?

2.2 How can architectural design promote the approachability of a building to the public?

3. How can the emergency services in the emergency station be organized in such a way that mutual cooperation is promoted?

THEORETICAL FRAMEWORK

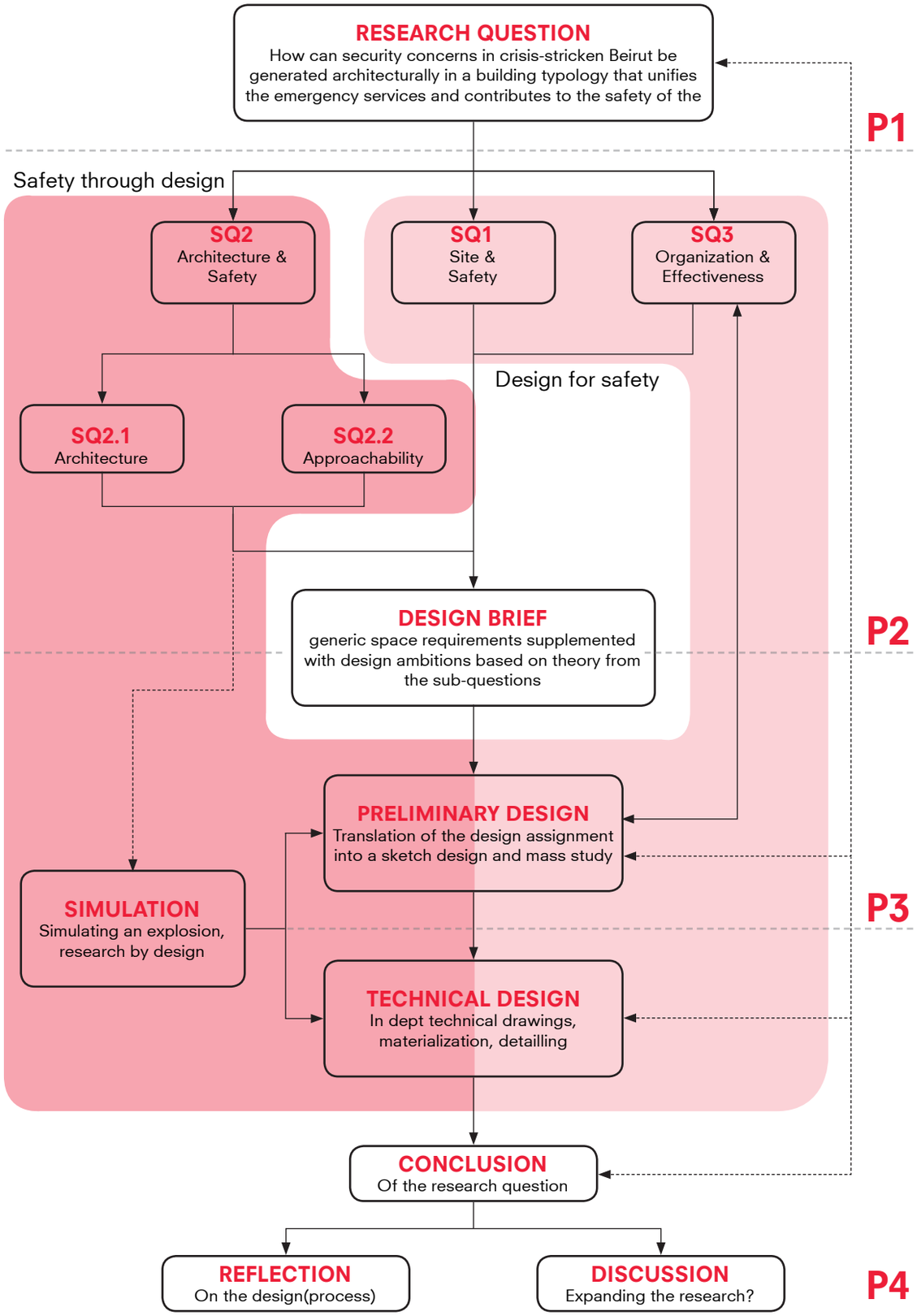
The research can generally be divided into two parts related to safety, namely the *internal* safety of the site and the building that are improved through architectural interventions and the *external* safety improvements of the urban environment, because of architectural and urban planning interventions. In other words, how do architectural interventions contribute to the concrete and tangible safety of the users of a building? And how can a building design (and environment) improve the safety of the people that use the surrounding urban fabric as effective as possible. For the purpose of comprehensibility, the terms 'safety through design' and 'design for safety' are used

In conjunction, the sub-questions posed in the previous chapter can therefore be divided into these two categories, which can be seen in the research diagram (see figure 4).

The broader theories and practices related to security are understood in two distinct parts, namely: Concrete and proven security measures and perceived security. Concrete and proven security measures to improve the safety of the users of a building are explained in detail in the report 'Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks' of the U.S. Department of Homeland Security and Federal Emergency Management Agency (2013). The report cites an explosion as the primary hazard to a building and how it can be accounted for in the design. Due to the civil unrest and the terrorist threat in Beirut, an explosion is seen as the main danger for the building that will be designed in the graduation project as well.

Furthermore, the perceived safety is also looked at, this does not concern physical safety, but the feeling of safety. To this end, the prospect-refuge theory developed by Appleton (1996) and related to architecture by Hildebrand (1999) is used, which looks at the influence of elements such as natural lighting, configuration of volumes, sightlines etc. has a strong influence on the user's perception of a space.

The academic research for this graduation project will be conducted using a range of different methods. For instance, precedent studies (including references), a simulation, and a mapping of user experiences will be utilized. Furthermore, the conducted research will serve to substantiate and help arguing design choices and will also play an important role in drawing up the design brief. However, the research is also tested in the context of the suburbs of Beirut through the design of the emergency station, so it is a constant interaction and reflection between research and design.



METHODOLOGY

As mentioned, the research consists of one overarching theme, safety. This is further subdivided into the two self-defined sub-themes 'safety through design' and 'design for safety'. The research approach of the research sub-questions, including the methods used, is now discussed in chronological order.

First of all, a precedent study will be used to investigate which aspects in the urban fabric are important for an effective and successful emergency station, such as visibility and accessibility. Then, with the acquired knowledge, the urban fabric of Beirut has been analysed by means of a targeted plan analysis and a site visit. Afterwards, a logical and argued project location could be designated for the emergency station (see figure 5). So this part of the research has already been done. Subsequently, the influence of the surrounding urban fabric of the chosen project location on the layout of the plot and the building shape will be examined. By means of a combination of typological and morphological research, appropriate conditions are set for the urban development and the building form, while keeping Beirut's building regulations according to Mohsen et al. (2020) in mind.

Additionally, the research on the scale of the building and the environment is further expanded by means of literature research on architectural vinterventions that can improve the safety of the building. For this, the book 'Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks' by U.S. Department of Homeland Security and Federal Emergency Management Agency (2013) used as a base information. Obviously, this information will be expanded upon through several different sources on architecture and security. Simulations of the impact of explosions on the building will be conducted at a further developed stage of design (MSc4). Furthermore, the building should still feel welcoming to the residents, despite good security. For this, a precedent study is also being conducted into the approachability of buildings, in which the research of Kalayci and Bilir (2016) will be used as a guideline. With the results of both studies in mind, In MSc4 the emergency station will be designed in a way that is both safe and approachable.

Fig. 5: Aerial of the project location (own picture)

Finally, it is examined how the three different emergency services, ambulance, police and fire brigade, in Beirut have developed over the years and how they currently work in order to gain basic knowledge into the current situation. The following studies and reports are cited for this purpose: the study of El-Jardali et al. (2017) into Lebanese medical emergency services, the report of the Internal Security Forces (2021) into the history of the police department and the research of Mohsen et al. (2020) into Civil Defense (fire brigade). Subsequently, after the program has been defined, the users of the building are mapped out. All users are then linked to the various rooms they use during a working day. After this, the spaces are connected by means of a space syntax so that users with the appropriate professions (ambulance personnel, police officers and firefighters) meet each other at the right times. In this way an attempt is made to improve the cohesion between the professions and to increase the interaction. Also, fewer square meters are used in this way because spaces are combined. By means of a narrative sensory mapping, the experiences that the different users have when using the building are used to create a narrative. Furthermore, the garages are placed next to each other so that if several emergency services have to turn out at the same time, they can manoeuvre through traffic together.

CONCLUSION

In conclusion, this research examines how a modern building typology, the emergency station, can work effectively and add to safety in the previously unknown context of Beirut, a relevant context due to the safety problems that the city faces as a result of the various crises it has endured. It provides insights into how a building can contribute to the redevelopment of a city (part) after crises, an exploration of a new building type that can contribute to security. Therefore, the study touches on one of the most fundamental human needs, namely safety, a tangible and relevant topic that is also related to architecture. Conclusions from the research can be used as a design tool for the graduation project, but the design also acts as an important resource and tool for the research.

Furthermore, the findings from the research, although tested and focused on Beirut's context, are more widely applicable. As made clear in the introduction, there are several cities around the world experiencing, or at risk of experiencing, crises for which the research may be relevant. In fact, the research can be relevant for any city where there are safety concerns, both at a building level or in the broader context.

While security issues in Beirut are an extreme example, building security in any city is important. Security can come under pressure in various ways, such as terrorism, crises and war, but also milder phenomena such as demonstrations that have gotten out of hand, other political unrest or crime. These are problems not specific to Beirut, but occurring worldwide, even in relatively safe cities. In addition, by improving the perceived safety of users and people who pass a building, a more pleasant experience can be made.

The knowledge gained in the field of architectural security without losing approachability can be used in buildings that have safety risks, such as government buildings, banks and buildings with a political function, but also commercial and non-commercial public buildings where many people gather. Moreover, the research into improving the functioning between building users, especially ambulance personnel, police officers and firefighters, can be used to further develop the building typology and make it more effective in combating safety issues.

DESIGN BRIEF

02

INTRODUCTION

Before drawing up the design brief, it is important to determine which party is funding the project, which stakeholders are involved and for whom the building is being designed. The advantages that an emergency station may provide are most beneficial to Beirut residents, yet citizens cannot be accountable for the funding. Therefore, because of the civic nature of the project, Beirut Municipality is chosen as the financial backer and regulatory authority. Additionally, the stakeholders in the project are the Lebanese ambulance service, police and fire brigade. As shown in figure 6, each of these four groups has its own range of building users. Finally, the building serves a public purpose, however as can be observed (highlighted in red), the public use is limited to the police department of the building.

With the management organization of the project in mind, the design brief is determined in this chapter. This design brief has been written in such a way that anyone with design experience can refer back to it to design the new emergency station in the context of Beirut.

The design brief is broken down into three main parts, namely: program, site, and architecture, which are covered in this order. As can be seen, these three categories correspond to the sub-questions from the previous chapter. For each category, the global ambitions are discussed first and then the architectural requirements that follow from these ambitions are written down in a bullet list. Furthermore, these ambitions and requirements will be supported and clarified by means of diagrams.

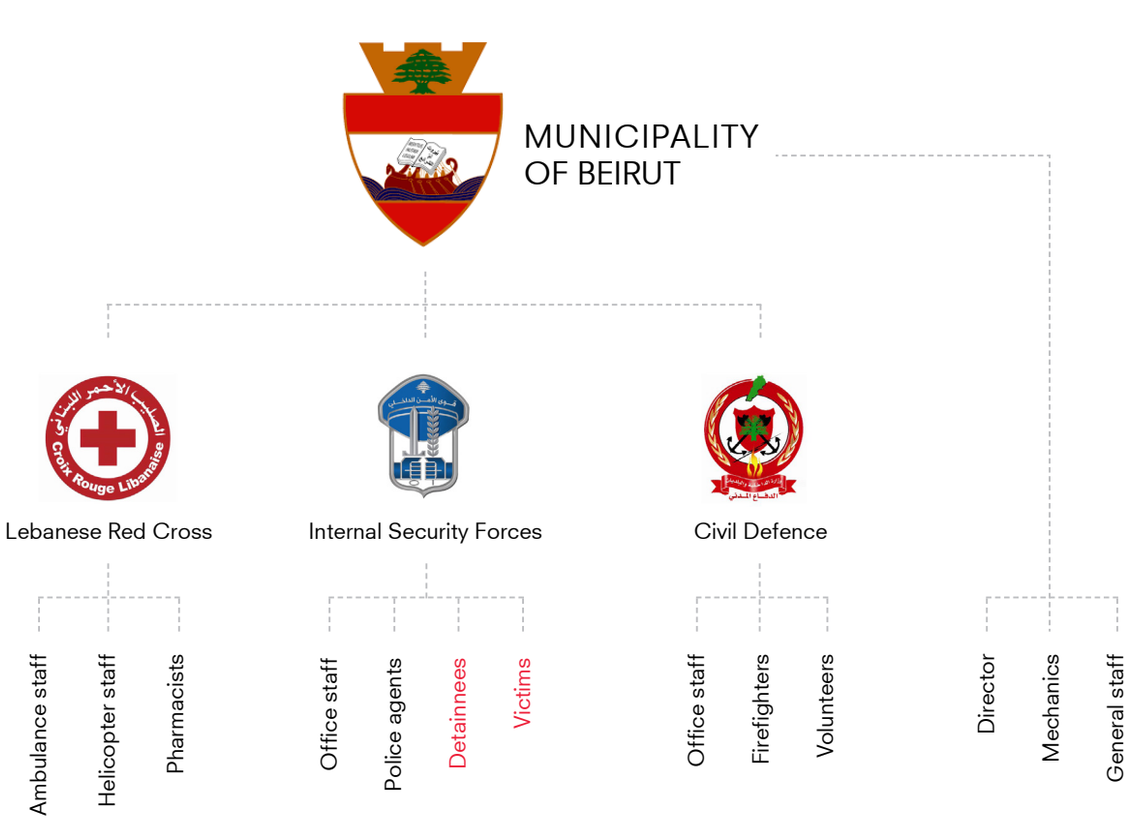


Fig. 6: Client, stakeholders & users of the Salam Emergency Station (own diagram)

PROGRAM

The emergency station aims to improve the security of an unstable city such as Beirut through an efficient unification of emergency services into one overarching building. The ambition is to align the arrival times of the various services in order to be able to provide better and more complete assistance in case of an emergency (see figure 7). Furthermore, by establishing a governing body with coördinating staff, an attempt is made to improve mutual coördination, which is currently inadequate. Finally, by means of shared facilities, employees of the services are encouraged to interact with one another more frequently, resulting in increased cohesion.

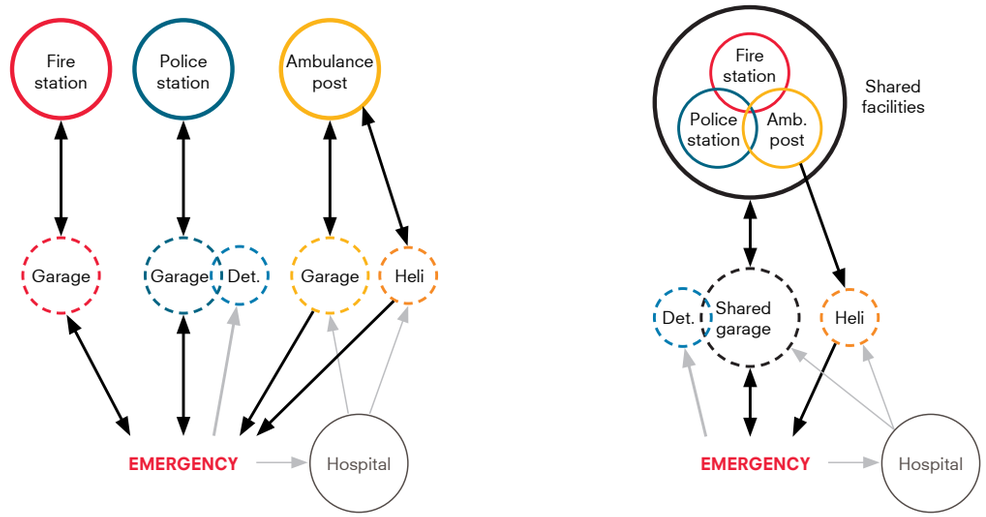


Fig. 7: Current situation emergency services (left) v.s. envisioned situation (right) (own diagram)

General requirements:

- Square meters and program percentages as shown in figure 8.
- All the program elements are linked to a specific security zone (see figure 9).
- The safety zoning in relation to the program and the relationships between the program elements themselves can be seen in figure 10.
- The complete program (excl. parking) should be in one overarching building.
- Shared facilities should be designed as an area for social interacting including an indoor sporting facility and a cafetaria.
- Offices, living/dressing and specialised rooms of services should be seperated from the other departments as shown in figure 11.
- Garage at least segregated in 3 areas: emergency, maintenance & detainnees.
- 3 staff entrances (can be combined) & 1 segregated public entrance.
- Rooms not in need of daylighting: holding cells, interrogation + identification + breath analysis rooms, armory, technical, storage and dressing rooms.
- Rooms without conditioning: garages, armory, storage, technical & workplaces
- Sleeping quarters can't be located at the Saeb Salam street north of the plot (noise).
- All dressing rooms should be next to adjacent garages.
- Ceiling level maintenance garage same height as fire brigade (largest vehicles).

Specifics (see figure 12):

- Helipad TLOF diameter = 6 m. (core)
- Helipad FATO diameter = 14 m. (solid)
- Helipad total diameter = 25 m. (nets/void)
- Ambulance parking space = 2 x 5 m. ≥ 2 m. till next parking space (restocking).
- Min. garage door opening 4 m. (width) x 4,2 m. (heigth)

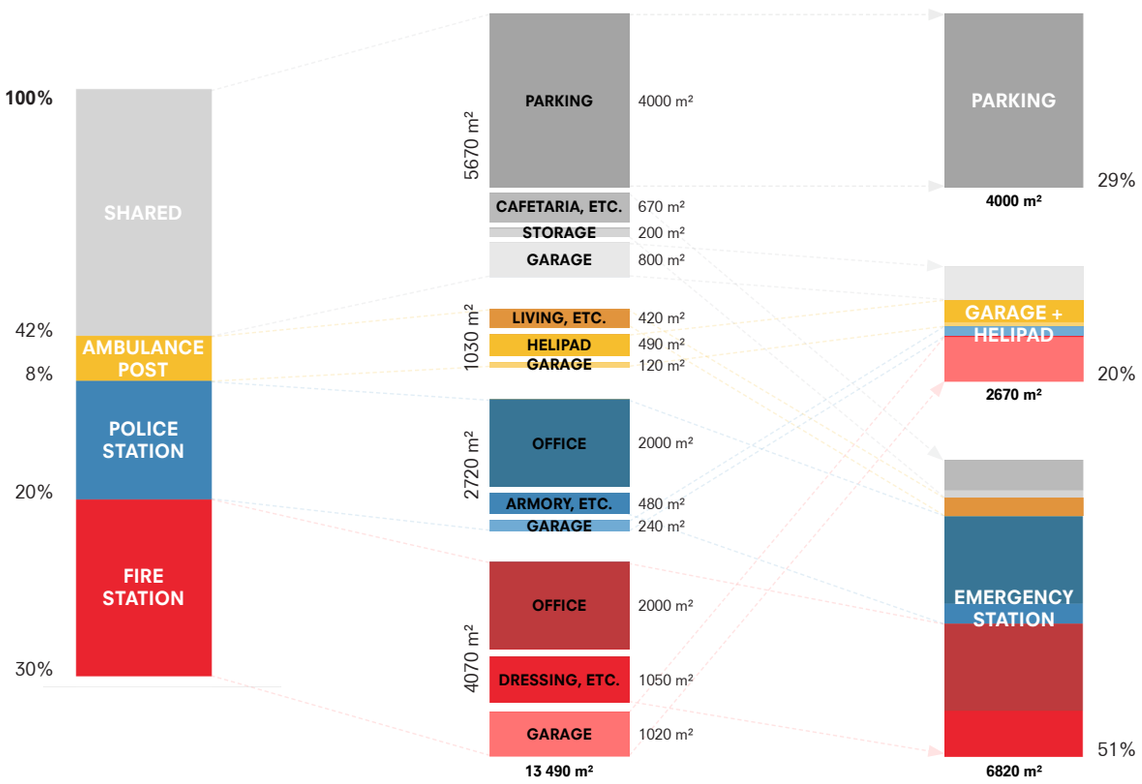


Fig. 8: Program bar of the emergency station (own diagram)

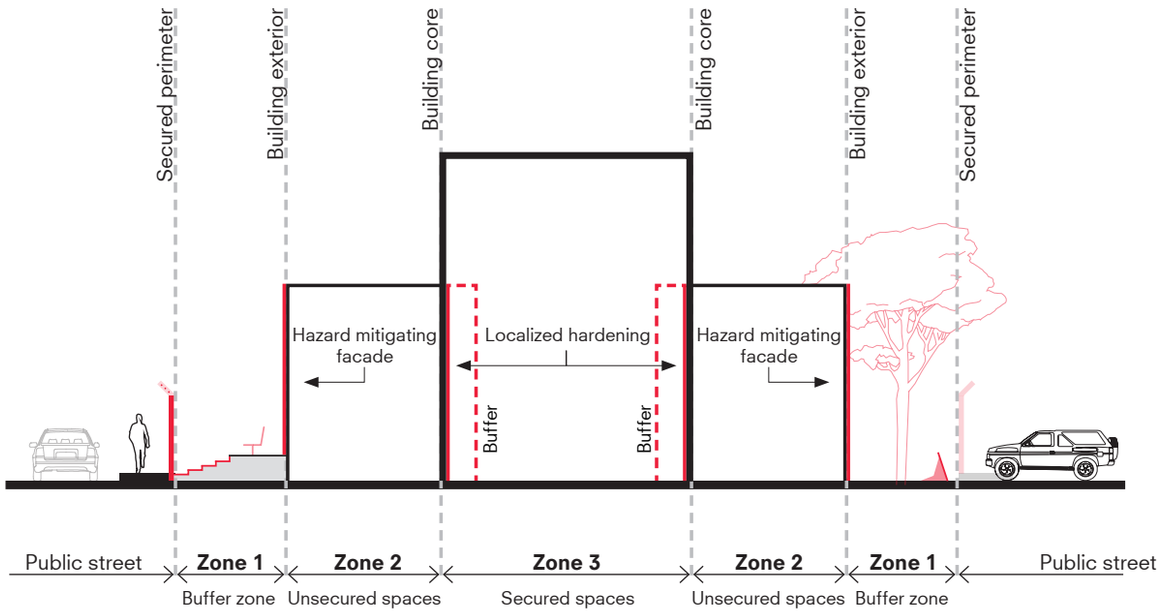


Fig. 9: Different security zones for the emergency station (own diagram, based on FEMA (2013))

