LINATE MOTUS AERII

TU Delft

CP

Building for Science and Learning

2025 - 2026

Complex Projects
Bodies and Building Milan
AR4CP020

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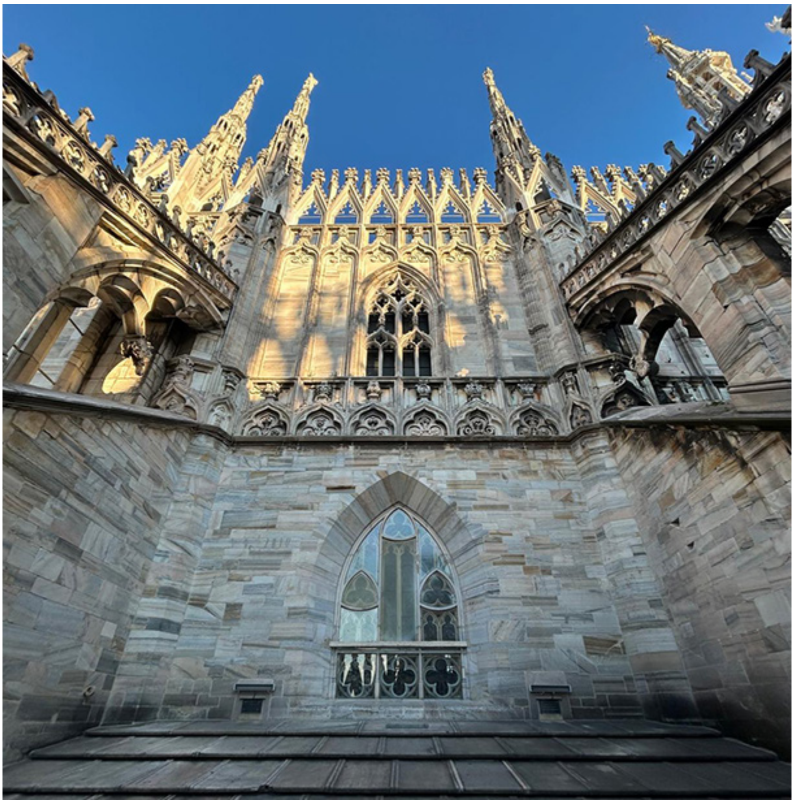
NOMENCLATURE

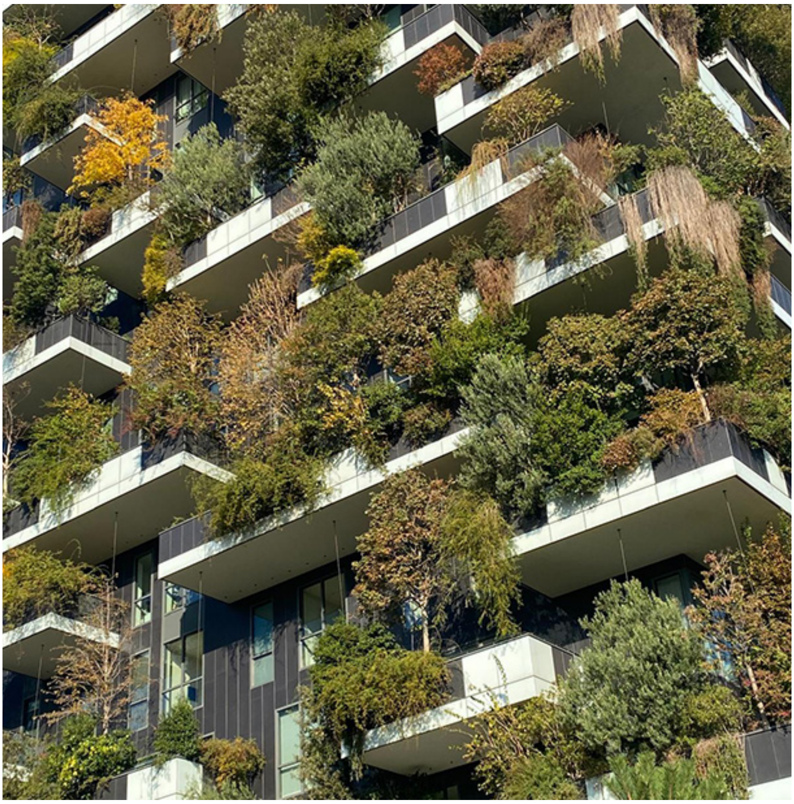
ATM – Air traffic management
TGSI – Tactile ground surface indicators
DTC – Digital travel credentials
PHPT – Peak Hour Passenger Throughput
PLF – Passenger load factor
CLF – Cargo load factor
MVT – Aircraft movements
ACFT – Aircraft
ACFT MVT YY – Yearly aircraft movements
GOT – Gate occupancy time
BHS – Bagage Handling System

ABSTRACT

This report tries to lay out the base to redefine airport terminals as a civic and urban space rather than an isolated infrastructure element next to a city. By using an exercise of designing a new airport in place of Milan's Linate Airport, it explores the possibilities of a new airport typology in which commercial and social functions are relocated to a publicly accessible landside space, transforming the airport from a closed, transactional environment into an open urban destination. Inspired by the Milanese piazzas, the landslide becomes a place of gathering for both travelers and residents, erasing the existing boundaries between airport infrastructure and Milan. The research also investigates how the development of electric aircraft, and its decrease in noise pollution, enables closer urban integration. The project is based on the principles of cultural integration, inclusivity, and spatial efficiency.




A VITTORIO EMANUELE II. I MILANESI



MILANO

Milan is a city where history and modern life come together. Located in northern Italy, it is known as the country's financial and fashion capital. With its rich cultural and architectural heritage, it attracts millions of visitors each year.

The culture of Milan is shaped by creativity, innovation, and a strong appreciation for both art and design. MIlan and its people value both tradition and progress, creating as a result an atmosphere that feels elegant yet dynamic.

Milan's architecture reflects its history and the development of technology and economy. From the gothic cathedral, Duomo, to contemporary residential buildings like Bosco Verticale; Milan's architecture expresses its people's culture and way of life.

Milan is therefore a place that respects its past while always, and continuously looking toward the future.

01. INTRODUCT

ION

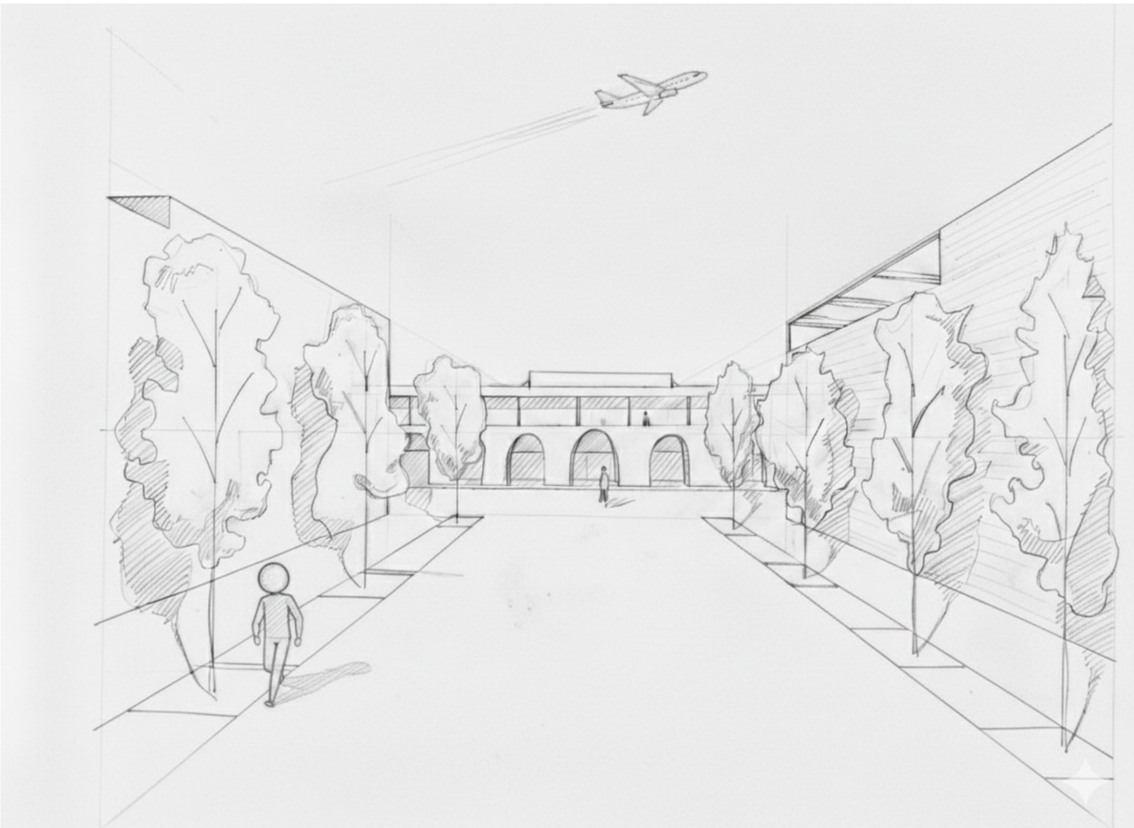
OBJECTIVE & MOTIVATION

The airport should evolve beyond its current role, the one of a machine for movement. It should not exist as an isolated object outside the city. Instead, it should become a public space; open, culturally embedded, and urban integrated.

The project should explore the potential of this idea by relocating the commercial functions of a terminal to a landside public space, fundamentally redefining the airport typology. By shifting the shops, cafés, and restaurants towards the public, the airport also is transformed from a closed, transactional place to an open urban destination; from a place of waiting to one of gathering. In this model, efficiency also becomes a key design choice. Passengers would traverse seamlessly from city to gate, with security and boarding reached in five minutes. By doing so, time is reclaimed from waiting in queues to being spent in meaningful ways.

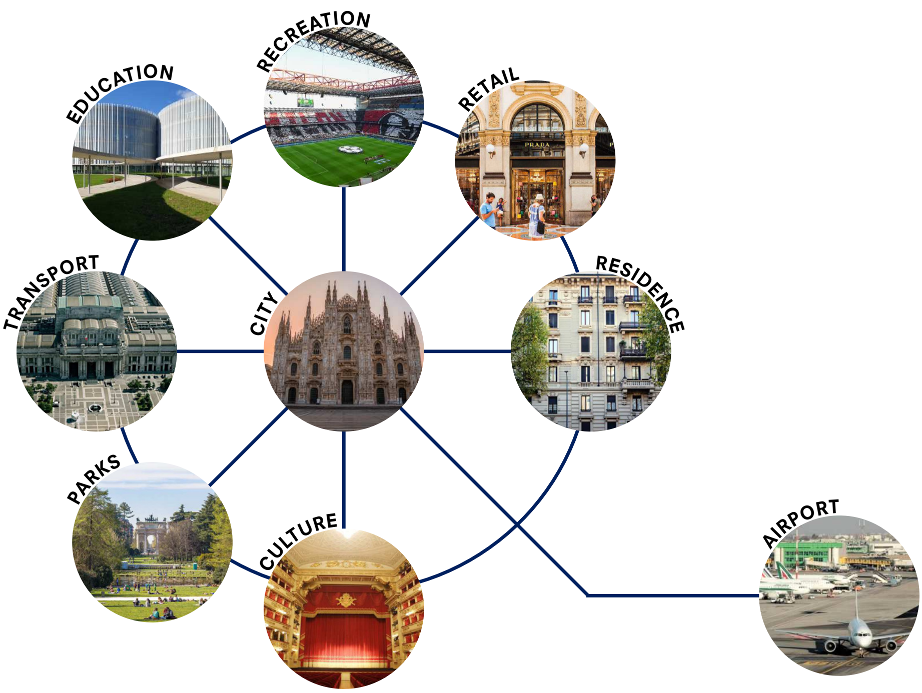
At the same time, this public space is envisioned not only for travelers but also for residents. Since it would be seen as an extension of the city, the landside becomes a place of dining, socializing, and cultural exchanges. Much like Milan's piazzas , this space would become an everyday city life location, blurring the boundary between infrastructure and public spaces.

The design should be guided by three principles. The architecture should become part of the cultural expression, making the public space, surrounding buildings, and the terminal reflects Milanese identity through form, material, and spatial organization. Commercial pricing should follow street pricing, ensuring inclusivity and everyday relevance for both travelers and locals. Security infrastructure in the terminal should be dimensioned to accommodate increased peak demand, therefore avoiding disrupting the public space and the passenger experience.



PROBLEM STATEMENT

Airports are frequently seen as disconnected infrastructural typologies, completely separated spatially and socially from the surrounding urban contexts. Located in most cases at periphery of cities they prioritize operational efficiency over civic engagement. The airfield typology, current aircraft noise pollution, and terminal uni-functional use make current airports "no-man's-lands" typologies.



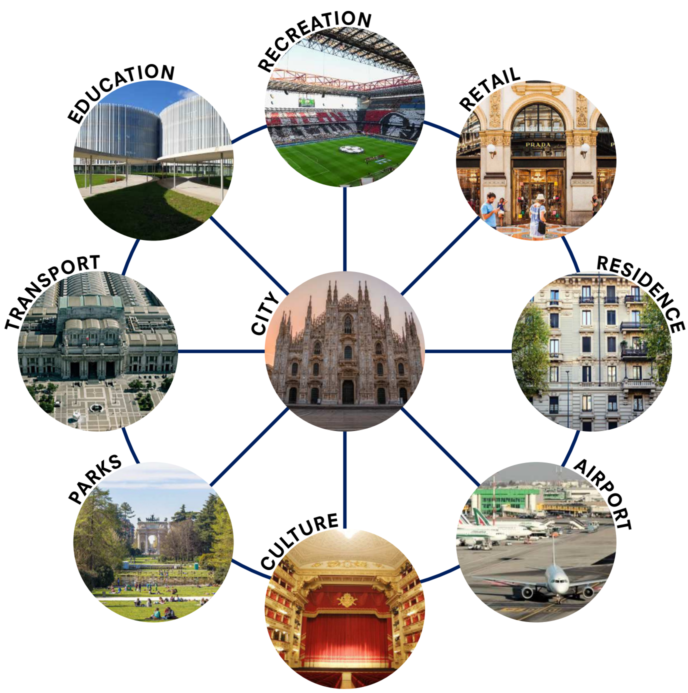
RELEVANCE

Academic relevance

Most airports around the world follow the same standard typology. A short, busy landside space leading to the security checkpoint so that passengers can go to the commercial space between it and the gates. For residents, this typology is irrelevant as there isn't any incentive to visit the airport. By studying alternatives for airport design, this research tries to recreate airports into public spaces which invite both residents and visitors to visit and enjoy the airport.

Practical relevance

Since the constant growth of the city of Milan as well as tourism being one of the main income generators of Milan, the development of new airport typologies that can create public spaces for both residents and tourists can be key for the future development of the city's urban fabric and economy.



IN WHAT WAYS WILL T
ELECTRIC AIRCRAFT I
PLANNING, AND INFRAST

THE DEVELOPMENT OF
IMPACT THE DESIGN,
TRUCTURE OF AIRPORTS?

DESIGN QUESTIONS

In addition to the main research question, several design questions will be explored, discussed, and tested throughout the design process of the new Milan airport:

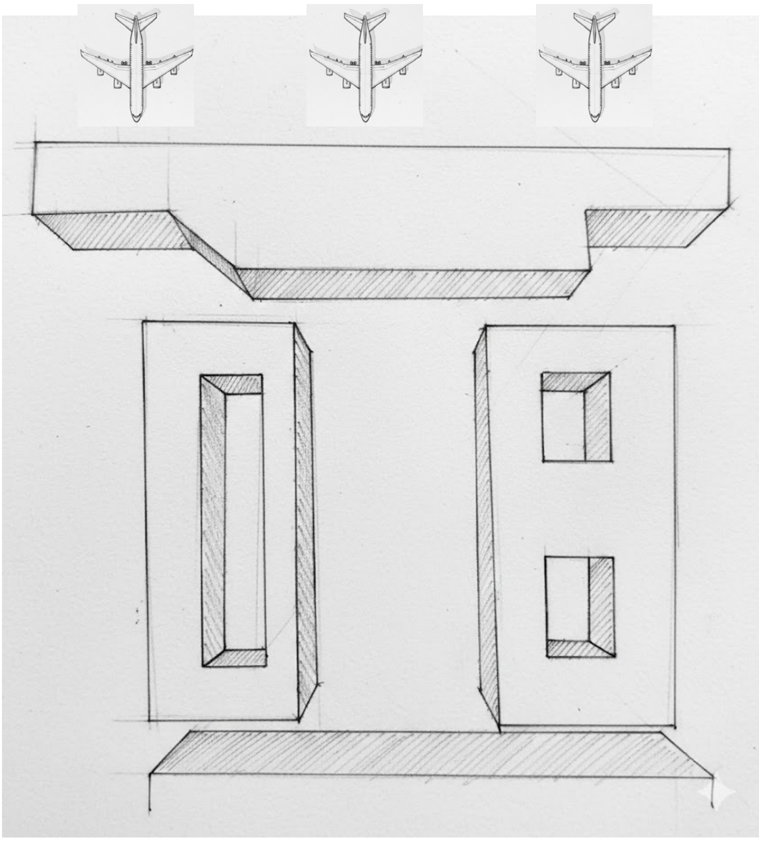
1. Urban Integration
Why are airports fragmented elements within the urban fabric, rather than being integrated into cities like other transport infrastructures such as train or bus stations?

2. City–Airport Relationship
What effects would result from transforming an airport into a publicly accessible civic space, and how might it change its relationship with its host city?

3. Identity and Infrastructure
How will the transformation of an airport into a public urban space for passengers and residents alike reinforce cultural identity while still serving as the main transport hub in a city?

4. Cultural Translation
Which cultural, historical, and architectural elements specific to Milan can be brought into the airport and public space's design to strengthen its connection to the city's identity?

5. Landside as Civic Space
Which function should the landside public space take in order to complement and extend the existing urban structure of Milan?



PLANNING

The Complex Graduation Studio follows the 2025 TU Delft AUBS masters' official date structure. It covers three quarters: Q6, Q7, and Q8. The project is then divided into three phases which relate to the research and design phases of the studio. These phases are the following:

Phase 1. Research Setup

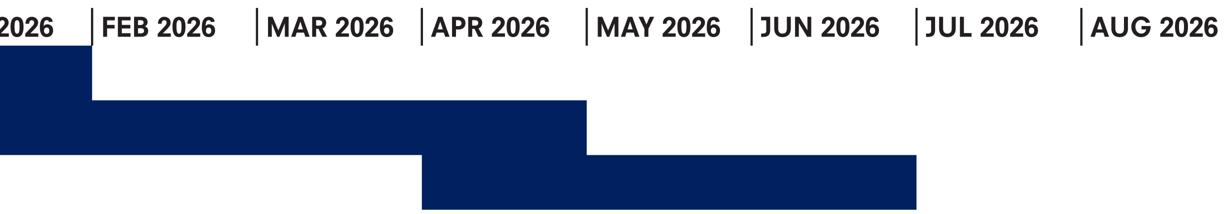
This phase works as a foundation for the entire project. In it, the student defines a problem, a methodology, and creates a concept based on initial research. This phase is also divided into two different parts, introduction and approach. The assessment for this phase of the studio, A1 'kick-off', occurs in January 2026, on week 4 or 5 (2.9 or 2.10 on the academic calendar.)

Phase 2. Research & Design

This phase focuses on analyzing in depth the building typology, the project needs, and a building design is developed. During this phase, the student tests its concept and comes to conclusions which are discussed during the midterm. The assessment for this phase, A2 'midterm', takes place in April 2026, on week 14 (3.8 on the academic calendar.)

Phase 3. Conclusion

The last phase of the graduation studio leads to the finalization of the design. The student is expected to correct and conclude its project and the research around it. This phase's assessment is divided into two moments. Firstly, A3 'green light' is a delivery moment where the written deliverables are sent to tutors for the final presentation approval. This happens in June 2026, on week 23 (4.7 on the academic calendar.) Finally, A4 'public presentation' is a project presentation to tutors and any interested public member. This final presentation takes place in June 2026, on week 26 (4.10 on the academic calendar.)



SCOPE

The research focuses on the transformation of the passenger airport terminal typology. The exercise will take place in the location of current Linate Airport in Milan, but in this scenario the current airport has never been built. Thus, inviting a discussion on how a newly developed airport in Milan should be designed and what the consequences of said design would be for the city and the aviation industry.

The research's main user group are the residents of Milan and travelers that would use the new Linate Airport. This focus on both the local and the external user will give an extra layer of complexity to the project while creating a healthy debate on how airports interact with their host cities.

The research will be limited to the airport terminal typology and will not be designing a city master plan. This choice is made to limit the extension of the research so that it may be visible for the Complex Projects Graduation Studio.

METHODOLOGY

In order to create a compelling design which could debate current airport typologies, extensive research has to be done. This research will need to be done on previous airports, current aviation regulations, and future scenarios in the aviation industry. The research is then divided into the following parts:

1. Literature analysis

Firstly, existing literature on airport design and regulations has to be studied in order to fully understand how airport typology works and why airports are designed how they currently are. The evolution of airport design from the first airports in the early 1900's, to the luxurious airports in the mid XX century (golden age of flying), to finally in late XX century when airports became focused on growing tourism and increasing commercial spaces (such as Pittsburgh airport.)

2. Site analysis

The location of the new Linate Airport has to be studied in order for a design to be developed. Not only is the airport able to function correctly and safely, but the architecture of it should represent the city of Milan and its culture. This section of research is one of the most important ones since it will define the project itself, making it unique and possible.

3. Scenario analysis

Airports are massive, complex buildings which take year to design and build. For this reason, when designing a new airport, architects need to think about the future and design a project not for the current times, but for what will come. Therefore, scenarios of what the aviation industry will become should be made. This will also shape how the airport can be integrated into the city and how the airport typology could change to be ready to adapt to the future.

4. Research-by-design

The last research phase will be the design itself. The Complex Projects Studio follows a research methodology called research-by-design. This means that findings and conclusions are drawn from designing a project. In other words, while designing a new airport typology, problems will be found and conclusions on the effect on the aviation industry will be made when changing how airports look and work.

THEORETICAL FRAMEWORK

Airports are generally seen as a mono-functional infrastructure element which is separated from cities and are only optimized for efficiency, security, and massive movement. Unlike other transport hubs such as bus or train stations, airports function as autonomous systems, reinforcing the concept of them being isolated infrastructural elements. They could be described with the term non-places by Marc Augué in his book "Non-Places: Introduction to an Anthropology of Supermodernity".

Contemporary architecture and urban theory should challenge this concept by reframing the airport as a civic space capable of supporting public life. With this perspective, the airport terminal could and should be redefined as a public accessible urban space. With the relocation of commercial spaces onto the landside, airports would shift from a closed environment to an open destination for both travelers and residents.

Within this concept, efficiency is rethought into a spatial quality that enhances the user's experience. At the same time, vernacular architecture would embrace the Milanese cultural identity into the architecture of the airport itself bringing it closer to the standing city. Lastly, the emergence of electric aircraft further enables this transformation by reducing environmental constraints and supporting closer urban integration.

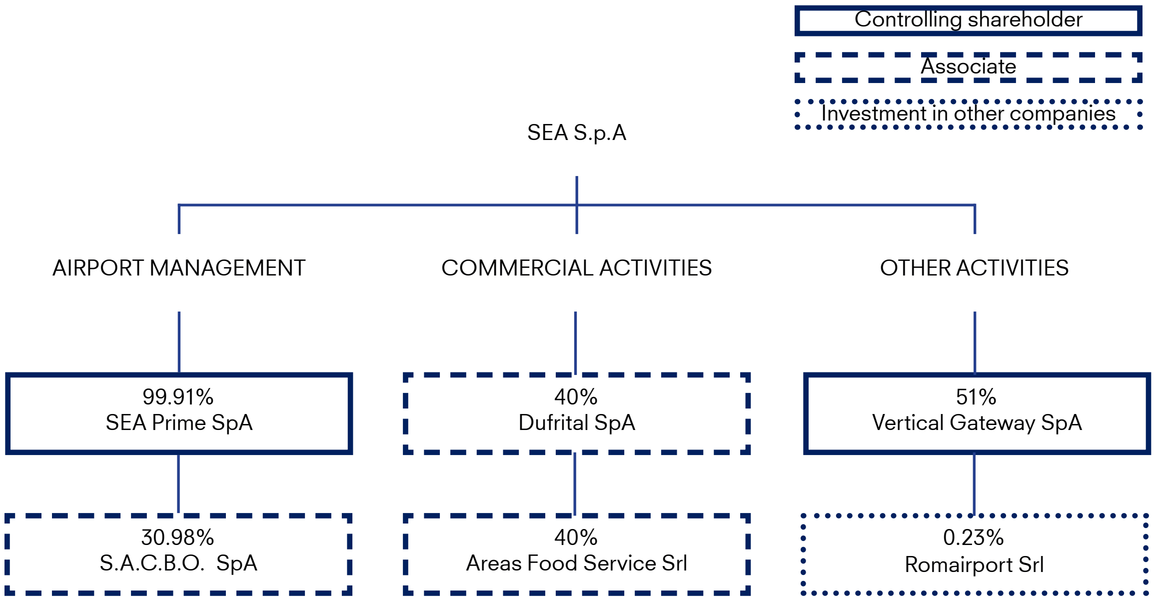
02. RESEARCH

STAKEHOLDERS

Milan Linate has four main stakeholders which work together to improve the quality of service of the airport. These four stakeholders are the Airport Operations Company (SEA), Italian Civil Aviation Authority (ENAC), National Flight Assistance Agency (ENAV), and shareholders.

ENAC regulates and supervises Linate Airport, ensuring compliance with national and EU standards on safety, security, passenger rights, and environmental protection, while certifying infrastructure and monitoring operators. ENAV provides air-navigation services, managing air traffic and defining flight paths that strongly influence airport layout, building heights, and noise mitigation due to Linate's proximity to Milan. Shareholders, led by the City of Milan, guide strategic development and fund major projects such as the Linate Airport District. SEA S.p.A. operates and manages all airport infrastructure, daily operations, services, and sustainability initiatives at Linate.

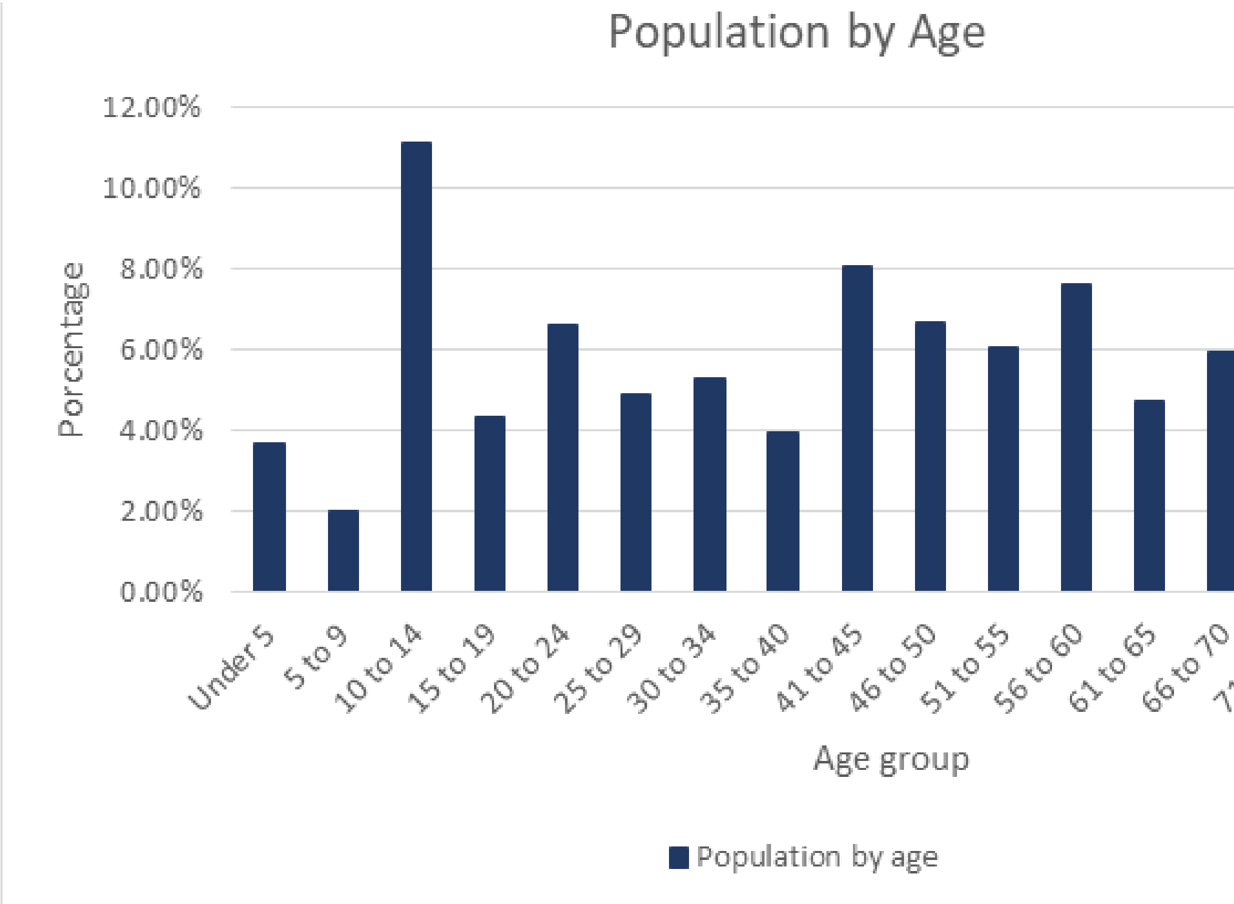
For more detailed information see *appendix 1. Stakeholders.*

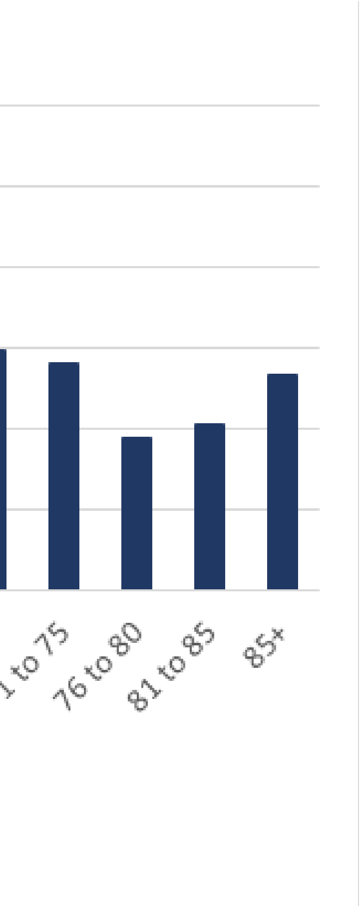


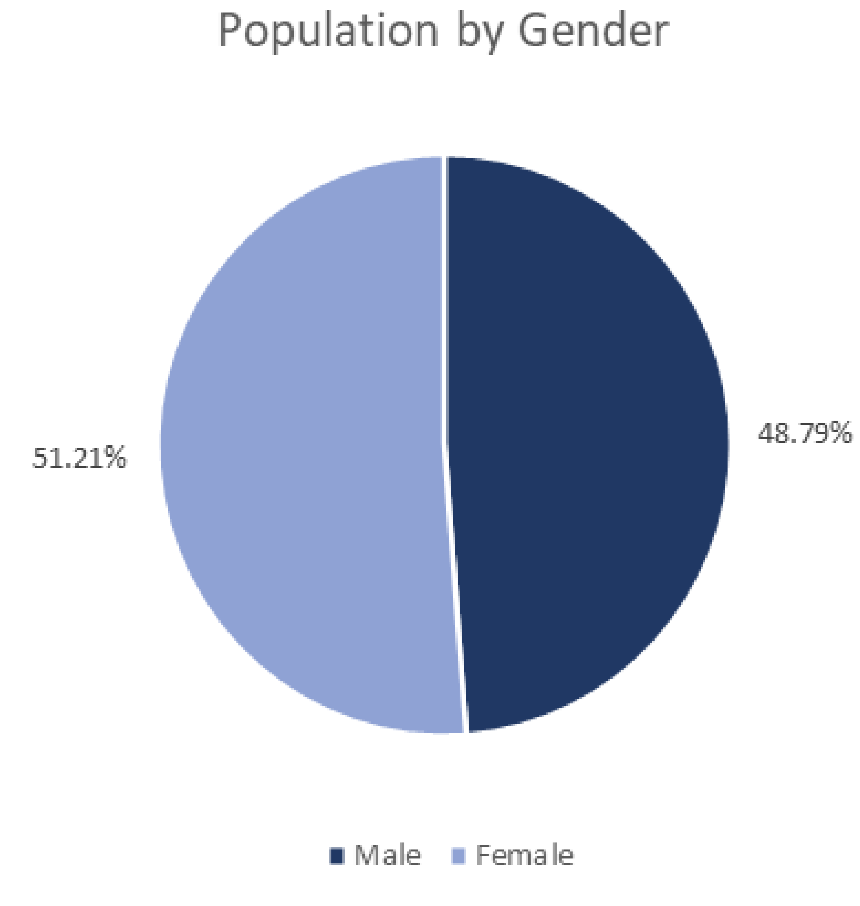
Group I.D.	
Founded	May 22, 1948
Headquarters	Milan Linate Airport - 20090 Segrate (MI)
Sharecapital	€ 27,500,000
Number of employees 2023	2,349
Revenues 2023	€ 801,100,000
Net profit 2023	€ 156,200,000
Passangers 2023	35.3 milion
Airport movements 2023	279.4 thousand
Freight movements 2023	667.2 thousand (tons)

SITE ANALYSIS: MILAN'S DEMOGRAPHICS

Milano is the capital municipality of the Italian region of Lombardy. The urban area of Milano has a population of around 3.2 million in 2023, while the city is estimated to have a population of around 1.7 million. Making it the second-largest Italian city after Rome and ahead of Naples.

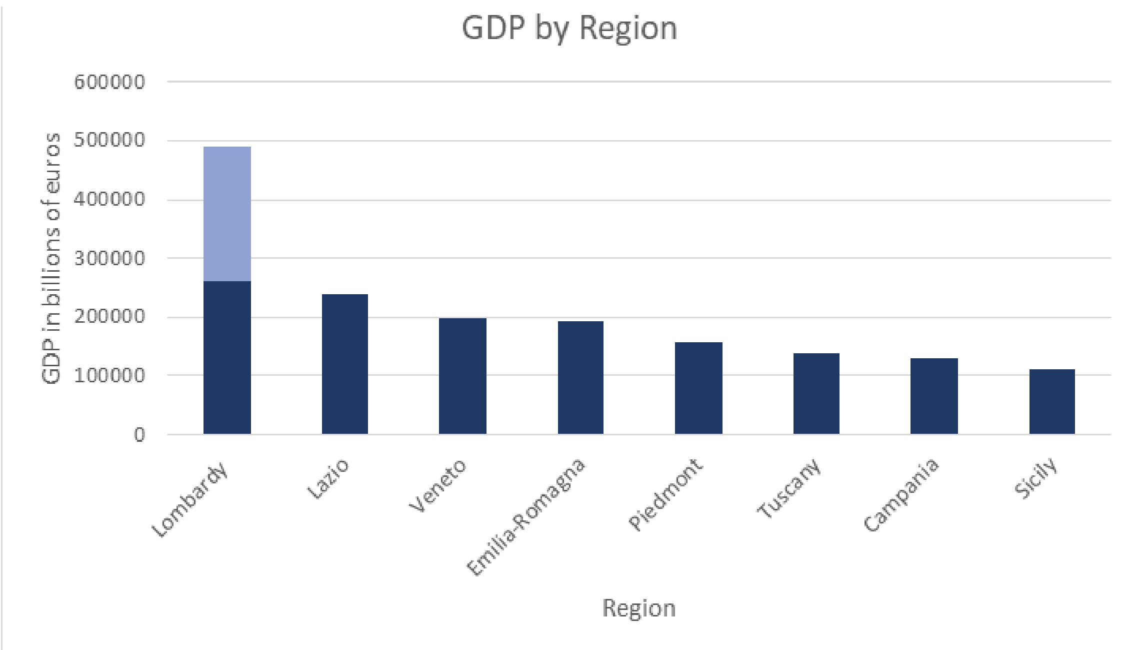



76 to 80
81 to 85
85+


Population by Gender
51.21%
48.79%
Male
Female

SITE ANALYSIS: MILAN'S ECONOMY

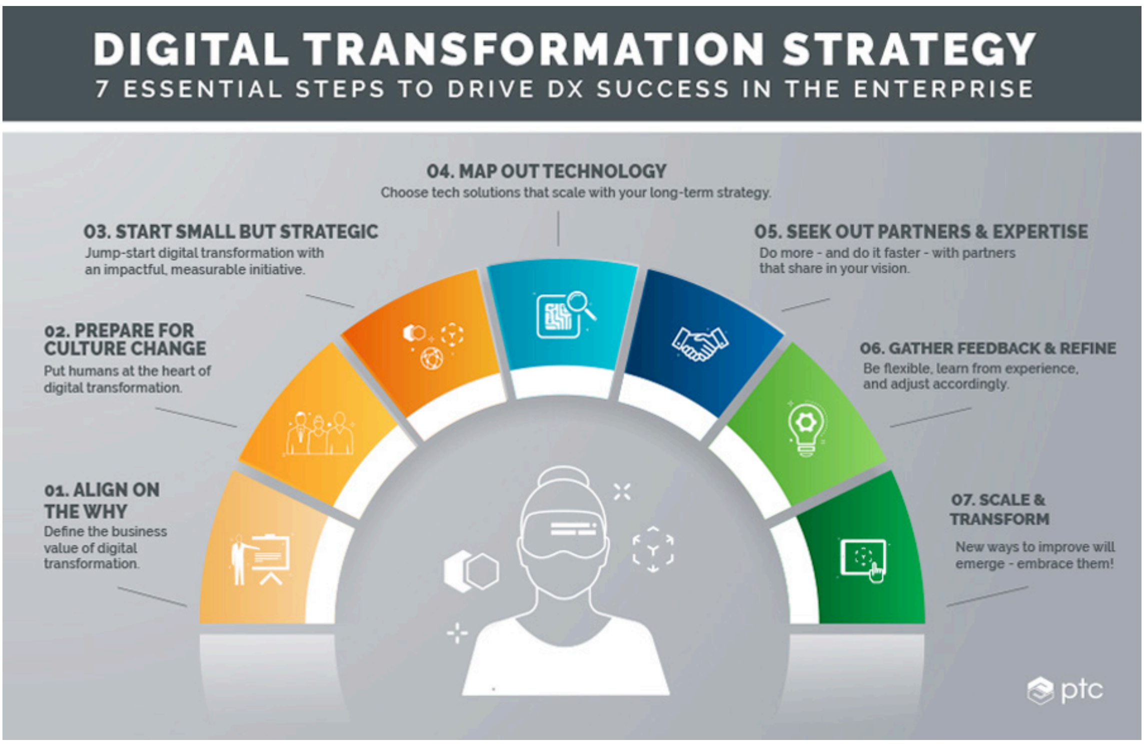
Milano functions as Italy's financial, commercial, and industrial hub. The main sector in Milano's economy is the tertiary sector, focusing on finance, fashion, design, advanced manufacturing, and tourism.

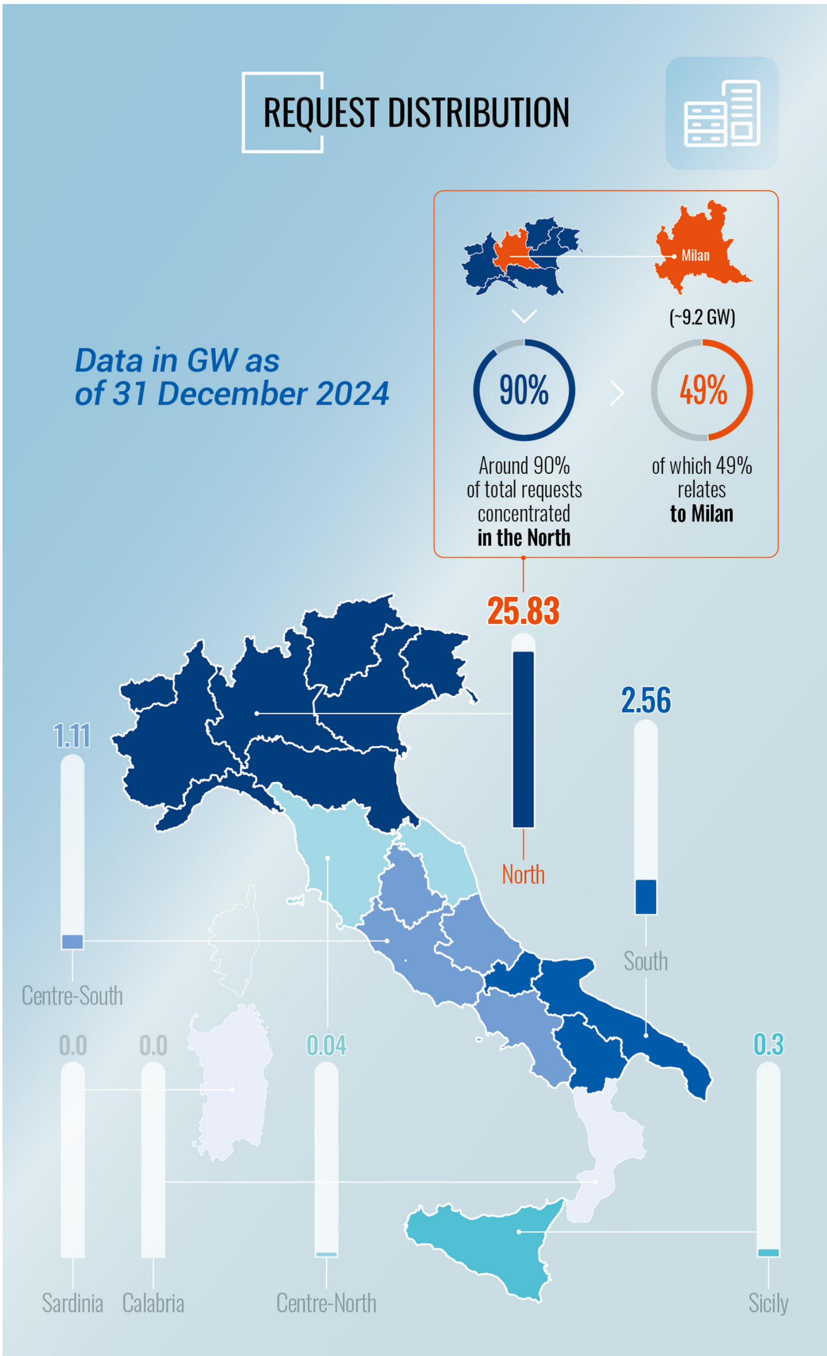


Tourism in Milan
Number of tourists in millions
0
1
2
3
4
5
6
7
8
9
10
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Year
Domestic
International

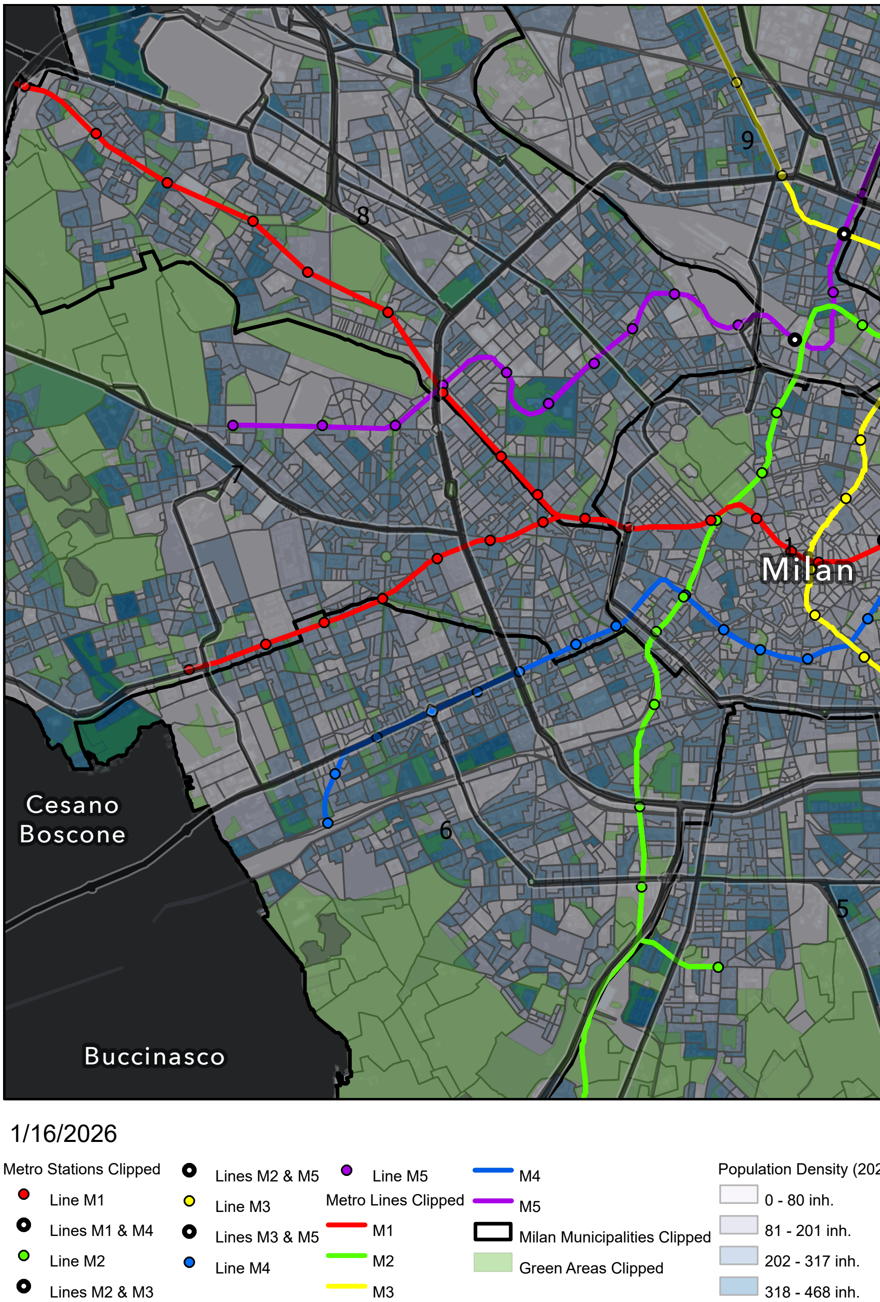
SITE ANALYSIS: MILAN'S INNOVATION

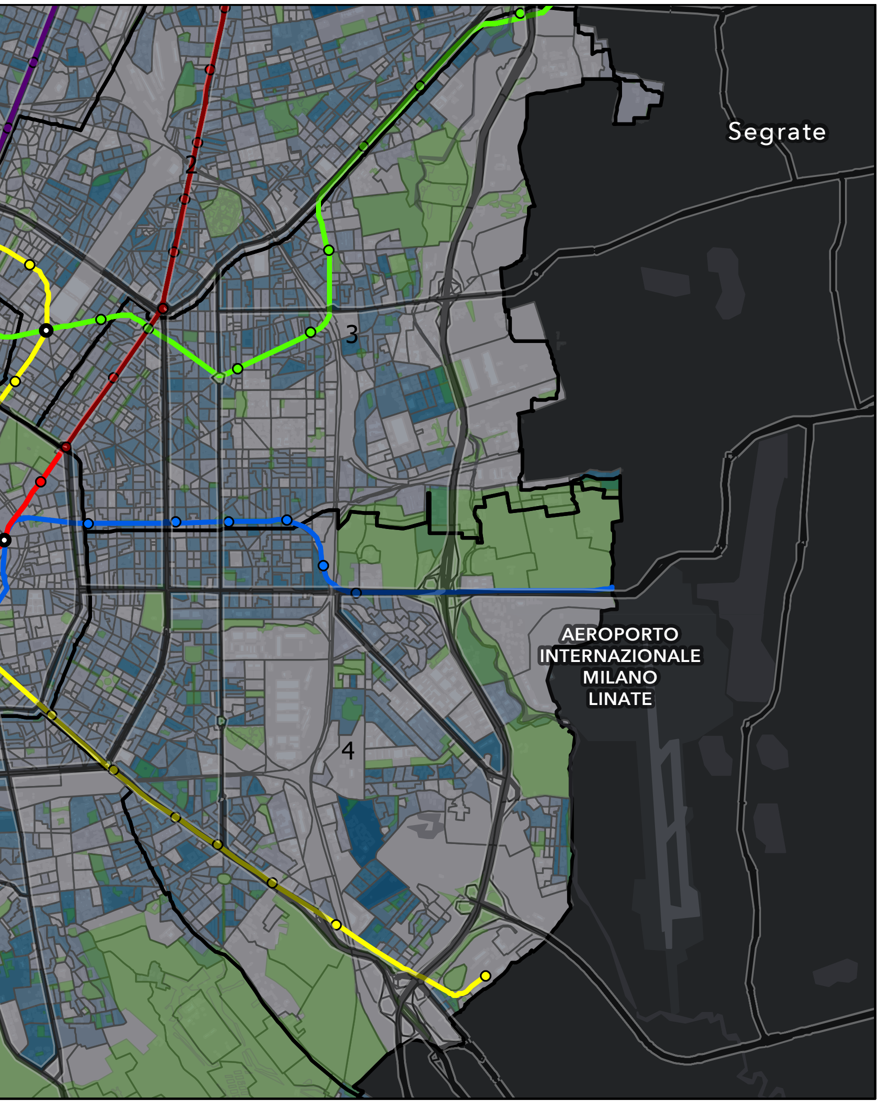
The city of Milano has been transformed from only an industrial city to an innovative city with two drives leading this transformation: infrastructure and local talent. The transformation is supported by a combination of government investment and physical infrastructure.




