

THE VERTICAL CITY

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2020

THE VERTICAL CITY

ACKNOWLEDGEMENTS

COMMITTEE
CO-CHAIR

ALEJANDRO BORGES

Thanks for encouraging me to push the boundaries of design and helping me discover how to make this project a reality. You helped me solve design problems with simple solutions and it is one of the reasons I was able to finish this project

COMMITTEE
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KOICHIRO AITANI

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COMMITTEE
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GALEN NEWMAN

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COMMITTEE
MEMBER

SHELLEY HOLLIDAY

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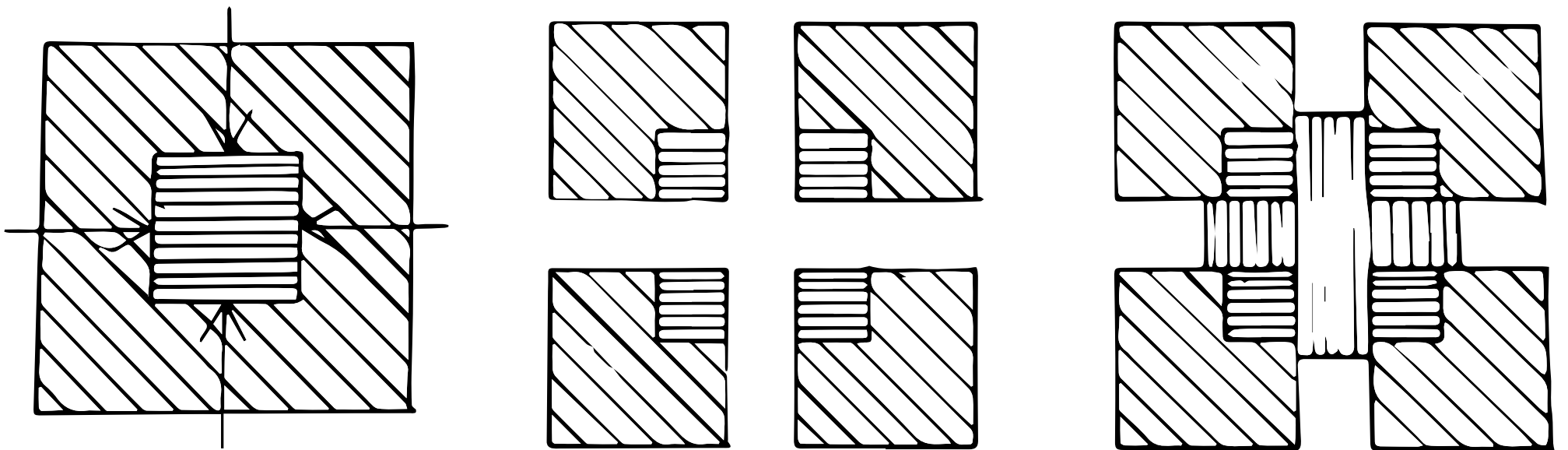
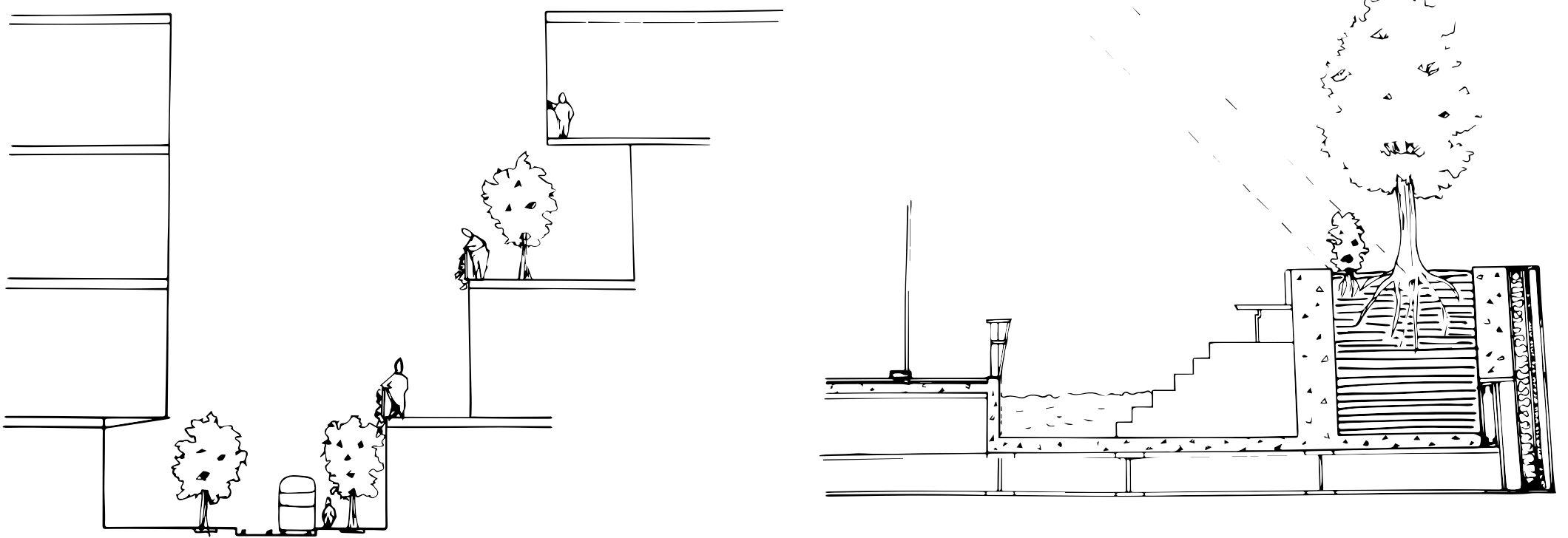
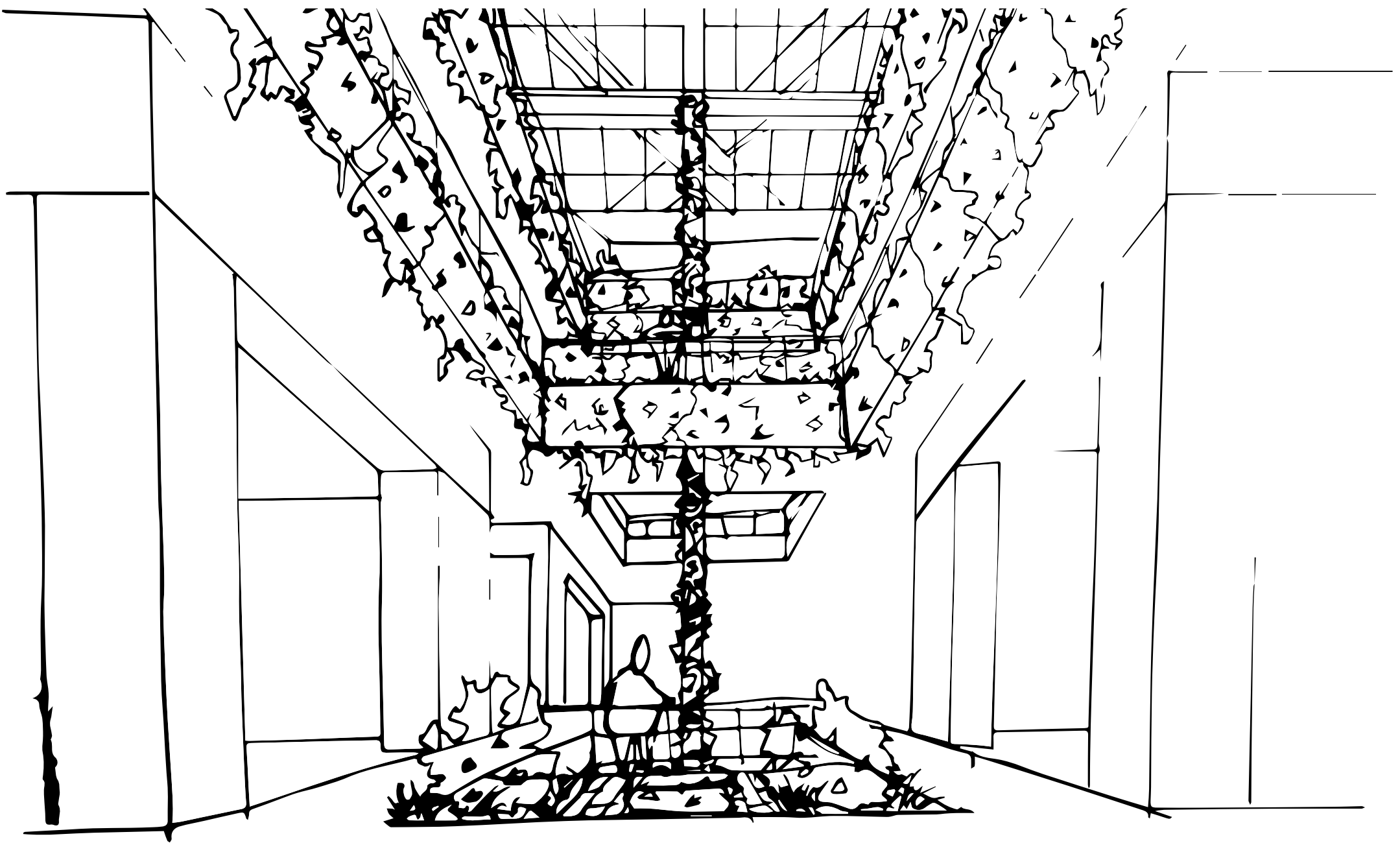
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CONCEPT

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CONCEPT

The Vertical City was a project meant to reexamine the role of skyscrapers within the urban environment. Rather than seeing skyscrapers as just another low to mid-rise building placed within the context of the city, the Vertical City sought to explore what would happen if the skyscraper was treated as a vertical extension of the city itself.

While many skyscrapers have taken approaches to change how the skyscraper is integrated within a city, most skyscrapers are inaccessible to the average urban pedestrian. Not in that you can't enter them, but rather, they are meant to be utilized only for the patrons who rent space within the building. As such, most skyscrapers don't have the same feeling of belonging that your local coffee shop might. While part of the reason for this stems from the monumentality of a skyscraper, that conception is often born from the notion that skyscrapers are representations of major corporations and thus have no place for the individual wanting to simply relax and read or grab a coffee. In order to overcome this, a different approach was taken that developed the skyscraper with the concept of a vertical city in mind. This came down to three main design aspects: urban approach, vertical purpose, and green infusion. All three elements were derived from components that make up great cities and would be developed utilizing concepts for good city design.

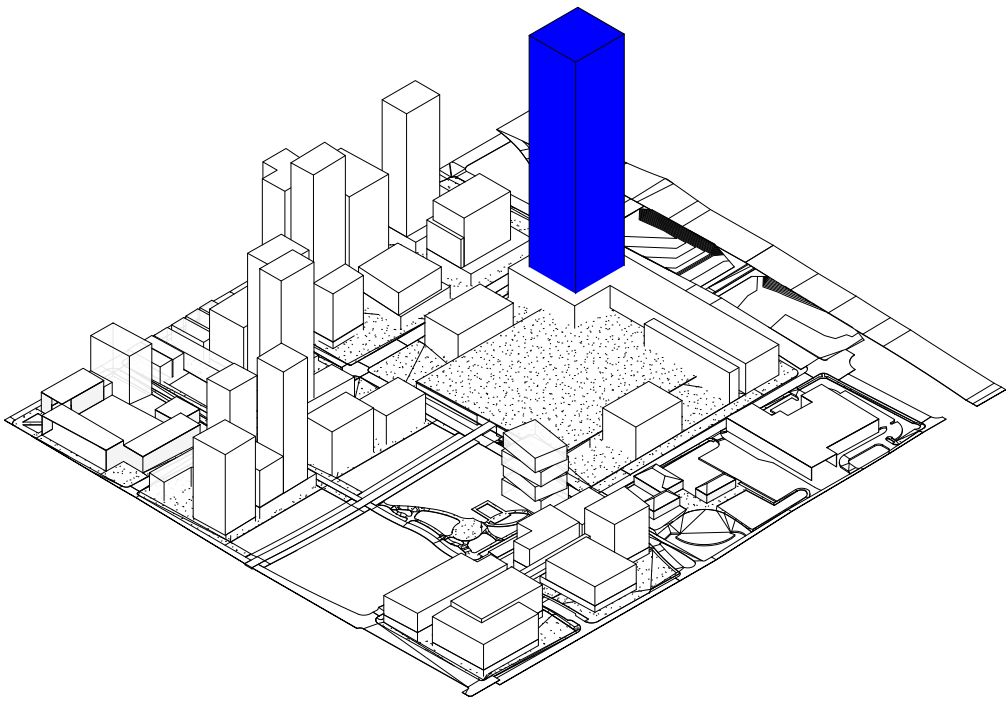
Urban approach is a concept meant to reconfigure the transition from the horizontal plane of the city to the vertical plane of the skyscraper. While both the infrastructure of the skyscraper and the streets of the city serve as a way to travel from one point to another, there is a stark difference in the

sense of community that each one provides. Utilizing an urban approach to infrastructure design would help mediate this difference and help create a stronger sense of connection within the building.

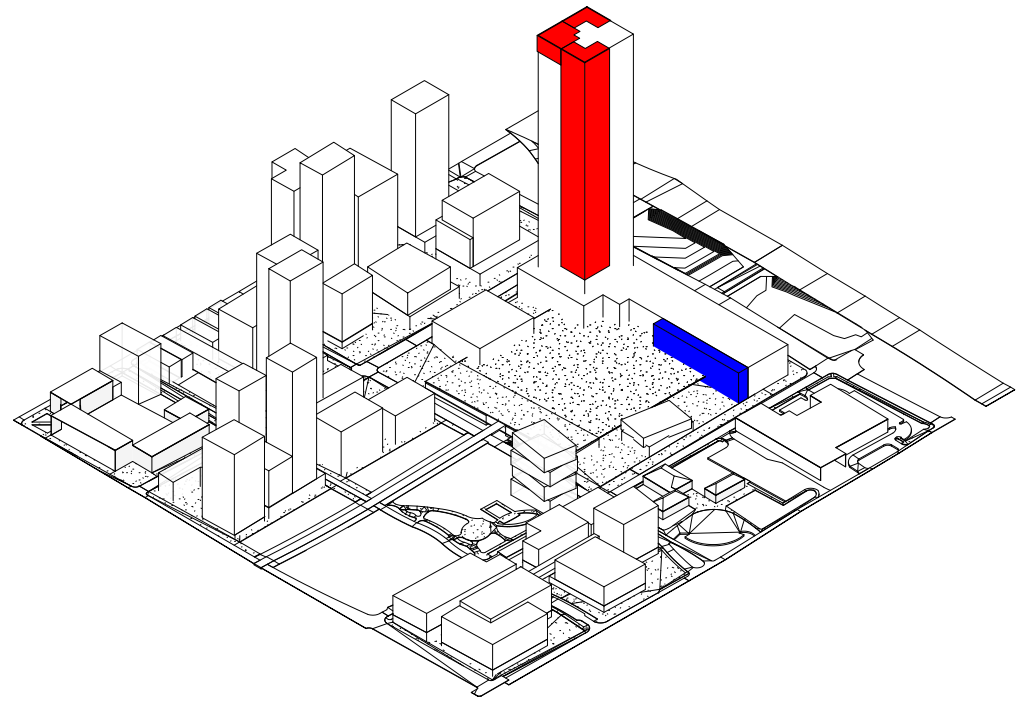
Vertical purpose stems from the concept that cities need a variety of business, commercial, and residential in close proximity in order to flourish. By doing so, it allows for a variety of pedestrian traffic throughout the day making the city feel alive and helping smaller businesses that give a city its character stay open.

