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The flagship NEOM hospital

The architectural designer roll in the fast-track projects in KSA.

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Abstract

What is architecture? What does an architect do? Designing, drawing and/or building? Questions that applicants, students and architects ask themselves more than one time, because the field of knowledge of an architect is so vast and complex that every time it seems to find an answer it is just a new question.

The dissertation analyzes and criticize the practice through some of the skills an architect must have, generating a series of questions and arguments from each one through the studio of the research develop by Danna Cuff in the 90's, and the now a days experience of the author focusing on the work developed in the Kingdom of Saudi Arabia with the case study of the Neom flagship hospital.

Introduction

The work of an architect has been evolving during the centuries and the understanding of the practice and what it needs follows these changes; raising up questions problems and solutions for the time to come. The time we are facing now is a moment where borders and frontiers start to have a no meaning to the professionals; that are following the explosion and creation of new markets all around the world to fulfil their necessities and looking forward to developing their careers. Considering these it is inevitable to stop and take some steps back to see the full picture of what we are doing as architects and to question our self's the way we are teaching, learning and apply the knowledge and abilities the practice provides.

There have been many scholars that have discussed about the practice and the differences between the academic environment and what the reality of the profession is; nevertheless, this dissertation focuses mainly on the studio of the work of Danna Cuff analyzed through the work experience of the author in Latin American (Mexico), Europe (Italy) and Middle East (Saudi Arabia).

It is important to highlight that the aim of the thesis, is not to propose a question and find an answer, this dissertation focus in providing a critical point of view of the professional practice in the Middle east through a project developed during the past year and with this generate more questions than answers. The purpose is to feed the debate of the architectural practice through the professional experience of what is happening in the Kingdom of Saudi Arabia, it doesn't have to be forgotten that...

"The first step in understanding architectural practice is to get into it."

Cuff, D.

Chapter 01 | The practice

“…who have aimed acquiring manual skill without scholarship have never been able to reach prestige for their job, while those who relied only upon theories and scholarship give the impression of chasing a shadow of the reality.”

Vitruvius M.

Professional Background

In a world full of differences, such as language, rase, religion and culture it is fair to say that one of the things that we have in common is space, no matter where, when, or how space is a constant that is around us; and this is the main playground area for architects. From one of the biggest cities in the world, Mexico City, to the red seaport city of Jeddah and passing by a city full of history and tradition as Torino the difference is how architects approaches the problem of transform space, but it is this completely true? The fact is that is not.

Lest start from this; It is known that the debate if architecture is natural or not has been raised up many times, depending on the definition of nature it could be say that the first architectural expression of creating the primitive hunt is the action to go against nature to transform the space and give an answer to our necessities of comfort and safety. It is this action that has taken us to the point where we are.

When knowledge is based on a scientific approach such as architecture is, the way the solution will be found it will be the same, no matter the location or the time.

Architecture?

Even it could seem early to remind it, remember that there is no intention to provide any answer, nevertheless, it is the intention to open the debate between colleagues and yourself. Say it so, the big question to start with, and the one with thousands of answers is, **Architecture? and what those an architect should be?** It was Vitruvius who mentioned, for some in a poetic and utopian way, that *"The architect requires a training in all the departments of learning; and finally, since reason, on account of the wide extent of the subject, concedes that he may possess not the highest but not even necessarily a moderate knowledge of the subjects of study"*. Knowing that are more modern and updated definitions It maybe consider for some nonsense to revisit this kind of citation, but let's accept that is a common practice to forget the basics.

Through the experience lived and seeing what architecture is in different parts of the world it is more now than ever that the idea that the architect has inside itself many professionals with different skills and personalities it is true. For understand this, the profession will be critical analyzed through seven disciplines that are crucial now a days in the professional market, these are **DESIGN**, **SUSTAINABILITY**, **HISTORY & THEORY**, **COMPUTER LITERACY**, **LEGAL KNOWLEDGE**, **BUILDING & CONSTRUCTION** and **PROJECT MANAGEMENT**. Every architect should have knowledge over each of these and they came with their own complications.

DESIGN could be considered the core of the practice, the one is supposed to have and fulfill every discipline that has been said, because of the simple fact that is the beginning of every process, and even though the importance it has it is the one that seems to be the less required. Everything starts with a conceptual idea, generated through the analysis of the site, the general knowledge of all disciplines and the requirements of the patron; but is here, in the very beginning of the process when it seems to get broken, mainly by two reasons, the miss understood of the designers of where does their responsibility finish and the tendency of the patron of minimizing it to a marketing tool instead of a creation process. Because of this and so much other factors the design seems to become just dreams that who knows what it will be at the end of the process. It seems that designers just create aesthetic images that will be solve by someone else because of the lack of attendance or even worst because ignorance of the steps forward for bringing the project into reality.

SUSTAINABILITY is a term that has being miss understood by architects for a long time. The practice keeps forgetting that the meaning of it is the capacity of a process to maintain itself in a certain level and it has been transformed into the slogan of the so call green actions taken to slow down and reverse the climate crisis. Actions that if it is true that helps it is also true that most of the developers have transform the crisis into a label of marketing, proposing green concepts, green buildings, green cities for a better future but leaving rotten economies that contribute more to the problem than what they proposed to solve. An example is what happened with Masdar city in Abu Dhabi, beginning their construction in 2008 and continuously being postpone now until 2030 leaving a modern desert in the desert because of the lack of investment.

As we can see, forgetting the basics and the past seems to be the way of the practice, and it is because **HISTORY & THEORY** is the most absence of all the disciplines, and it is not a surprise because the construction discipline has a conception of the theory as just words and talks with a compilation of minimal technical knowledge, and the neglection of the practice, but it is not like the builders are doing an outstanding job.

At the beginning of the chapter was said that for creating architecture and architects every discipline is necessary, a big example of the consequences of neglect history & theory is the next comparison; in one side we have Sedra by Roshn, a giga project financed by the public investment found for the housing program in the kingdom of Saudi Arabia, a project that sell itself as “inspired by tradition yet meeting modern needs for the cities of the future¨, year 2023; in the other side Casas GEO and the social housing boom in Mexico, the company GEO develop housing projects all over Mexico building up to 160 houses per day in their peak, projects that where fraud leaving debt, low quality buildings and scars in the cities and economy, year 2000 to 2015.

