Kingdom of Saudi Arabia

AL HIJARAH

الهجرة

AL HIJARAH

JEDDAH KSA

INTRODUCING THE FUTURISTIC VERTIPORT
IN JEDDAH, KSA

BUILDING TOMORROW'S MOBILITY, TODAY
SUPPORTING VISION 2030

رؤية VISION 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

INTRODUCTION

VISION رؤيـــة 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

Saudi Arabia is redefining the future of mobility, infrastructure, and urban development through innovation and sustainability. Initiated under the leadership of King Salman bin Abdulaziz Al Saud and Mohammed bin Salman, the vision aims to create a vibrant society, a thriving economy, and an ambitious nation.

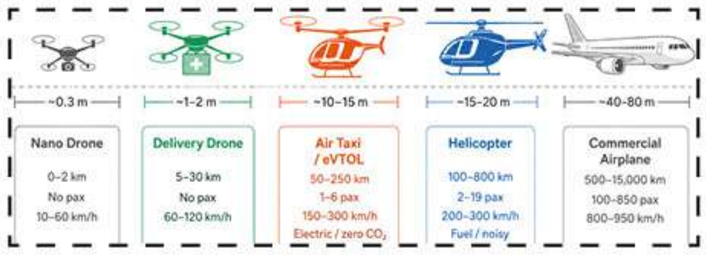
This thesis proposes a Vertiport in Jeddah as a future-ready urban air mobility hub connecting air taxis with metro, bus, and pedestrian networks. Supporting the transformation of Saudi cities into smart and globally connected destinations, the project reflects the Vision 2030 statement: "Our Vision is a strong, thriving, and stable Saudi Arabia that provides opportunities for all."

WHAT IS A VERTIPORT?

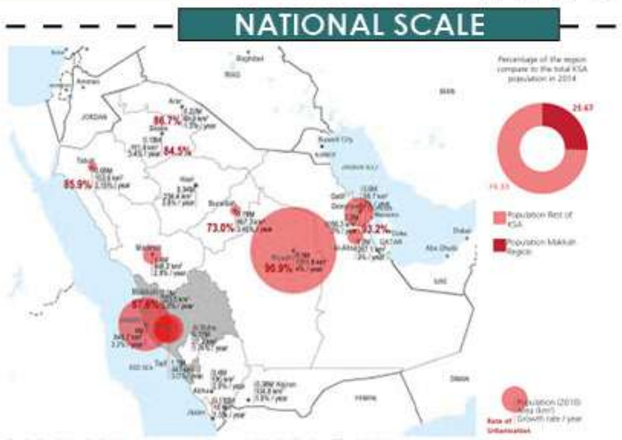
A dedicated hub for eVTOL (electric Vertical Takeoff and Landing) aircraft supporting takeoff, landing, charging, parking, and passenger handling. Classified by the FAA as a next-generation heliport integrated into urban transport networks.

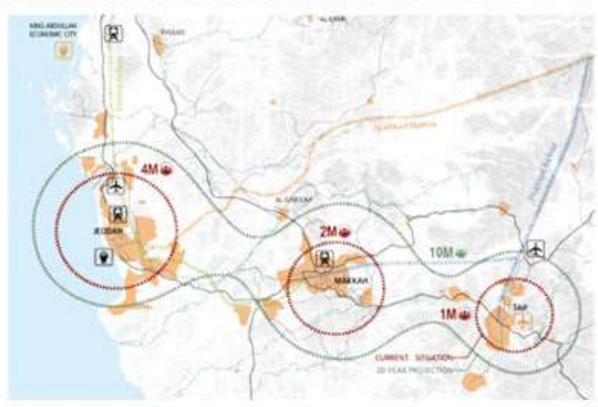
WHAT IS AN AIR TAXI?

An electric, multi-passenger eVTOL aircraft that shuttles people across urban and regional distances quietly, efficiently, and with zero emissions far cleaner and quieter than conventional helicopters.



NATIONAL SCALE





REGIONAL

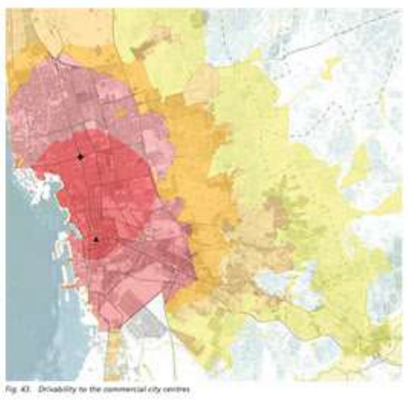


Fig. 43 : Drivability to the commercial city centres

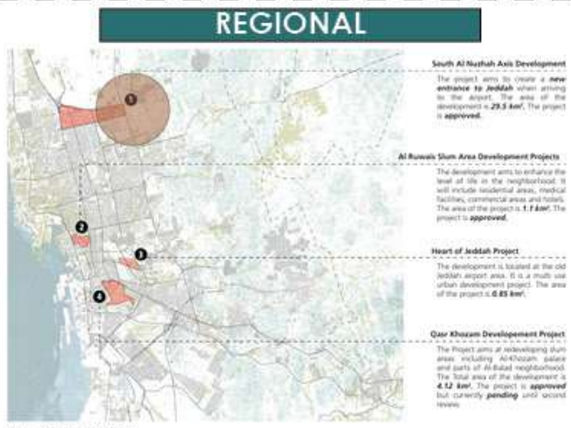
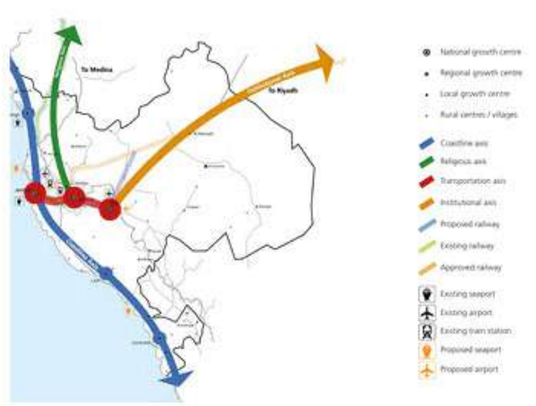


Fig. 36 : Major investment projects



POPULATION 7,664,547

POPULATION DENSITY on built-up area 41.21 p/ha

AGE PROFILE 41% < 24

POPULATION GROWTH RATE 3.2 %

Hence, the rapid population growth, increasing urban density, and rising mobility demands in Makkah Province , particularly Jeddah, demonstrate the need for future air mobility infrastructure such as vertiports and eVTOL air taxi services to reduce congestion and enhance sustainable urban connectivity. Consequently, the demographic and urban growth trends in Jeddah indicate a strong need for next-generation transportation infrastructure such as vertiports and urban air mobility services.

VISION 2030 FACTORS

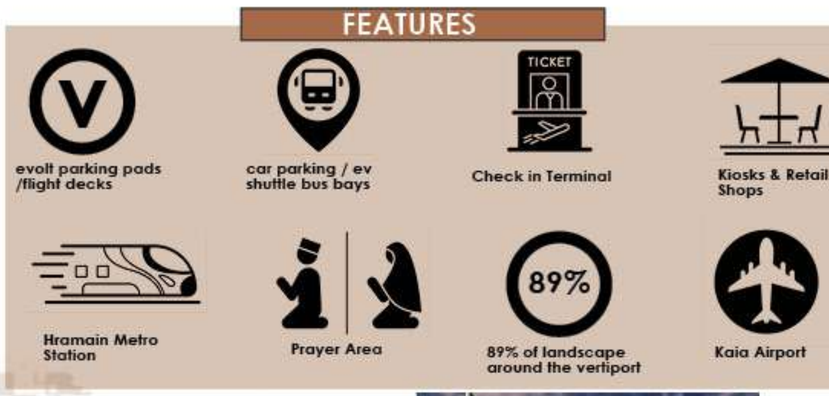
TOURISM · RENEWABLE ENERGY · TECHNOLOGY & DIGITAL · HEALTHCARE · EDUCATION · LOGISTICS & TRANSPORT · ENTERTAINMENT & CULTURE · FINANCIAL SERVICES

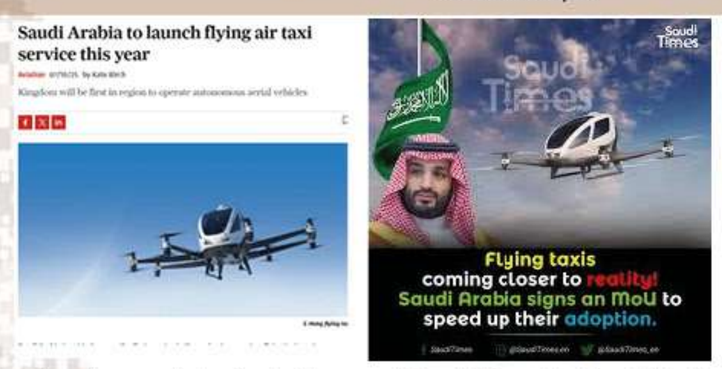
MINING & INDUSTRY · REAL ESTATE & HOUSING · AVIATION & AIR MOBILITY · SPORTS · SUSTAINABILITY & ENVIRONMENT · WATER & FOOD SECURITY · DEFENCE & SECURITY · SMART CITIES & URBAN DEV

WHY VERTIPORT NECESSARY

- **Eve Air Mobility × Flynas (2023) -** Confirmed eVTOL operations planned for Jeddah from 2028
- **UrbanV × Cluster2** - Active vertiport network development across Saudi Arabia under Vision 2030
- **$38B Industry** - Saudi Arabia identified as regional AAM leader by US aerospace delegation to Jeddah & Riyadh
- **2034 FIFA World Cup** - Accelerates demand for futuristic, high-capacity urban mobility in Saudi cities
- **Hajj & Umrah** - 20M+ annual pilgrims create critical need to decongest ground transport around KAIA

FEATURES





According to reports by Arab News and Saudi Gazette, Saudi Arabia is actively exploring advanced air mobility and eVTOL transportation systems as part of its future smart mobility and Vision 2030 initiatives.

Passengers · Employees · Visitors

USERS

LINKING ALL KIND OF TRANSPORT

sources :unhabitat,Vertiport guidelines ,Saudi Times,Saudi Gazette

SYNOPSIS

AIM

This research aims to design an air mobility hub and vertiport in Saudi Arabia that integrates with existing urban transport networks to enhance regional connectivity, reduce congestion, and advance sustainable mobility in alignment with Vision 2030.

OBJECTIVES

The study analyzes global vertiport precedents to define best practices for safety,passenger flow, eVTOL operations, and multimodal integration. It explores climate-responsive materials and energy-efficient technologies suited to Saudi Arabia's desertenvironment, addresses local regulatory and environmental challenges using international AAM standards, and develops spatial and user experience strategies that activate the hub as a civic and commercial destination.