REQUEST DISTRIBUTION
Data in GW as of 31 December 2024
Milan
(~9.2 GW)
90%
49%
Around 90% of total requests concentrated **in the North**
of which 49% relates **to Milan**
25.83
North
2.56
South
1.11
Centre-South
0.0
0.0
0.04
0.3
Sardinia
Calabria
Centre-North
Sicily

SITE ANALYSIS: MILAN’S ACCESIBILITY



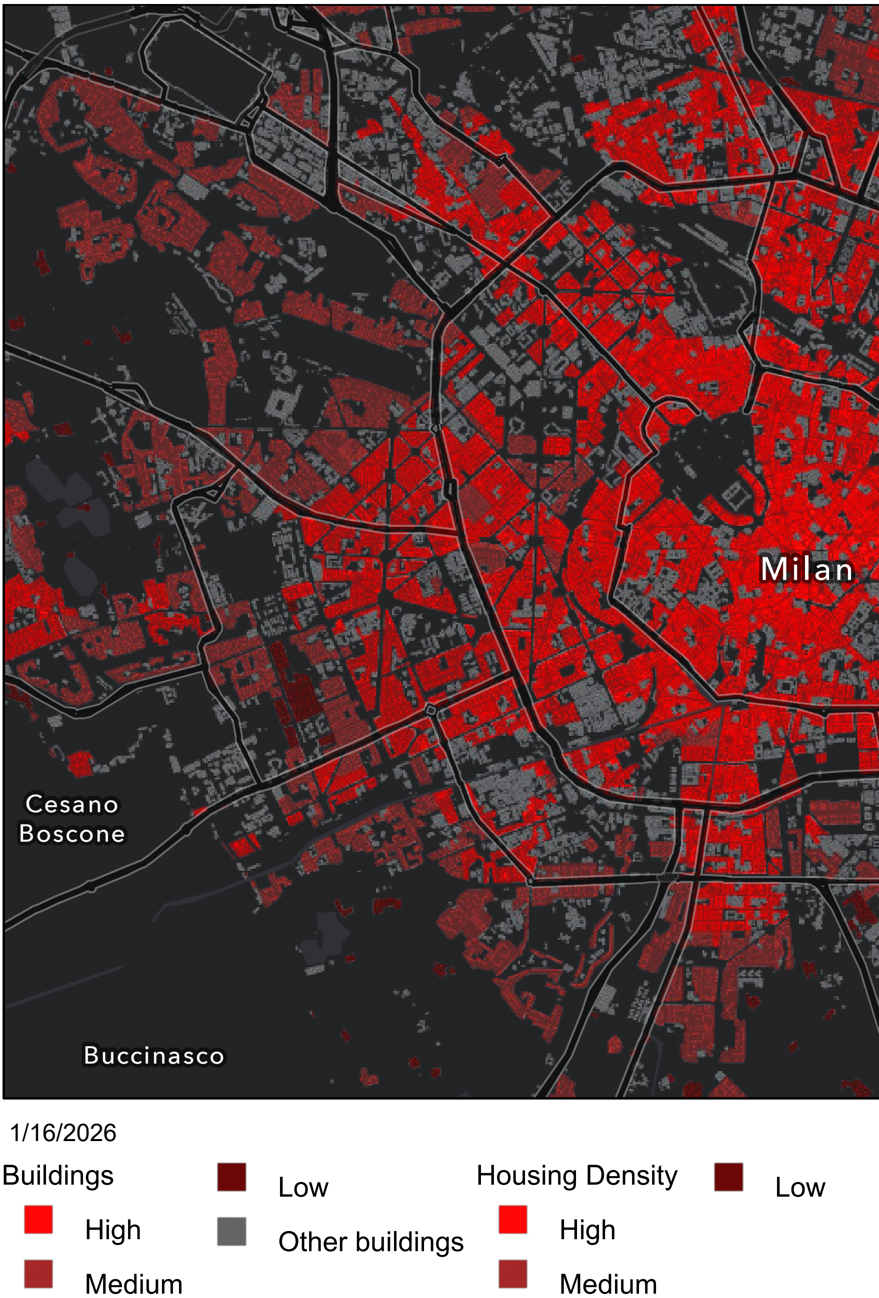


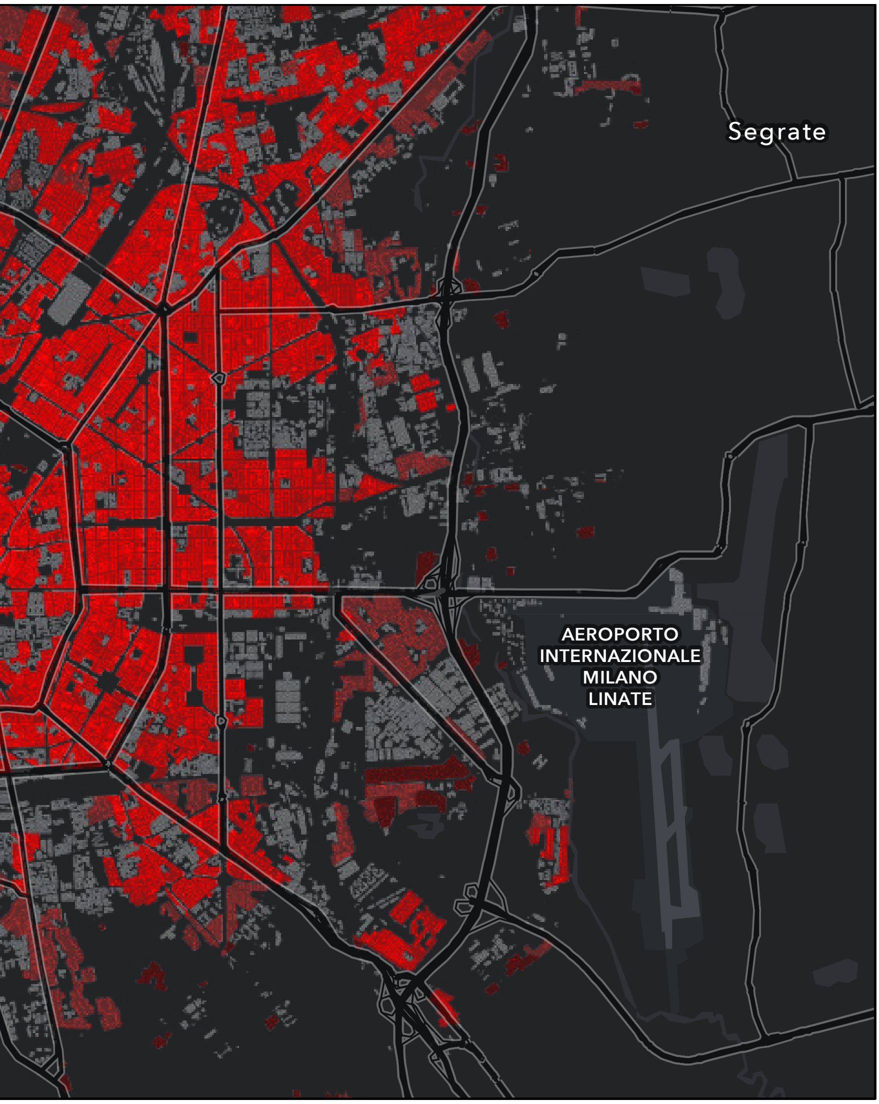
21) 469 - 982 inh.
983 - 2,587 inh.
2,588 - 8,545 inh.
Buildings

1:93,494
0 0.5 1 2 mi
0 0.75 1.5 3 km

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

SITE ANALYSIS: HOUSING DENSITY





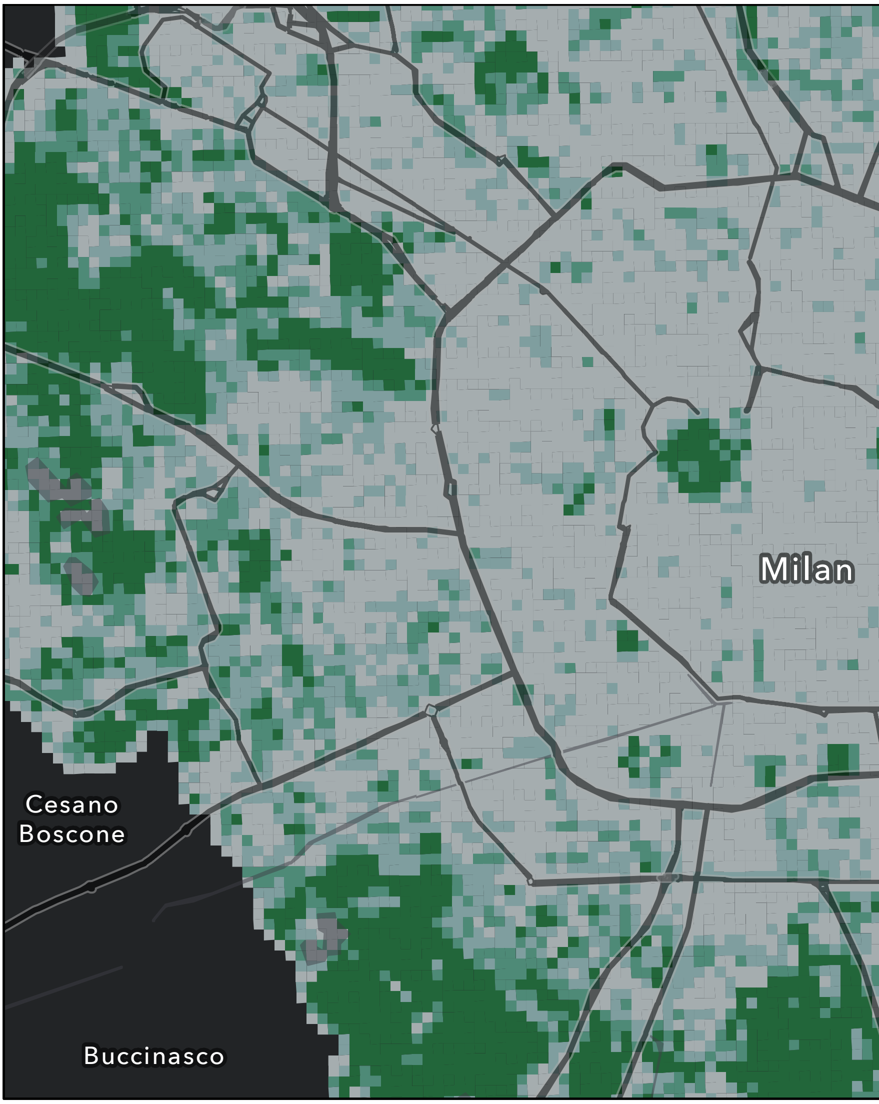
1:93,494

0 0.5 1 2 mi

0 0.75 1.5 3 km

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Commune of Milan

SITE ANALYSIS: PERMEABILITY



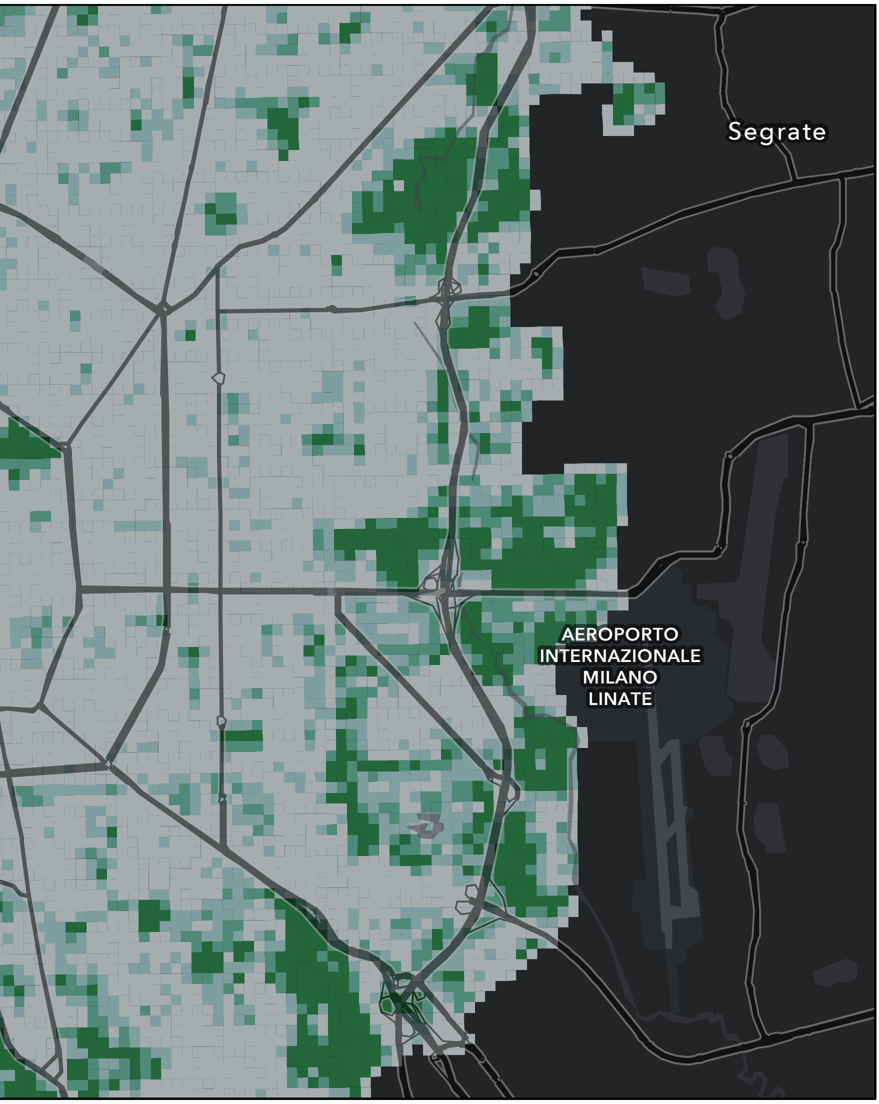
1/16/2026

CAS171_grid_permeability

0,000000 - 25,000000

25,000001 - 50,000000

50,000001 - 75,000000



75,000001 - 100,000000

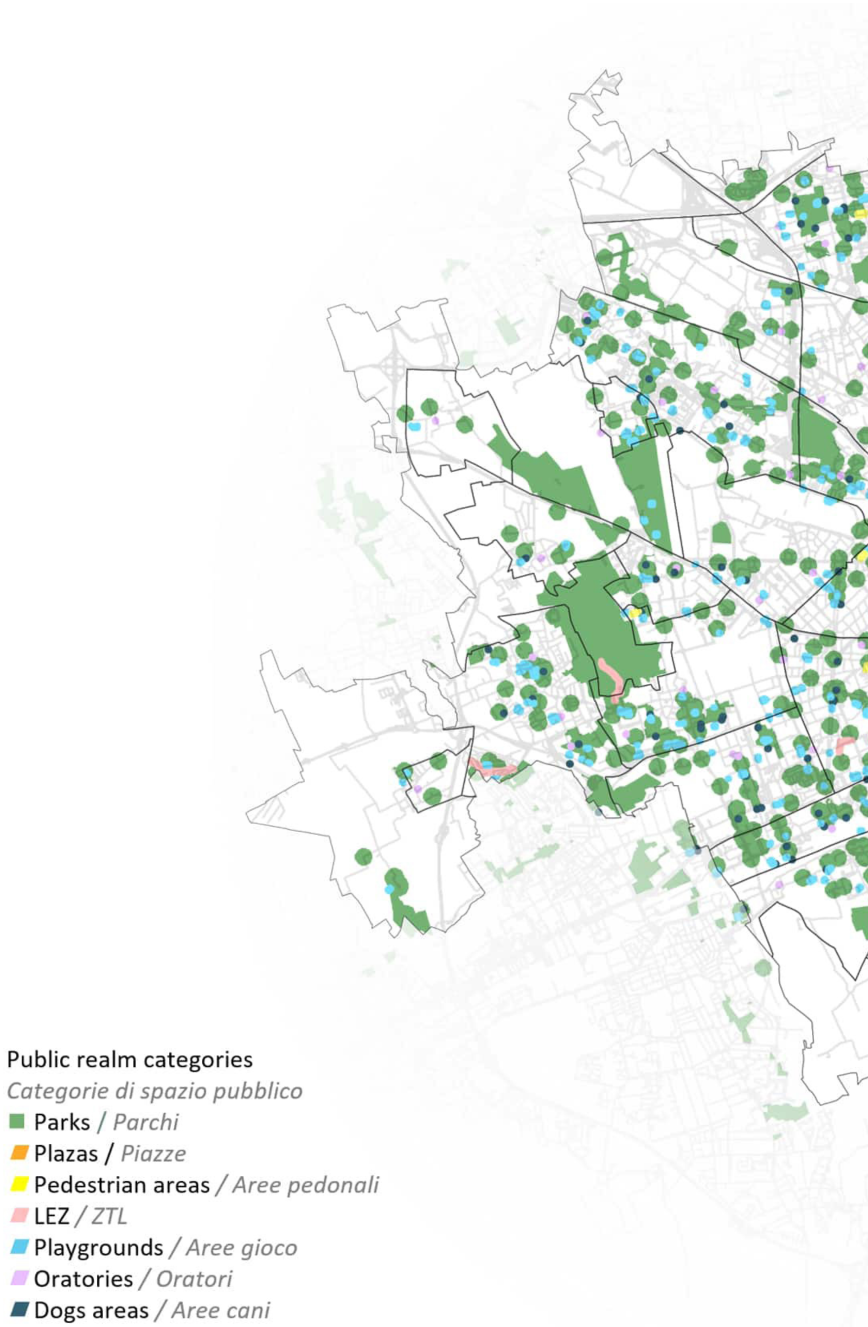
1:93,494

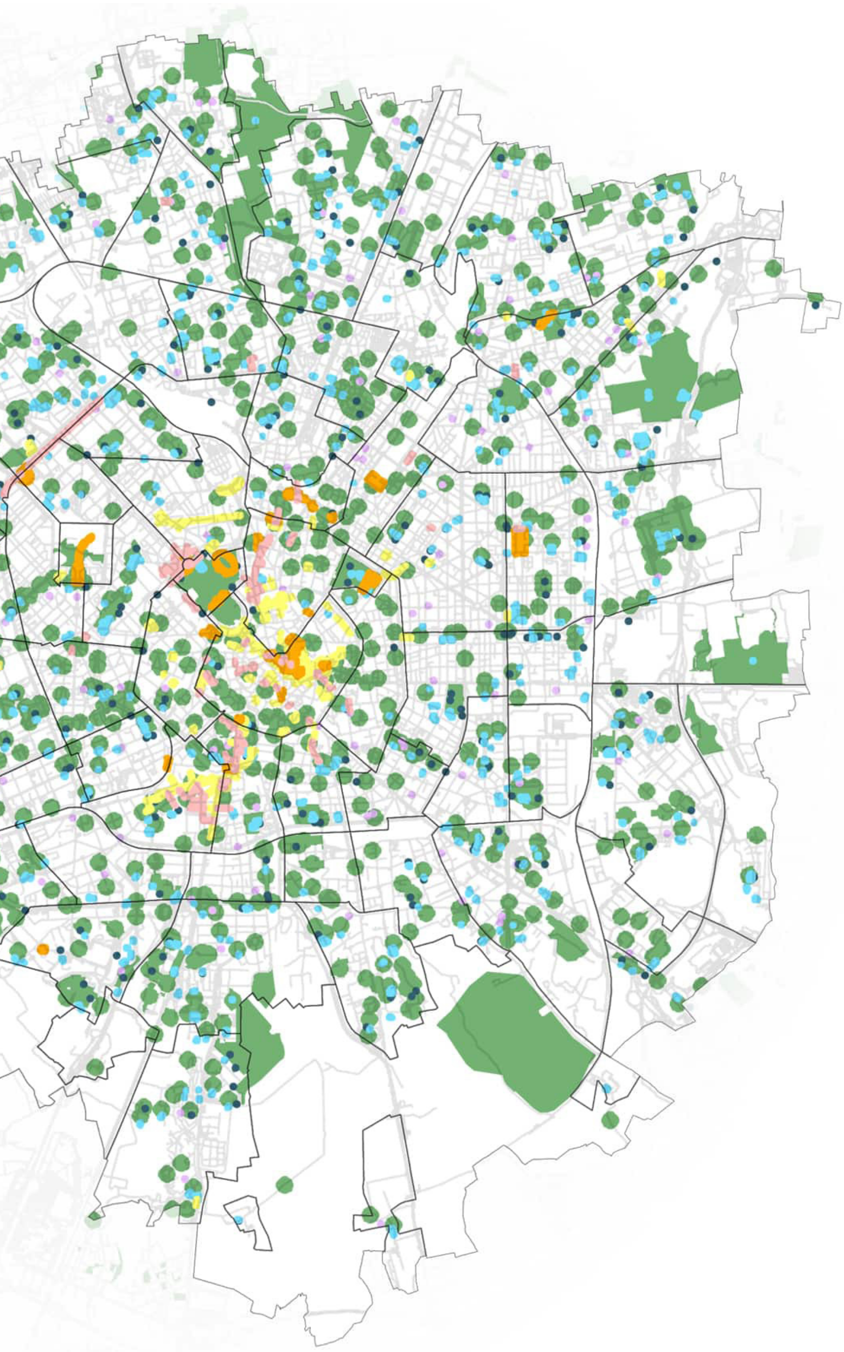
0 0.5 1 2 mi

0 0.75 1.5 3 km

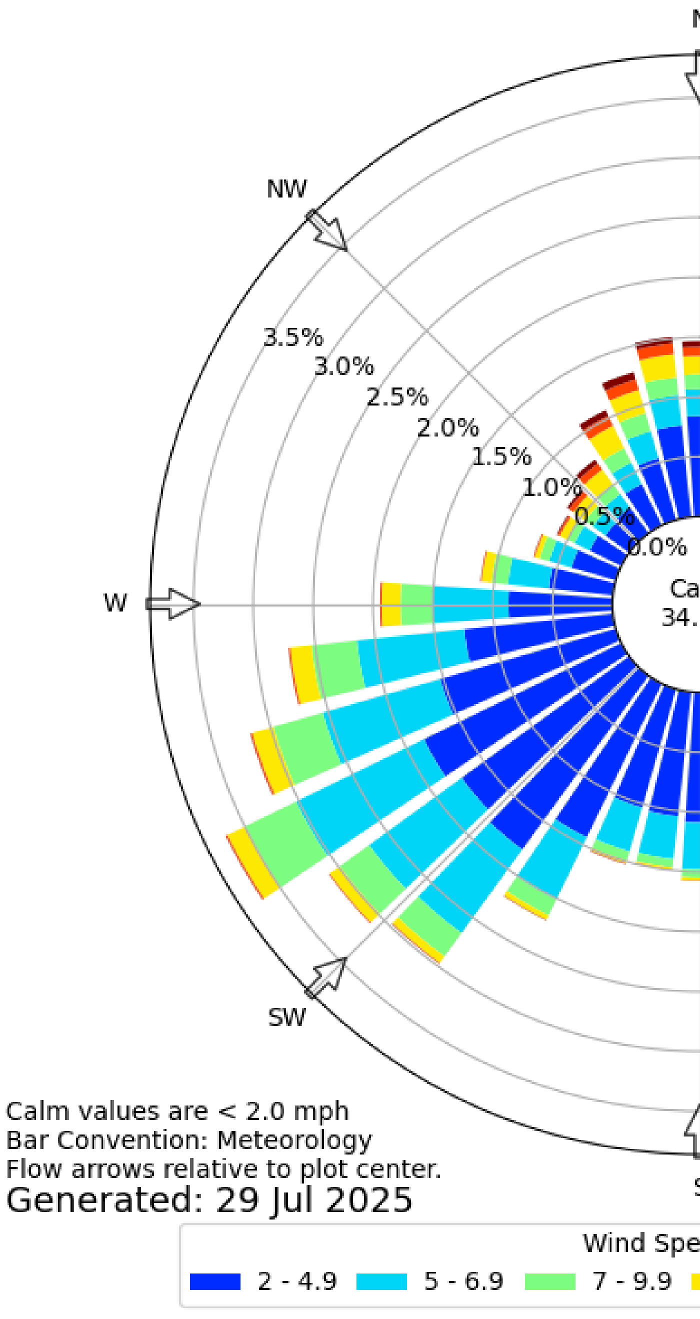
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

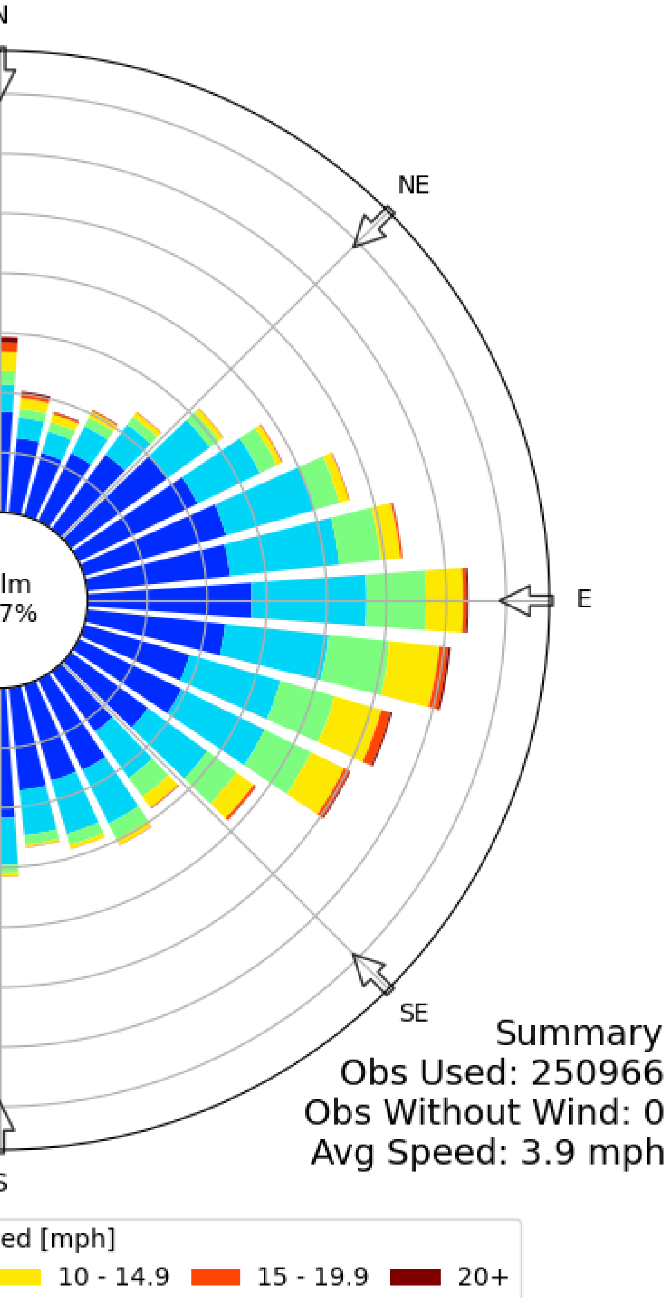
SITE ANALYSIS: PUBLIC SPACES



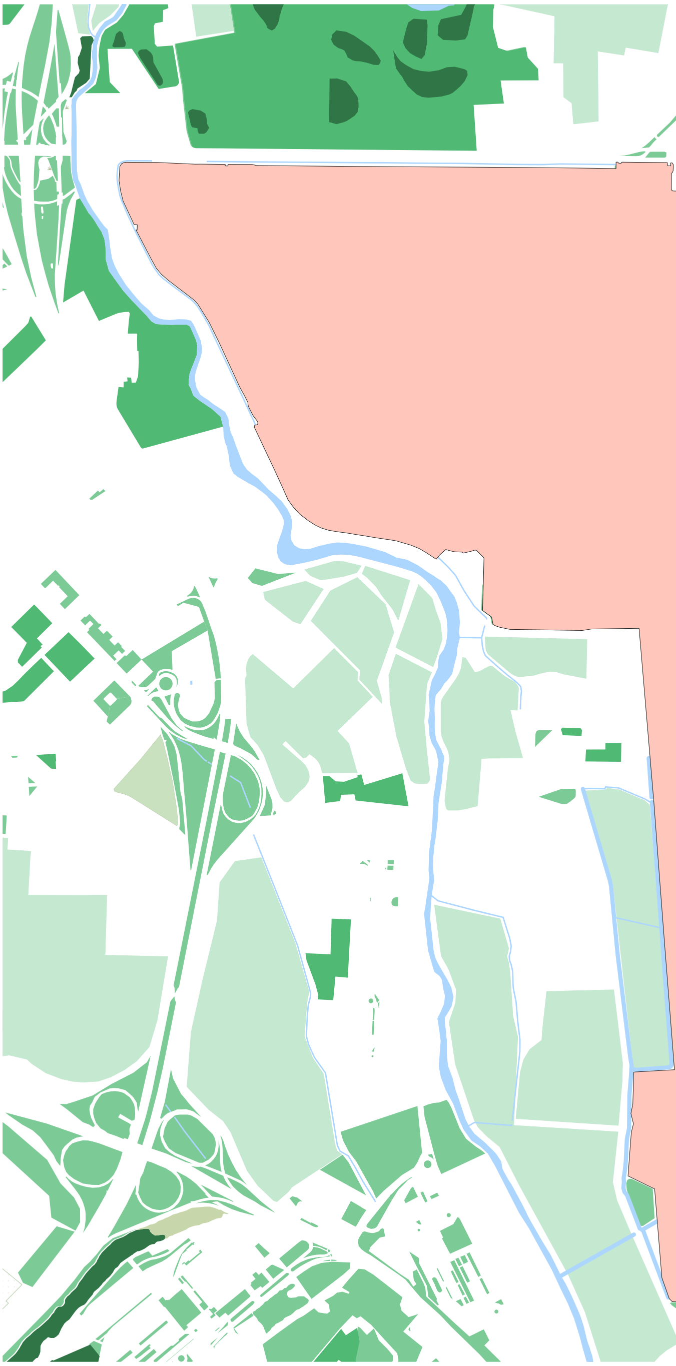


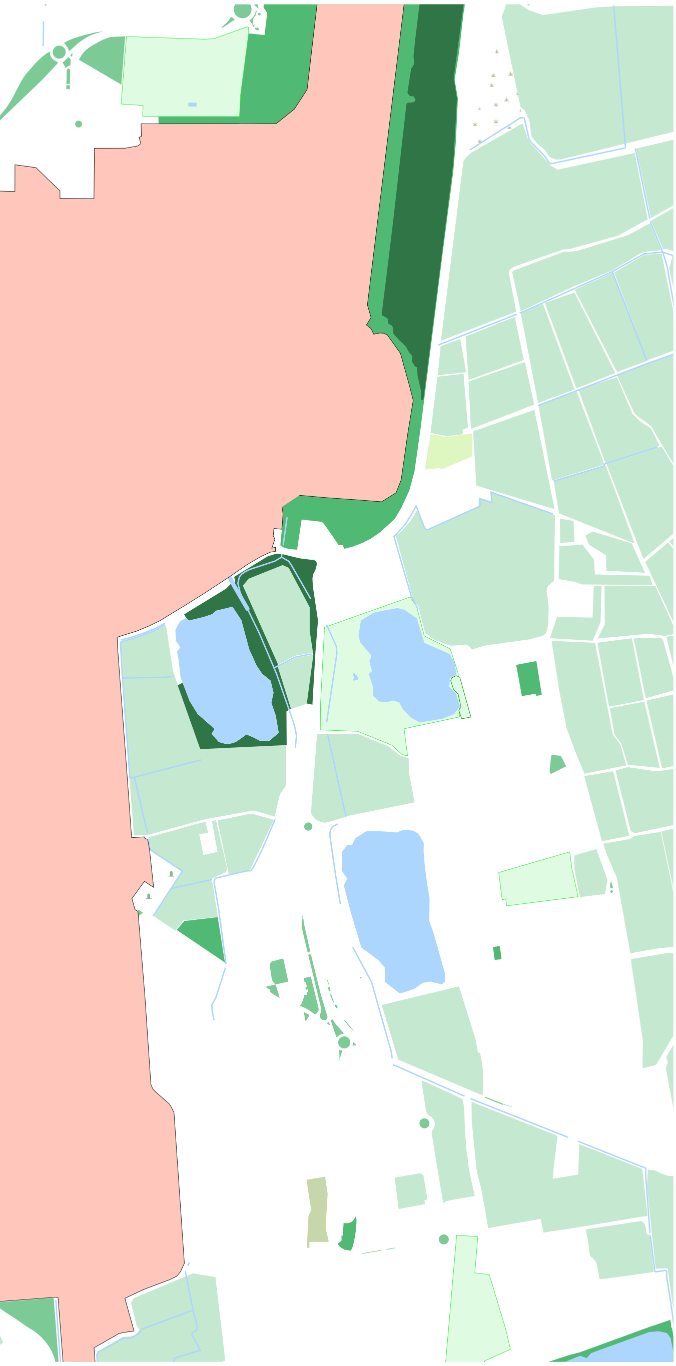
SITE ANALYSIS: WIND



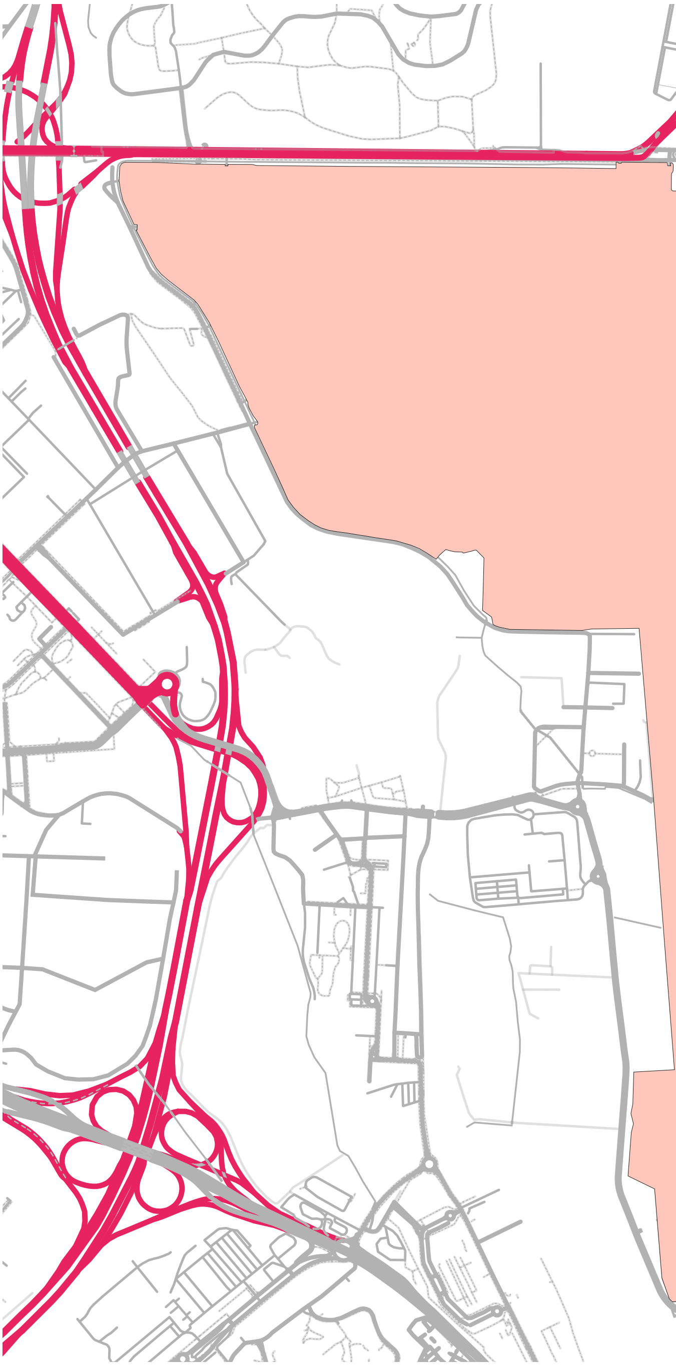

NE
E
SE
Summary
Obs Used: 250966
Obs Without Wind: 0
Avg Speed: 3.9 mph
10 - 14.9
15 - 19.9
20+

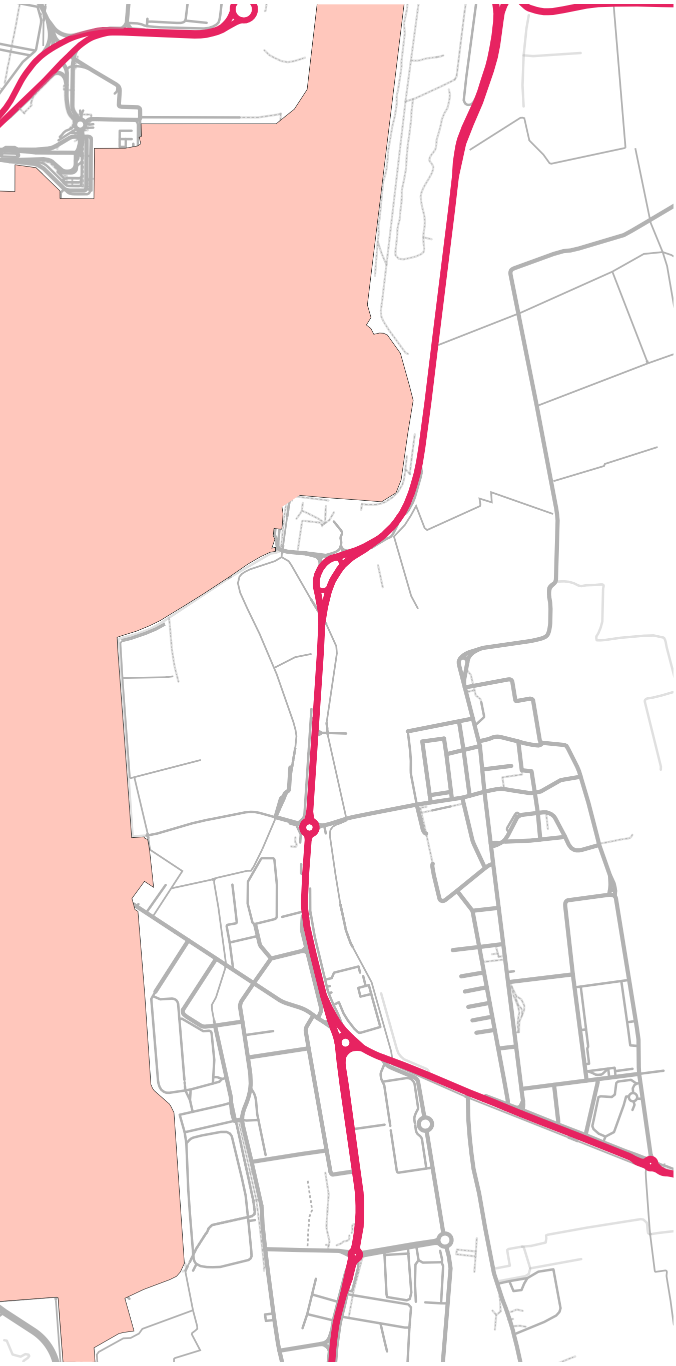
SITE ANALYSIS: SITE NATURE





SITE ANALYSIS: SITE ROADS

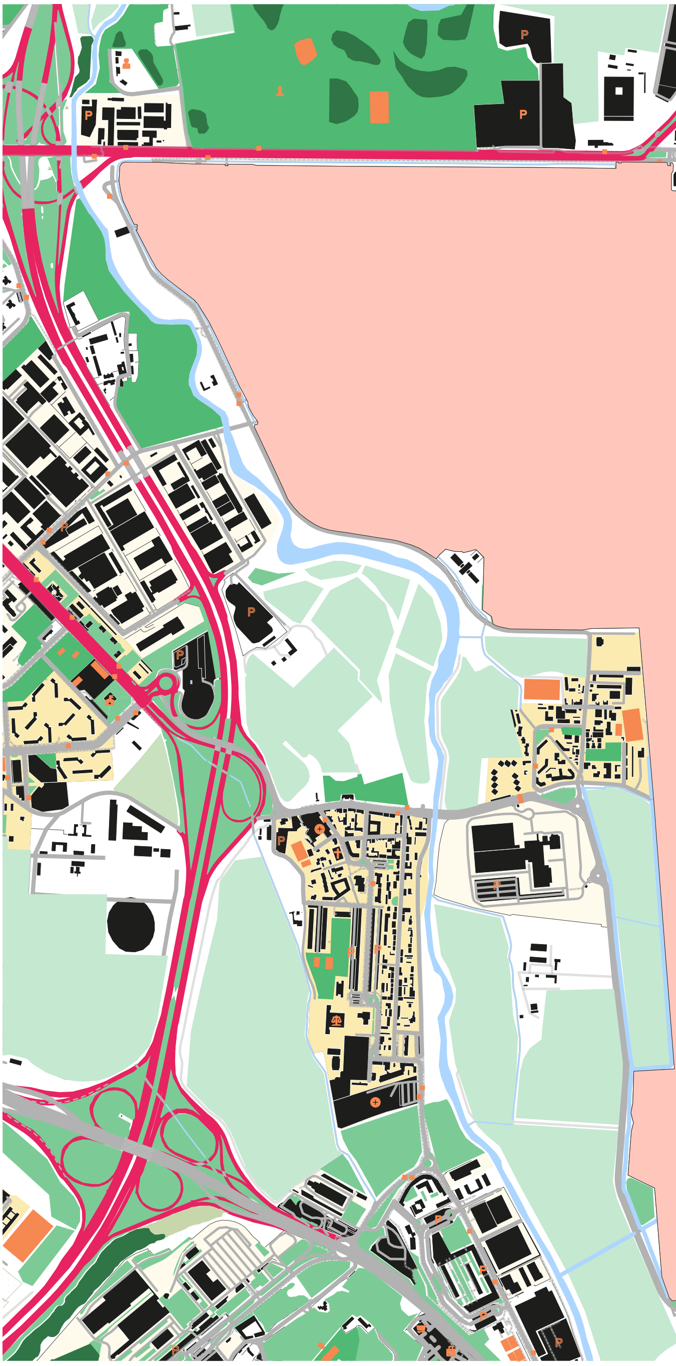




SITE ANALYSIS: SITE BUILDINGS


P
P
P
P
P
P
P

SITE ANALYSIS: FULL PICTURE



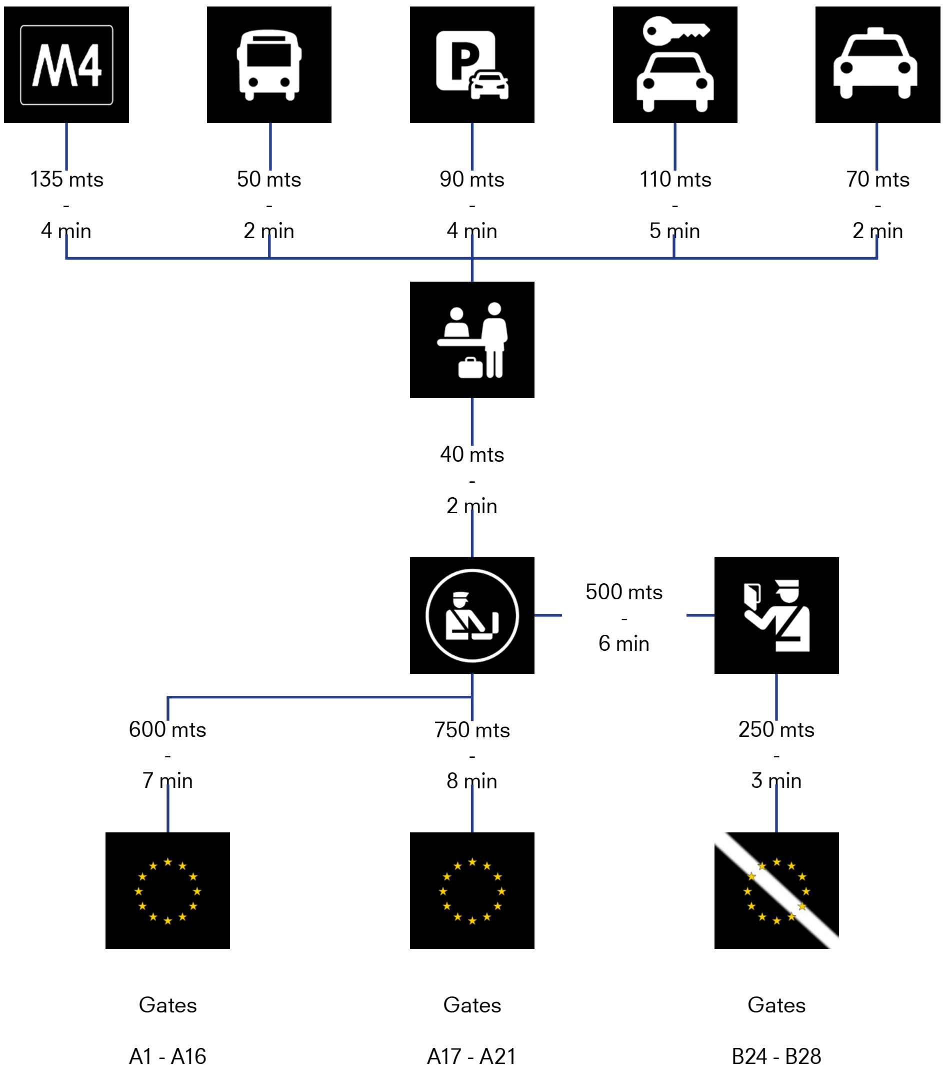
SITE ANALYSIS: AIRPORT ARRIVAL

One of the most unique factors about Linate is the proximity and its connectivity to the city of Milan. In the following chart we can the result of an analysis of the different ways to get to and from the airport to different iconic locations in the city. These locations are the train station Milan Centrale, the new commercial district next to Garibaldi Station, the Duomo, Fondazione Prada, and finally the Stadio Giuseppe Meazza (often called San Siro). The analysis studies the number of transfers made throughout the trip, the average arrival time and its cost.

Route	Transport	Average arrival time	Price
Milan Centrale - Linate Airport	Bus autostradale 144	25 min.	€ 5.00
Milan Centrale - Linate Airport	Taxi	23 min.	€ 15.00 - 20.00
Garibaldi Station - Linate Airport	Metro 1 | Metro 4	22 min.	€ 2.20
Duomo - Linate Airport	Metro 1 | Metro 4	12 min.	€ 2.20
Porta Romana (Fondazione Prada) - Linate Airport	Train S9 | Metro 4	16 min.	€ 8.30
Stadio Giuseppe Meazza - Linate Airport	Metro 5 | Metro 1 | Metro 4	36 min.	€ 2.20

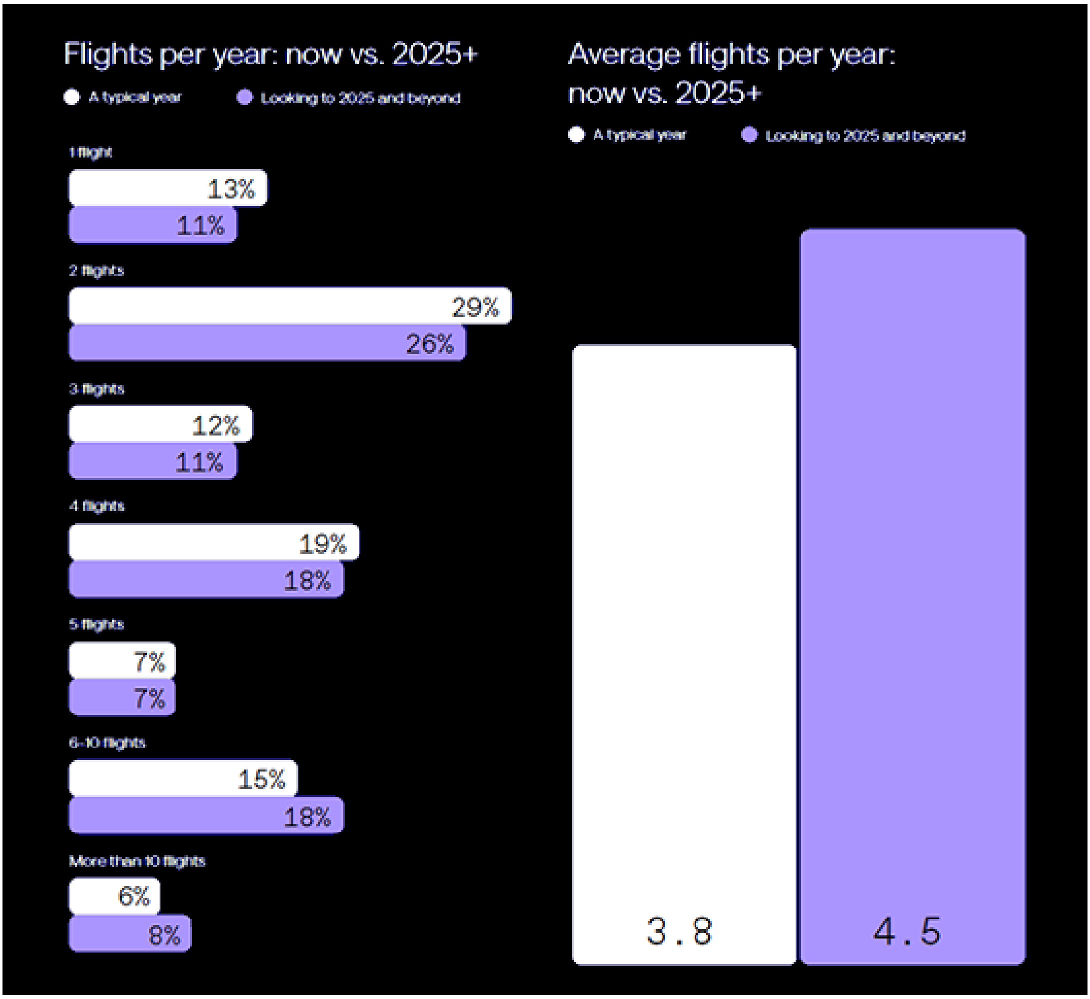
DISTANCE BETWEEN ACCESS POINTS, CONGESTION POINTS, AND GATES

Once inside the airport, one of the main design choices that defines how passengers move through the building is the location of congestion points and the distances between them, as well as their relationship to entrances and gates. The diagram on the following page illustrates these distances and the average time taken by passengers at Linate Airport. It is important to note that the times shown represent average walking times only and do not include time spent at congestion points. These aspects will be explored in a later section of the report.