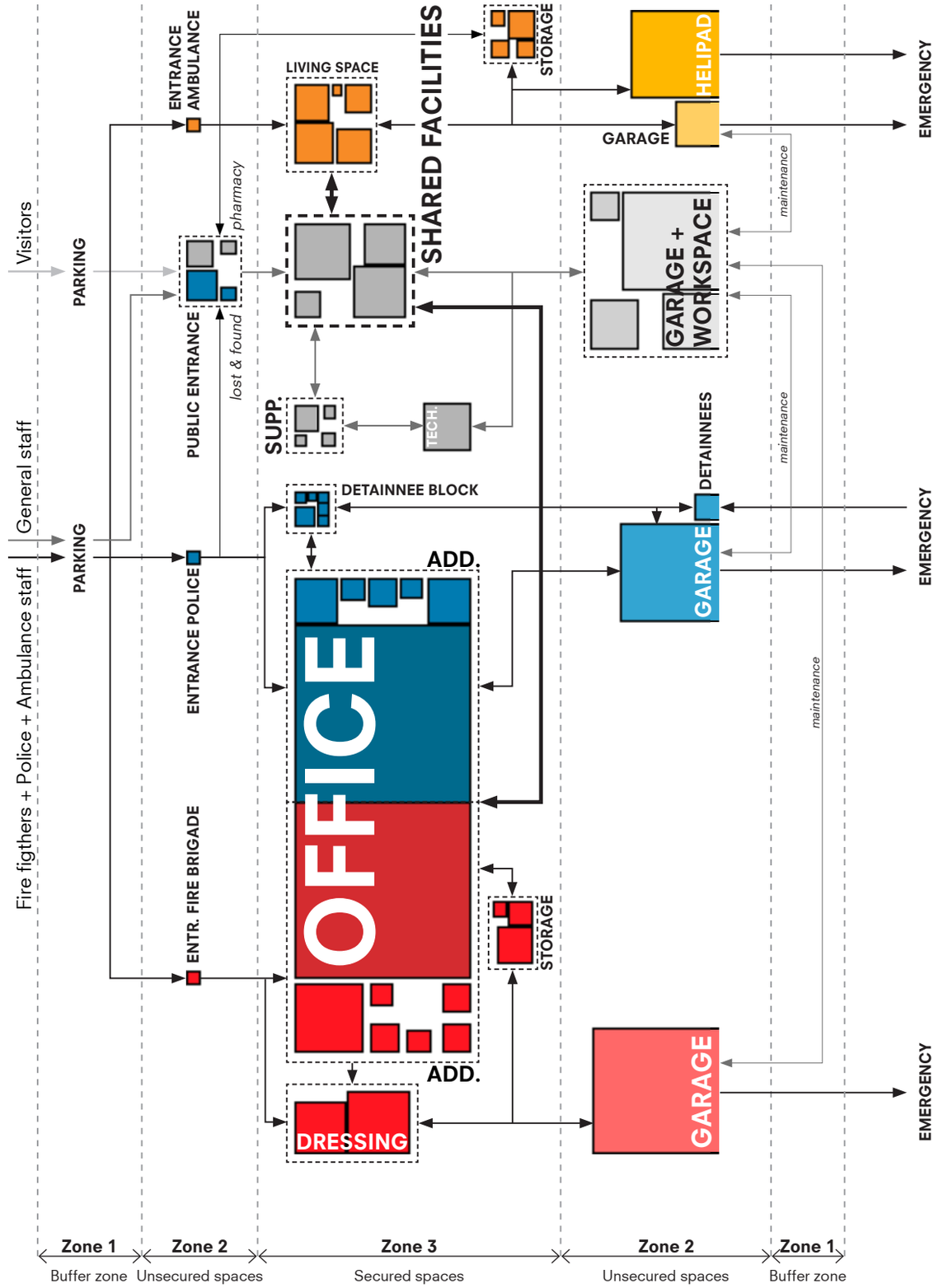


Fig. 10: Relationship diagram the emergency station (own diagram)

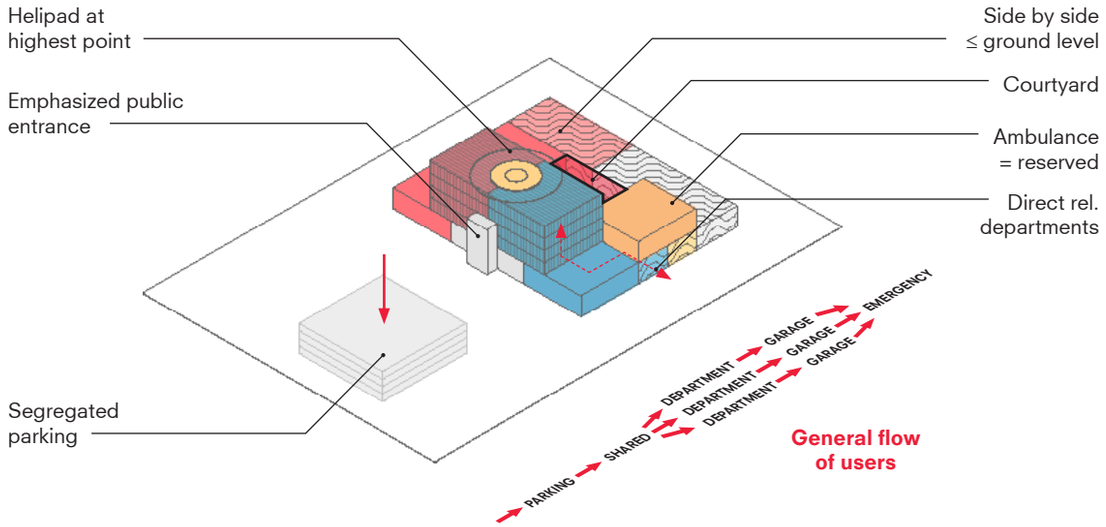
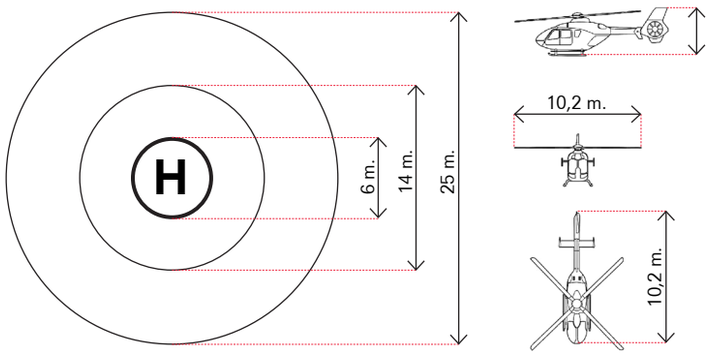
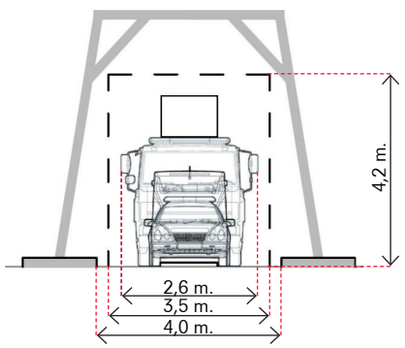


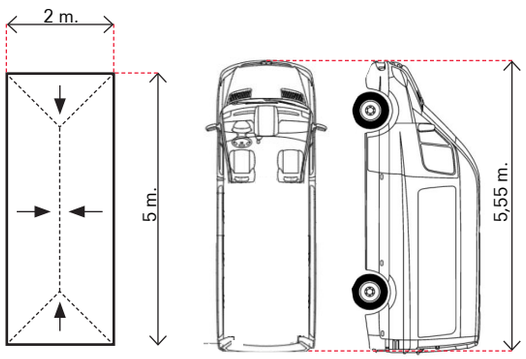
Fig. 11: Program restrictions based on different program massings (own diagram)



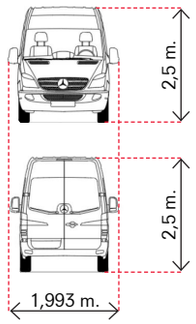
Helipad + Ambulance helicopter

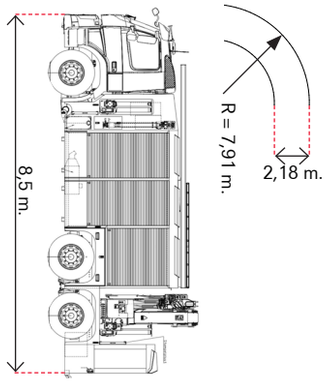


Opening garage doors



Parking & restocking space ambulance





Fire engine with turning circle

Fig. 12: Specific requirements of emergency vehicles (own diagrams)

SITE

On a bigger scale, the emergency station aspires to serve as the city's panic button. In order to reduce response times, it must be positioned at an infrastructural node from which services can quickly reach anywhere in Beirut (see figure 11). Additionally, this will have to be considered into the site's design as well. Besides from serving as the city's panic button, the emergency station aspires to be a safe haven in the urban fabric where conflicts can be resolved. This indicates that the project is situated where the urban fabric abruptly changes in height and density, resulting in a recognisable public void comparable to a forest's open space (see figure 11). Logically, this will have to be factored into the emergency station's design as well, as it will impact the maximum dimensions of the building volume. Because of these aims, the project location is at the infrastructure crossing of the Saeb Salam, El Rachidine and Unesco streets (see figure 12). In addition, a balance must be sought between the ambiguity of security and approachability. So that victims of crime feel safe, but aren't deterred by excessive security measures. This affects the layout and design of the site as well as the emergency stations architecture (see next chapter: architecture). Finally, the entrances to the plot and the emergency station should be easy to find for the general public.

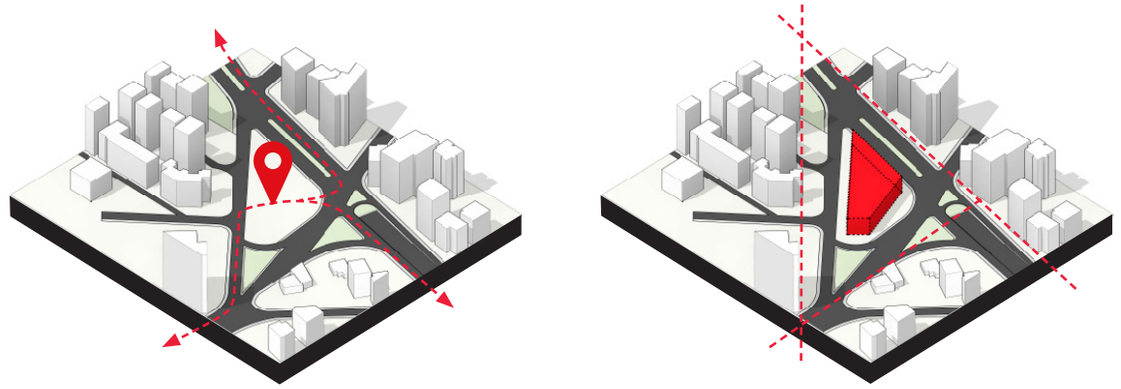


Fig. 11: Site ambitions, fast emergency response (left) and a recognisable public void (right) (own diagram)

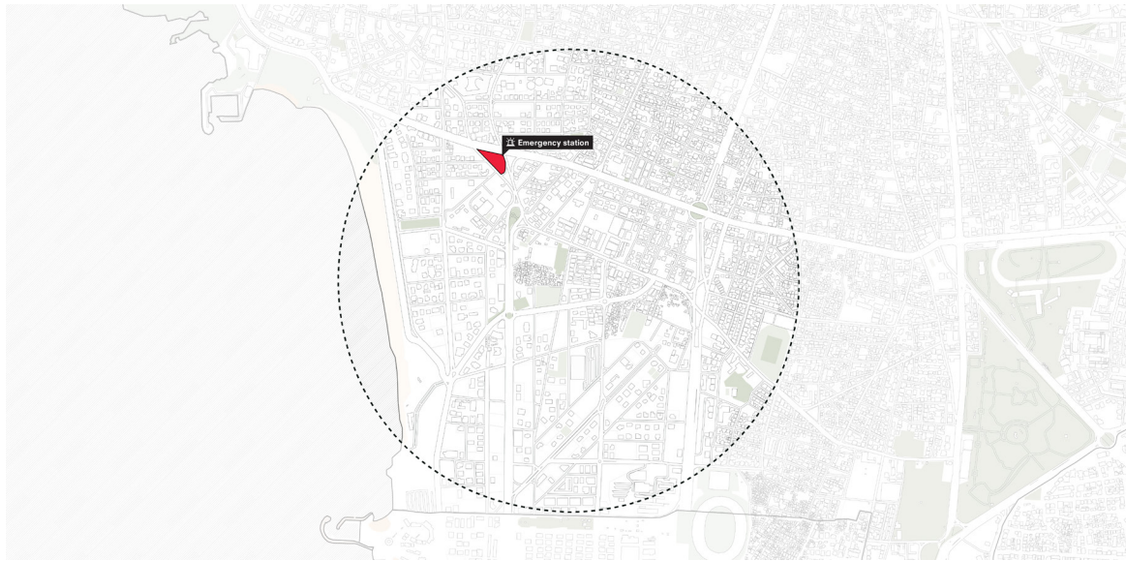
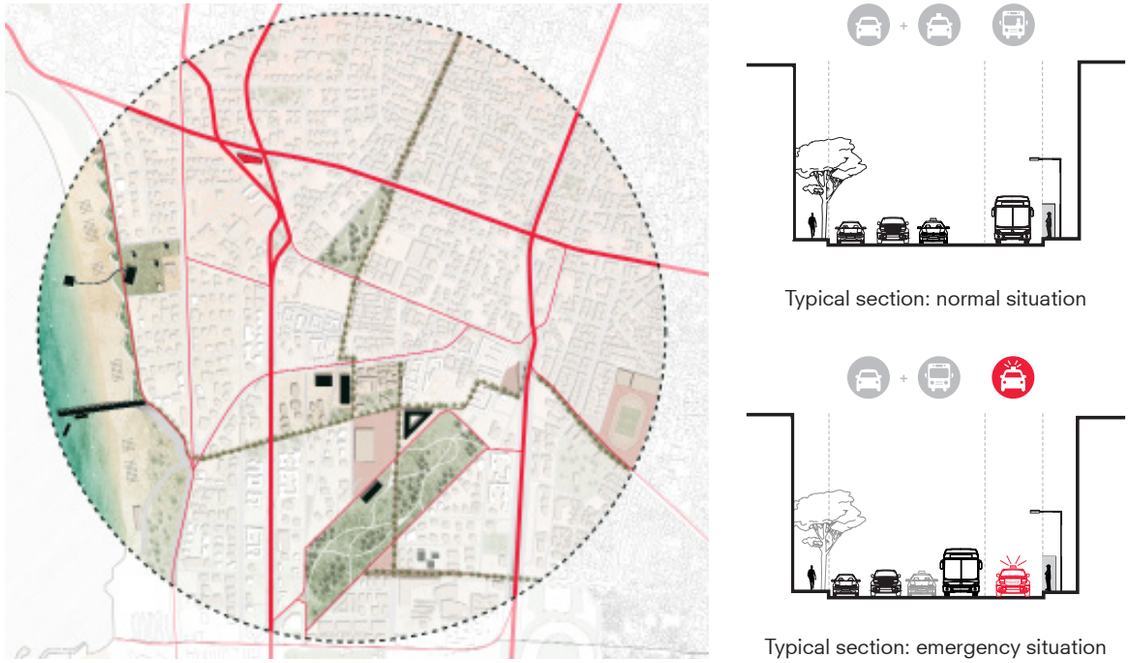


Fig. 12: Project site of the emergency station (own drawing)

The Salam Emergency Station is part of the *Beirut Mosaic* master plan area (see figure 13). In this master plan, 7 main projects are added, of which the emergency station is one. A major aspect of the redevelopment of the area is the addition of several public spaces in the form of parks and a beach promenade. The emergency station plays a vital role in preserving the security of these public spaces (in addition to the role it plays throughout Beirut). In order to guarantee fast response times, bus lanes will be added that can be used by the emergency services in case of an emergency (see figure 13).



Typical section: normal situation

Typical section: emergency situation

Fig. 13: Beirut Mosaic masterplan incl. sections with safety measures (own drawing & diagrams)

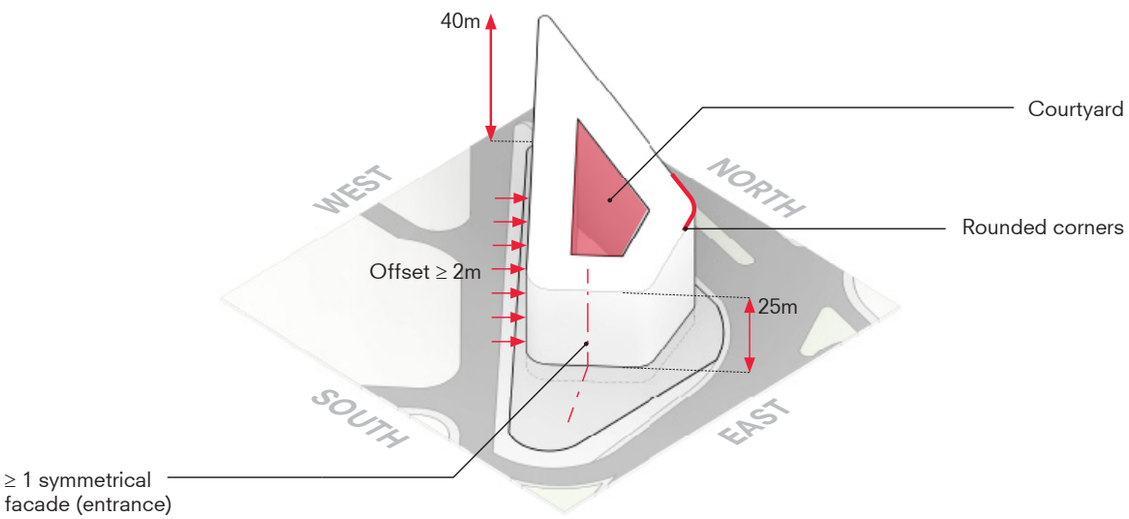


Fig. 14: Urban restrictions based on different urban massing studies (own diagram)

General requirements:

- Building above ground level is only allowed in the buildable area as shown in figure 15.
- Going outside this area below ground level is permitted, for example, to create an underground parking garage.
- Coverage is limited to 50% of the total number of square meters on the plot, meaning 2500 m². (Beirut zoning regulations)
- The FAR of 2.5, according to Beirut zoning regulations, is unattainable and should be disregarded.
- There should be no towers since the building typology should be distinct from the surrounding urban fabric (recognisability).
- Maximum building height is 40 m. (see figure 14).
- Because of the sun's path, the structure must be built to the north of the plot.
- On the property, two streets should be realised (is not added to built-upon area). One for emergency services, the other for ariving/departing staff and visitors.
- These streets may only be connected to the Unesco and El Rachidine streets.
- Create a separate pedestrian entry.
- Planting should be preserved as much as possible.

Security requirements:

- The plot boundary should be designed as a secured perimeter.
- No site entrance/exit at oncoming streets.
- The building has at least a 2 m. offset from the property boundary in order to create a buffer zone (see figure 14).
- Fill this buffer zone with elements that make getting to the building by car difficult.
- The parking facilities should be underground and disconnected from the main building.
- Clear sightlines on and from the site.
- The site should be illuminated.

Approachability requirements:

- Visitor entrance (car) on the southwest plot boundary. Staff entrance (car) at the East plot boundary. Visitors/Staff entrance (pedestrians) on the North plot boundary.
- The sites and building's public entrances should be easily visible and recognisable.
- Visitor & staff parking should be seperated.
- To improve legibility of the site, it should have a clear hierarchy.
- Make the terrain difference at the site wheelchair accessible.
- Integrate security elements architecturally to make the site more approachable.
- The path to the entrance should be well-lit.

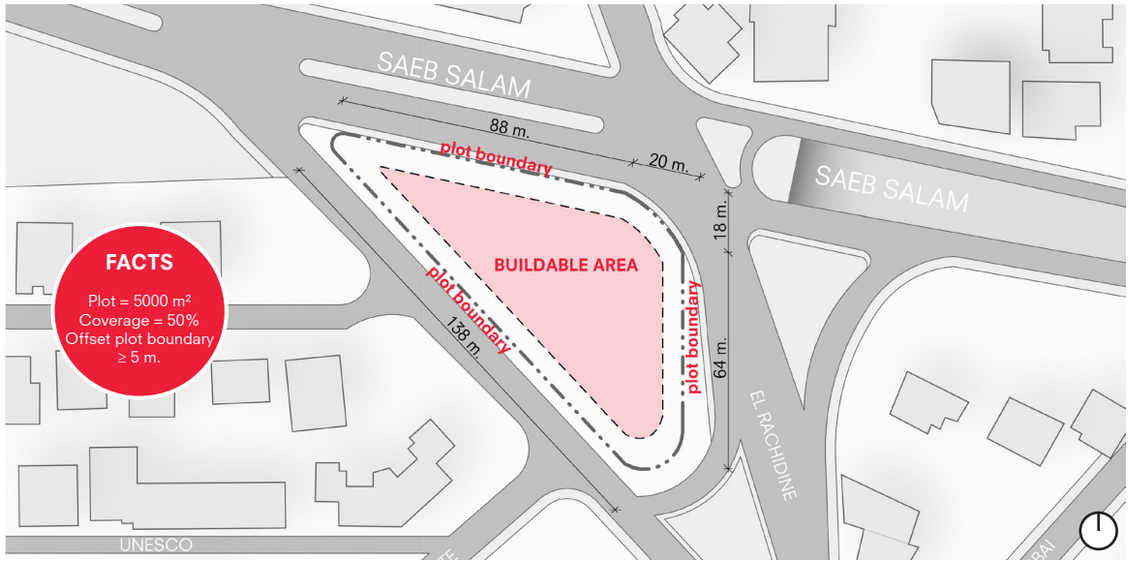


Fig. 15: Site restrictions as a result of urban planning-, safety- & approachability research (own drawing)

AMBITIONS

The ambiguity that arises through the convergence of the topics of safety and approachability really comes into its own in the architecture of the building. Although the building must be made extremely safe, in response to violence against the police in particular and the terrorist threat, it should not deter people from going there to resolve conflicts. Therefore, the architectures goal is to to create a very secure building without compromising on approachability (see figure 16). The emphasis is on *safety through design* within the architectural objectives, which will be expressed through numerous aspects such as building shape, materials, daylight, sightlines, structural integrity and detailing. Additionally, the enhanced security measures should not result in a loss of building functionality or comfort. Furthermore, the architecture must convey to the outside world what functions it serves, as the combination of the three services into one overarching building is new to the Beirut context. Historically, the three separate building elements, ambulance station, police station and fire station, have always been a celebration of function from an architectural point of view. Despite all this, the new international buildingtypology must fit into its more conventional and conservative environment as well as possible in order to relate to the people of Beirut. In short, the ambitions:

A compromise between traditional and modern

The stations different functions are legible from the outside

The building reflects the dynamic nature of the program

The building serves as a safe refuge for the emergency services

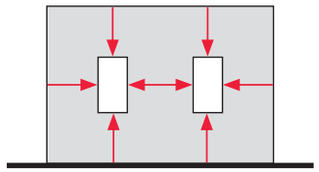
Fig. 16: The project attempts to find a balance between safety & approachability (own collage)

Security requirements:

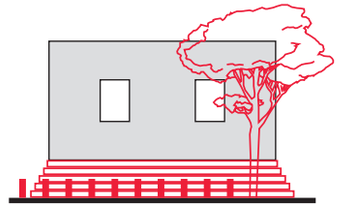
- The building should be based on the safety design principles, as shown in figure 17, that have been concluded through literature research and a precedent study.

Approachability requirements:

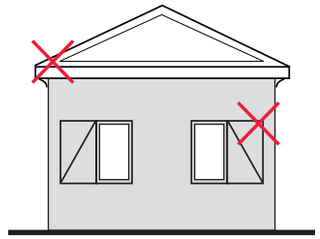
- The building (mainly the entrance facade) should be based on the approachability design principles, as shown in figure 18, that have been concluded through literature research and a precedent study.