Mexico - Casas Geo

KSA - Sedra Roshn

After more than 10 years and during a time where information can be reached instantly why we decide to ignore it? If it didn’t work in America, neither in Europe, what make us think it will work in Middle East.

The use of the technology is a must now a days, the way we represent our ideas change and improve arriving to the point of creating photorealistic images or BIM digital twins. It is true that the **COMPUTER LITERACY** an architect has increase his value in the professional market, but this is not always a positive thing, because companies appreciate the experience of using a tool more than be an architect, giving the message that knowing architecture is not required to be eligible. The more specialized

the architect is in a software the more it is considered a drafter that just follow instructions.

The **LEGAL KNOWLEDGE** is the only discipline that is not a constant, this one change depending the location, client and kind of project, these changes can be significant or minor and even in the same country they can happen, and the importance of acknowledge them is vital. Every time a project starts the first thing to do is understand which are the “rules” that have to be follow, the neglection of these will determine if the regulations are restrictions or a tool that help architects to develop their work. A phenomenom that is happening, is that with the constant rush for covering the Saudi Arabian agenda, it is the legal area where architecture develop most of their businesses with the variation order loop creating a game based on contracts for deviating responsibilities when the delivery schedule is not achieved.

It looks like when the topic of **BUILDING & CONSTRUCTION** enters to the conversation all the other disciplines stop and listen, and it is because the final objective of architecture is to be built. Therefore, if it is not known how to build it the design will be in risk or fail. This idea it may be refused by saying if you can imagine it, you can build it, but this is an optimistic and just academic quote far from the reality. Even if the technical knowledge is there it will not be enough if the correct technic is not chosen considering the environment and investment that are the real deal breakers of the construction debate. For making a project to arrive to a construction face must considerate all the other specialities.

The building technics have change and the technological advances achieved until now are reflected directly into the industry but this doesn’t mean that is done worldwide and in the globalize time that we are living, the ignorance of this has created a rising market in Saudi Arabia, the architect of the architect phenomenon, well known as the architect of record, where local companies work to translate designs from international firms into buildings solved with the technology available on site that at the end became into an inevitable variation or a complete change of the projects.

Architects are problem solvers, each project is a spatial riddle, and this condition give them the capability to manage resources of all kinds, specially time. With projects becoming more complex, and the disciplines more specialized, the necessity of an actor that control the resource flow became indispensable. The **PROJECT MANAGEMENT** became the pilar of any project, but the more the architects focus on this the more is forgotten or even worst completely neglect the architectural practice, and the ignorance of it, transformed the solution making process to the main problem generator.

As it can be seen, trying to explain the practice and some of the different parts of it just take us in to a loop of questions with no answers, and every single architect, depending on their specialty, will give different point of views.


Does analysis of the proportion, conception and intention will be
simplified to process of selection? The project management era and the neglect of the practice.
The architect of the architect, phenomenon. Each place has their techniques and technology.
The variation order loop, a contract game, architecture is just a business?
It is required to know architecture to be part or eligible in the professional market, or is just enough know
how to operate some software to follow instruction? Are talks of architecture, a compilation of minimal technical knowledge, and
The designs are just dreams that who knows what it will be at the end of the process? neglection of the practice?
Where does the designer responsibility finish? Architecture? Is juts a crisis transformed into a label for marketing?
Green concepts, green buildings, rotten economies... sustainability?
Has the profession been reduced to a technical problem? Are we studying to be architects or just drafters?
In a time where information can be reached instantly why we decide to ignore it and follow the same path? If it didn't work in America, neither in
Europe, what make us think it will work in Middle East...? The regulations are a design tool or a restriction? The difference between knowing and ignoring them.
Environment and money the deal breakers of the construction debate.
Does the ignorance of the practice have transformed the solution making process to the main problem generator?
The creative process game change, the narrative as the substitution of the sketch.

The contrast between theory & reality

In 1991 Danna Cuff publish her book, The story of practice, and this became a milestone to understand it and show the contrast between the academy and professional work environment that still can be use. Cuff divides the practice in specialties arguing that the architectural projects can be only done thanks to the conjunctions of different skills hold by different persons. She recognizes that the design is consider as the core of the practice thanks mainly to the academy that support the idea that to be an architect depends mainly on the artistic skills. With this, is created an utopic believe that the architect has “autonomy” on the creative process. This rise conflicts in the professional practice and the author mention some of theme that are important to be accepted and solved. First it is spotted that the academy doesn’t impulse the teamwork and support the individual one, this for example is something that continue happening now a days in some universities, the work it is mainly requested to be done individually instead of generating results through collective efforts as in the professional practice. Second, Cuff spots that the schools neglect the participation of people that have low or nothing in common with the architectural practice, and the projects created by the students are evaluated entirely by an architectural audience, this made architects to consider the intervention of these actors as interruption or not valuable into the que process. Third, int theory business is integrated into the design but the reality is that they are always in conflict and the true is that projects are solved mainly in the contracts than in the drawing board.

The author concludes that these issues have derive in the consequence that the architectural practices loss the creative autonomy and continue to be consider a luxury and artistic activity that depends on the investment of a patron and not a work that it is needed as other professions like doctors or lawyers. After analyzing the work of Cuff, it is fair to continue asking ourselves the same questions as her; What we are teaching and how we are doing it is enough? Does the academy have to be shaped by the professional market needs or offer? The fact is that it doesn’t matter what is taught if the architects doesn’t develop a critical point of view that helps them to move around the market offered by the profession.