Green infusion refers to the concept of green community space. Most great cities have a variety of parks and green spaces for the community to meet up, relax, and spend part of their day. As such, it is important that those "moments" occur throughout the skyscraper. While this element alone doesn't result in a vertical city, the culmination of all of these concepts create the essence of a vertical city.

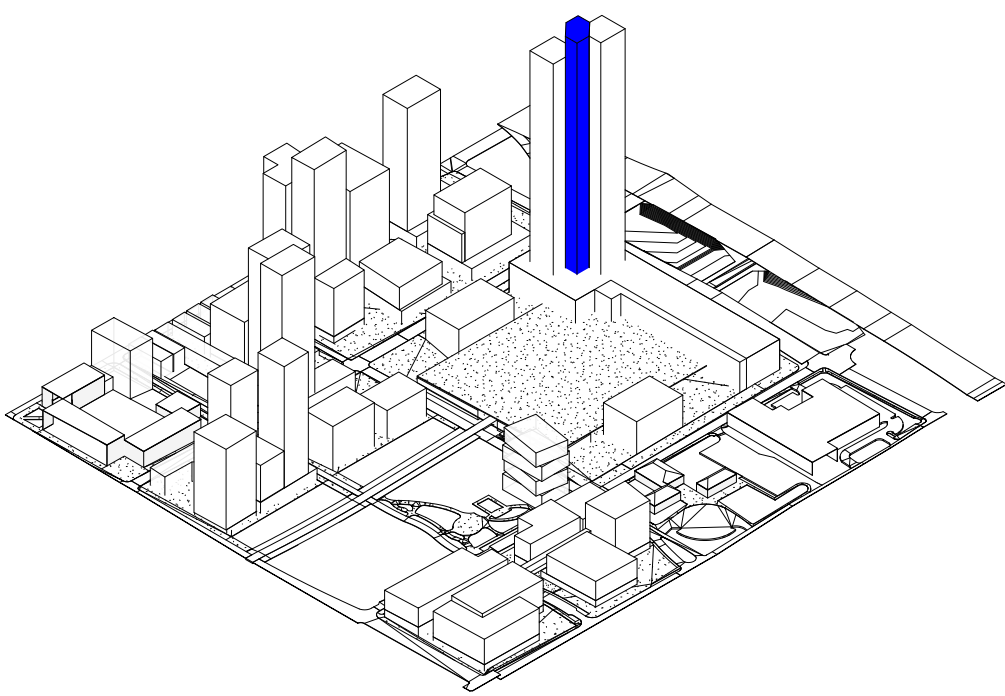
While more of a conceptual project, steps were taken in order to make this new design more feasible. With innovative design often come new costs and so it is important to consider the economics of the project. This was done by designing in such a way that new elements would serve multiple purposes thus reducing costs and giving credence to any new design elements.



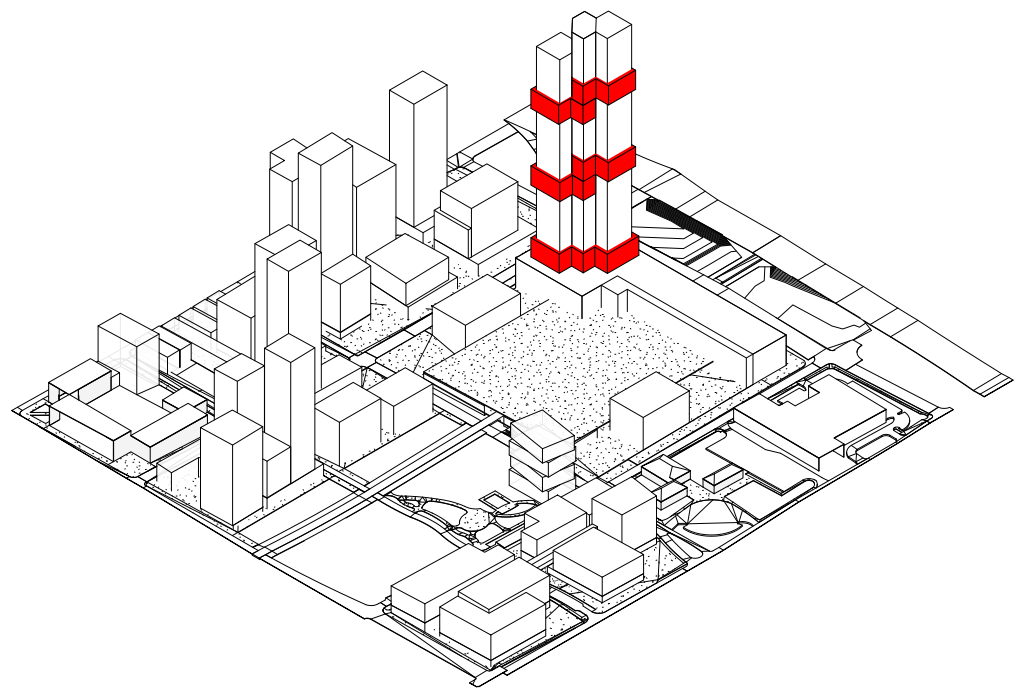
Extrude Skyscraper



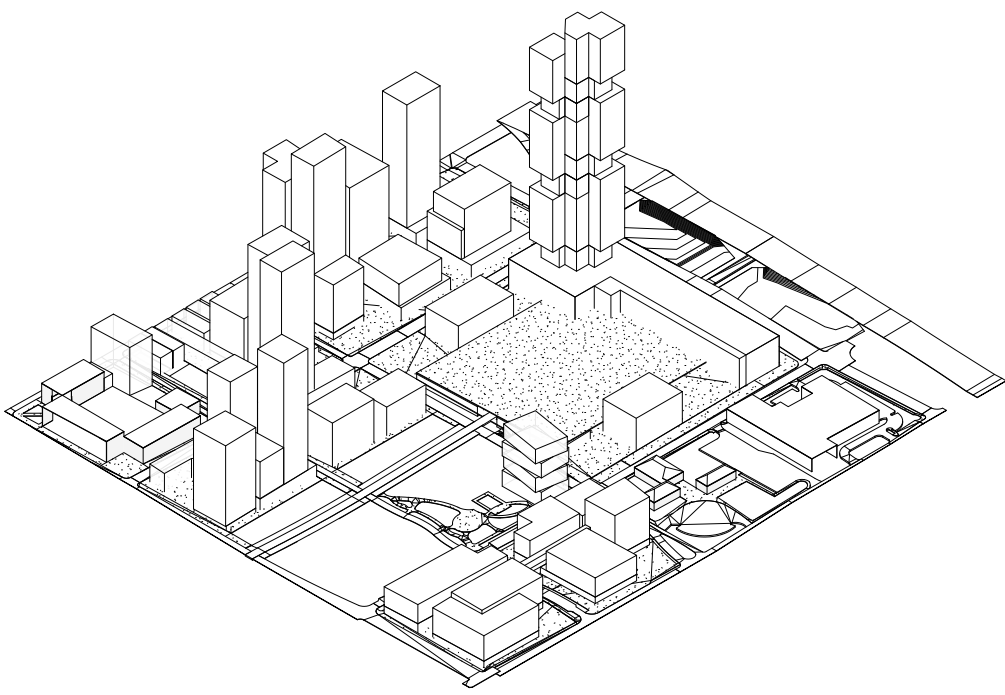
Trim Form



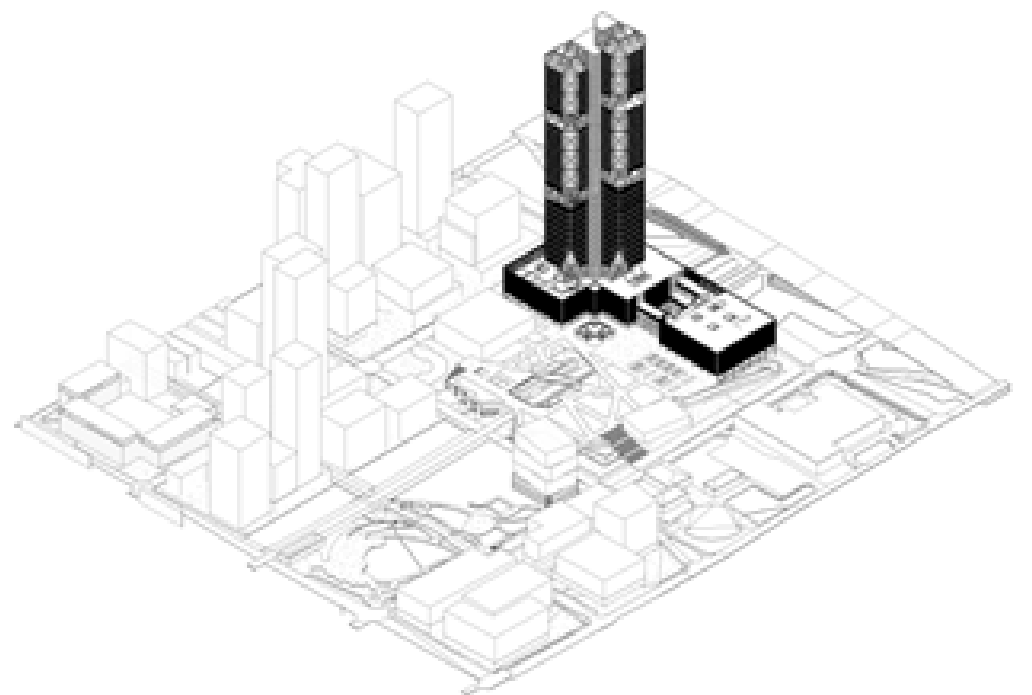
Structural Core



Green Scape



Final Abstracted Form



Final Structure

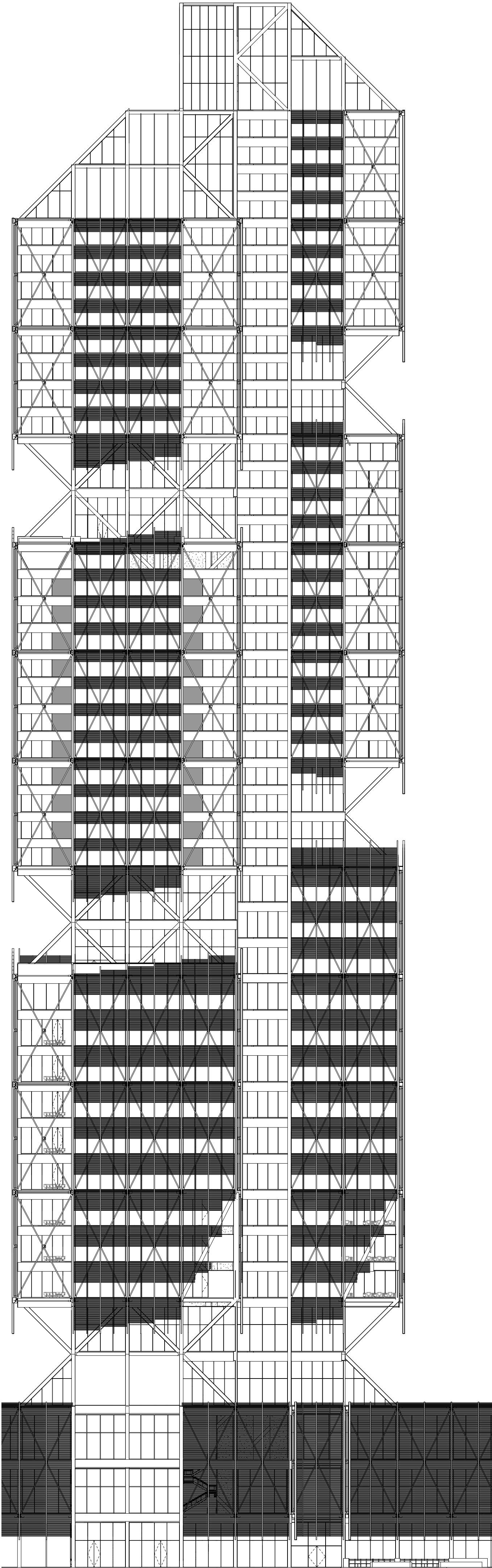
FORM EVOLUTION

Throughout the process of its development, the building form went through four iterations. The first building form was derived entirely from the function of the building. A thirty foot by thirty-foot structural grid was used in order to allow for large open spaces for the offices and apartments further up the skyscraper while still maintaining an ideal storefront entry dimension for the lower commercial sector. From here, the building was broken down into three sections vertically based on program. Each section would maintain the thirty-foot grid, however, as the building transitioned from commercial to residential vertically, the human density would decrease as well. As a result, the façade elements would transition similarly with higher densification at the commercial sector and lower densification at the residential sector.

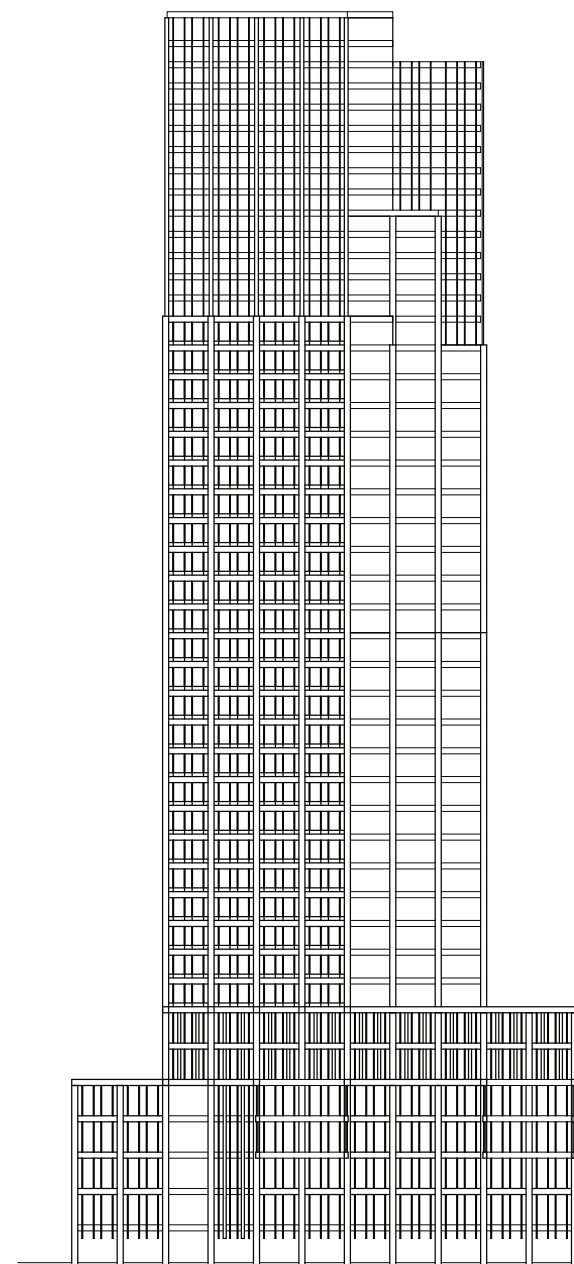
While highly functional, the initial iteration design was stylistically similar to skyscrapers of the 1950s. In the effort to maximize efficiency, the building was simplified as if it was constrained by the structural implications of the past. As such, a second iteration was developed. This iteration would be entirely conceptual and would develop more innovative design concepts to be implemented in the building. From this came the concept of mass and void that would be utilized in the final design. In this iteration, the building was conceived as a vertical mass. From there, portions of the building would be “cut” revealing the “central core” of the skyscraper. These “cuts” would not only serve an aesthetical purpose but also provide community green space centrally located within the skyscraper.