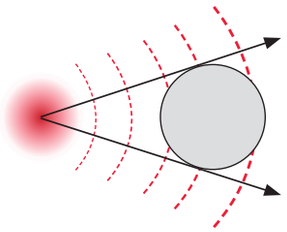
MINIMIZE EXTERIOR WINDOWS



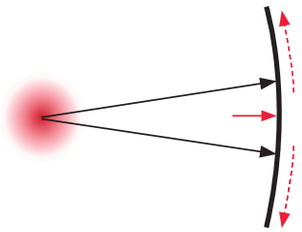
SECURITY LANDSCAPING



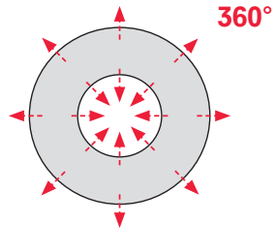
AVOID DECORATIVE DETAILLING



FORM DISSIPATES BLAST

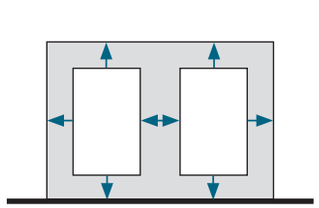


STURDY, ELASTIC FACADE

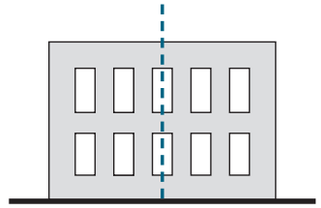


CLEAR SIGHTLINES

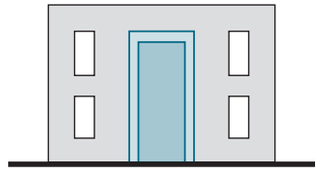
Fig. 17: Architectural principles to improve building safety (own diagrams)



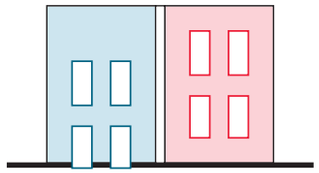
INCREASE TRANSPARENCY



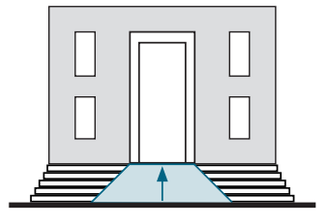
FRONT FACADE SYMMETRY



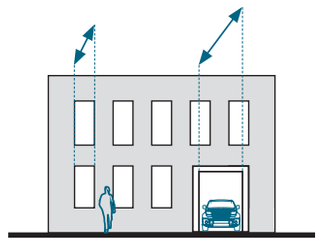
EMPHASIZE PUBLIC ENTRANCE



LEGIBLE DEPARTMENTS



ACCESSIBLE TO ALL



HUMAN SCALE

Fig. 18: Architectural principles to improve building approachability (own diagrams)

EMERGENCY STATION

03

INTRODUCTION

This chapter outlines how the **Salam Emergency Station** was developed from the design brief. This begins with a review of the design brief: what does the project entail, and what is the program? What impact does the site have on the project, and vice versa? Following this examination, the Salam Emergency Station concept and its development are discussed further. After explaining the concept, the design itself is delved further into through various topics such as; layout, circulation (routing/flows), construction, climate design, materialization and detailling. The chapter concludes with a reflection on the design, its relationship to the research, and its global relevance.

SALAM
Emergency Station

Fig. 19: Salam Emergency Station logo (own diagram)

DESIGN BRIEF ANALYSES

The departments of the building each have their own program with varying sizes. Space can be conserved by merging these departments; for example, not all services require their own cafeteria, fitness center, etc. By connecting these places, the various services are encouraged to interact with one another. The total program is organized around a courtyard for daylight and safety. Figure 20 shows how the program relates to the different security barriers discussed in figure 9. Only a small part of the building is publicly accessible (see figure 20, program that sticks out), this part of the building will, for security reasons, fall into zone 2 (see figure 21). Except for their public activities, the departments are located in zone 3, the most guarded zone. When looking at the project's current project location (see figure 22), it is clear that the project will be formed by the site itself, despite the fact that it does not fit into the urban fabric. Thus, the building stands out as a public void between Beirut's towers, from which it adresses emergencies.

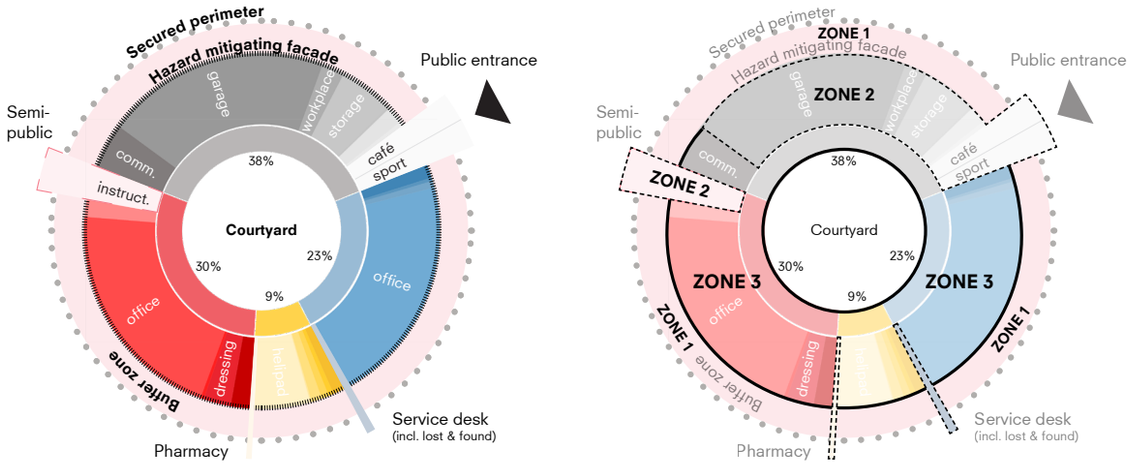


Fig. 20 & 21: Analyses of the program (left) and the security zoning (right) (own diagrams)

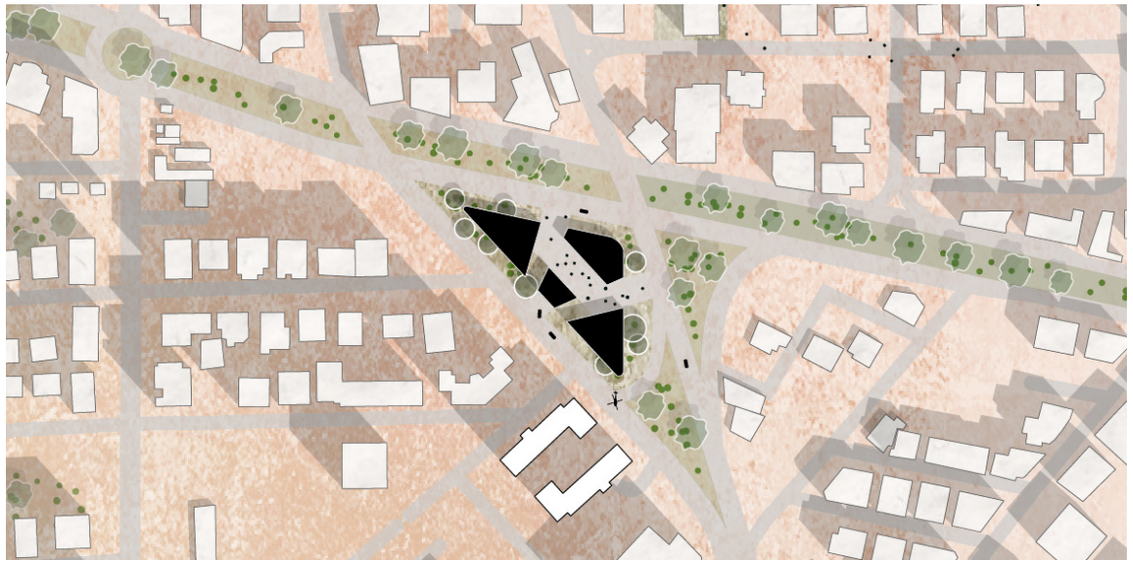


Fig. 22: Salam Emergency Station site in the Beirut Mosaic Masterplan (own drawing)

CONCEPT

Three potential choices were initially investigated in order to arrive at a direction for the Salam Emergency Station concept, as depicted in figures 23, 24, and 25. The research focused on the key themes of safety, approachability, relationship with the public and its surroundings and climate. The studie has shown that the crisis castle, although it offers the most security, is too closed off from its environment and therefore compromises on approachability. The emergency square, unlike the crisis castle, has been designed for public use, however this undermines the complex's safety. It's also worth noting that the departments have no direct connection with one another, and the fact that they're in separate buildings makes conditioning less efficient. Finally, the emergency lookout is a more extreme variant in which it is assumed that emergencies in the future will be addressed by means of drones. This allows the square underneath to be released to the public, but this also causes the necessary security risks. In conclusion, it was determined to optimize the concept by combining the three most significant components (courtyard, permeability, and outlook).

The combination of these aspects, as shown in figure 26, is thus included in the first three steps of the finalized concept (1. courtyard 2. permeability & 3. outlook). As a result, a fragmented courtyard block is created, with the employees having access to it. Permanent office functions are positioned on the higher floors, where they have a clear view of the complex and its surroundings. The people and car flows are separated by the garage underneath the square, preventing them from unnecessary disruptions (4.). Furthermore, each department, including public functions, is given its own place in the station (5.). Finally, for the sake of safety, the different security layers are added to the design (6.), completing the concept. The concept results in a **futuristic fortress**, with its services it watches over Beirut's safety. At the same time, it is itself well protected against dangers and works like a well-oiled machine.

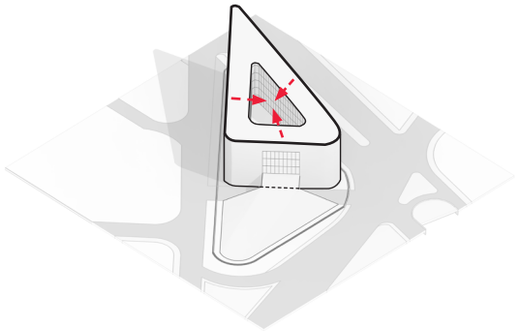


Fig. 23: Crisis castle (own diagram)

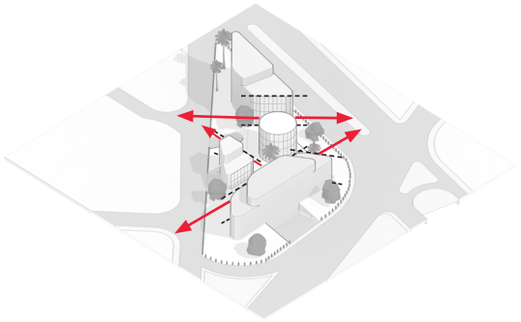


Fig. 24: Emergency square (own diagram)

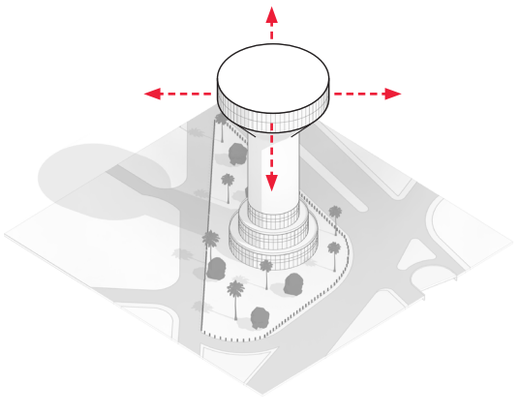
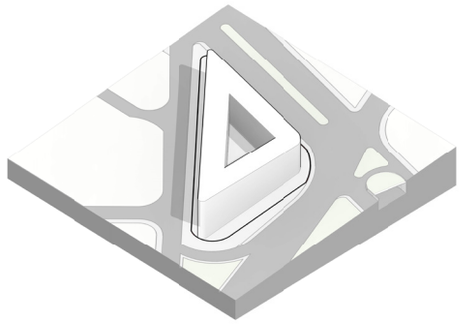
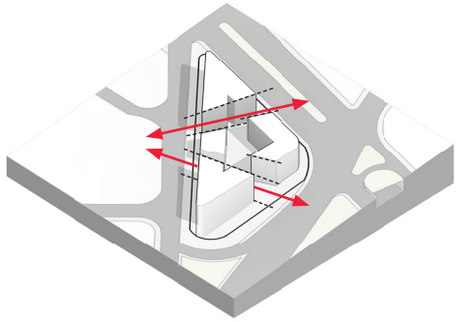


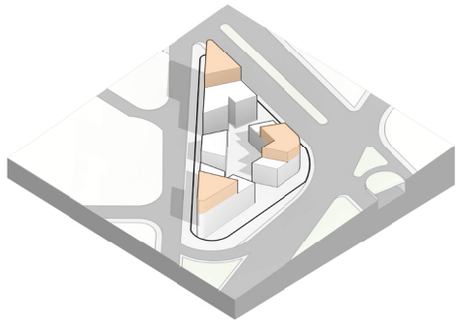
Fig. 25: Accident lookout (own diagram)



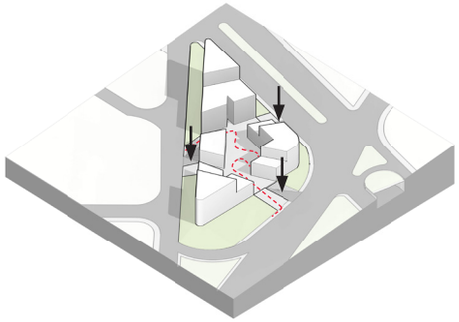
1. courtyard typology



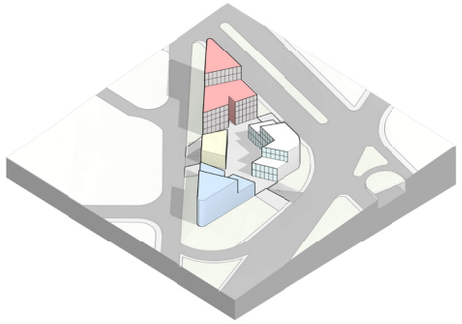
2. open up the block



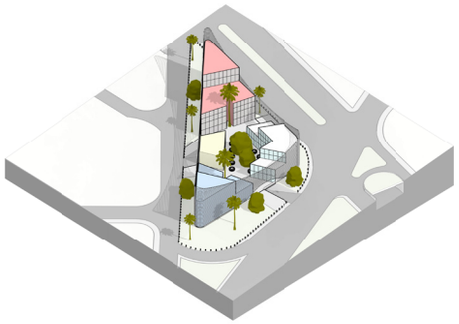
3. 'watchtowers' at corners



4. seperate pedestrians from vehicles



5. identify different departments



6. add security layers

Fig. 26: Concept development (own diagrams)

DESIGN

The overall design of the Salam Emergency Station is explained in this chapter based on several architectural components. The following are the themes covered in this chronological order: layout, circulation (routing/flows), construction, climate design, materialization and detailling. This chapter serves as an addition to the drawing set shown in the sixth chapter of this article.

Layout

The various departments of the emergency station are clearly structured around a central courtyard that is used by the staff. The building has a distinct front and back, with the public and shared functions (security zone 2) located at the front, as shown in figure 27. A larger quantity of transparency emphasizes this public side of the building (see figure 28).

On top of this public entrance is the command center, and it is from here that the emergency phone calls are taken and the coördination of the emergency services is done.

The police station and fire station are on the other two corners, and each feature a big atrium in the centre to let plenty of natural light in. In addition, on top of these corners are the helicopters of the police and ambulance. The police and medical helicopters are also stationed on these corners. The ambulance station is positioned between the police and the fire department. Staff entrances can be found next to it on both sides (see figure 29), forming a logical border between public and private. Furthermore, the departments have their leisure functions adjacent to the courtyard (see figure 30) in order to distinguish between the working environment in the corners and the resting atmosphere in the center of the building.

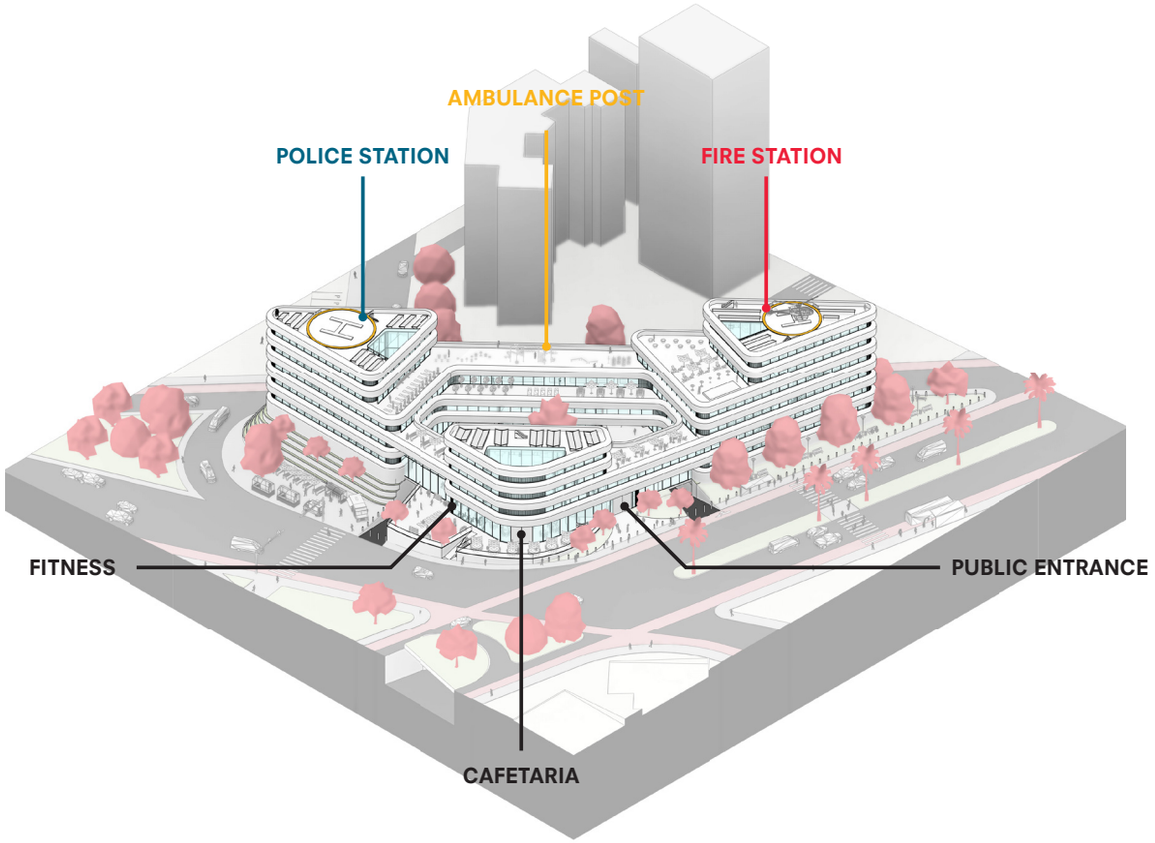


Fig. 27: Salam Emergency Station front axonometry (own drawing)

Fig. 28: Clear public entrance (own picture)

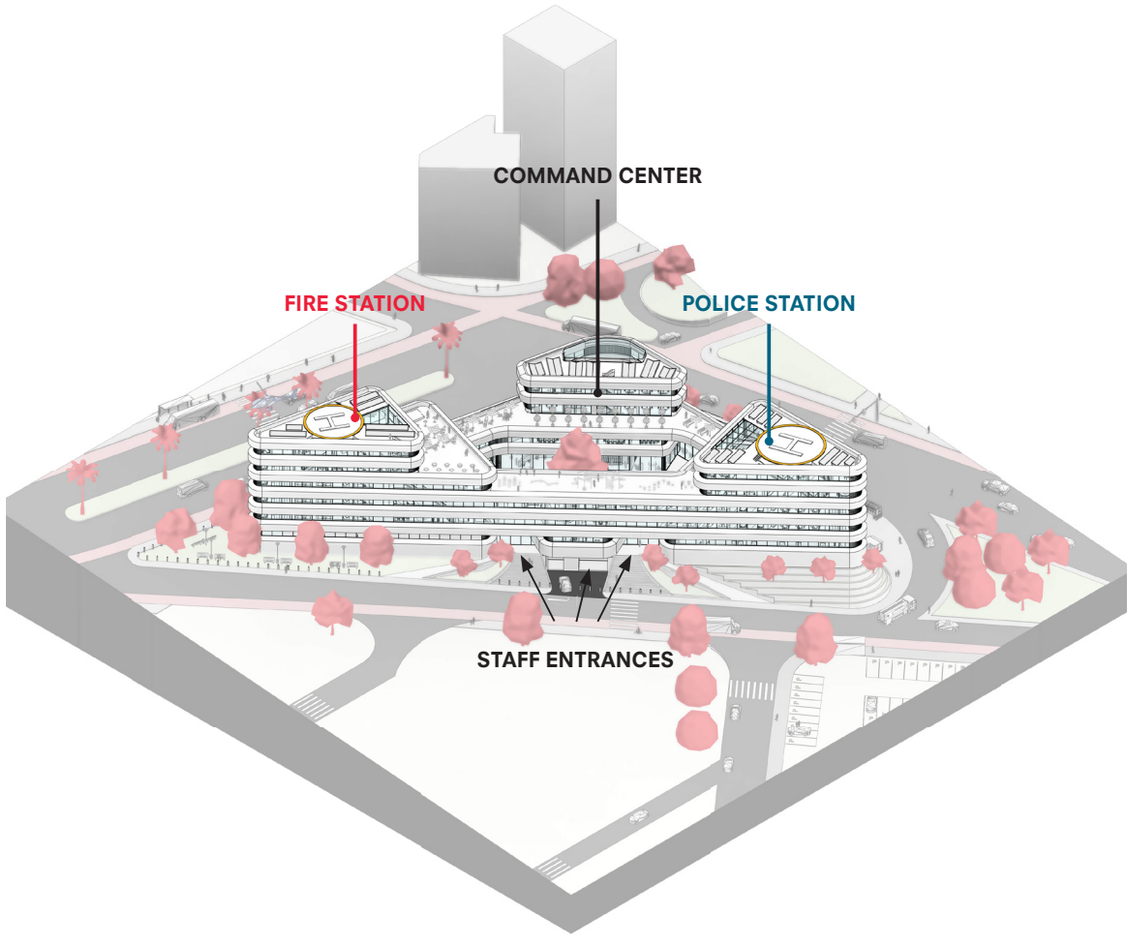


Fig. 29: Salam Emergency Station back axonometry (own drawing)