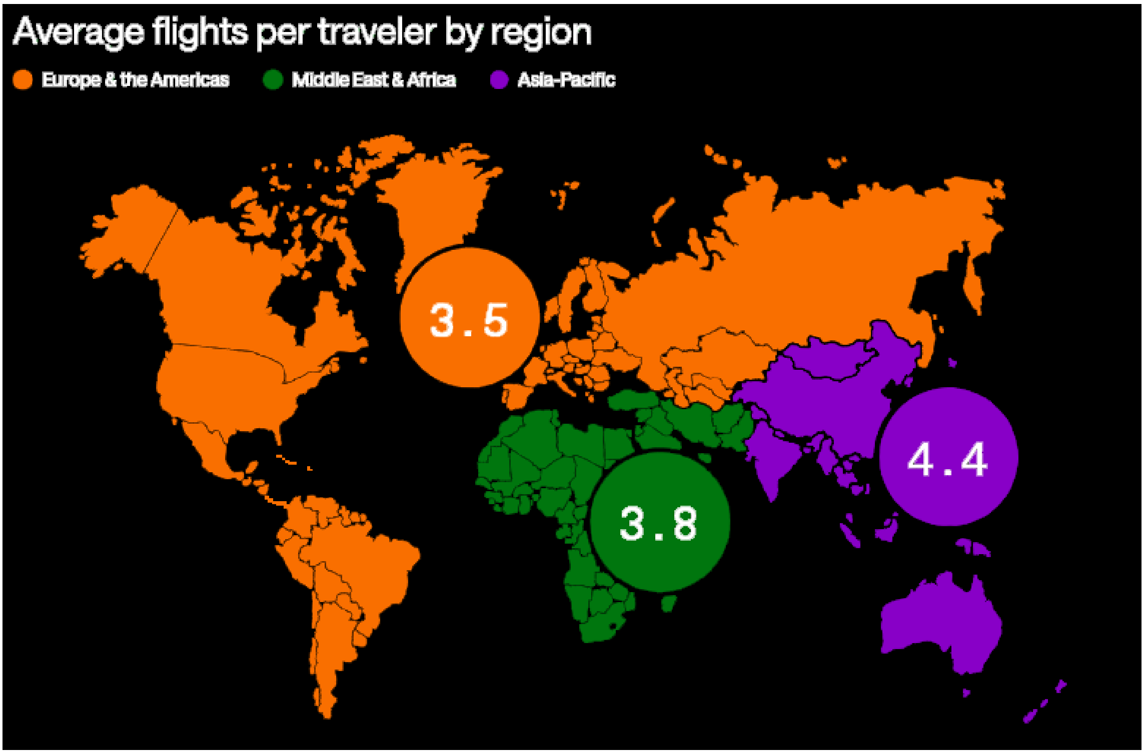
STATISTICS

Airports, airlines, and other statistic organizations study in depth passengers, airports, flights, and any concern that might exist in the travel system. In this section of the report, we will analyse the most relevant data, which will hopefully help us understand the future concerns for airports and the air travel sector. Most of these statistics come from the SITA 2025 passenger report and the IATA 2025 Global Passenger Survey, but all other sources are listed in the reference list. For more information about statistics, as well as a concluding passenger type analysis based on the statitics see *appendix 2. Statistics.*



The global aviation traffic is expected to grow the coming years, as it's has since around 1985 with the exemption of 2020. The annual income in the aviation sector was 800.000 million in 2021, and it's expected to grow a 10.58% for 2027. These numbers are supported by the growth in global traffic which grew 10.6% in 2024.

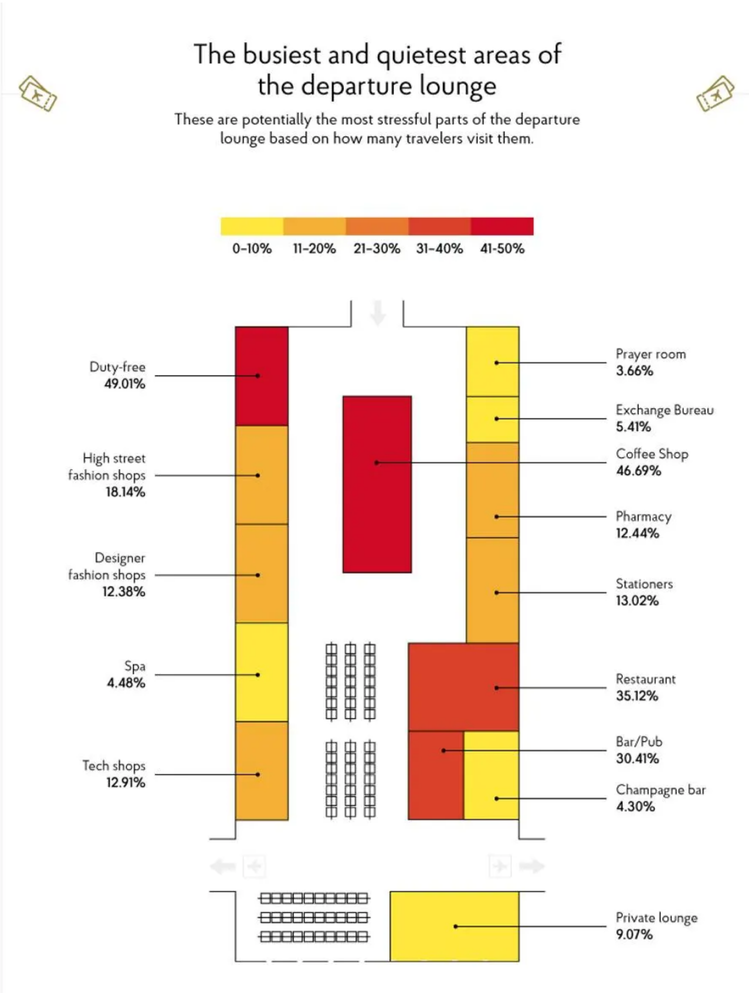
When looking at the origin of the passengers flying, statistics show that Asia-Pacific leads the air traffic with 4.4 flights per traveller, followed by the Middle East and Africa at 3.8. Europe and the Americas trail at 3.5.



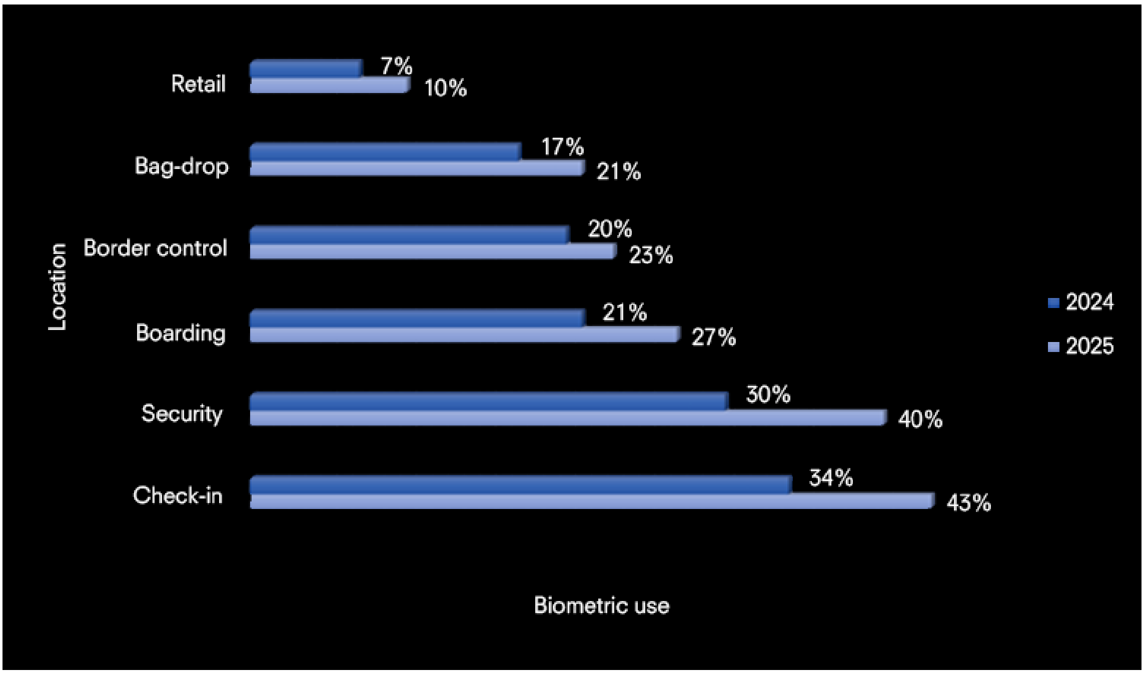
Sustainability is one of the newest factors for travel preferences between passengers. The average percentage of ticket price passengers would be willing to pay on top of the price of their ticket to offset carbon emissions of their flights is 11.3%, an increase from 10.8% in 2024. On the following chart we find the net increment range that travellers would be willing to apply on their flights.

Net range	2024	2025
<10%	49%	47%
10-20%	38%	39%
21-30%	6%	7%
31-40%	3%	3%
41-50%	4%	4%

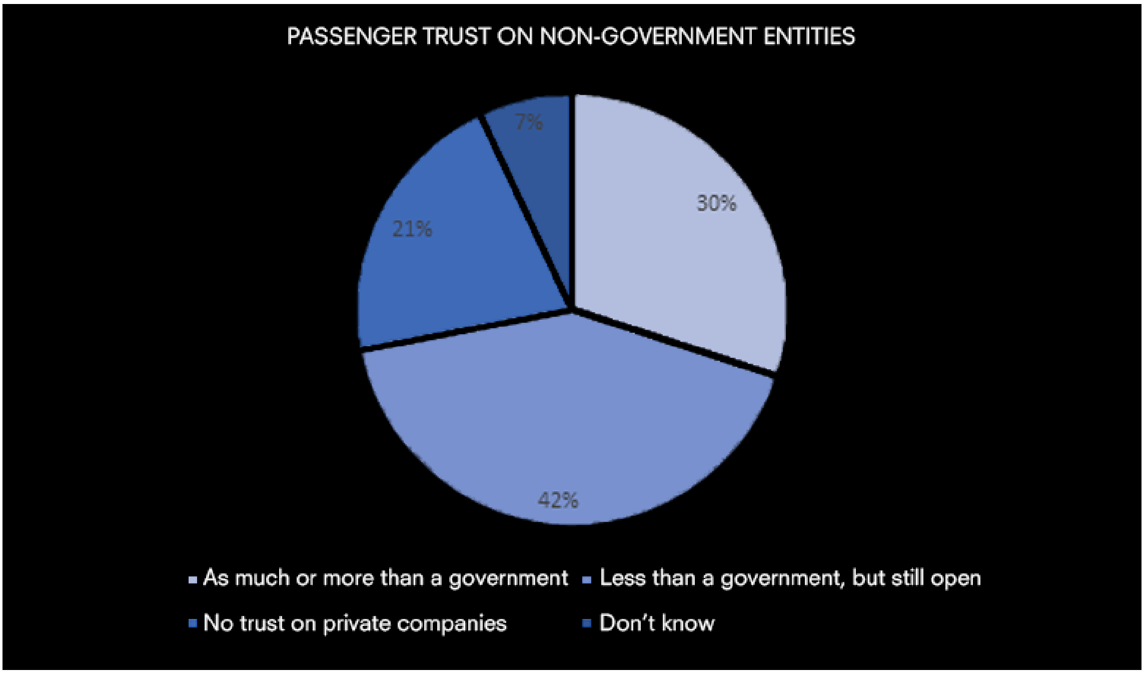
In the next diagram, the busiest areas in a lounge are shown. Although the reasons (marketing or visibility) for the amount of use is not stated, it shows the importance of these spaces while waiting at gates.



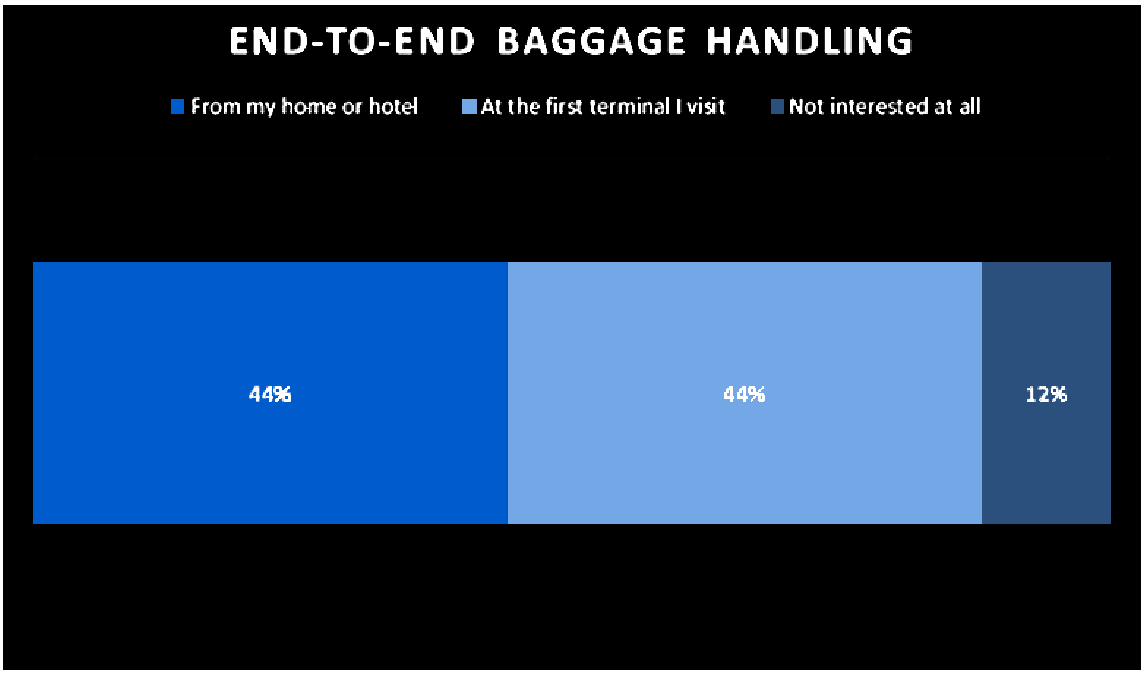
The use of biometric technology has grown in all the different travel points in an airport compared to 2024, which aligns to the data previously described. The interesting part that can be seen in the following graph is the places where it is mostly used. This information could help designers to find a way to increase this technology everywhere in the airport.



When speaking of trust in external parties to personal DTCs, passengers were asked on their trust levels on non-governmental entities. The results are shown in the following graph.



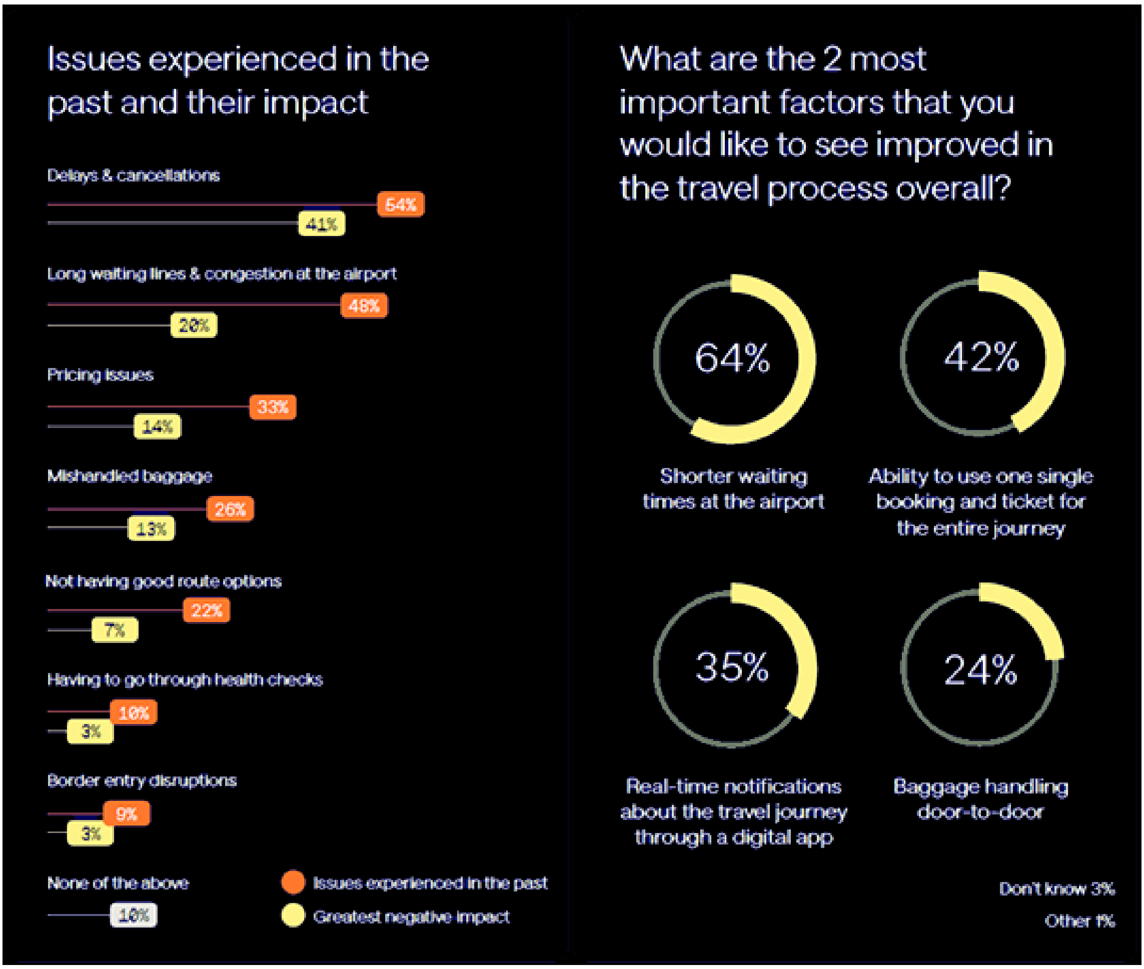
End-to-end baggage handling is a popular service request (27% of passengers) coming second only to better coordination between providers during disruption. If this service where to exist, passengers were asked where the service should start. The results can be seen in the following graph.



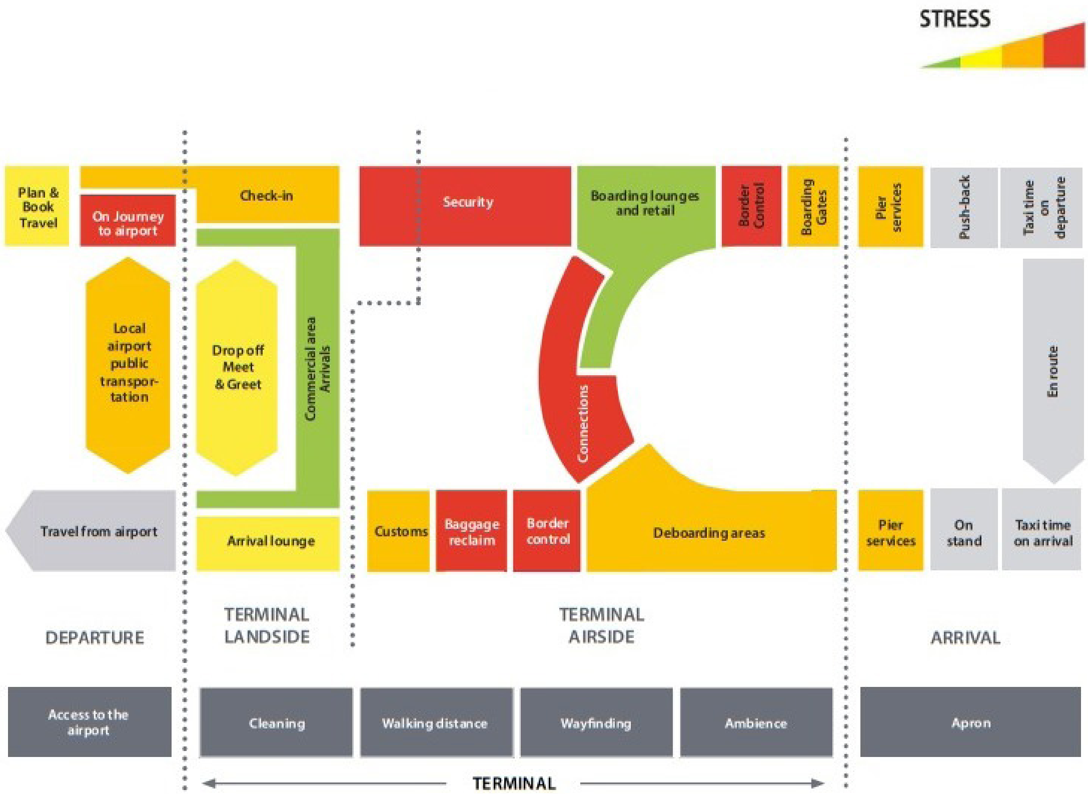
One of the frequently asked questions is “what is the satisfaction percentage of passengers about the different key points in their trips?”. In the following table we can see a satisfactory/dis-satisfactory percentage per location.

Location	Satisfaction	Dissatisfaction
Booking	85%	5%
Final dest. reach	83%	4%
Travel options	82%	6%
Check-in	82%	7%
Payments	81%	6%
Airport arrival	81%	5%
Boarding	75%	11%
Bag drop	74%	10%
On-board	73%	10%
Security	72%	11%
Transfer	69%	9%
Immigration	66%	15%
Bag collection	65%	16%

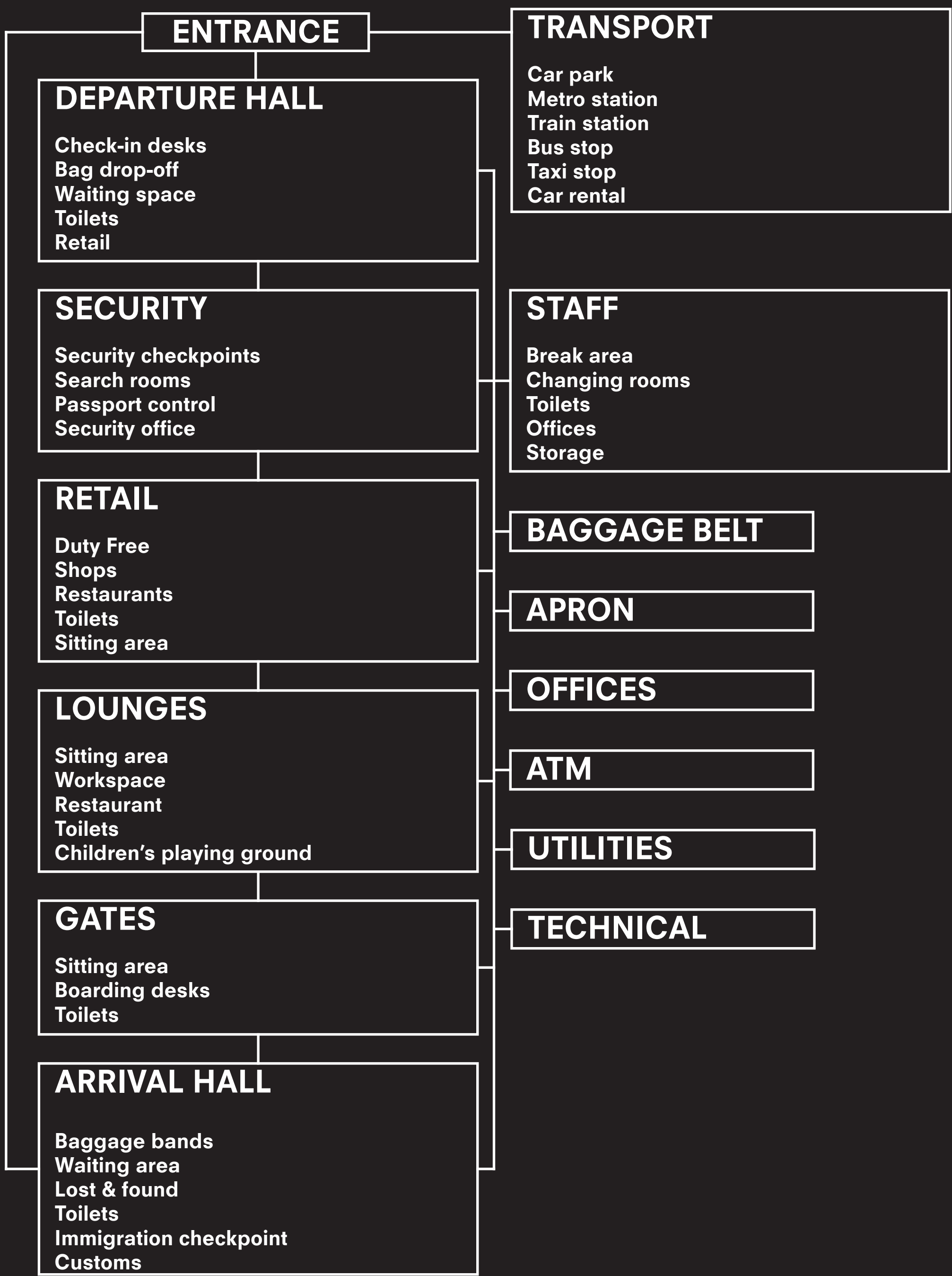
When passengers were asked on the biggest issues that damaged their traveling experience, 41% mentioned delays and cancellations and 20% mentioned long waiting lines. As a solution passengers gave three main ideas. Shorter waiting times (64%), one single booking for the entire journey (42%), and real-time updates in a single app (35%). In the following graphic we can see an extensive representation for these two themes.

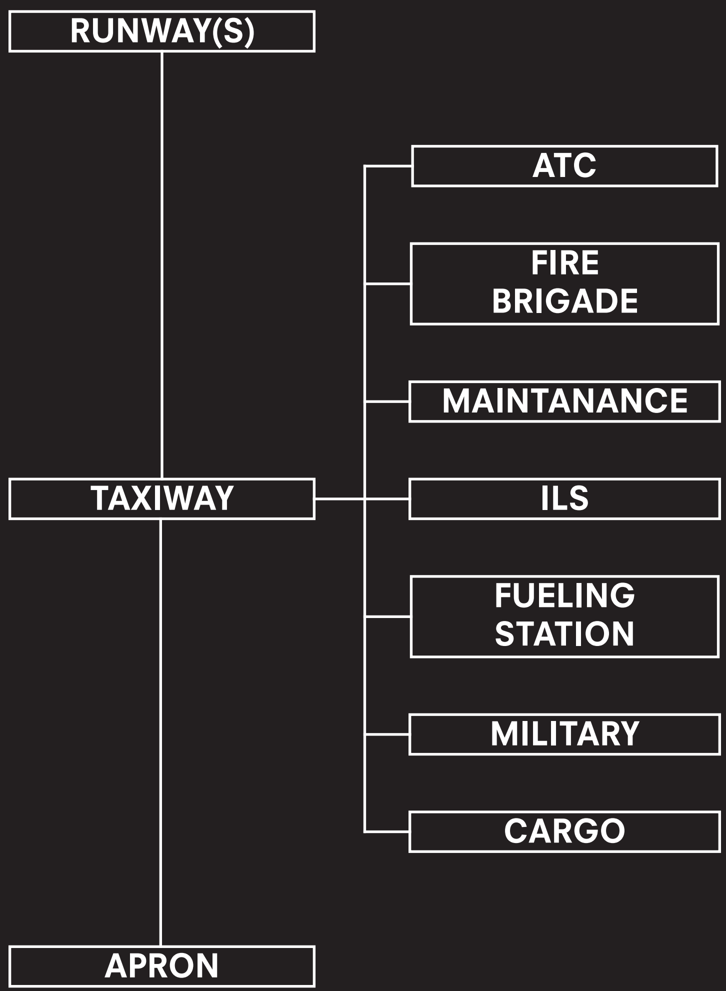


Finally, in the following diagram we can see a representation of the most stressful areas or moments during passenger's stay at terminals. This kind of graphic shows were designers should focus in order to decrease the overall stress experienced while traveling.



RELATIONS ANALYSIS




RUNWAY(S)
TAXIWAY
APRON
ATC
FIRE BRIGADE
MAINTANANCE
ILS
FUELING STATION
MILITARY
CARGO

AIRSIDE SPACE REQUIREMENTS

Introduction

The exterior airside areas are the operational heart of an airport, which have strict spatial requirements derived from aircraft size, performance, and safety. These requirements determine how both the aircraft and terminal operate within an architectural masterplan. In general terms we can differentiate landside to airside design by focusing on visibility and risk mitigation, resulting in large but precise open spaces.

It is important to explain that airside layout and dimensions are developed in accordance with ICAO annex 14, volume I, using the aircraft code system. This code divides aircraft into 6 categories based on their wingspan. These categories are called ICAO Code Letter, which are relevant for architecture and its airport and terminal design. Most airports are designed with code C-E in mind. The code is shown below.

Code	Wingspan
A	< 15 m
B	15 – 24 m
C	24 – 36 m
D	36 – 52 m
E	52 – 65 m
F	65 – 80 m

Gate-to-Gate Spacing

Gate-to-gate spacing defines the distance between aircraft stands, which are measured from centerline to centerline. This space has to be able to accommodate the aircraft wingspan, its engine clearance, ground service operations, and pushback movement without affecting any adjacent aircraft. It i simportant to mention the that within the centerline-to-centerline distance, a 7.5 meter distance between each stand has to be respected.

Sufficient gate spacing prevents wing collisions and allows multiple aircraft to be docked simultaneously under safe conditions. In terms of architecture, gate-to-gate spacing determines terminal length, pier density, and the total gates that can be placed within the terminal. In conclusion, it acts as a central role in balancing operational safety with spatial efficiency and passenger convenience.

Aircraft Code	Centerline to Centerline
C	45 – 50 m
D	52 – 60 m
E	65 – 75 m
F	80 – 90 m

Apron Depth

The apron depth is the distance between the terminal façade and the apron taxiway centerline. This space must include the aircraft length, safety buffers, ground handling zones, and extra space for the aircraft to be able to do pushback operations.

The correct apron depth ensures that the aircraft engines have unobstructed clearance as giving safe maneuvering space during arrival and departure to the gate. In terms of architecture, the apron depth influences terminal section depth, separation between possible terminal fingers, façade exposure to jet blast. This makes this category one of the most influential when designing a terminal's proportions and land use.

Aircraft Code	Depth
C	70 – 80 m
D	80 – 90 m
E	90 – 105 m
F	110 – 130 m

Taxiway Measurements

Taxiways are connectors in the circulation network for aircraft. It connects runways with aprons and other facilities such as hangars. Taxiway measurements define the pavement and shoulder width.

Properly dimensioned taxiways make aircraft movement stable and safe; they prevent pavement damage and allow safe steering margins. In terms of architecture, taxiways define the land use and, together with the runway(s), the general masterplan of an airport.

Aircraft Code	Taxiway Width
C	18 m
D	23 m
E	23 – 25 m
F	25 m

Aircraft Code	Taxiway Shoulder Width (each)
C	10.50 m
D	17.50 m
E	23.00 m
F	30.00 m

Runway Measurements

The runway measurements define the dimensions of the runway and its safety margins. They are designed to safely accommodate aircraft during take-off, landing, and rejected takeoff scenarios. The width of runways ensures lateral clearance for landing gear, tolerance for crosswind landings, and reduces risk of deviation. The dimensions of the runway also account for pilot visibility and aircraft tracking accuracy.

In terms of architecture, runway measurements determine size of the airport, airport category, location of infrastructure and buildings. Although it might seem that the length of the runway should be defined by ICAO, runway lengths are defined by aircraft performance and not wingspan.

Aircraft Code	Runway Width
C	45 m
D	45 m
E	45 m
F	60 m

Aircraft Code	Runway Shoulder Width (each)
C	7.50 m
D	7.50 m
E	7.50 m
F	7.50 m

Taxiway to Taxiway Separation

Taxiway-to-taxiway separation is the minimum distance between two parallel taxiway centerlines. This separation is needed to make sure that aircraft can simultaneously make their taxi operation on adjacent routes while maintaining safe lateral clearance.

The separation between taxiways prevents both wing and engine conflicts, allowing independent taxiing movements. This influences network density, the possibility for parallel circulation systems, and the possibility for future expansion. While wider separations increase safety margins and allow future airport expansion and category upgrades, they expand the overall footprint of the airport.

Aircraft Code	Centerline to Centerline
C	44 – 47 m
D	60 – 65 m
E	80 – 90 m
F	97 – 107 m

Runway to Taxiway Separation

Similar to the taxiway-to-taxiway separation, runway-to-taxiway separation is the minimum centerline-to-centerline distance between a runway and a parallel taxiway. This protects the runway environment and ensures that taxiing aircraft are not in proximity to have an effect on departure and landings happening in the runway.

The correct distance reduces the risk of runway incursions and ensures safe takeoff and landing operations. In terms of architecture, runway-to-taxiway separation is, with the width and length of the runway, determinant of the airport width and land footprint, defining the minimum scale of the airfield.

Aircraft Code	Centerline to Centerline
C	168 m
D	176 m
E	190 m
F	210 m

Parallel Runway Separation

When applicable, the parallel runway separation determines the space between two parallel runways. This distance is measured just as previous separation measurements, from centerline to centerline. The separation distance ensures safe simultaneous operations under various visibility and traffic conditions.

An adequate runway separation allows independent takeoff and landing operations without the risk of wake turbulence or collisions. In terms of architecture, the distance (and number of runways) determines the airfield size and the capacity of flights per hour.

Operation	Separation
Independent parallel approaches	1,035 – 1,310 m
Dependent approaches	760 – 1,035 m
Visual only	300 – 600 m

Jet Blast Clearance

The clearance from jet blast defines the area behind aircraft engines that must remain free of structures, vehicles, and personnel due to high-velocity exhaust airflow during engine operations, both idle and with breakout operations.

Jet blast clearance is a key factor in airport design since it can cause severe damage to infrastructure, surrounding aircraft, and ground personnel. In terms of architecture, jet blast constraints influence the location of service roads, façades, lightweight structures, and any apron equipment. One of the great challenges when designing a correct terminal is designing great architecture with the operational constraints.

Aircraft Code	Idle/Low Power	Breakaway/ Pushback
C	30 m	45 m
D	40 m	60 m
E	45 m	75 m
F	60 m	90 m

Object Free Area

The Object Free Area or OFA is a protected zone around runways and taxiways where no fixed objects are allowed. It accounts for any aircraft deviations from the intended path and provides a safety buffer during emergency situations.

The OFA is one of the ways airports reduce collision risk and avoid accidents due to minor steering or alignment errors. In terms of architecture, the OFA establishes spatial boundaries that limit building placement, infrastructure, and landscape elements near movement areas.

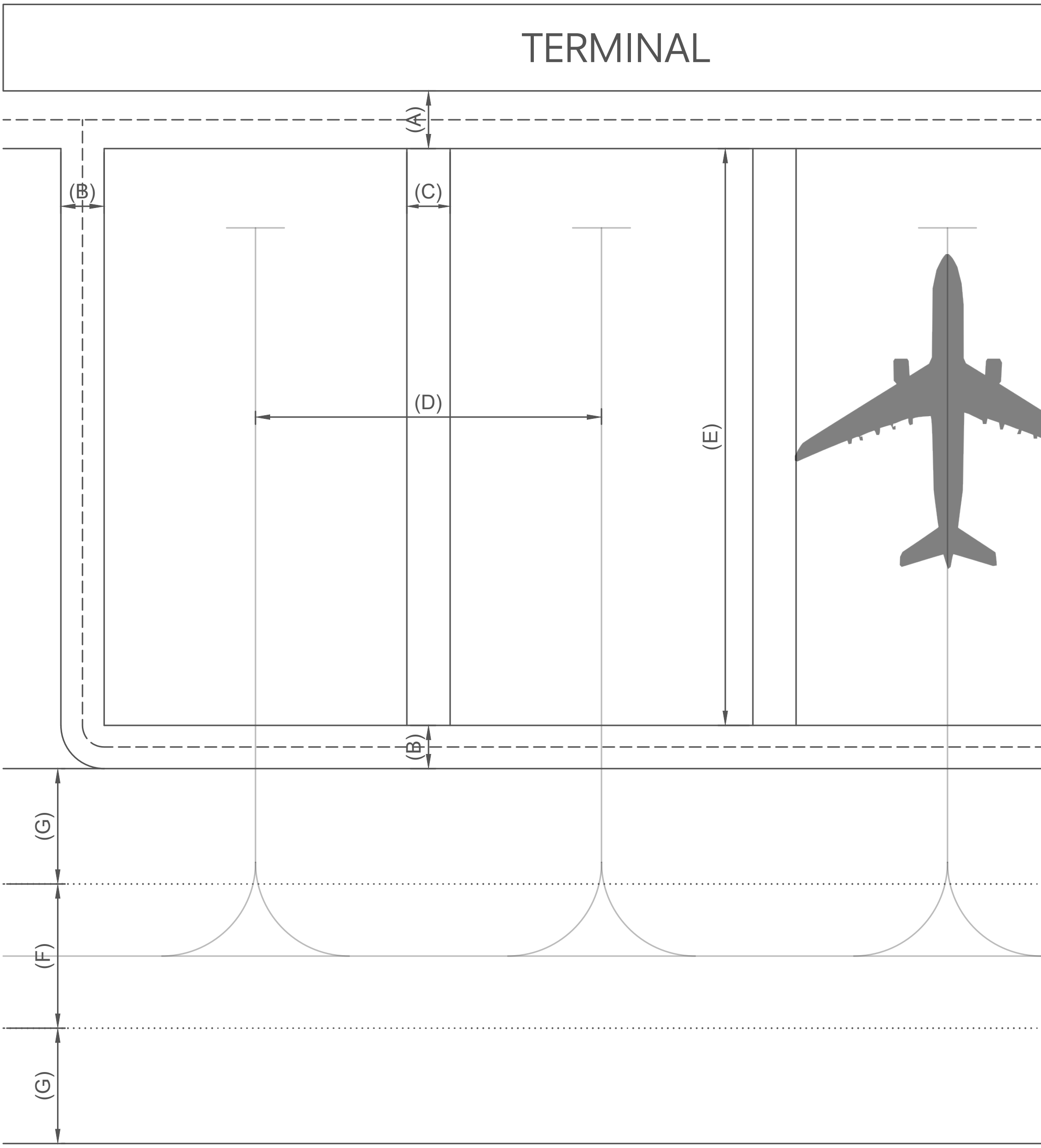
Aircraft Code	From Centerline Taxiway
C	28.50 m
D	36.00 m
E	42.00 m
F	47.00 m

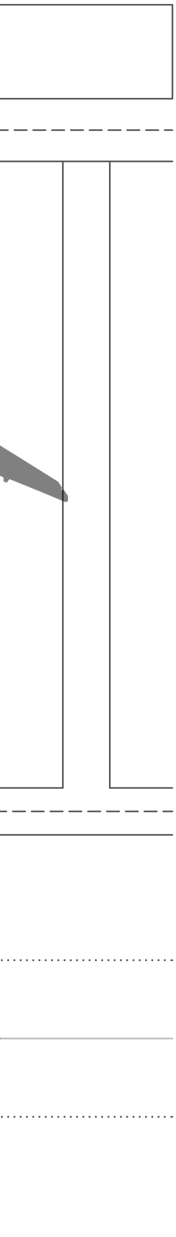
Aircraft Code	From Centerline Runway
C	75 m
D	150 m
E	150 m
F	175 m

Other

Service road width 7.5 – 10 m

Terminal setback: 10 – 15 m clear of aircraft envelope


TERMINAL
(A)
(B)
(C)
(D)
(E)
(B)
(G)
(F)
(G)



LEGEND

(A) Terminal setback
(B) Service road
(C) Aircraft stand distance
(D) Gate-to-gate spacing
(E) Apron depth
(F) Taxiway
(G) Taxiway shoulder

Gate-to-Gate Spacing

Aircraft Code	Centerline to Centerline
C	45 – 50 m
D	52 – 60 m
E	65 – 75 m
F	80 – 90 m

Apron Depth

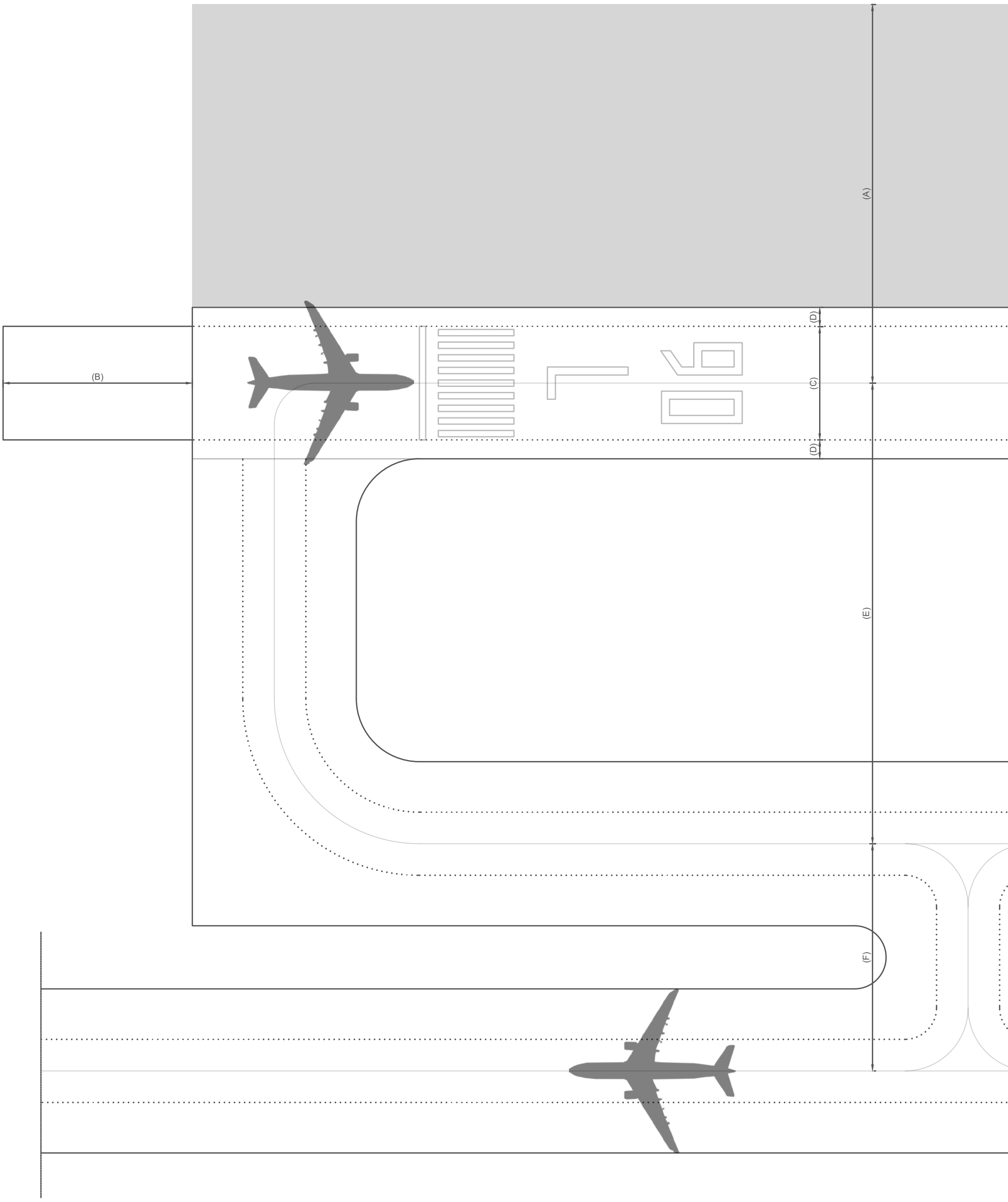
Aircraft Code	Depth
C	70 – 80 m
D	80 – 90 m
E	90 – 105 m
F	110 – 130 m

Taxiway Measurements

Aircraft Code	Taxiway Width
C	18 m
D	23 m
E	23 – 25 m
F	25 m

Aircraft Code	Taxiway Shoulder Width (each)
C	10.50 m
D	17.50 m
E	23.00 m
F	30.00 m

Other
Service road width 7.5 – 10 m
Terminal setback: 10 – 15 m clear of aircraft envelope



(A)
(B)
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(D)
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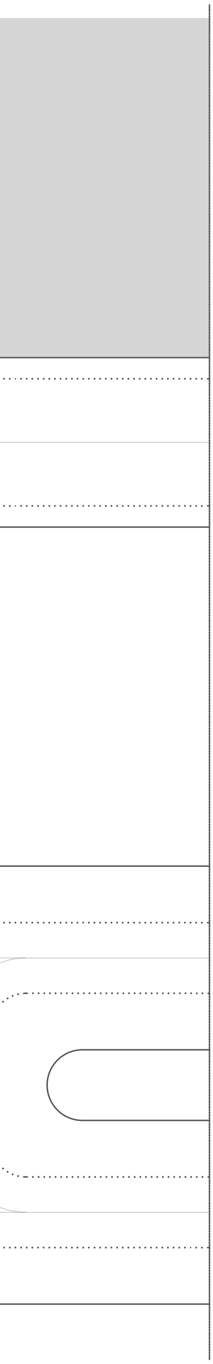
(F)
06
L



LEGEND

(A) Object free area
(B) Jet blast clearance
(C) Runway
(D) Runway shoulder
(E) Runway to taxiway separation
(F) Taxiway to taxiway separation

Runway Measurements

Aircraft Code	Runway Width
C	45 m
D	45 m
E	45 m
F	60 m

Aircraft Code	Runway Shoulder Width (each)
C - F	7.50 m

Taxiway to Taxiway Separation

Aircraft Code	Centerline to Centerline
C	44 – 47 m
D	60 – 65 m
E	80 – 90 m
F	97 – 107 m