SCOPE

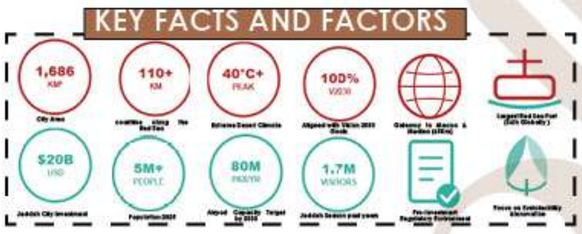
The project envisions a next-generation air mobility hub in Saudi Arabia supporting eVTOL passenger services, emergency flights, and urban freight while reducing congestion and advancing Vision 2030. It encompasses vertiport terminal design, ground transit integration, commercial and public spaces, intermodal connectors, and embedded sustainability principles including passive climate design and renewable energy.

LIMITATIONS

No mature eVTOL vertiport exists at commercial scale, so the design relies on emerging pilots rather than proven precedents. User acceptance data for aerial mobility in a Saudi context remains limited, and the region's extreme climate poses unresolved material and energy challenges.

METHODOLOGY

KEY FACTS AND FACTORS



SITE LOCATION

Al-Nuzhah District is located in the northern part of Jeddah, within Makkah Province in the Kingdom of Saudi Arabia, and is situated near King Abdulaziz International Airport and major urban transportation corridors.

وزارة النقل
TRANSPORT MINISTRY

Makkah Province, particularly Jeddah, has strong potential for future urban air mobility due to its strategic location, rapid urban growth, major transport infrastructure, and proximity to King Abdulaziz International Airport.
As a gateway for tourism, business, and pilgrimage, the region supports future mobility systems such as vertiports and eVTOL air taxis to improve connectivity, reduce congestion, and support sustainable urban development.

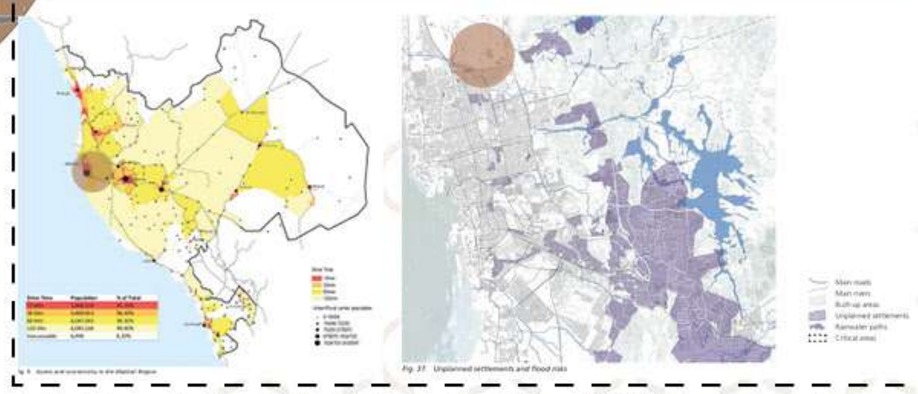


Fig. 9 : Routes and connectivity in the Makkah Region

Fig. 37 : Unplanned settlements and flood risks

Jeddah, home to King Abdulaziz International Airport (KAIA), is a major gateway for Hajj, Umrah, tourism, and business travel, handling over 40 million passengers annually amid rapid urban growth.
With the population projected to reach approximately 7+ million by 2030 and KAIA expanding toward 114 million passengers annually, the site holds strong potential for a vertiport hub aligned with Saudi Vision 2030 and future Advanced Air Mobility (AAM) development.

Its strategic connectivity through airport infrastructure, metro networks, Haramain rail, and major highways supports the integration of eVTOL air taxi systems to reduce congestion and enhance regional mobility.

REDUCED TRAFFIC CONGESTION · REDUCED TRAVEL TIME · SUSTAINABILITY · COST COMPETIVE

Air taxis can significantly reduce the problem of traffic congestion. More efficient and emit less carbon. Will be cost competitive with on-road services. Reduce travel time.

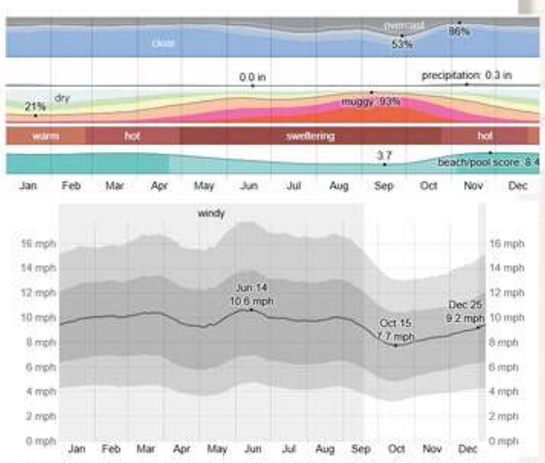
LOCATION

Location : Airport Buffer Zone, Al Nuzha District, Jeddah, Makkah Province, Kingdom of Saudi Arabia
Site Area : 62.5 Acres (252928.5 sqm)
Coordinates : 21°40'58"N 39°12'03"E
Set Backs : Front : 5 metres , Sides/Rear :2 metres

TOPOGRAPHY AND SOIL

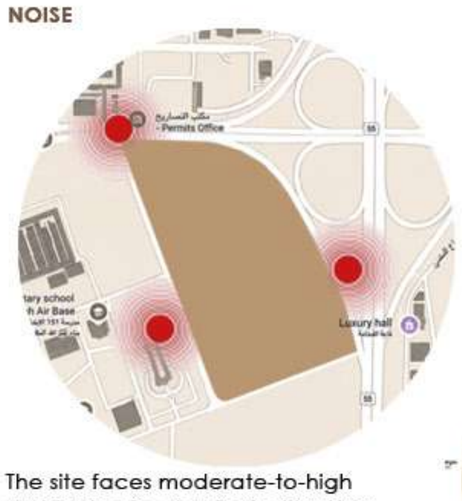
- Gently sloping terrain descends from a 10 m high point to nearly flat land, minimizing cut-and-fill requirements.
- Surface soil comprises loose aeolian quartz sand (0–2 m depth) with low cohesion.
- Deep pile foundations (15–30 m) are recommended to support vertiport thrust loads and heavy structures.

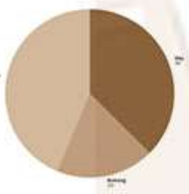
CLIMATE AND WIND



- Jeddah has a hot-arid climate with summer highs of 39°C, winter lows of 18°C, and low annual rainfall (~50 mm).
- Optimal vertiport operations occur from November–April.
- Average wind speeds range from 7.9–10.4 mph, predominantly from the north and northwest.
- N–S oriented pads utilize prevailing NW winds for safer aircraft approaches.

NOISE





The site faces moderate-to-high ambient noise dominated by Hwy 60/40 traffic reaching 68-75 dBA Leq daytime from trucks and vehicles 100-500m away, while industrial zones 52-62 dBA with intermittent peaks Design features: Install 4-6m absorptive concrete noise barriers along high; use double-glazed terminal facades green roofs to achieve indoor levels

LANDSCAPING

Jeddah Municipality (Nuzha Road guidelines) recommends drought-tolerant natives for highway sites.

DATE PALM

BOUGAINVILLEA

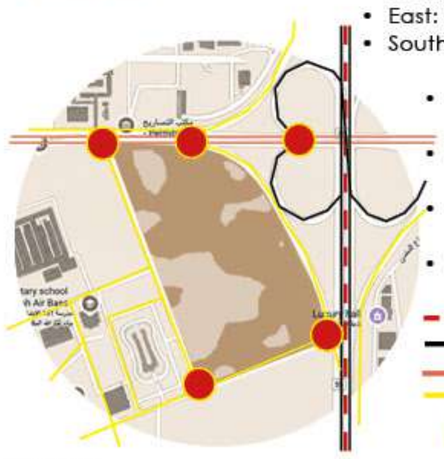
LANTANA

BUTTONWOOD

ACACIA

WASHINGTONIA PALM

ACCESIBILITY

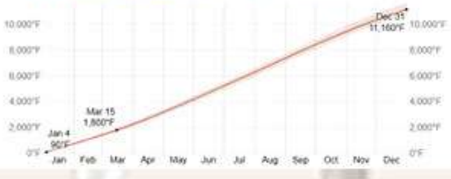


- North: Rail line (5.5m height)
- East: Hwy 40 & primary access road
- South/West: Service roads

- **Primary roads:** Abuts Airport Road (Hwy 60)
- **Buses:** SAPTCO stops along Airport Rd (every 15 min to KAIA)
- **Rail:** Haramain HSR King Abdullah station
- **Airport:** KAIA 2.5km

Rail
Highway Road
Secondary road
Service Road
Nodes

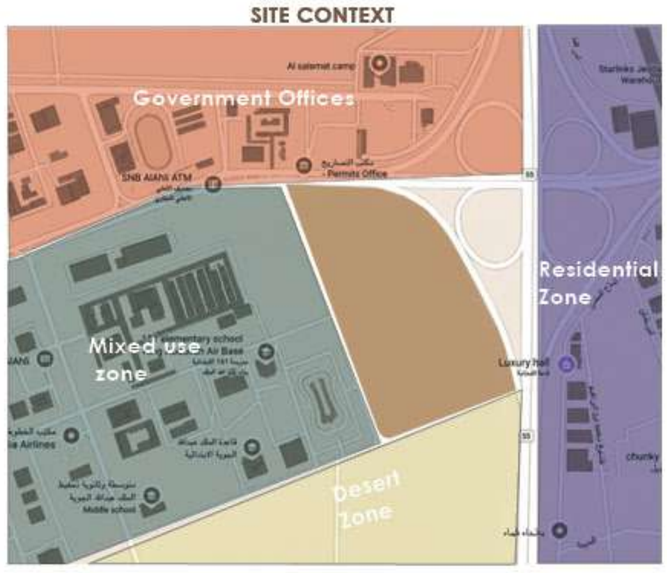
SUNPATH



- Jeddah's sun path ranges from 120°E in winter to 290°W in summer, with ~10 hours of daily solar exposure.
- Flat terrain provides minimal shading; southwest pads face strong afternoon glare.
- South and west edges receive extreme summer heat (>45°C), while northern zones remain cooler.

- **Design Inference :**N–S pad orientation minimizes SE/SW glare during landing.
- 2.5 m south overhangs provide summer shading and winter solar gain.
- High-albedo TLOF concrete reduces pavement heat by ~15°C and improves skid resistance.
- E/W perforated brise-soleil block low-angle sun while enhancing ventilation.

SITE CONTEXT



BUS / TRAIN ROUTES

DRAINAGE

The site is characterized by flat, desert topography While existing natural sheet drainage flows toward southwest with no evidence of established channels or standing water the area remains vulnerable. Despite low annual rainfall (50mm/year), the site faces significant flash flood risks from distant during extreme weather events.