It was stablished that the analysis will be focus on seven categories, now how does the importance of these are different in between the theory and the reality in the KSA market, as shown in the graphic 1.1, the proportion of knowledge of each skill is completely different in the two fields, also we can see that the level of knowledge in the academic period never arrives to the proficient or expert levels because after the university it is expected that each professional develop them with time depending on the path they focus. **DESIGN** from being one of the core disciplines in the academy reduce its importance in the professional practice, **SUSTAINABILITY** has a bigger importance in the practice than in the academy thank to the phenomenon that it is happening because of the climate crisis, **HISTORY & THEORY** considered a pillar on the formation is the less required in the practice, **COMPUTER LITERACY** is a most on the academy but not as the same as design and theory meanwhile in the practice it became in one of the pillars of the market, the **LEGAL KNOWLEDGE** is one of the

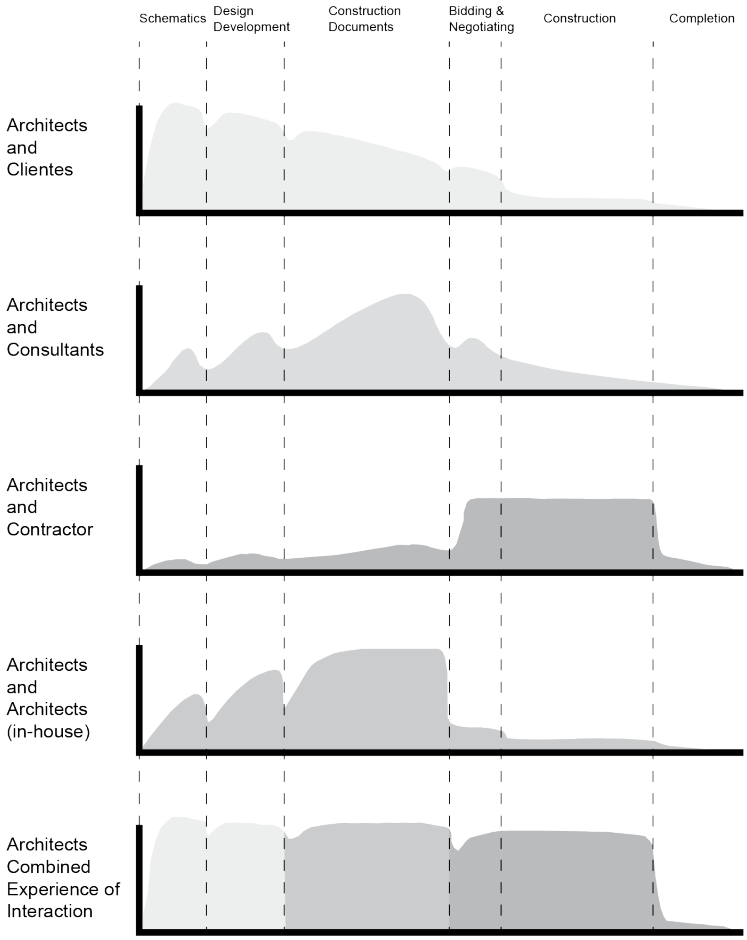
1.1 Comparison of skills level.

biggest incongruence of the academy because it is not really used as it is in reality and it seems the reason is to not restrain the creativity of the students but in the practice nothing can be done if this are not minimum managed in a proficient level, **BUILDING & CONSTRUCTION** is another pillar of the practice and in the academy it is considered with a middle importance, and finally **PROJECT MANAGEMENT** is the third pilar in the professional practice meanwhile in the academy is a mid-importance skill.

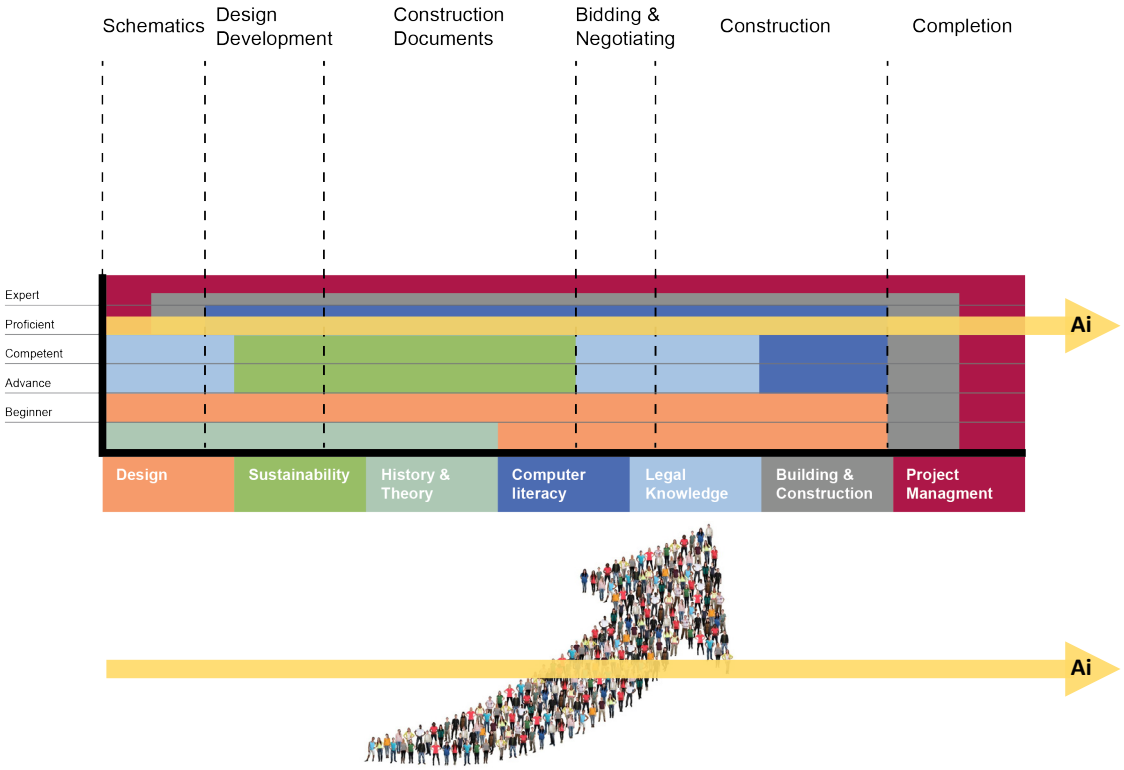
This doesn't mean that the academy is wrong, or that the market is correct, it is imperative to understand that the curiosity and profile of the students is the one that close the breach in between these two worlds, and it must not be forgotten that architecture is a practice that evolve though the experience.

Cuff made an analysis of the participation and relation between architects and stake holders during the time and phases of a project, as seen in figure 1.2. Following the example of her it was made a reinterpretation of this graphic using the same metrics and merging them with the level required of each discipline proposed, and the presence needed or expected from them to be involved during the development of a project. It can be notice that the level of the skills it doesn't represent the level of participation, for example, design is the second lowest skill required but its presence during a project is one of the highest, after analyzing this relation it can be understood that the level of the skill is proportional to the number of people required to be specialized on it. Project management, construction, BIM and legal teams are bigger than the design and sustainability teams creating a big job opportunity for the first and few positions for the second ones.