Runway to Taxiway Separation

Aircraft Code	Centerline to Centerline
C	168 m
D	176 m
E	190 m
F	210 m

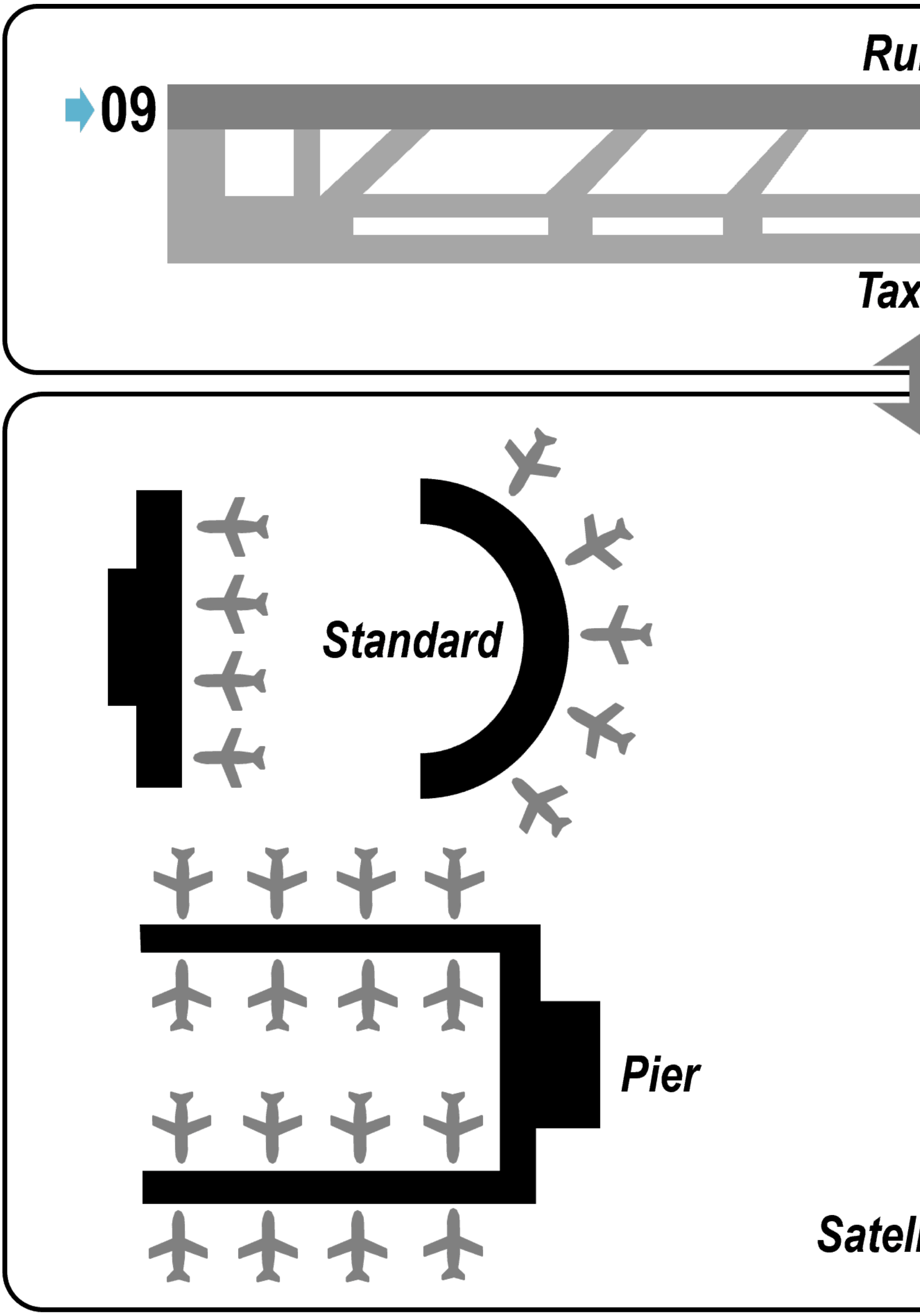
Jet Blast Clearance

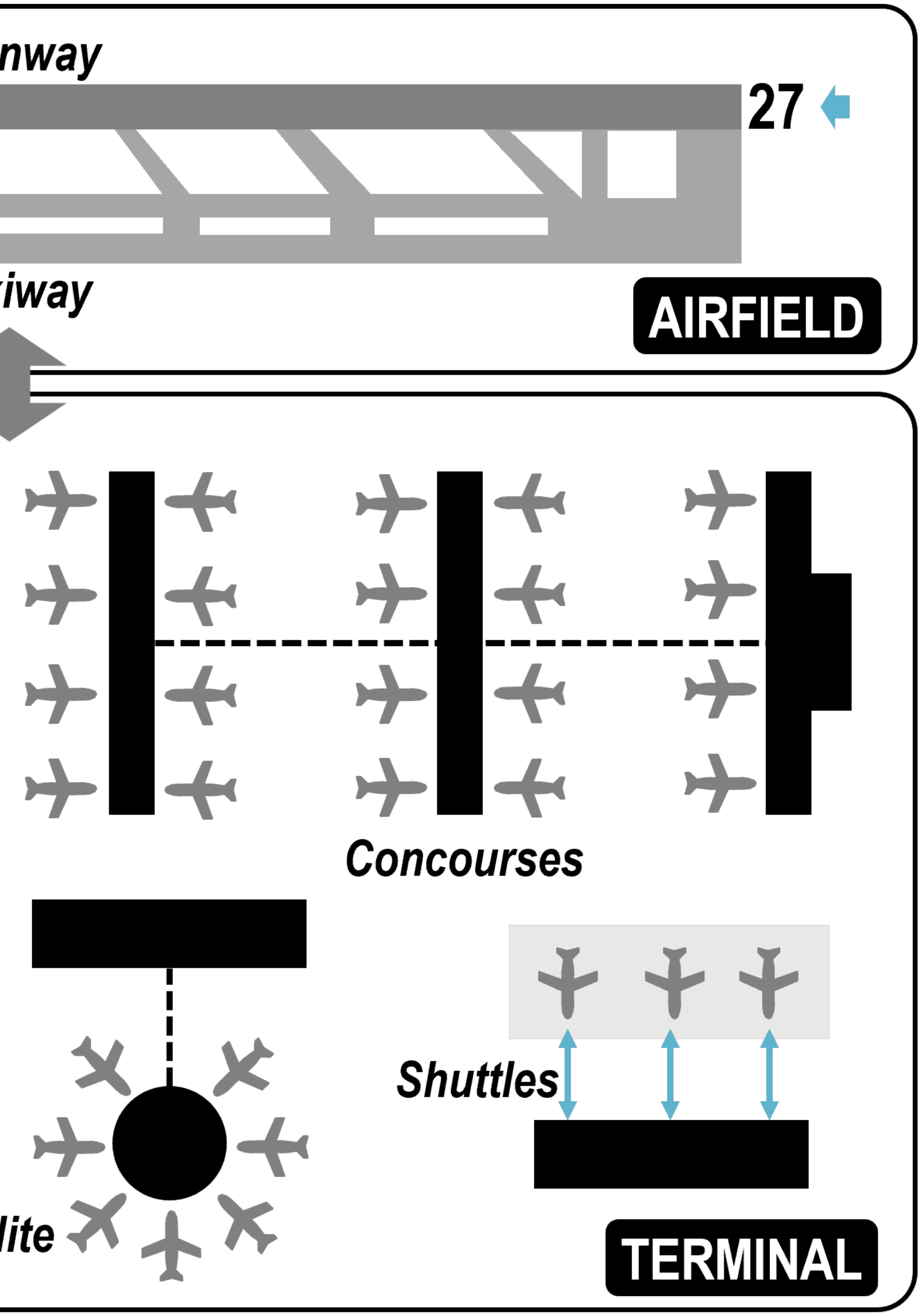
Aircraft Code	Idle/Low Power	Breakaway/ Pushback
C	30 m	45 m
D	40 m	60 m
E	45 m	75 m
F	60 m	90 m

Object Free Area

Aircraft Code	From Centerline Runway
C	75 m
D	150 m
E	150 m
F	175 m

TERMINAL TYPOLOGIES




nway
27
iway
AIRFIELD
Concourses
Shuttles
lite
TERMINAL

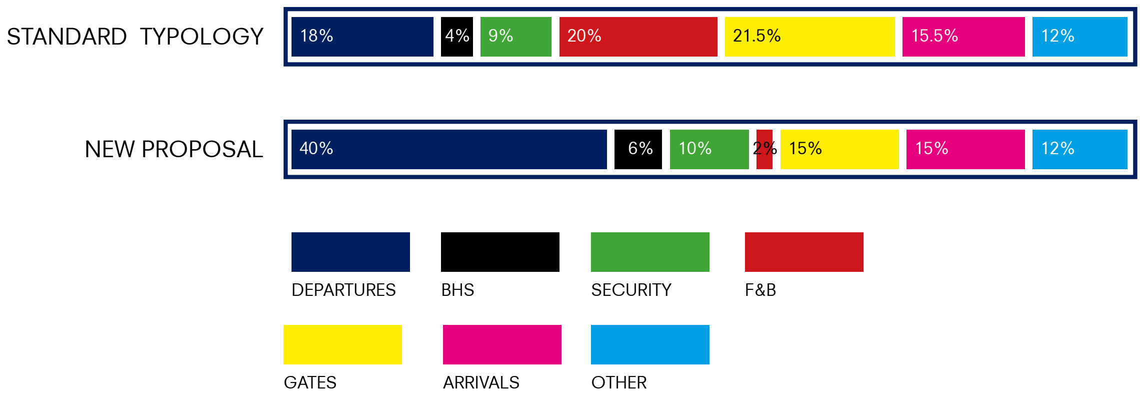
PROGRAM

SPACE	AREA AS % OF TOTAL	SECURITY ZONING	FLEXIBILITY/ MODULARITY
Check-in Hall / Departures Concourse	**18 %**	**Public**	
Circulation & Buffer Space	6.5%	Public	High
Check-in / Bag Drop Zone	6%	Public	High
Landside Retail & F&B (Kiosks, Cafés, Impulse Buy)	2%	Public	Medium
Ancillary Services (Car Rentals, Bank/ ATM, Lost & Found, Pharmacy)	1.5%	Public	Medium
General Information / Ticket Sales (Airline & Airport Service Desks)	1%	Public	High
Public Toilets & Aminities	1%	Public	Low
Bagage Handling System	**4%**	**Private**	**High**
Security	**9%**	**Semi-Private**	
Security Screening (General Passenger Area)	4%	Public	High
Border Control (Immigration)	2.5%	Public	High
Secondary Screening / Search Rooms	1.5%	Private	Low
Staff Control & Break Room (Security / Immigration Personnel)	0.3%	Private	Medium
Equipment Storage & Maintenance	0.7%	Private	Medium
F&B (Food & Beverage)	**20%**	**Public**	
Main Commercial Concourse (Duty-free. High-End Retail)	10%	Public	High
Airside F&B (Restaurants & Cafés)	5%	Public	Medium

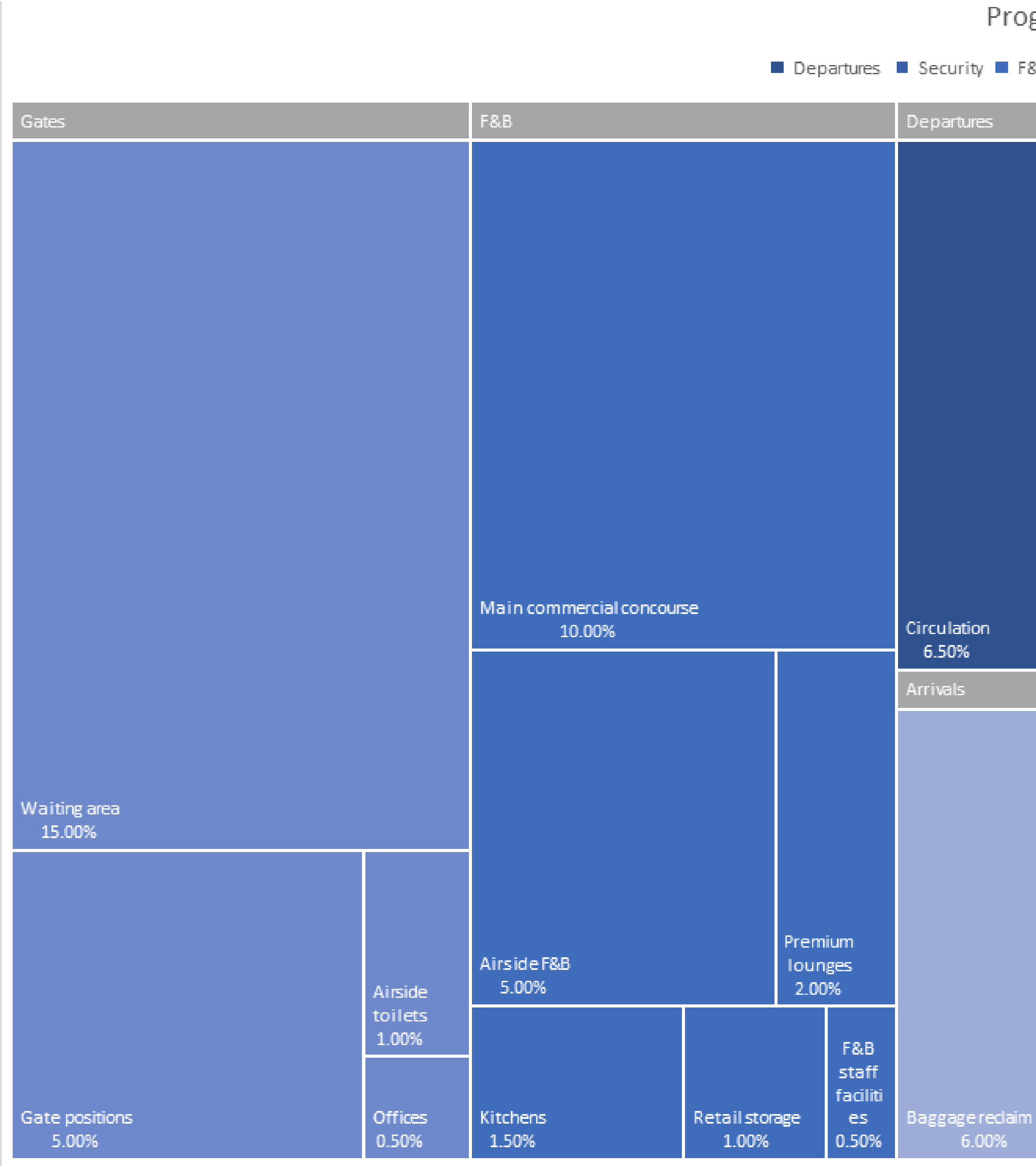
SPACE	AREA AS % OF TOTAL	SECURITY ZONING	FLEXIBILITY/ MODULARITY
F&B Kitchens & Storage (Common Use/Shared)	1.5%	Private	Low
Retail Storage & Logistics	1%	Private	Medium
F&B Staff Facilities (Break rooms, Lockers, Toilets)	0.5%	Private	Medium
Premium Lounges (Airlines/VIP)	2%	Semi-private	Medium
Gates & Piers	**21.5%**	**Public**	
Public Gate Waiting Area	15%	Public	High
Gate Positions (Contact Gates)	5%	Public	High
Airside Toilets & Amenities (Gate Areas)	1%	Public	Low
Gate Operations Offices (Airline Staff/ Ground Handling)	0.5%	Private	Medium
Arrivals	**15.5%**	**Public**	
Arrivals Border Control / Customs	1.5%	Public	Medium
Baggage Reclaim Hall	6%	Public	Medium
Baggage Support (Lost & Found / Damage Claims)	0.5%	Public	Medium
Arrivals Public Lobby (Meet & Greet / Circulation)	3%	Public	Medium
Arrivals Car Rental / Hotel Desks	1.5%	Public	Medium
Arrivals Toilets & Amenities	0.5%	Public	Low
Baggage Handly System (BHS Main, Maintenance & Staff Facilities)	2.5%	Private	Low

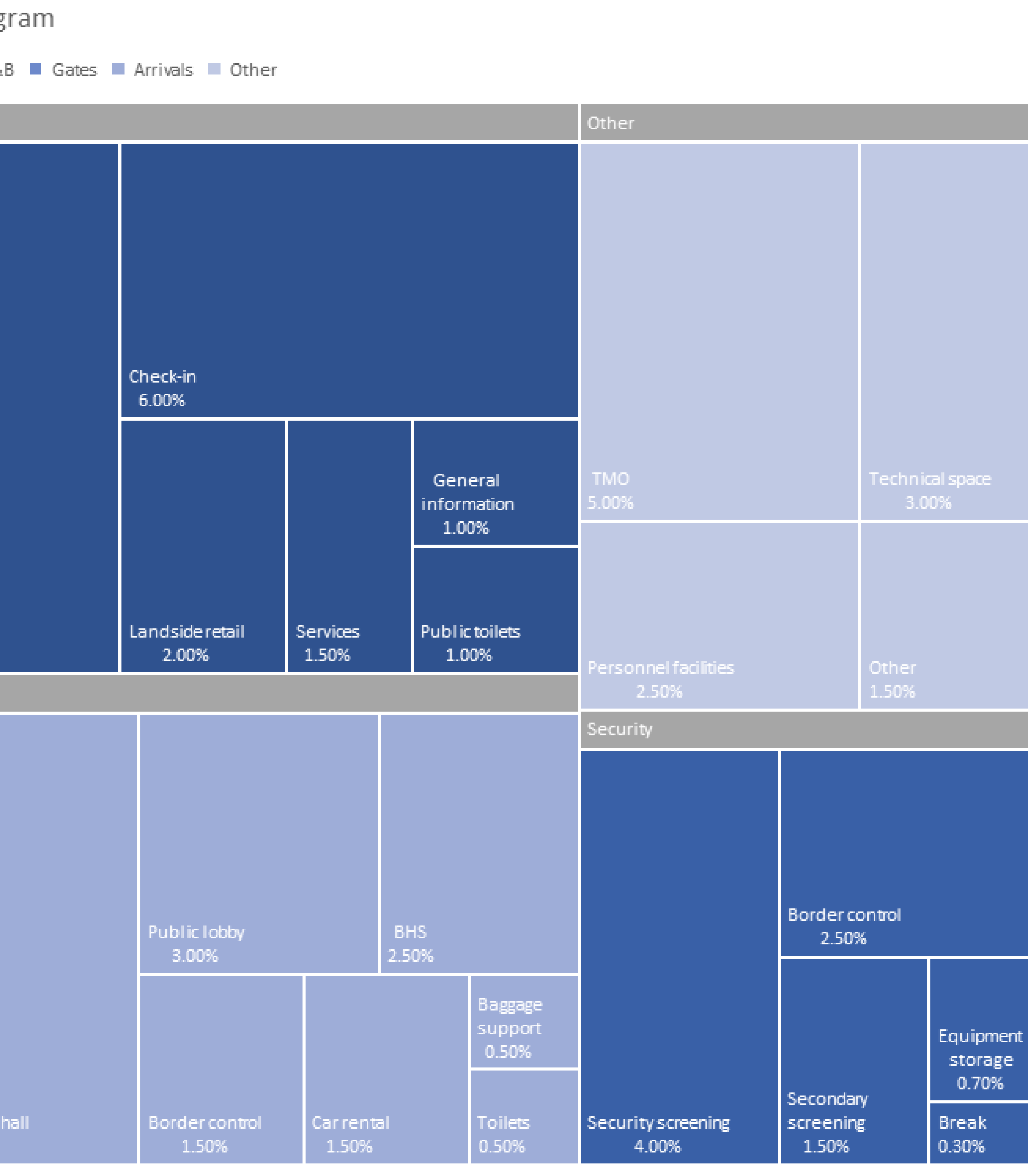
PROGRAM

SPACE	AREA AS % OF TOTAL	SECURITY ZONING	FLEXIBILITY/ MODULARITY
Other	**12%**	**Private**	
Terminal Management Offices (SEA Group, ENAC, Airlines)	5%	Private	High
Technical Spaces (HVAC, Electrical Server/Data Rooms)	3%	Private	Low
Personnel facilities (Central: Canteen, Fitness, Lockers)	2.5%	Private	Medium
Other	1.5%	-	-



PROGRAM


Prog
Departures
Security
F&
Gates
F&B
Departures
Waiting area
15.00%
Main commercial concourse
10.00%
Circulation
6.50%
Arrivals
Airside F&B
5.00%
Premium lounges
2.00%
Airside toilets
1.00%
Gate positions
5.00%
Offices
0.50%
Kitchens
1.50%
Retail storage
1.00%
F&B staff faciliti es
0.50%
Baggage reclaim
6.00%


gram
&B
Gates
Arrivals
Other
Check-in
6.00%
Landside retail
2.00%
Services
1.50%
General information
1.00%
Public toilets
1.00%
Other
TMO
5.00%
Technical space
3.00%
Personnel facilities
2.50%
Other
1.50%
Public lobby
3.00%
BHS
2.50%
hall
Border control
1.50%
Car rental
1.50%
Baggage support
0.50%
Toilets
0.50%
Security
Security screening
4.00%
Border control
2.50%
Secondary screening
1.50%
Equipment storage
0.70%
Break
0.30%

CONGESTION POINT ANALYSIS

Congestion point	Time per pax	Pax/hr	m² per unit	m² per pax/hr
		Check-in		
Check-in counter	90 - 120 sec	40 - 30	18	0.45 - 0.6
Self check-in kiosk	45 - 90 sec	80 - 40	5	0.06 - 0.13
Bag drop (staffed)	60 - 90 sec	60 - 40	14	0.23 - 0.35
Bag drop (self-service)	30 - 60 sec	120 - 60	7	0.06 - 0.12
Oversize baggage desk	90 - 180 sec	40 - 20	22	0.55 - 1.1
		Security		
Walk-through metal detector	5 - 7 sec	720 - 515	-	-
Milimeter-wave scanner	15 - 20 sec	240 - 180	-	-
Traditional X-ray scanner	6 - 9 sec	600 - 400	55[1]	0.09 - 0.14
CT scanner	9 - 14 sec	400 - 257	63	0.16 - 0.25
		Secondary screening[2]		
Manual bag search	60 - 120 sec	60 - 30	-	-
Explosive trace swab	20 - 30 sec	180 - 120	-	-
Pat-down	60 - 120 sec	60 - 30	-	-
		Exit immigration		
Automated e-gates	12 - 20 sec	300 - 180	8	0.03 - 0.04
Manual passport booth	40 - 60 sec	90 - 60	8	0.09 - 0.13
Secondary immigra-tion	120 - 240 sec	30 - 15	13	0.43 - 0.87

1 This takes into account the full length of the security lane. All elements of security are included
2 Average of 10 - 20% of passengers

Congestion point	Time per pax	Pax/hr	m² per unit	m² per pax/hr
Boarding				
Boarding pass scan	4 - 6 sec	900 - 600	5	0.006 - 0.008
Jet bridge flow	8 - 12 sec	450 - 300	95 - 120	-
Bus boarding	20 - 30 sec	180 - 120	45 - 50	-
Aircraft aisle stow-age	30 - 60 sec	120 - 60	-	-

03. CONCEPT

NOISE REDUCTION IN ELECTRIC PLANES

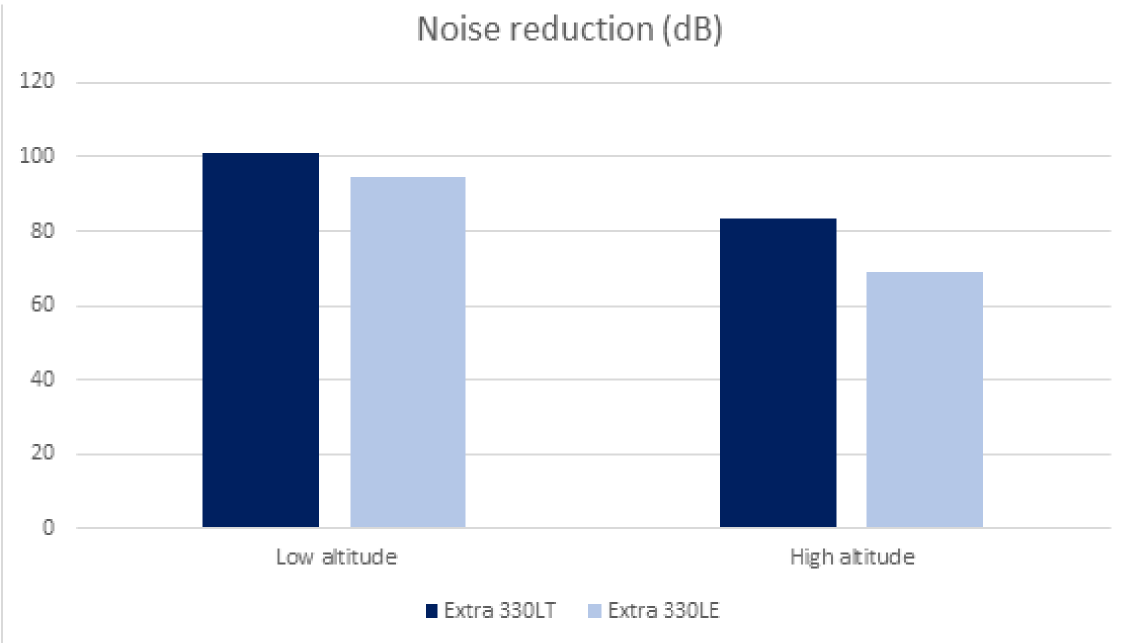
Noise pollution has always been one of the main factors which force airports to be built on the outskirts of cities. Aircraft generate the highest sound levels during take-off and landing, creating the need for a separation of the airport to surrounding urban areas. For this reason, if airports are to become part of the urban environment, noise pollution produced by aircraft should be reduced.

In recent years, the development of electric aircraft has shown that aircraft could, just like electric cars, be less noise polluting. The main difference between regular combustion engines and electric ones is the absence of the combustion process and/or the use of slower-rotating propellers, reducing in this way the noise produced. This reduction in noise has been tested only on smaller planes since medium-sized electric aircraft are still being developed and therefore tests are yet to be made.

The implications of quieter aircraft would influence the urban design of cities and the location of airports. Reduced noise pollution outputs would enable more compact airport layouts, lowering the need for conventional sound-buffer areas, and allow surrounding land to be used more efficiently. As a result, airports could start to function as mobility hubs, connected to public networks and public urban spaces.

In the following chart and graph, we can see the test results about noise reduction in small-sized aircraft made by Raphael Hallez, Claudio Colangeli, Jacques Cuenca, and Laurent De Ryck in their research paper “Impact of electric propulsion on aircraft noise – all-electric light aircrafts case study”. Although the amount of sound produced by the small aircraft would be less than a medium commercial aircraft, the logic of sound reduction should work on all types of aircraft.

LASmax [dB(A)]	Extra 330LT with combustion engine	Extra 330LE with electric motor	Noise reduction
Low altitude (50 ft)	101.2 dB	94.5 dB	6.7 dB
High altitude (1000 ft)	83.7 dB	69.2 dB	14.5 dB



SCENARIO ANALYSIS

Airports are massive complex buildings that take years (often decades) to plan, design, and build. For this reason, a well-thought-out proposal in 2025 should be in mind not the needs of today, but the needs of the future. In other words, there has to be discussions and speculation on what air travel will become in the future. To start with we have to define the time frame this project should be using in its design. The time stated below is taken from two documents, one by San Antonio International airport and the other by the Federal Aviation Administration. The overview is as follows:

Planning and feasibility

2-5 years. During this stage the design team has to do a site selection analysis, expansion feasibility plan, a masterplan, economic impact studies, and stakeholders have to coordinate and decide on viability.

Regulatory approval

3-7 years. Since airports are among the most regulated building types, this process takes a long time to finalize although this process can be merged partially with the planning process. The regulatory process includes: an environmental impact assessment; noise, air quality, and land-use studies; legal procedures; and national and international aviation approvals.

Design and engineering

2-4 years. This phase is a very volatile time since plenty of changes can occur during the design process. Steps in this phase are: (1) conceptual designs, (2) detail architectural designs, (3) airside-landside integration, (4) structural, MEP, and security systems design, and (5) phasing strategies for construction

Construction

4-8 years. This phase depends on the size of the airport, efficiency while building, the phasing plan, and any problems and interventions found through the building process.

Conclusion

We can average the full building process to take from 11 years with small airports and no complications up to 24 years. Taking the assumption that this process would start in 2026 or 2027 we can define 2050 as the full inauguration of the airport. From this point we should be expected to be able to cope with at least 25 years (ideally 50) of use without the need for major expansions.

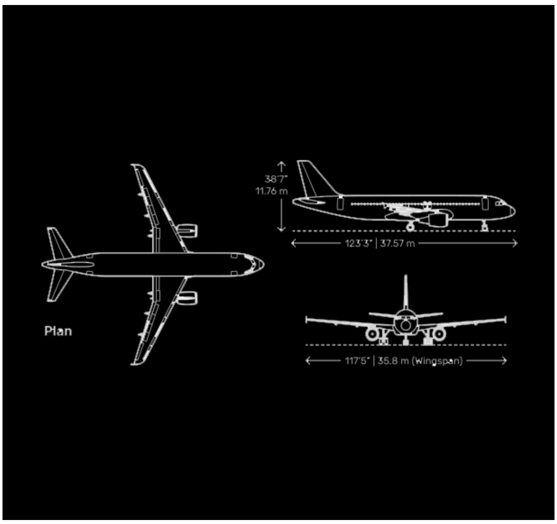
To be able to design the airport of the future, I have created a few scenarios that could become a reality in the years 2050 to 2075.

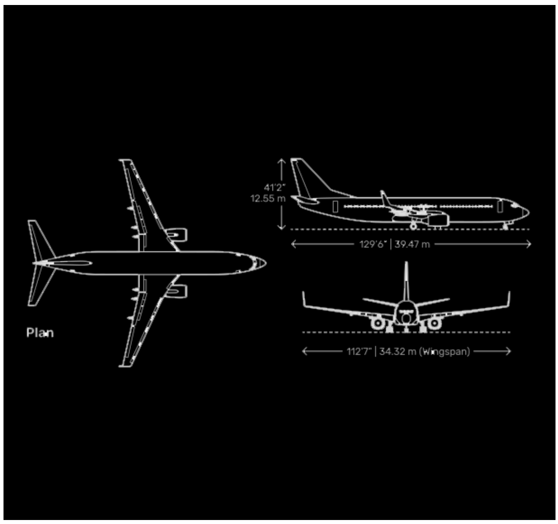
SCENARIO ANALYSIS

Scenario 0. No Changes

This scenario represents current Linate Airport air traffic and peak capacity. Linate's operational status is characterized by a successful, high-yield operation that is already running close to its structural and political capacity limits. Although this might seem a very urgent problem, Linate's capacity is also limited by the Bersani Decree which caps operations at 22 Aircraft Movements per hour (ATM/hr.) In the following table we can see the current numbers at Linate Airport.

For this analysis, both Airbus A320 and Boeing 737 MAX 7 will be analyzed. These two types of aircraft are comparable in size and capacity. By comparing them we could conclude what the minimal requirements are for Linate Airport.





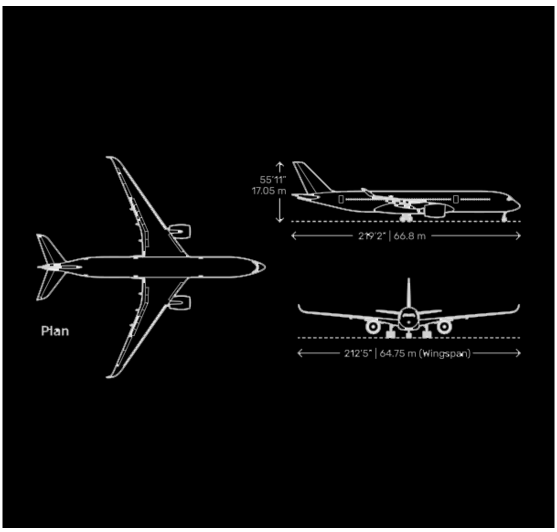
Parameter	Airbus A320	Boeing 737 MAX 7
Standard pax seating	150	153
Overall length	37.57 m	36.56 m
Cabin width	3.95 m	3.75 m
Wingspan	34.10 m	35.92 m
Height	11.70 m	12.30 m
Minimum runway length	1,900 m	2,100 m

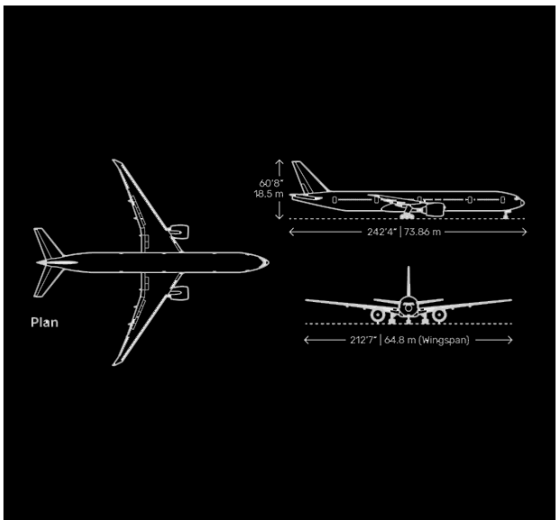
Metric	Calculation	Results 2050
Aircraft type	Narrow-Body	150 seats (average)
Peak hour ATM	Bersani Decree	22 ATM/Hour
Design year ATM	22 ATM/hr * 16 hr/day * 365 days	130,000 movements
Design year pax	130,000 ATM * 150 seats * 85% LF	16,575,000 Ann. Pax
Design day pax	16.6M Pax / 365 days * 1.15	52,301 Pax/Day
Peak hour pax	52,301 DDP / 16 hrs	3,269 Pax/Hour

Scenario 1. Maximizing Aircraft Size

This scenario explores an expansion on passenger flow while maintaining the flight limit decreed in the Bersani decree. The way to accomplish this is by changing the types of aircraft that land at Linate from narrow-body aircraft to wide-body aircraft. This change represents an increment of 230% on seats per flight, from 150 seats to 350. For the measurements we well keep the load factor at 85% and the growth in air travel at 115%.

For this analysis, both Airbus A350-900 and Boeing 777-300ER will be analyzed. These two types of aircraft are comparable in size and capacity. By comparing them we could conclude what the minimal requirements are for Linate Airport.





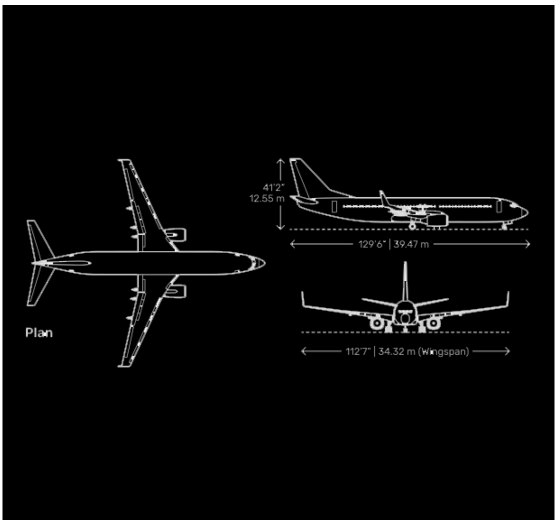
Parameter	Airbus A350-900	Boeing 777-300ER
Standard pax seating	312	380
Overall length	66.80 m	73.90 m
Cabin width	5.96 m	5.86 m
Wingspan	64.75 m	64.80 m
Height	17.05 m	18.50 m
Minimum runway length	2,600 m	2,700 – 3,000 m

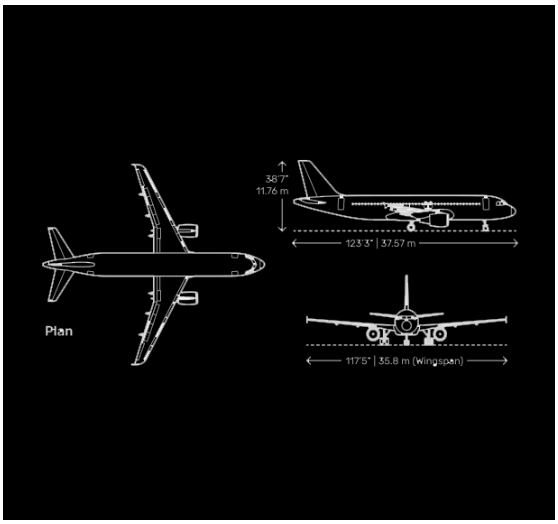
Metric	Calculation	Results 2050
Aircraft type	Wide-Body	350 seats (average)
Peak hour ATM	Bersani Decree	22 ATM/Hour
Design year ATM	22 ATM/hr * 16 hr/day * 365 days	130,000 movements
Design year pax	130,000 ATM * 350 seats * 85% LF	38,675,000 Ann. Pax
Design day pax	38.7M Pax / 365 days * 1.15	121,932 Pax/Day
Peak hour pax	121,932 DDP / 16	7,621 Pax/Hour

Scenario 2. Longer Aircraft

This scenario explores the current development of longer planes to increase aircraft capacity in a cost-effective way. In this scenario the Bersani Decree remains as it is currently, limiting flights to 22 flights per hour. The change in length will increase aircraft capacity 120%, from 150 seats to 180 seats. For the measurements we well keep the load factor at 85% and the growth in air travel at 115%.

For this analysis we will analyze the conceptual Boeing 797 and Airbus A321-200. Just as with the Elysian Aircraft, the data about the Boeing 797 is not fully known as it is a conceptual aircraft. The information from the Airbus A321-200 is official as the plane is a current commercial aircraft.





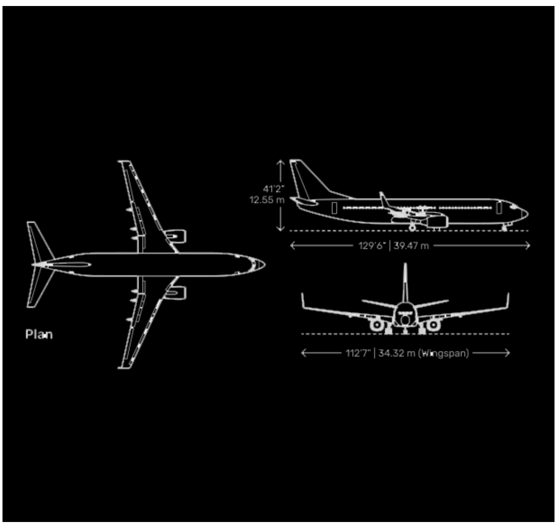
Parameter	Airbus A321-200	Boeing 797
Standard pax seating	185	225
Overall length	44.50 m	~ 47.3 m
Cabin width	3.85 m	Unknown
Wingspan	34.10 m	~ 38.0 m
Height	11.70 m	~ 13.5 m
Minimum runway length	2,200 m	Unknown

Metric	Calculation	Results 2050
Aircraft type	Wide-Body	180 seats (average)
Peak hour ATM	Bersani Decree	22 ATM/Hour
Design year ATM	22 ATM/hr * 16 hr/day * 365 days	130,000 movements
Design year pax	130,000 ATM * 180 seats * 85% LF	19,890,000 Ann. Pax
Design day pax	19.9M Pax / 365 days * 1.15	62,699 Pax/Day
Peak hour pax	62,699 DDP / 16	3,919 Pax/Hour

Scenario 3. Increment on Aircraft Movements

This scenario explores the conceptual idea of the use of smaller, electric aircraft. This concept would negate the Bersani Decree since the planes that would land in Linate are carbon emission-free and more silent than current models. These planes are not only theoretical but are also currently being designed and, in some cases, tested. Examples of these aircraft are the Airbus E-fan X, the Elysian Aircraft, or the ZeroAvia concepts. These planes are being developed currently with a limited capacity of 30-90 passengers but are expected to be able to carry 100 to 200 passengers by the time Linate Airport is fully operational. For this scenario we will measure aircraft with an average of

180 seats. Although this means the passenger account grows, airport design will change to be able to accept these new aircraft models as well as having more freedom about design because of sound mitigation. For these measurements we will maintain the load factor at 85% but the growth in air travel will increase to 120%. This change would reflect the change in easiness of travel, making more flights available, comfortable, and eco-friendly.



For this analysis we will analyze Elysian Aircraft, a TU Delft-based startup which is developing electric passenger aircraft. Although the size of this type of aircraft is not fully defined as it remains a concept, it is comparable with a Boeing 737 as from Elysian official webpage.

Parameter	Boeing 737 MAX 7	Elysian Aircraft
Standard pax seating	153	90
Overall length	36.56 m	~ 35.35 m
Cabin width	3.75 m	Unknown
Wingspan	35.92 m	~ 42.06 m
Height	12.30 m	Unknown
Minimum runway length	2,100 m	2,000 m

Metric	Calculation	Results 2050
Aircraft type	Wide-Body	180 seats (average)
Peak hour ATM	-	32 ATM/Hour
Design year ATM	32 ATM/hr * 16 hr/day * 365 days	187.000 movements
Design year pax	187.000 ATM * 180 seats * 85% LF	28.611.000 Ann. Pax
Design day pax	28.6M Pax / 365 days * 1.20	94.027 Pax/Day
Peak hour pax	94.027 DDP / 16	5.876 Pax/Hour

FUNCTIONAL PROGRAM OF REQUIREMENTS

Scenario 0. No Changes

As we saw in the scenario analysis, the PHPT by scenario 0 is 3,269 pax/hr. This PHPT is total number of passengers per hour, including both departures and arrivals. For many equations shown in this section, only half of the total PHPT will be used. The total PHPT is the result of the following equation:

((ACFT MVT 2050 x Average seats x PLF x Airline industry growth) / 365) / 16

(130,000 x 150 x 0.85 x 1.15) / 365 = 52,301 Pax/day

52,301 / 16 = 3,269 Pax/hr

Gates

Departures PHPT ≈ 1,635 pax/hr
Arrivals PHPT ≈ 1,635 pax/hr
MVT = 22
GOT ≈ 45-60 min
Minimal GOT in design for narrow aircraft: 90 min
Operational buffer = 15 %

Number of gates = Arrivals per hour x Gate occupancy time (hours) x Operational buffer
Number of gates = 11 x 1.5 x 1.15 = 19 gates

Check in desks

30% of passengers do online check in. So, we assume that 75% of passengers will use check-in desks.
Planning value (LoS C): 75 pax/hour per desk

1,635 x 75% = 1,227 pax/hr at check-in

1,227 / 75 = 16.4 = 17 check in desks

Baggage drop-off

60% of departures PHPT ≈ 981 pax/hr
Staffed bag drop = 50 pax/hr
Self service bag drop = 90 pax/hr
Average bag drop = 70 pax/hr

981 / 70 = 14 bag drop desks

Oversize baggage

3% of departures PHPT ≈ 49.05 pax/hr
Oversized bag drop = 40 pax/hr

49.05 / 40 = 1.23 = 2 oversized bag drop offices

Other

Function	ICAO Benchmark	Required 3,269 PHPT
Security lanes	150–220 pax/hr	11 - 8 lanes
Staff screening	-	1 lane
Immigration desks	90–120 pax/hr	19 - 14 desks
Baggage belts	400–500 pax/hr	4 - 5 belts
Customs area	1.0–1.2 m²/pax	1,635 - 1,962 m²
Gate lounges	1.2–1.4 m²/pax	1,962 - 2,289 m²
Corridors	1 m / 1k pax	3 - 4 m
Toilets	1 WC / 60 pax	28 units
Lost & Found	-	1 desk + back office

Scenario 1. Maximizing Aircraft Size

As we saw in the scenario analysis, the PHPT by scenario 1 is 7,621 pax/hr. This PHPT is total number of passengers per hour, including both departures and arrivals. For many equations shown in this section, only half of the total PHPT will be used. The total PHPT is the result of the following equation:

((ACFT MVT 2050 x Average seats x PLF x Airline industry growth) / 365) / 16

(130,000 x 350 x 0.85 x 1.15) / 365 = 121,932 Pax/day

121,932 / 16 = 7,621 Pax/hr

Gates

Departures PHPT ≈ 3,810 pax/hr
Arrivals PHPT ≈ 3,810 pax/hr
MVT = 22
GOT ≈ 75-90 min
Minimal GOT in design for wide aircraft: 120 min
Operational buffer = 15 %

Number of gates = Arrivals per hour x Gate occupancy time (hours) x Operational buffer
Number of gates = 11 x 2 x 1.15 = 26 gates

Check in desks

30% of passengers do online check in. So, we assume that 75% of passengers will use check-in desks.
Planning value (LoS C): 75 pax/hour per desk

3,810 x 75% = 2,858 pax/hr at check-in

2,858 / 75 = 38.1 = 39 check in desks

Baggage drop-off

60% of departures PHPT ≈ 2,286 pax/hr
Staffed bag drop = 50 pax/hr
Self service bag drop = 90 pax/hr
Average bag drop = 70 pax/hr

2,286 / 70 = 32.66 = 33 bag drop desks

Oversize baggage

3% of departures PHPT ≈ 114.3 pax/hr
Oversized bag drop = 40 pax/hr

88.2/ 40 = 2.86 = 3 oversized bag drop offices

Other

Function	ICAO Benchmark	Required 7,621 PHPT
Security lanes	150–220 pax/hr	26 - 18 lanes
Staff screening	-	2 lanes
Immigration desks	90–120 pax/hr	43 - 32 desks
Baggage belts	400–500 pax/hr	10 - 8 belts
Customs area	1.0–1.2 m²/pax	3,810 - 4,572 m²
Gate lounges	1.2–1.4 m²/pax	4,572 - 5,334 m²
Corridors	1 m / 1k pax	7 - 8 m
Toilets	1 WC / 60 pax	127 units
Lost & Found	-	1 - 2 desk + back office

Scenario 2. Longer Aircraft

As we saw in the scenario analysis, the PHPT by scenario 2 is 3,919 pax/hr. This PHPT is total number of passengers per hour, including both departures and arrivals. For many equations shown in this section, only half of the total PHPT will be used. The total PHPT is the result of the following equation:

((ACFT MVT 2050 x Average seats x PLF x Airline industry growth) / 365) / 16

(130,000 x 180 x 0.85 x 1.15) / 365 = 62,699 Pax/day

62,699 / 16 = 3,919 Pax/hr

Gates

Departures PHPT ≈ 1,960 pax/hr
Arrivals PHPT ≈ 1,960 pax/hr
MVT = 22
GOT ≈ 45-60 min
Minimal GOT in design for narrow aircraft: 90 min
Operational buffer = 15 %

Number of gates = Arrivals per hour x Gate occupancy time (hours) x Operational buffer
Number of gates = 11 x 1.5 x 1.15 = 19 gates

Check in desks

30% of passengers do online check in. So, we assume that 75% of passengers will use check-in desks.
Planning value (LoS C): 75 pax/hour per desk

1,960 x 75% = 1,470 pax/hr at check-in

1,470 / 75 = 19.6 = 20 check in desks

Baggage drop-off

60% of departures PHPT ≈ 1,176 pax/hr
Staffed bag drop = 50 pax/hr
Self service bag drop = 90 pax/hr
Average bag drop = 70 pax/hr

1,7176 / 70 = 16.8 = 17 bag drop desks

Oversize baggage

3% of departures PHPT ≈ 58.8 pax/hr
Oversized bag drop = 40 pax/hr

58.8/ 40 = 1.47 = 2 oversized bag drop offices

Other

Function	ICAO Benchmark	Required 3,919 PHPT
Security lanes	150–220 pax/hr	14 - 9 lanes
Staff screening	-	1-2 lanes
Immigration desks	90–120 pax/hr	22 - 17 desks
Baggage belts	400–500 pax/hr	5 - 4 belts
Customs area	1.0–1.2 m²/pax	1,960 - 2,352 m²
Gate lounges	1.2–1.4 m²/pax	2,352 - 2,744 m²
Corridors	1 m / 1k pax	4 - 4.5 m
Toilets	1 WC / 60 pax	66 units
Lost & Found	-	1 desk + back office

Scenario 3. Increment on Aircraft Movements

As we saw in the scenario analysis, the PHPT by scenario 3 is 5,876 pax/hr. This PHPT is total number of passengers per hour, including both departures and arrivals. For many equations shown in this section, only half of the total PHPT will be used. The total PHPT is the result of the following equation:

((ACFT MVT 2050 x Average seats x PLF x Airline industry growth) / 365) / 16

(187,000 x 180 x 0.85 x 1.20) / 365 = 94,027 Pax/day

94,027 / 16 = 5,876 Pax/hr

Gates

Departures PHPT ≈ 2.940 pax/hr
Arrivals PHPT ≈ 2.940 pax/hr
MVT = 32
GOT ≈ 45-60 min
Minimal GOT in design for narrow aircraft: 90 min
Operational buffer = 15 %

Number of gates = Arrivals per hour x Gate occupancy time (hours) x Operational buffer
Number of gates = 16 x 1.5 x 1.15 = 28 gates

Check in desks

30% of passengers do online check in. So, we assume that 75% of passengers will use check-in desks.
Planning value (LoS C): 75 pax/hour per desk

2.940 x 75% = 2.205 pax/hr at check-in

2.205 / 75 = 29.4 = 30 check in desks

Baggage drop-off

60% of departures PHPT = 2,940 pax/hr ≈ 1,764 pax/hr
Staffed bag drop = 50 pax/hr
Self service bag drop = 90 pax/hr
Average bag drop = 70 pax/hr

1,764 / 70 = 25.2 = 26 bag drop desks

Oversize baggage

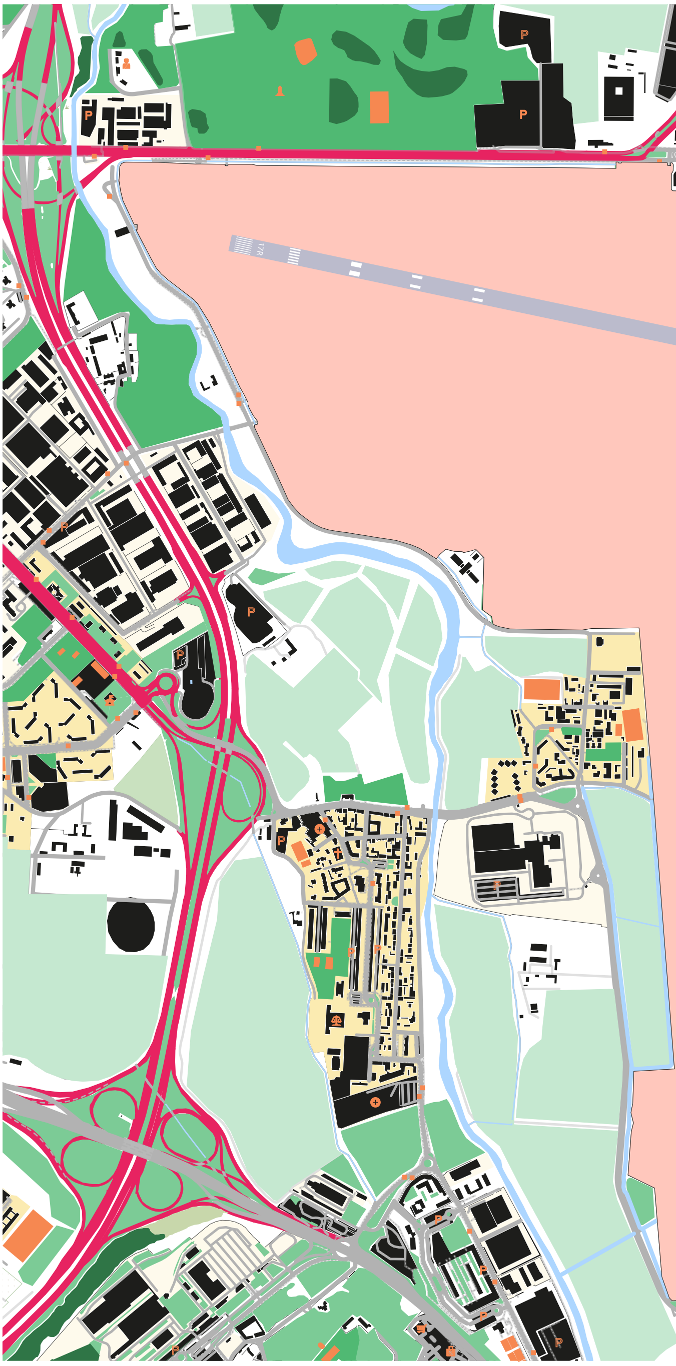
3% of departures PHPT = 2,940 pax/hr ≈ 88.2 pax/hr
Oversized bag drop = 40 pax/hr