MACRO ZONING

Scale:1:5000

STRENGTH

- Road on all 4 sides of the site.
- Metro line adjascent to the side boundary improves accessibility to site.
- Direct Hwy 60/40 access improves passenger flow
- Easy vehicular and pedestrian movement around the site
- Proximity to metro line increases connectivity.

WEAKNESS

- Highway noise 70+ dBA exceeds SBC limits.
- Flash flood risk from wadis despite low rain.
- Sparse vegetation needs xeriscape import.

OPPORTUNITY

- Extend future metro/Haramain line into SE zone.
- Vision 2030 AAM hub leverages Hajj demand.
- Existing Metro line can be extended and incorporated intothe project.
- Govemment proposals for Model improve public amenities around the site.
- Close proximity to major cities that can be possibly be connected using modular flight deck design.

THREATS

- High rise Buildings in the close proximity would interrupt the take-off and landing activities
- Distribution tower proximity restricts public access.
- Hajj traffic surges overload interchanges.

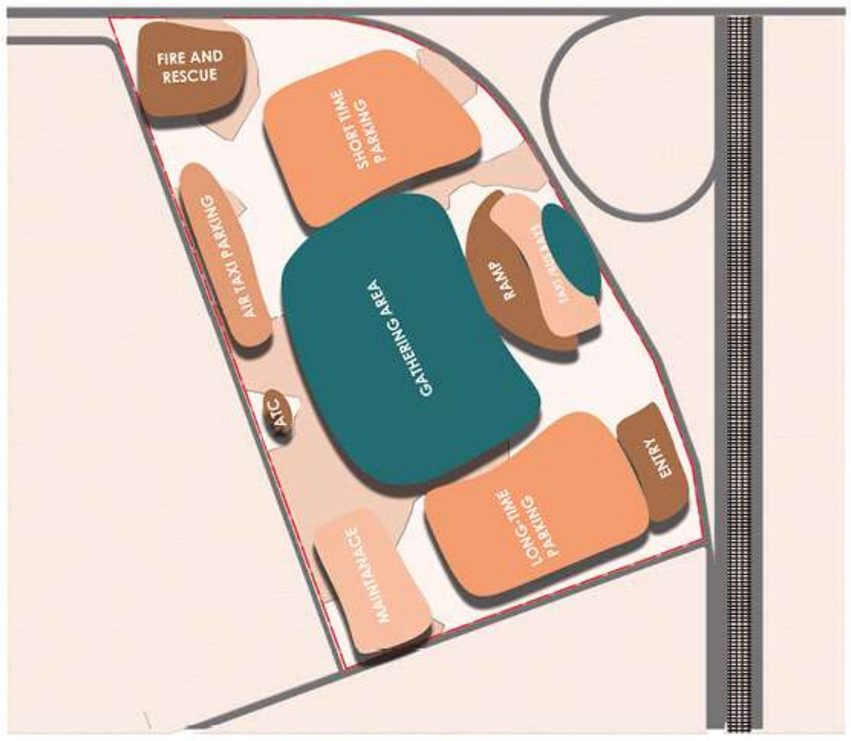
INFERENCE

- Friction pile foundations can be adopted for the construction.
- Increased green spaces enhance liveliness across the site.
- Efficient connectivity is provided to all major nodes.
- High-intensity spaces are oriented in the direction of prevailing winds.
- A well-planned drainage system ensures effective water management.
- An organized parking system supports smooth vehicular movement.

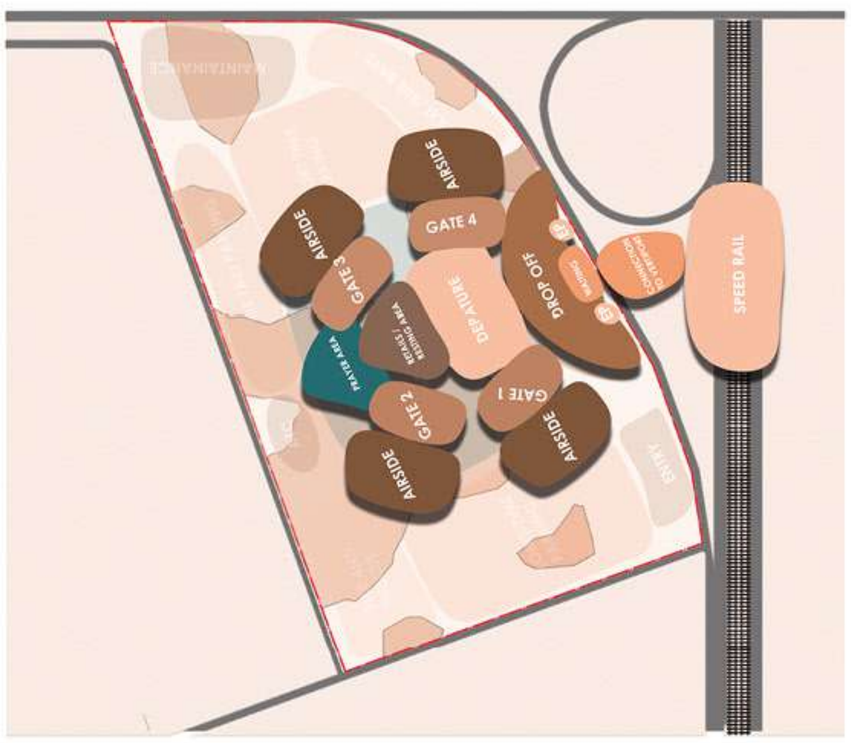
Sectional View

Souther side

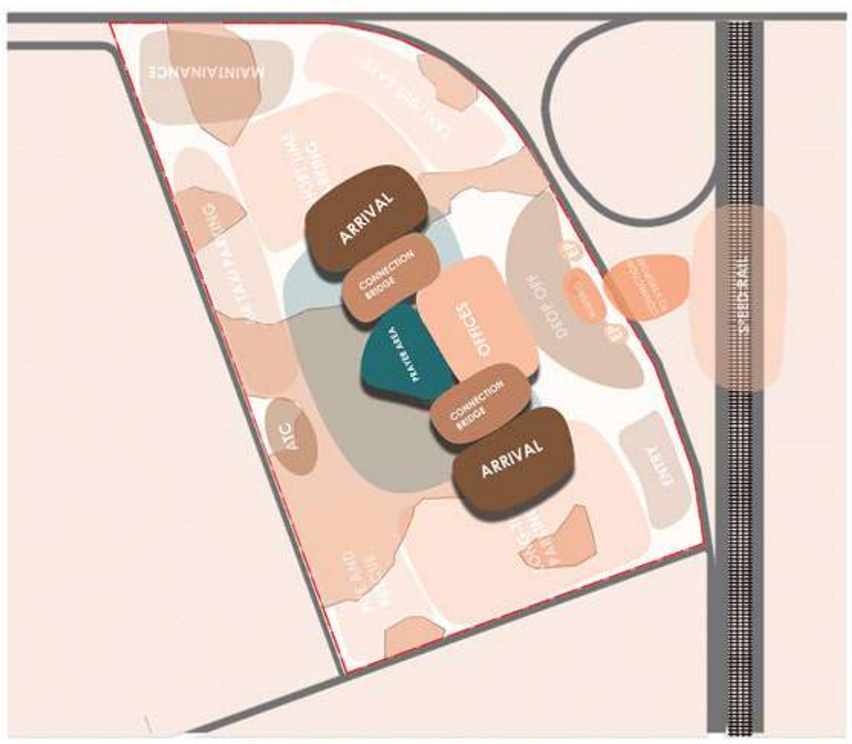
ZONING



GROUND FLOOR



FIRST FLOOR

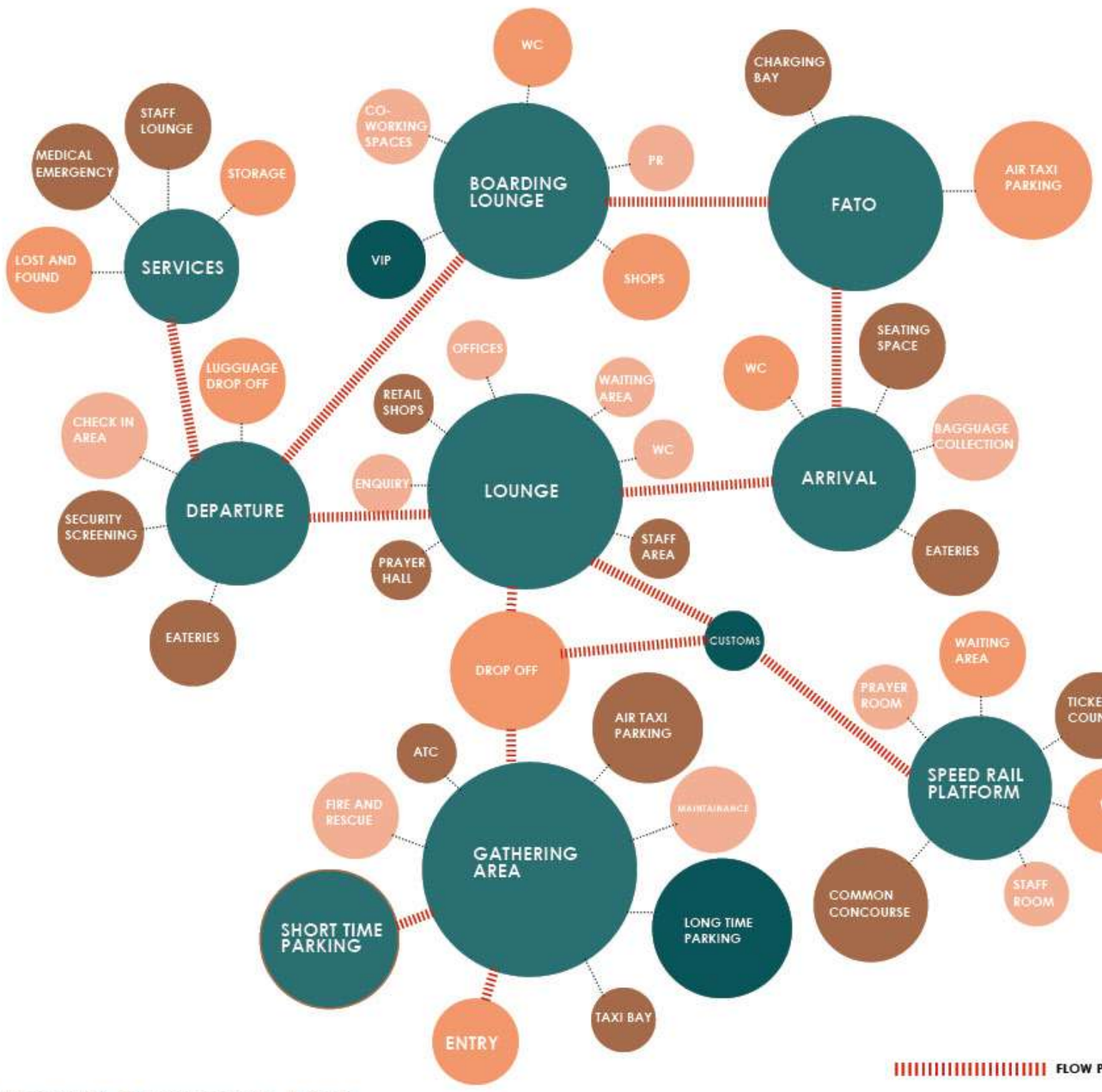


SECOND FLOOR

PROXIMITY CHART

	Arrival Lobby / Concourse	Drop-off / Pick-up	Parking (Short + Long)	Security Screening	Departure Lounge	Boarding Lounge	Gates (1A–4B)	Transfer Corridor (Rail)	Speed Rail Station	ATC Tower	Fire & Rescue	Maintenance / Storage	Offices	Retail / Café	Garden / Gathering	Medical / Emergency	Service Road / BOH
Arrival Lobby / Concourse		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Drop-off / Pick-up	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Parking (Short + Long)	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■
Security Screening	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Departure Lounge	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■
Boarding Lounge	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■
Gates (1A–4B)	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■
Transfer Corridor (Rail)	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■
Speed Rail Station	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■
ATC Tower	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
Fire & Rescue	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■
Maintenance / Storage	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■
Offices	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■
Retail / Café	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Garden / Gathering	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■
Medical / Emergency	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Service Road / BOH	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