This analysis has been made to understood what does the professional practice offers and needs but since the times change and the technology evolves now there is a new category that has to be mention and that has open a big debate in different professional practices, it is the **ARTIFICIAL INTELIGENCE** a high rise market that is evolving day by day and in the Saudi Arabian market it has started to be introduced in the companies, there is so much it can be say about this, but is subject of a bigger debate and a wider conversation than the one this dissertation attempt, but the reality is that with this new actor the game has change and the conception of it from the companies as a solution to overcome the demanding time lines of the Saudi Arabian market and not as a tool, leaves a deep blue feeling for the future where the sketch will substitute by the narrative. The AI companies promote the software as a chance to stop investing in human capital and level up all the skills to the same level, it seems that the creative process, the analysis of proportion, conception and intention will be simplified to a process of selection.



1.2 Relative levels of interaction experienced by architects
Source: The story of practice, Cuff D.

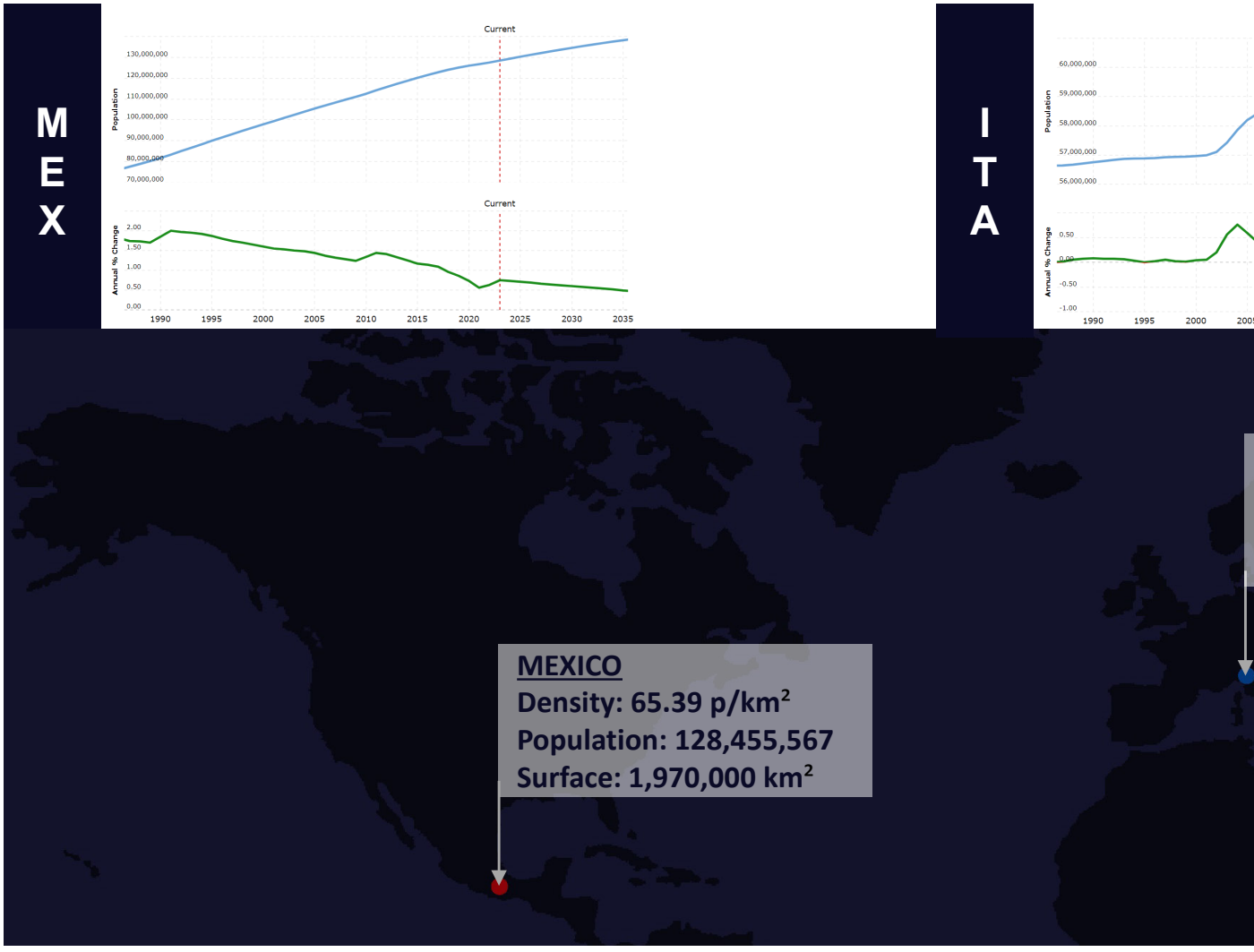


Skills level = N° of personal

Chapter 02 | Professional context

Geographical differences and space.