Taking both the facade shading of the first iteration and the angled “cuts” of the second iteration, the third iteration was realized. Despite the merger of these iterations, a design issue arose in regards to the façade. While the initial façade design was based on limiting solar heat gain into the building, the way it was implemented was limiting views out from the skyscraper. Because it utilized vertical shading mechanisms and implemented them in to the structural grid, the viewing spacing between the members was minimal. In addition, structural and programmatic needs necessitated changes to the form.

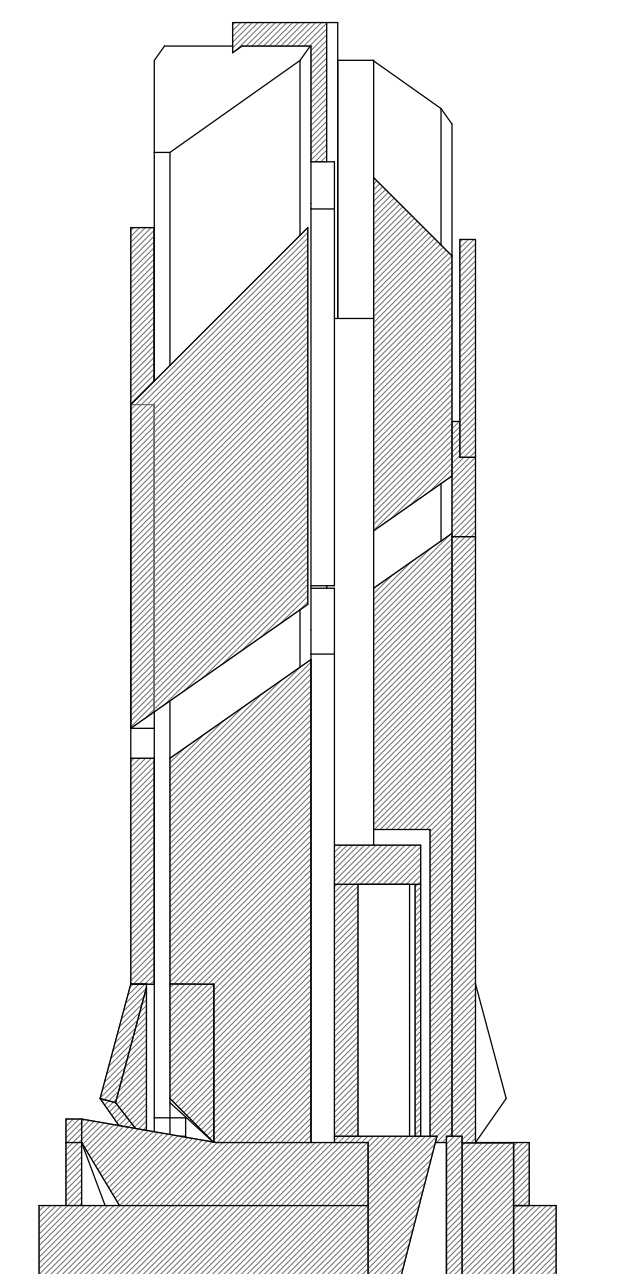
A final iteration was developed that would integrate the previous iterations but redesign how the façade was implemented into the building. To minimize the impact the façade had on views to the outside, the shading façade was separated from the structure resulting in a double skin for the building and utilized horizontal members rather than vertical. This would allow for unhindered views while still shading the building from the sun. In regards to the overall form, the number of vertical cuts was increased both for structural and programmatic reasons. Furthermore, the junction of the commercial and business portion of the building was “cut” in order to provide a visual distinction between the skyscraper and the rest of the complex.



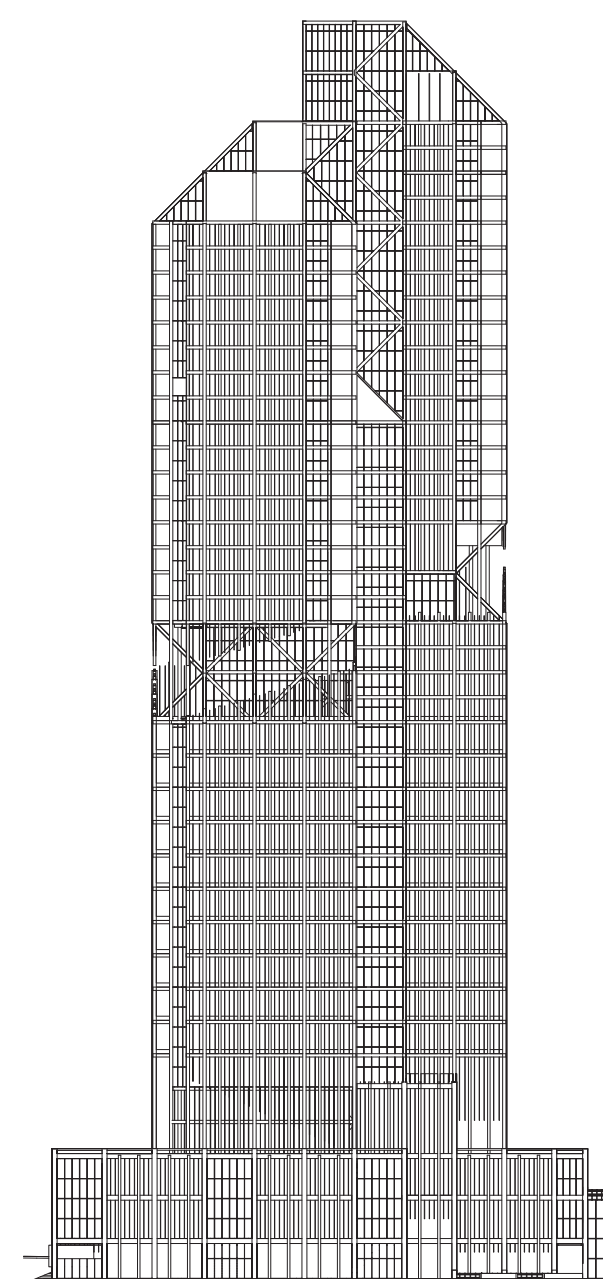
Final Iteration



Iteration 1



Iteration 2



Iteration 3



URBAN REDEVELOPMENT

In the search for an ideal site for the skyscraper, a few different parameters were set. The city needed to exhibit growth, however, it could not be too developed otherwise there would be issues finding space for the new building. After doing an extensive search on a fitting site for the project, it was decided that the best location would be Charlotte, North Carolina. One of the top twenty growing cities for the past two years, Charlotte provided a host of opportunities in terms of design. Within the downtown area was a four by four block area composed mostly of just parking. This would allow for urban redevelopment that would give more design freedom with the skyscraper. Furthermore, Charlotte had a very unique feature in the shape of a light rail line. Unlike most other cities across the U.S., Charlotte invested in a rail line running from the University of North Carolina through the downtown area of Charlotte itself. This would allow for a way to shift the parking outside of the downtown area and create a focus on pedestrian traffic and how they experience the city.

It was important that the city surrounding the skyscraper complied with the vision for the skyscraper as well as the city's requirements. Part of the reason why the skyscraper was located on this specific site was to help stimulate growth throughout this area of downtown. If successful, the new skyscraper would help raise the value of the land surrounding the skyscraper. This in turn would promote urban growth within the area that would help create a cohesive whole. As such, an extensive examination was done on the chosen site and what the city of Charlotte wanted done in terms of urban design. Working block-by-block, each existing structure on

the site was compared to the requirements listed out in the city guidelines. If they met the requirements and created a pedestrian friendly environment they were implemented into the new design. If they failed to meet the city requirements and created a less than ideal environment, they were demolished and the space was redeveloped with a more pedestrian focused urban environment.

Working from this, a building usage map was generated showing the distribution of the existing building types and which buildings would be demolished. This information was then used to create a pedestrian path map showing which users went where on the site from the existing rail line station. With this knowledge in hand, building massing was generated in compliance with the projected pedestrian paths and existing structures. Each mass was carefully placed in order to correlate with its surrounding context, meet existing urban requirements of the city, and create a thriving urban area. In addition, certain strategies the city had devised for development were used as inspiration for the new design. For instance, the existing list of city requirements states that any new parking structure must utilize the first floor as usable commercial space. This strategy was extended with the new urban plan to include all business-related structures. The reason for this was to create a street that was focused on pedestrian usage and helped stimulate the daily life of the city.

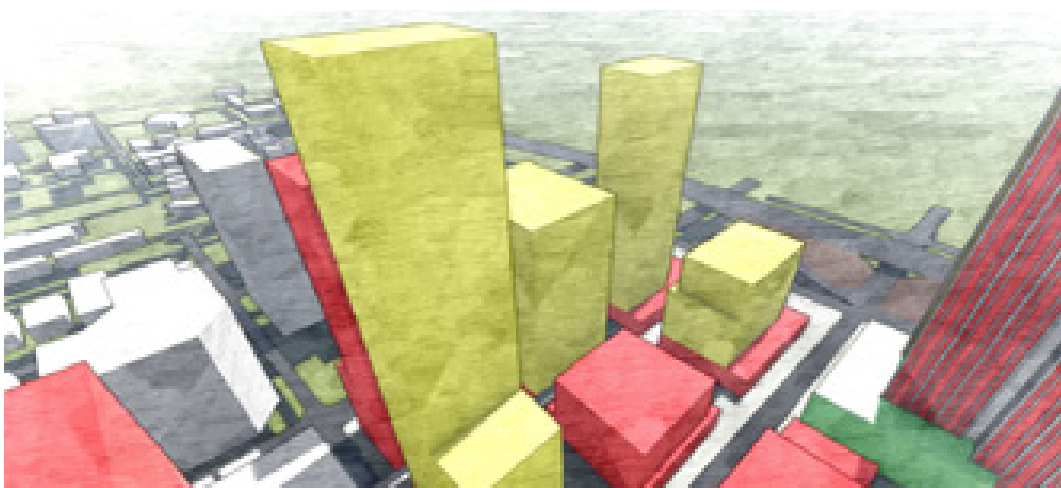
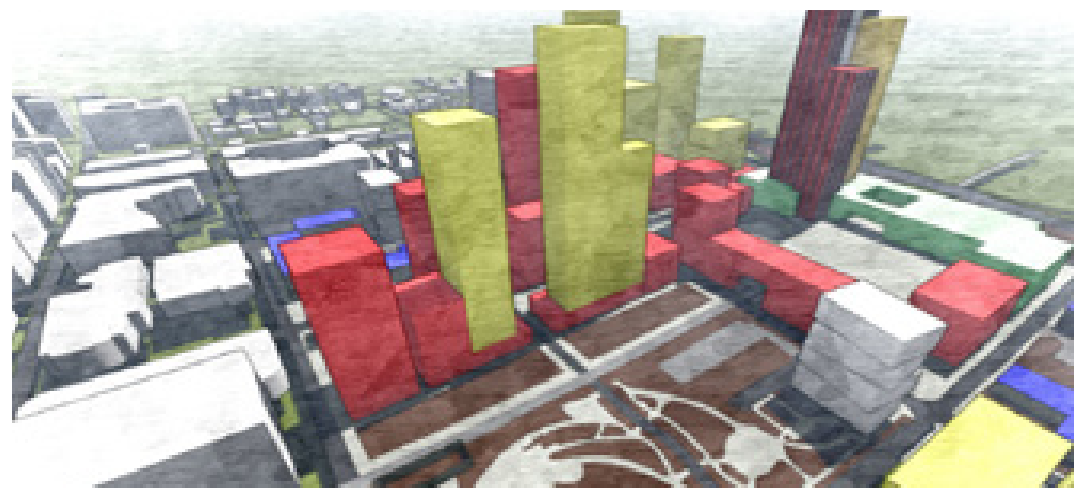
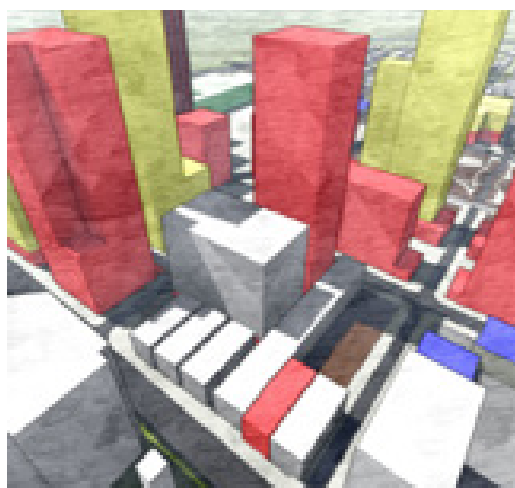
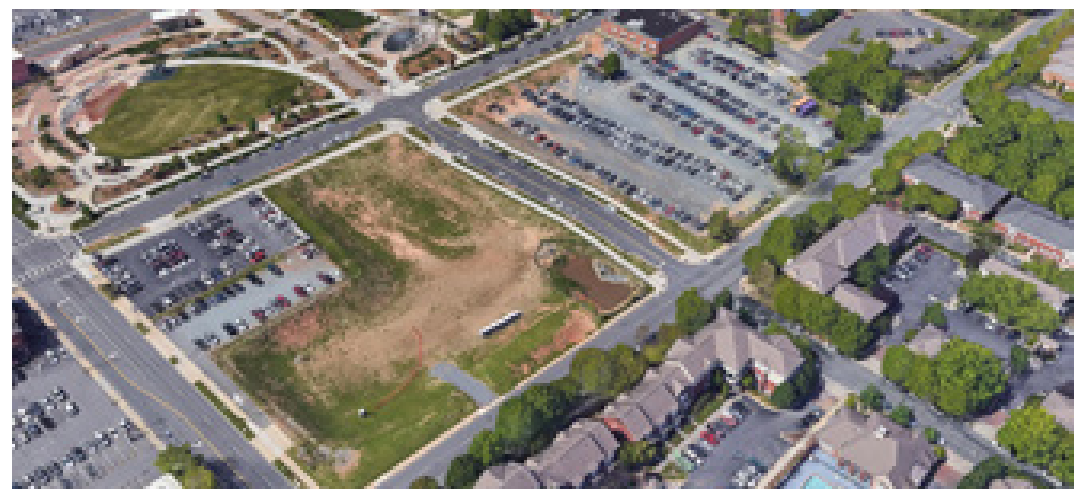
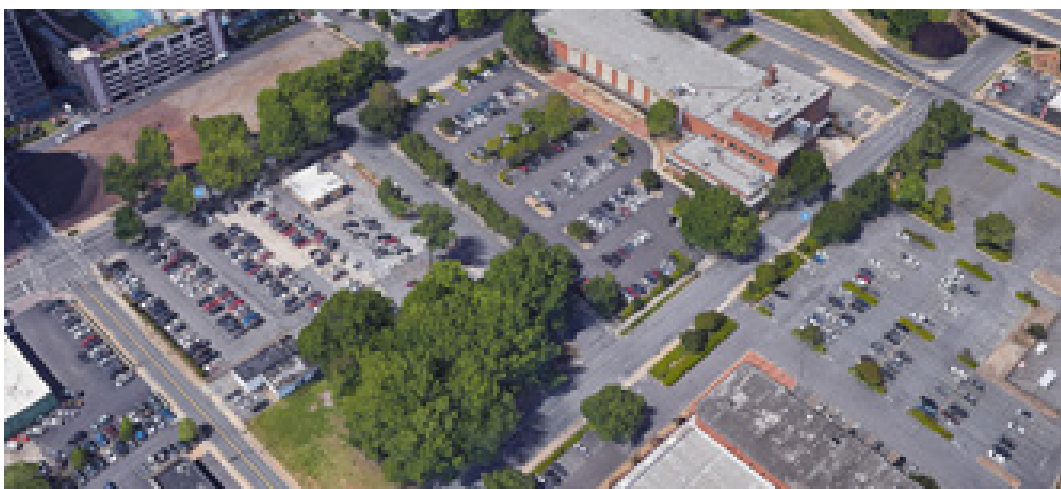
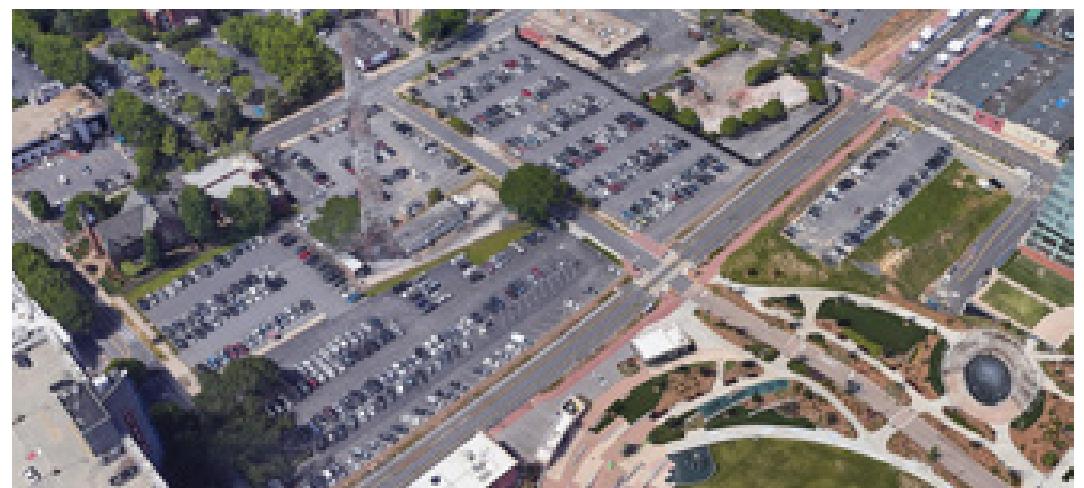
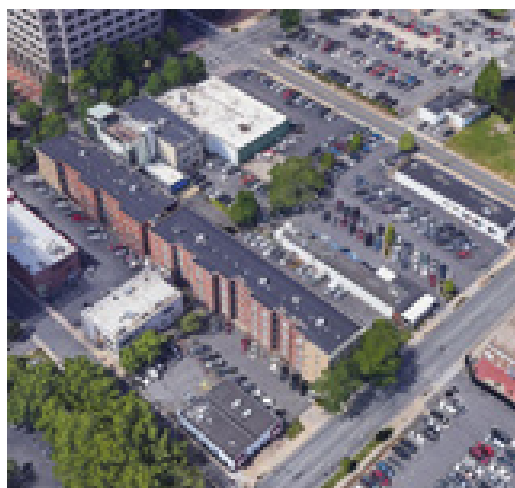
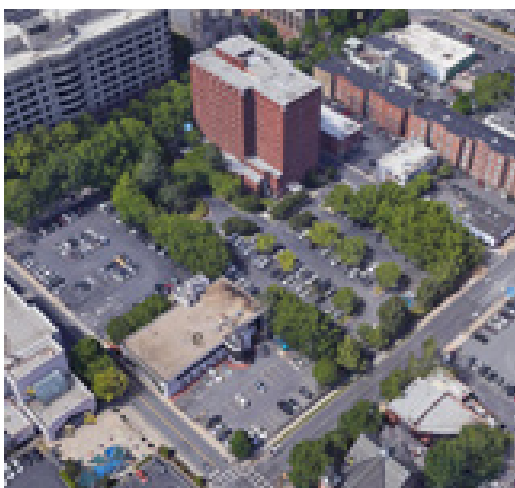