88.2/ 40 = 2.2 = 3 oversized bag drop offices

Other

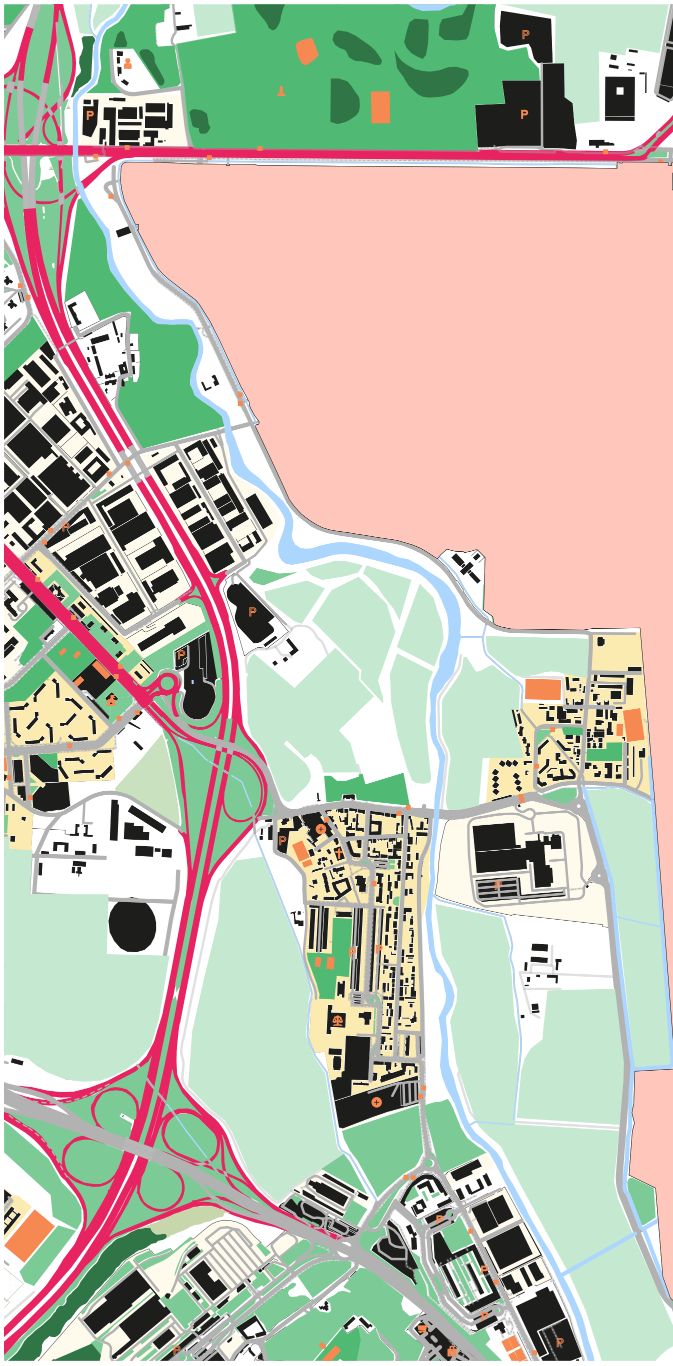
Function	ICAO Benchmark	Required 5,876 PHPT
Security lanes	150–220 pax/hr	20 - 14 lanes
Staff screening	-	1-2 lanes
Immigration desks	90–120 pax/hr	33 - 25 desks
Baggage belts	400–500 pax/hr	8 - 6 belts
Customs area	1.0–1.2 m²/pax	2,940 - 3,528 m²
Gate lounges	1.2–1.4 m²/pax	3,528 - 4,116 m²
Corridors	1 m / 1k pax	6 – 7 m
Toilets	1 WC / 60 pax	98 units
Lost & Found	-	1 desk + back office

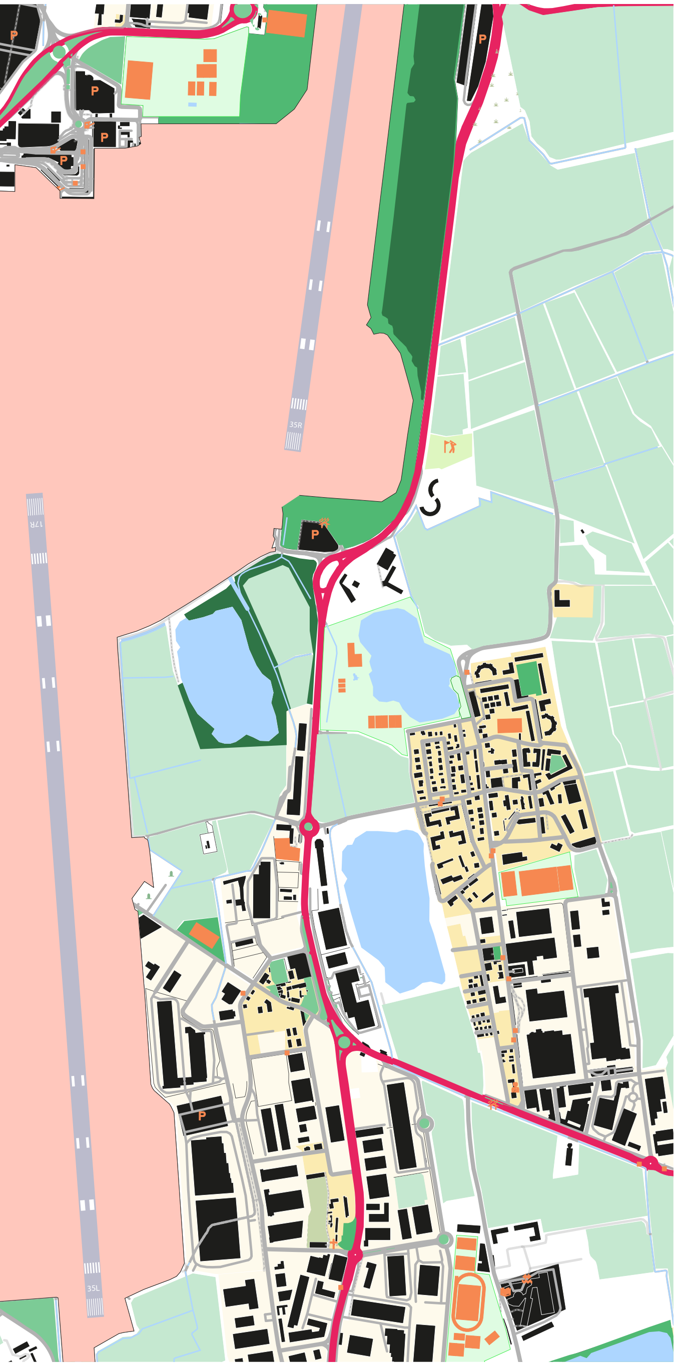
RUNWAY CONCEPT 1




35L
35R

RUNWAY CONCEPT 2

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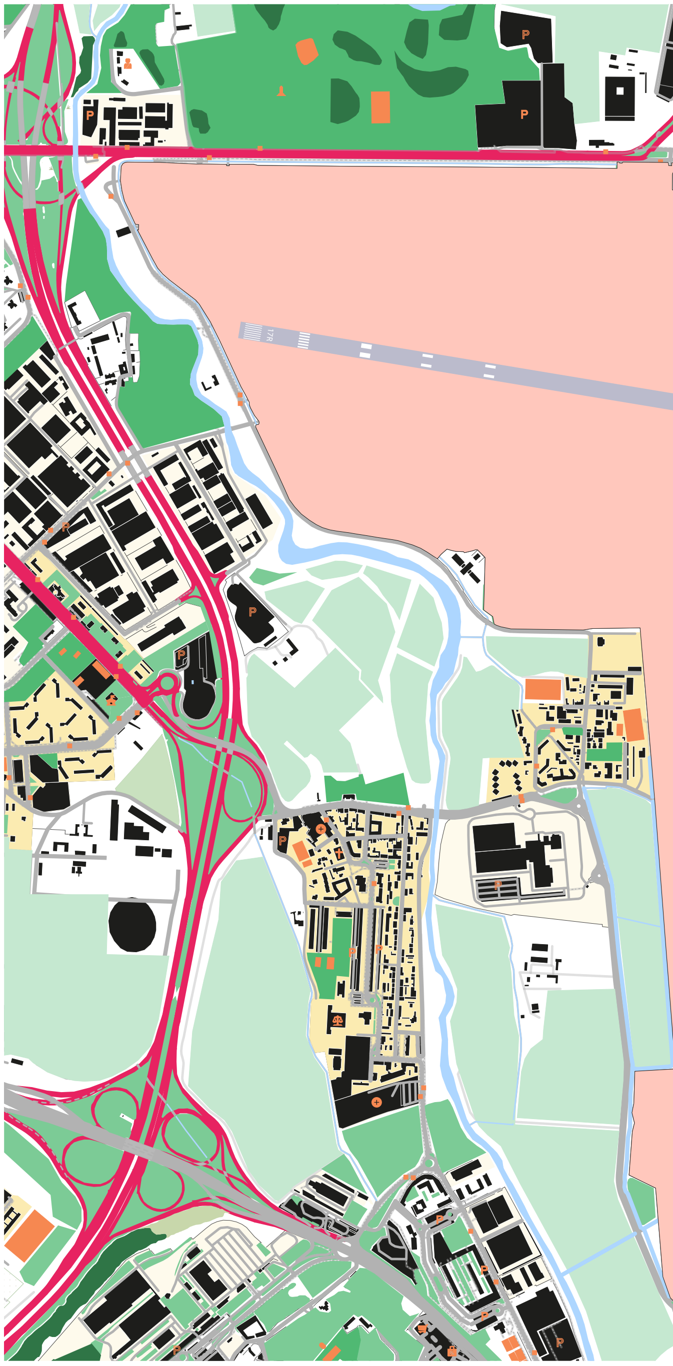
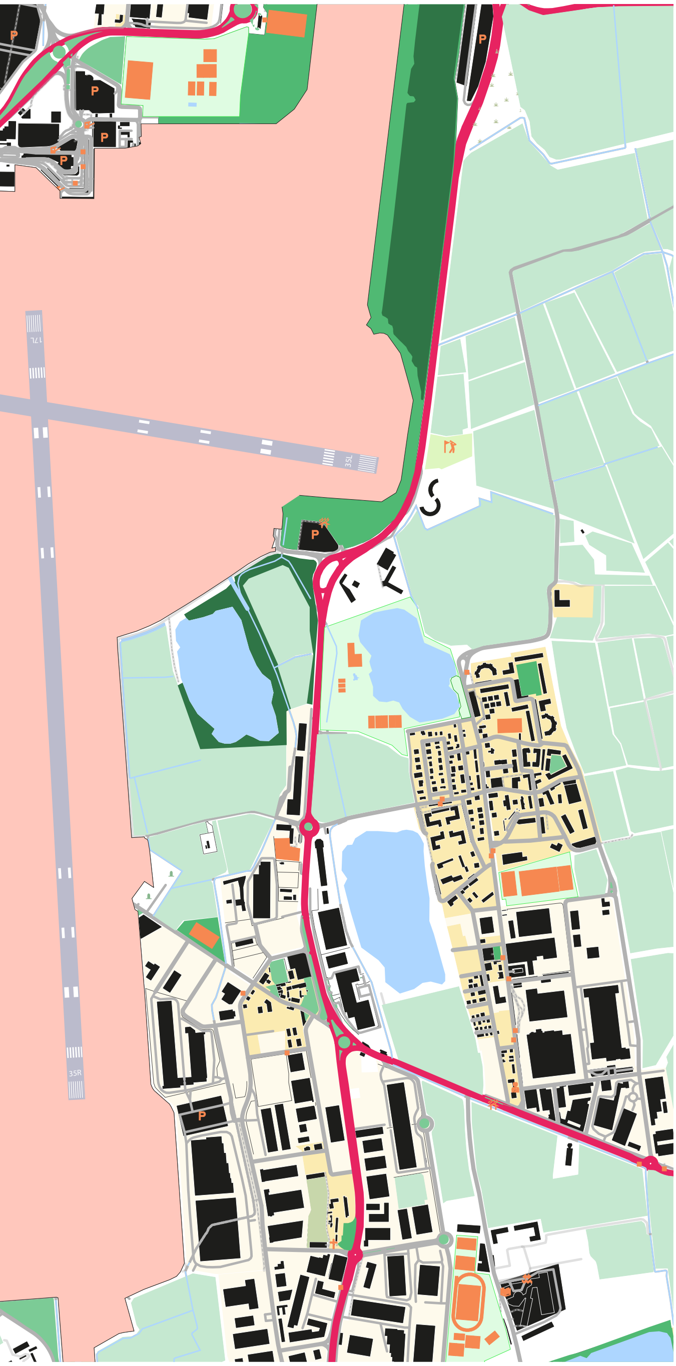
RUNWAY CONCEPT 3

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35L
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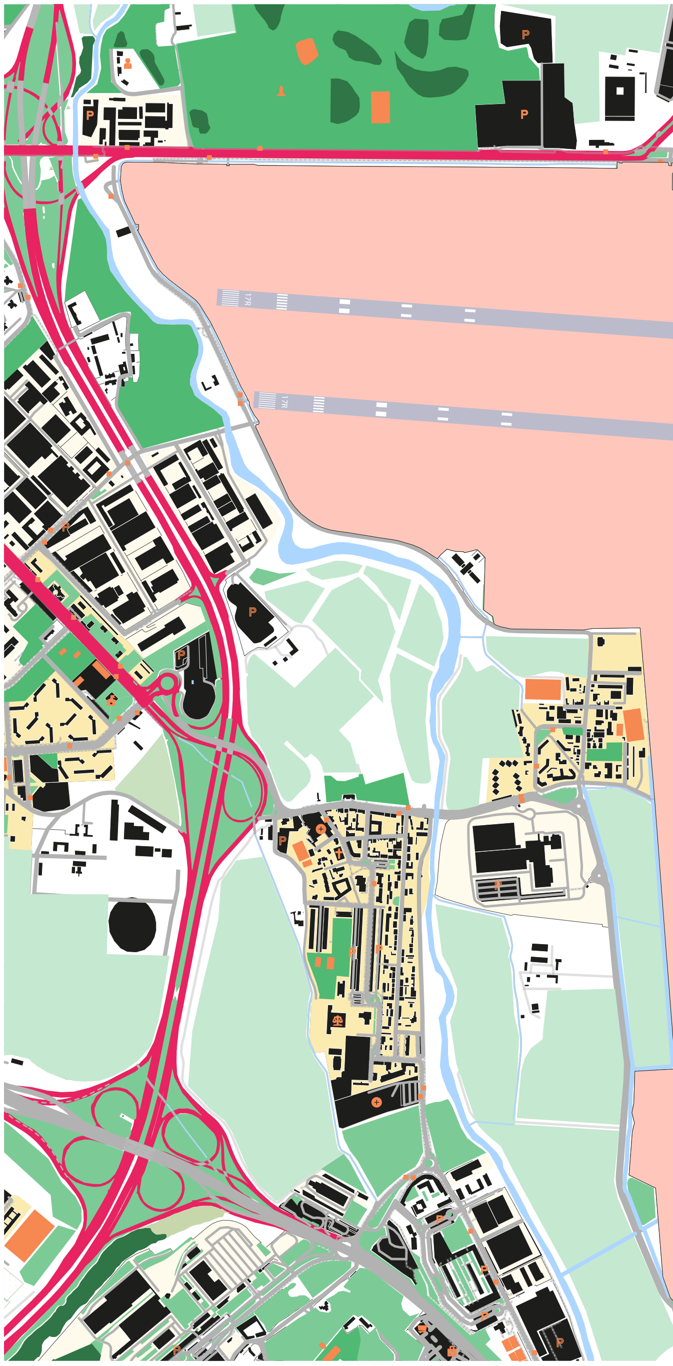
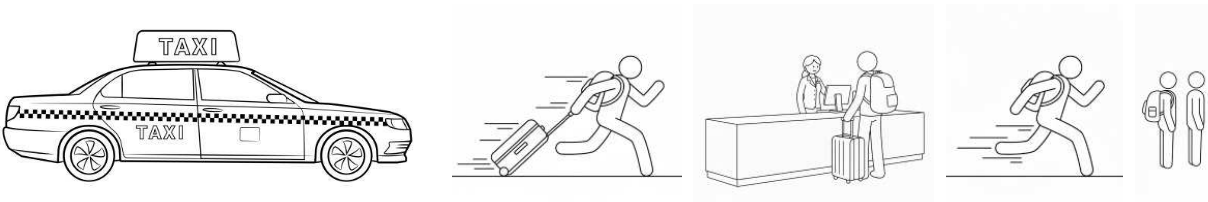
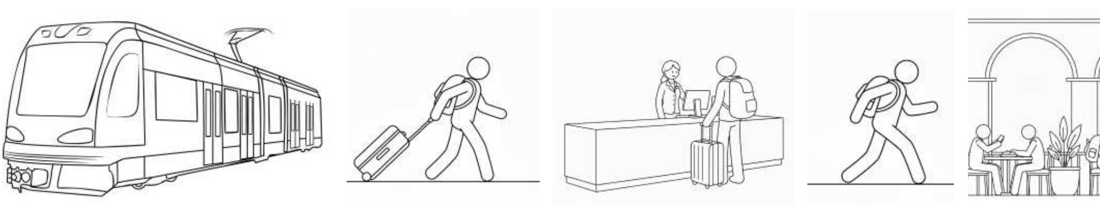
RUNWAY CONCEPT 4

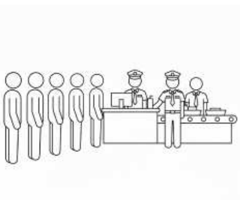
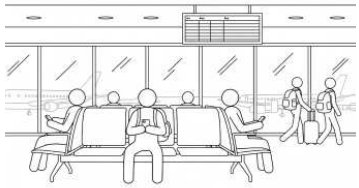


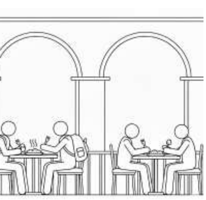
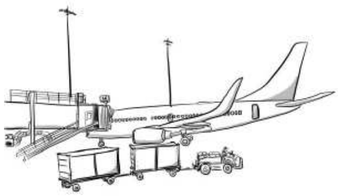