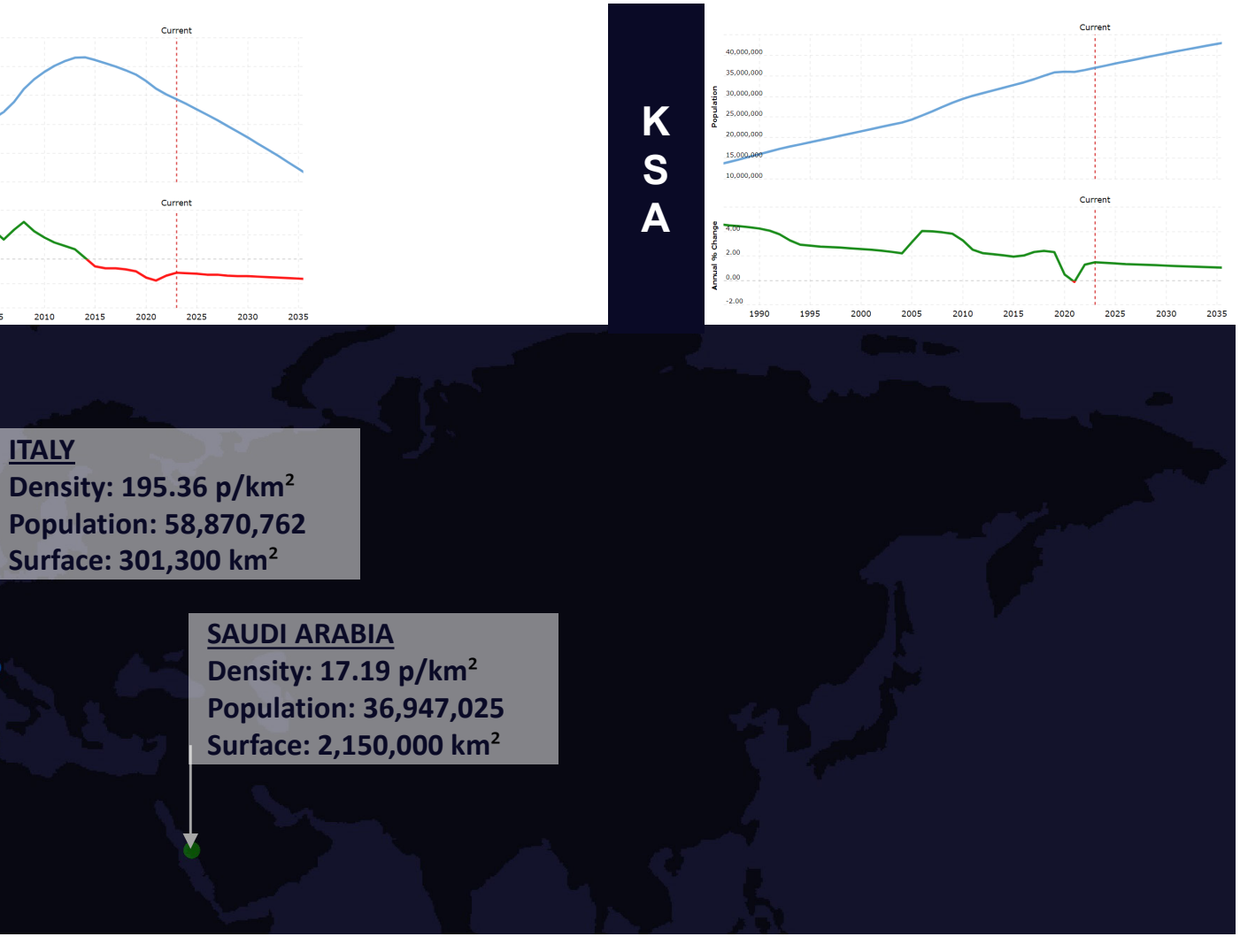
One of the most important dimensions that needs to be consider for understanding the professional context is the spatial dimension. In the Kingdom of Saudi Arabia is fair to say that most of their territory is a big extension of nothing. Even it seems to be an exaggerated affirmation, lets analyze it through a perspective that will provide a sense of scale. For this a comparison between the extension of the territories and population between Mexico, Italy, and Saudia Arabia must be done. Saudi Arabia occupy the 12th place in the world ranking according to their surface with 2,150,000 km², followed by Mexico in the 13th with 1,970,000 km² and Italy with 301,300 km² is in the 71st, even the surface of Mexico and Saudi Arabia is way bigger than Italy it is in the population where the order changes, Mexico has 128 million people, Italy has 59 million and Saudi Arabia 38. To understand the density picture yourself and other 17 persons in a square kilometer, this means that the nearest person to you in any direction will be approximately 235 mts away and nothing in between. Also needs to be noted that 95 % of the territory of Saudi Arabia is a desert, meanwhile in Mexico is only the 35% and in Italy the Accona desert is a semi-arid region but still with mediterranean climate that represent only the 1% of the territory; this is one of the reasons of the low density