Image from Transit Station Area Principles

CHARLOTTE'S FUTURE CITY PLAN

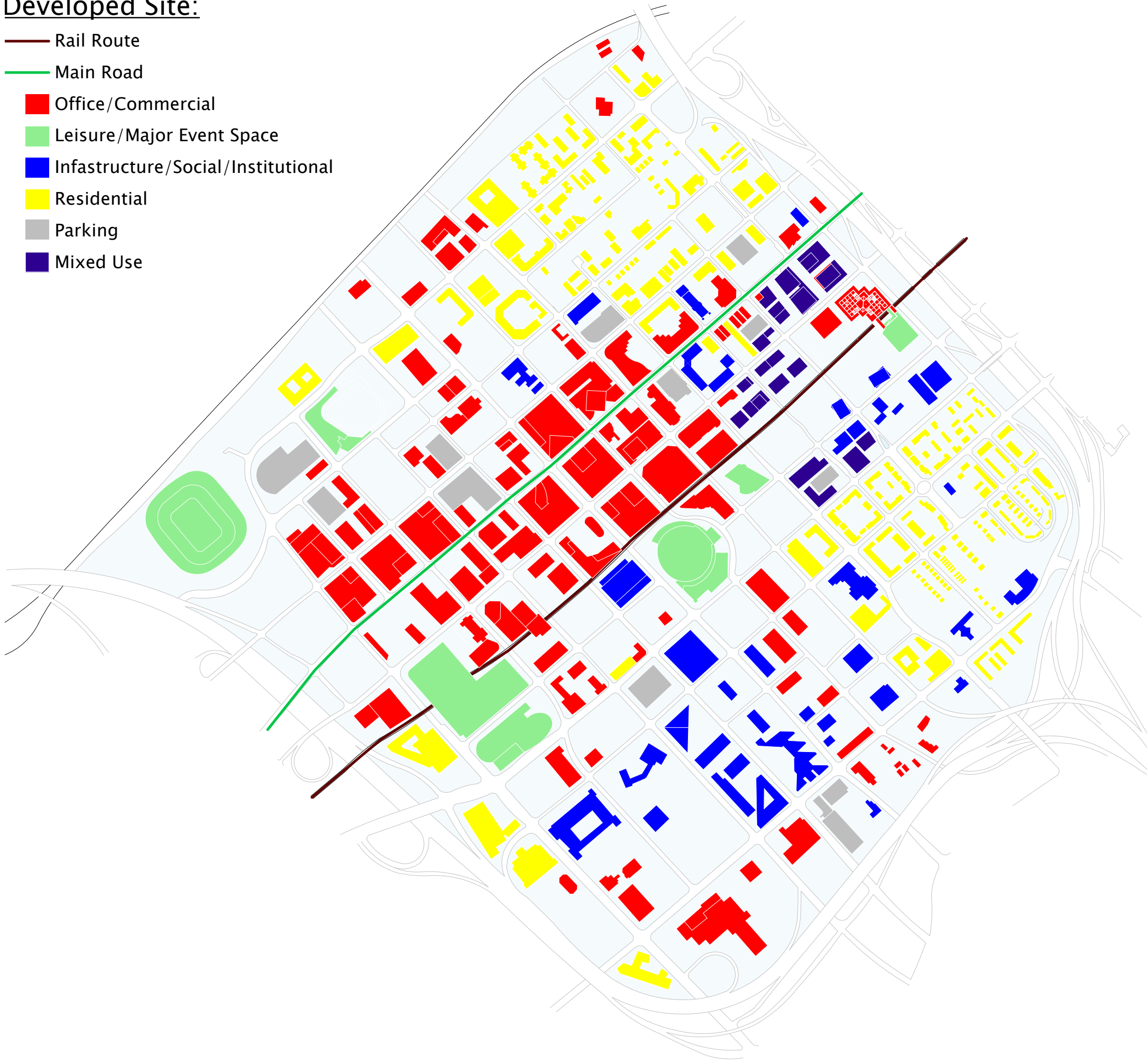
A vital component of Charlotte's redevelopment was an examination into the city's future plan for the city. Charlotte City Council adopted several principles for city growth years earlier. Each of these were specifically chosen in order to create an ideal city plan. As such, these principles were used to determine which structures would remain while also providing design guidelines for new design. Each city block within the redevelopment area was examined and compared to the requirements and redeveloped accordingly.

- Integrated land use and transit system
- Higher density residential
- Employment growth in station areas
- Major activity centers best accommodated by transport services
- Compact neighborhoods with variety of uses within walking distance of station
- Avoid car usage
- Provide uses that attract pedestrian activity
- Higher density for new developments
- Buildings to front on public streets, minimal setbacks
- Streets to include trees, lighting, benches



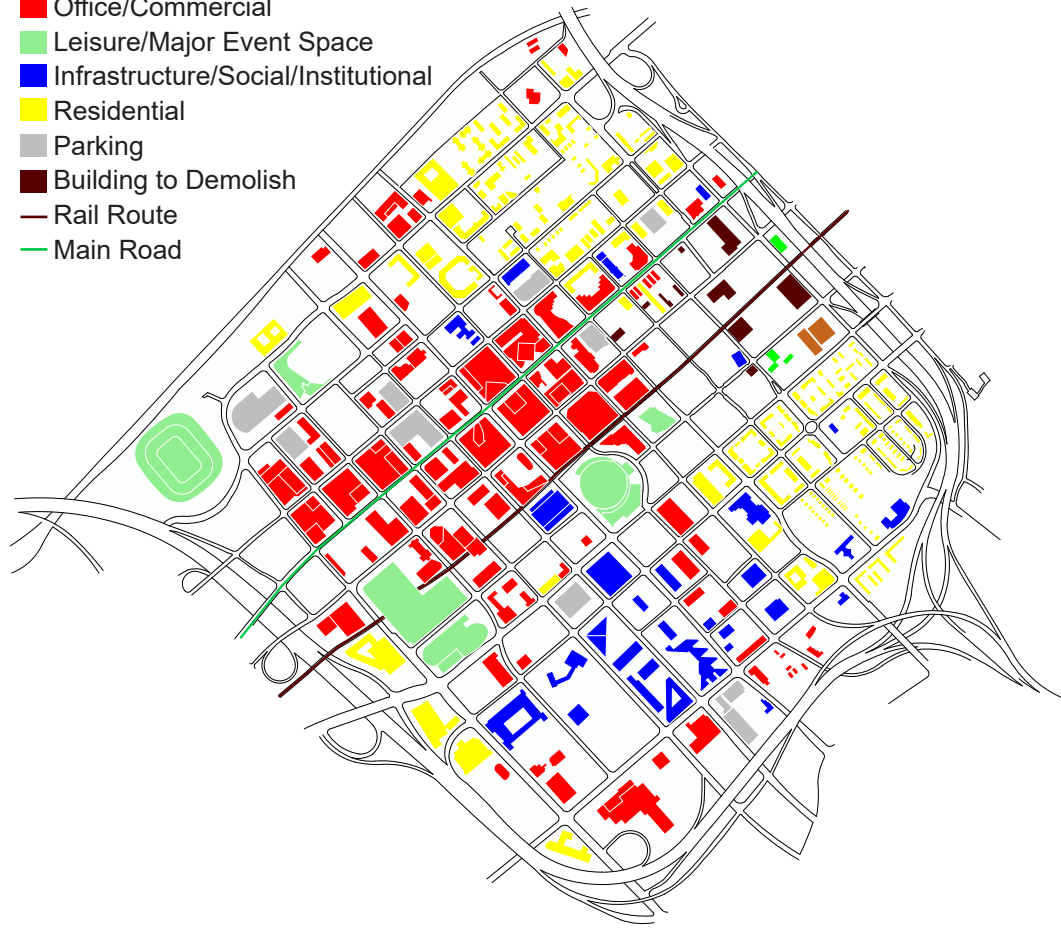
Developed Site:

- Rail Route
- Main Road
- Office/Commercial
- Leisure/Major Event Space
- Infrastructure/Social/Institutional
- Residential
- Parking
- Mixed Use



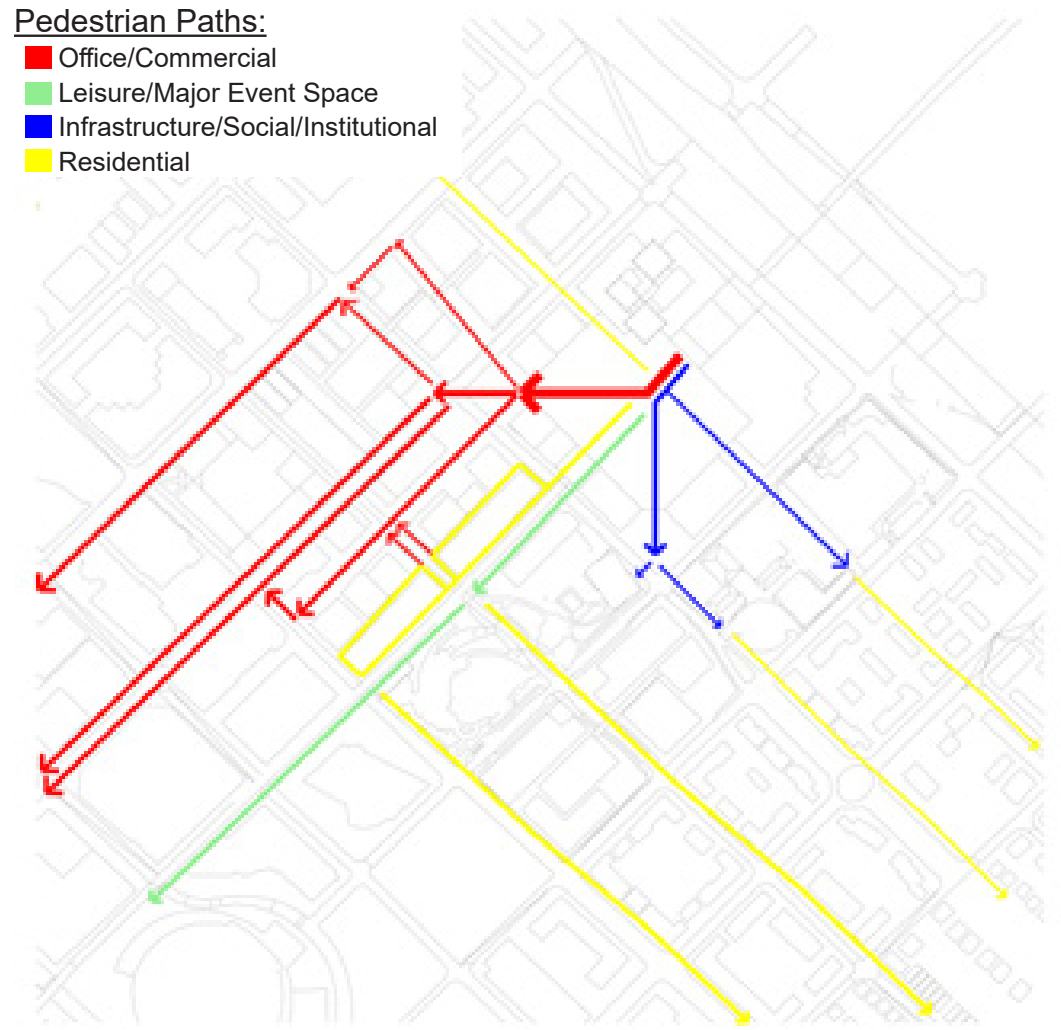
Existing Site:

- Office/Commercial
- Leisure/Major Event Space
- Infrastructure/Social/Institutional
- Residential
- Parking
- Building to Demolish
- Rail Route
- Main Road



Pedestrian Paths:

- Office/Commercial
- Leisure/Major Event Space
- Infrastructure/Social/Institutional
- Residential



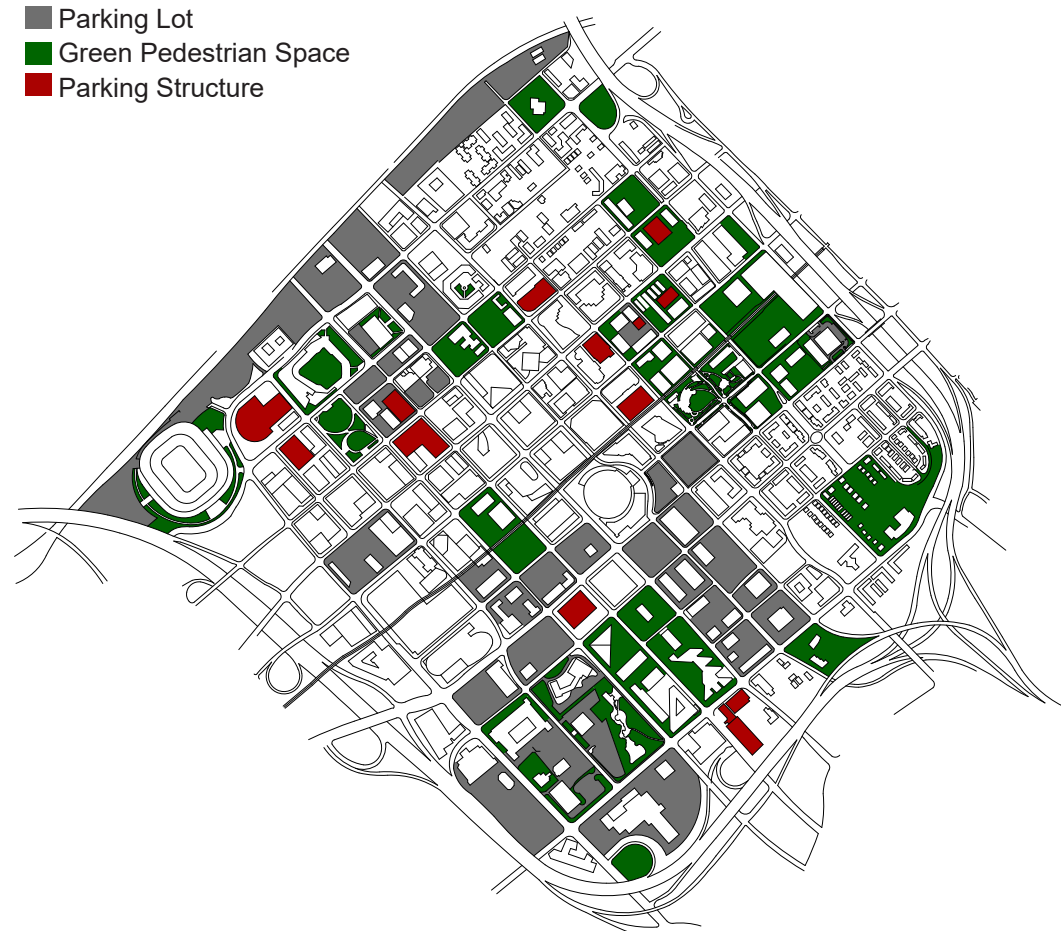
Current Land Usage:

- Parking Lot
- Green Pedestrian Space
- Parking Structure



Future Land Usage:

- Parking Lot
- Green Pedestrian Space
- Parking Structure





URBAN APPROACH

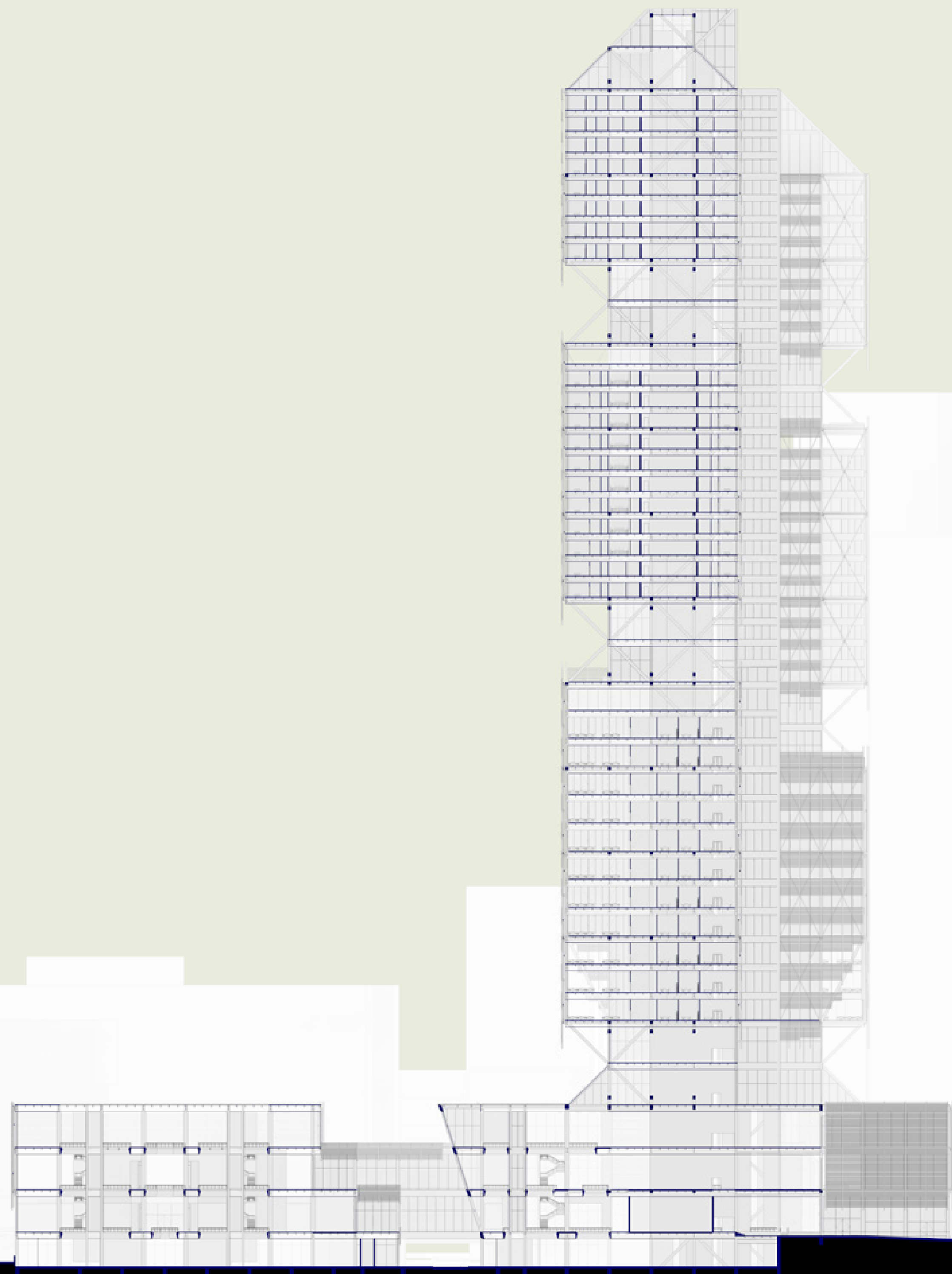
In the design of a skyscraper, it is important to create a sense of community internally. One of the ways this occurs within the urban context is through the usage of streets. While streets and sidewalks serve as a way to travel from one point to another, they also provide a sense of community as you traverse past people making their way through the streets of the city. In this way, the street not only serves a functional use but also a social one as well. Unfortunately, this concept is lost when it comes to most skyscrapers. Infrastructure within skyscrapers is designed specifically as a way to transport people from one location to another. As such, all elevators are clustered towards the center, mostly for structural purposes, and any sense of community is lost as you are silently transported in an enclosed metal box from one location to another.

While this method is highly efficient, it does not comply with the concept of a vertical city. In order to make the skyscraper serve as a vertical extension of the city, the infrastructure needed to be redesigned with the concept of community in mind. The first step to this was changing the layout of elevators at the central core. Rather than grouping them together and creating a central mass, they were each placed around a lobby space

that would be centrally located within the skyscraper's core. This would change the design of the infrastructure from one that was more functionally focused to one that was more community focused. Furthermore, glass elevators were used in order to create a connection to each level as you traveled to your specific floor. Lastly, each lobby would open to the level below in a varying pattern allowing for a visual connection from floor to floor.

By implementing these simple design elements, a sense of connection and community begins to take form within the skyscraper itself.





VERTICAL PURPOSE

While a seemingly simple concept, implementing a variety of usages within a skyscraper is vital to creating a vertical extension of the city and quickly makes the design process more complicated. A mixed program allows for a mix of people to inhabit the building. Much like how cities need varying programs in order to thrive throughout the day, the skyscraper would serve multiple uses including commercial at the levels closest to the rail station, business for the next sector, and lastly residential further up. This brings complications as the building must create a sense of community while also allowing for privacy for those living within the building. However, it is important to have a varying program as this element helps break the issue of belonging and possession that some might find foreboding with most skyscrapers.

The concept of vertical purpose is simply to provide a reason for those in the city to traverse vertically. While the populace's perception of the skyscraper might be different, everyone could look to the skyscraper and have a reason to enter. Whether seen as a residence, work, or a place to relax on the weekend, the skyscraper would serve as a vertical representation of community much like the urban city does today.

Total Rentable Square Footage: 839,600 SQ. FT.

GREEN COMMUNITY SPACE

Commercial Square Footage: 27,200 SQ. FT.

MECHANICAL SECTOR

RESIDENTIAL SECTOR TYPE 2

Level Specifications

Rentable Square Footage: 132,800 SQ. FT.

Number of Floors: 8 Floors

Number of 2,766 SQ. FT. Apartments: 48

Floor-to-Floor Height: 15 FT.

GREEN COMMUNITY SPACE

Commercial Square Footage: 13,600 SQ. FT.

Green Space Square Footage: 13,600 SQ. FT.

MECHANICAL SECTOR

RESIDENTIAL SECTOR TYPE 1

Level Specifications

Rentable Square Footage: 151,800 SQ. FT.

Number of Floors: 11 Floors

Number of 800 SQ.FT. Apartments: 66

Number of 1,500 SQ.FT. Apartments: 66

Floor-to-Floor Height: 15 FT.

GREEN COMMUNITY SPACE

Commercial Square Footage: 13,600 SQ. FT.

Green Space Square Footage: 13,600 SQ. FT.

MECHANICAL SECTOR

OFFICE SECTOR

Level Specifications

Rentable Square Footage: 209,800 SQ. FT.

Number of Floors: 11 Floors

Floor-to-Floor Height: 25 FT.

GREEN COMMUNITY SPACE

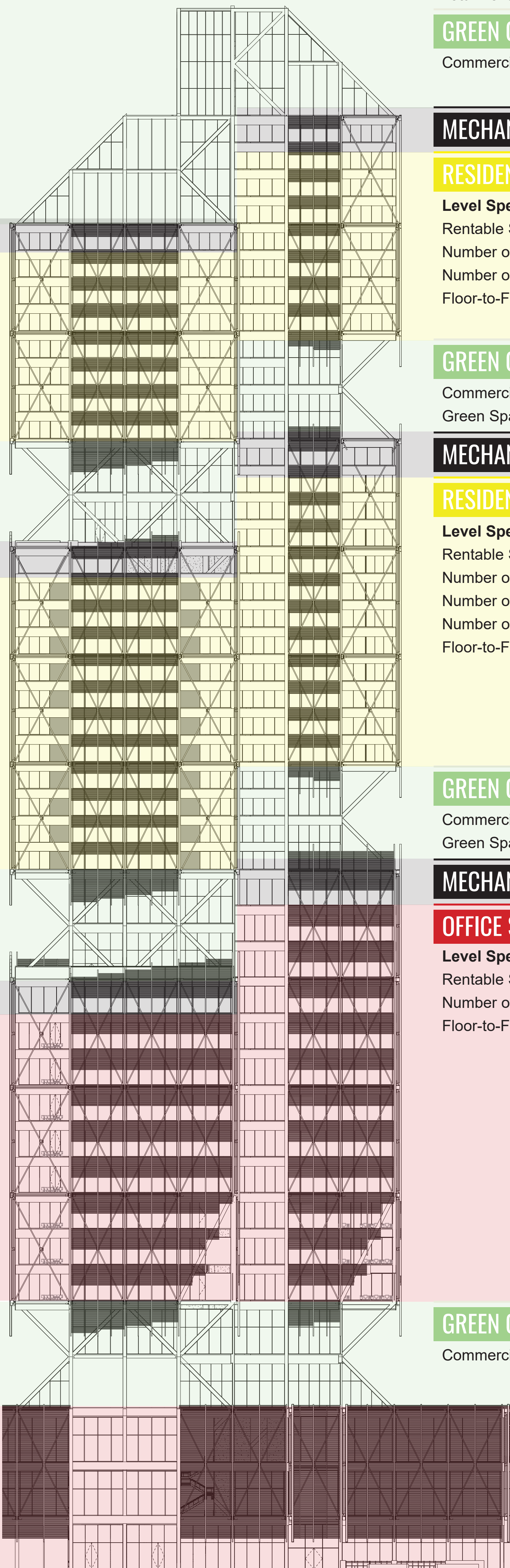
Commercial Square Footage: 13,600 SQ. FT.

COMMERCIAL SECTOR

Commercial Square Footage:
250,000 SQ. FT.