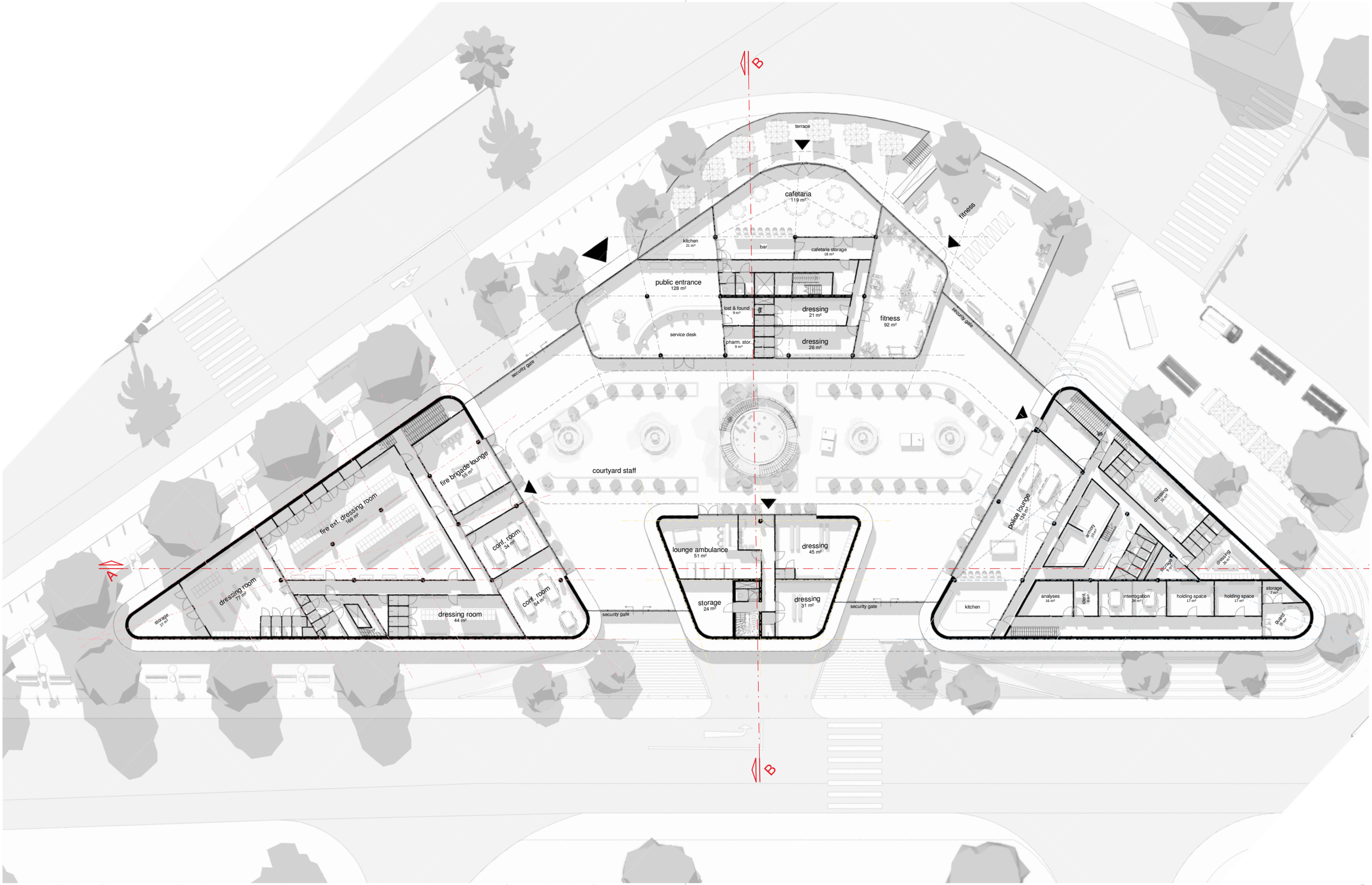
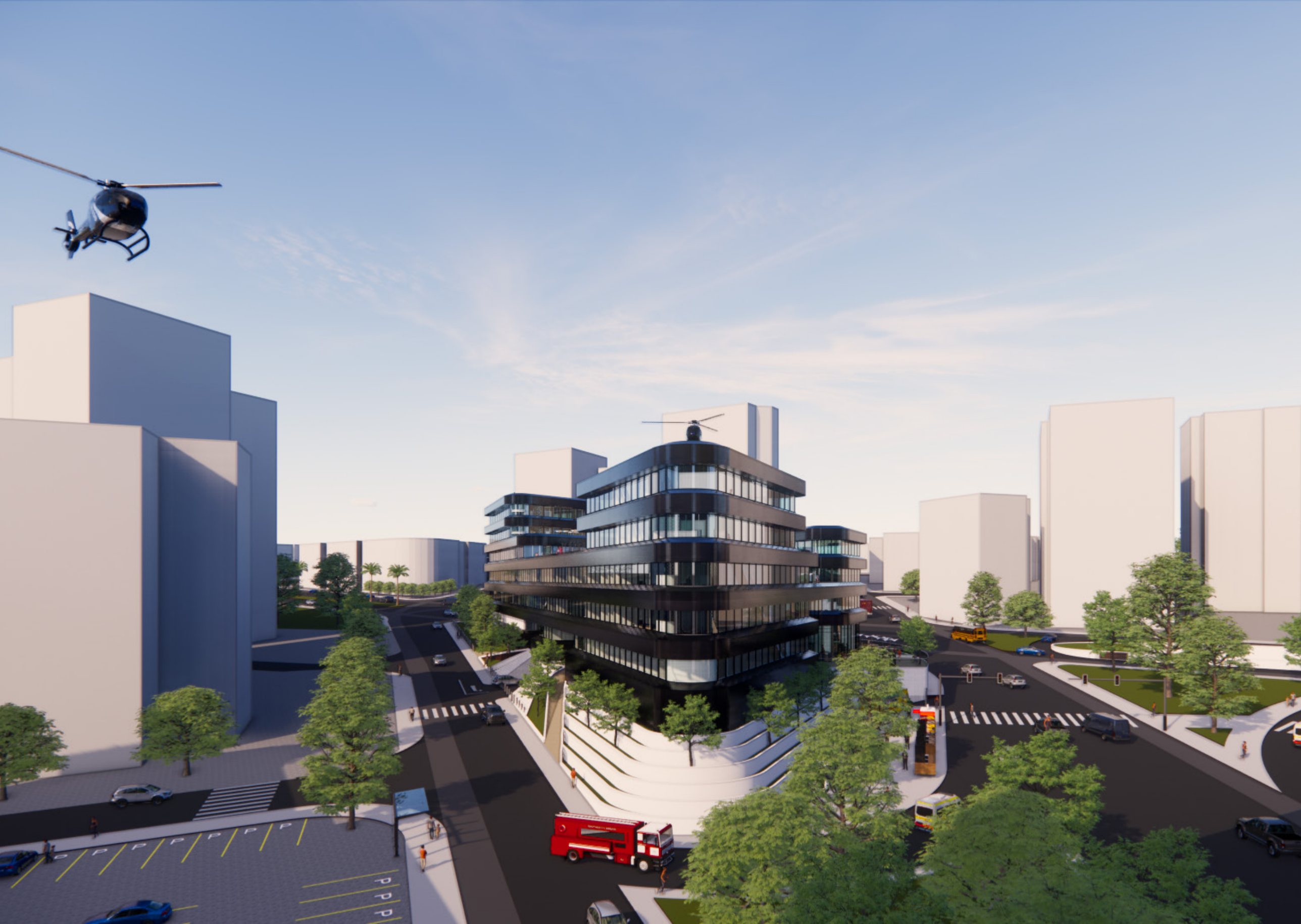


Fig. 30: Salam Emergency Station ground floor, orientated around courtyard (own drawing)



Circulation

The structure is separated into distinct sections. These various elements are linked in different ways. The garage (below ground), department building, and public entrance are the three largest segments of the structure. Furthermore, the departmental section is further divided into three different disciplines. There are always two separate vertical flows from the departments to the garage , ensuring speedy access to the emergency vehicles (see figure 31). As well as atriums to create a visual link between the levels (see next page). In addition, there is a direct link between the ambulance and police and the helicopter platforms as well. Prisoners arrive through the underground garage and from there go to an enclosed block for detention. When they are released again, they go back to the outside world through the public entrance. Finally, the command center has a direct connection to the garage as well, from which mechanics can access the garage's repair zone to perform vehicle maintenance. Figures 32 and 34 depict cross-sections of the emergency station, which indicate how the building is constructed vertically. As previously stated, the garage from which emergency vehicles dispatched to incidents located underneath. The changing rooms for the various departments are on the ground floor to allow for the fastest possible flow. The building's office and living areas are located above this. Furthermore, the ambulance's sleeping accommodations are at the top of the ambulance block, in order to establish as much distance as possible between them and the public places below.

Finally, there is a clear distinction between the level of responsiveness of the staff and the floor on which they are stationed. Figures 33 and 35 show, for instance, that the most responsive employees are on the lower floors, with backup personnel on higher floors. Permanent office staff, who in general stay in the building, are at the top of the emergency station (the ambulance does not have this type of staff). Of course, this split can be traced back to the ambition of maintaining response times as short as possible.

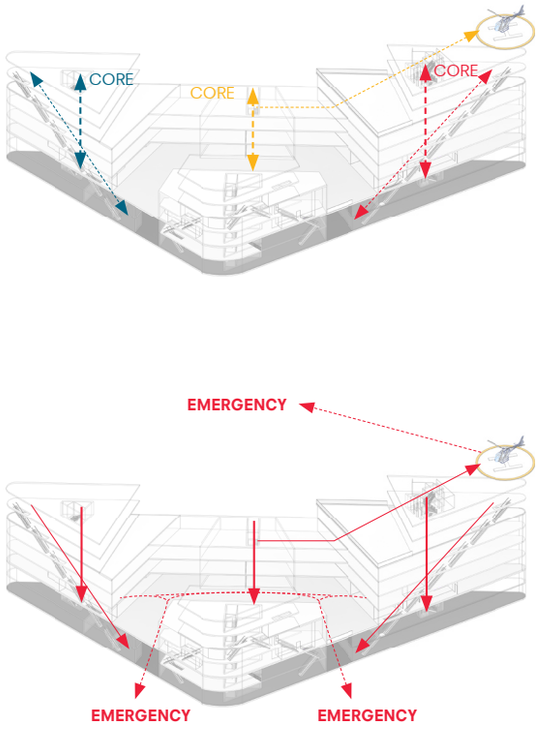


Fig. 31: Diagrams of the flows througout the Salam Emergency Station (own diagrams)

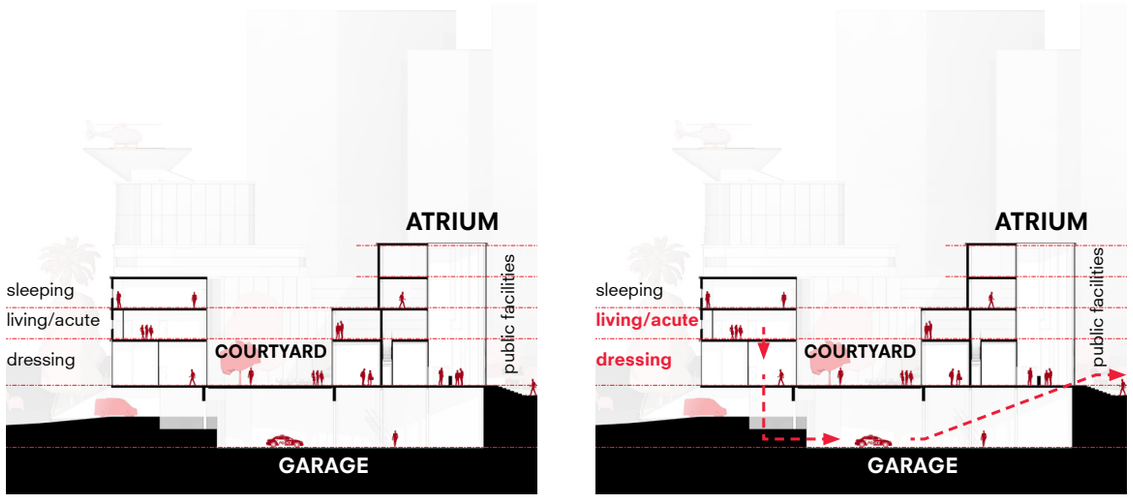


Fig. 32 & 33: Section A-A in normal situation (left) and in emergency situation (right) (own diagrams)

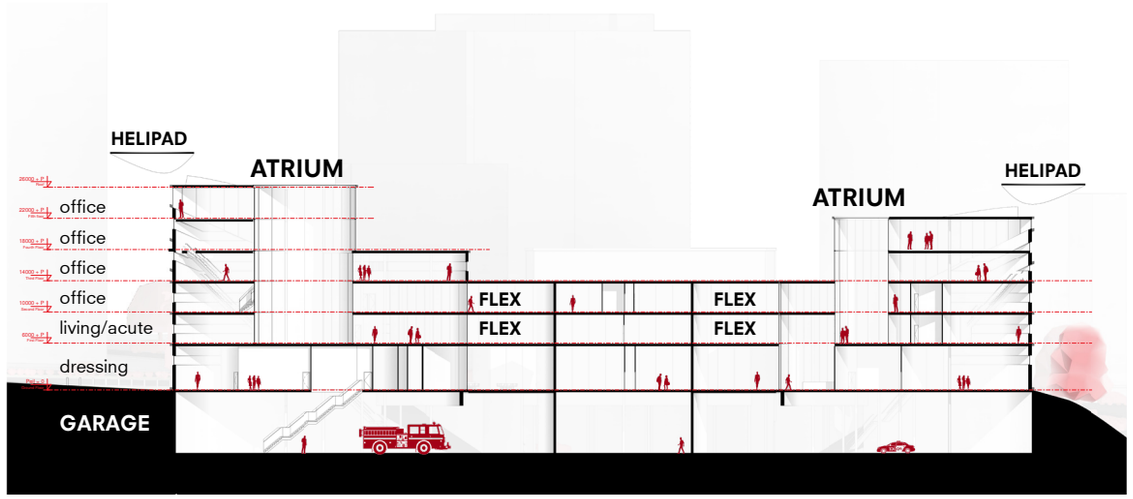


Fig. 34: Section B-B in normal situation (own diagrams)

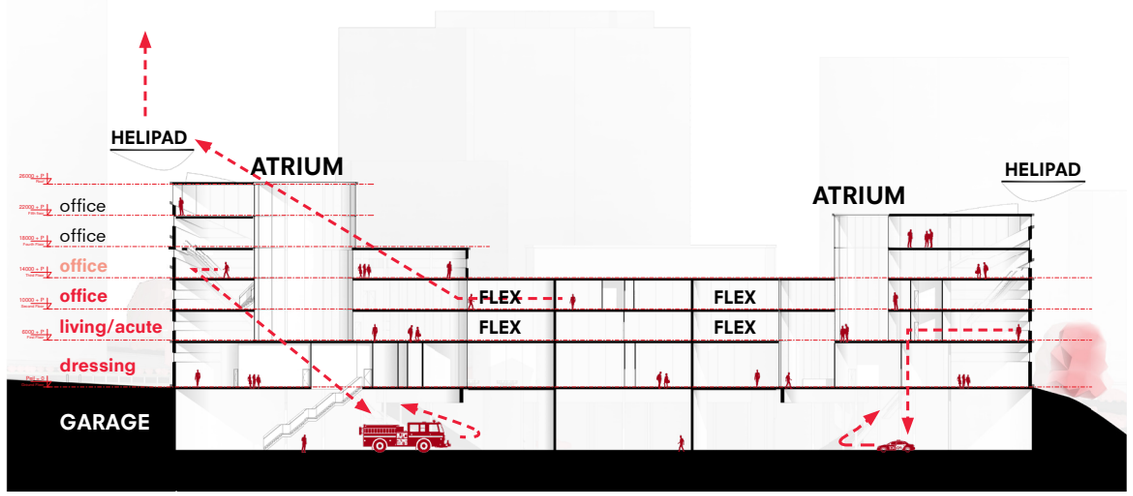
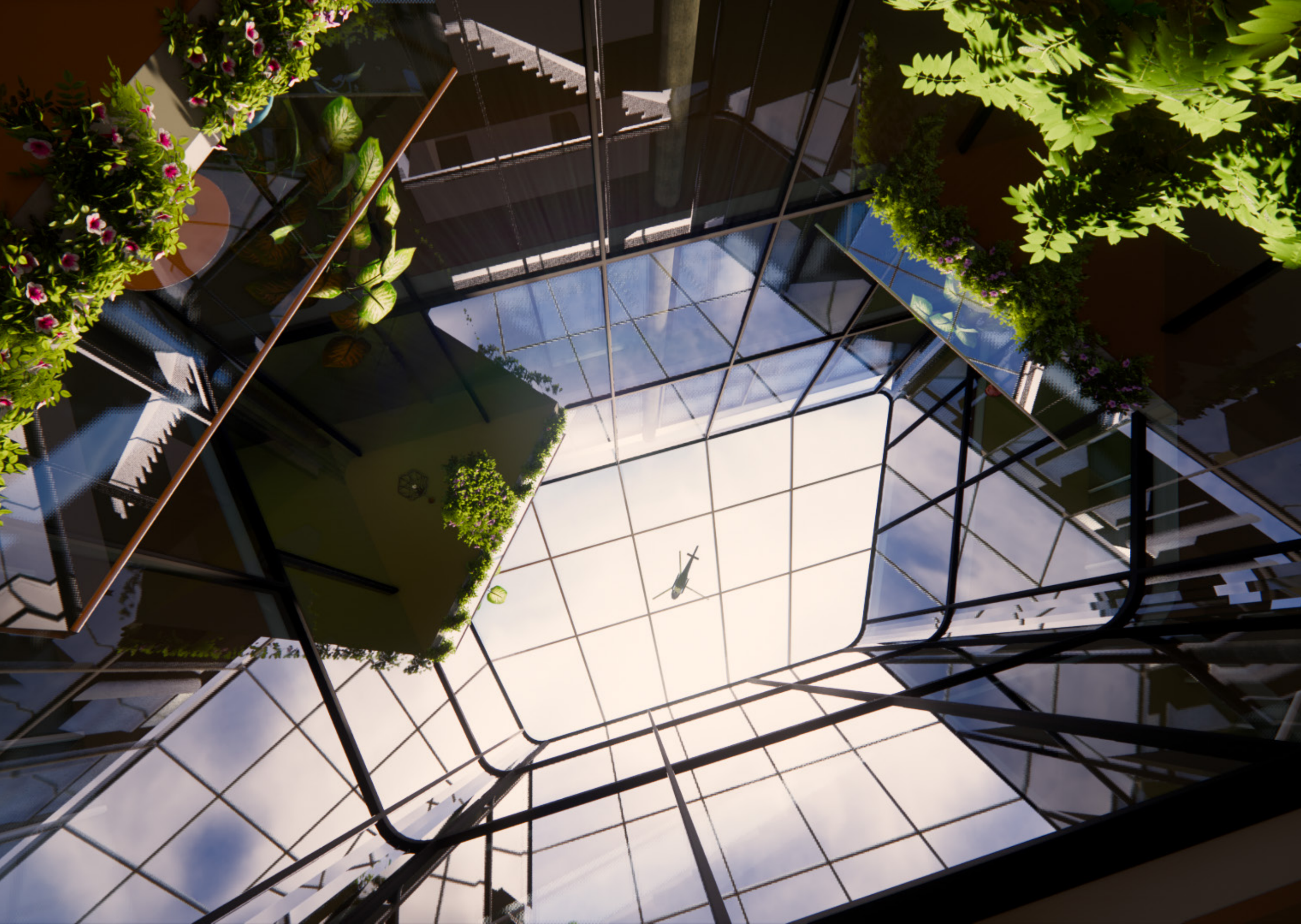


Fig. 35: Section B-B in emergency situation (own diagrams)



Construction

It was chosen to divide the construction into 4 distinct, cooperating segments because the building comprises of multiple disciplines and, as a result, multiple volumes. As shown in figure 36, each of the four grids has a unique coloring. In order to establish a coherent structure, the seperate grids are based on a measurement in the sum of 300a. Due to the building shape, it is necessary to rotate the grids in certain angles, standardization is therefore not possible.

It was determined to employ reinforced in-situ concrete as a construction material in order to be able to construct the building's organic design shape and meet the high safety criteria (bomb proof). For added safety, the construction is overdimensioned, it's thicker then it has to be to just bear the loads. The floors (see figure 37.3) connect the various parts of the building, adding to its overall stability. Since there is no fear of an explosion inside the building, columns are used to create more open facades. However, the column construction is made in a way that, in the event of a column failure, the building still stands. Furthermore, the outer wall is designed as an extra thick load-bearing wall due to its significant explosion risk. The structure will easily withstand wind forces due to the facade's direct connection to the floors and triangle building design (see figure 37.6). As a result, the building's form makes it stable and moment-resistant. Finally, a secondary structure consisting of aluminum tubular profiles (80x80x5) hangs on this concrete load-bearing facade. Shear bolts are used to secure the skeletal construction to the concrete facade so that if it is overburdened during extreme calamities, it will fall apart so the rest of the building will still be standing and be operatable.

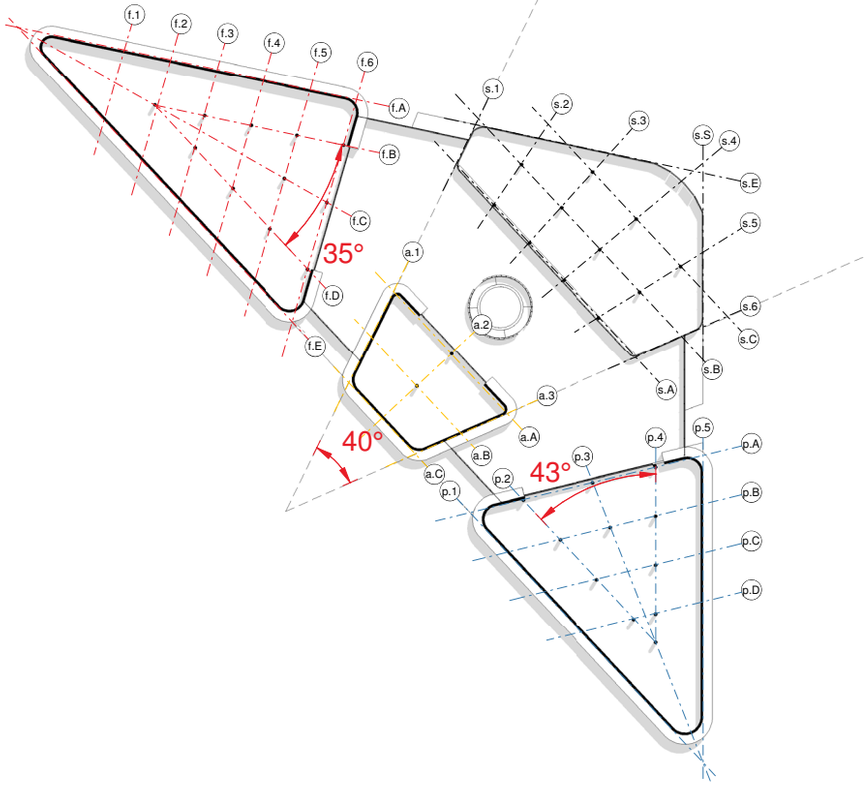
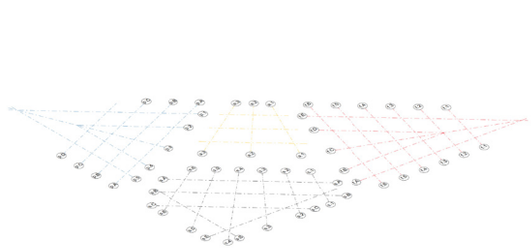
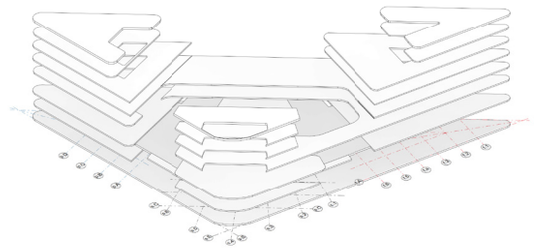


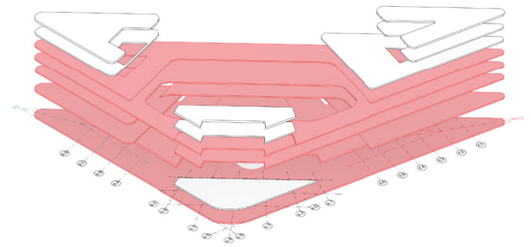
Fig. 36: Construction grid in floor plan (own drawing)



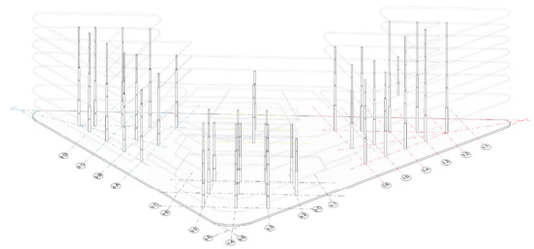
1. 3D construction grid



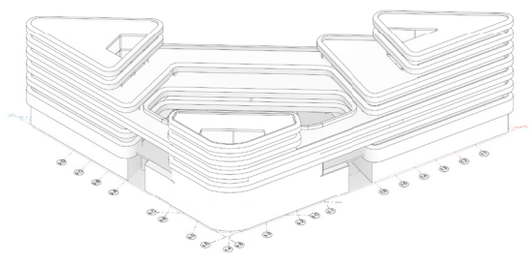
2. In-situ concrete floors



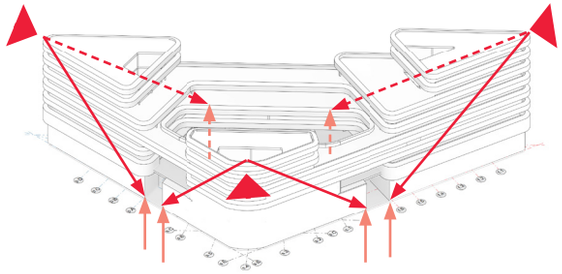
3. Red floors make the building one whole



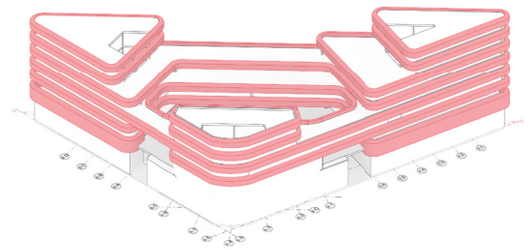
4. Column structure at the inside



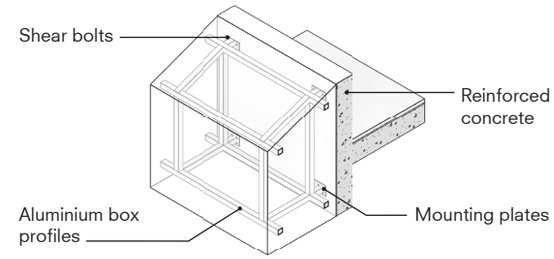
5. Load-bearing strong outer wall



6. Stability through building form



7. Additional facade structure is secondairy



8. Secondairy facade structure

Fig. 37: Construction principles (own diagrams)

Climate design

Although it is unavoidable that the Salam Emergency Station contribute more vehicles to the city, it will adversely increase the amount of CO2 and particulate matter in the environment. Something that is currently a significant issue in Beirut. For this reason, the climate concept's primary goals are to cut down on the building's emissions while simultaneously purifying the air in the neighborhood.