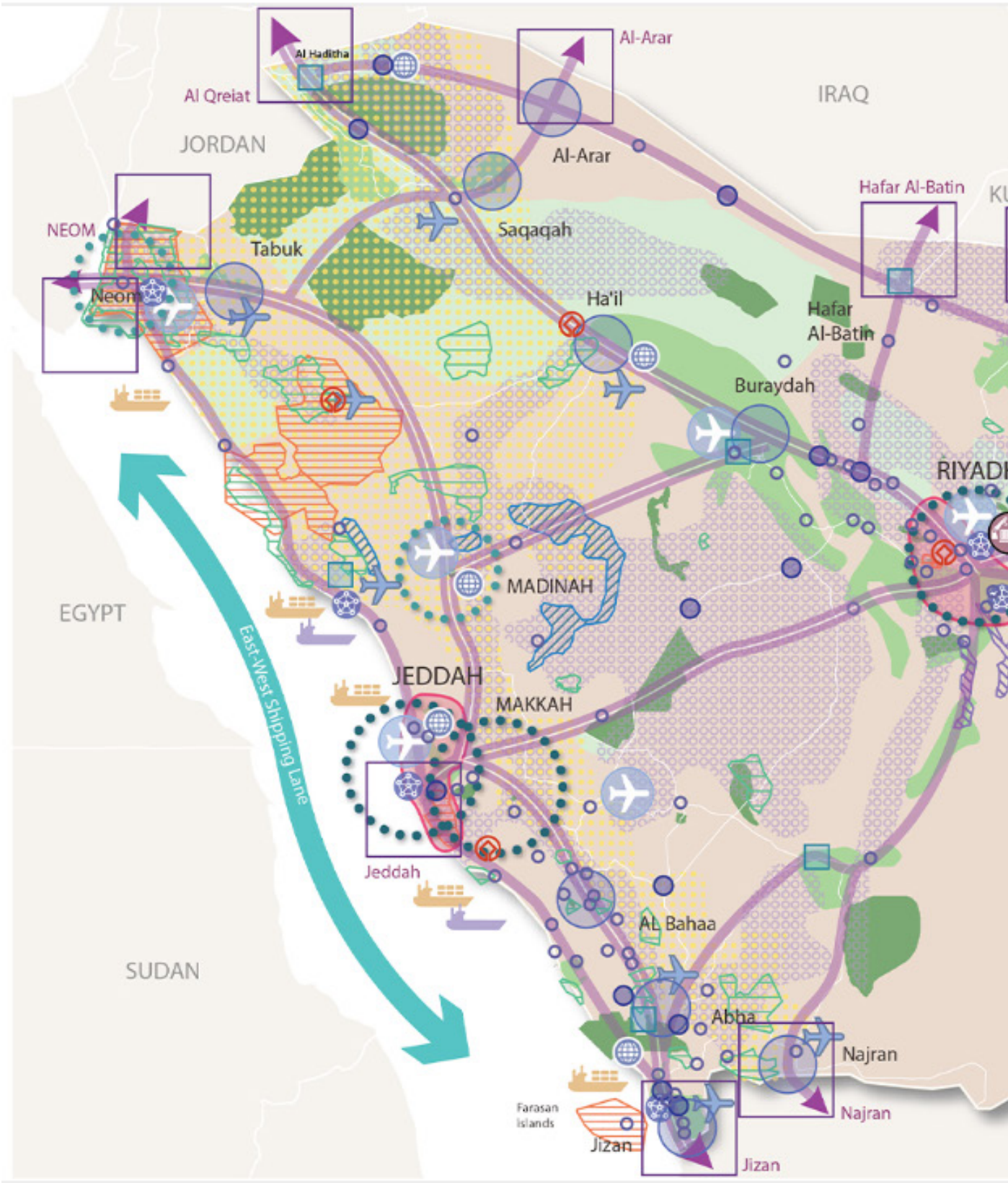


Source: Macrotrends | The Long Term Perspective on Markets

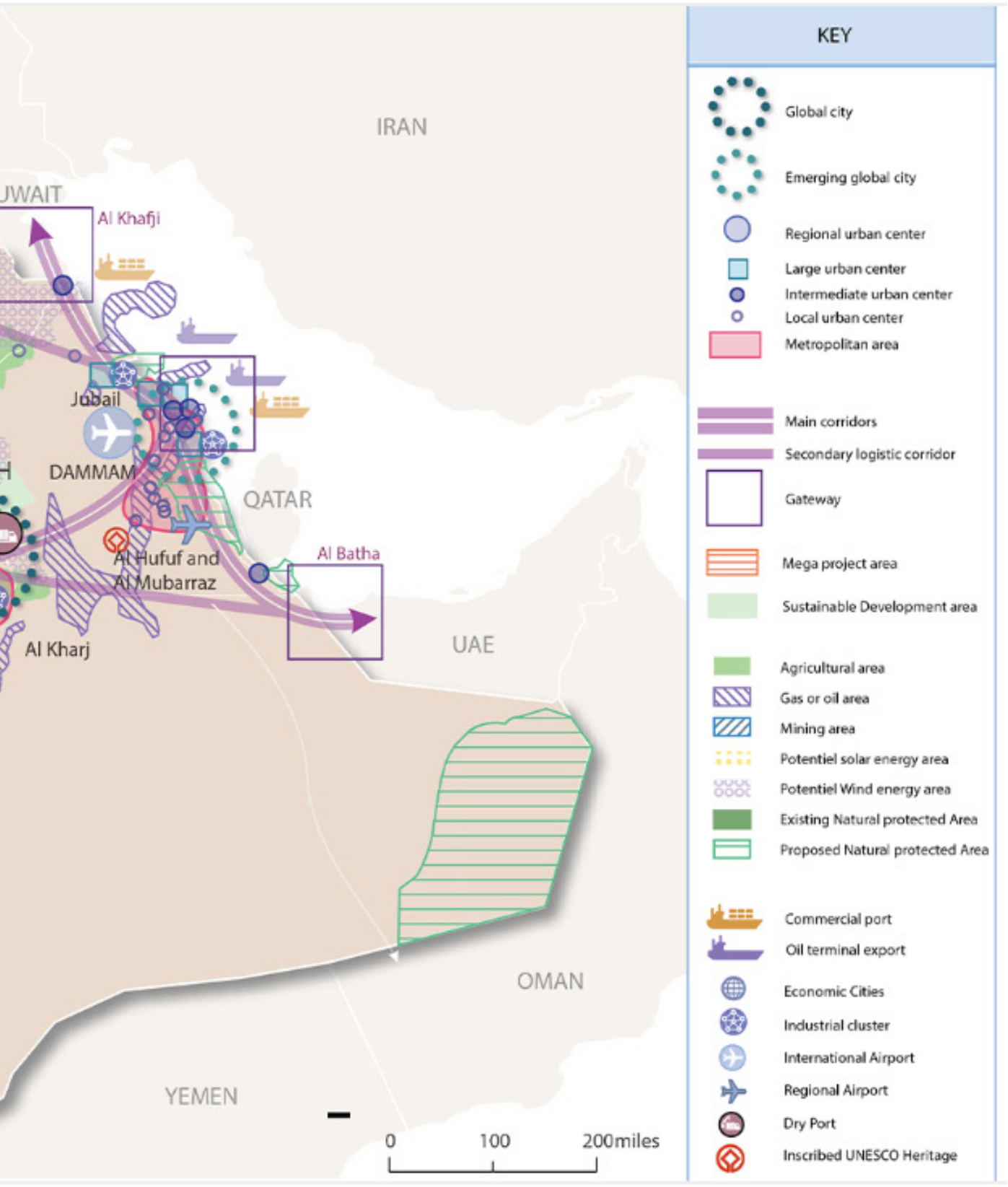
in the country because of the challenge that represent create urban settlements on it.

The kingdom now a days has come with a strategy to impulse the development of more cities in the country. As shown in the national spatial strategy from the Ministry of Municipal and Rural Affairs, figure 1.3, there are only three cities catalogued as global cities, Riyadh, Makkah and Jeddah, these has arrived to this level of development, thanks mainly to their cultural, religious, and economic value, plus the privilege geographic location of the last two. The plan contemplates to impulse the growth of three cities more to the global level through a plan of connectivity and infrastructure development; these are Neom, Madinah and Dammam, why? Because they have the same features as the three cities previously mentioned. Madinah is one of the most important places of peregrination in the world as Makkah, Neom has a privilege geographic location thanks to its climate and proximity to the Sues canal and Dammam is the most important port city of the country facing the Persian Gulf as important as it is Jeddah for the Red Sea coast. All of this impulse by the Vision 2030 of the kigdom.