BUBBLE DIAGRAM



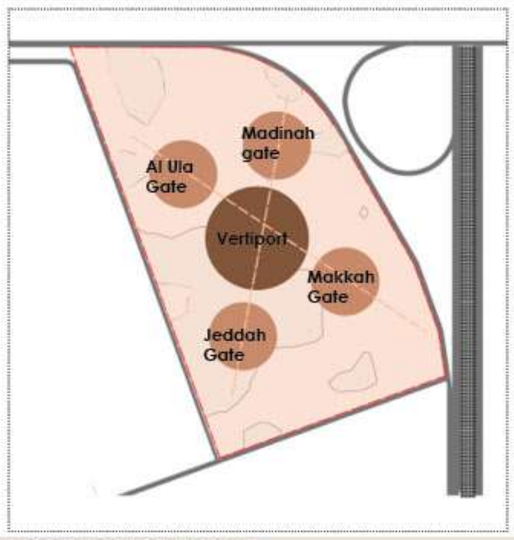
CONCEPT-DESERT OASIS

Inspired by the desert oasis, the vertiport is envisioned as a calm refuge within Jeddah's hot-arid environment — a place where shade, greenery, water, and movement come together to create comfort and orientation.

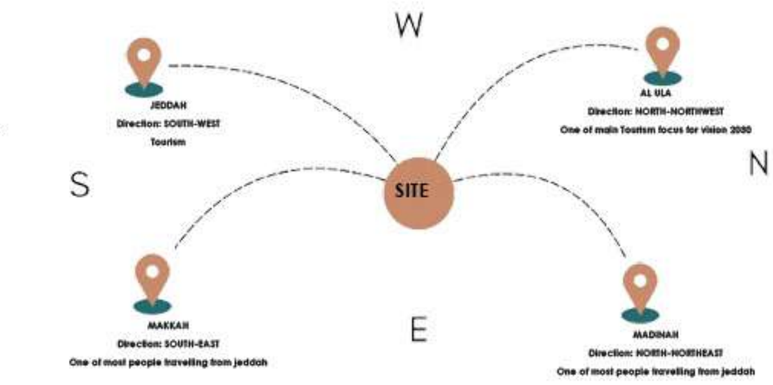
PASSENGER EXPERIENCE & CULTURAL IDENTITY

- Air-taxi passengers often experience anxiety, waiting delays, and rapid mode shifts
- This environment slows movement, reduces stress, and improves comfort and wayfinding
- Visual connection to landscapes creates clarity, orientation, and calm
- The vertiport reads as a place of calm not a machine building
- The oasis concept reflects Saudi cultural identity, drawing from:
- Islamic courtyards
- Najdi and Hijazi urban forms

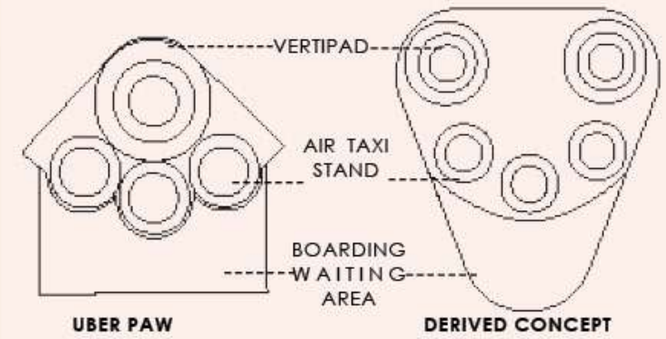
ORIENTATION OF THE VERTIPADS



It also enhances safety through clearer wayfinding and passenger flow segregation, shortens turn around times, minimizes noise concentration in one area, and
allows future expansion without disrupting existing operations

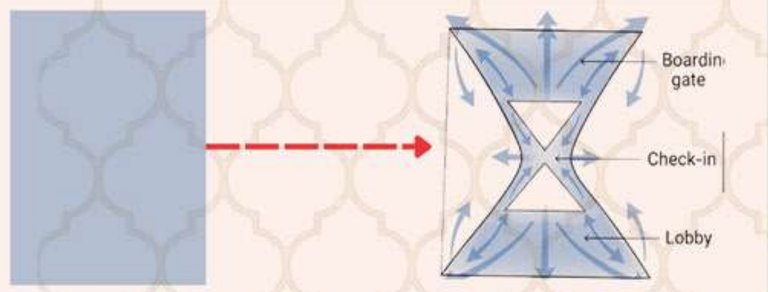


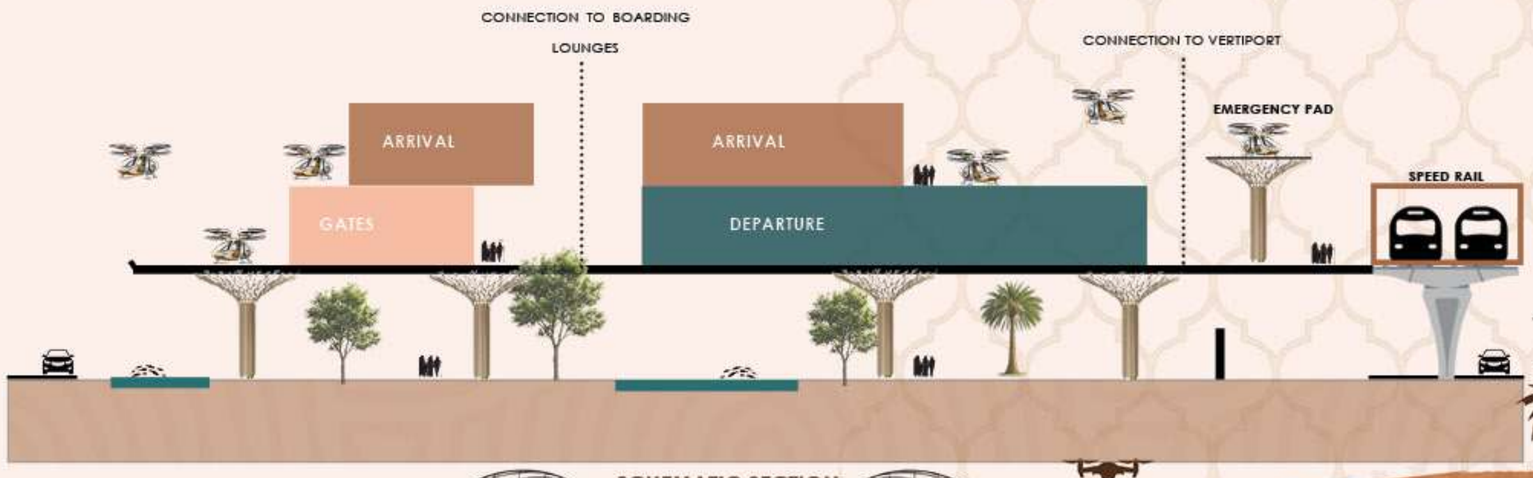
FORMATION OF LAYOUT



The vertiport design creates a comfortable environment for passengers in a hot-arid climate. Planning and circulation follow Uber Skyport guidelines, with efficient vertipad arrangement and passenger flow. The design maximizes green and open spaces while minimizing the platform footprint to enhance comfort and overall passenger experience.

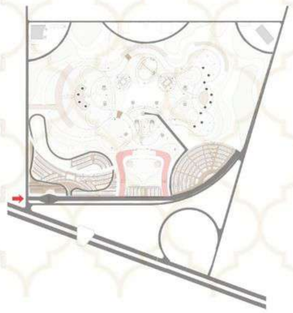
The vertipad is divided into four pads aligned with primary destinations, each oriented to its flight path for safe and conflict-free operations. This separation improves air traffic management, reduces passenger congestion, and enhances operational flexibility, allowing independent pad use during peak hours or maintenance to minimize delays.



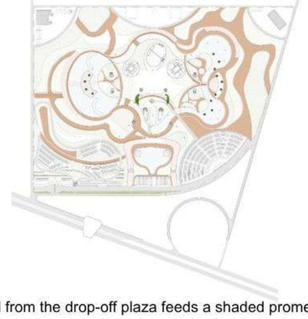


SCHEMATIC SECTION

SITE DEVELOPMENT



The highway is diverted at the site boundary, feeding a single entry point with a securitycheckpoint. From here, traffic branches to a dedicated services road, a passenger drop-offzone at the terminal, and a car park separating vehicular, service, and public flows.



Arrival from the drop-off plaza feeds a shaded promenade spine that leads directly to theterminal entry. Secondary pedestrian loops branch off toward the public park, amphitheatre,and waterfront creating a clear hierarchy loop from arrival to dispersal.

The butterfly-wing lattice shell forms the primary roof, its open woven geometry referencing Islamic mashrabiya screens while allowing energy storage in Jeddah's climate. A structural central spine anchors the tower; canopy wings extend to shade outdoor arrival zones

Concentric landscape rings frame the terminal a palm buffer at the perimeter screenshighway noise, a central green lawn with a stepped amphitheatre defines the public realm,and reflective pools linking the two wings cool the microclimate and signal arrival.