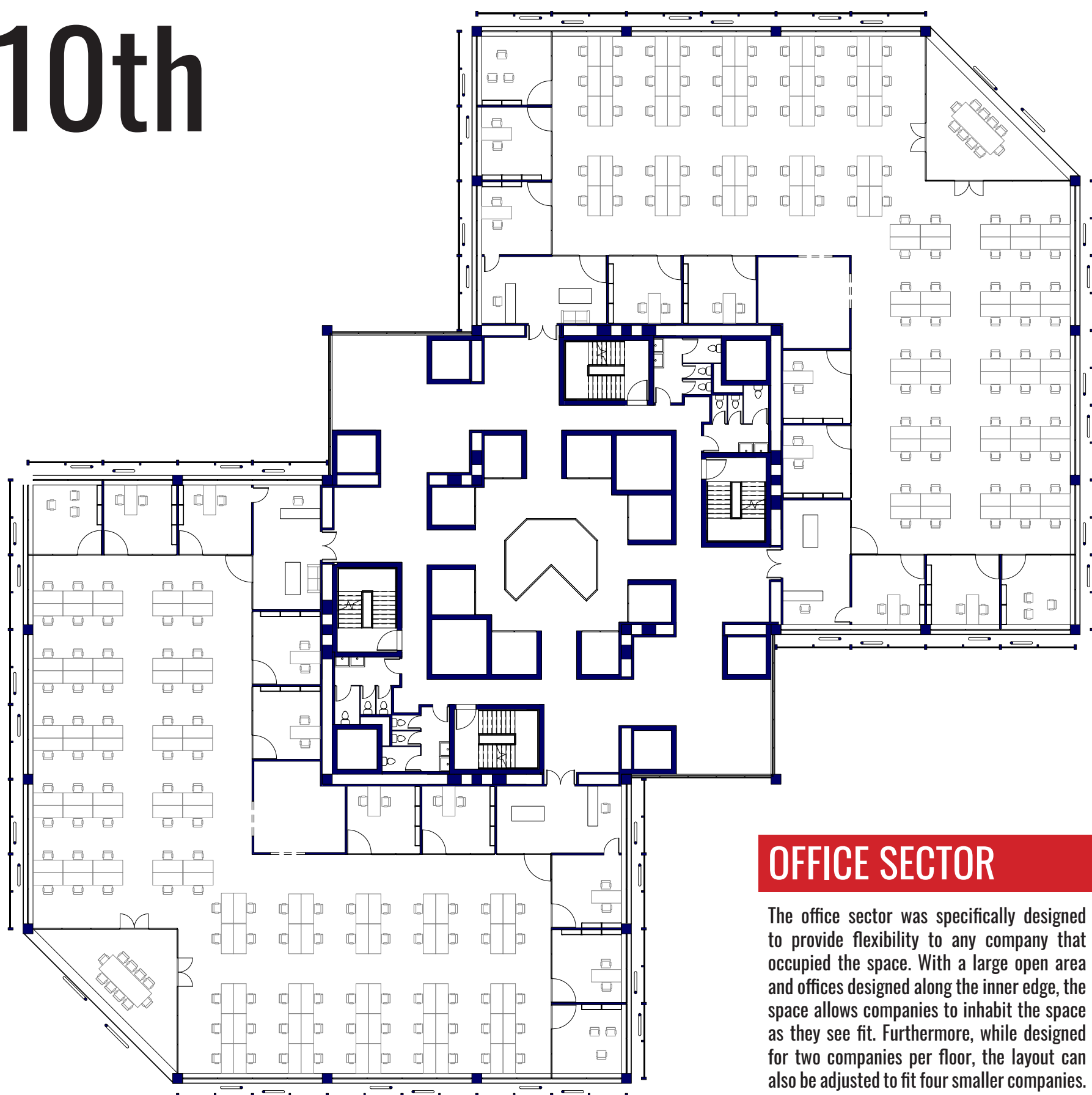
Number of Floors: 4

Floor-to-floor Height: 30 FT.





10th

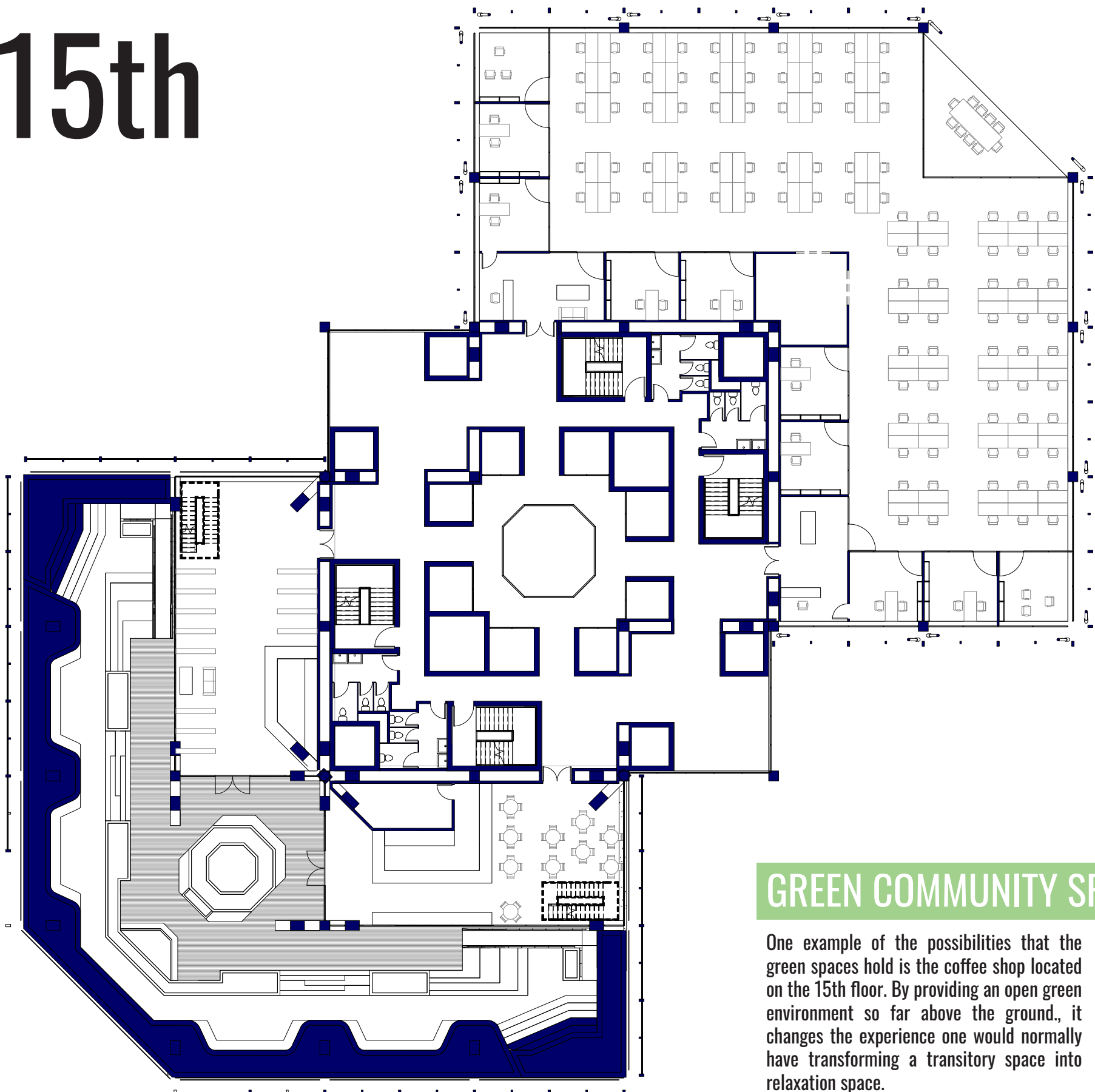


OFFICE SECTOR

The office sector was specifically designed to provide flexibility to any company that occupied the space. With a large open area and offices designed along the inner edge, the space allows companies to inhabit the space as they see fit. Furthermore, while designed for two companies per floor, the layout can also be adjusted to fit four smaller companies.



15th

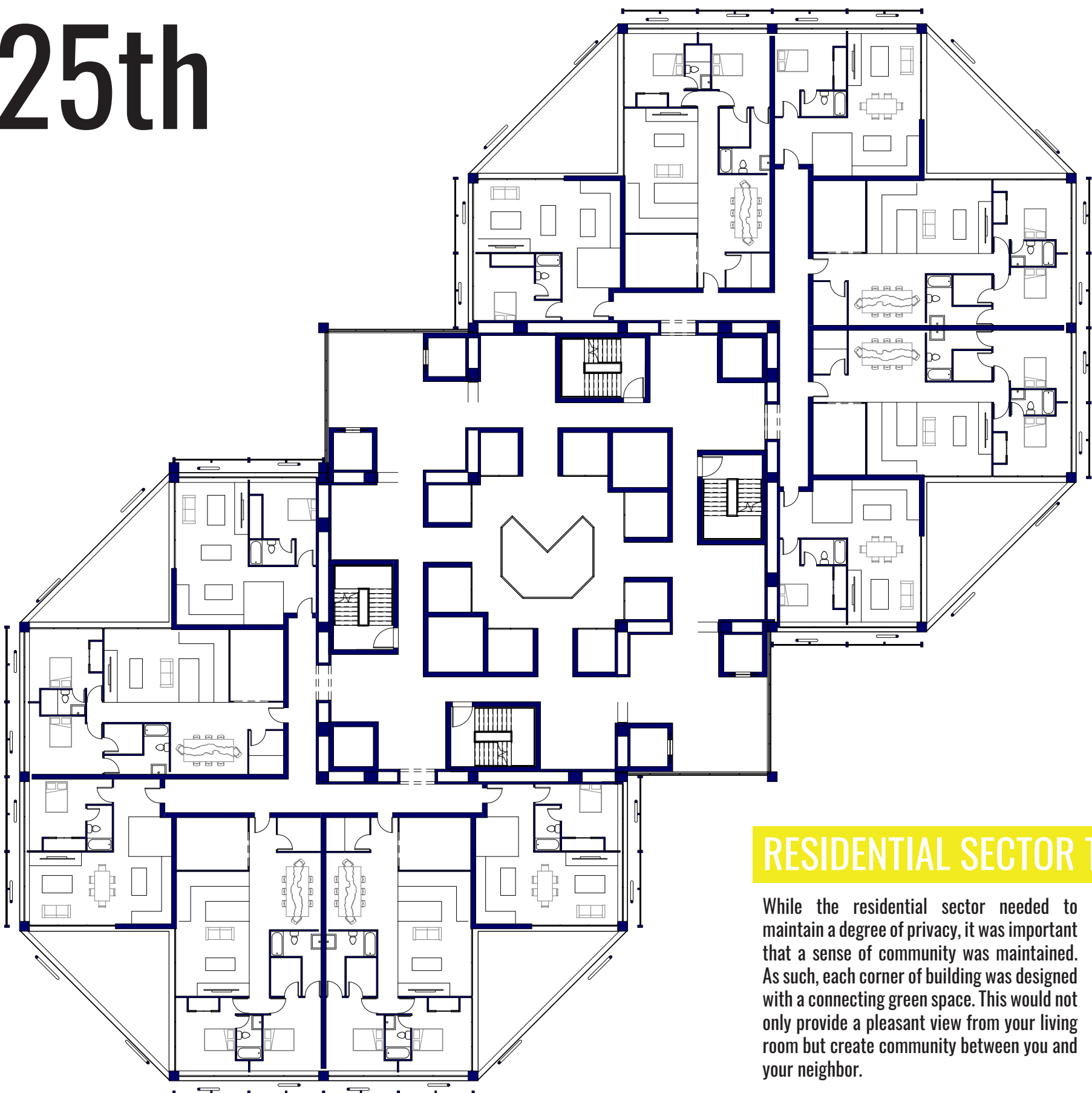


GREEN COMMUNITY SPACE

One example of the possibilities that the green spaces hold is the coffee shop located on the 15th floor. By providing an open green environment so far above the ground., it changes the experience one would normally have transforming a transitory space into relaxation space.



25th

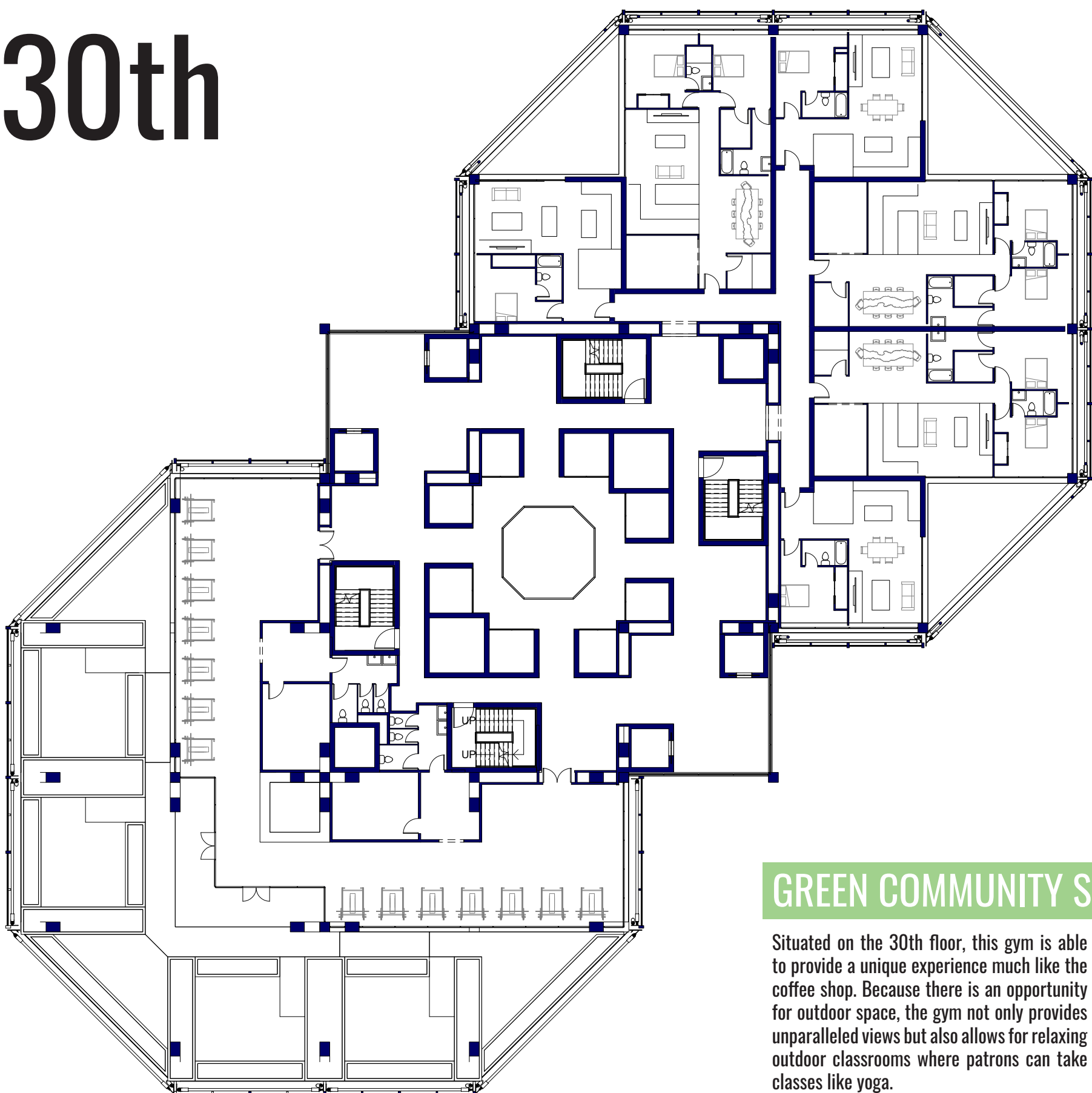


RESIDENTIAL SECTOR TYPE 1

While the residential sector needed to maintain a degree of privacy, it was important that a sense of community was maintained. As such, each corner of building was designed with a connecting green space. This would not only provide a pleasant view from your living room but create community between you and your neighbor.