1.3 National spacial strategy
Source: Ministry of Municipal and Rural Affairs (momrah.gov.sa) | Saudi Arabia National Spatial Strategy & Planning Act - Arcadis IBI Group


IRAN
UWAIT
Al Khafji
Jubail
DAMMAM
QATAR
Al Hufuf and
Al Mubarraz
Al Batha
Al Kharj
UAE
OMAN
YEMEN
0
100
200miles
KEY
Global city
Emerging global city
Regional urban center
Large urban center
Intermediate urban center
Local urban center
Metropolitan area
Main corridors
Secondary logistic corridor
Gateway
Mega project area
Sustainable Development area
Agricultural area
Gas or oil area
Mining area
Potentiel solar energy area
Potentiel Wind energy area
Existing Natural protected Area
Proposed Natural protected Area
Commercial port
Oil terminal export
Economic Cities
Industrial cluster
International Airport
Regional Airport
Dry Port
Inscribed UNESCO Heritage

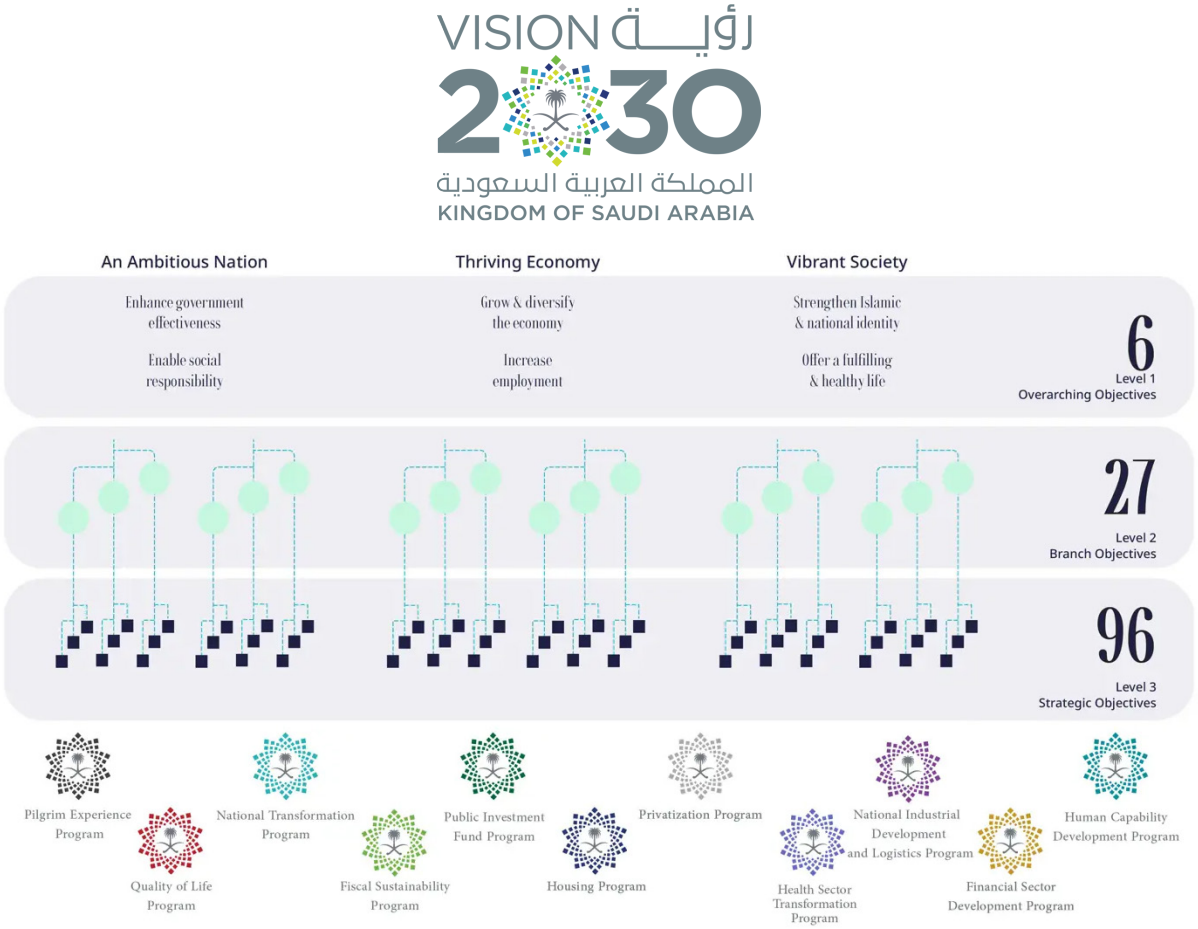
The Saudi vision 2030.

To understand the Saudi Arabian Vision 2030 is important to see it in a timeline format and the key events that had happen since the release of it.

In **2016** King Salman bin Abdulaziz Al Saud announced the Saudi Arabian vision 2030, conceived by the Crown Prince Mohammed bin Salman Al Saud, this as the plan for reform and modernize the Kingdom maintaining their heritage and protecting the Islamic values. The vision is based on three objectives that are, creating a vibrant society, a thriving economy, and an ambitious nation. To achieve these pillars, the program proposed is a cascade scheme of objectives as seen in the figure 1.4.

In **2017** the creation of the Neom city in the northern area of Tabuk was presented and described as the city of the future, these rapidly became into an icon of the transformation of the country.

In **2020** the first review report of the vision was release, showing that the first actions taken by the kingdom were improving the existing social programs and prepare the