LEGENDS

1:Long Term Parking
2:Short Time Parking
3:Taxi Parking
4:Gathering Graden
5:Bio pond
6:Mosque
7:Maintainance Workshop
8:Fire and Rescue
9:Atc Tower
10:Logistics
11:Mushroom Column
12:Emergency Vertipad
13:Water Curtain

PROJECT DETAILS

(191.82 acres built , 193.78 extension for future)
Setback :5m Every side
Total Built : 10.84%
landscape : 89.16%
Total Height of Vertiport :26m

Project Type : Air Mobility Hub
Site : Jeddah, Saudi Arabia
Site Area : 385.6 acres

SCALE1:2000

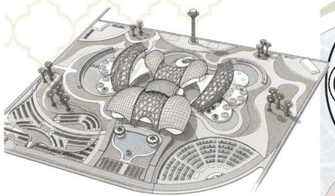
HIJRAH
INTRODUCING VERTIPORT IN JEDDAH, KSA

RISVANA.R BGAVEBC019 S10

MASTERPLAN
GLOBAL INSTITUTE OF ARCHITECTURE

FORM DEVELOPMENT

Final form — Hijrah Vertiport
Cardinal orientation · Pinched check-in · Curved heat-deflecting wings · Bridge passages



06 BRIDGES CONNECTION & EXPERIENCE

Bridges connect each wing backto the main terminal body — creating an elevated, distinctpassage that offers a visualand spatial experience in transit.

04 CURVED WINGS AT FOUR CORNERS

Four curved wings extend to each corner housing private programme away from the public zone. Curved outward, each wing deflects solar heat to the sides, reducing thermal gain on façades.

03 EXPANDED PUBLIC ZONES

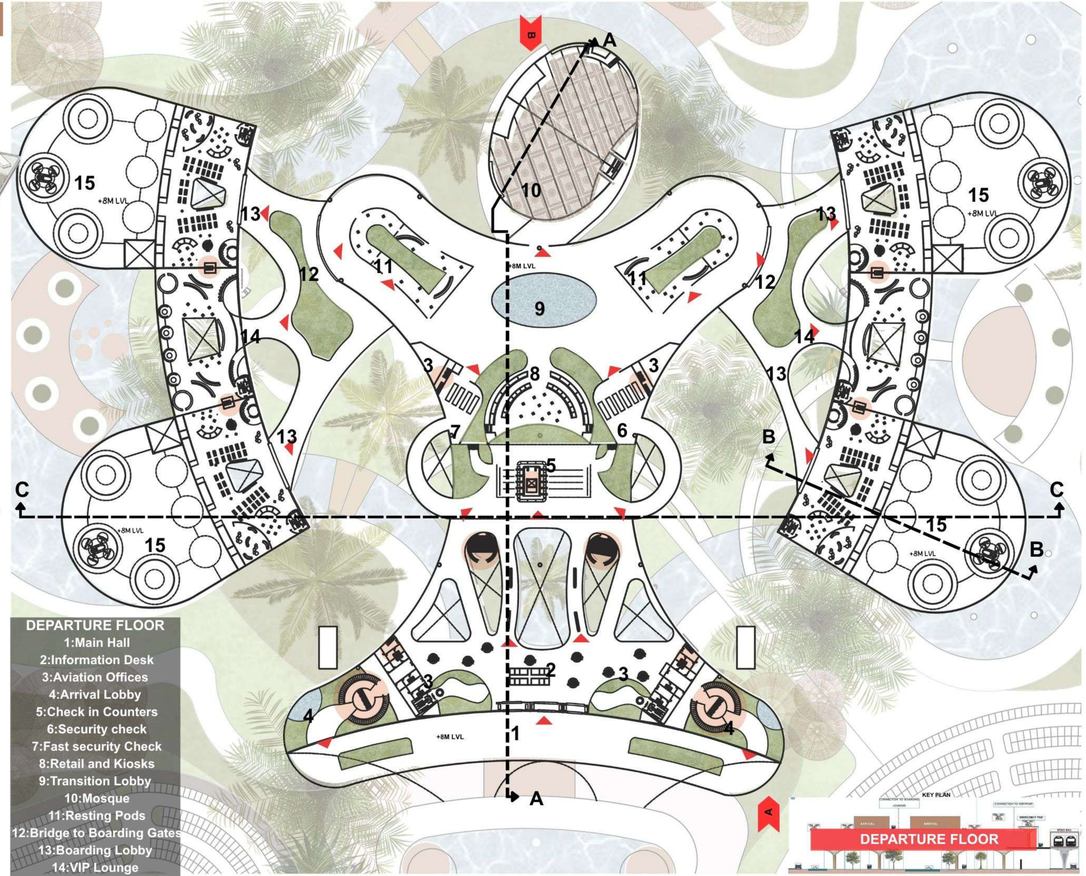
Top (departure) and bottom(arrival) zones widen out the wider form creates focus toward the narrow check-in, guiding the passenger sequence.

02 COMPRESSION AT CENTRE

The transitional zone check-in and security is pinched inward, drawing the eye and directing movement.

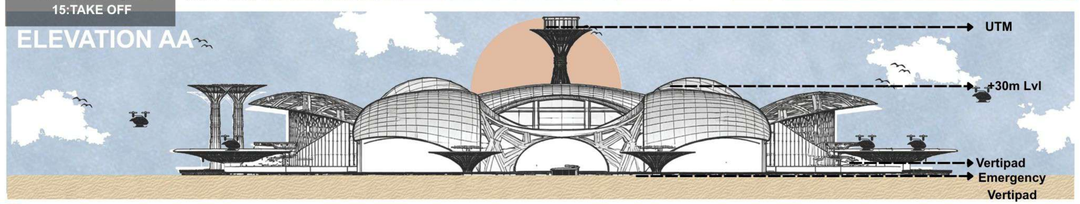
01 SQUARE BASE

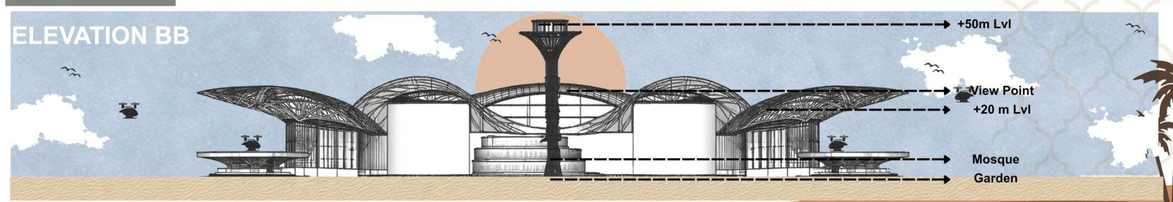
The form originates froma pure square establishinga neutral, grounded footprint.



DEPARTURE FLOOR
1:Main Hall
2:Information Desk
3:Aviation Offices
4:Arrival Lobby
5:Check in Counters
6:Security check
7:Fast security Check
8:Retail and Kiosks
9:Transition Lobby
10:Mosque
11:Resting Pods
12:Bridge to Boarding Gates
13:Boarding Lobby
14:VIP Lounge
15:TAKE OFF

ARRIVAL FLOOR
16:Arrival Gate
17:Sim and Taxi Services
18:Mep Rooms
19:Resting Lounge
20:Bridge to Arrival Lobby





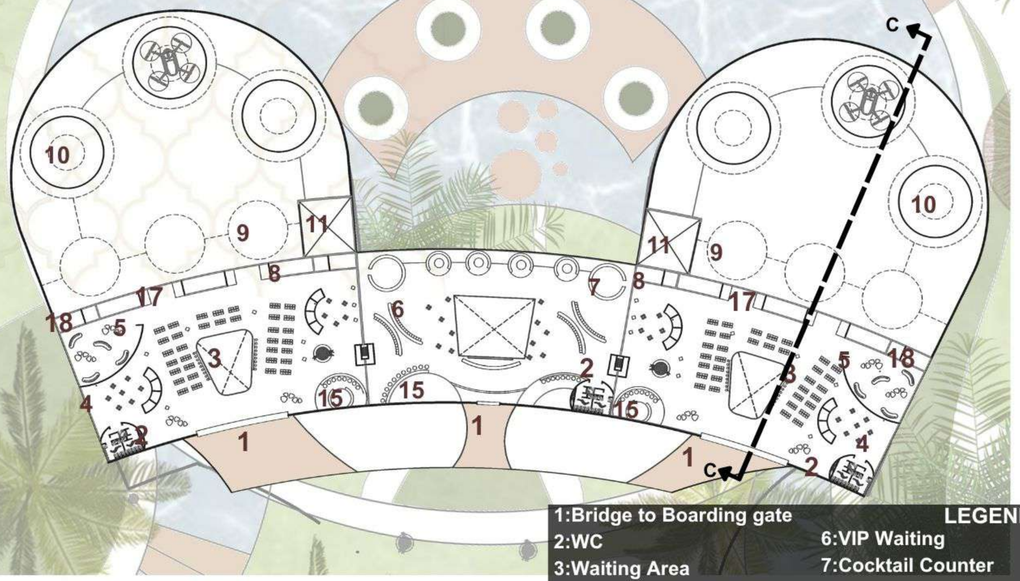
SCALE 1 :1000

HIJRAH
INTRODUCING VERTIPORT IN JEDDAH, KSA

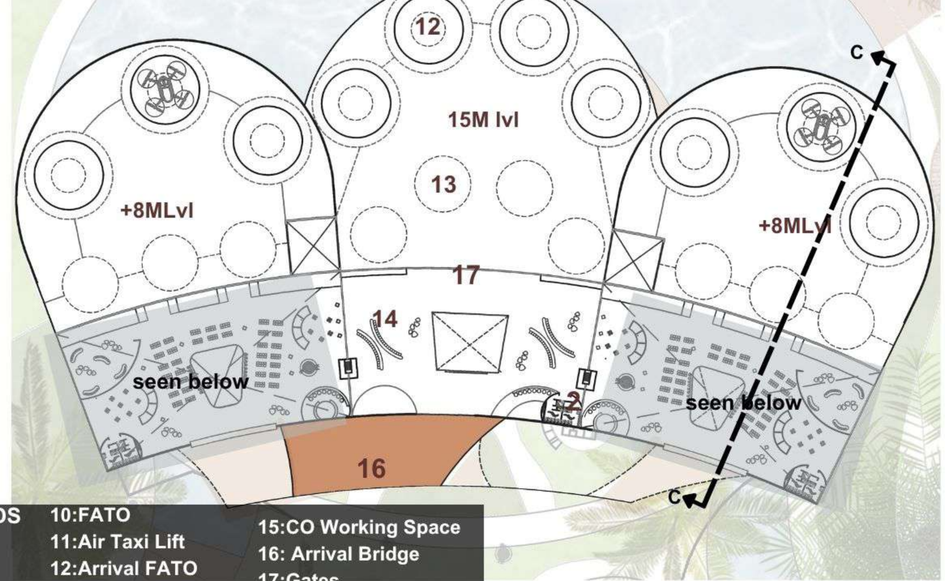
FLOOR PLANS
GLOBAL INSTITUTE OF ARCHITECTURE