30th



GREEN COMMUNITY SPACE

Situated on the 30th floor, this gym is able to provide a unique experience much like the coffee shop. Because there is an opportunity for outdoor space, the gym not only provides unparalleled views but also allows for relaxing outdoor classrooms where patrons can take classes like yoga.



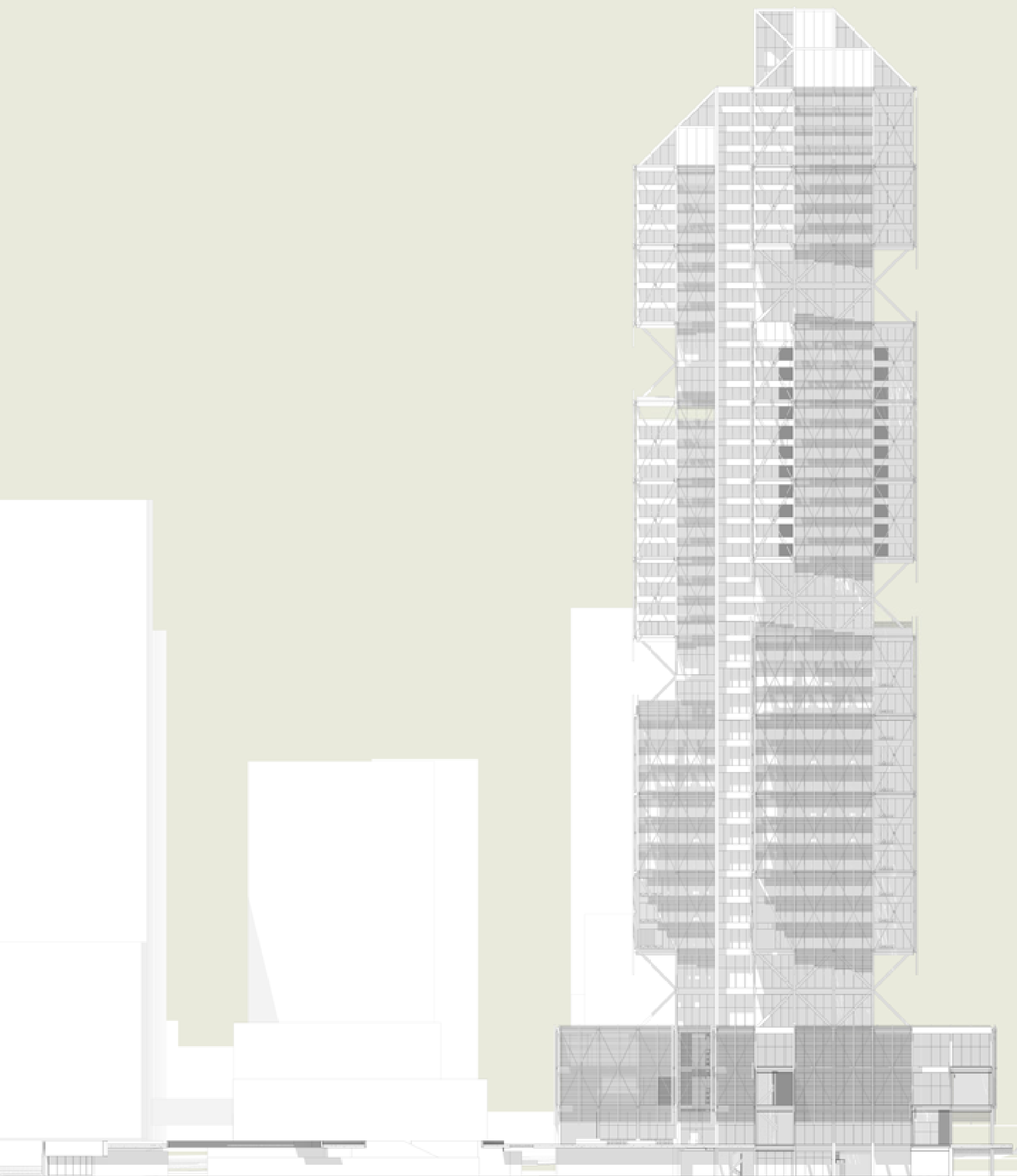
GREEN INFUSION

A foundation of good urban design, green space can often be the distinguishing factor between good and great space. While not an absolute necessity, green space allows for a comforting environment for the populace to enjoy. As such, the infusion of green space was vital for this project. Just as green space often fills the gaps between sections of the city, green space would work as a connecting floor between each of the different sections of the skyscraper.

While green space by itself is wonderful, given the nature of the skyscraper, it was decided that each green space should be paired with a commercial function. For instance, the green space on the 15th floor would not only serve as a public place to relax, but also house a cafe and library. This would not only provide the skyscraper a source of revenue that could support the outdoor green space, but also give the space another purpose other than relaxing as well.

With the progression of the skyscraper structure and form, it was decided that the number of green spaces would increase to match the number of outrigger trusses placed across the skyscraper. Each of these would serve a unique function while also providing landscaped outdoor space to be enjoyed.





WHERE VERTICAL AND HORIZONTAL MEET

After doing an extensive examination into the site and revitalizing the surrounding context, a focus was placed on how the skyscraper was integrated into the surrounding site. It was quickly decided that the skyscraper should be located where the existing rail line station was currently situated on site. This was due to the fact that all of the other stations were located by some sort of significant structure. The city had stated in its guidelines that each station should be near some sort of significant structure or hub within the downtown area. However, the station located on site was in the midst of parking with only a few small buildings around it. Thus, the original station would be demolished and rebuilt as part of the new skyscraper complex.

A study was then done on public transportation paths within the city, both current and those planned for the future. It was discovered that the city was planning a secondary rail line running past the upper northeast portion of the site perpendicular to the existing rail line. As a result, it was decided to place the skyscraper complex along the back northeast portion of the rail line site. This would allow for the building to function as a rail line stop for the existing line and still be able to serve the secondary line in the future.

During the development of the project, it was discovered that there was a significant drop across the chosen site. Because of the rail line, there was a slope of twenty-five feet from one side of the site to the other. This was to allow for the northeast street to cross over the rail line while the southwest streets met up at the rail line level. In order to overcome this,

the decision was made to create two distinct levels for the site. One would serve as the rail line path running below the site unobstructed. The second would be twenty-five feet above the rail line and serve as the plaza for the skyscraper. This would allow the plaza to remain on level with the northeast street.

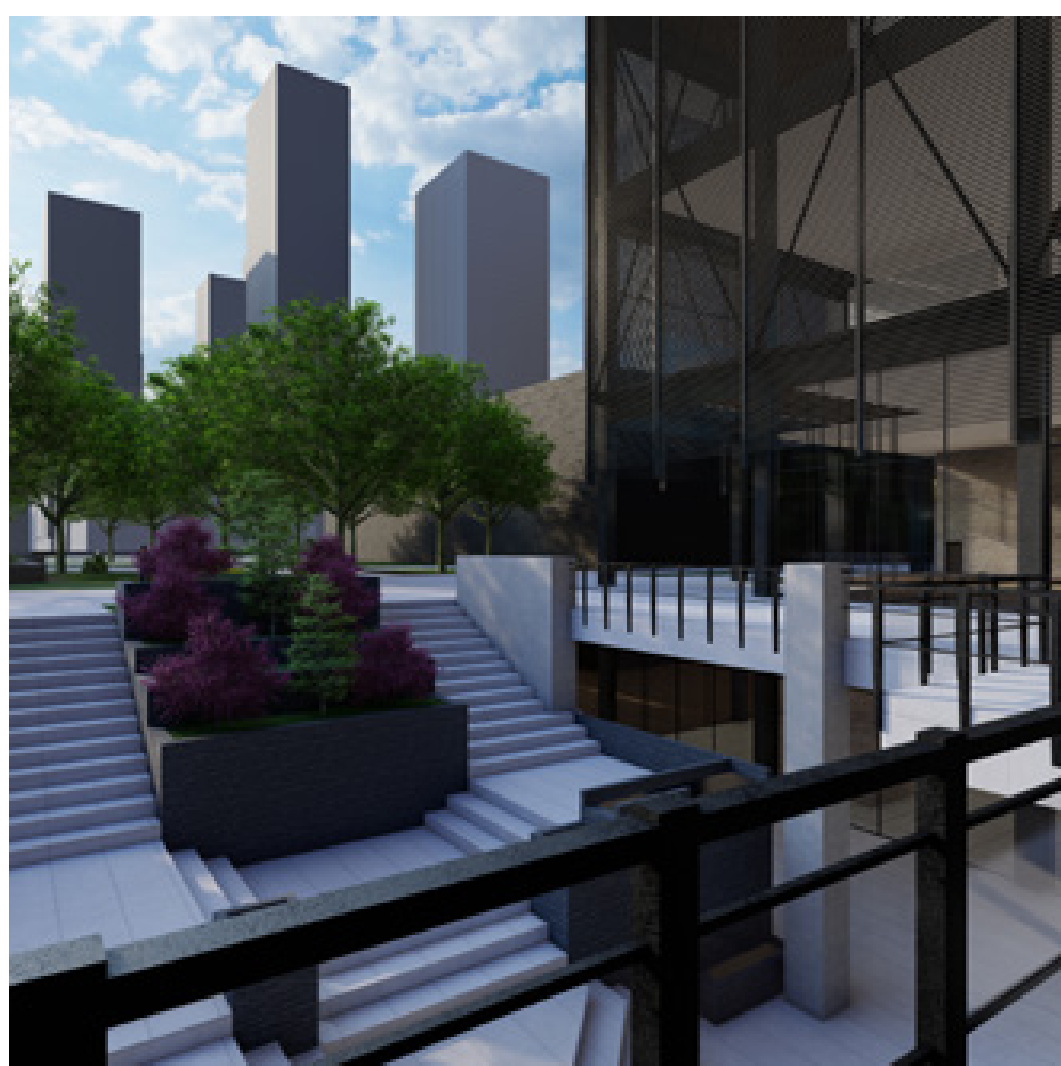
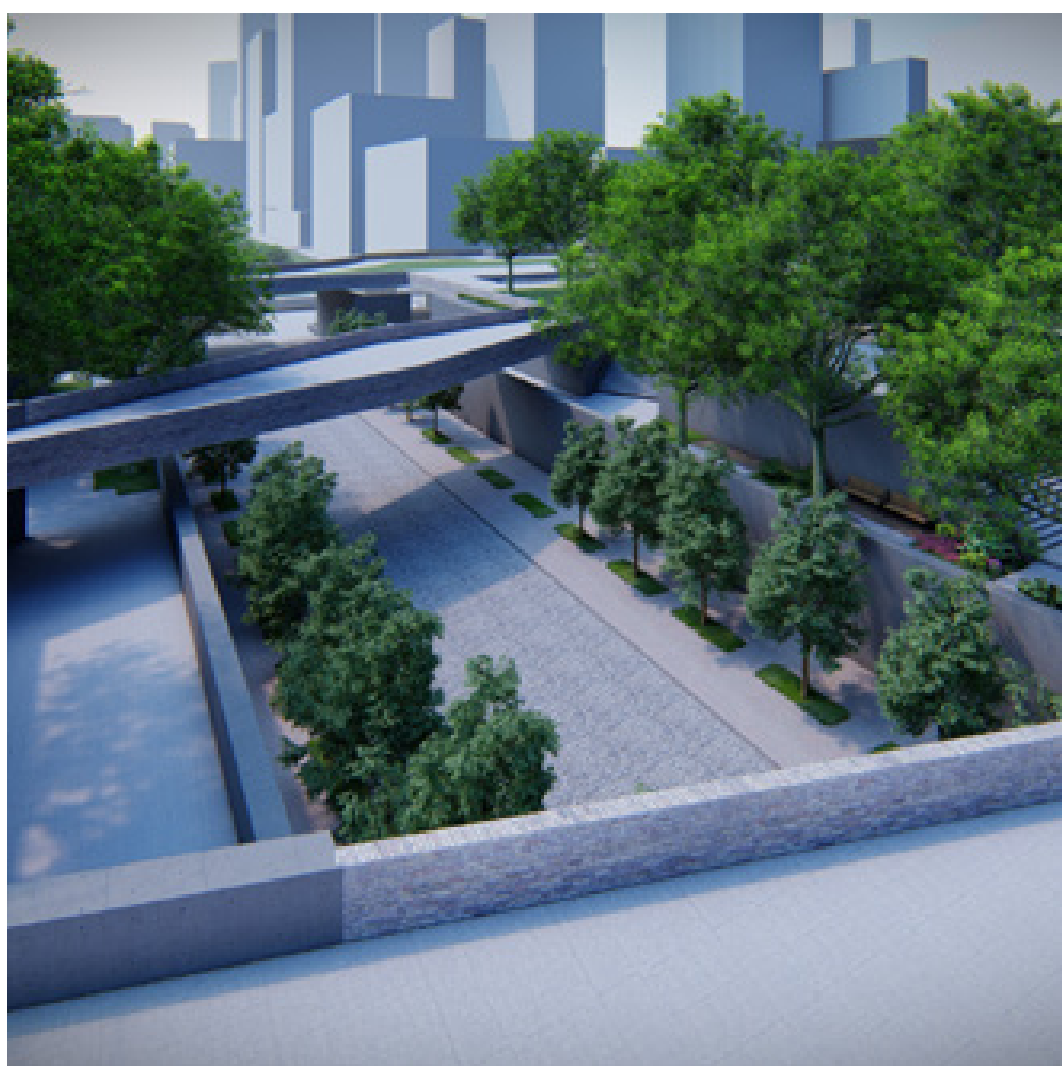
While the new plaza fixed the sloping issue, it created a separation between the urban elements of the skyscraper and the rail line station itself. It was important that the skyscraper was integrated into the site and enclosing the rail line station prevented that from being realized. As a result, certain sections of the site and the rail station itself were opened to the levels above. This would allow for a connectivity between both levels and allow for a more open environment that allows visitors to see what the station has to offer. Furthermore, it was important that the rail line station felt like a feature of the site rather than just a mode of transportation. As such, green space was designed along the rail line to provide areas for people to relax while waiting for the light rail to arrive.