As can be seen in figure 38, the environment is designed as green (naturally) as possible in order to reduce the local temperature and filter particulate matter from the environment. The climate concept and the safety concept are combined here because in addition to the climate aims, this green zone also serves as a safety buffer zone. In order to establish a microclimate and encourage daylight entrance, a courtyard is created in the midst of the structure as well (see figure 39). Large volumes are also being built with atriums to let natural light into their interiors and reduce the need for lighting. As shown in figure 40, there are numerous uses for the facade structure as well. It offers shade, but also space for energy generation by means of PV-panels at the location of the relevant facades (orientation wise). Ventilation also takes place here, where heat recovery units are used to save energy. Outgoing air is filtered by the innovative GapS panels so that hardly any particulate matter and CO2 is added to the air. Finally, low temperature underfloor heating is used to attain the optimum heating and cooling. The emergency station is divided into three sections, each of which has a heat pump to which the underfloor heating system is connected. To utilize as little energy as possible, the heat pumps are each connected to one overarching thermal energy storage.

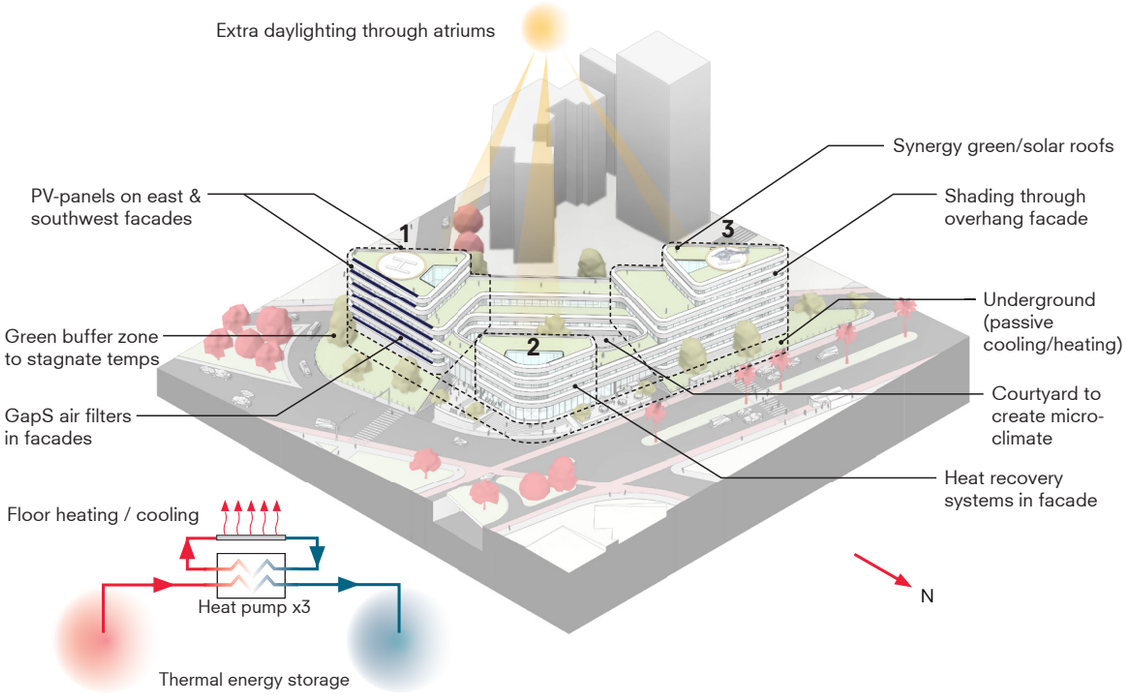


Fig. 38: Climate design (own drawing)

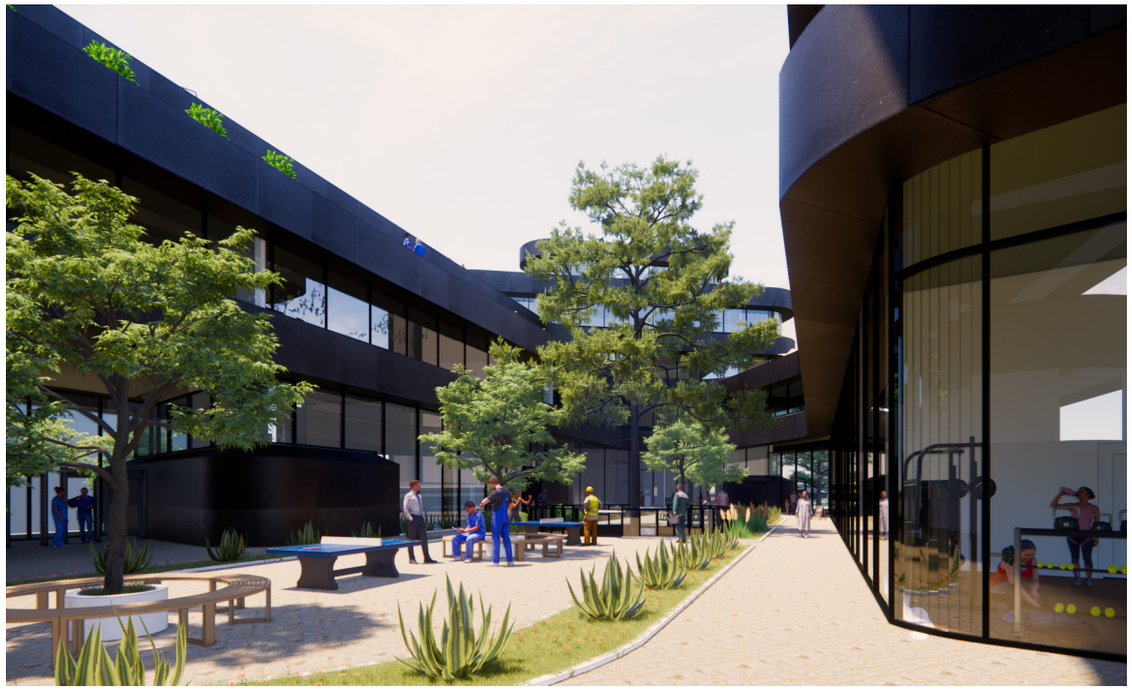


Fig. 39: Courtyard used in climate strategy (own picture), like Lebanese traditional architecture

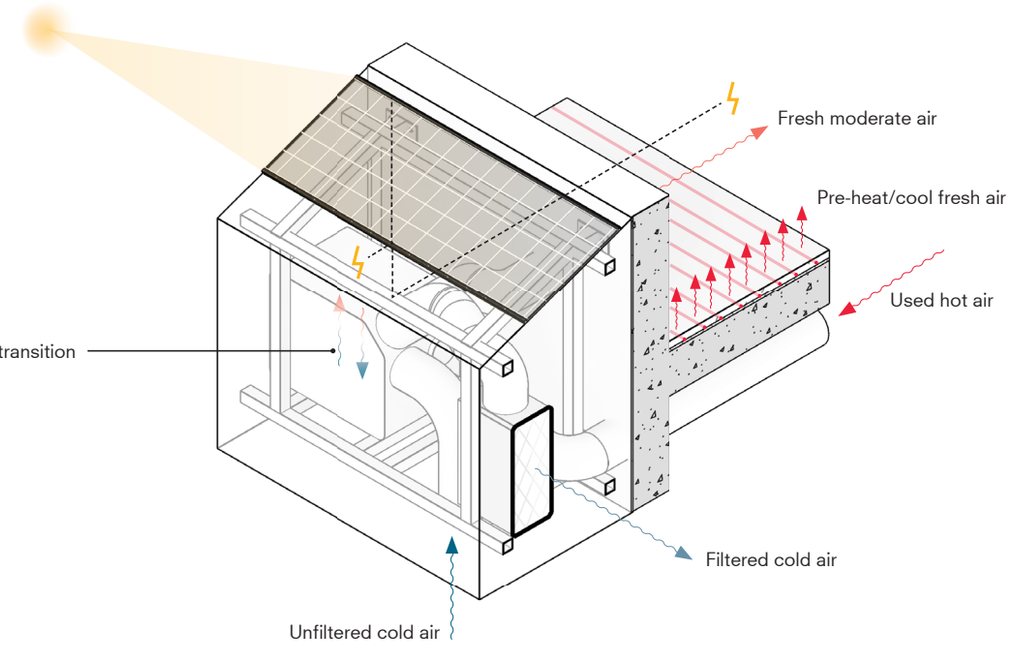


Fig. 40: Ventilation, heating/cooling & energy generation through facade elements (own diagrams)


SALAM
Emergency Station

Materialization

In this chapter, the project's materialization is covered. A distinction is made herein between the interior (see figure 41 and the pages above) and the exterior (see figure 42 and the exterior renders), both are therefore treated separately.

Interior
The ambition of the interior of the building is to find a balance between functionality and the feeling of a tranquil and safe refuge. Because of this, a separation between fast zones (circulation) and office circumstances has been made. For instance, the floors of the offices are built of conventional cedar wooden planks, however the floors of the hallways are manifested differently using non-slip tarp (speed and safety). To emphasize a nice, tranquil ambiance, the offices are additionally furnished with acoustic wooden wall panels and green walls. By not adopting an open floor plan, there is also a distinct hierarchy in the offices. To ensure that the disciplines are transparent, the walls are glazed. In order to bring in light and nature, atriums with gardens at the bottom have been created in the centre of the big volumes. The building has no ceilings so installations can easily be accessed. To aid with navigating, the ducts are painted in the colors of the relevant disciplines (red for firebrigade, etc).

Exterior
Smooth and long triple glazed strips and the secondary construction form a horizontal stratification that distinguishes the building's appearance. Black aluminum window and door frames are part of the glazed lines. A reflective panel will occasionally break up the transparency; in this case, the construction runs behind the facade. The secondary structure is covered in black reflective aluminum panels, highlighting the stations dynamic vehicle-oriented character. The seams are always at mullions and the fact that the panels are black makes the seams (black shadows) hard to spot, creating a feeling of continuity. On the south, east, and west edges of this band, black PV panels are seamlesl integrated. In order to prevent temperature fluctuations and provide users with a comfortable environment, the roofs are covered in greenery. Furthermore on the roof there can be found an arrange of different activities, such as: sport, relaxation, event spaces & energy production.

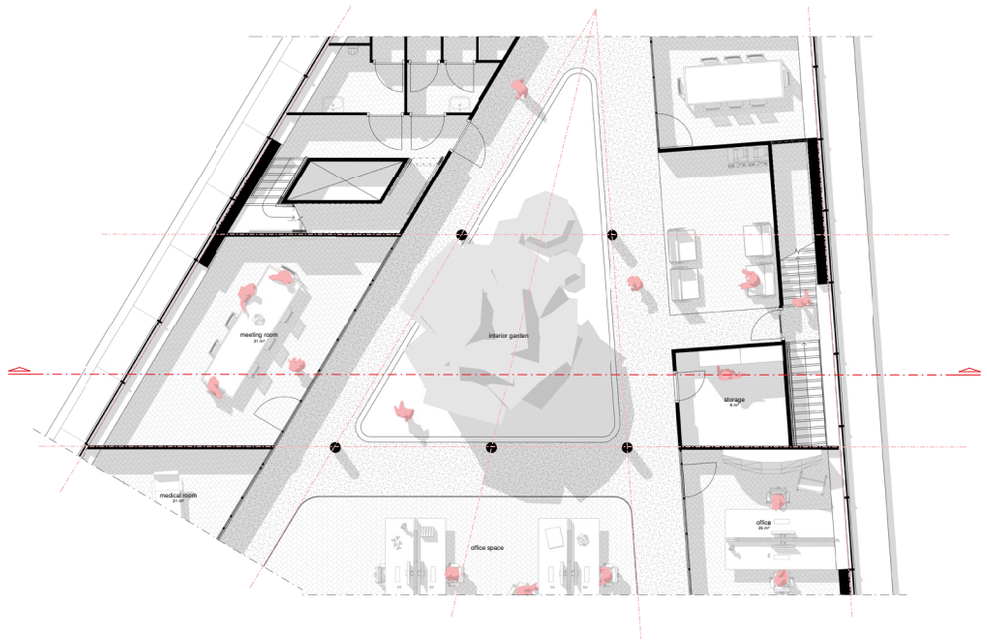
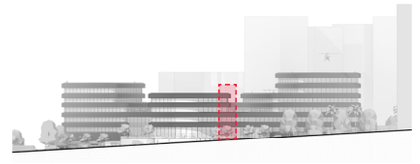


Fig. 41: Interior fragment, atrium fire department (own drawing)



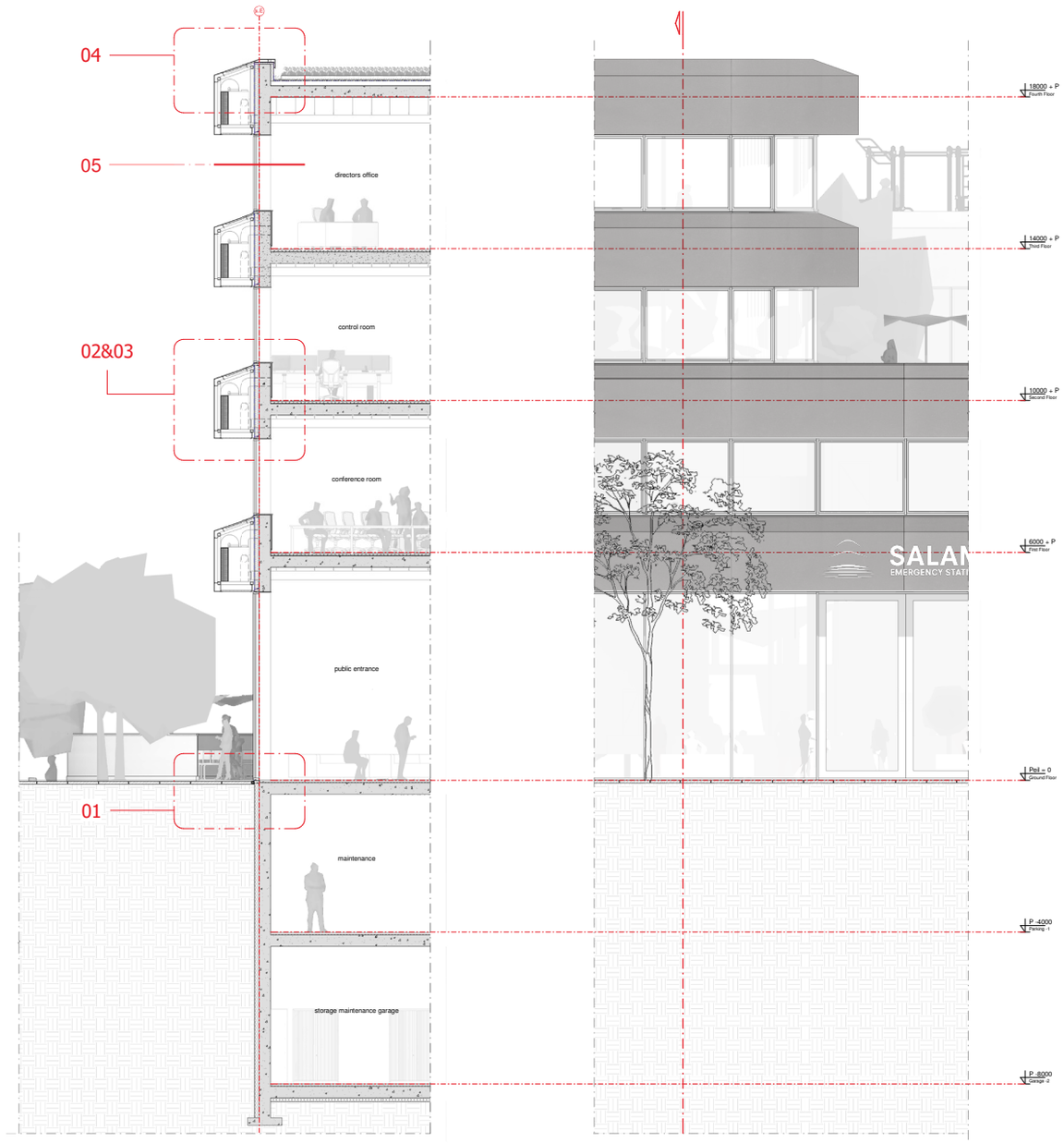


Fig. 42: Exterior fragment, entrance facade (own drawings)


SALAM
POLIZIA

Detailling

How the typical facade element functions in detail is outlined inside the detailing chapter. This is conducted both horizontally (see figure 43) as well as vertically (see figure 44).

As was previously mentioned, the horizontal detail also reveals that the construction occasionally extends behind the glass facade. Where this occurs, the glass is coated with an opaque layer to provide the appearance that the glass facade is still present even though the structure is not visible. The window frames continue here, although they logically cannot be opened. The aluminum window frames are fixed at the bottom and top of the structure, but if it is possible, they are also mounted horizontally (the intermittend mullions consist of strong T-profiles that do not bend due to the wind). Furthermore, the facade openings on the inside are finished with painted plywood and window sills. The acoustic wall panels with built-in sockets in the plinth connect neatly underneath. Lastly, the concrete floor will be finished with a sand cement decking equipped with floor heating and carpeting on top.

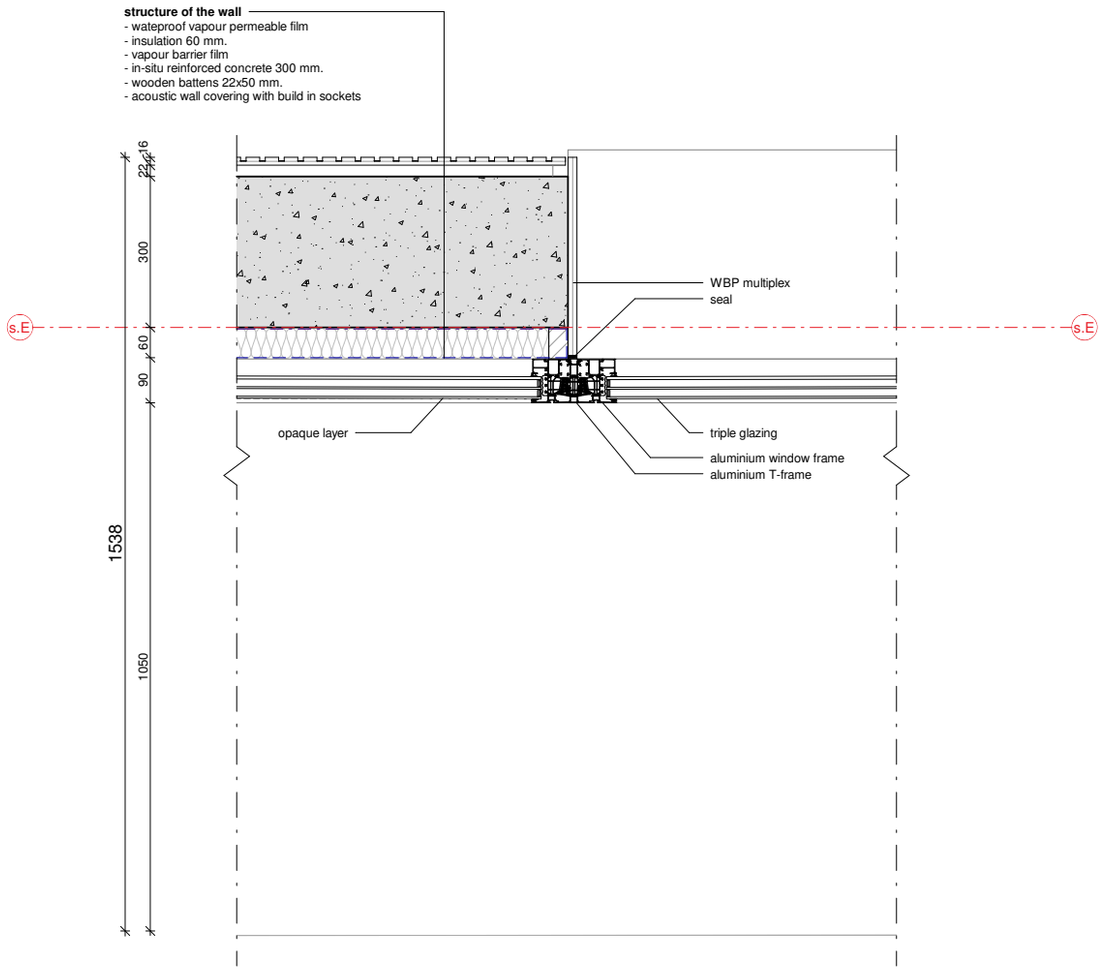


Fig. 43: Horizontal detail of the typical facade element (own drawing)

The glazing and insulation on the outside of the building naturally follow the thermal line. This is made water-resistant and vapour-permeable on the outside so that any incoming moisture can escape from the insulation. Additionally, it is made vapour-resistant on the inside using a foil. Additionally, aluminum flashing is used on both sides of the window frames (top, sill - bottom, seal) to ensure that they are watertight.

As can be seen, the aluminum tube construction creates a lot of unused space. A heat recovery unit and the separate GapS air filtration devices are installed here. To allow clean air to enter and "dirty" air to exit the facade, aluminium grated panels are suspended from the underside of the facade. In order to prevent it from destabilizing the entire facade in the event of an emergency, the construction is shear bolted to the main structure. Aluminum mounting profiles are used to hang the aluminum facade cladding from the framework. To avoid severe solar distortion, the cladding is made up of components that are each around 2m. long. Finally the cladding is tilted 20°, because of rain, the integrated solar panels & aesthetics.