RISVANA.R
BGAVEBC019
S10

DEPARTURE LOBBY



ARRIVAL LOBBY

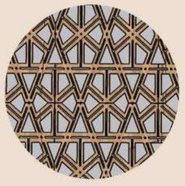


LEGENDS

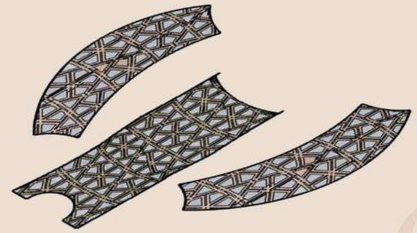
1:Bridge to Boarding gate
2:WC
3:Waiting Area
:Kiosks
5:Pilots Waitings
6:VIP Waiting
7:Cocktail Counter
8:Charging Bay
9:Air Taxi Parking
10:FATO
11:Air Taxi Lift
12:Arrival FATO
13:Arrival Parking
14:Reating Area
15:CO Working Space
16: Arrival Bridge
17:Gates
18:Staff Area

HYBRID ROOF

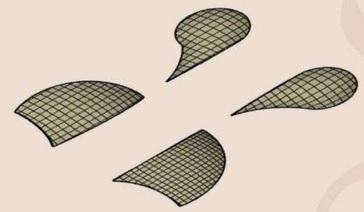
MASHRABIYA TESSELLATION



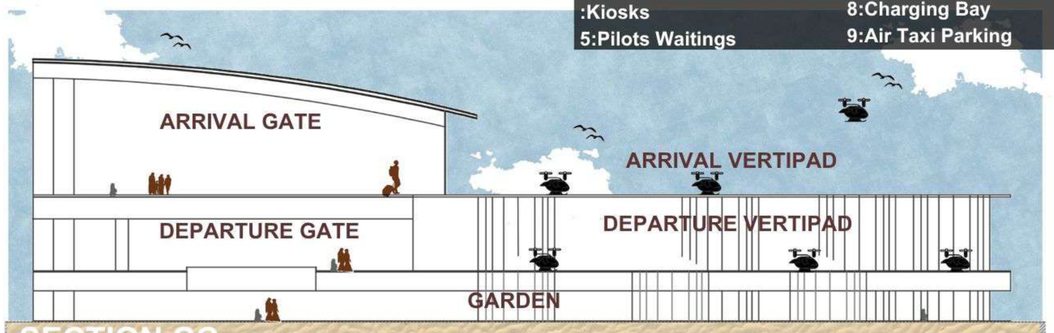
repeating geometric lattice to distribute shear and pressure loads evenly across the roof, enhancing structural stability and minimizing deformation through a design that is both engineered for performance and culturally resonant.



Solar Fabric Semi-transparent textiles integrated with PV cells to generate clean electricity.

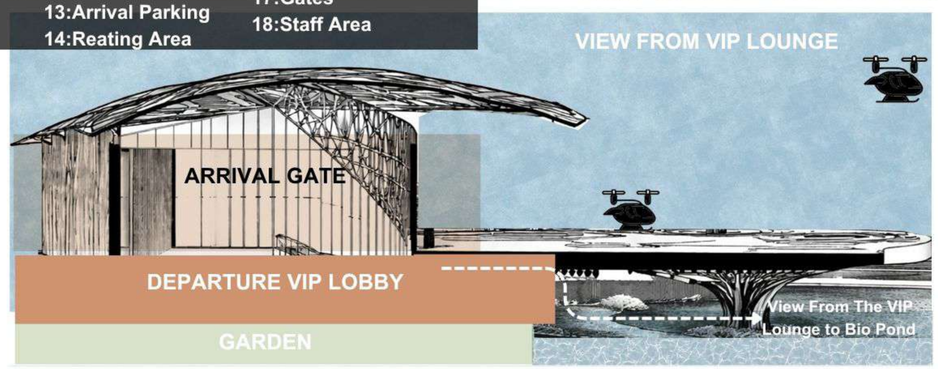


Sorption-based atmospheric water harvesting utilizes hydrophilic mesh or radiative cooling surfaces to efficiently extract moisture from the air.

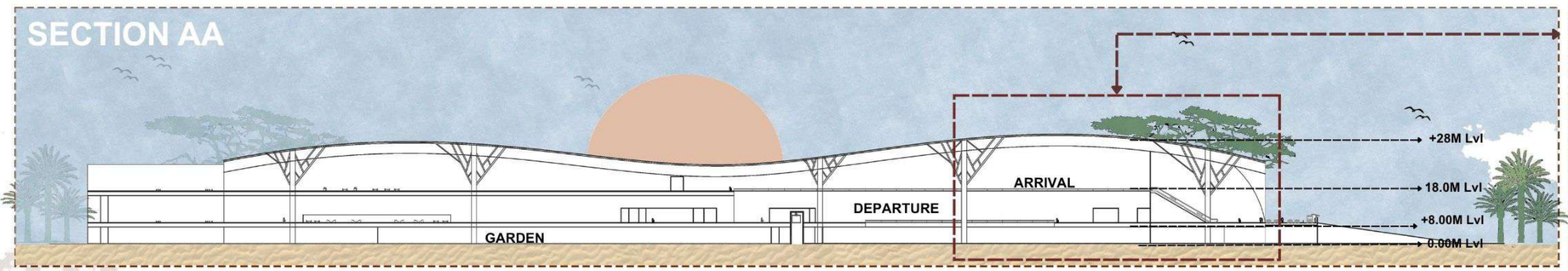


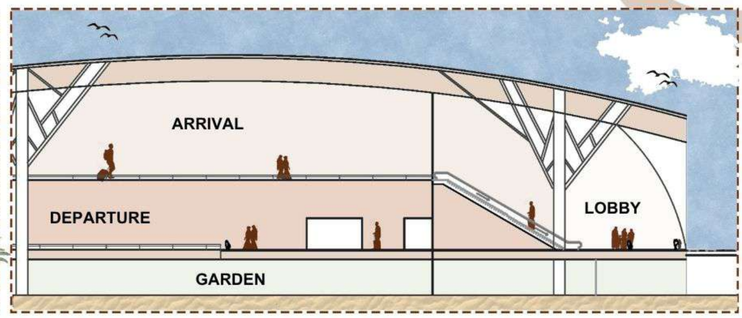
SECTION CC

VIEW FROM VIP LOUNGE



SECTION AA





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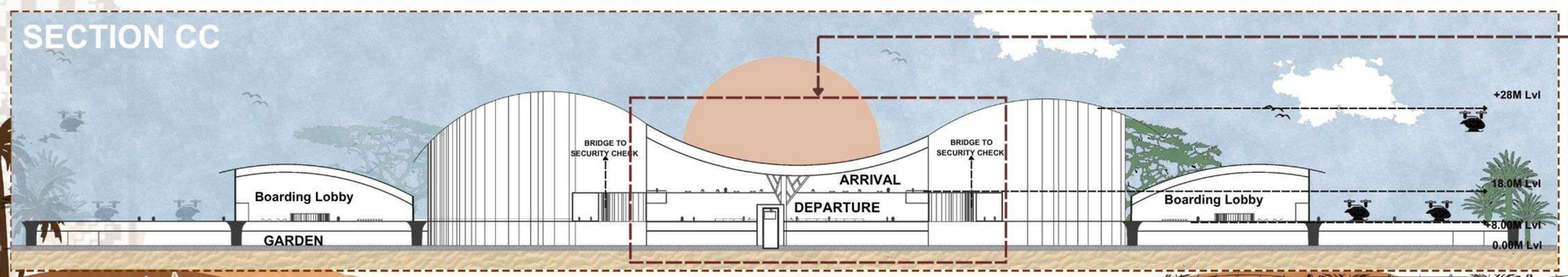

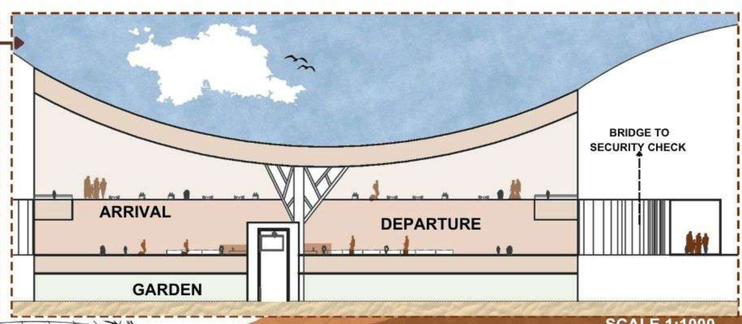

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BOARDING GATES /SECTIONS

SCALE 1:1000

LEGEND

- Date Palm (Phoenix dactylifera)
- Umbrella Thorn Acacia (Vachellia tortilis)
- Ghaf Tree (Prosopis cineraria)
- Mushroom Column

SCALE:1:3000

Local trees provide a sandstorm defense and a distinct Arabian identity. A Bio Pond filters stormwater while creating a serene focal point. The Water Curtain cools the site and serves as a Ramadan light feature. Shaded canopies offer a flexible space for community gatherings and passengers. Together, these features create a resilient, culturally rich public destination.

The Water Curtain cools Jeddah's intense climate while creating a soothing, multisensory arrival experience through the gentle movement and sound of flowing water. By day, it provides a refreshing microclimate that enhances pedestrian comfort and encourages moments of pause, reflection, and social interaction. By night, it transforms into an illuminated landmark for Ramadan gatherings, blending functional climate control with cultural elegance and spiritual ambiance. The dynamic interplay of light, water, and architecture establishes the space as both a memorable civic destination and a serene environment for community connection.

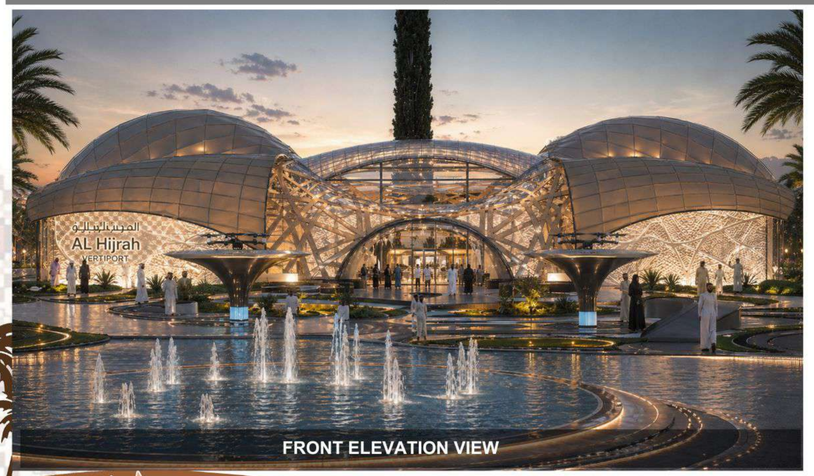
A serene mosque precinct embraced by tranquil water features and graceful water curtains, creating a peaceful and immersive atmosphere that encourages meditation, reflection, and prayer. The gentle sound and movement of water enhance the spiritual character of the space, offering visitors a calming sanctuary for contemplation and community gathering.