35L
35L

CONCEPT COMPARISON. STANDARD - PROPOSAL





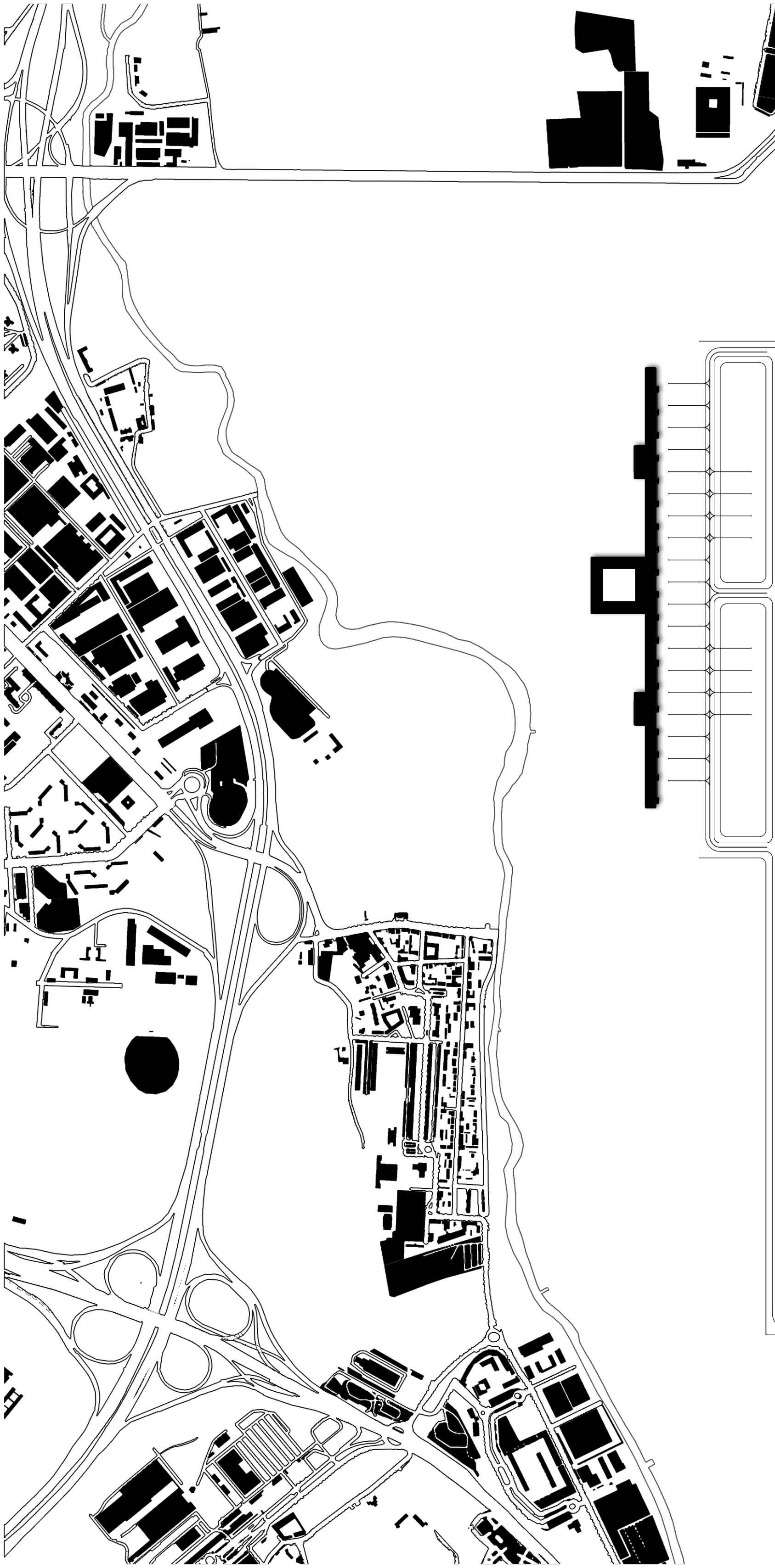
    

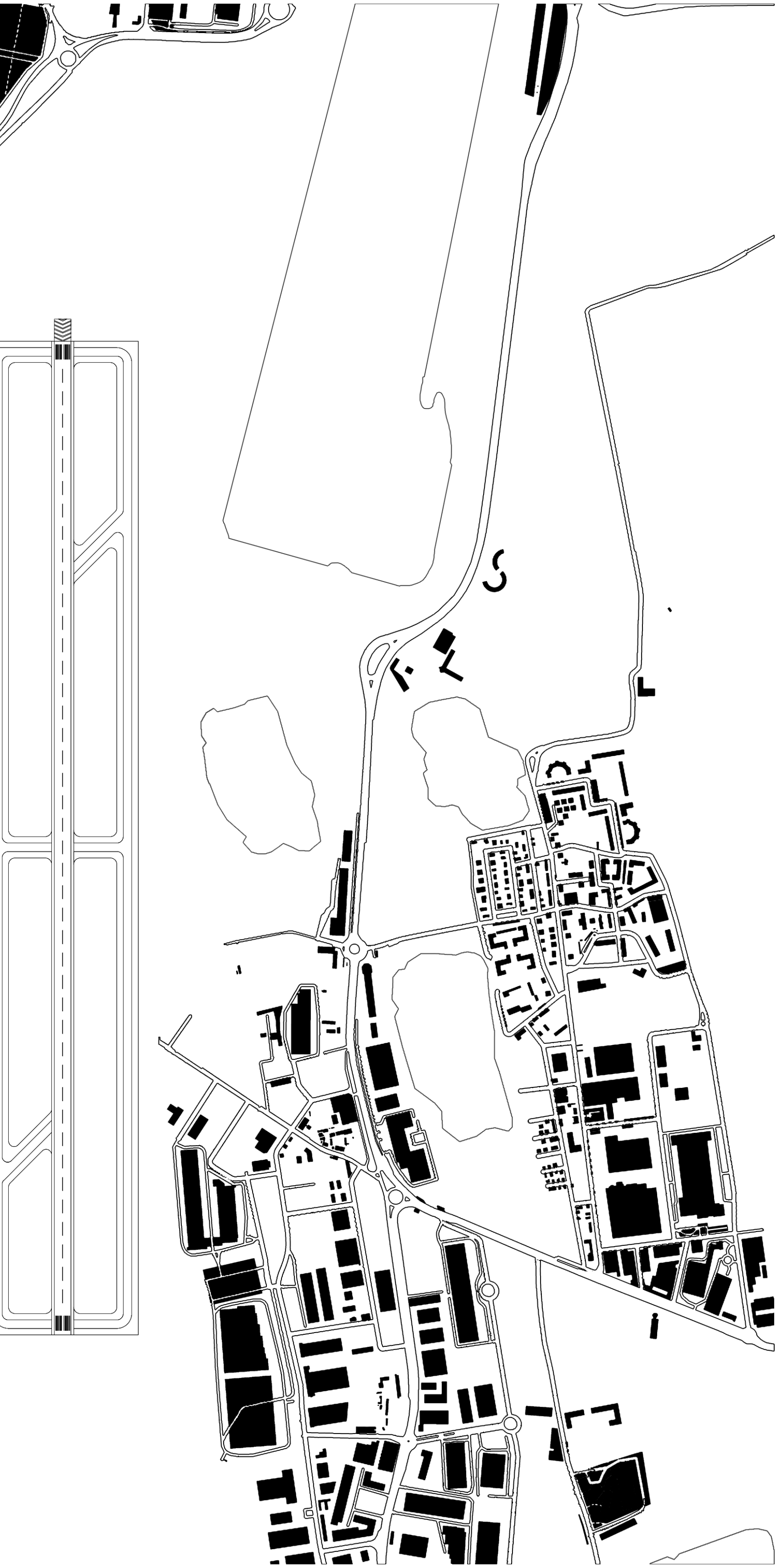
    

VISUAL CONCEPT A1

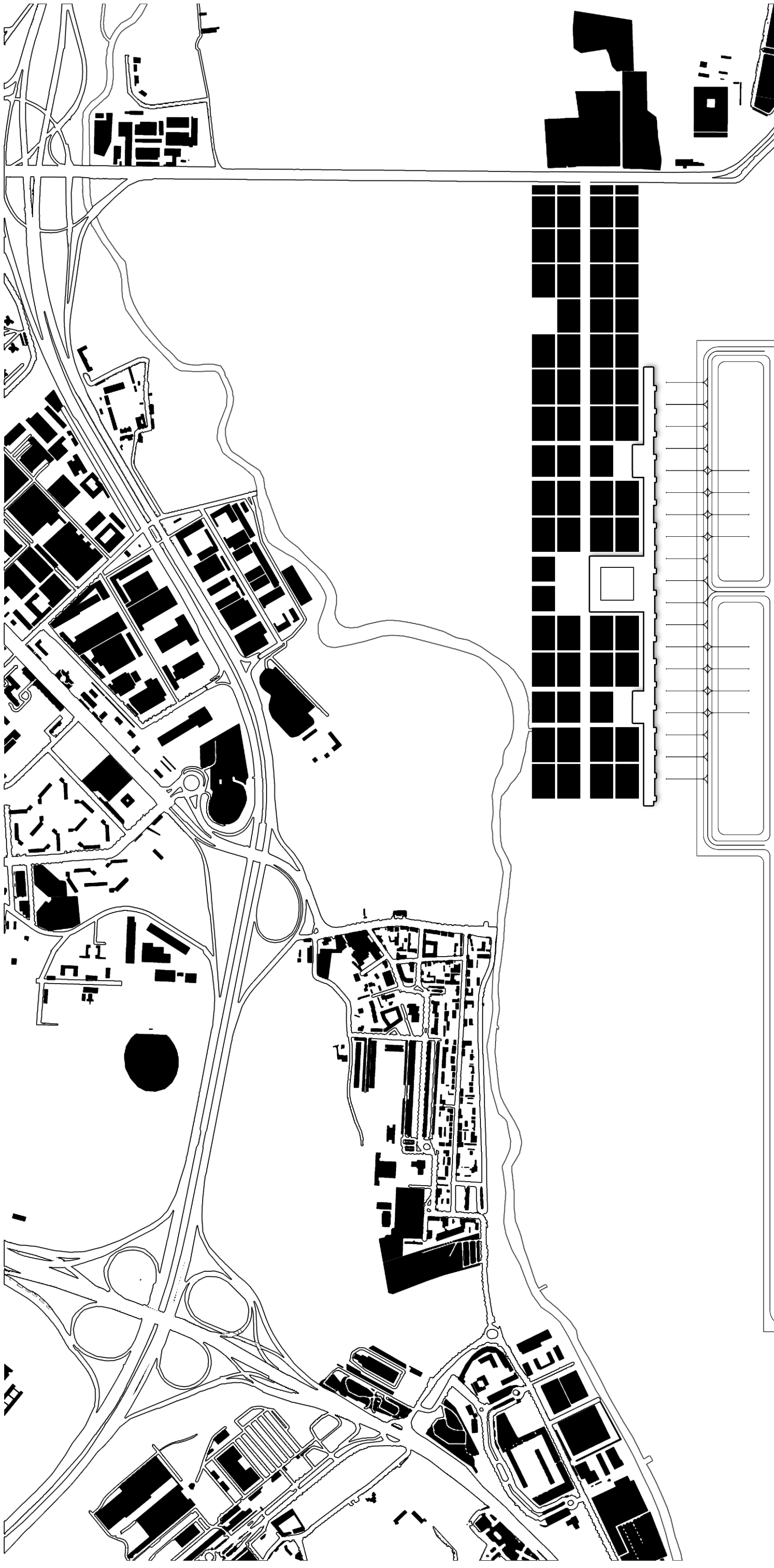
04. DRAWINGS

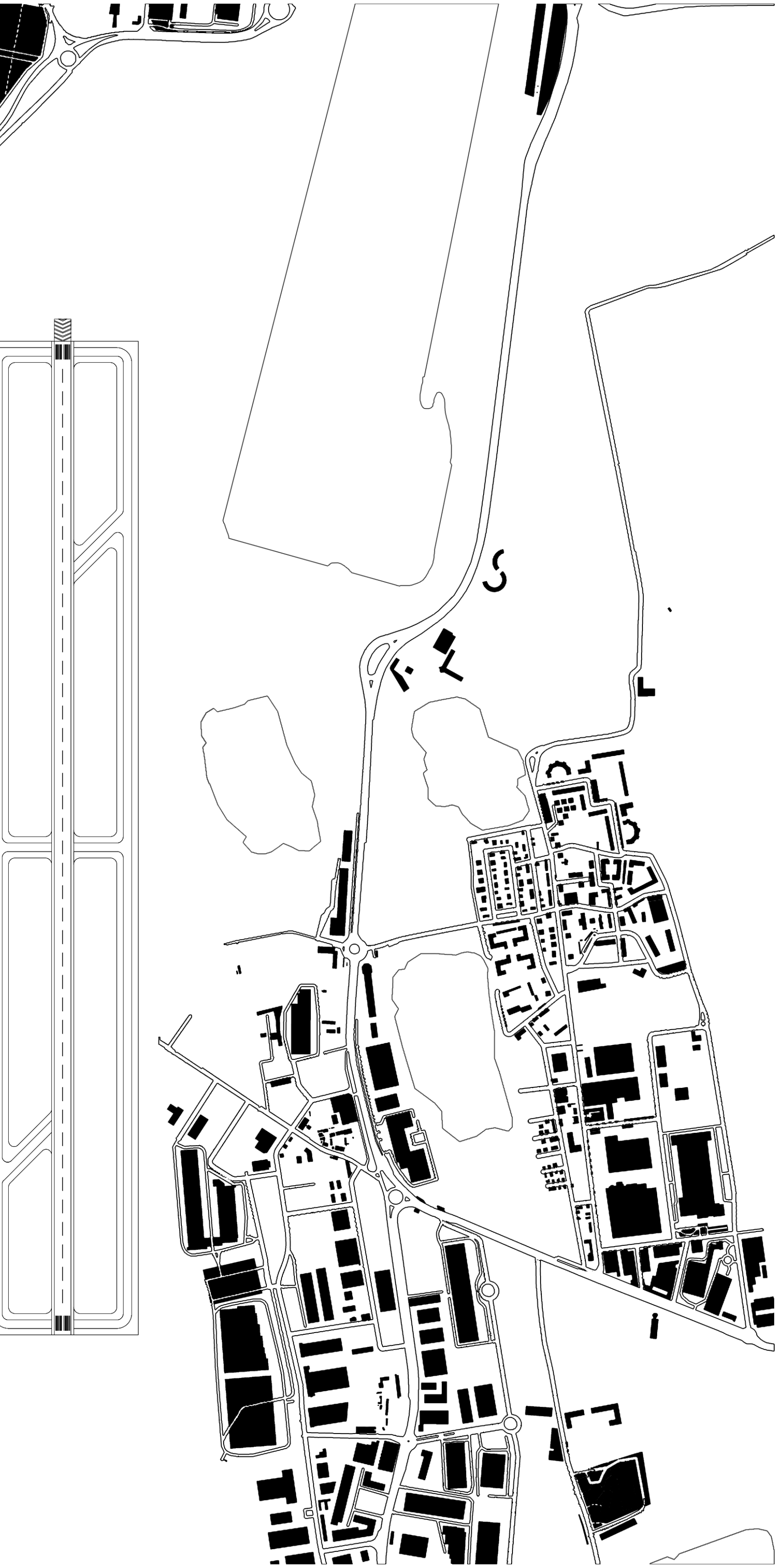
SITUATION STEP 1



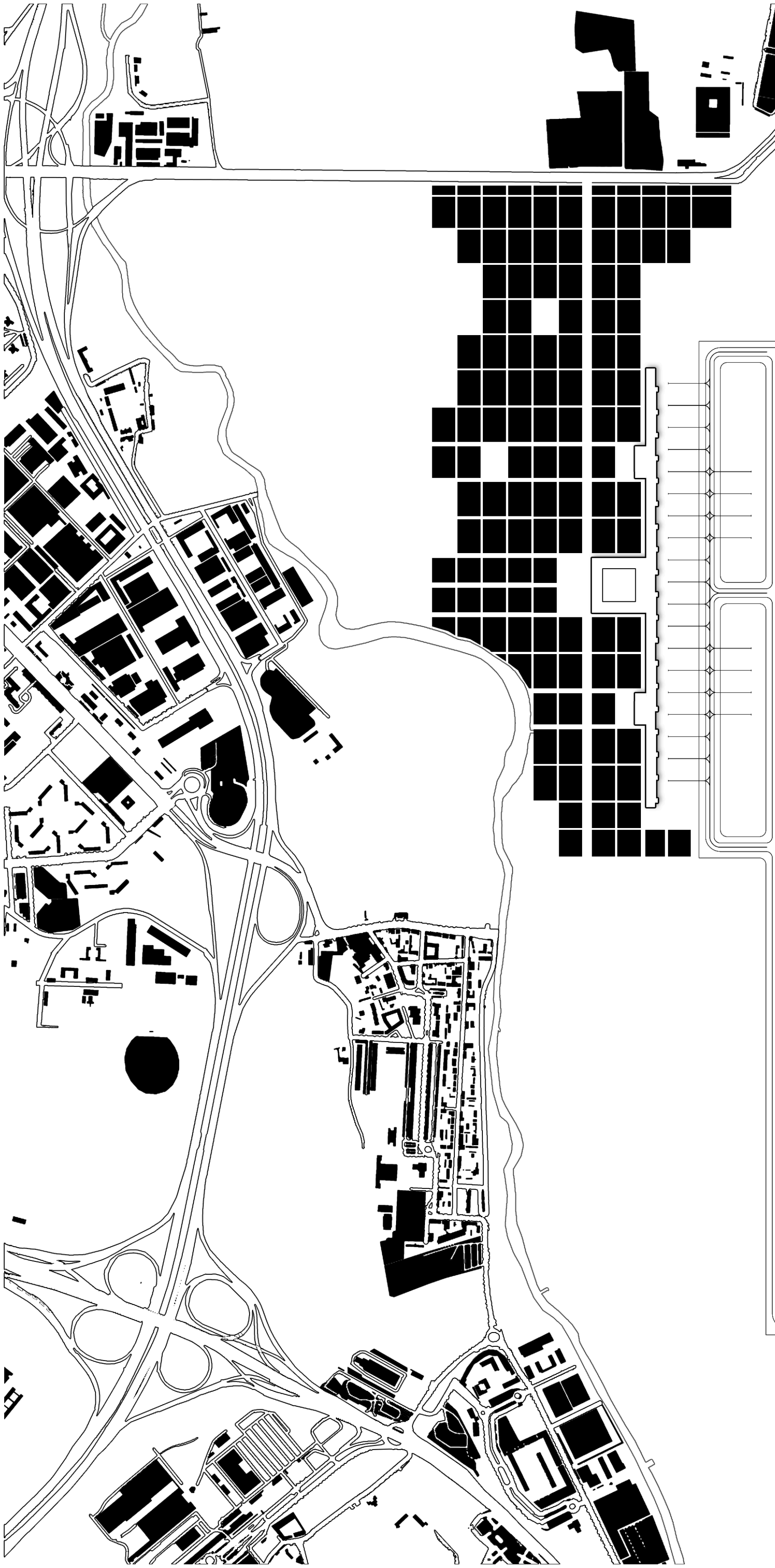


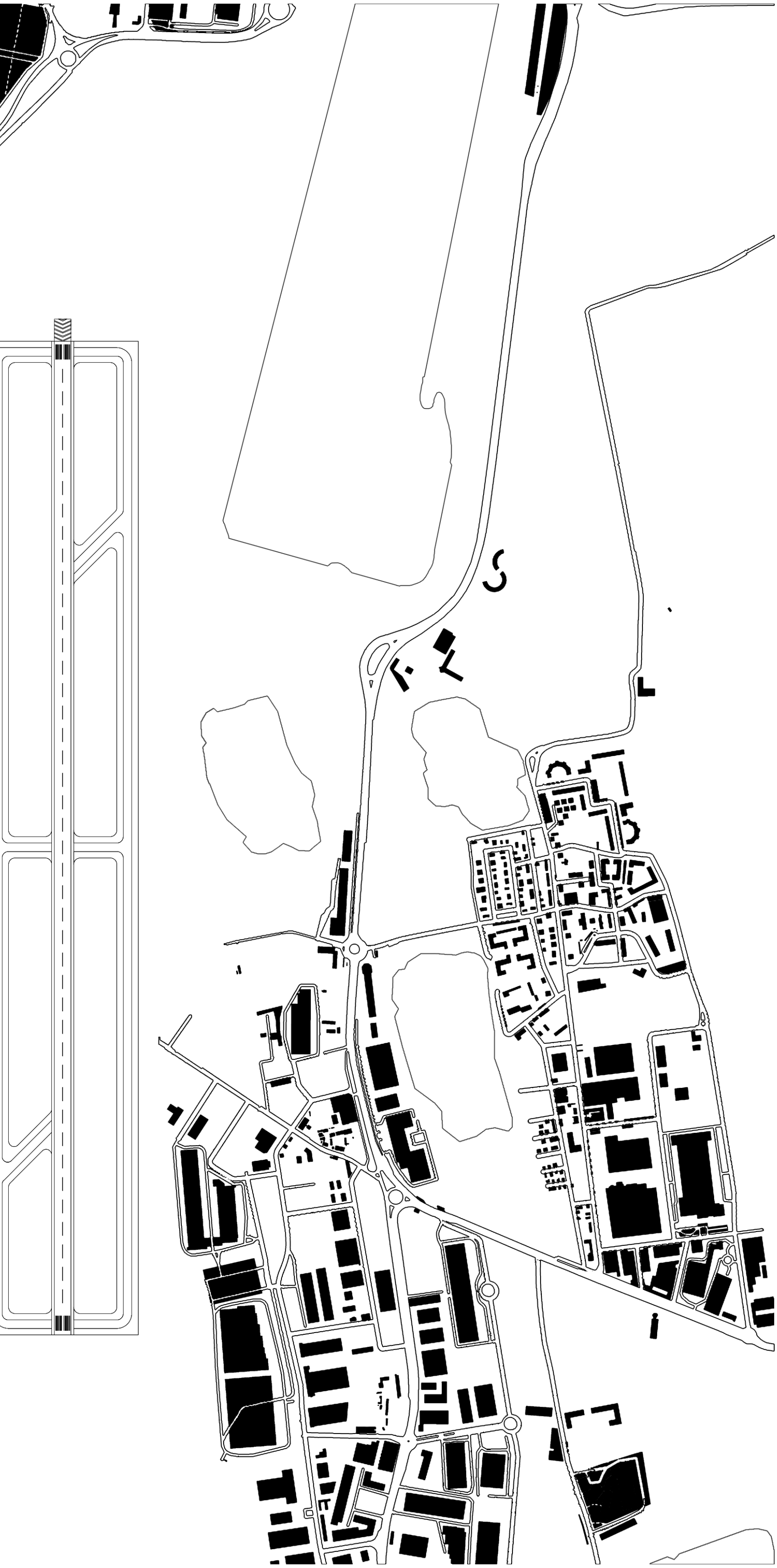
SITUATION STEP 2



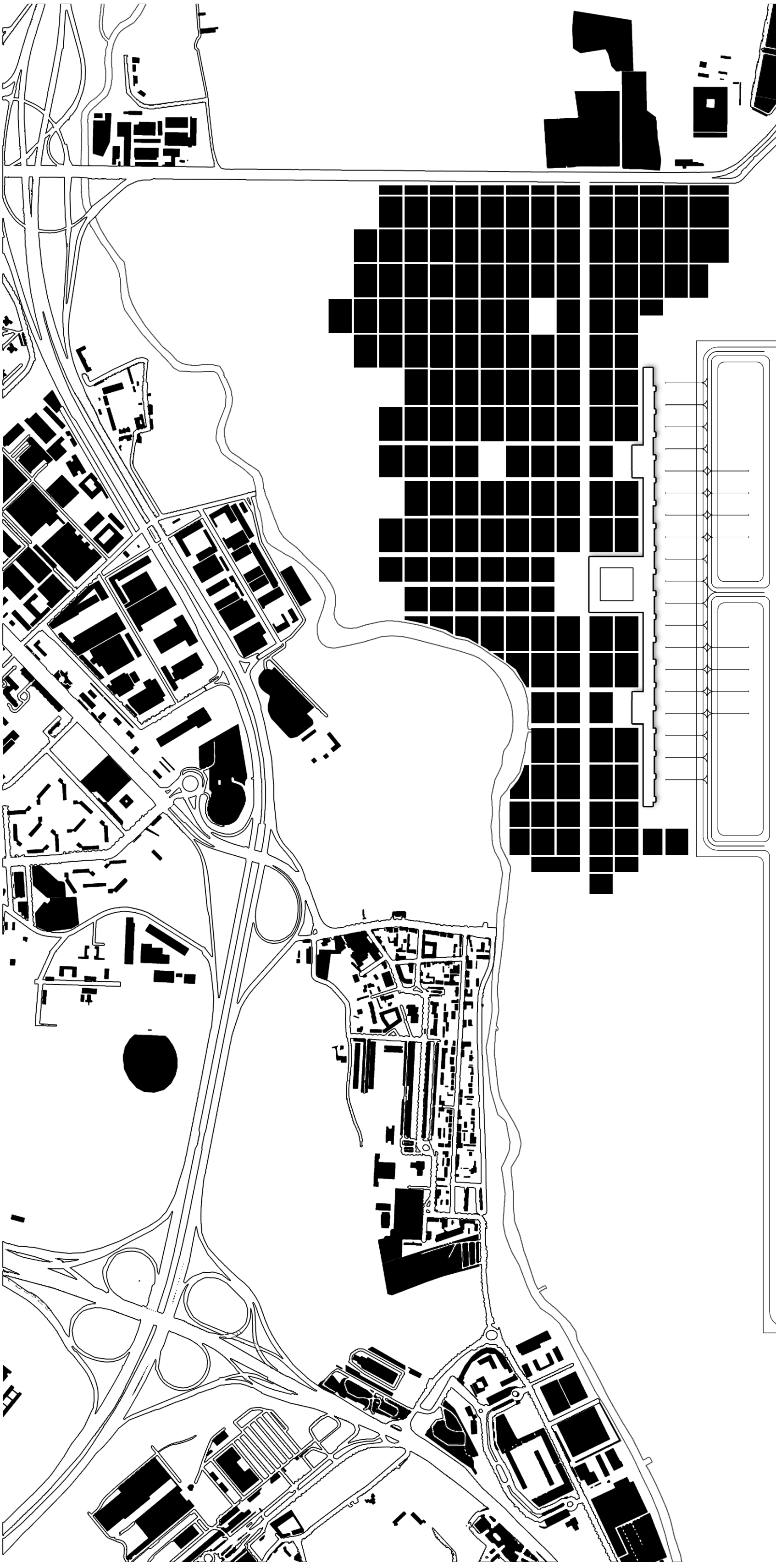


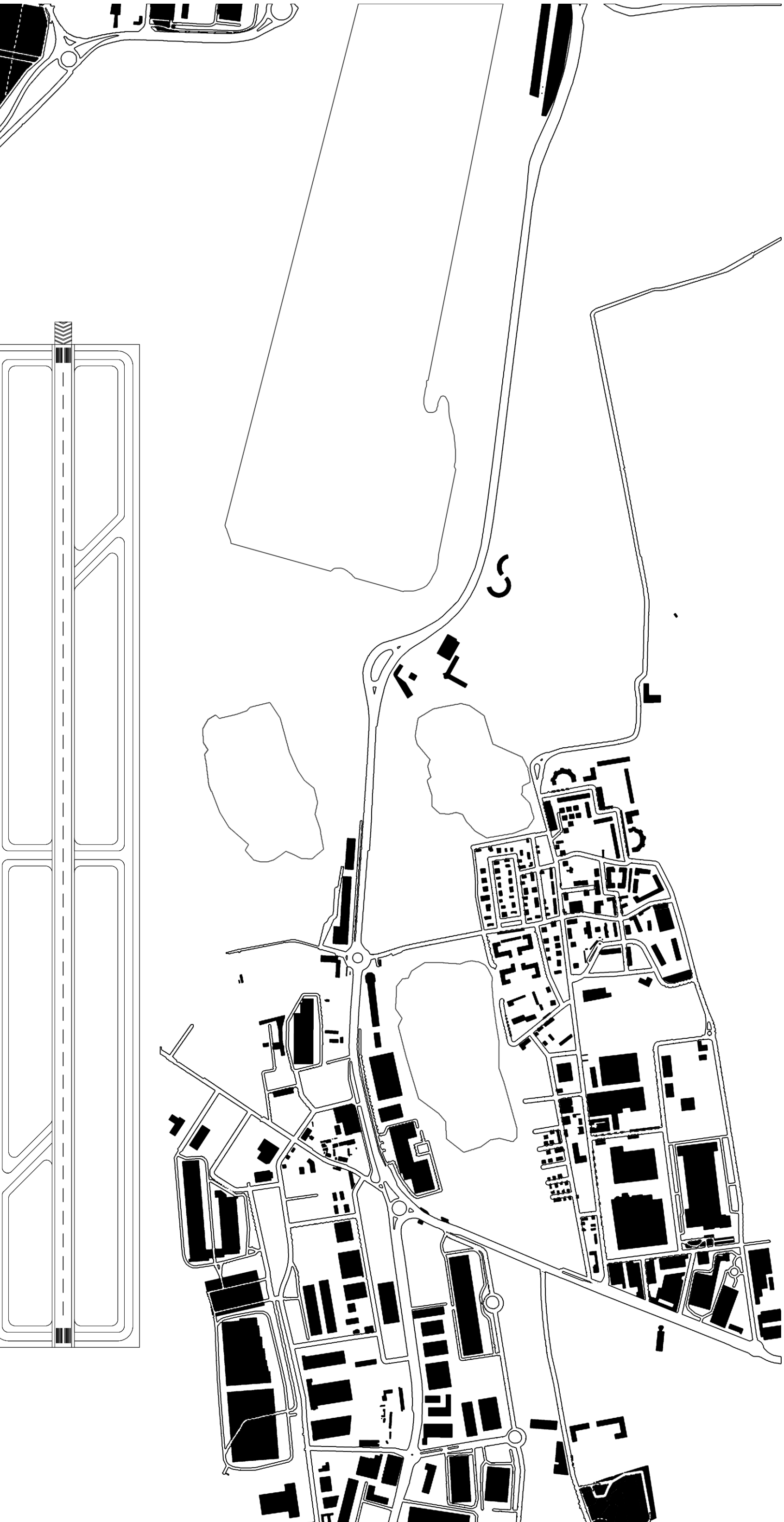
SITUATION STEP 3



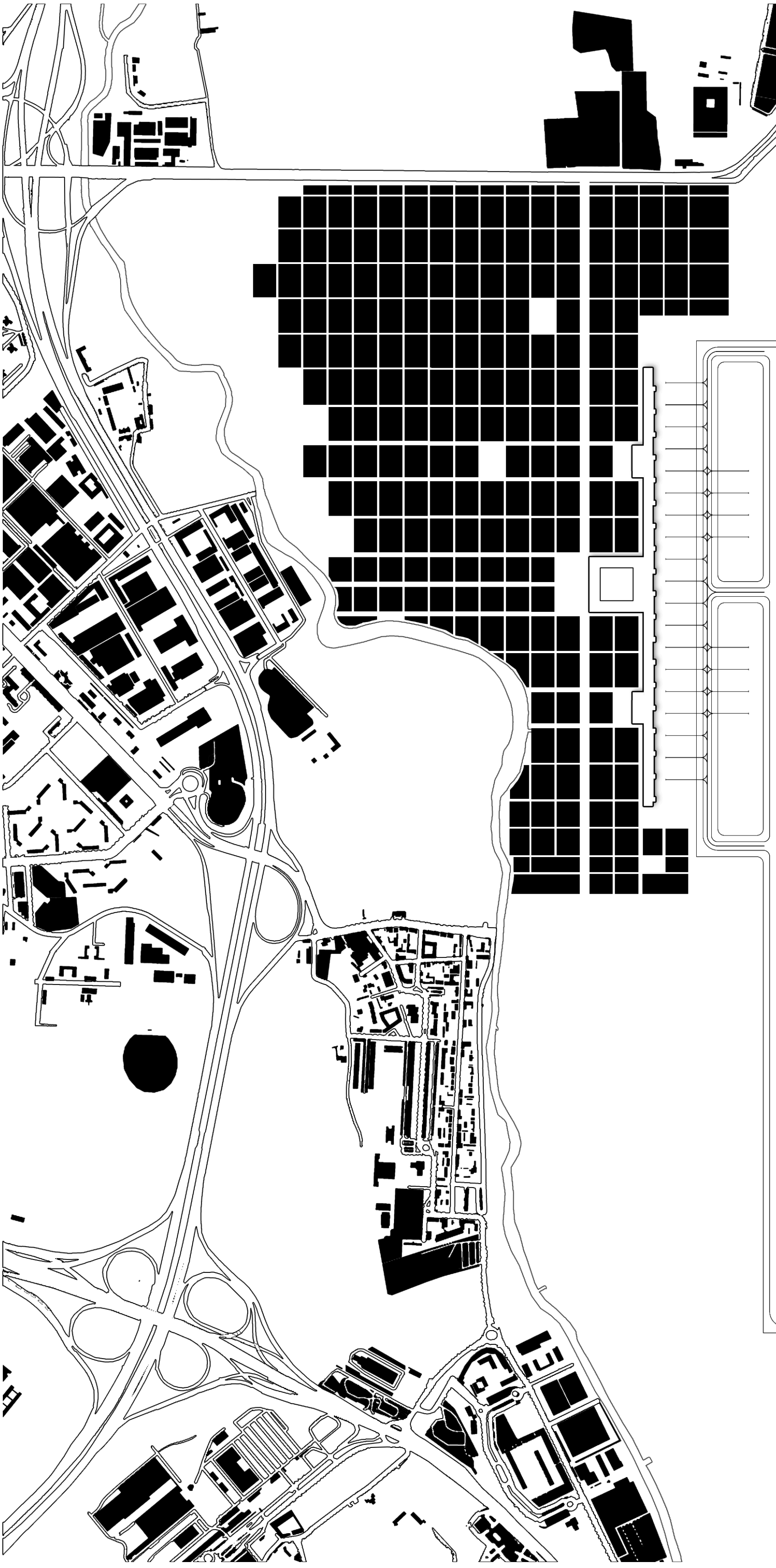


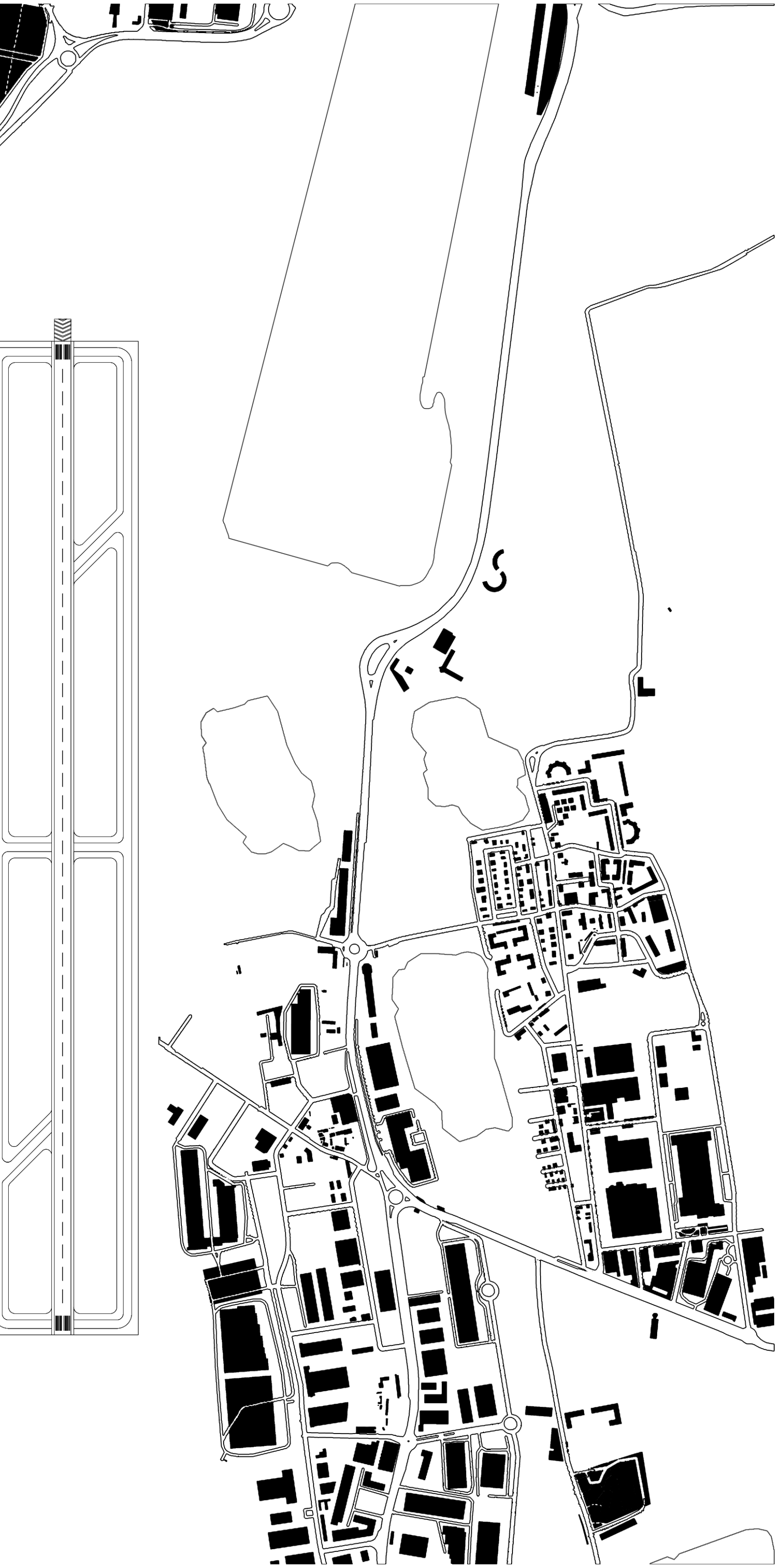
SITUATION STEP 4



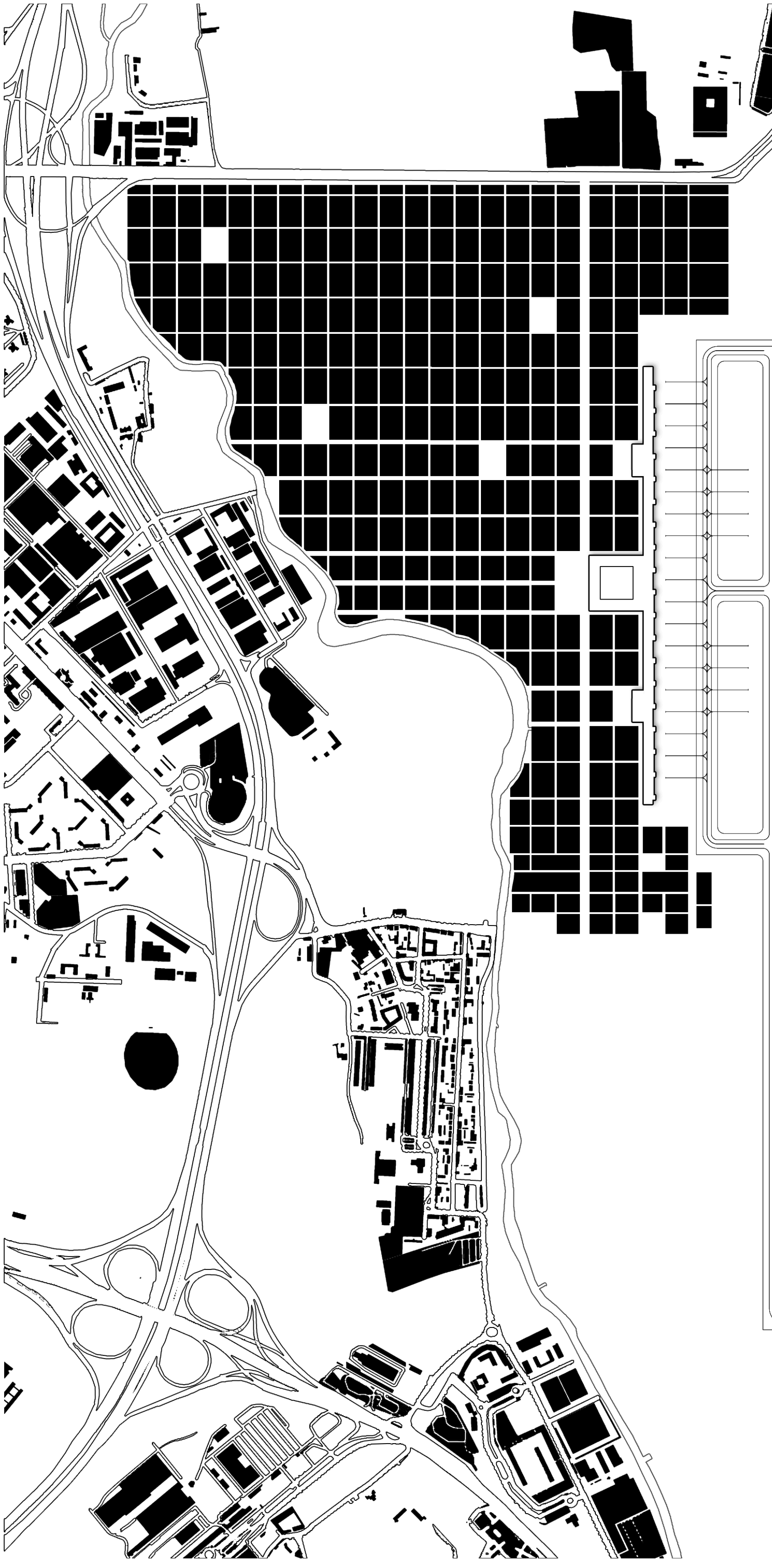


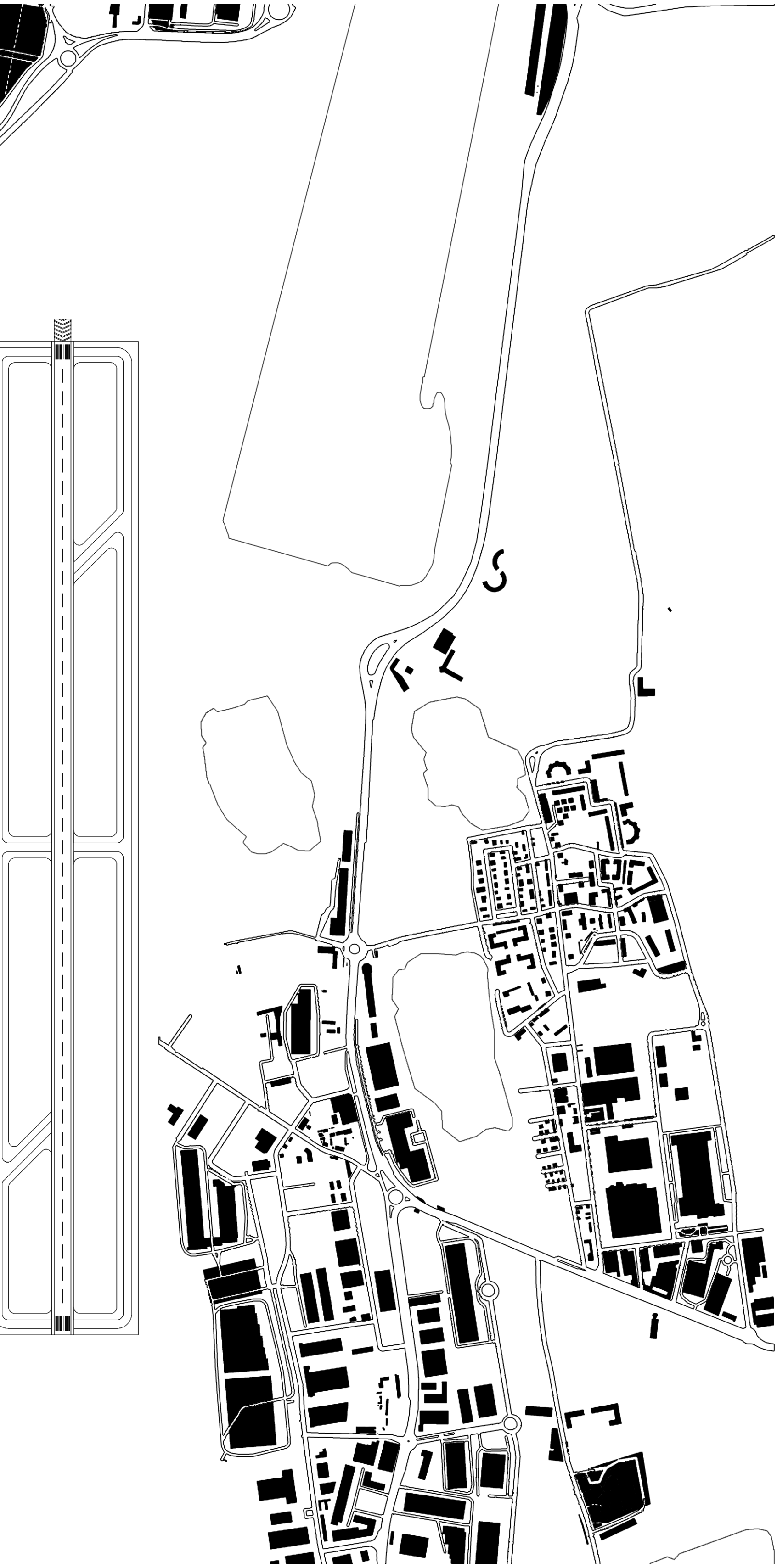
SITUATION STEP 5



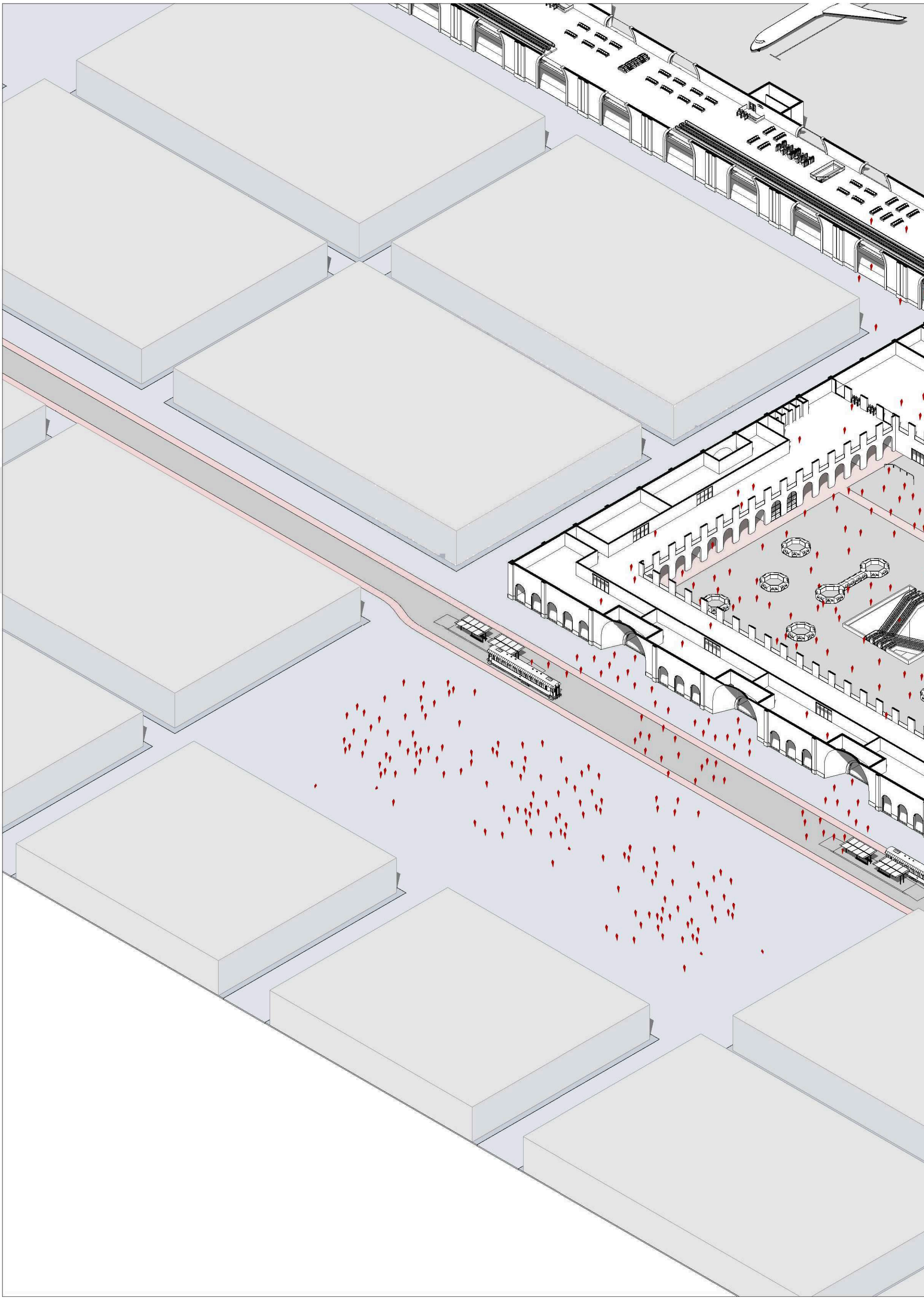


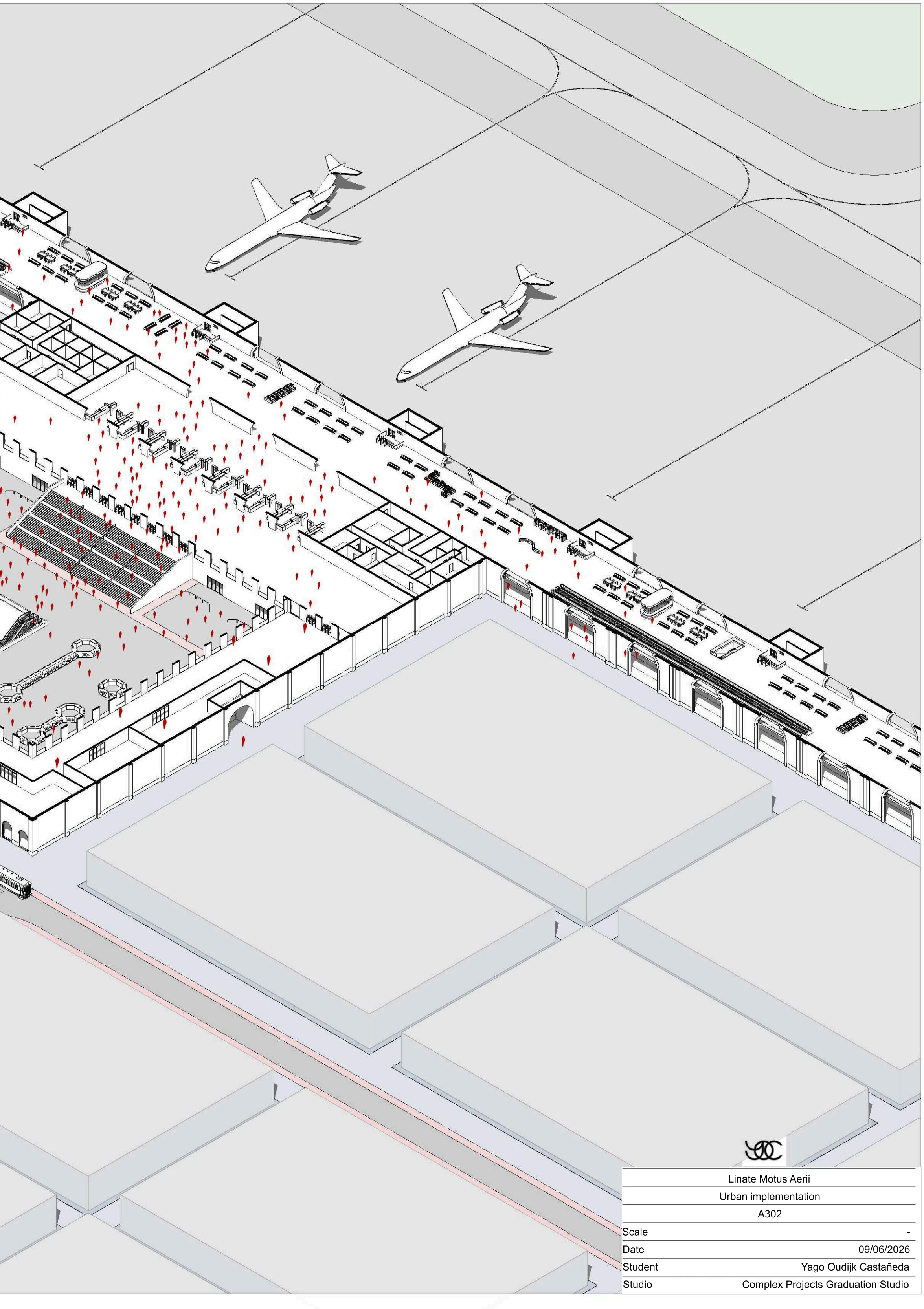
SITUATION STEP 6





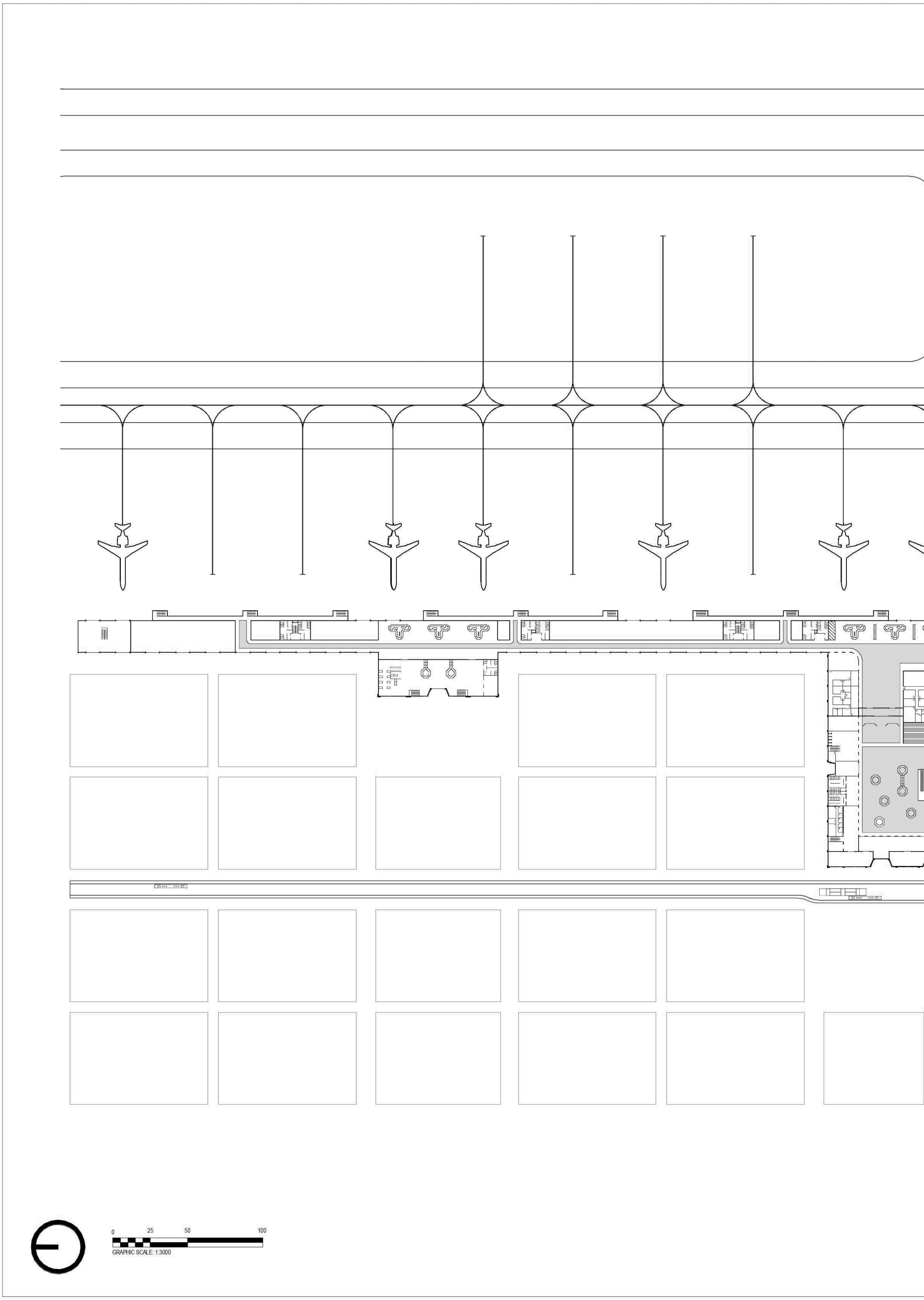
URBAN IMPLEMENTATION

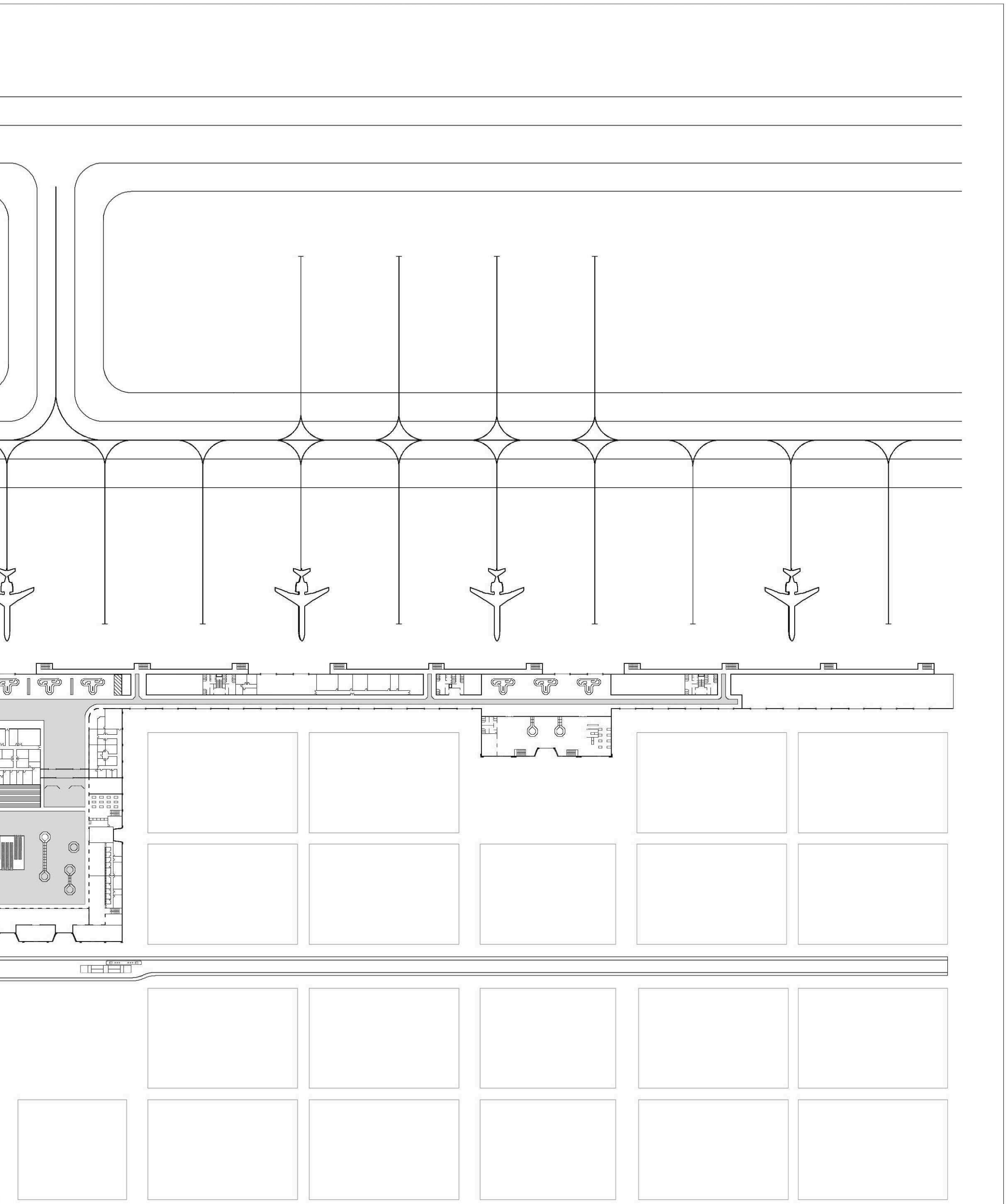




Linate Motus Aerii	
Urban implementation	
A302	
Scale	-
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

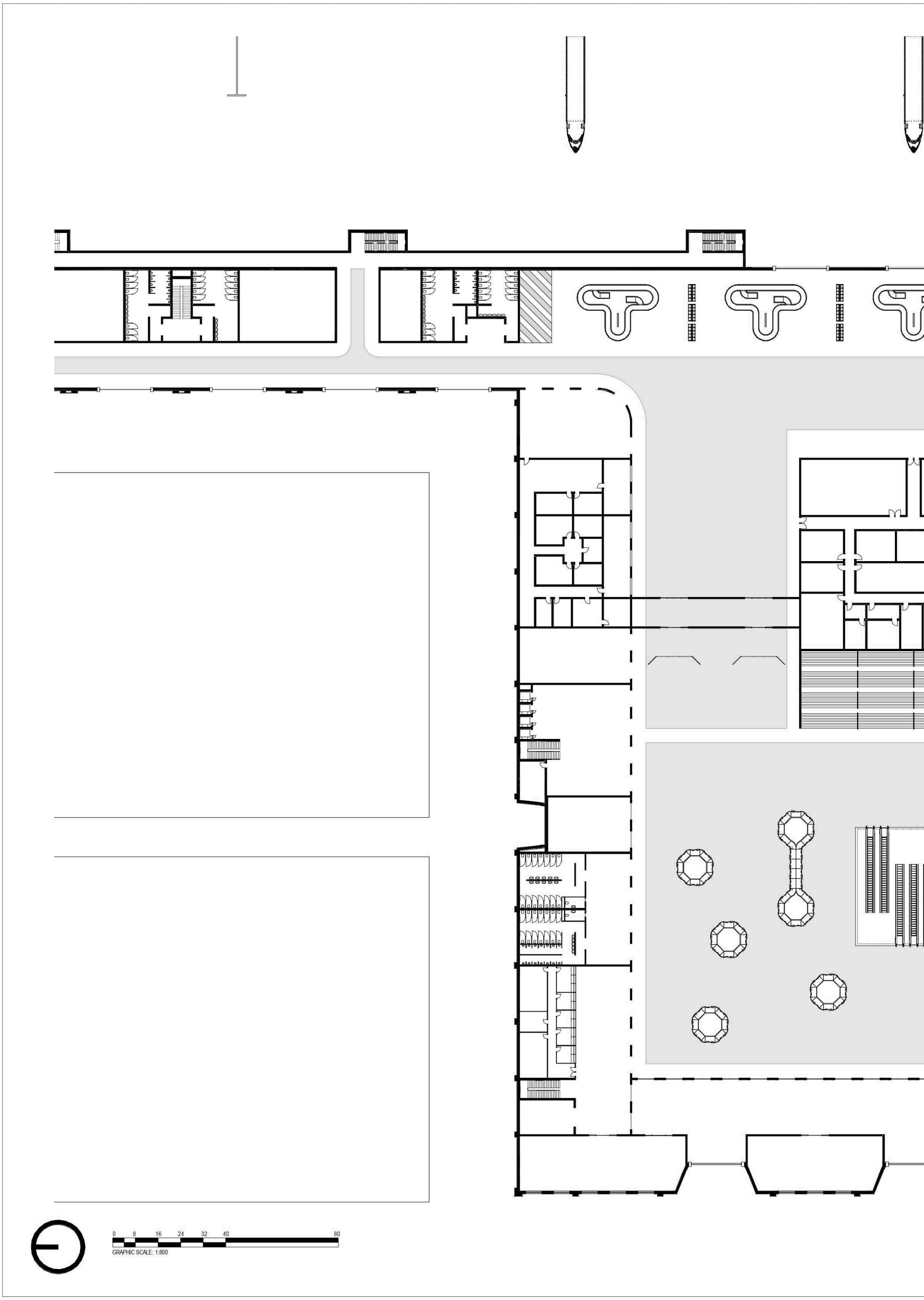
GROUND FLOOR - TERMINAL

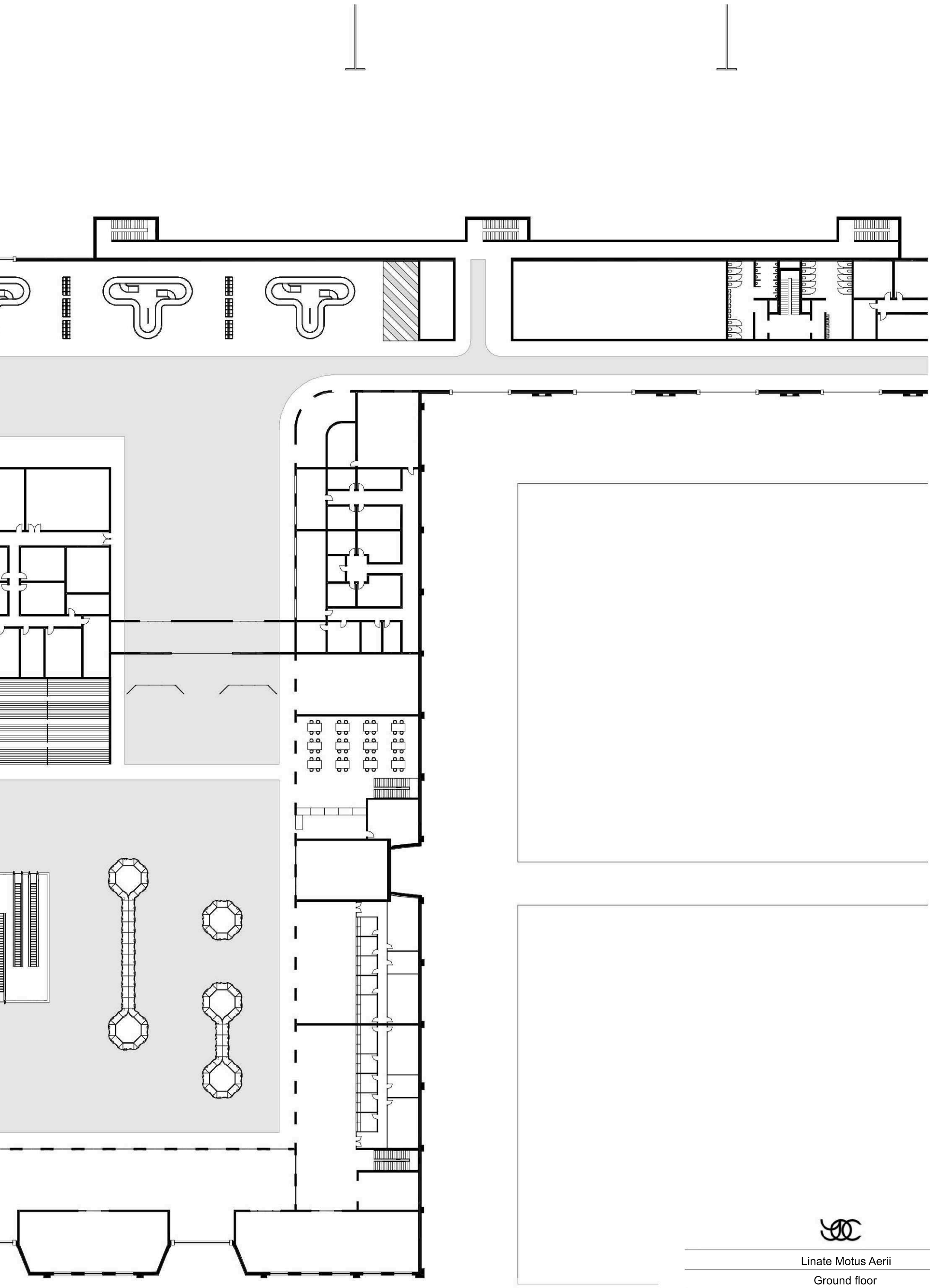




Linate Motus Aerii	
Ground floor	
A303	
Scale	1:3000
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

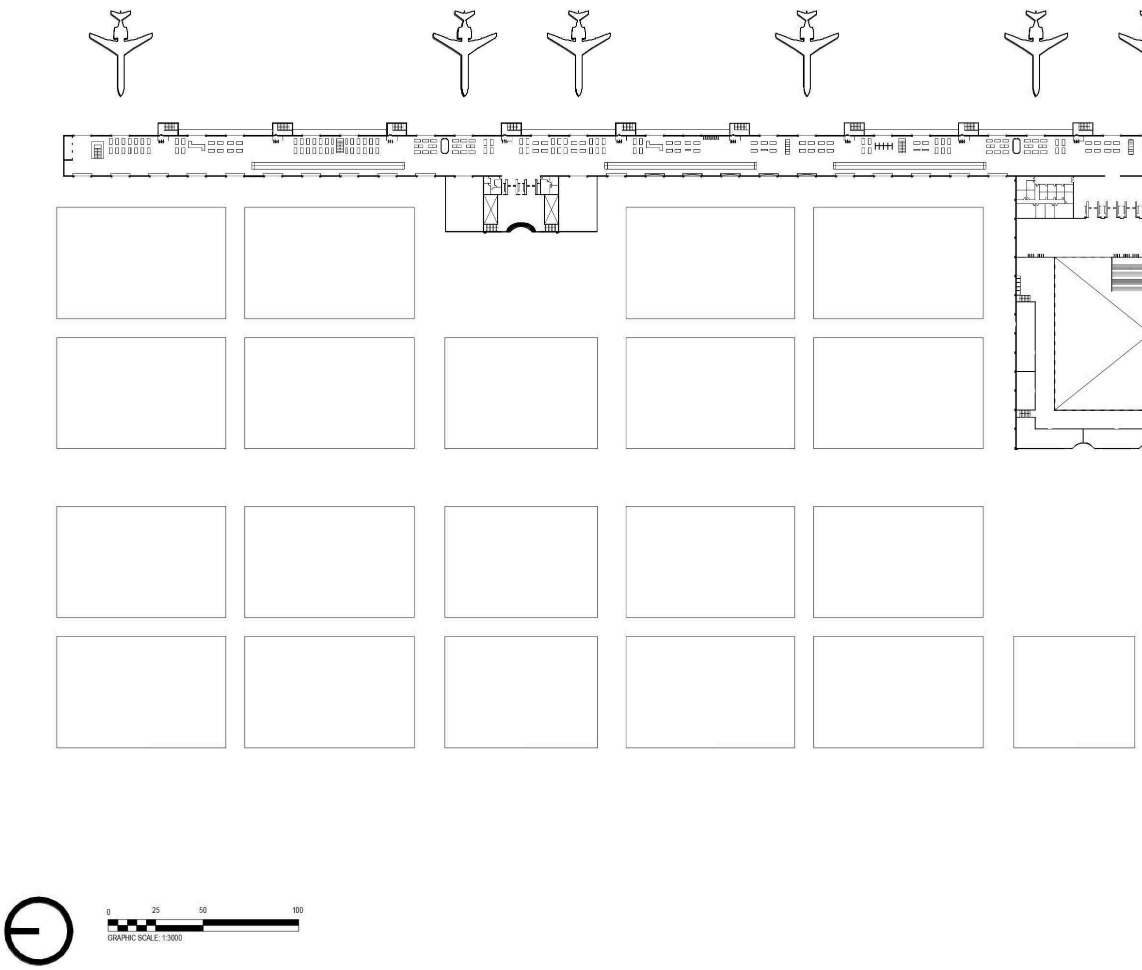
GROUND FLOOR - ENTRANCE

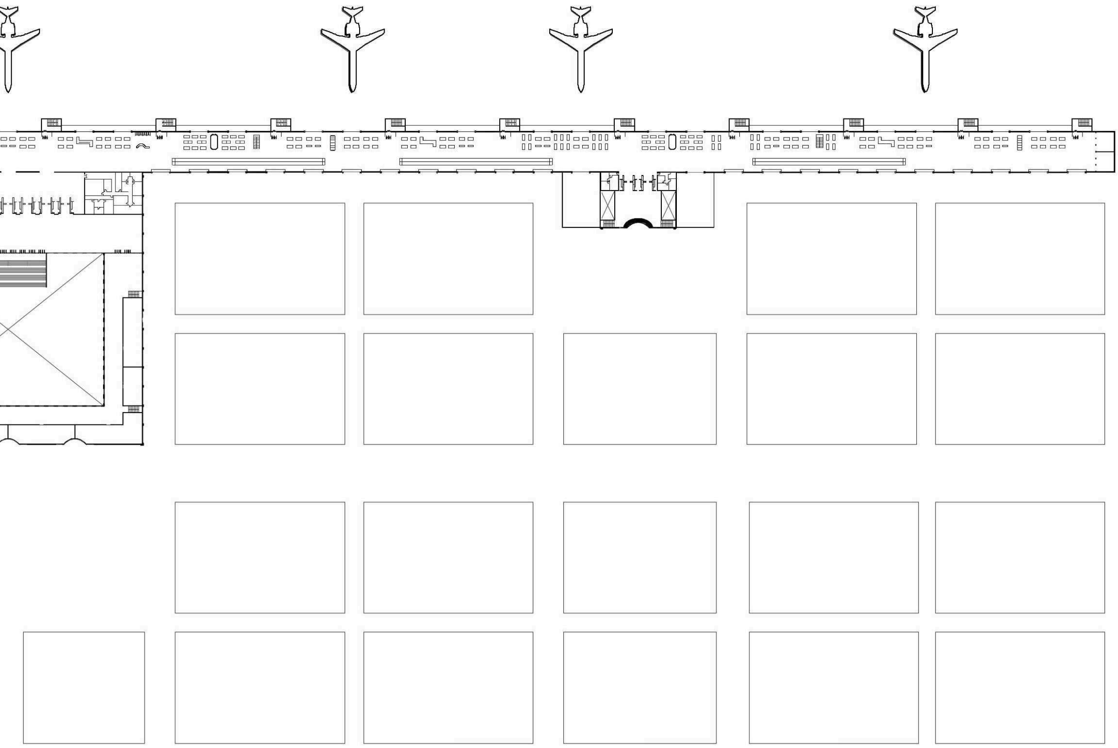




Linate Motus Aerii	
Ground floor	
A304	
Scale	1:800
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

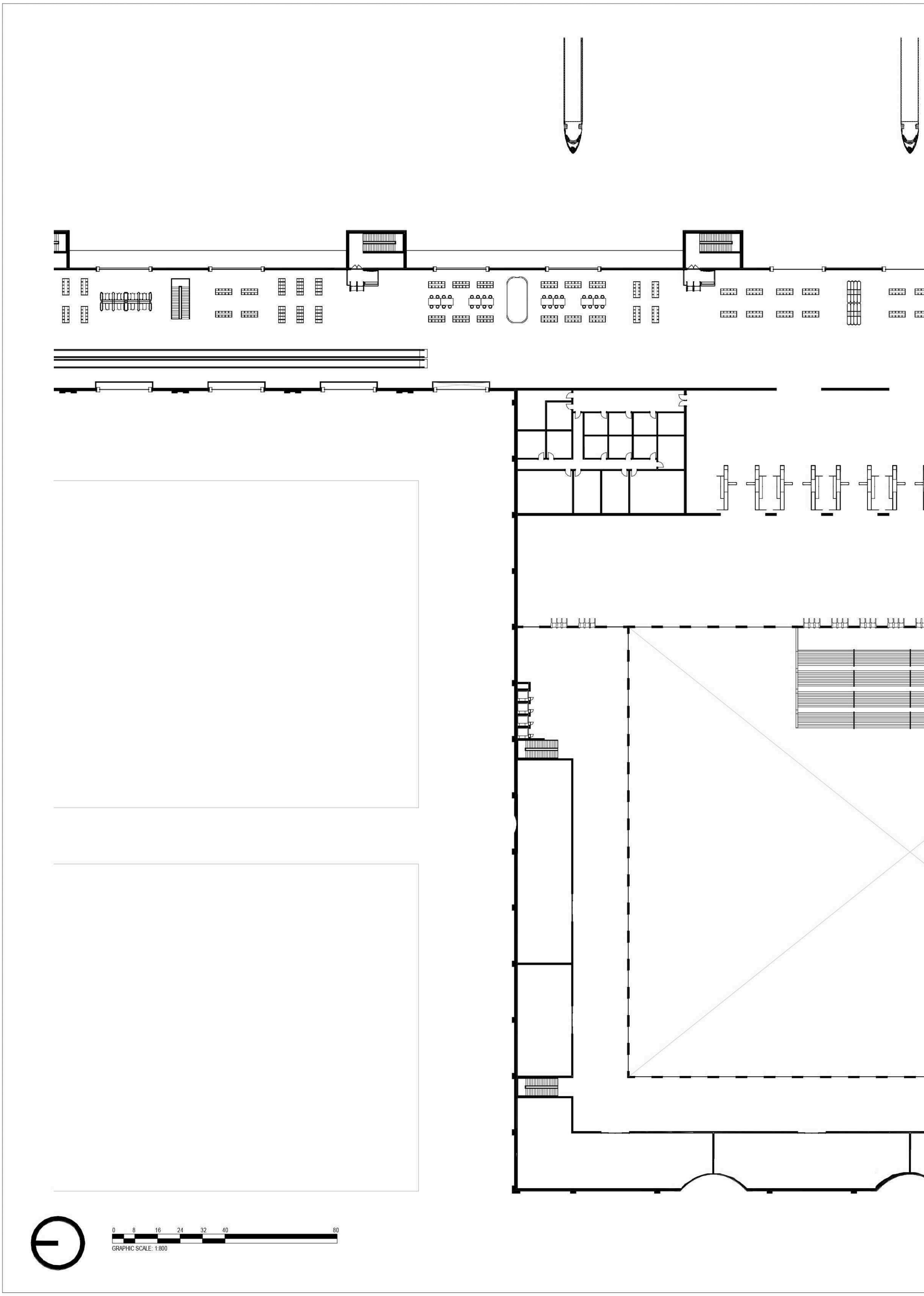
FIRST FLOOR - TERMINAL

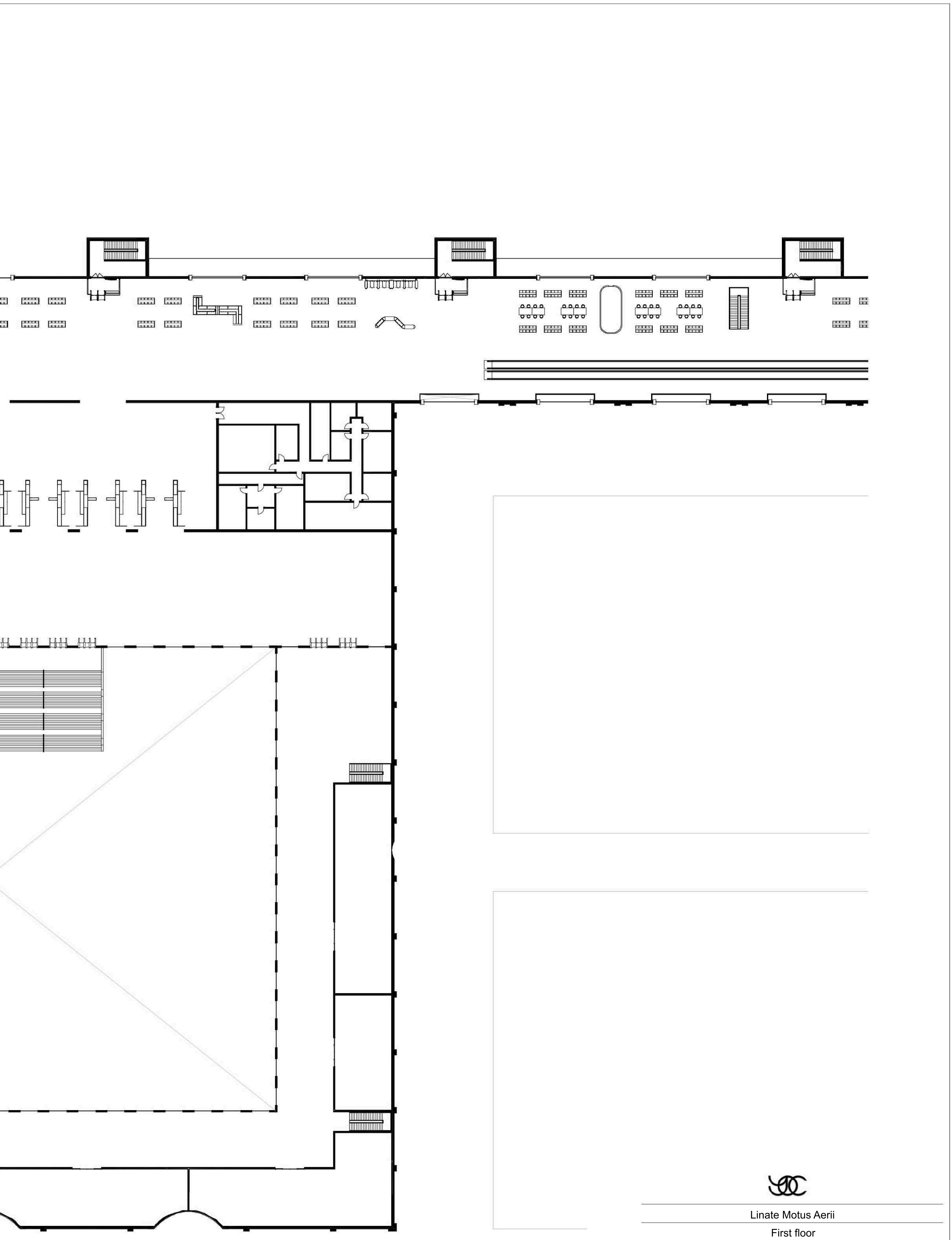




Linate Motus Aerii	
First floor	
A305	
Scale	1:3000
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