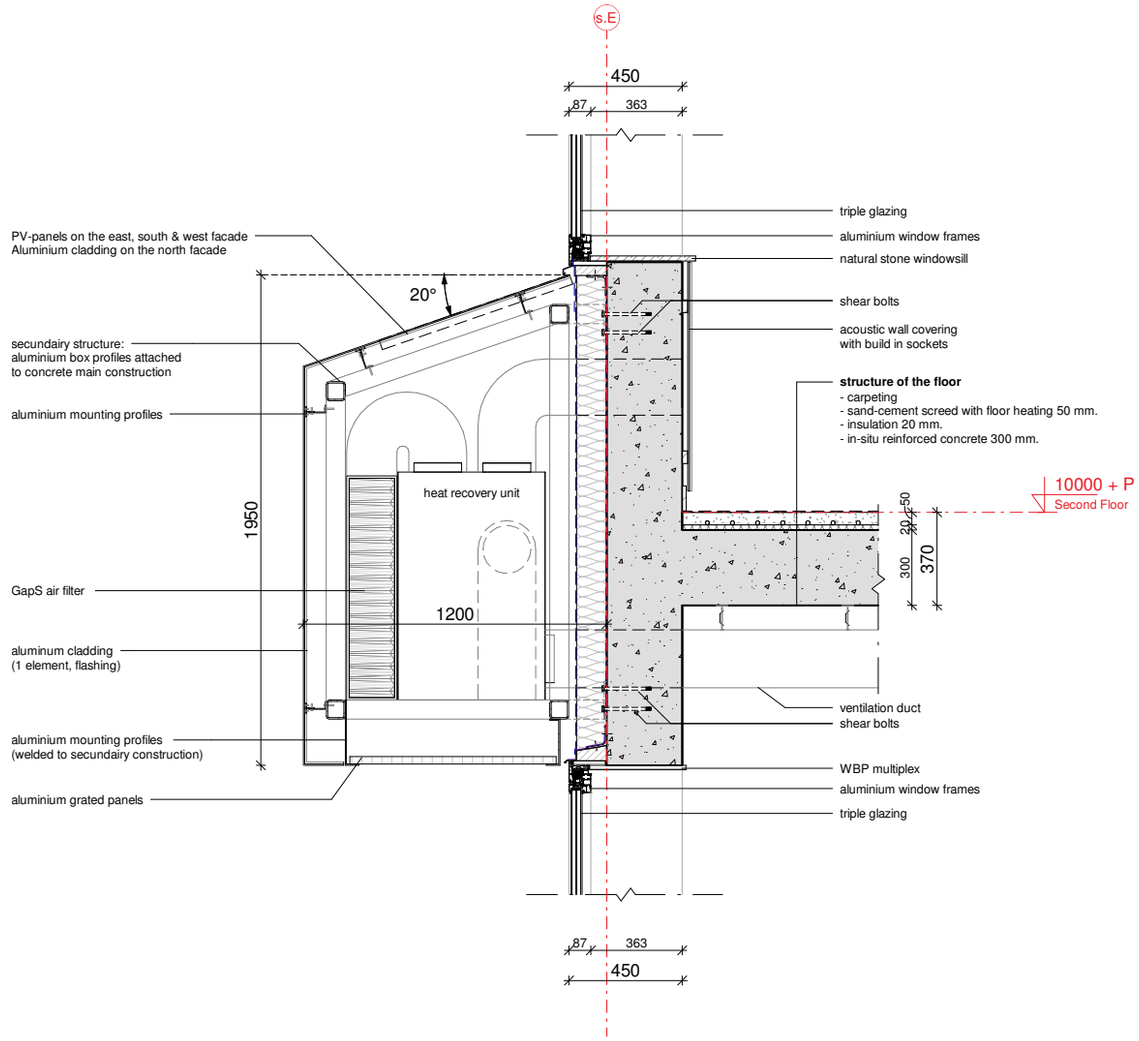


Fig. 44: Vertical detail of the typical facade element (own drawings)

REFLECTION

04

ASPECT 1

relationship between research and design

On numerous levels, the research has influenced the design and the design has influenced the research, which will be discussed here.

First of all, study into the context (Beirut) has shown which combination of building functions is required and relevant in this setting, a combination between a police station, fire station and ambulance post. Furthermore, clear goals for the design of the Salam Emergency Station could be created as a result of this context research. These goals are, respectively, fast response time of the emergency services, better organization among themselves and a resilient but open design. By drawing up these design ambitions, the research was given more direction, for example, a targeted search could be made for a location that guarantees rapid response times of the emergency services. As a result, this is a clear illustration of how the design (its aims) influenced the research. On the other hand, conducting research into the substantiated selected site imposed design constraints. Better-formulated design choices can be generated precisely by imposing constraints on the design. Moreover, study into resilient architectural principles and research into approachable architecture generated a pool of possible design principles that could be applied to the design. Some of these principles in both research contradicted each other, necessitating ethical considerations; this is covered further in aspect 5.

In addition, research into the required number of emergency services has had a significant impact on the design brief; for example, the number of vehicles required in the context of Beirut, each has its own set of employees. These employees, in turn, generate programmatic requirements. A design brief could be created this way through research. However, it is rapidly determined during the design phase that some program components (from the three different functions) could be merged. There were other program components introduced that were not established through research but were recognized throughout the design phase to bring a lot of value to the design. In this manner, the research is once again influenced by the design.

Finally, there were research phases during the design process, because there was a need for an in-depth approach for the development of the design. The facade, for example, was a challenge during the design phase, prompting various investigations into its materialization and design.

ASPECT 2

relationship between the graduation topic and studio topic

The focus of the Beirut Studio is on dealing with catastrophe within the built environment. It uses the context of Beirut where on August 4, 2020 a huge explosion destroyed a large part of the bustling city and damaged an even larger part, injuring a lot of people in the process. This occurrence sparked interest in the graduation topic of emergency response and the architectural generation thereof.

According to research, Beirut's emergency services do not work effectively together and do not perform optimally, and there are far too few services in general. On top of that, a significant portion of the services has been wiped out due to the blast. The need for these emergency services is therefore crucial in this graduation research, especially in a city ravaged by a disaster. As a result, the research examines how it might integrate these critical functions and operate optimally in a disaster-stricken community.

In addition, the Salam Emergency Station will be built to withstand eventual future blasts. Creating a base of operations for emergency services that will remain operational during disasters (a futuristic fortress). In this way, the city's safety will be assured and garanteed in the future. Concluding, the research with its supplementary design has a direct link to dealing with catastrophes in the future as well as dealing with the current situation in Beirut.

ASPECT 3

research method and approach in relation to the graduation studio

The graduating studio of complex projects has a clearly defined research method and approach in which you don't get a lot of freedom to disperse. First of all the urban fabric of a two-kilometer circle in Beirut is being reconstructed in a group. This circle is thoroughly studied in the group (including a site visit to study the atmosphere of the place, as well as an arrange of consultations with universities and more), with hard and soft data being collected. Various conclusions are formed from this data collection that influence the redevelopment of the urban fabric of the circle, as well as individual projects. Furthermore, the individual projects can influence the redevelopment of the area as well. For example, the Salam Emergency Station, has affected the area's redevelopment in such a way that multiple road segments have been reserved for public transportation. These can be utilized by emergency services in the event of an emergency to ensure a swift response time.

Individual research and design are carried out in parallel with group research. Almost all of the guidelines set by the complex projects graduation studio have been followed. This necessitates a thorough site analysis as well as research into the design brief and programmatic relations. In complex projects the design brief is typically created through reference research in order to arrive at a justified square meter program. This research took a different approach than this standard, because the project's combination of functions is relatively new, so there aren't enough reference projects to conduct this research properly. Therefore, the demand for emergency services in Beirut is studied in order to calculate the required number of cars and staff. The program bar was a result of the spacial requirements of the vehicles and employees (functions). Of course, research on the three diverse building types (police station, fire station, and ambulance post) has been conducted to get an understanding of the spaces (and the functions they need).

The design is based on the constraints imposed by the urban redevelopment strategy and those imposed by the individual design brief. Therefore, the design is directed as much as possible by these constraints in order to arrive at a well-founded design. Self-imposed limitations will logically be tested during the design process, and will need to be modified if necessary. The design brief, for example, originally called for the various building functions to be visible from the outside, but it became clear throughout the design phase that this would detract too much from the building's architectural coherence. As a result, this requirement has been changed to only require different interiors to indicate different functions.

ASPECT 4

wider social, professional and scientific relevance

The findings from the research, although tested and focused on Beirut's context, are more widely applicable. For instance, there are several cities around the world experiencing, or at risk of experiencing, crises for which the research and design choices may be relevant. In fact, the research can be relevant for any city where there are safety concerns, both at a building level or in the broader context. While security issues in Beirut are an extreme example, building security in any city is important. Security can come under pressure in various ways, such as terrorism, crises and war, but also milder phenomena such as demonstrations that have gotten out of hand, other political unrest or crime. These are problems not specific to Beirut, but occurring worldwide, even in relatively safe cities.

The balancing between security and approachability can be used in buildings that have safety risks, such as government buildings, banks and buildings with a political function, but also commercial and non-commercial public buildings where many people gather. Additionally, by improving the perceived safety of users and people who pass a building, a more pleasant experience can be made.

ASPECT 5
ethical issues and dilemmas

Beirut is home to a large number of Muslims, Christians, Jews, atheists and people from other various ethnic and religious backgrounds. Of course, the Salam Emergency Station is there to help people in need, but some people who are strongly devout will refuse to be helped by emergency station stafft that have a different religion. Of course, a building cannot resolve a theological disagreement, but it should not actively contribute and stimulate to a possible conflict of interests. Therefore, no religious forms or other references to faith were included in the architectural design of the building.

Furthermore, the police have a negative public image, which means they often come into conflict with citizens. By locating the police in the same building as the ambulance and fire department, both of which are well-liked institutions, and highlighting their cooperation, an attempt is made to improve their image. Moreover, the building's restaurant and fitness center have been made public so that the citizen can interact with the police in a casual environment. However, it is impossible to ignore the attacks on the local police, which is why the structure was engineered to be explosion-proof.

Making this building explosion-proof instantly leads to the last conundrum: the building must be incredibly safe while yet providing and displaying public activities. As mentioned before, a balance between the dichotomy of safety and approachability must be struck. As a result, the research's design concepts for safety and approachability may contradict each other. Consequently, the public functions were separated as much as possible from the main volume in the design. Therefore, public functions can be designed to be more transparent, allowing them to stand out more and making the building more legible and approachable. However, as a consequence, they will be slightly less secure than the remainder of the emergency station.

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DRAWING SET

06

INDEX

** scales refer to detail level, for drawings in the rigth scale see the seperate drawing set.*

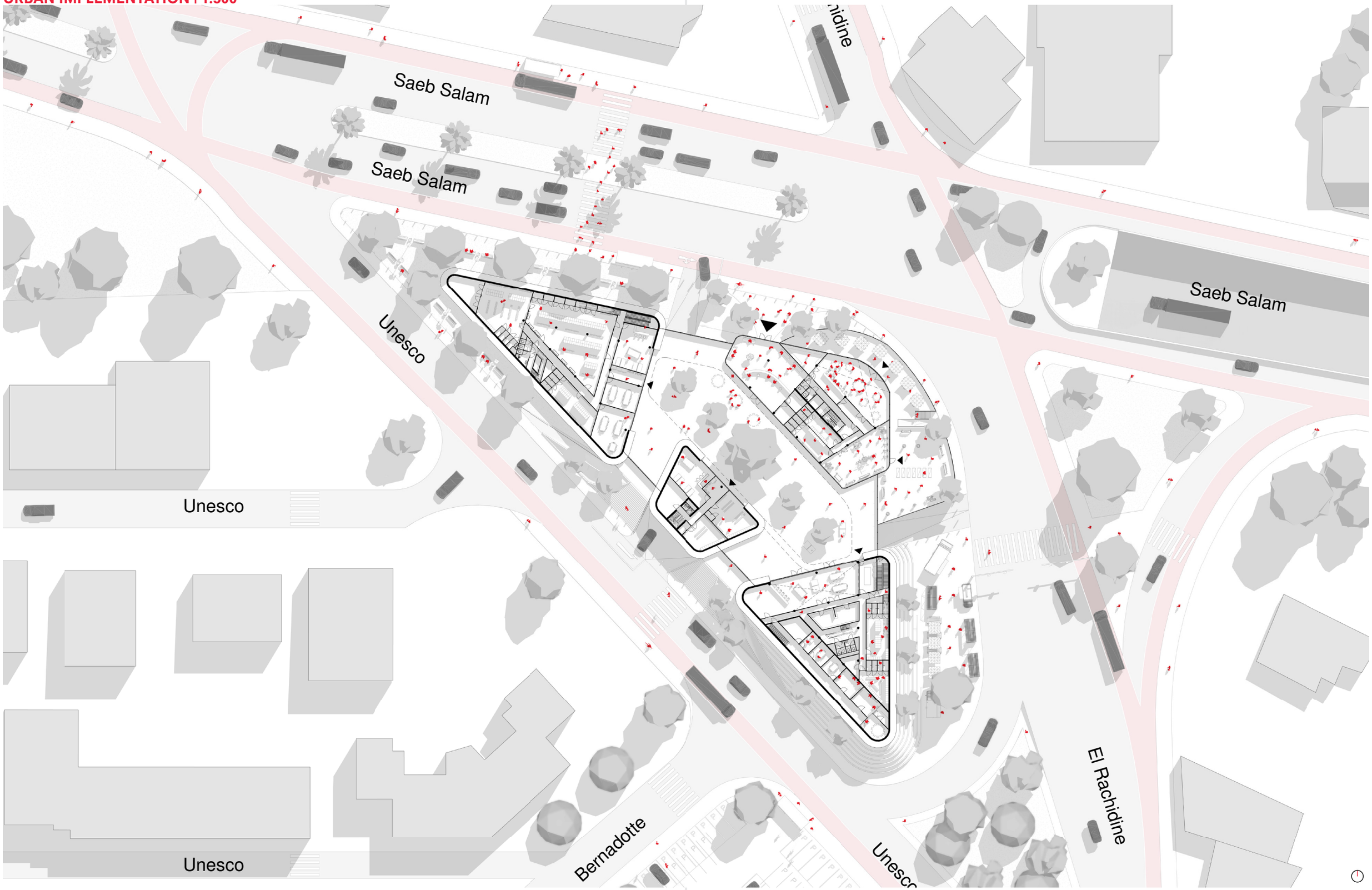
GROUP SITE PLAN

Detail level: 1:10.000

SALAM
Emergency Station

SITE PLAN | 1:1000

URBAN IMPLEMENTATION | 1:500



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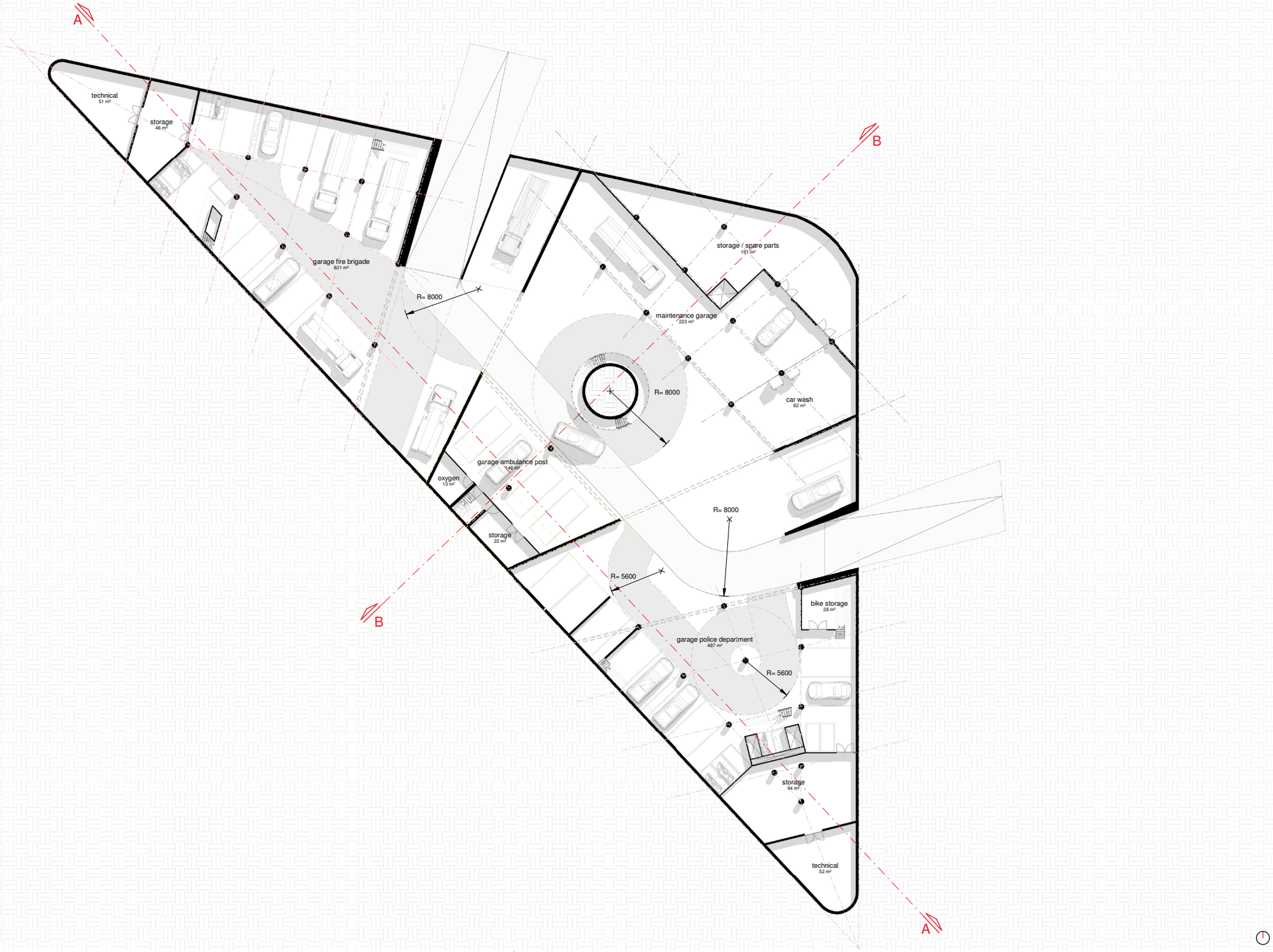

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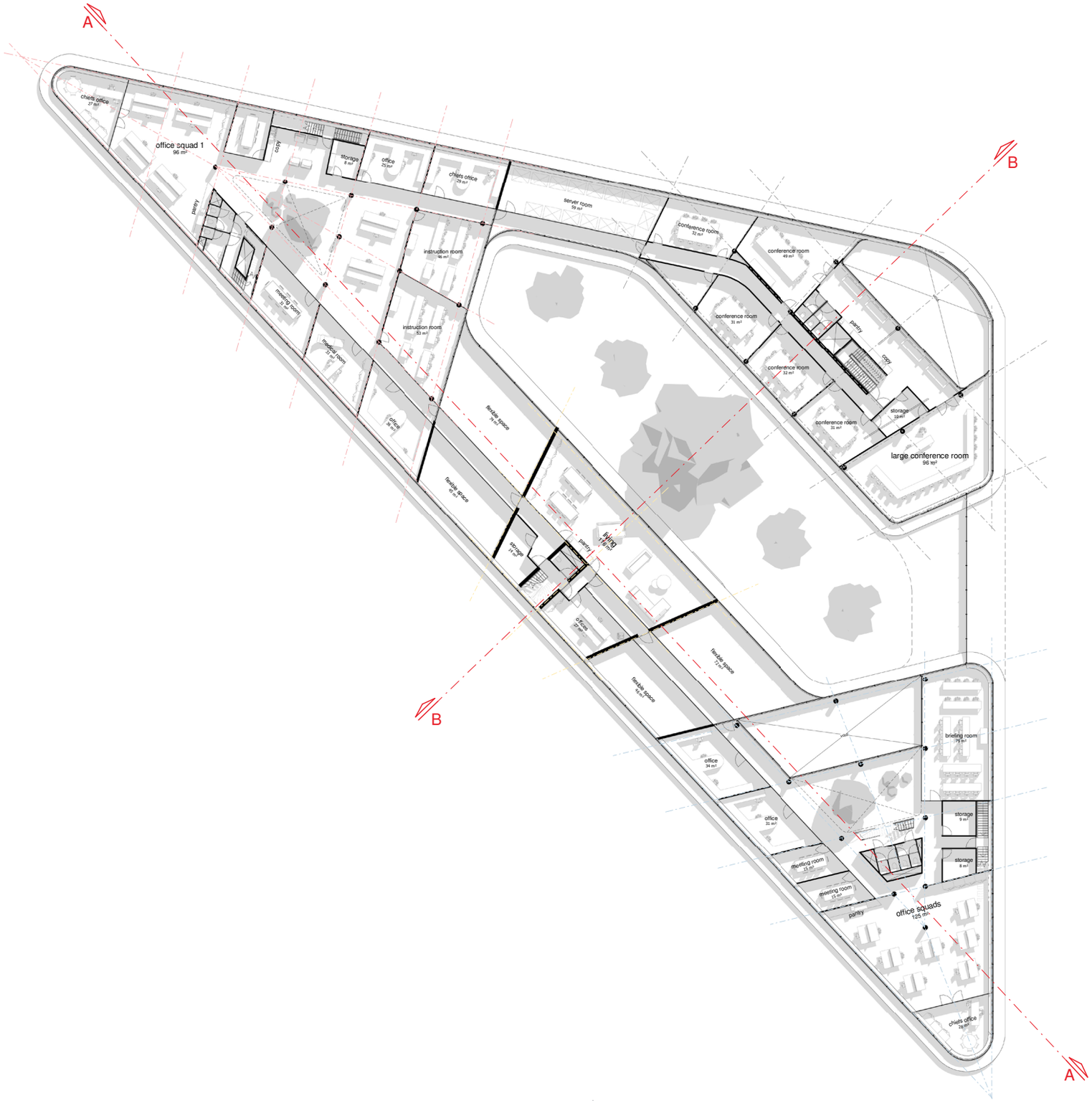

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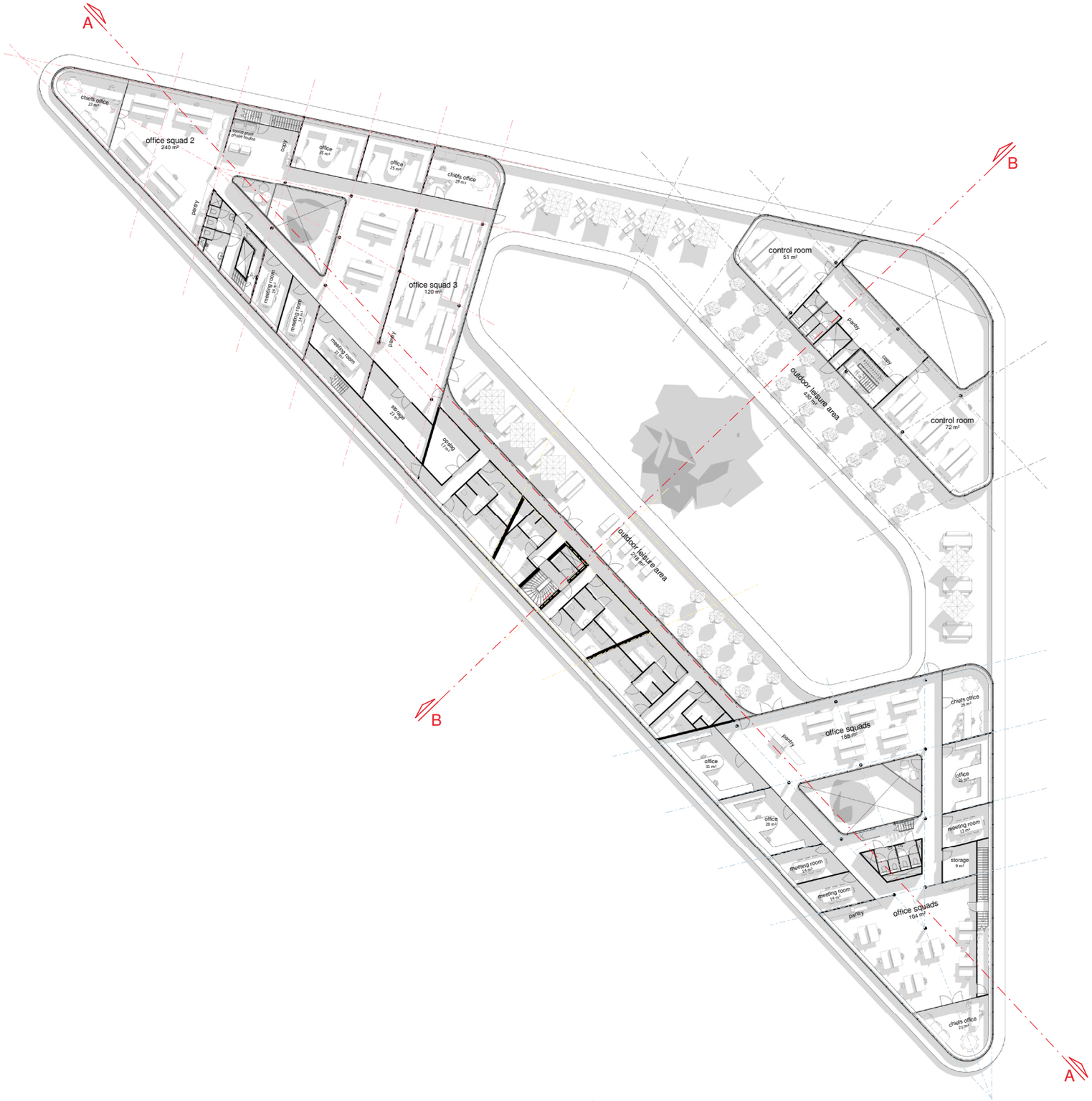