A welcoming waterfront promenade defined by sculptural mushroom-shaped columns, designed as a comfortable and family-oriented gathering space for all ages. The shaded pathways and calming waterside setting create an inviting environment where children can play freely while families relax, socialize, and enjoy moments of joy, comfort, and tranquility together.

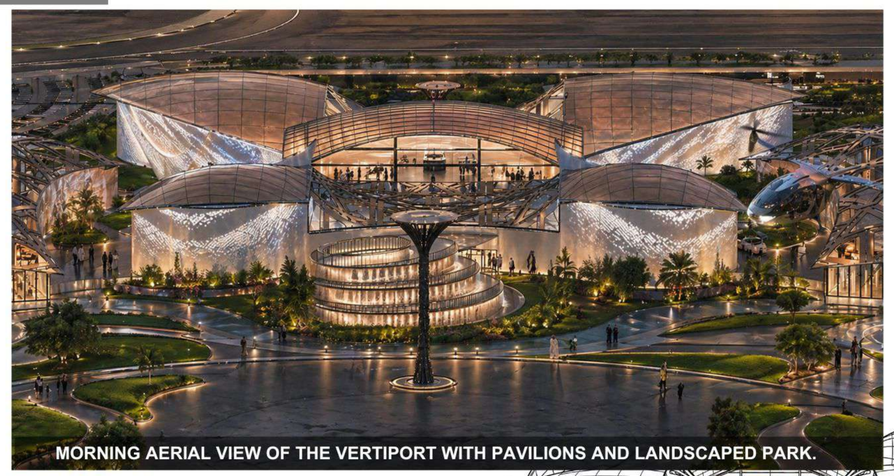
GROUND FLOOR WITH WATER CURTAIN

VIEW OF DEPARTURE CHECK IN BRIDGE TO SECURITY CHECK

DEPARTURE CHECK IN AREA

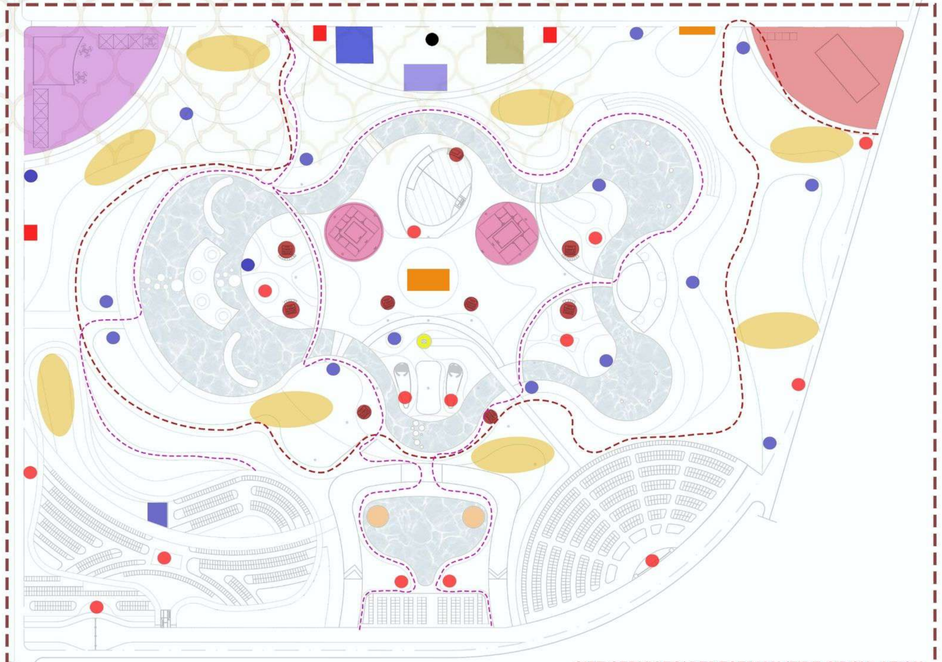


FRONT ELEVATION VIEW

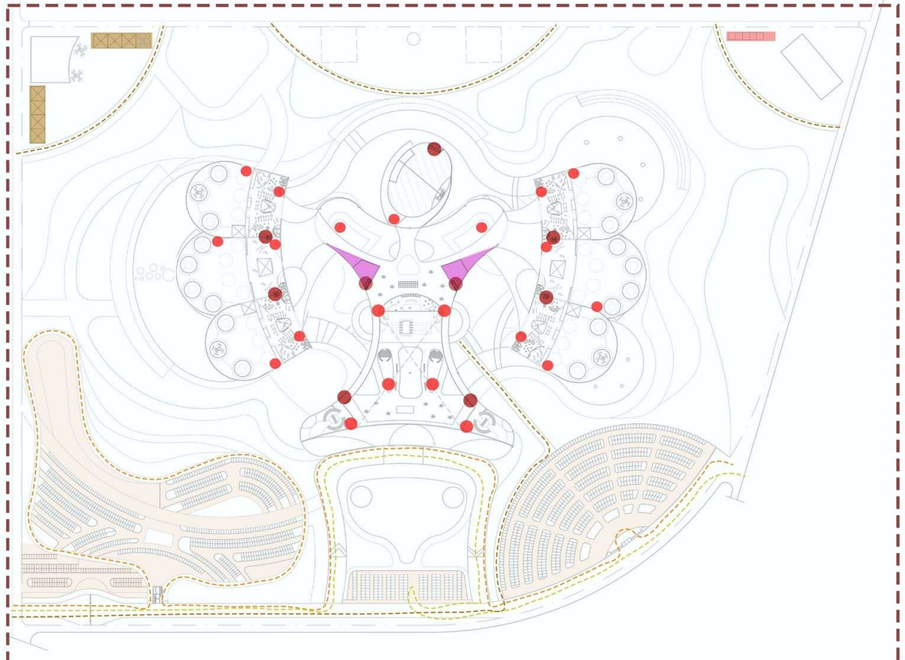


MORNING AERIAL VIEW OF THE VERTIPORT WITH PAVILIONS AND LANDSCAPED PARK.

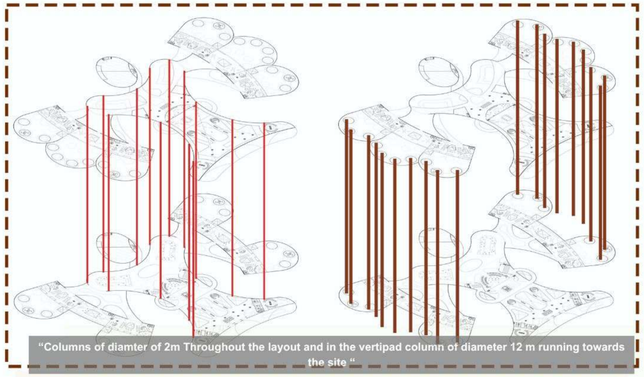
VIEW OF DEPARTURE AND ARRIVAL VERTIPAD WITH WATER CURTAIN IN GROUND



SITE SERVICES/ PEDESTRIAN /FIRE CIRCULATION

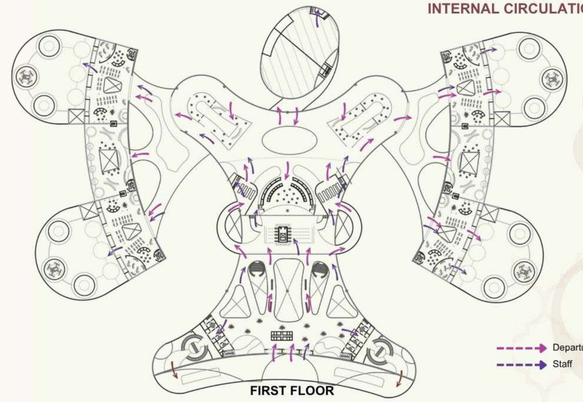


TRANSPORTATION CIRCULATION / INTERNAL SERVICES

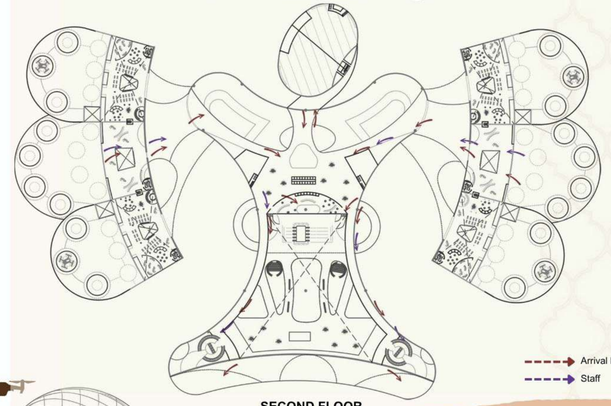


"Columns of diamter of 2m Throughout the layout and in the vertipad column of diameter 12 m running towards the site "

INTERNAL CIRCULATION



FIRST FLOOR



SECOND FLOOR

LEGENDS

- Air Taxi Maintainance Workshop
- Water Tank
- Fire Tank
- STP
- FIRE AND RESCUE
- Mushroom Columns
- Water Point
- Emergency Exit
- Fire Point
- Cargo
- Emergency Vertipad
- MEP Rooms
- UAMTS
- Air Taxi Parking
- Vehicle Parking
- Emergency Vehicle Parking
- Taxi Pathway
- Service Pathway
- Fire Pathway
- Pedestrian
- Vehicle Pathway

Air taxis are electric vertical take-off and landing aircraft (eVTOL) **mix of helicopter + drone + airplane**

Speed:
Typical cruise speed: 240–320 km/h
Some advanced models: up to ~320 km/h

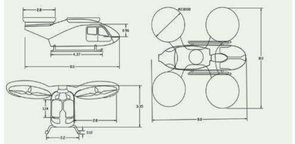
Flying Height (Altitude)
Typical operating altitude:
300 m – 900 m (1000 – 3000 ft)

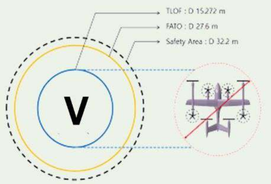
Noise Level
65–80 dB (much quieter than helicopters)

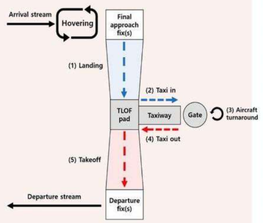
Range
Current: 300-450 km per charge
Future: 500+ km expected

Circulation
Passenger flow < 10 min processing

AIR TAXI AND AVIATION MANAGEMENT





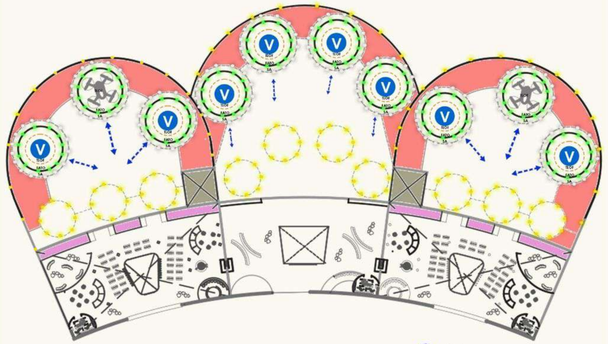


Urban Air Mobility (UAM) Traffic System

The Urban Air Mobility (UAM) Traffic System is a digital and AI-based platform that manages low-altitude urban airspace by controlling flight paths, altitude layers, landing sequences, and airspace separation. It monitors real-time factors such as wind, speed, battery level, weather, and traffic density to ensure safe and efficient operations, while automatically rerouting aircraft and prioritizing emergency flights when required.