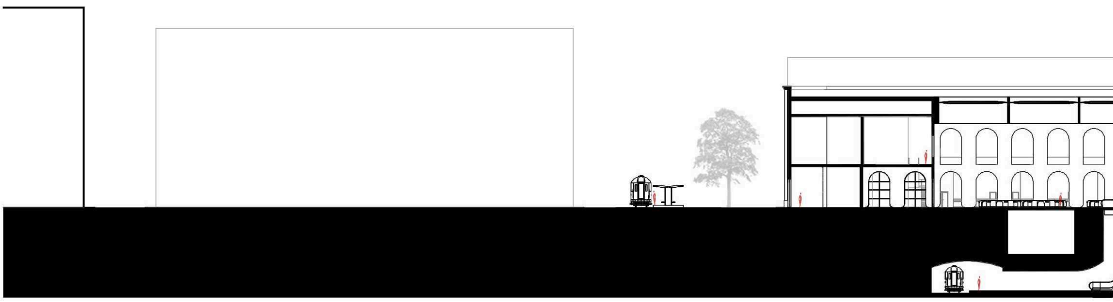
FIRST FLOOR - ENTRANCE

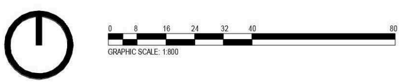


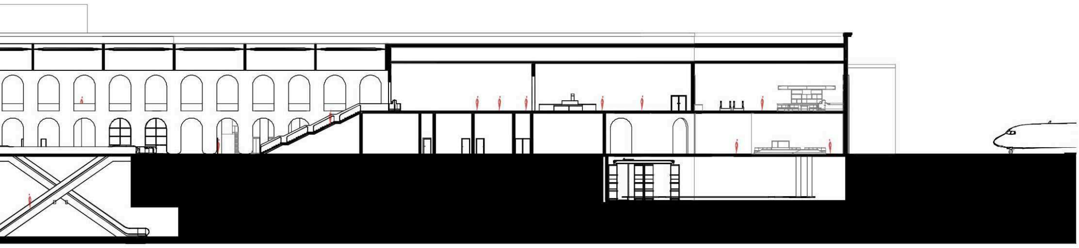


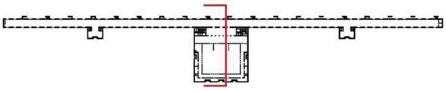
Linate Motus Aerii	
First floor	
A306	
Scale	1:800
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

VERTICAL SECTION



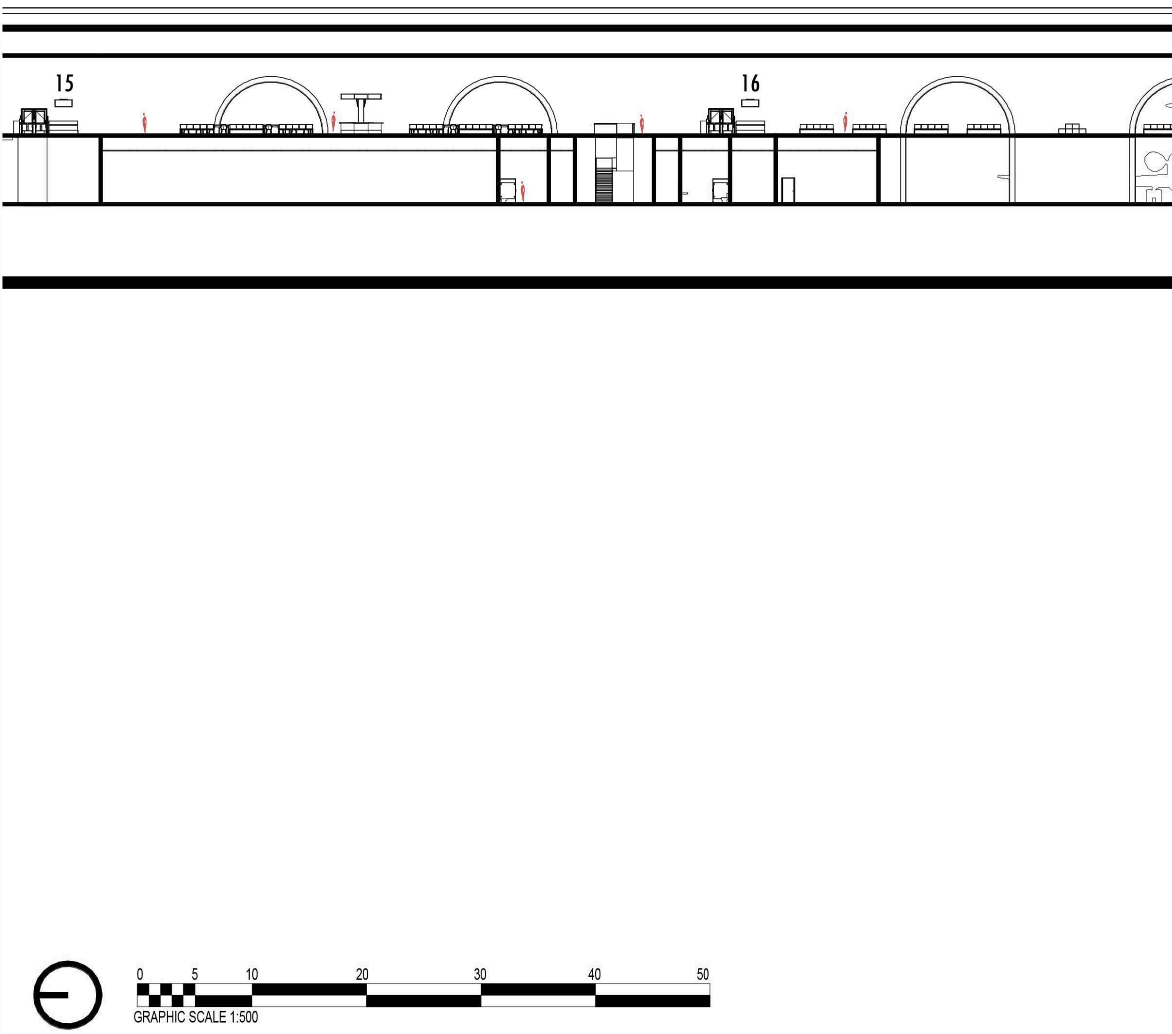


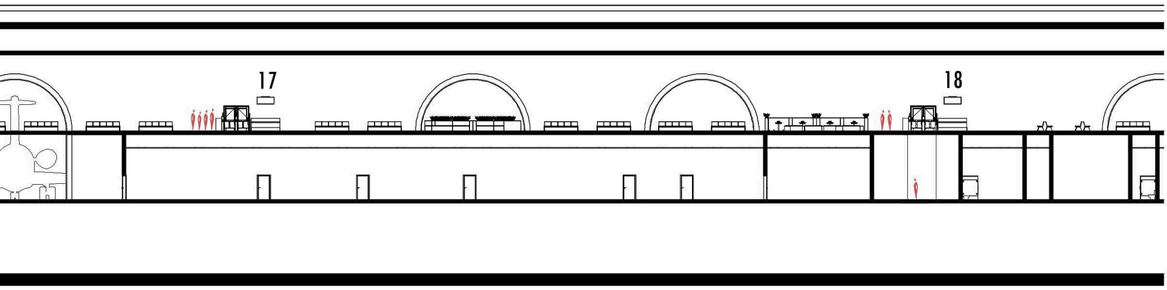


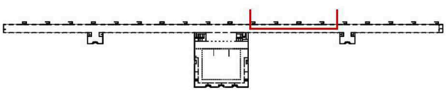


Linate Motus Aerii	
Vertical section	
A307	
Scale	1:800
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

HORIZONTAL SECTION

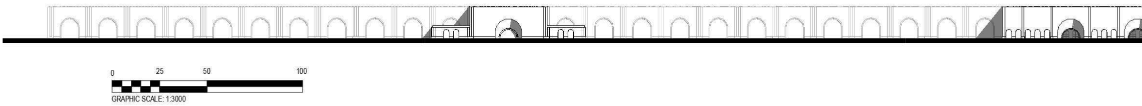


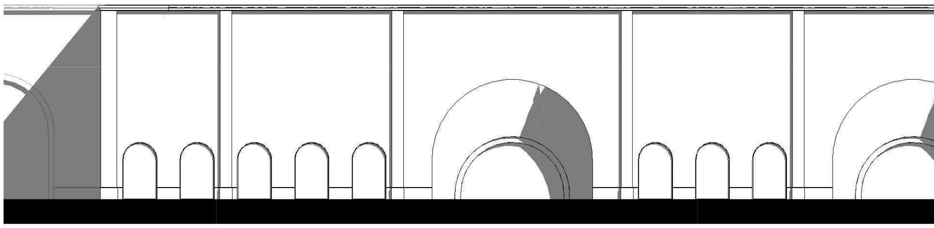




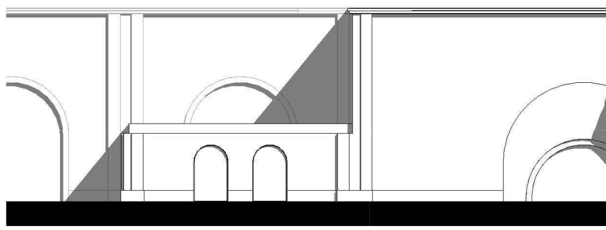
Linate Motus Aerii	
Horizontal section	
A308	
Scale	1:500
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

FAÇADE

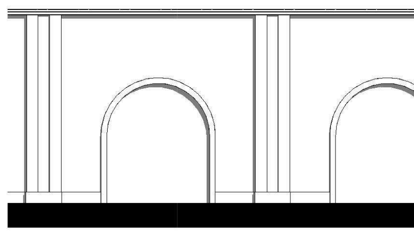




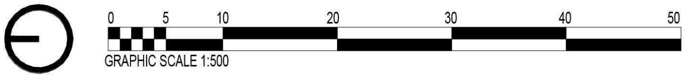
Main entrance
1:500

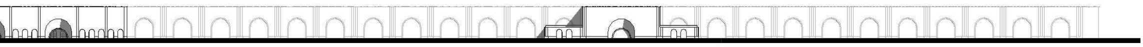


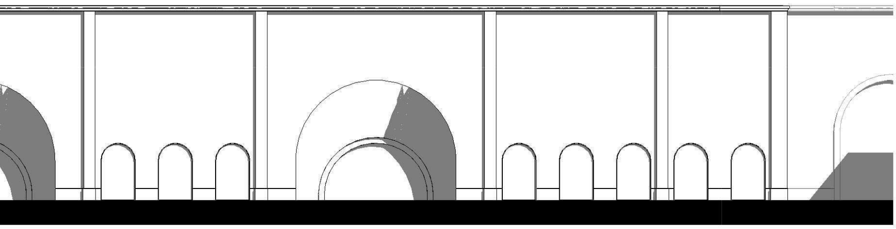
Secondary entrance
1:500

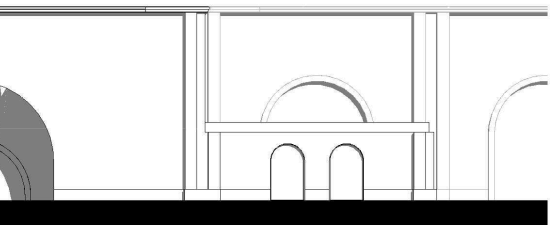


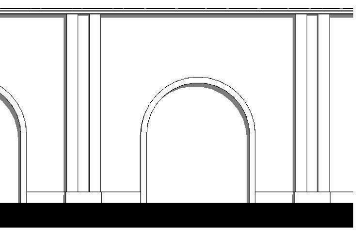
Concourse
1:500





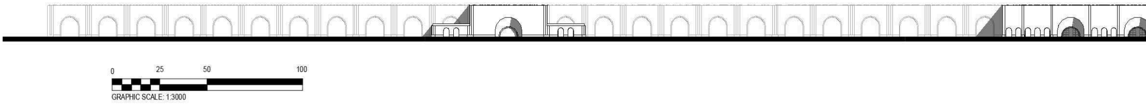


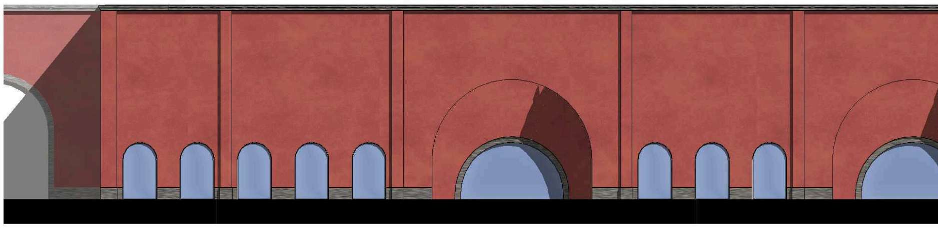




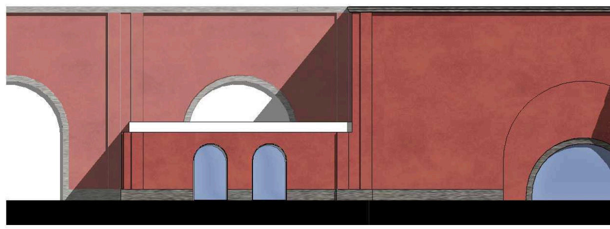
Linate Motus Aerii	
Elevation	
A309 (1)	
Scale	1:3000 & 1:500
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

FAÇADE



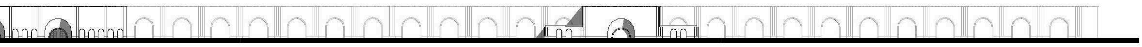


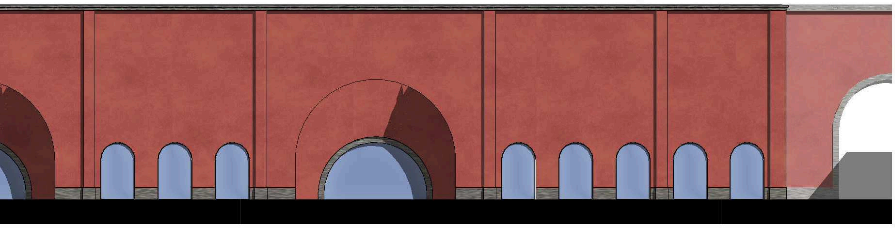
Main entrance
1:500

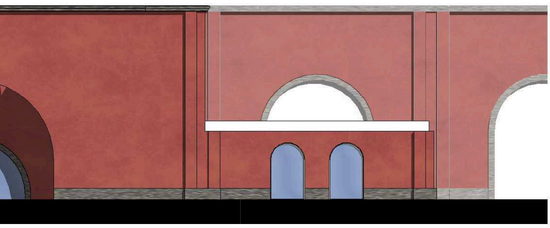


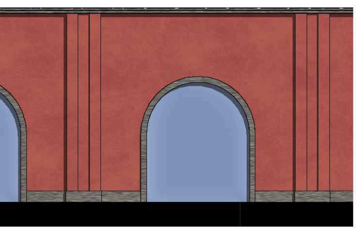
Secondary entrance
1:500

Concourse
1:500



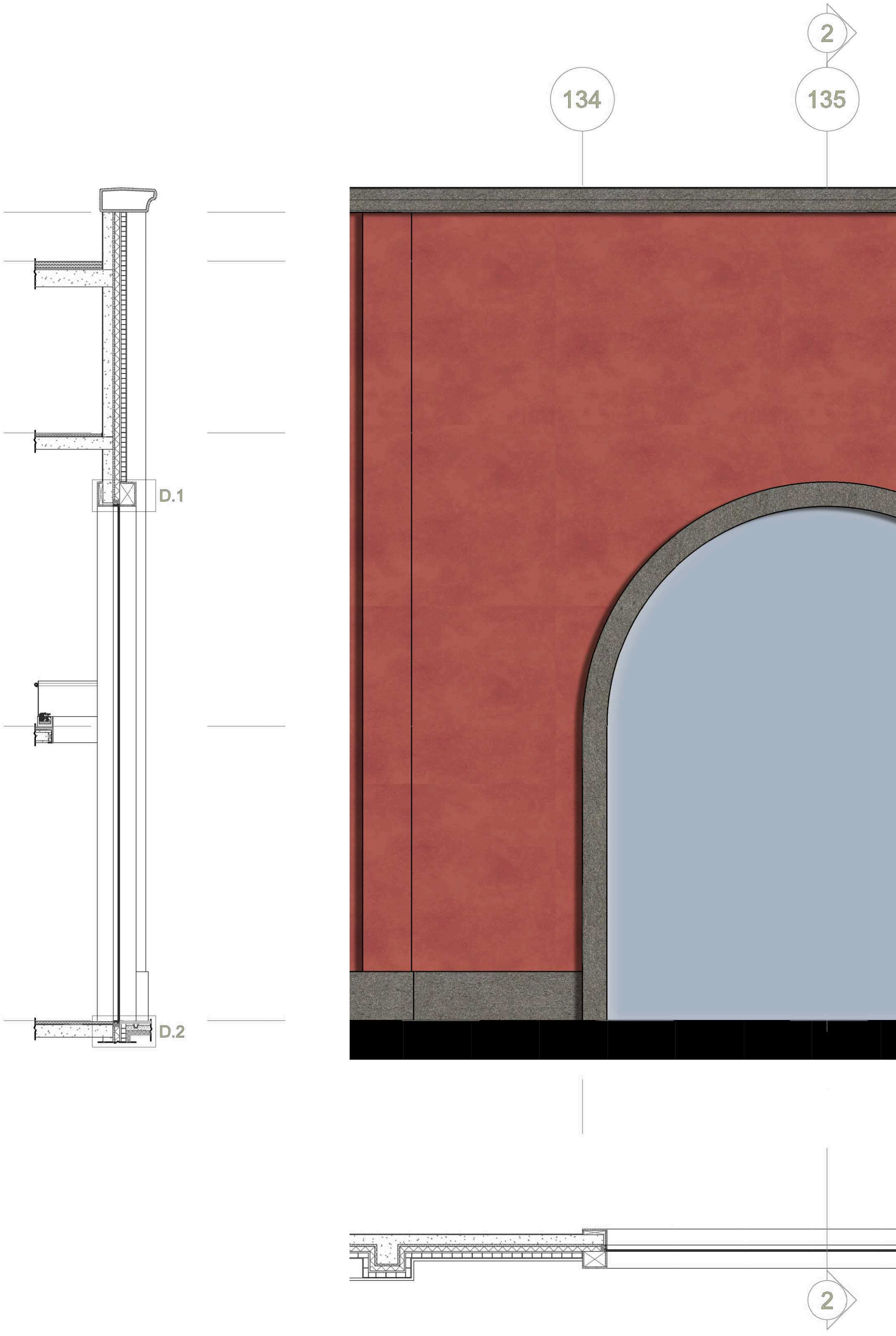


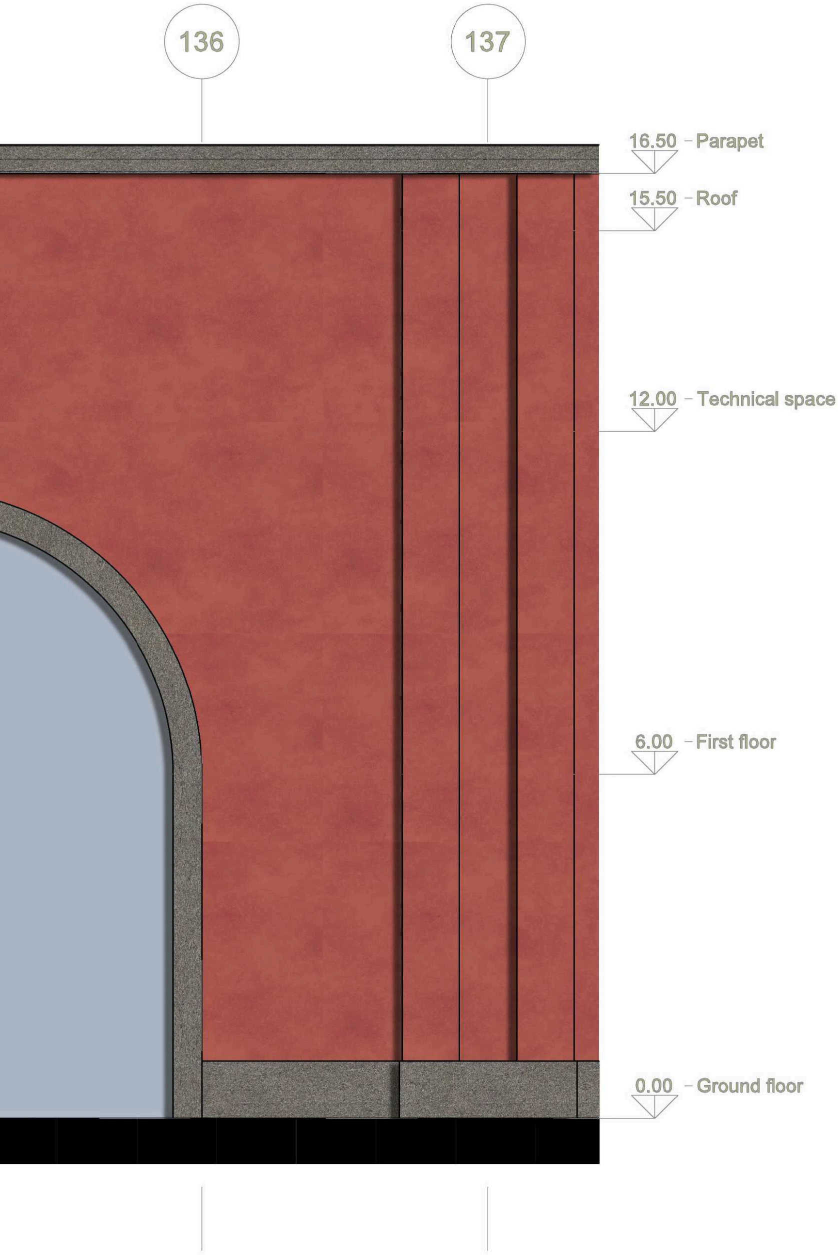


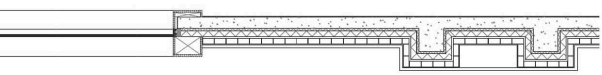


Linate Motus Aerii	
Elevation	
A309 (2)	
Scale	1:3000 & 1:500
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

FRAGMENT

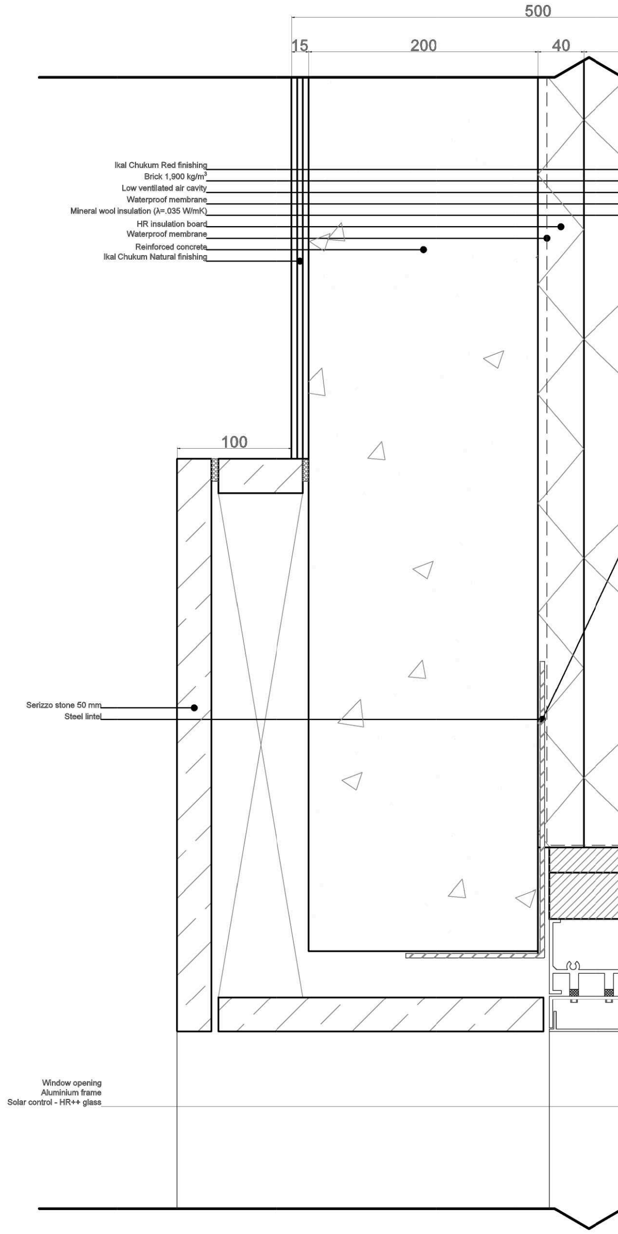


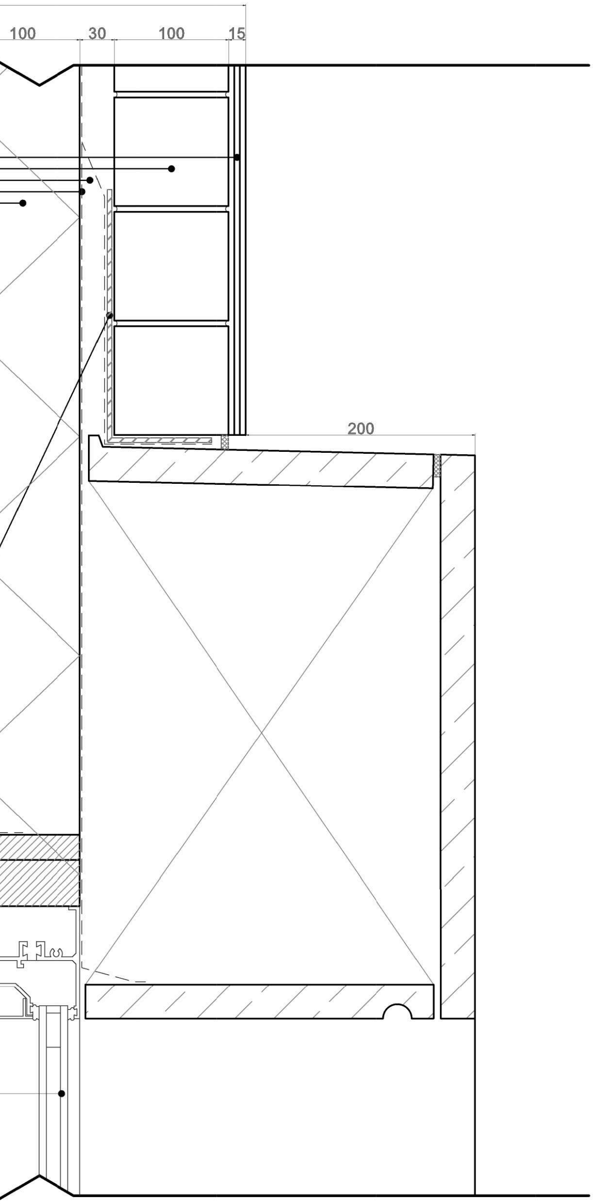




Linate Motus Aerii	
Fragment	
A310	
Scale	1:100
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

DETAIL 01


500
15
200
40
Ikal Chukum Red finishing
Brick 1,900 kg/m3
Low ventilated air cavity
Waterproof membrane
Mineral wool insulation (λ=.035 W/mK)
HR insulation board
Waterproof membrane
Reinforced concrete
Ikal Chukum Natural finishing
100
Serizzo stone 50 mm
Steel lintel
Window opening
Aluminium frame
Solar control - HR++ glass



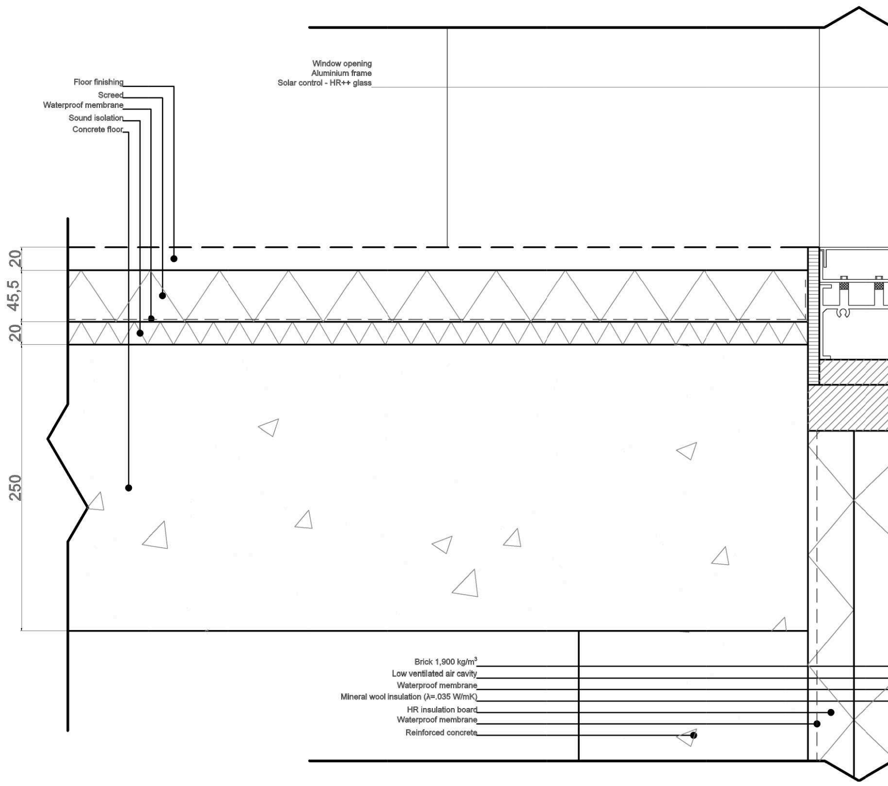
Linate Motus Aerii

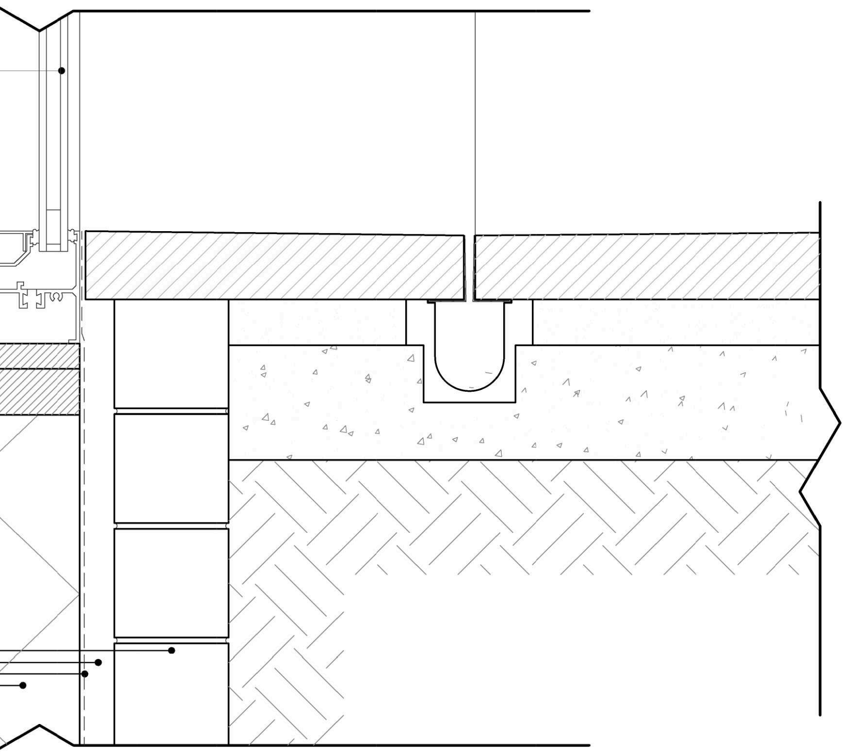
Detail 01

A311

Scale	1:5
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

DETAIL 02

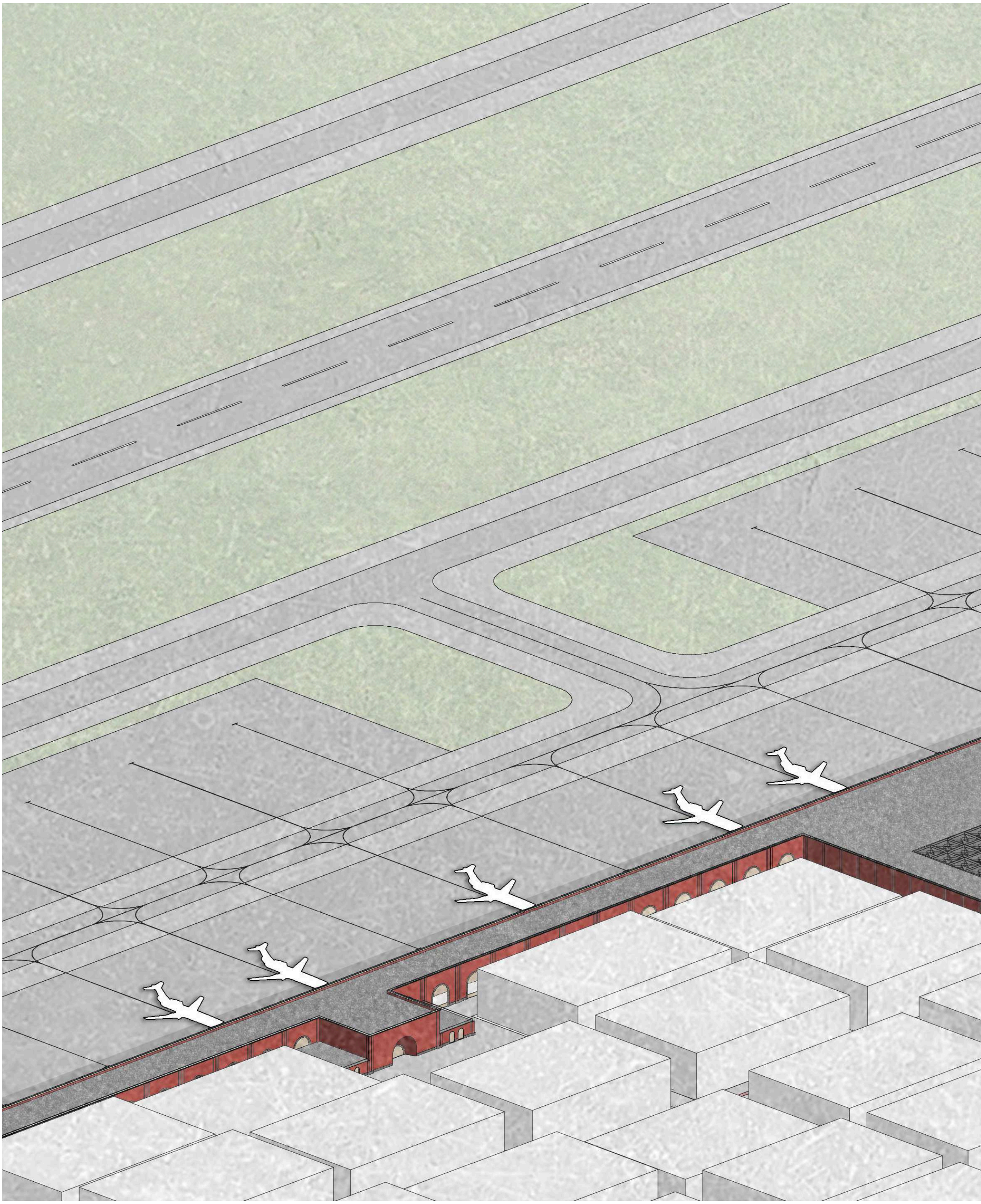

Window opening
Aluminium frame
Solar control - HR++ glass
Floor finishing
Screed
Waterproof membrane
Sound isolation
Concrete floor
20
45,5
20
250
Brick 1,900 kg/m³
Low ventilated air cavity
Waterproof membrane
Mineral wool insulation (λ=.035 W/mK)
HR insulation board
Waterproof membrane
Reinforced concrete

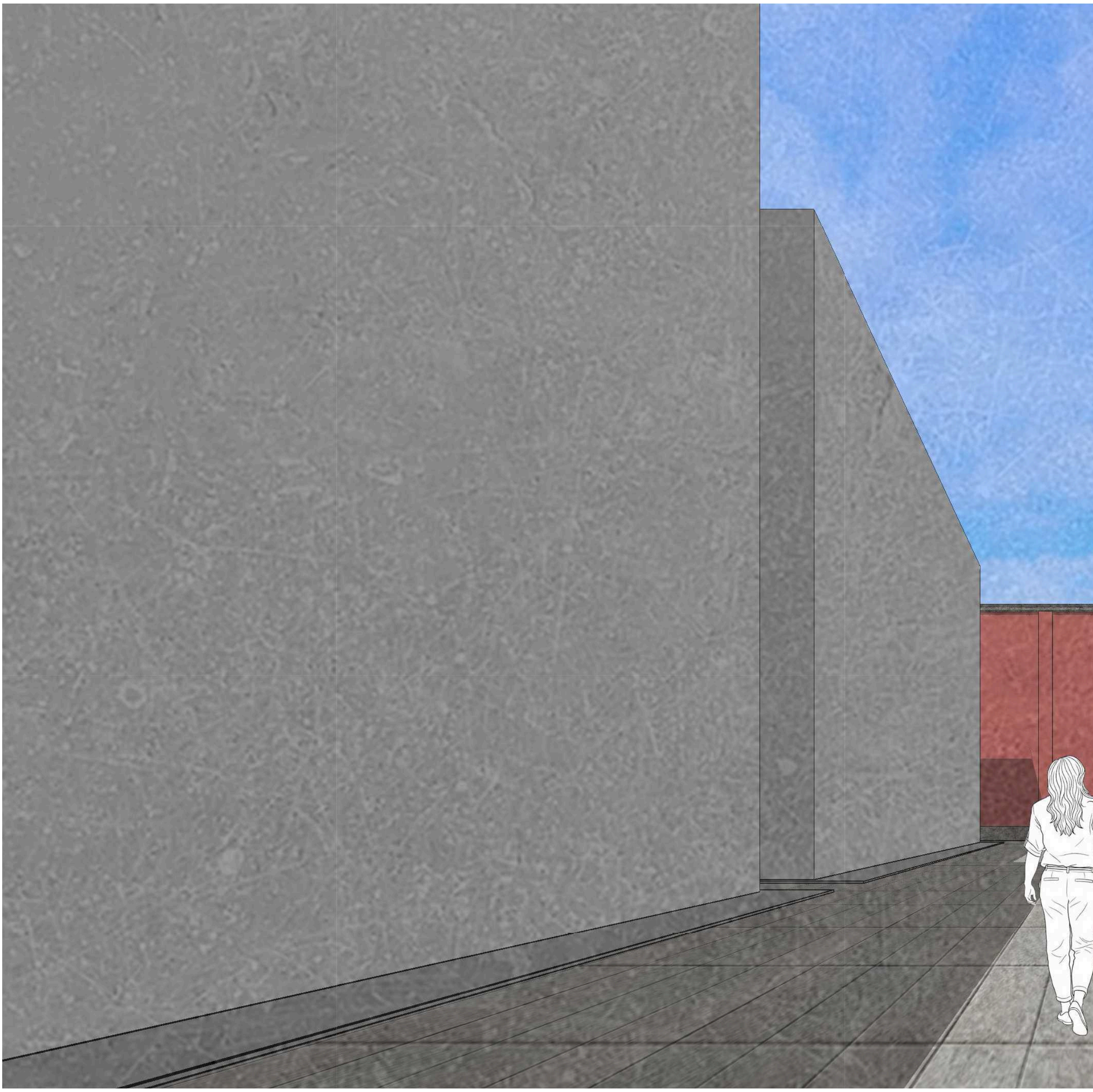


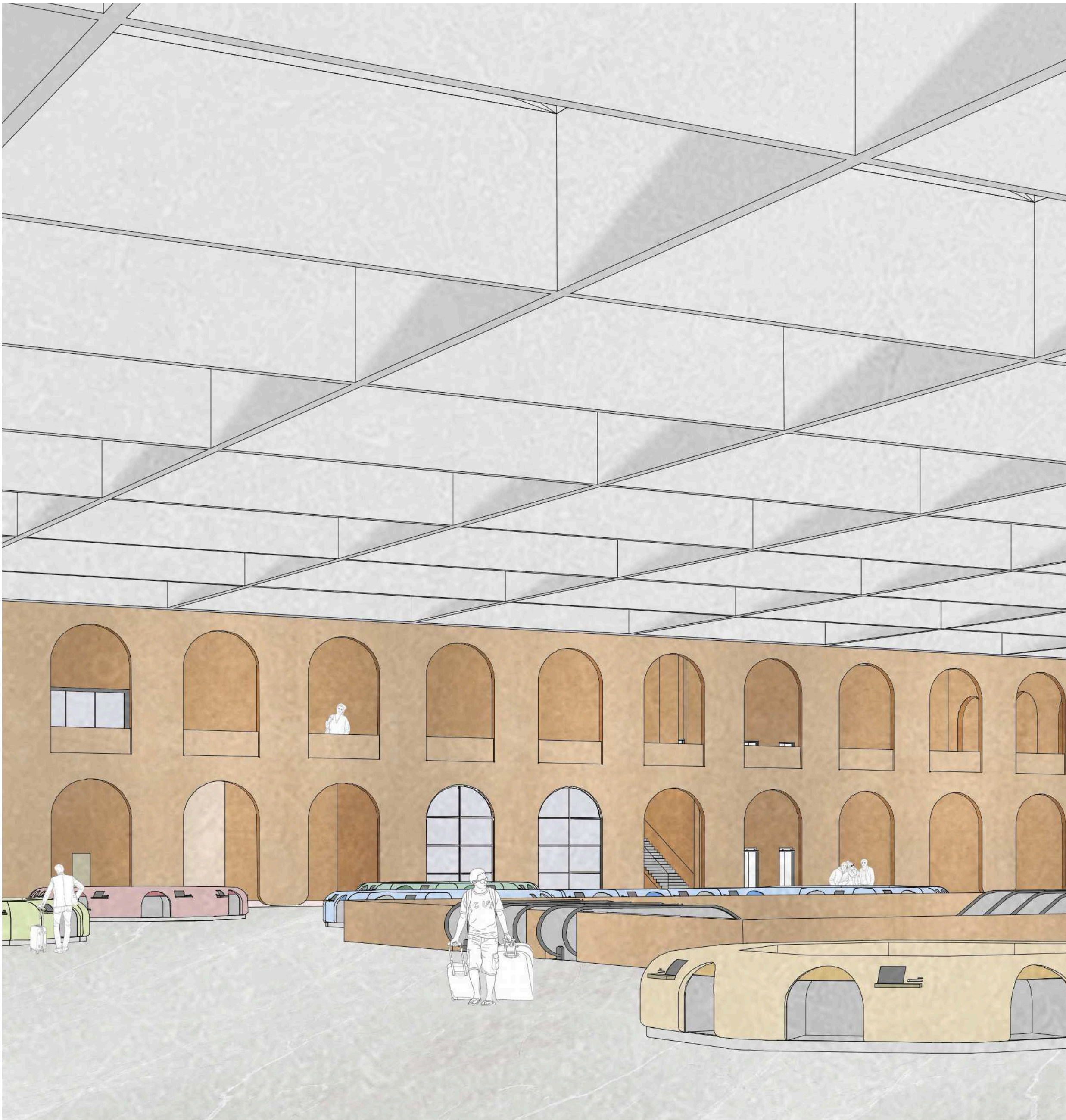
Linate Motus Aerii	
Detail 02	
A312	
Scale	1:5
Date	09/06/2026
Student	Yago Oudijk Castañeda
Studio	Complex Projects Graduation Studio

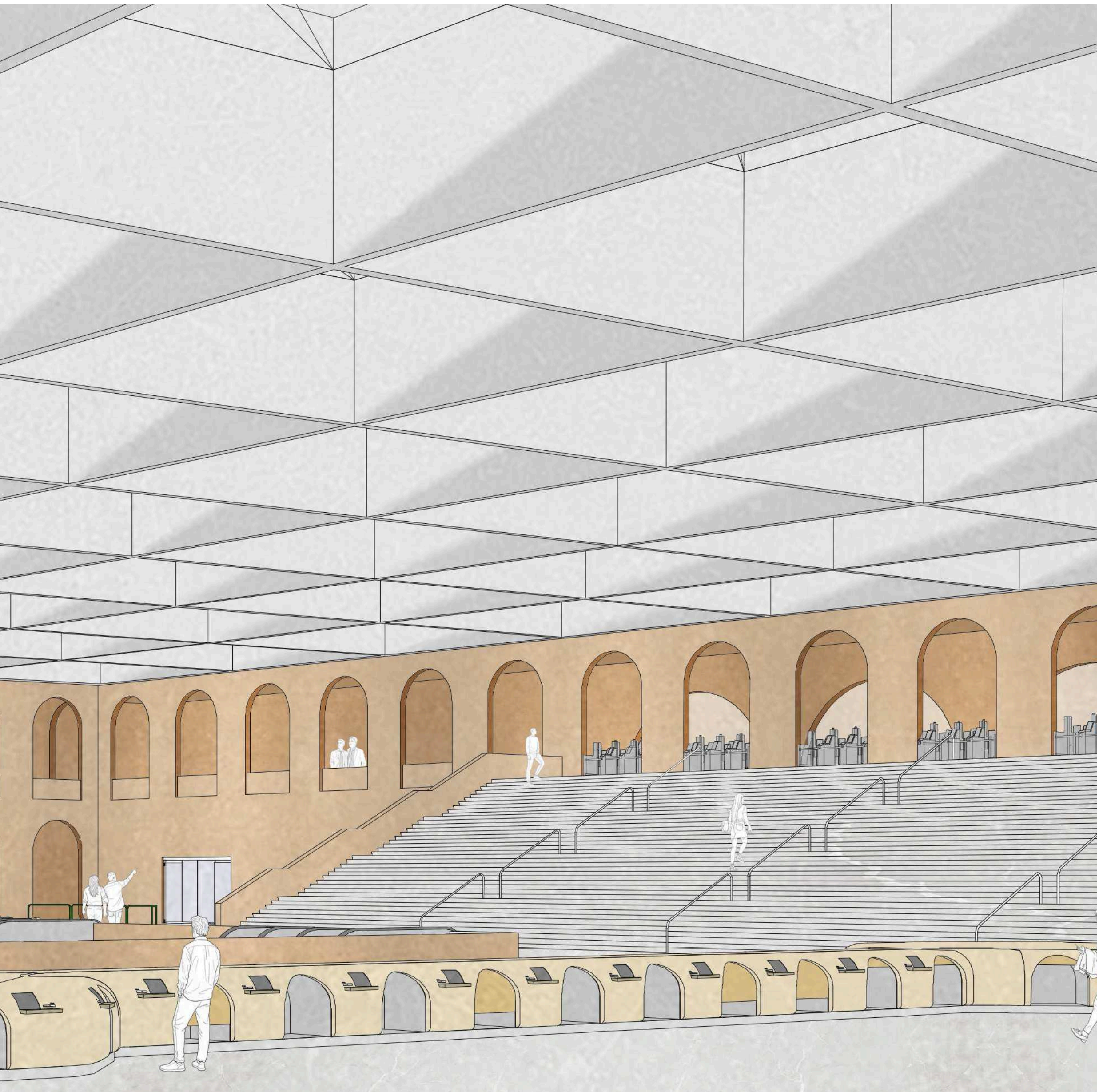
05. VISUALIZATIO

ONS









06. DISCUSSION

N

FINAL THOUGHTS

The airport should evolve beyond its current role, the one of a machine for movement. It should not exist as an isolated object outside the city. Instead, it should become a public space; open, culturally embedded, and urban integrated.

These were the first words of this report, and they represent an idea that I believe should shape the future of airports and the aviation industry as a whole. Over the past semester I have researched, designed, and tested whether this idea could be viable and whether it should indeed be pursued in the future. With my work completed, I believe these words to be true.