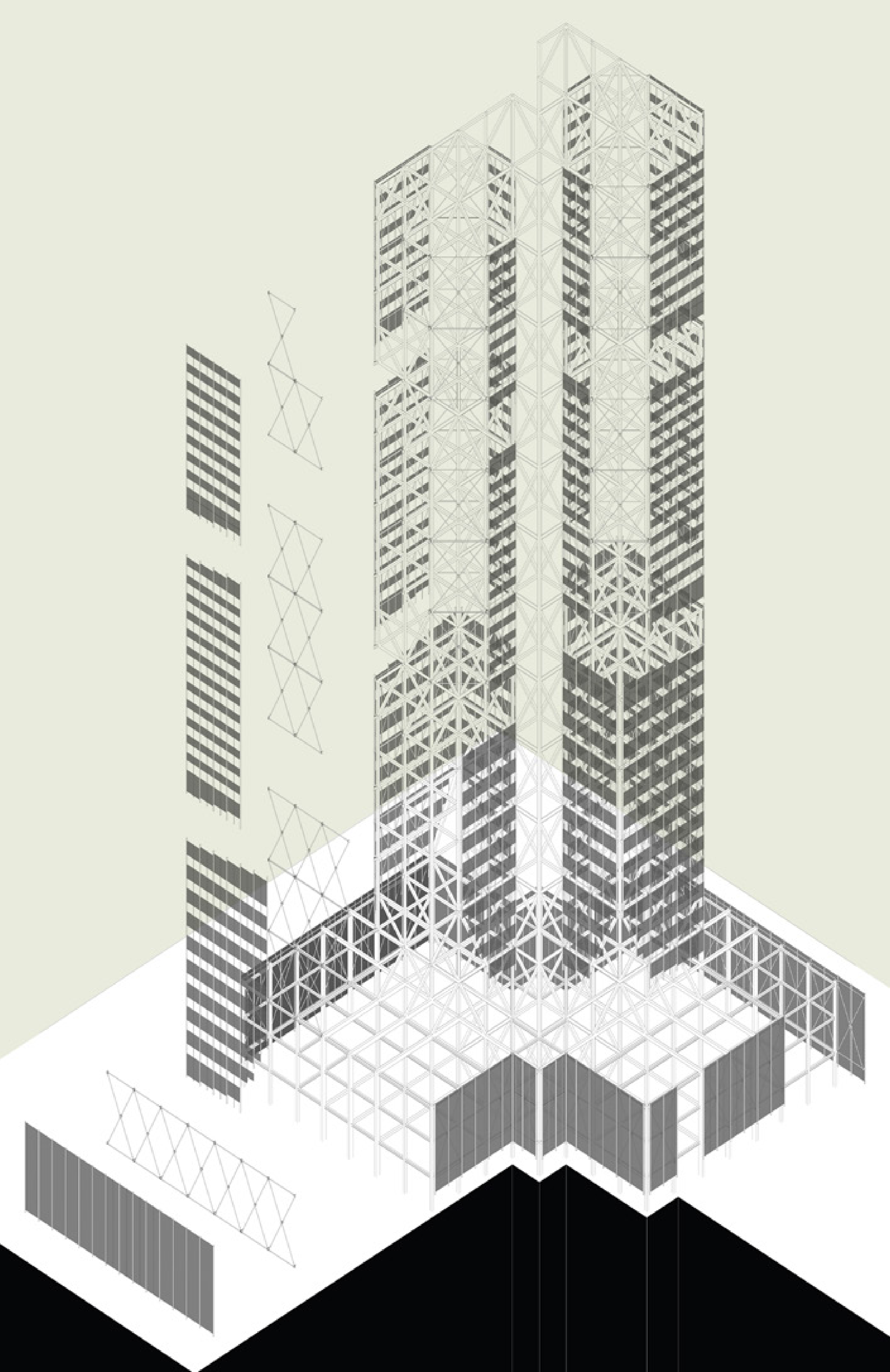


Legend:

- Light Rail Route
- Main Road
- Streetcar Route
- Future Rail Route
- Express Bus Route
- Bus Route
- Current Rail Stations
- Future Silver Line Stations
- Express Bus Stop
- Bus Stop





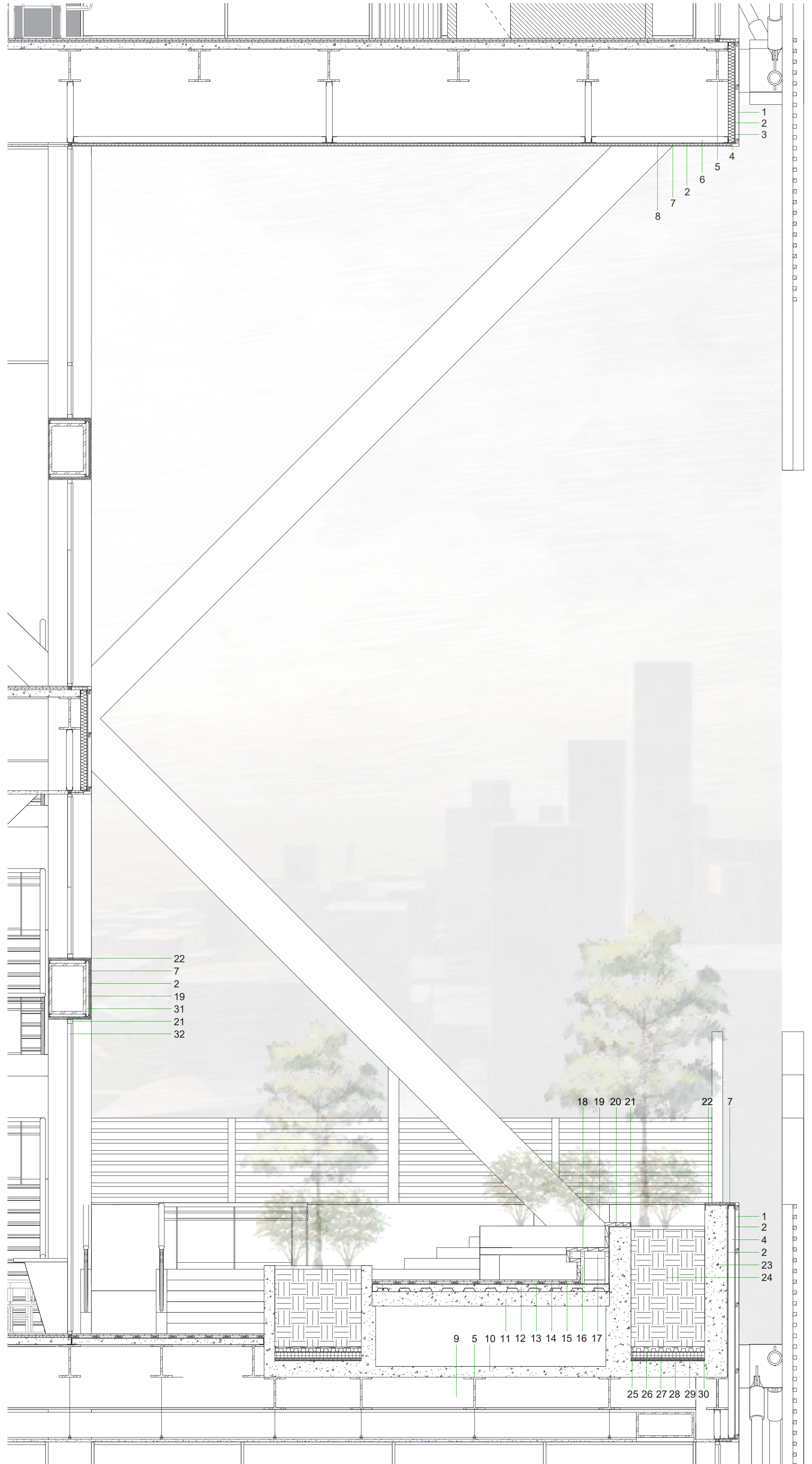


STRUCTURE

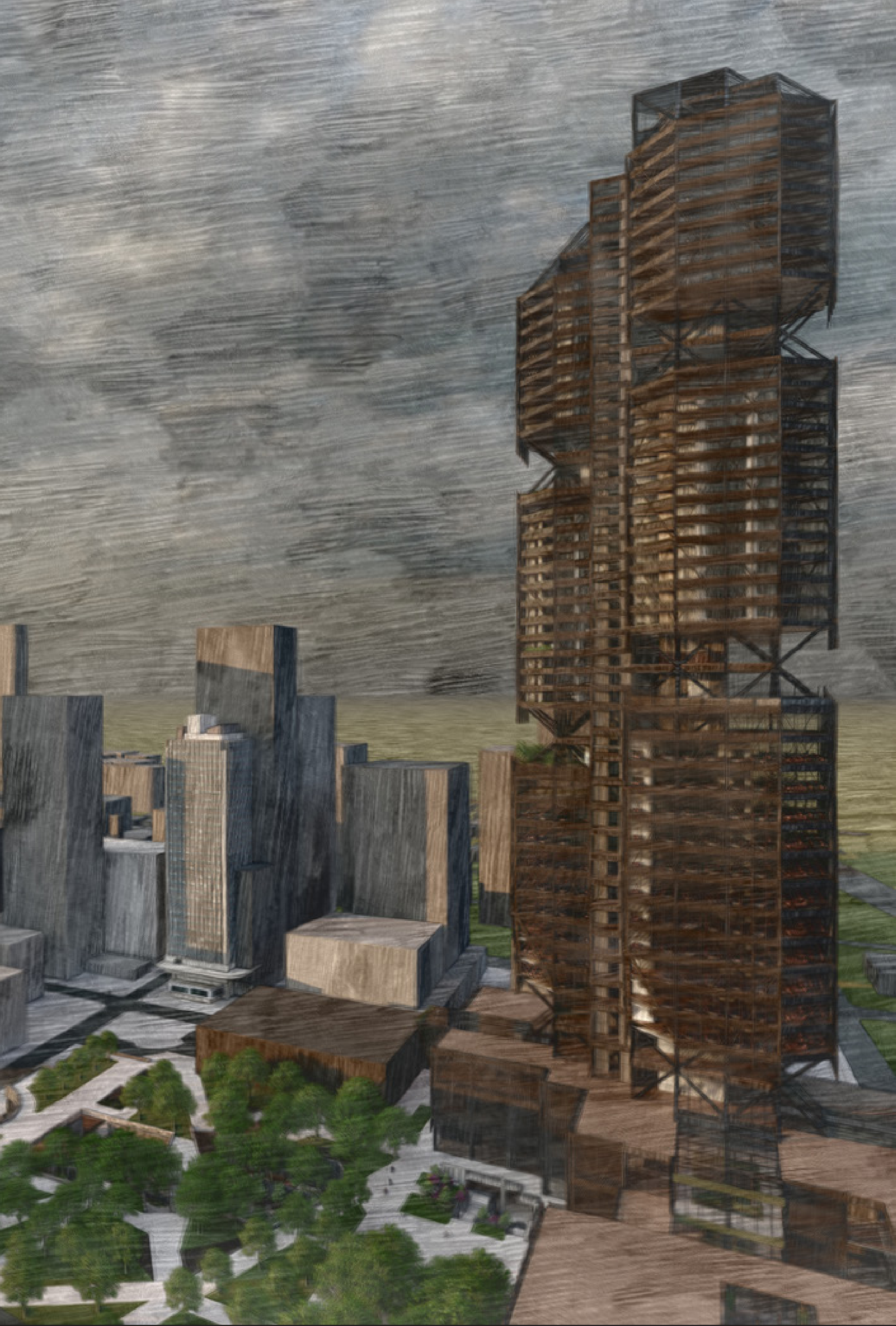
The structural system of the skyscraper experienced several changes over the development of the project. By redesigning how the infrastructure of the building worked, it resulted in the need for a structural system different from most skyscrapers. Because of the new approach to skyscraper design, innovative structural approaches needed to be implemented. This in turn could raise costs for the project. Because of this, it was important that design, function, and structural elements worked together. The idea behind this was to use each element together to further the concept of the skyscraper while minimizing the costs of the new design.

The best example of this can be seen in the outrigger trusses of the building. Structurally, the building acts much like a vertical truss. The central core consists of two intersecting trusses which allowed for the

infrastructure to be rearranged. In order to keep the usable floors free of columns, the supporting columns were moved to the exterior of the building sixty feet out. These would tie back to the building through beams and outrigger trusses. However, while most skyscrapers hide outrigger trusses within the facade of the skyscraper, the Vertical City enlarged the outrigger trusses so that they served as extensions of the central truss and exposed them to the outside. This not only allowed for a visual "cut" in the skyscraper but also created an optimal open air area for the green community spaces to be located. In this way, all elements of design came together and were showcased.



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|--|---------------------------------|--------------------------------------|--|
| 1. 22/26 gage G-90 galvanized steel face and liner with polyisocyanurate foam-insulated core | 8. Soffit Finish | 17. 2x4 Wood Frame | 26. Moisture Retention Layer w/ Aeration Layer |
| 2. 1/2" Gyp Board | 9. 36" W Section | 18. 2x6 Wood Seating Finish | 27. Thermal Insulation |
| 3. Batt Insulation | 10. Concrete Structural Deck | 19. Steel Truss System | 28. Drainage Layer w/ Root Barrier |
| 4. 3 1/2" Metal Stud | 11. 8" Concrete Beam | 20. 2x4 Wood Seating Finish | 29. Protection Course |
| 5. 18" W Section | 12. 2" Corrugated Steel Decking | 21. Wood Blocking | 30. Waterproofing Membrane |
| 6. 3 1/2' Metal Channel | 13. 1/2" Insulation Barrier | 22. Metal Fascia | 31. 1 1/2" Steel Channel |
| 7. Rigid Insulation | 14. 1x4 Wood Blocking | 23. Concrete Wall | 32. Curtain Wall System |
| | 15. Wood Floor Finish | 24. Engineered Soil With Plantings | |
| | 16. 2x2 Wood Frame | 25. Filter Fabric w/ Reservoir Layer | |



CONCLUSION

In conclusion, the Vertical City was a project meant to push the bounds of what a skyscraper can be within the urban context of the city. While still a conceptual project, every innovation was carefully designed to maintain as much efficiency as possible. New elements like green space that were infused into the building design were paired with commercial space in order to provide monetary incentives to the design. The structural system was designed in such a way that function, structure, and aesthetics came together giving credence to the design principles utilized.

Even with the focus on the skyscraper, a large amount of time was spent on the site both in the large and small scale. While seemingly not as important as the building design, it was vital that the site was designed in such a way that it was integrated with the site so that the transition from the horizontal city to the vertical city was seamless. This helps give the building more credence in its role as a vertical city because it must respond to the context it is located within in order to be successful.

Throughout this process, the design experienced many changes and iterations as the concept of a city and a skyscraper were merged to create this project. While a skyscraper can never exactly replicate the urban city due to its height, design needs, and the fact that it is vertical, skyscrapers can still be seen as an extension of a city. In the end, the vertical city must function as a hybrid of both the city and a skyscraper in order to function. While the thought of a hybrid may seem like a compromise, it is a compromise worth taking as it allows for incredible moments that wouldn't have been attained previously. Moments like grabbing a coffee on the fifteenth floor and reading a book outside surrounded by nature, taking an outdoor workout class on the thirtieth floor high above the city below, or dining at the top floor and viewing the unparalleled views of the surrounding city. Often times, it's small moments like these that give us drive to design something innovative.

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