Vertiport operations use a slot-based system (1 aircraft every 2–3 minutes) controlled by digital UAM ATC, which regulates speed, separation, and landing order through fully pre-scheduled routes. With no taxiways required, aircraft perform direct vertical takeoff and landing, guided by automated systems and ground crew, achieving a capacity of approximately 10–20 flights per pad per hour. Each slot is coordinated with neighboring vertiports to minimize delays across the urban air mobility corridor. Passenger turnaround is streamlined through dedicated gates and digital check-in, achieving as little as 2–5 minutes per aircraft. In cases of adverse weather or conflicts, the UAM ATC autonomously reroutes aircraft to ensure uninterrupted operations.

AVIATION -LIGHTING /CHARGING



- Indicates Final Approach and Take-Off (FATO)
- Safety Area
- Indicate caution/Parking
- Taxi way
- Refugee Area
- Charging Control Room
- Air Taxi Lift

SCALE NTS

Topic: Net - zero Vertiport In Saudi Arabia

"A vertiport that breathes with the desert harvesting sun, wind and sky-water while sheltering pilgrims in living shade."

AIM - To Design an Net-Zero (energy-efficient) vertiport that generates its own power, harvests its own water, cools its own site, and creates meaningful civic space for pilgrims.

SCOPE

- Site outdoor thermal comfort
- Bio Pond
- Building envelope: BIPV roof
- Water: AWG + condensate
- Flood: wadi drainage
- Civic: pilgrim park zones

WHY IT MATTERS

Saudi Vision 2030 mandates sustainable infrastructure. UAM (urban air mobility) is one of its core future transport pillars. This vertiport is the first touchpoint between passengers and electric aviation.

Saudi Arabia's Climate Challenges

- **Solar Radiation -** 6.5–8.5 kWh/m²/day. Must be shaded AND harvested simultaneously.
- **Sandstorm (Haboob) -** NW–NE prevailing direction. Landscape must act as first defence.
- **Water Scarcity -** <100mm/yr rainfall. Every drop must be harvested, treated, reused.
- **Flash Floods -**Sudden intense events despite arid climate. Site drainage is critical.
- **Pilgrim Volume -**2–3M during Hajj/Ramadan. Civic space must flex for congregation.

PRECEDENT STUDIES

Bahr Towers, Abu Dhabi - Dynamic BIPV mashrabiya faqade. Primary BIPV ref.
Masdar City, Abu Dhabi - Wind towers, passive cooling,AWG. Zero-carbon desert city.
Warka Water Tower - Biomimicry AWG via mesh condensation. Mushroom column ref .
KAFD, Riyadh- BIPV integration in Saudi Arabia context.
Crossrail Stations- Piezoelectric passenger engagement

01 ZONE SECURITY MODEL

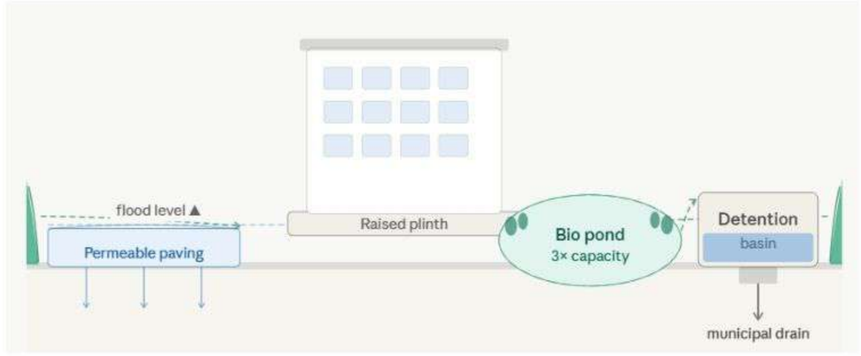
Zone 1 Civic Landside - Park, pond, observation terrace. Fully public. No aviation access.
Zone 2 Terminal - Check-in, boarding, piezo walkway. Controlled access through security gate.

During Ramadan, it serves as a shaded, mist-cooled iftar rest area with landside exit and re-entry for boarding. During Hajj peak, it becomes a quiet overflow spiritual space with shaded seating, water features, and no commercial activity. Daily, it functions as a community green space with paths, shaded seating, and an observation terrace for safe eVTOL viewing across Zones 1–2. On Fridays, it shifts to a post-prayer contemplation garden for quiet family use, with no vendors and passive landscape use.

STRATEGIES USED IN VERTIPORT / SITE

01 FLASH FLOOD - 5-LAYER DEFENCE

- Permeable Paving – Civic zone paving reduces peak flood flow by 60%.
- Raised Plinth – Elevated base protects buildings from flash flooding.
- Retention Swales – East/west edge channels slow and store stormwater.
- Bio Pond Buffer – 3× capacity pond absorbs overflow during flash events.
- Detention Basin → Municipal Drain – Controlled overflow directed to city drainage network.

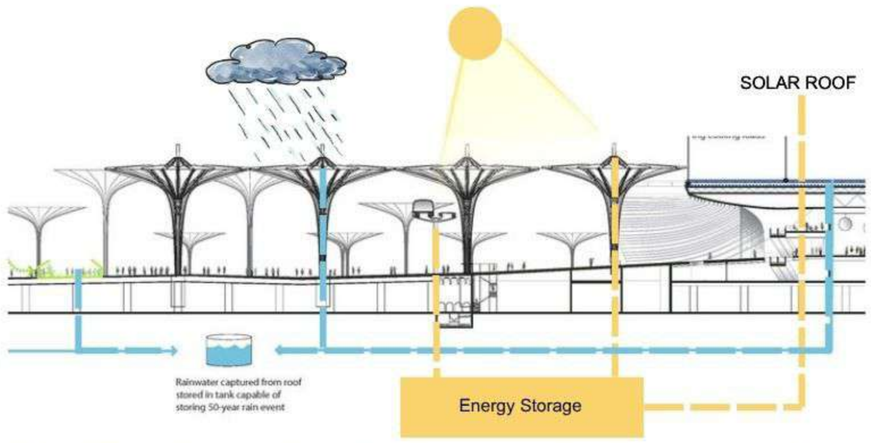


02 NATIVE PLANTING

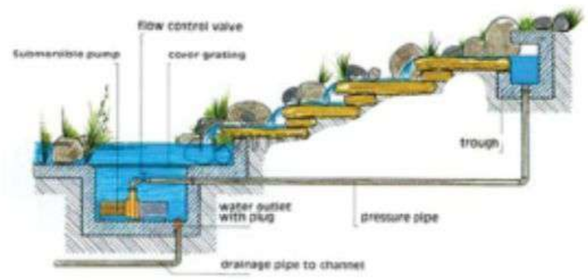
Ghaf - Prosopis cineraria · windbreak · deep root
Date Palm - Phoenix dactylifera · transpiration
Sidr - Ziziphus spina-christi · pilgrim significance
Acacia tortilis - umbrella canopy, fast shade

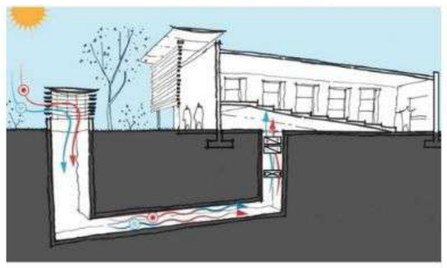
The landscape uses native desert plants, shaded seating, and minimal irrigation. Water features like bio-ponds help cool the surroundings, while trees act as natural windbreaks, reducing sandstorms and improving comfort for passengers in harsh desert conditions.

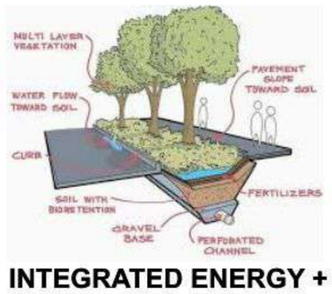
03 MUSHROOM COLUMN



hydrophilic mesh cap → night condensation → stem channels → underground storage pipe
The DUAL function: mushroom cap also has solar PV cells on top so the column collects water AND generates electricity simultaneously





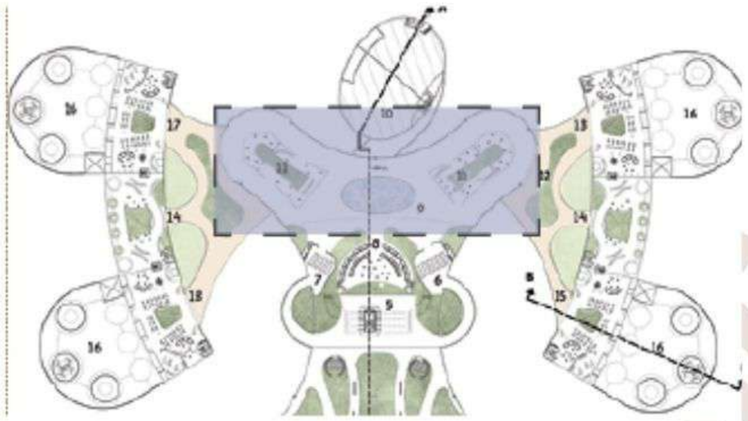


04 BIPV MASHRABIYA ROOFING

Traditional mashrabiya geometry is reinterpreted as a PV module grid, reducing glare by about 40%, generating electricity, and filtering the harsh KSA sun into soft, diffused interior light. The extended roof overhang shades the entrance plaza, while its layered, ventilated construction reduces heat gain, improves airflow, and creates a transitional microclimate that keeps the arrival space cooler and more comfortable.

05 PIEZO ELECTRIC TILES

Pressure-sensitive boarding walkway tiles generate 0.1–1W per footstep supplementary, not primary. Framed as passenger engagement: real-time display shows energy generated today by passengers. Powers LED gate signage and ambient lighting.



PERFORMANCE TARGETS

Energy	
Solar roof coverage	70%
Renewable self-sufficiency	65%
HVAC load reduction (wind)	25%
Water	
Grey water recycled	80%
Potable water reduction	60%
Mist fed by AC condensate	100%
Outdoor Thermal	
Perceived temp reduction	-20°C
Shaded public space	85%
Cool paving surface temp ↓	-36°C

"TOTAL PERCEIVED TEMPERATURE REDUCTION: 15–22°C
48°C UNSURVIVABLE → 26–32°C COMFORTABLE OUTDOOR EXPERIENCE"

INTEGRATED ENERGY + WATER SYSTEMS FLOW DIAGRAM