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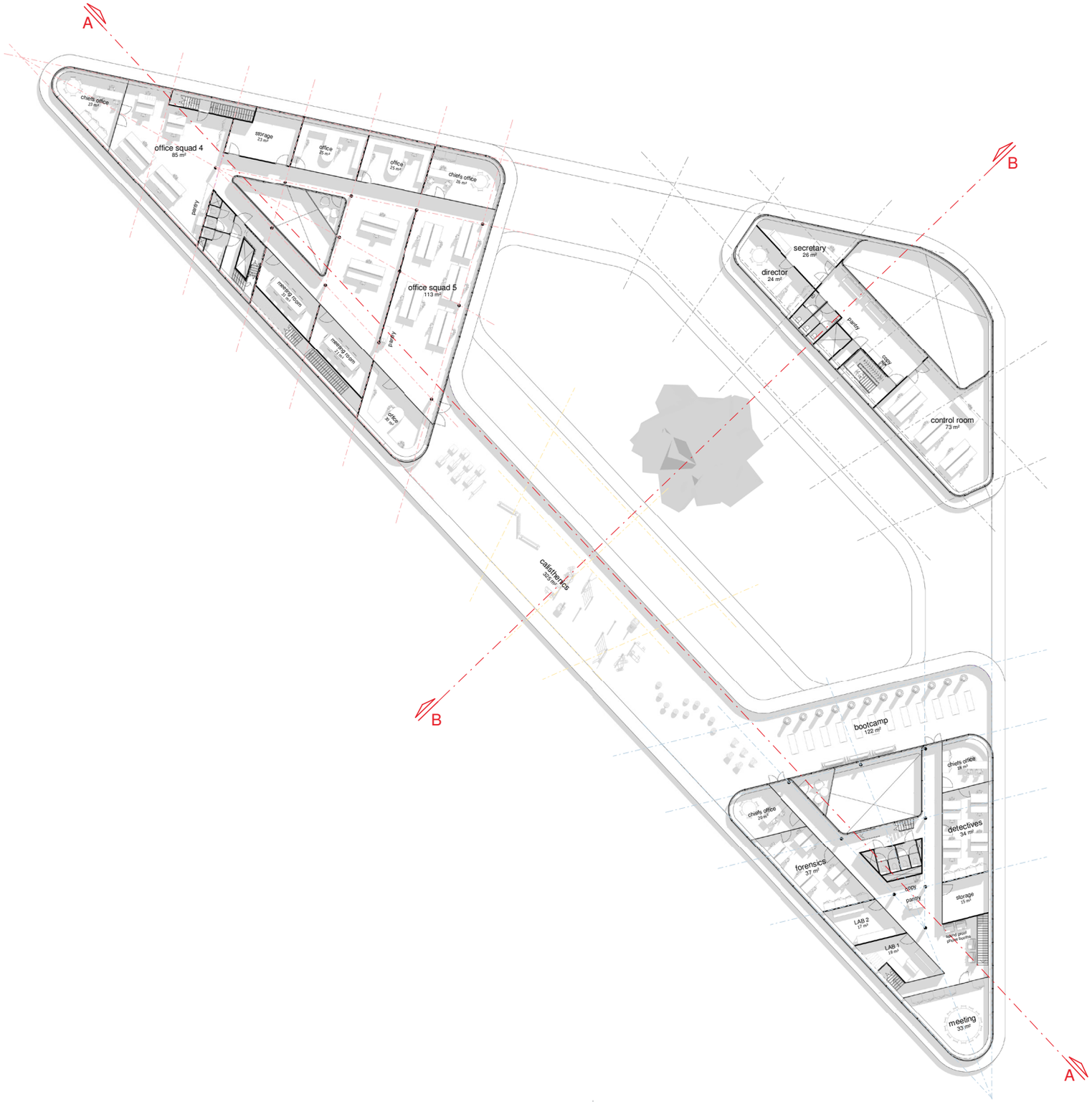

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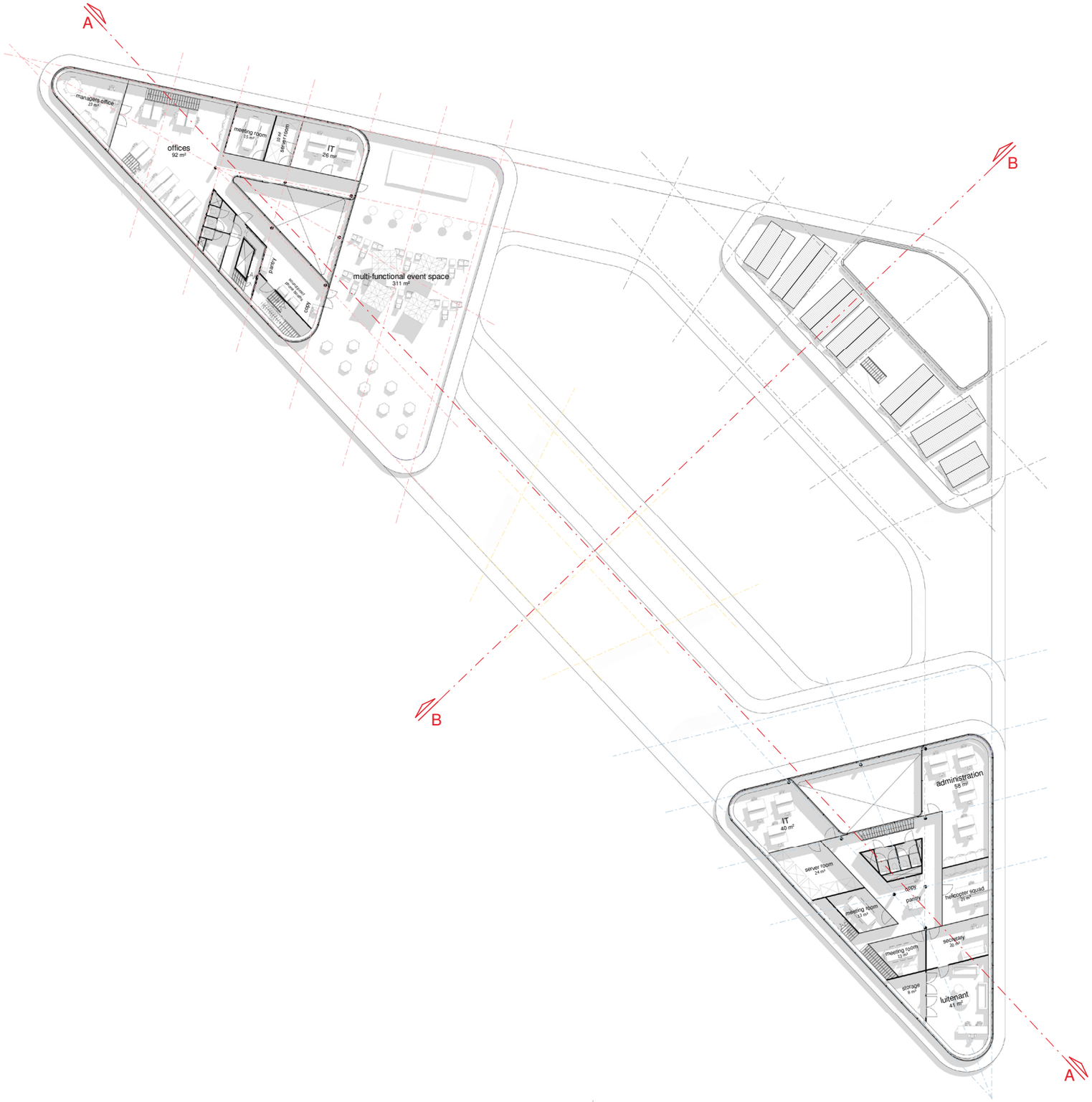

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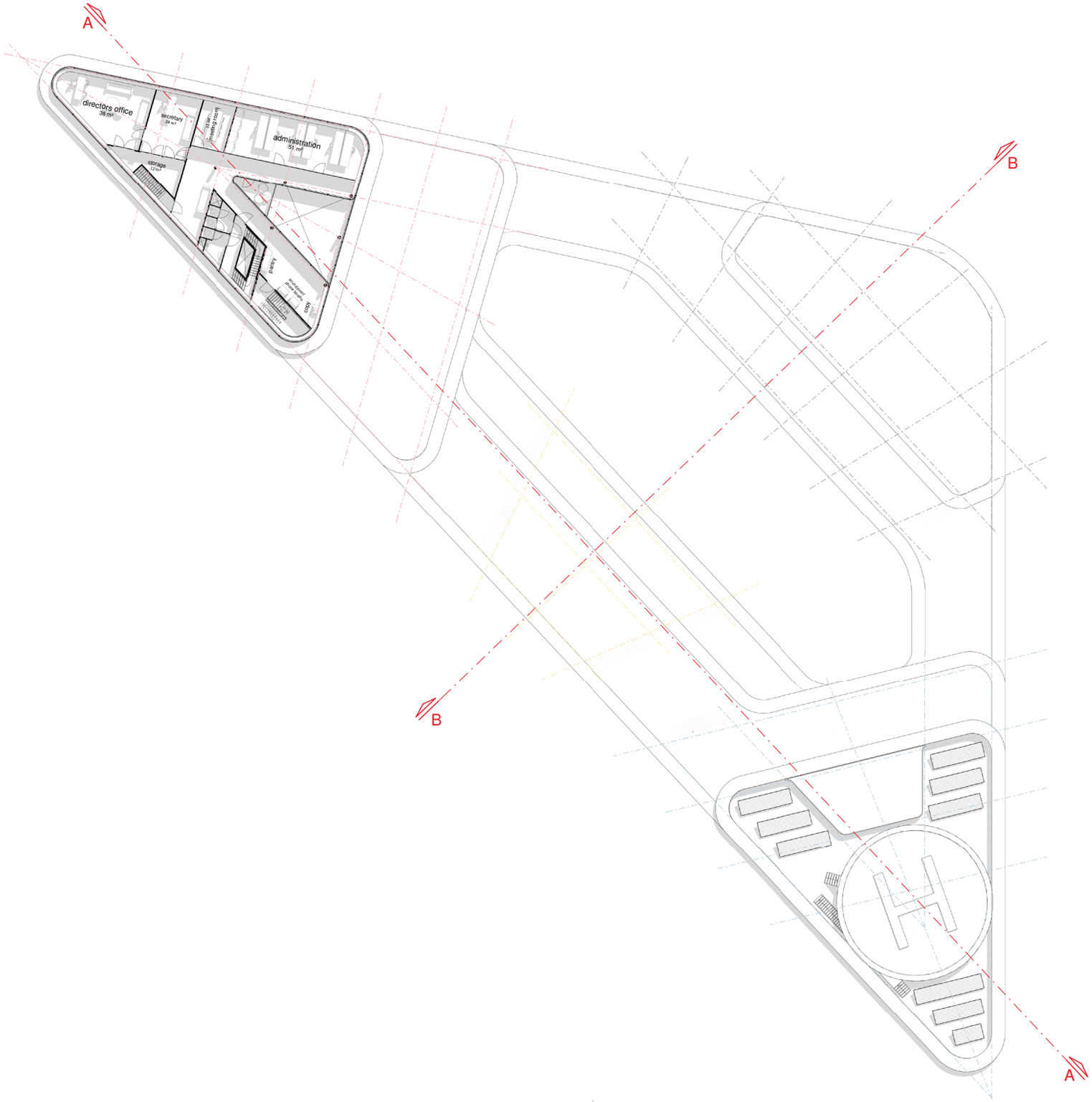

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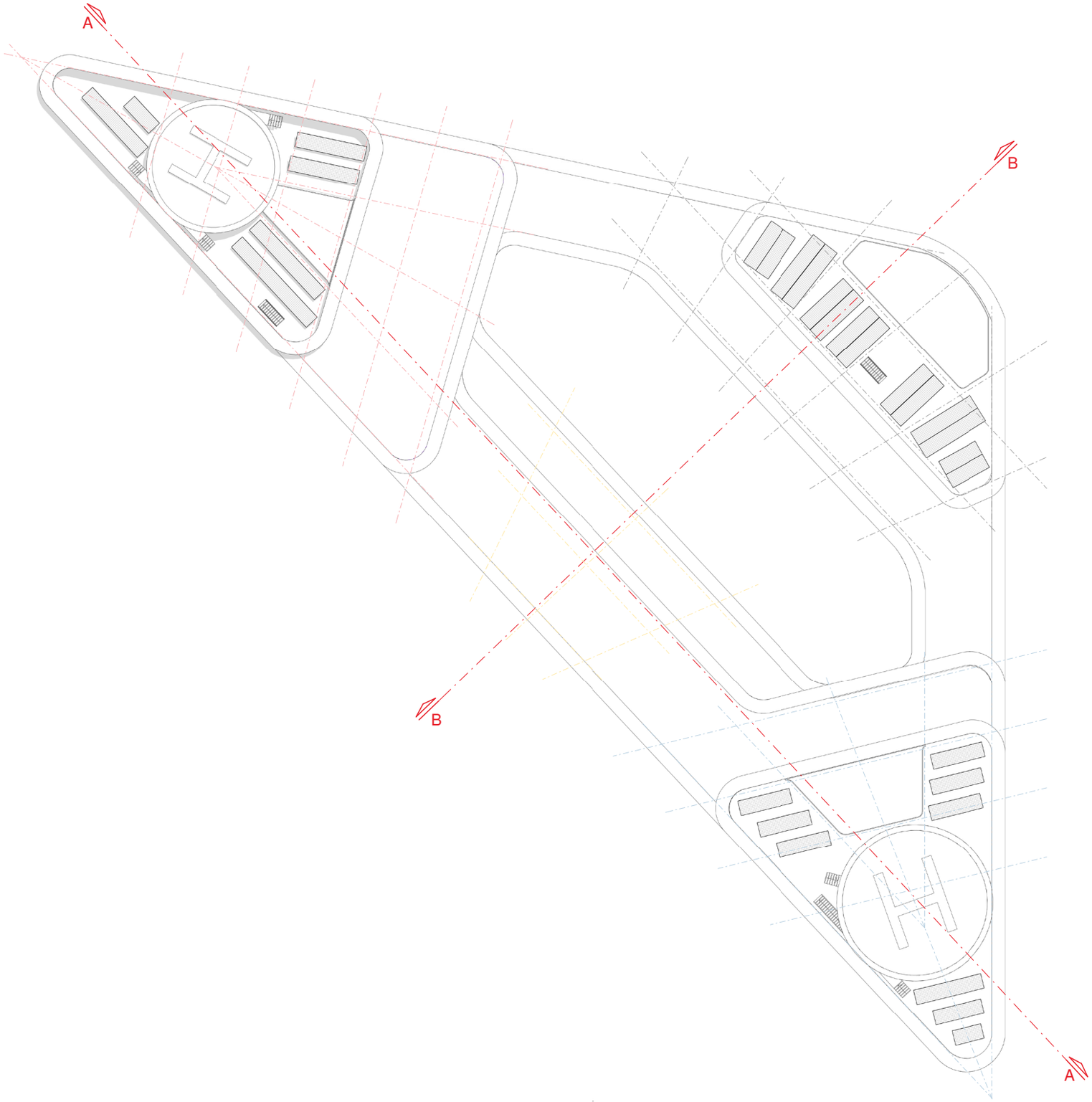

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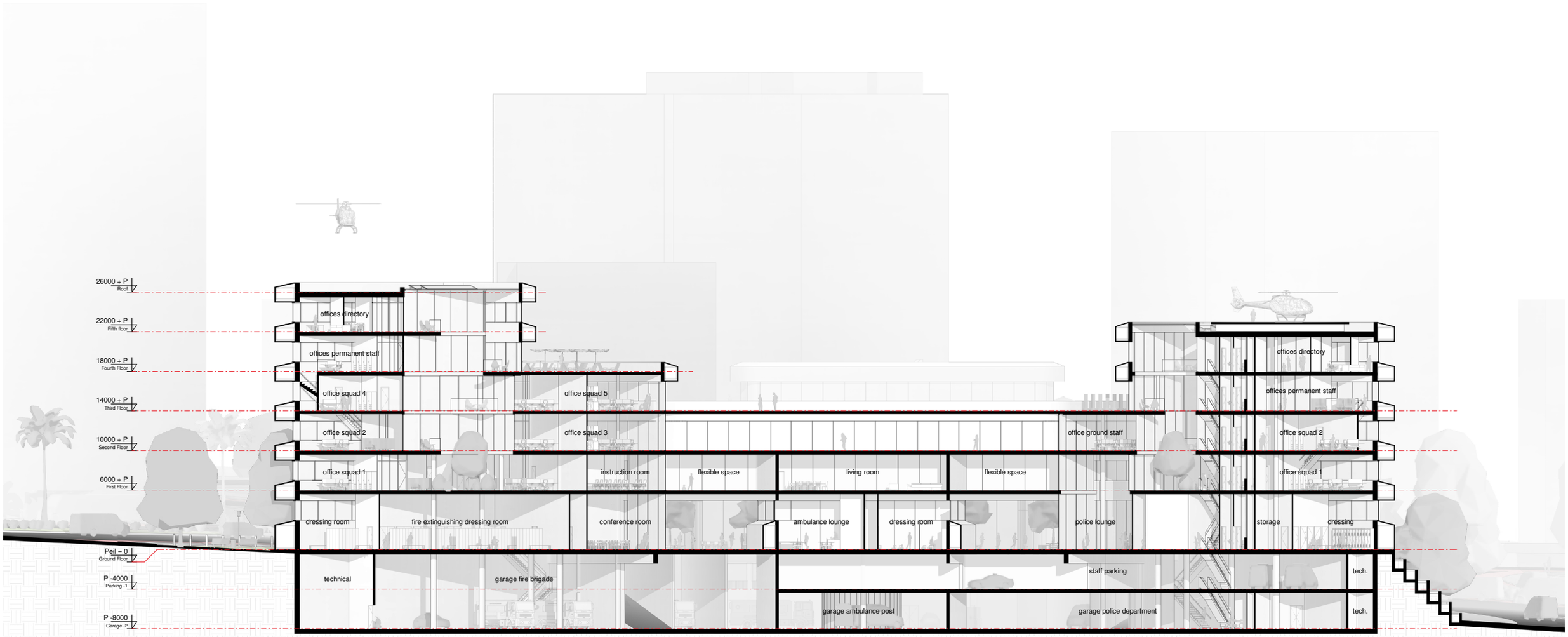

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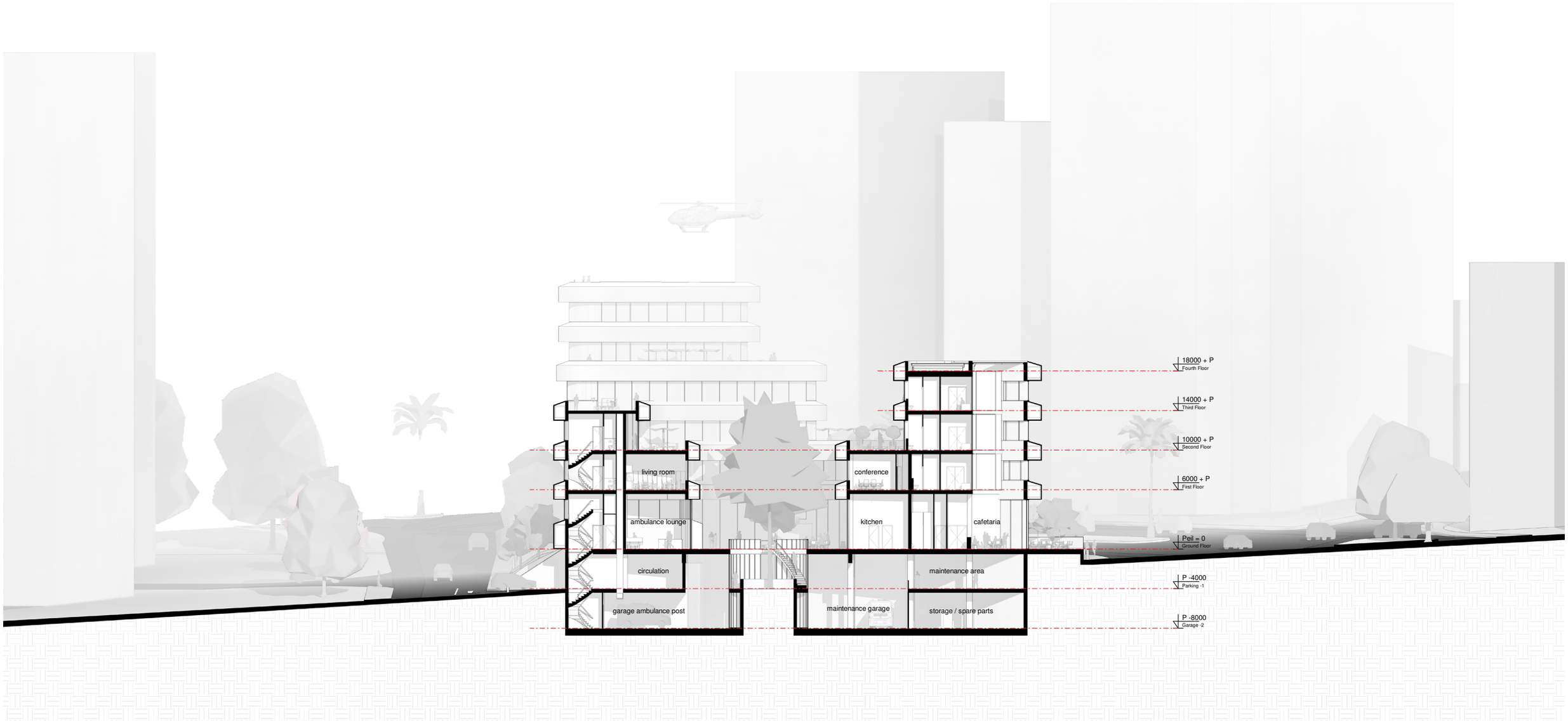