It is important to acknowledge that several conditions have to be in place for this idea to become a reality. The main one being electric aircraft being developed and introduced into the general aviation market. Although statistics, the historical adoption of electric transportation, and broader technological trends suggest that electric aircraft will be the future of aviation; some experts remain skeptical. This became evident during discussions with Miguel de Bernardo, a highly respected expert in airport planning.

Almost as important as a variable as electric aircraft is, the financial aspects of changing the airport typology can define if such a project could be made. In the case of Linate Airport, the main stakeholders are the city municipality of Milan which could be encouraged to experiment with a new business plan where airport and city help each other to grow and to improve for passengers and inhabitants.

I believe the final project I developed during this graduation semester is a good representation of the idea that started it. I think that the developed terminal expresses Milan's culture and identity, while also being functional and hyper efficient. It also shows the advantages of such a concept: very narrow buildings, with great visual connection to the city, possibility of integration of residential and commercial buildings around the terminal, and quick ways to travel from and to the gate from wherever in Milan.

Even though this research project was made with the specific case of Linate Airport, it raises questions about the relationship between infrastructure like airports and the contemporary and future cities. Since (mainly) the 1990's, airports have been planned and designed as very optimized and specialized infrastructure buildings with efficiency as their main goal. As technologies are developed

and environmental needs increase, opportunities arise to rethink airports into buildings that are part of the city and its planning strategies. The project thus demonstrates that airports can actually become contributors to the city, improving urban quality.
With that being said, I believe that this idea should be studied in more depth to develop the urban aspects better. A joint graduation studio between Complex Projects and Urban Design could be interesting for this. I think that with this extra, precise urban development, the project could be designed to the next level. Therefore, the proposal presented in this report is not the definitive solution, but it does contribute to creating a multidisciplinary discussion on airport design.

I am very satisfied with the concept that was researched and tested, the building that was ultimately designed, and the discussions and enthusiasm it generated. Most importantly, it inspired not only me but also my tutors, who I could see sharing in the the excitement throughout the semester.

07. BIBLIOGRAPH

HY

BIBLIOGRAPHY

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08. APPENDIX

APPENDIX 1. STAKEHOLDERS

Milan Linate has four main stakeholders which work together to improve the quality of service of the airport. These four stakeholders are the Airport Operations Company (SEA), Italian Civil Aviation Authority (ENAC), National Flight Assistance Agency (ENAV), and shareholders.

ENAC

The Ente Nazionale per l'Aviazione Civile (ENAC) is Italy's civil aviation authority. Its role inside the aviation system in Milan Linate is of regulatory and supervisory nature. In it, ENAC ensures that all airport activities comply with national and European aviation standards. These standards cover safety, security, passenger rights, and environmental protection.

One of ENAC's primary responsibilities at Linate is the certification and monitoring of airport infrastructure, such as runway conditions, terminal facilities, emergency plans, and maintenance procedures. ENAC also supervises the operations of airlines and ground-handling companies, making sure they follow safety regulations, operational procedures, and service-quality requirements.

Last but not least, ENAC collaborates with SEA and ENAV to improve flight efficiency and reduce environmental impact. At Linate, this includes noise-mitigation strategies and oversight of flight-path procedures, due to the airport's proximity to the city of Milan.

ENAV

The ENAV (Ente Nazionale Assistenza al Volo) is Italy's air-navigation service provider. ENAV has a decisive role in the functioning and spatial organization of Linate Airport since its operational requirements strongly influence the airport's architecture, airside layout, and surrounding urban environment.

ENAV manages all air-traffic control services, coordinating arrivals, departures, ground movements, and flight-path procedures. Since Linate is located so close to the city of Milan, ENAV has to think and implement precise approach and departure routes that minimize noise impact on citizens. These flight-path decisions directly shape height limits, land-use restrictions, and the placement of new structures both inside and outside the airport. Their operational guidelines influence runway orientation, taxiway geometry, visibility requirements, and the spatial relationship between terminal buildings and airside circulation.

Shareholders

The shareholders of Milan Linate Airport are the last key stakeholders in the airport. As shareholders, they shape the airport's development, governance, and long-term strategic direction. From the Linate Airport's shareholders, the City of Milan is the largest public shareholder (54.81%), while investment funds such as F2i Sgr S.p.A. and 2i Aeroporti S.p.A. hold significant stakes (8.62% and 36.39% respectively). These shareholders provide the capital necessary for infrastructure projects, upgrades, and urban redevelopment initiatives.

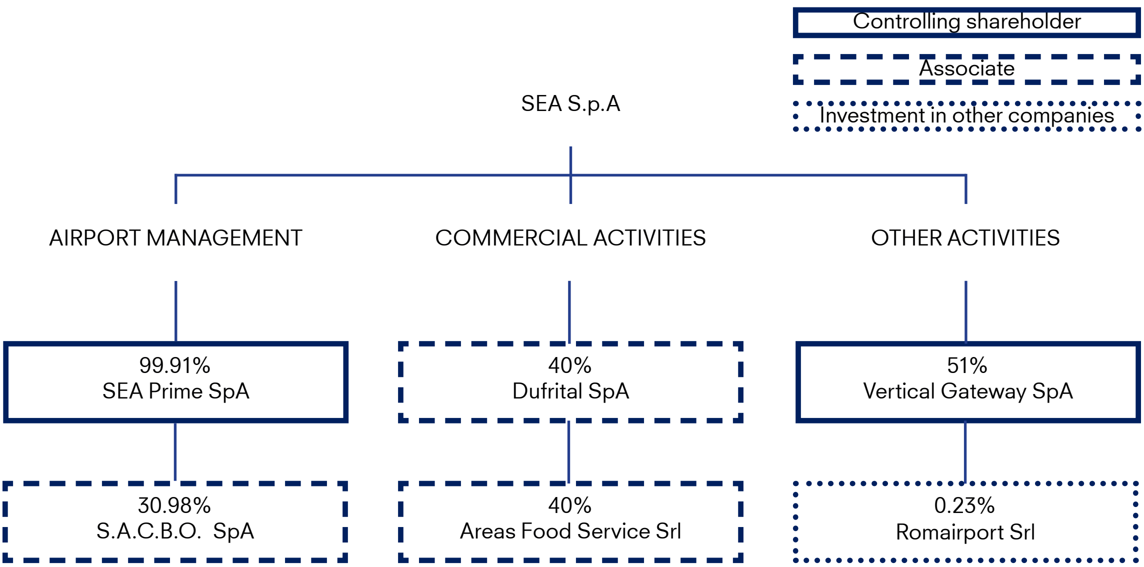
From an architectural perspective, shareholders influence the design and planning of Linate's terminals, runways, and surrounding areas through their approval of major investment plans. One example of these investments is the ongoing Linate Airport District (LAD) redevelopment. This project is planned to integrate airport facilities with commercial, residential, and green spaces. As with all shareholders in transport companies, their priorities balance operational efficiency, passenger experience, financial return, and city integration.

SEA

The Airport Operations Company or SEA S.p.A. from Italian Società Esercizi Aeroportuali, is the main operator and manager of Milan's airport system, which translates primarily to both Milano Malpensa and Linate.

At Linate Airport, SEA manages all airport infrastructure and daily operations, from runways and terminals to passenger services and commercial areas. They are also responsible for the airport's improvements in efficiency, sustainability, and customer experience, thus managing retail spaces, mobility connections and the Linate Airport District.

In the following graph we can see its group structure. This graph is taken from their website but has been visually edited to fit with this report style. To find the original graph and information see the reference list at the end of the book.


Controlling shareholder
Associate
Investment in other companies
SEA S.p.A
AIRPORT MANAGEMENT
COMMERCIAL ACTIVITIES
OTHER ACTIVITIES
99.91%
SEA Prime SpA
40%
Dufrital SpA
51%
Vertical Gateway SpA
30.98%
S.A.C.B.O. SpA
40%
Areas Food Service Srl
0.23%
Romairport Srl

Group I.D.	
Founded	May 22, 1948
Headquarters	Milan Linate Airport - 20090 Segrate (MI)
Sharecapital	€ 27,500,000
Number of employees 2023	2,349
Revenues 2023	€ 801,100,000
Net profit 2023	€ 156,200,000
Passangers 2023	35.3 milion
Airport movements 2023	279.4 thousand
Freight movements 2023	667.2 thousand (tons)

APPENDIX 2. STATISTICS

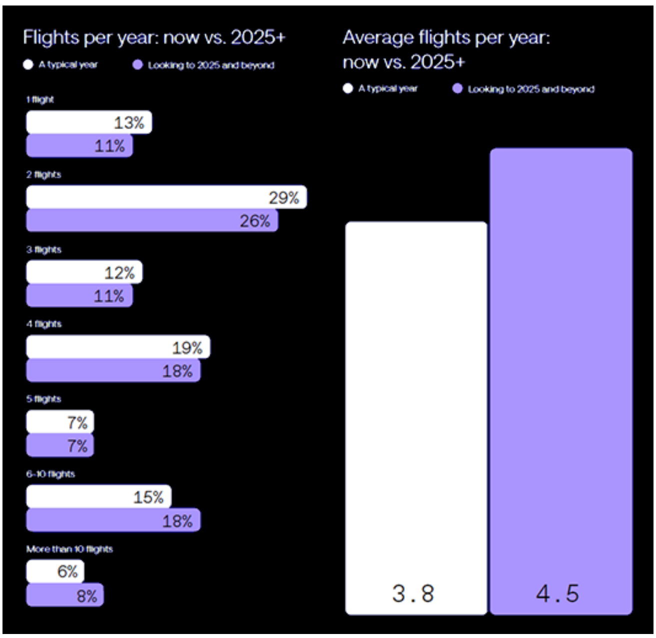
Airports, airlines, and other statistic organizations study in depth passengers, airports, flights, and any concern that might exist in the travel system. In this section of the report, we will analyse the most relevant data, which will hopefully help us understand the future concerns for airports and the air travel sector. Most of these statistics come from the SITA 2025 passenger report and the IATA 2025 Global Passenger Survey, but all other sources are listed in the reference list.

The global aviation traffic is expected to grow the coming years, as it's has since 1985 with the exemption of 2020. The annual income in the aviation sector was 800.000 million in 2021, and it's expected to grow a 10.58% for 2027. These numbers are supported by the growth in global traffic which grew 10.6% in 2024.

When looking at the frequency of flights and the passengers that take them. We see that men are the most frequent flyers: 23% take 6 or more flights a year in contrast with 18% of women.

We can also see that people between 25 and 40 years old are the group that fly the most frequent, leading the category of 6+ flights a year.

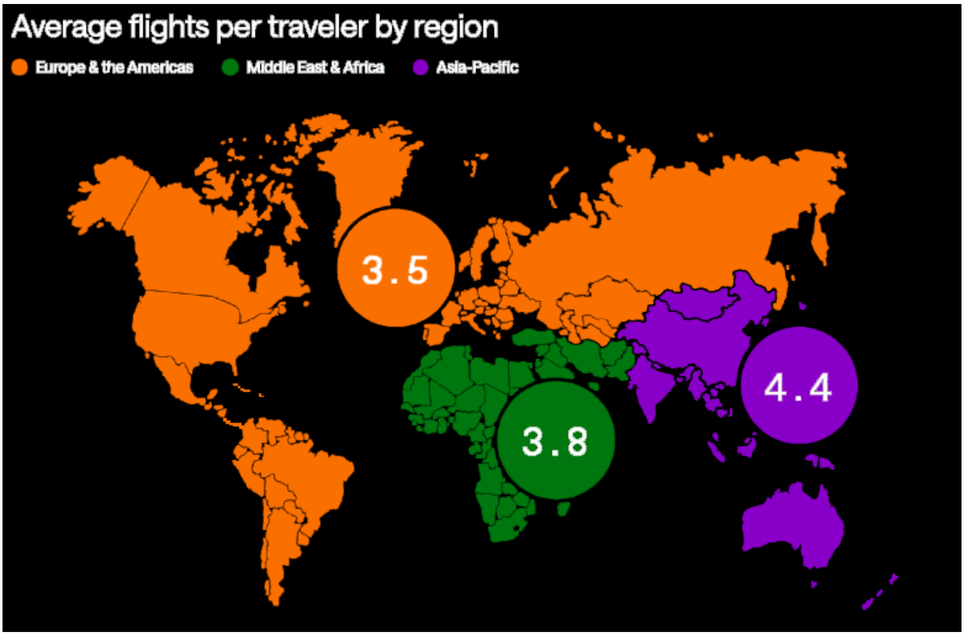
While business travellers are the most frequent taking 5.2 flights per year



against leisure passengers which travel 3.2 times a year, leisure trips dominate air travel with 79% of the total trips being leisure focused.

When looking at the origin of the passengers flying, we see an interesting statistic. Asia-Pacific leads the air traffic with 4.4 flights per traveller, followed by the Middle East and Africa at 3.8. Europe and the Americas trail at 3.5. This could reflect a strong economic momentum, fewer high-speed rail alternatives, tourist destinations being located in Europe and America, and/or younger demographics driving demand.
As to be expected, Millennials (born between 1981 and 1996) and Gen Z (born between 1997 and 2010) are becoming the aviation majority. With it, new expectations arise. Complete and easy to use apps are a request that is rapidly becoming one of the main requirements for good service. 30% of Millennials and Gen Z book their flights in Airline Apps. This can also be seen in the drop in use of airline websites, a drop from 46% in 2020 to 35% in 2025.

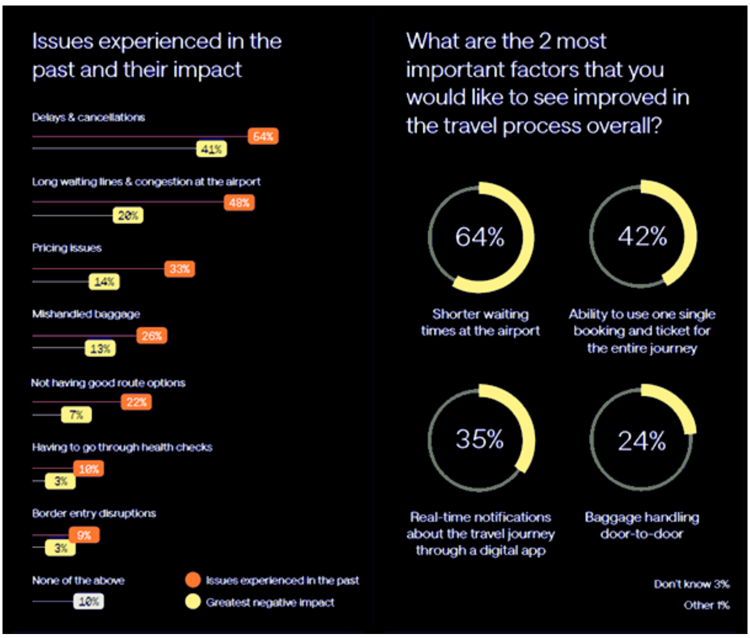
In general numbers, we can see that 73% of passengers book their flight online, 31% do their check-in online, and only 11% get their boarding pass online. These numbers differ per region as for example 80% of European flights are booked online,



35% do check-in online, and 31% get the boarding passes from home. One of the reasons for this difference might be the typical flight that passengers take, since most flights in Europe are short distance flights which often require less luggage.

Proximity to the airport is one of the most important reasons a specific airport is chosen. 75% of passengers mention it as one of their 3 most important factors when booking a flight. Other reasons mentioned by passengers are flight price, difficulty of getting a visa, airport efficiency, and a relatively new factor: sustainability.
As mentioned, one factor that is often overlooked are visas. Most passengers around the world require visas to travel. Besides the political difficulty that obtaining a visa might be, the way to get it is also relevant when discussing air travel. 66% of travellers obtain their visa online, 20% get it through the consulate or embassy, and 14% obtain it in the airport itself.

Sustainability is one of the newest factors for travel preferences between passengers. In here we see different statistics that represent this mentality shift in passengers, most often in young travellers. The average percentage of ticket price passengers would be willing to pay on top of the price of their ticket to offset carbon

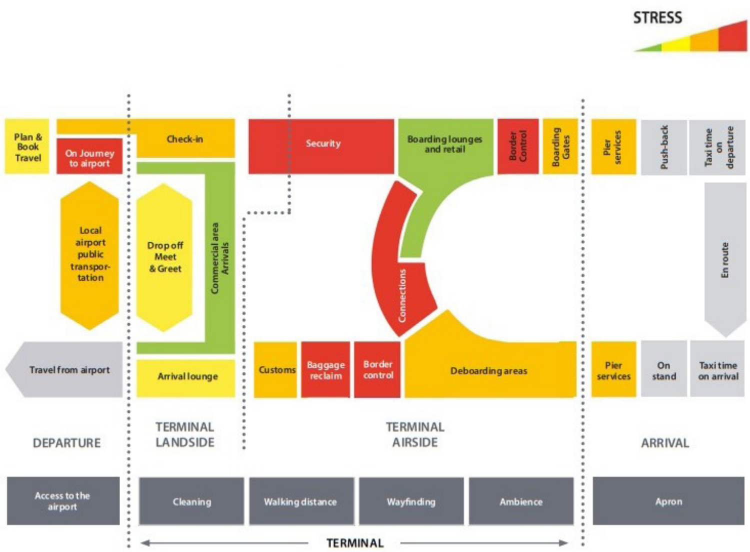


emissions of their flights is 11.3%, an increase from 10.8% in 2024. On the following chart we find the net increment range that travellers would be willing to apply on their flights.

Net range	2024	2025
<10%	49%	47%
10-20%	38%	39%
21-30%	6%	7%
31-40%	3%	3%
41-50%	4%	4%

Besides economic factors, passengers are also willing to make other changes in how they fly to cut emissions from their flights. 59% of passengers would be willing to fly 1 hour longer to cut emissions by 25%, and 50% would extend their travel time 2 hours if it would halve emissions. Up to 80% of passengers are willing to reduce luggage brought if that would help cut emissions from flights. Although passengers are willing to change their traveling ways, 58% of passengers expect airlines to build new strategies that are based on sustainability while 53% expect the same from airports.

When passengers were asked on the biggest issues that damaged their traveling experience, 41% mentioned delays and cancellations and 20% mentioned long waiting lines. As a solution passengers gave three main ideas. Shorter waiting times (64%), one single booking for the entire

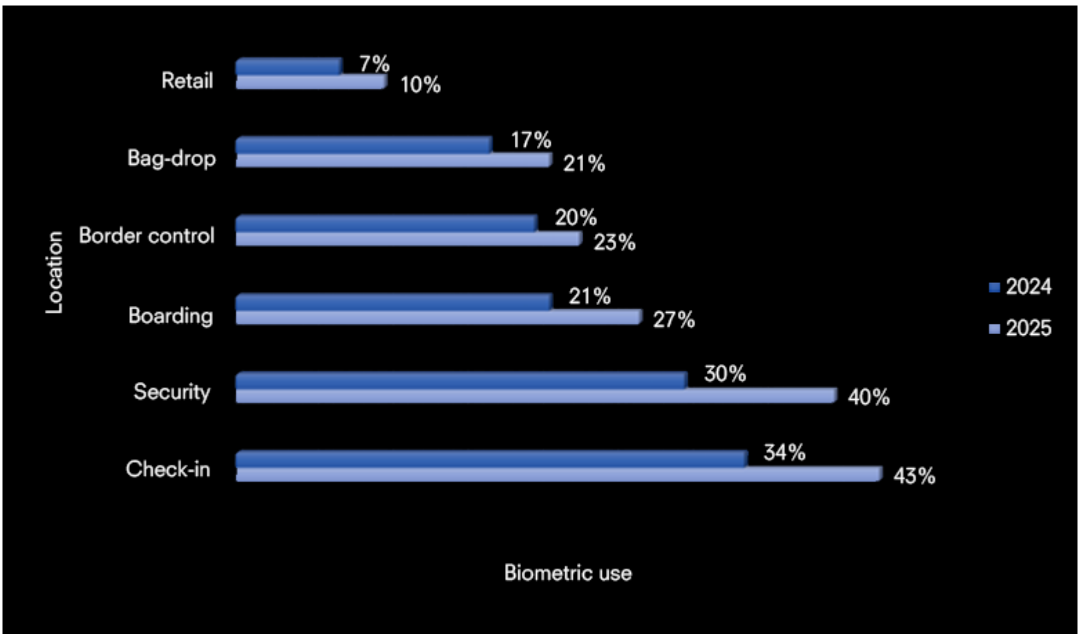


journey (42%), and real-time updates in a single app (35%). In the following graphic we can see an extensive representation for these two themes.

The use of biometrics at different moments through the airport experience has increased throughout the years. This increment can be seen in the first graph, where the increments on biometric use in the different travel points are shown. The biggest increases since 2024 have been seen in the check-in points, security, and boarding process with an increase of 11%, 10%, and 6% respectively. The biggest users of this technology are young passengers, men, and frequent flyers. On the second graph we can see one of the reasons why biometric technologies are frequently been used: comfort and trust on these technologies.

As with the introduction of all new technologies, the use of biometrics has brought new concerns in passengers. The three main ones are data privacy (54%), data misuse (44%), and identity fraud (44%). With only a 3% of passengers not having any concerns about the use of biometrics, it is safe to assume that human interaction will always have to be available for passengers.

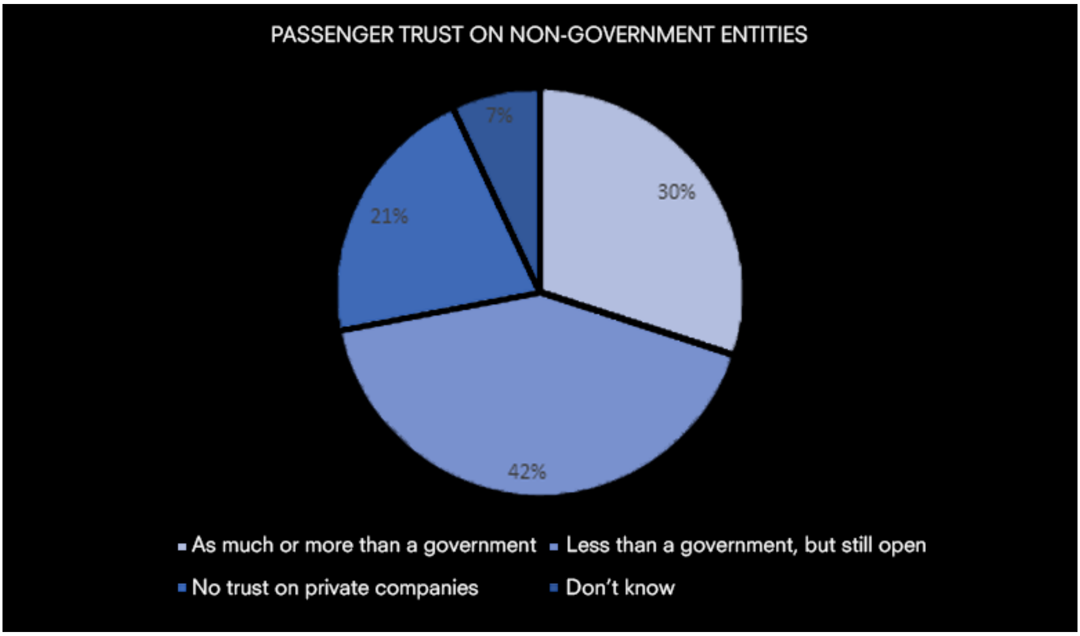
Following the theme of trust, the trust on digital ids and data sharing



with airports and border agencies is somewhat high, having 86% of passengers trusting them. Although this percentage is a sign of trust, only 20% of passengers mention that they "trust a lot" both parties. This trend follows on with third-party platforms where 30% of people would definitely share their data, 46% would probably do it, and finally 24% would not do it or would not trust third party platforms.

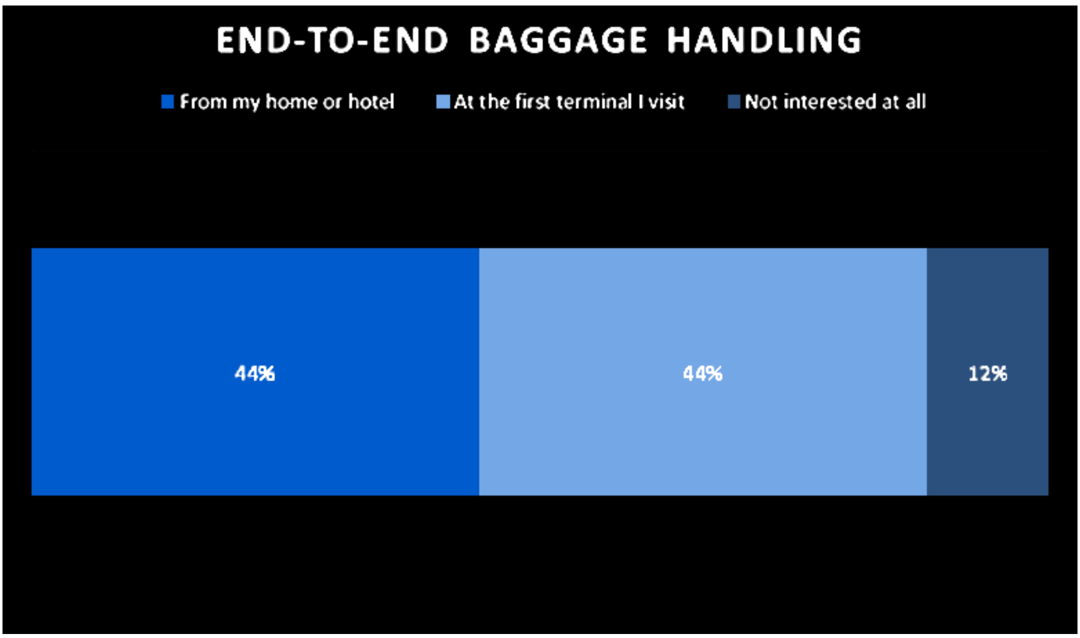
The use of biometric technology has grown in all the different travel points in an airport compared to 2024, which aligns to the data previously described. The interesting part that can be seen in the following graph is the places where it is mostly used. This information could help designers to find a way to increase this technology everywhere in the airport.

Digital Travel Credentials (DTC) are digital version of passports. With them, the travel experience is meant to be smoother and faster. When asked who they would be comfortable sharing their DTC with travellers responded with Airlines 80%, airports 77%, border control authorities 74%, and hotels 65%. Expanding on this theme in external parties to personal DTCs, passengers were asked on their trust levels on non-governmental entities. The results are shown in the following graph.



One more topic that is becoming a trend are luggage services. Only 8% of passengers say lost bags worries them when booking a trip. This confidence is also seen when looking at the SITA Baggage IT Insights Report 2025 where it is stated that mishandling rates have dropped from 6.9 bag per 1,000 passengers in 2023 to 6.3 in 2024. With this said, end-to-end baggage handling is a popular service request (27% of passengers) coming second only to better coordination between providers during disruption. The 27% of requests for this service only are increased when looking at people willing to pay for this service, where the percentage increases to 78% of passengers. If this service where to exist, passengers were asked where the service should start. The results can be seen in the following graph.

The question that remains is "what is the satisfaction percentage of passengers about the different key points in their trips?". In the following table we can see a satisfactory/ dissatisfactory percentage per location.



Location	Satisfaction	Dissatisfaction
Booking	85%	5%
Final dest. reach	83%	4%
Travel options	82%	6%
Check-in	82%	7%
Payments	81%	6%
Airport arrival	81%	5%
Boarding	75%	11%
Bag drop	74%	10%
On-board	73%	10%
Security	72%	11%
Transfer	69%	9%
Immigration	66%	15%
Bag collection	65%	16%

APPENDIX 3. REGIONAL PREFERENCES

Europe

Have a strong preference for booking through airline websites and paying by credit card.
81% vs 72% globaly

Least likely to use biometrics during 2024-2025.
41% vs 50% globaly

Least willing to share data in advance or replace documents with biometrics
37% vs 43% globaly

Latin America and Caribbean

Second-highest acceptance globaly to biometric technologies.
79% vs 74% globaly

Most likely to obtain visas from a consulate or embassy
31% vs 22% globaly

Most likely to book tickets through human interaction
23% vs 15% globaly

North America

Most likely to choose flights based on journey time and fewer layovers
81% vs 65% globaly

Most likely to rely on airline websites for booking flights
39% vs 31% globaly

Widely use of biometrics, but privacy concerns are the strongest
61% concern on data breaches

Middle East

Most favorable for airports with service reputations and their preferred airlines
52% vs 42% globaly

Utilize a balance of mix payments methods, includin credit cards and loyalty points
27% vs 23% globaly

Highest willingness to use biometric technologies
85% vs 74% globaly

Asia Pacific

Strongest preference for using digital wallets such as PayPal, Alipay, and Apple Pay
46% vs 28% globaly

Least likely to pay for travel with a credit card
55% vs 72% globaly

Lowest satisfaction with the use of biometric technologies
46% vs 50% globaly

Africa

Most likely to book through airline affices or call centers
11% vs 04% globaly

Most likely to use bank transfers for travel payments
38% vs 18% globaly

Most likely to be deterred from travel by visa complexity and costs
82% vs 72% globaly

APPENDIX 4. PASSENGER TYPES

Name:
Blanca

Age:
45

Nationality:
Spanish

The Organized Frequent Visitor

Blanca is a 45-year-old Spanish retail shop manager who travels about three times a year, usually to attend to a yearly regional store meeting or to visit family after busy seasons. Since her divorce, travel has become a personal need. When traveling she feels she can reset, breathe, and enjoy a predictable time.

Blanca likes to keep everything well-planned and stress-free, so she always checks in online the night before and avoids checking luggage whenever possible. Her cabin bag is always neatly packed. Once in the airport, she moves with confidence since she knows exactly where to go. She arrives at the airport 2 to 2.5 hours before departure.

To get through all the processes of the airport she fully supports the use of biometric systems and prefers them over traditional checks. What she enjoys about facial recognition gates and automated identity verification is that it helps her move through security and boarding more smoothly. After passing through security, she heads to a familiar restaurant, ordering always the same meals. Once at the gate, Blanca switches into her usual travel mode where she takes out her book or listens to an interesting podcast.

Blanca believes that travel works best when it is efficient, comfortable, and predictable. Her routine gives her a sense of control and peace.

Name:
Paolo

Age:
62

Nationality:
Italian

The Executive Frequent Flyer

Paolo is an Italian architect on the verge of retiring. He flies about 9-10 times a year, mostly for international meetings and client visits. After years of travelling, he has earned an elite airline status, and he makes full use of its benefits. Paolo typically arrives by taxi at the airport within 90 minutes before his flight. He trusts that priority check-in and fast-track security will allow him to get his flight with minimal complications.

He travels almost exclusively with cabin luggage. In his suitcase he brings a laptop, a notebook, and a book. This allows him to move efficiently and avoid waiting at baggage claim. Once airside, Paolo always enjoys the luxurious lounges. In there, he finds a comfortable place to work. Often, he enjoys a light meal accompanied by an espresso or a glass of wine.

Since the lounge staff will notify him of his plane getting ready to board, he is able to relax about his flight. He only leaves the lounge when boarding for his priority group begins. Paolo values a smooth and luxurious travel experience. As a result. Paolo sees the airport as an extension of his workspace; therefore, it must be a place where comfort, productivity, and premium service come together.

Name:
Sanne

Age:
52

Nationality:
Dutch

The Curious Terminal Wanderer

Sanne is a 52-year-old Dutch school teacher who travels as a chance to get to know new countries and cultures as well as recharging her creativity. She flies 2 times a year, during school breaks, and enjoys the airport experience, as she sees it as part of the journey.

Sanne always arrives at the airport from 3.5 to 4 hours early. She always checks her suitcase at one of the check-in counters, as she prefers human interaction to using self-check-in screens. After dropping her suitcase off she begins her travel ritual: she wanders through the terminal looking at any interesting small detail she can find, treating the airport almost like a piece of art. She appreciates its architecture, staff working, its installations, and any design features that most passengers would overlook. One of her favorite activities is sitting down and admiring the open views of the runway, often watching takeoffs and landings, just like when she was a kid.

She loves trying local foods and specialty snacks from unique cafés, restaurants, and shops she hasn't tried before. Her phone is full of photos of interesting patterns on the floor, sunlight reflections, themed displays, unique signs, and other live moments that she finds while at the airport. Sanne always tries to find out if the terminal has any temporary exhibitions or cultural displays. Whenever she finds one, she always stops exploring them in depth.

Only when the boarding process has started does she head toward the gate, enjoying watching people rush towards other flights, imagining what their stories could be. For Sanne, the airport is not a place to rush through; it is a space of discovery, design, and atmosphere.

Name:
Kanu

Age:
21

Nationality:
Nigeria

The Anxious Traveler

Kanu is a 21-year-old Nigerian medical student living in Italy. His main drive in life is a deep sense of responsibility toward his family back home. He flies only once every year, usually when he has saved enough to visit his parents and sister. Because of the importance of these trips, the airport experience often feels overwhelming. For him, every step carries emotional weight, and he always fears making a mistake at the airport which could make him miss his flight back home.

Kanu arrives at the airport around four hours early, long before the check-in counters get busy. This way he makes sure he has time to do everything he needs. Even when he checks in online, he still approaches the desk to confirm everything is correct such as seat, documents, baggage, and boarding time. Kanu always appreciates an easy-to-follow airport and friendly airport staff. The reassurance of being helped by people helps him down.

He often brings two bags, usually filled with gifts, clothes, or items his family asked him to bring. Sometimes he overpacks out of excitement or worry, leading him to always double-check suitcase weight, and their tags. Throughout the terminal, he often checks his passport, boarding pass, and the departure screens to make sure (hoping) nothing has changed.

Kanun always walks first to his gate to make sure he knows where it is and to make sure his flight will depart from the gate signaled in the screens. As soon as he finds his gate, he goes to a shop to buy some chips and a small book to enjoy the flight. Eventually, he settles at the gate long before anyone else, sitting quietly while watching other passengers for cues.

For Kanu, travel involves a mix of anticipation and anxiety. He values clarity, reassurance, and safety, and he tries to avoid anything uncertain.

Name:
Nakata

Age:
28

Nationality:
Japan

The Creative Adventurer

Nakata is a 28-year-old Japanese graphic design graduate who has decided to take a gap year before starting to work in his father's company. With a curious mind and a desire to gather inspiration for his future creative career, he plans to travel extensively. He sometimes flies solo, but more often than not with his girlfriend. They enjoy exploring new cultures, landscapes, and cities. He flies 5-10 times a year, usually on budget airlines and for short, flexible trips.

Nakata travels with a clear philosophy, be quick and flexible. He arrives at the airport about one to one and a half hours early, just enough to move calmly through the airport. It also limits the time he has to shop and so he avoids getting tempted to spend money. He always checks in online and carries only one backpack. He has optimized everything for efficiency: neatly packed clothes, a compact sketchbook, a tablet, and essential travel gear. Avoiding luggage fees is part of a personal challenge and part of what he considers fun about his way of traveling.

At the airport, Nakata refills his water bottle, eats simple food he prepared at home, and chooses a quiet bench next to the windows to relax and enjoy the views. Sometimes he sketches planes, people, or architecture, appreciating the small details or moments from ordinary spaces.

He has no interest in shopping or waiting in crowded areas. To Nakata, the airport is a functional transition point, not a destination. He prefers to save his energy, attention, and budget for the actual trip.

Name:
Mario

Age:
47

Nationality:
Argentina

The Enthusiastic Airport Indulger

Mario is a 47-year-old successful civil engineer from Argentina with a deep love for football and a joyful and fun personality. He travels for leisure about twice a year, often for family holidays with his wife Delfina and their son Sergio. For Mario, the holiday begins the moment he steps into the taxi and finds the airport another step of the trip. He enjoys the full adventure just as he would a football match: from start to finish.

He likes arriving around three hours early, not because he's worried, but because he wants to savor the whole experience with his family without rushing. After checking in, getting through security, and helping Delfina to settle somewhere comfortable, Mario heads straight for his favorite part of the terminal: duty-free.

There, he moves from section to section with genuine excitement. He tests colognes for him, perfumes for Delfina, and hunts for good deals to bring home. Chocolates are a must; he loves buying them as gifts for family, friends, and coworkers. He also browses electronics, books, and football-related merchandise. Even though he doesn't plan to buy everything he sees, browsing itself is part of his airport hobby.

Mario's cheerful approach to airports is part of his charm. He wanders through souvenirs and accessories, picking up items, comparing them, joking with staff, and sometimes convincing Delfina to get something "because it's vacation!"

He only heads to the gate when the final call begins echoing through the terminal (or when his wife calls him because it's time to board). Mario values shopping, fun experiences, and small indulgences, treating the airport as a part to play into the family memories ahead.

Name:
Delfina

Age:
44

Nationality:
Uruguay

The Strategic Family Navigator

Delfina is a 44-year-old Uruguayan entrepreneur with a sharp mind for business and an even sharper for keeping her family together, while managing smooth trips. She and her husband, Mario, travel twice a year with their son, Sergio. For Delfina, family travel is a full-scale operation. She approaches it with the same structure and efficiency she does to her business.

To avoid stress and unexpected delays, Delfina tries to arrive at the airport 3 to 3.5 hours early, ensuring there's plenty of time for the check-in/baggage drop-off process, security queue, buying snacks, and letting his husband enjoy the shopping experience at the airport shops. At the counter, she handles the logistics: multiple suitcases, backpacks, and Mario's extra shopping bags from previous trips. She is always responsible to double-check the tags, tickets, and documents, making sure everything is in order.

After security, Delfina chooses a strategic spot where the family can settle comfortably. These spots always have to be close to the gate, restrooms, and charging points. From there, she becomes the family's tower control. She manages snacks and activities, keeps the peace between their excited son and her distracted husband, ensures every device is fully charged for the flight, and checks the flight status on the airline app.

Delfina values organization, predictability, and minimizing chaos, turning what could be a stressful travel day into a well-managed, enjoyable family adventure. She may not treat the airport as a playground like Mario does, but thanks to her leadership, the journey feels safe, smooth, and under control. She always thanks an airport that is clear and not stressful.

Name:
Sergio

Age:
14

Nationality:
Argentina

The Digital Passenger

Sergio is a 14-year-old kid who has grown up traveling with his parents, Mario and Delfina. For him, the airport is not about shopping (although he always wants his father to buy him something) or logistics and more about having a fun time enjoying his iPad.

He always travels with his parents and, while he isn't the quietest kid, he manages long waits well thanks to his digital routine. As soon as the family settles in Delfina's carefully chosen base of operations, Sergio pulls out his iPad to dive into games, videos, or football content, which he and his father often talk about excitedly.

But what he enjoys most, and what has become a small family tradition, is doing sudokus and word puzzles with his parents. His father always challenges him with harder puzzles, while his mother teaches him to be calm and create strategies to solve any puzzle that comes his way. What Sergio loves the most is the shared focus and collaboration that this activity brings. It's one of (probably the only one) airport activities where he willingly looks up from his screen for long periods of time.

He moves through travel days with a teenager's mix of curiosity, boredom, and bursts of enthusiasm. He relies heavily on his parents, as is normal for a kid his age, for organization and timing but is becoming gradually more independent with each trip. He is excited to travel on his own in the future, where he swears, he will make use of digital technologies to travel faster.

Name:
Christian

Age:
82

Nationality:
United States

The Assisted Senior Traveler

Christian is an 82-year-old American (USA) who has continued traveling despite the loss of his wife two years ago with whom he always went everywhere with. Since then, airports feel different: emptier and quieter. Even with this feeling, he still makes an annual trip to visit his children and grandchildren. Because mobility has become challenging, he now relies fully on airport assistance services, which his family always books for him in advance.

He usually arrives 3 to 4 hours early, as is recommended by most airports. This ensures there's enough time for staff to help him comfortably and without rushing. The wheelchair attendant meets him at the entrance and guides him through check-in, security, and eventually to the gate, often using priority lanes so he never has to wait for long.

Nowadays Christian travels light, with a small, checked suitcase and a simple personal bag with his medications, glasses, and a few sentimental items. While he can no longer move around the airport independently, the journey still brings him joy. He often gets involved with fun and warm conversations with the assistant staff. They often talk about their day, the airport itself, or tips to get the best view of the runway. Their presence reassures him, turning what could be a stressful process into something safe and comfortable.

He values kindness, clarity, and patient guidance, depending on others to help him move calmly through a world that once was like a second home to him. Travel is no longer as easy as before, but it still connects him to the people he loves and that makes his new way of traveling worth it.

Name:
Hugo

Age:
49

Nationality:
Mexico

The Independent Disability Passenger

Hugo is a 49-year-old Mexican who lives in Puerto Escondido and comes from a wealthy, supportive family that has encouraged his independence despite his blindness. He travels confidently for both personal and professional reasons. This happens about 2 or 4 times per year.

Though blind, Hugo always traverses airports, whenever possible, with autonomy. He books assistance only for essential moments, such as navigating security or boarding the aircraft. He usually arrives 2–2.5 hours early. This has proven enough time to follow tactile guidance paths, listen to airport announcements, and interact with personnel when needed.

Hugo is technologically adept and relies heavily on his Iphone's accessibility features to manage boarding passes, gate updates, and airline notifications. He and his family are very grateful for the advancements airlines and airports have made in this aspect. His luggage is meticulously organized: carry-on with tactile markers, containing clothes, documents, and essential items, along with his guide dog Cuauh.

At the gate, he chooses quiet, open spaces that allow him to focus on announcements and remain aware of boarding instructions. Hugo values autonomy, clear communication, accessible infrastructure, and respectful assistance.

APPENDIX 5. ACCESIBILITY

Linate airport counts with several features meant to assist people with any kind of disabled people. Examples of these features are mechanical escalators, tactile paving, and floorplans with braille text. In this section we will be exploring all the features that can be seen in and around the airport.

Tactile paving
Tactile paving or tactile ground surface indicators (TGSI) is a system of profiled ground surface elements that are engineered to help individuals with visual impairments or blindness navigate public spaces. There are six main tactile paving tyles available: blister, hazard warning, platform edge, lozenge, shared cycle track, and directional.

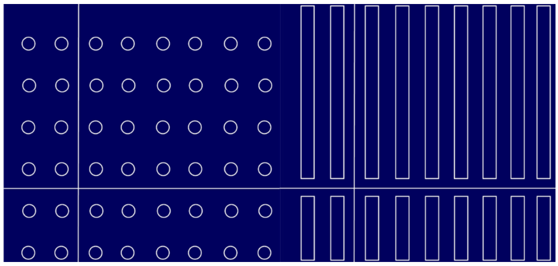
Blister
Blister tactile paving is primarily used to indicate pedestrian priority pedestrian zones as well as controlled crossings. It is conformed by raised, truncated domes arranged in a regular grid pattern. Its specific function is to indicate users that they will be entering a vehicle present space. In airports, blister tactile paving is used at terminal entrances, curb side crossings, drop-off zones, and pedestrian crossings within landside transport areas.

Hazard Warning
Hazard warning tactile paving warns users the presence of potential dangers and any change in height level. It is composed of a dense arrangement of raised domes or studs. When felt by blind users, it indicates them to either slow down, stop, or proceed with caution. In airports, this type of pavement is used at top and bottom of staircases, escalators, ramps, changes in floor height, and at private service zones.

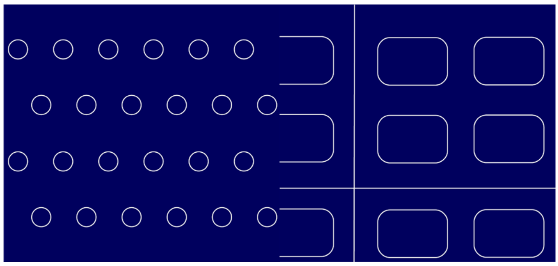
Platform Edge
Platform edge tactile paving is used, as its name suggests, along edges where the risk of falling is high. It is composed of highly detectable studs in an offset pattern. In airports, this type of paving is used in very specific uses: train tracks, automated people movers, or shuttle boarding edges.

Lozenge Tactile
Lozenge tactile paving signals decision points or key destinations. What this means is that this tyles are used to let users know they have arrived at an important location where further information or orientation is required. These tyles consist of elongated diamond or rectangular raised elements, all in a parallel direction. In airports, it's used at information desks,

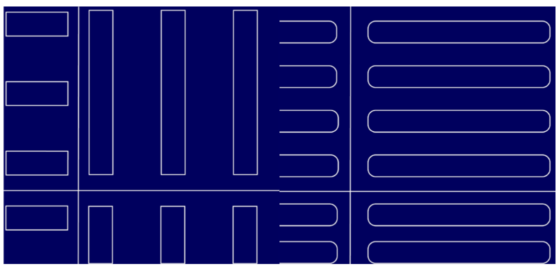
ticket counters, elevators, accessible restrooms, assistance points, security entrances, or by braille floorplan locations.



Shared Cycle Track
Shared cycle track tactile paving is designed to signal the differentiation between pedestrian areas from cycle routes. It is composed of horizontal elevated elements in a ladder-like pattern, at the bicycle lane in a parallel composition and at pedestrian lanes in a perpendicular orientation. In airports, this type of paving is not common.



Directional
Directional tactile paving is composed by parallel, raised bars aligned with the intended walking direction, which provides users with a continuous guidance. In airports, directional paving is the most common type of tactile pavement tyle seen as it is essential for guiding passengers between entrances, check-in halls, security screening, boarding gates, restrooms, transport links, and any other facility a passenger could need.



High-contrast signs

Airport signs use strong tone contrast between the background and the text and symbols. This helps people with low vision, color vision deficiency, and cognitive impairments to travel through the terminal with clear instructions, thus supporting fast orientation and reducing reliance on staff assistance, also benefiting passengers without any disabilities. A clear typography and standardized symbols are also key in achieving this objective.

Non-glare materials

Non-glare surface finishes reduce any reflections which can disorient passengers with low vision or sensory sensitivities, as well as induce stress in passengers. In airports, glaring surfaces can create mirror effects that hide obstacles, make reading of signs harder, or make changes in level difficult to visualize. Therefore, the use of matte or low-reflectance materials is key when designing a safe and non-stressful environment.

Uniform lighting

Lighting, as in most projects, is a key design choice in airports. Uniform lighting provides even illumination across floors, walls, and furniture, creating circulation paths without harsh shadows or sudden changes in brightness. In airport, this type of lighting is critical for passenger's pathfinding, reading signage, and detecting hazards such as steps or ramps.

Digital customer support and flight alerts

App-based flight alerts and digital customer support provide real-time, accessible information through text or voice-based communication. For passengers with disabilities, these systems can reduce reliance on audio announcement, signs, and staff support. In airports, digital accessibility supports the existing physical infrastructure by giving updates directly to personal devices.

Trained staff

Correctly trained staff are one of the most fundamental components of airport accessibility. Staff trained in disability awareness, communication techniques, and assistance procedures can support passengers who are blind, deaf, or have a lack of mobility. In airports, where despite good design some systems may be complex, knowledgeable staff provide flexibility and reassurance, ensuring that all passengers can travel in a comfortable way.

Wheelchair-based architecture

Wheelchair-based architecture designs spaces which include elements for wheelchair users in the design itself rather than treating accessibility as later add-ons. In airports, wheelchair-based architecture includes step-free routes, generous (not minimal) turning radii, wide corridors, lowered counters, accessible restrooms, and levelled boarding systems.

Service animal infrastructure

Service animal infrastructure is placed in airports to support passengers who rely on guide dogs or assistance animals for mobility, navigation, or medical needs. In airports, the infrastructure includes designated relief areas, water points, and clear signage. Integrating these features into terminal planning acknowledges service animals as essential mobility aids.

APPENDIX 6. SECURITY FEATURES

The average time spent through security and customs in Linate Airport is around 15 to 25 minutes, as for QSensor. From my own research following live feed from FlightQueue, the average time is about 10-15 minutes on off-peak hours and between 25-40 minutes on peak hours.

The peak hours in Linate Airport are between 5:00 - 8:00, 11:00 - 13:00, and 16:00 - 19:00. In combination with the three busiest days: Monday, Friday, and Sunday, we obtain the busiest times at the airport throughout the week.

Linate Airport uses Explosives-Detection CT-based machines (EDS-CB) in their security controls. These scanners are more advanced than their X-ray counter parts as they create detailed 3D images of luggage and automatically detect explosive materials. This feature allows passengers to keep liquids, laptops, and electronics inside their bags. Therefore, it reduces time spent preparing security trays. As a result, passenger flow is improved.

As a result of EU regulations, at both Linate Airport and Malpensa Airport (T1) it is permitted to carry liquids, aerosols and gels in individual containers with a maximum capacity of 2 Lts.

FaceBoarding
Linate Airport features the FaceBoarding system, a facial recognition system designed to speed up the security checkpoint throughout the airport. This system replaces the need to show a passport or personal identity card. The FaceBoarding system is meant for any adult with digital IDs. To activate it, the passenger needs to register for it either after checking in online or at kiosks near the check-in island 8. This system is optional for all passengers.

Centralized Security Screening Layout
Linate Airport currently uses a centralized security checkpoint configuration. This means that all passengers have to pass through one consolidated security point instead of several scattered ones. As a result, Linate airport sees two benefits: faster reallocation of staff during peak hours and improved response times to irregularities.

Fast Track

Linate Airport also provides passengers with a dedicated security lane, facilitating access to the safe zone through airport security. This service called Fast Track can be purchased online, at the airport's service desks or self-service machines. Once purchased, travelers only need to show their digital ticket and their boarding pass to security personnel at the security area in the airport. This service minimizes waiting times for passengers, but it is not possible to see any records on how much time could be saved by using it.