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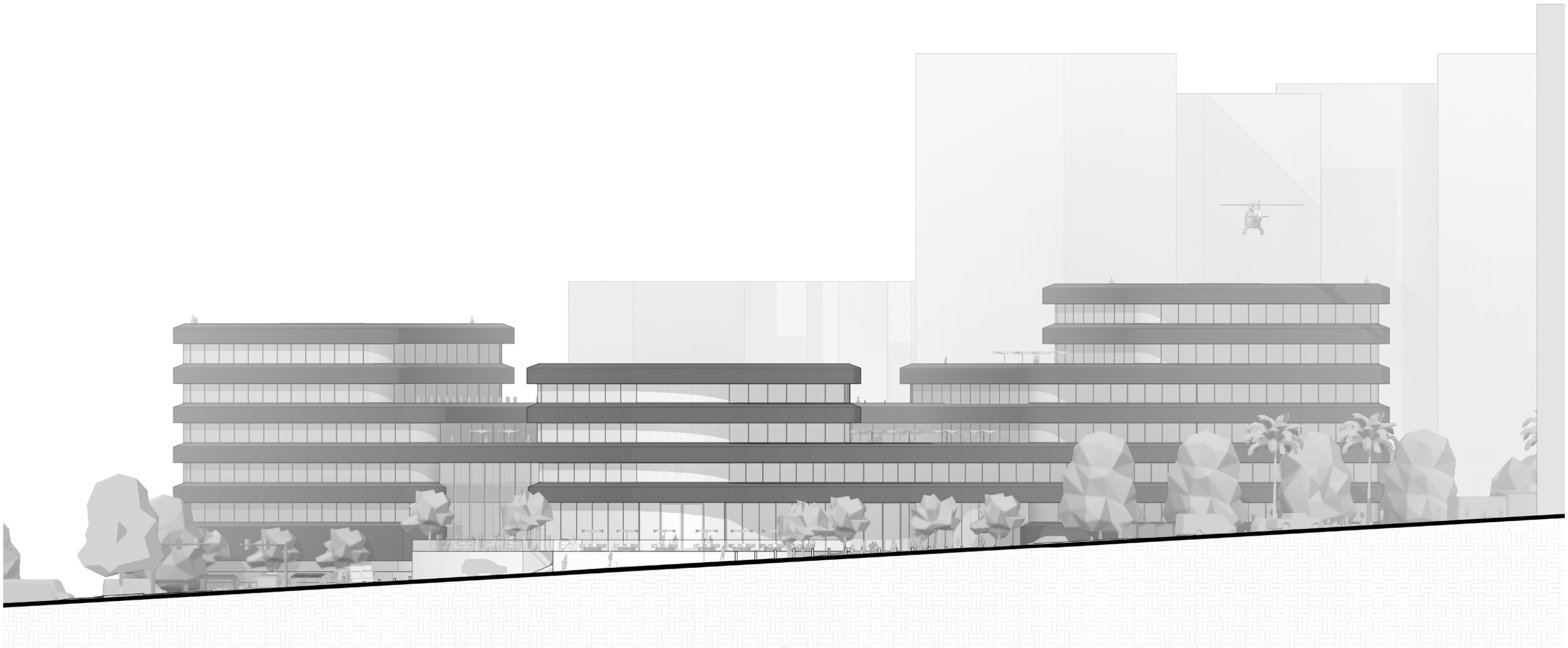

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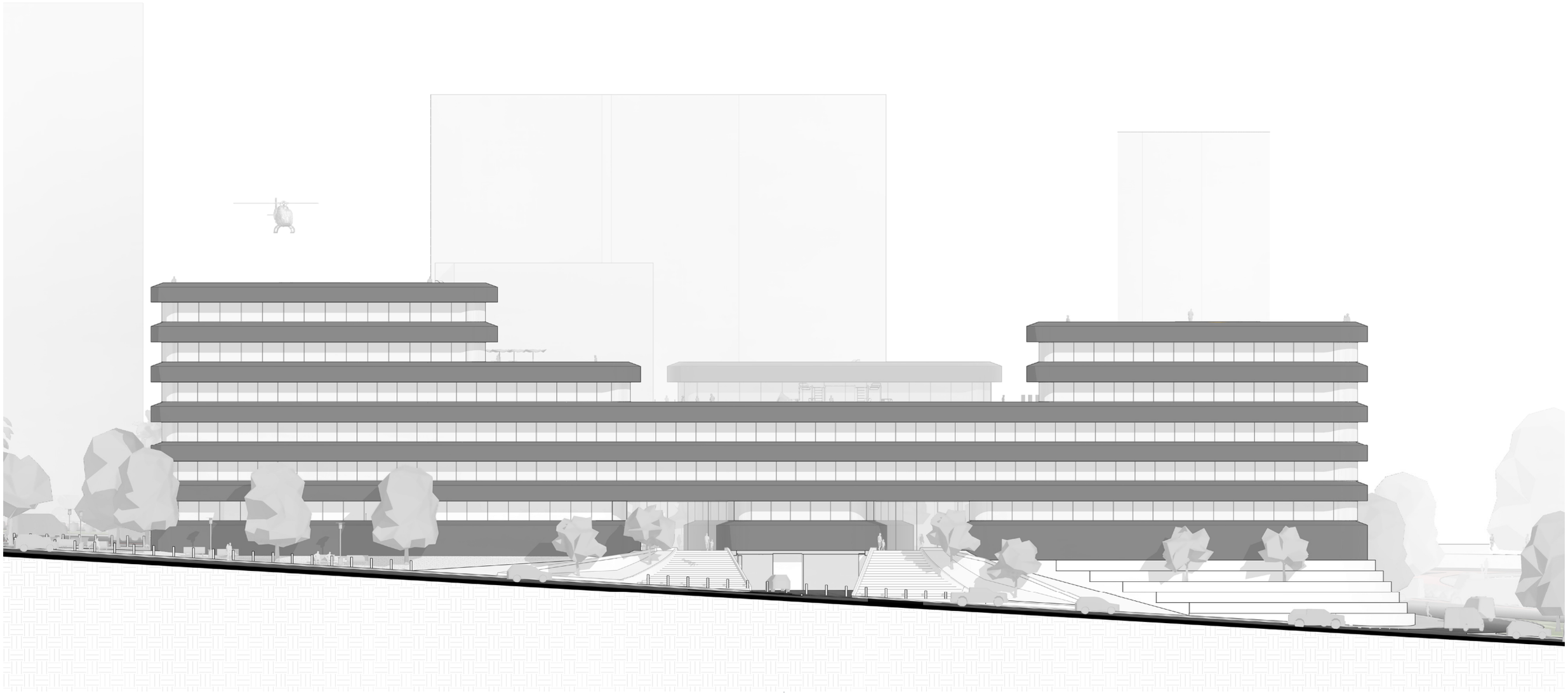

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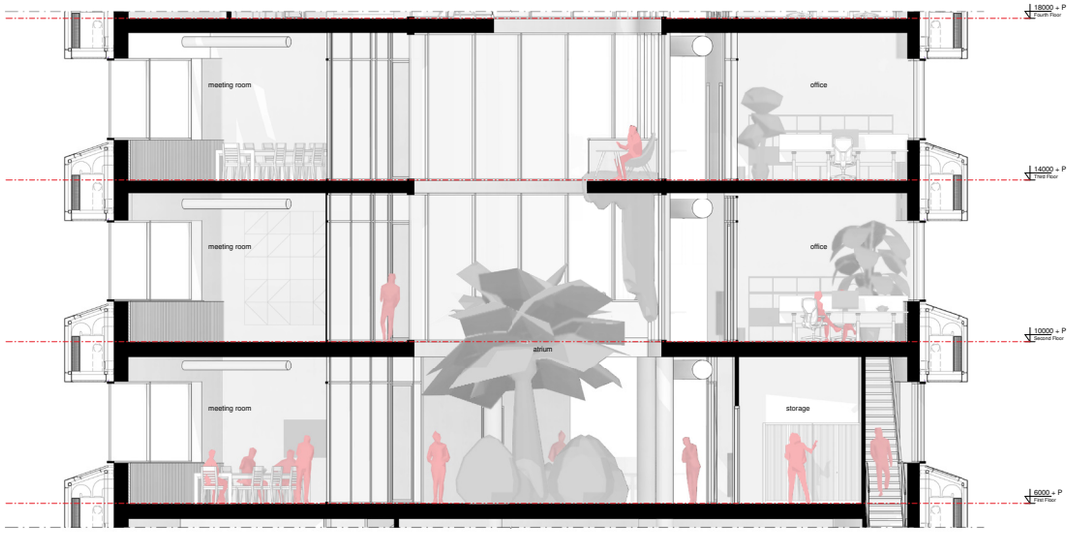
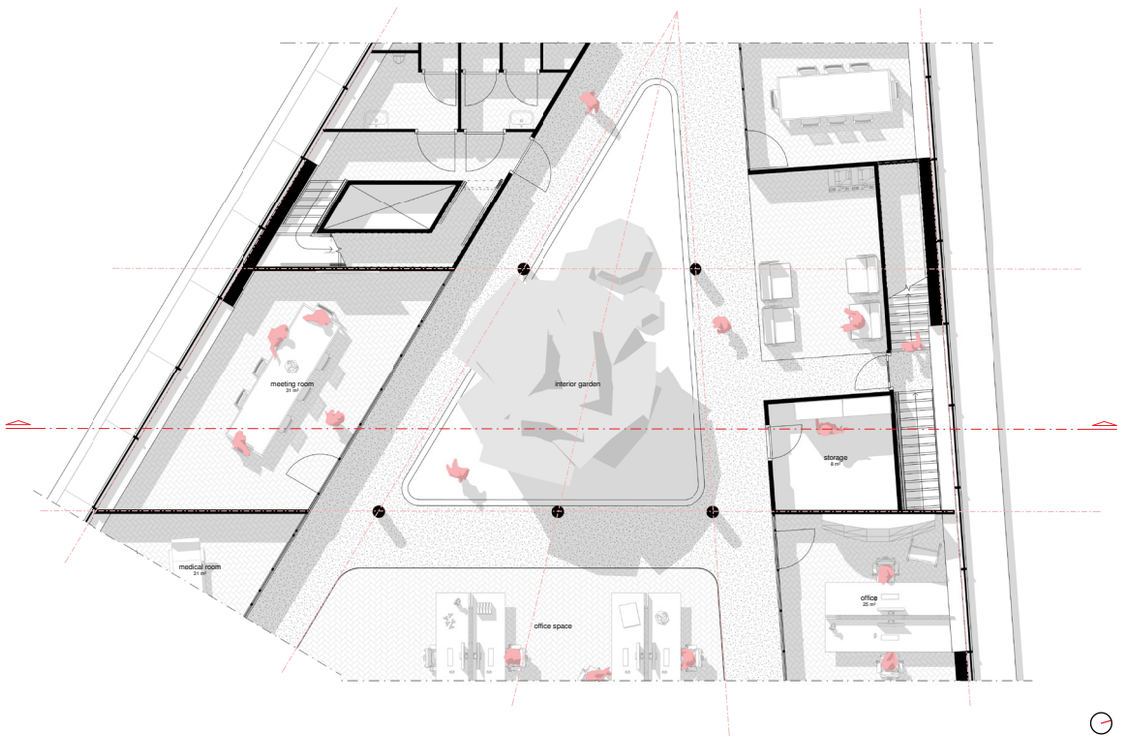
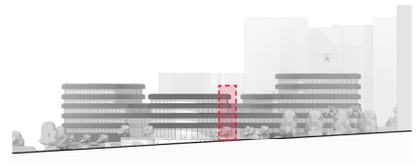
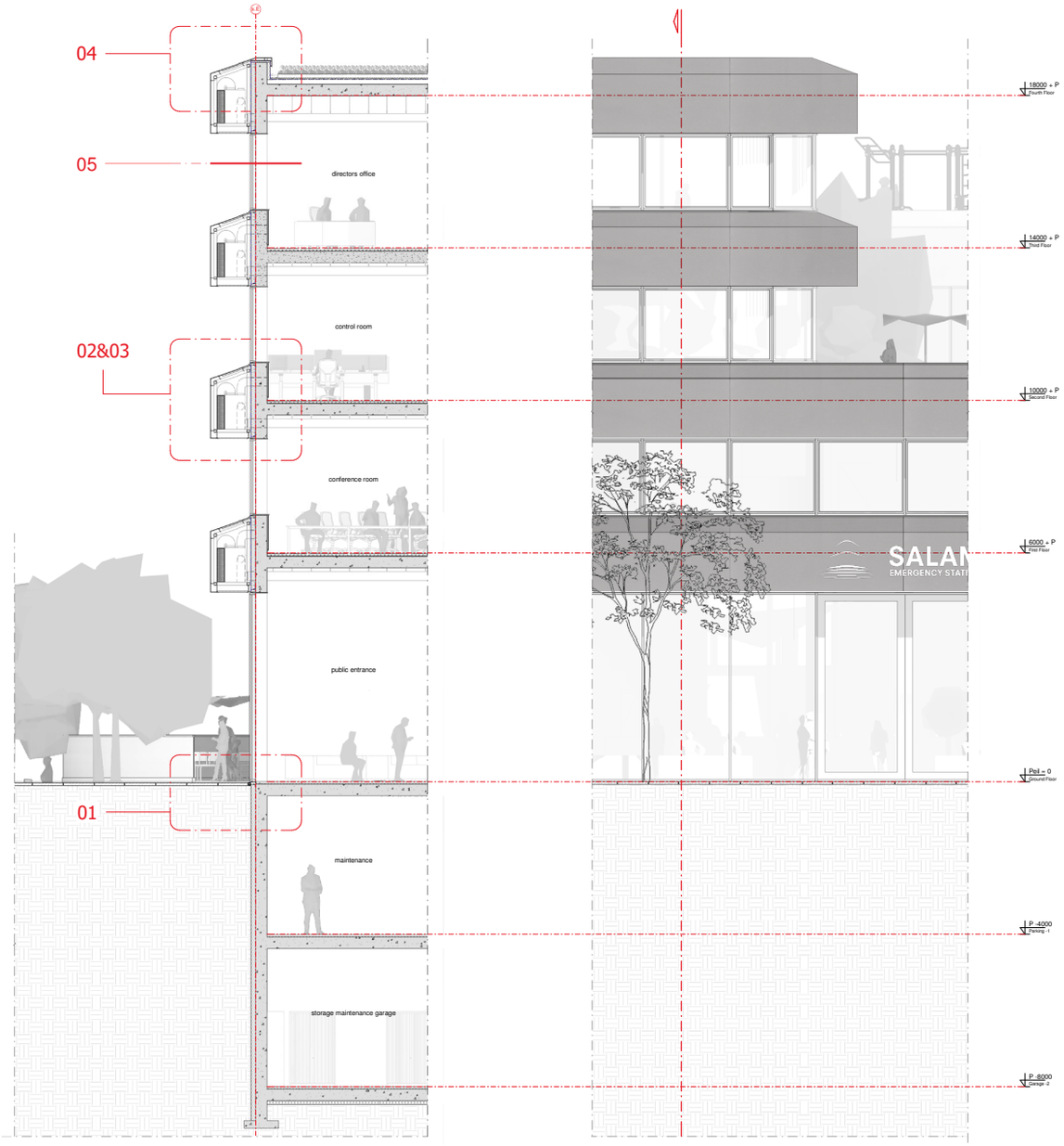




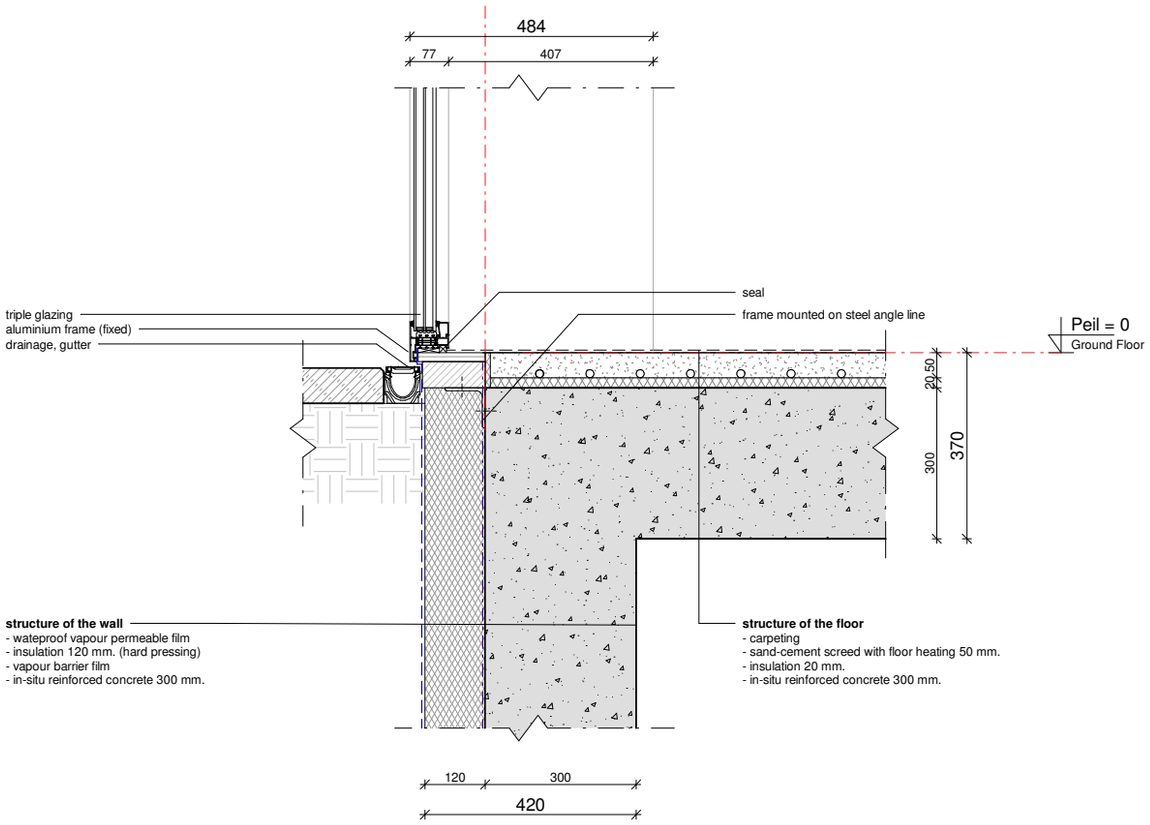
EXTERIOR FRAGMENT | 1:20



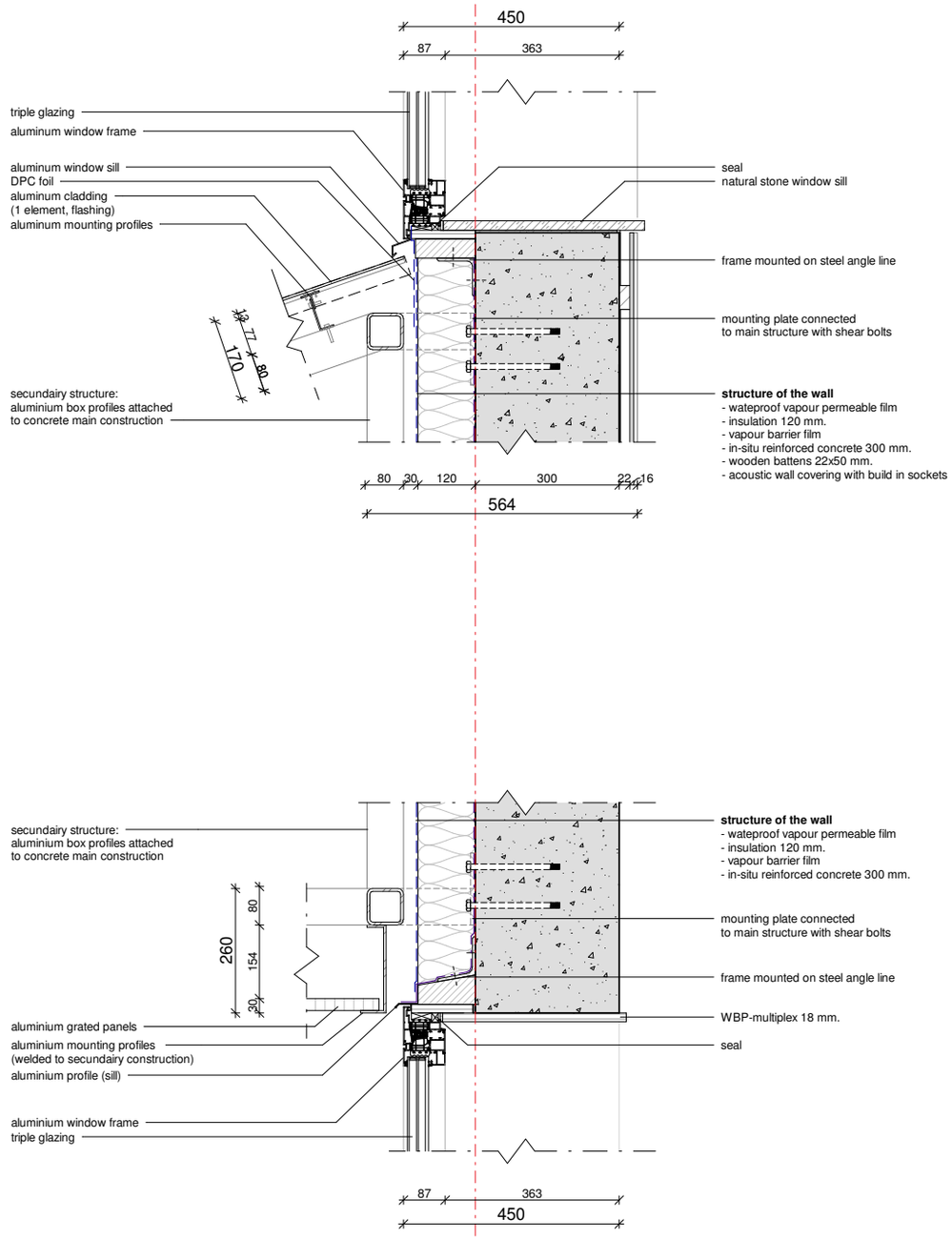


INTERIOR FRAGMENT | 1:50

Detail 1: Ground level

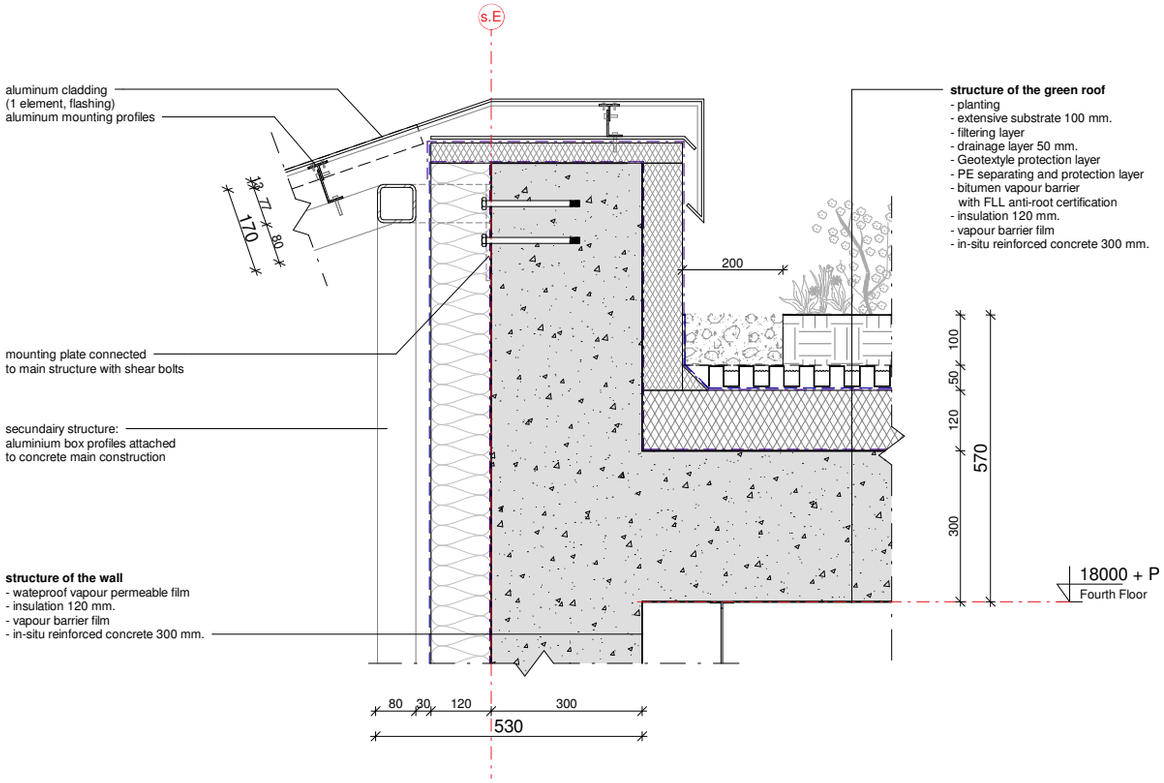


Detail 2 & 3: Window top & bottom



INTERIOR FRAGMENT | 1:50

Detail 4: Roof eave



Detail 5: Window side