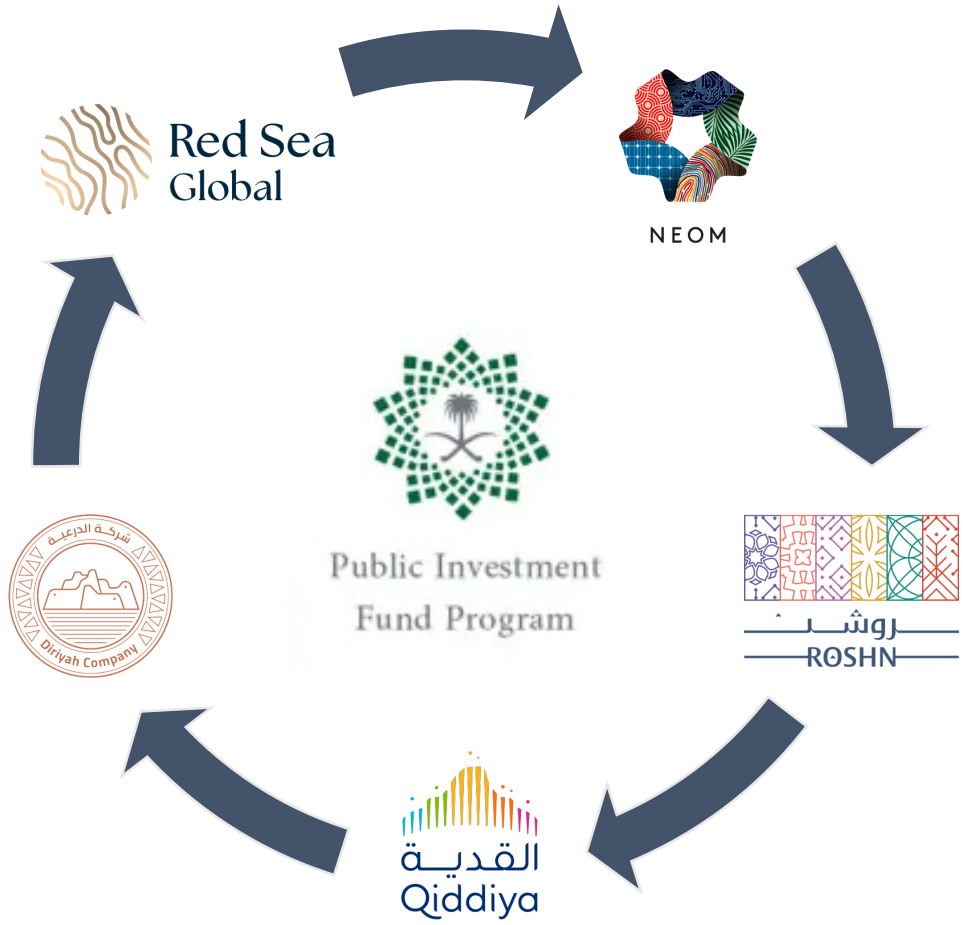


1.4 Objectives cascade strategy.
Source: Saudi Vision 2030.

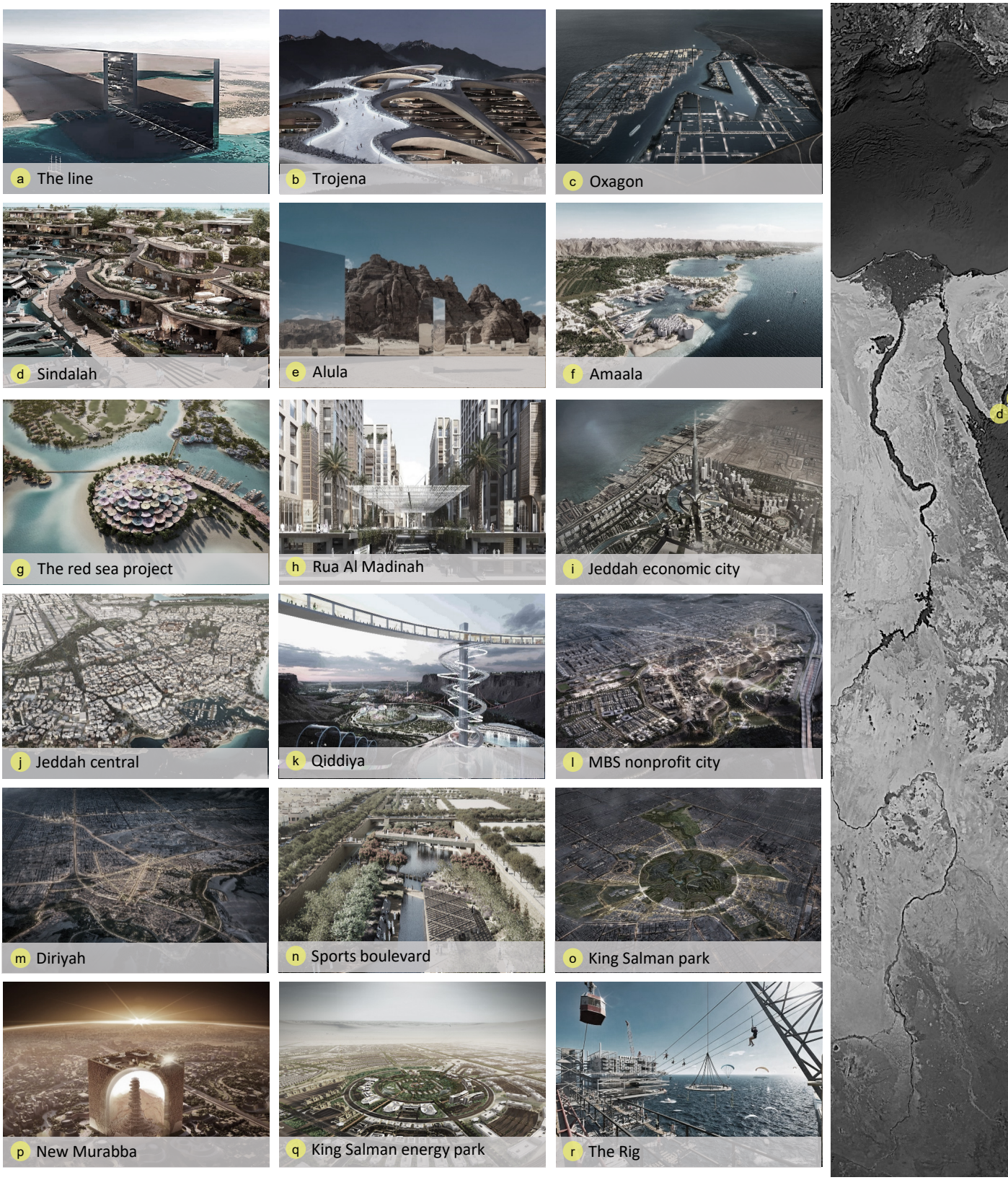
public administration and infrastructure to be able to hold the quick changes and projects that will happen in the years to come. One of the most important of them was the preparation of the foundation of the public investment fund (PIF), thanks to this program the giga projects such as the Red Sea global, Neom, Roshn, Qiddiya and Diriyah.

In **2021** the Crown Prince announced the project of the line in Neom, and this marked the starting point for the rapidly presentation of giga projects. With this the local and international architecture practice start to boom in the country.

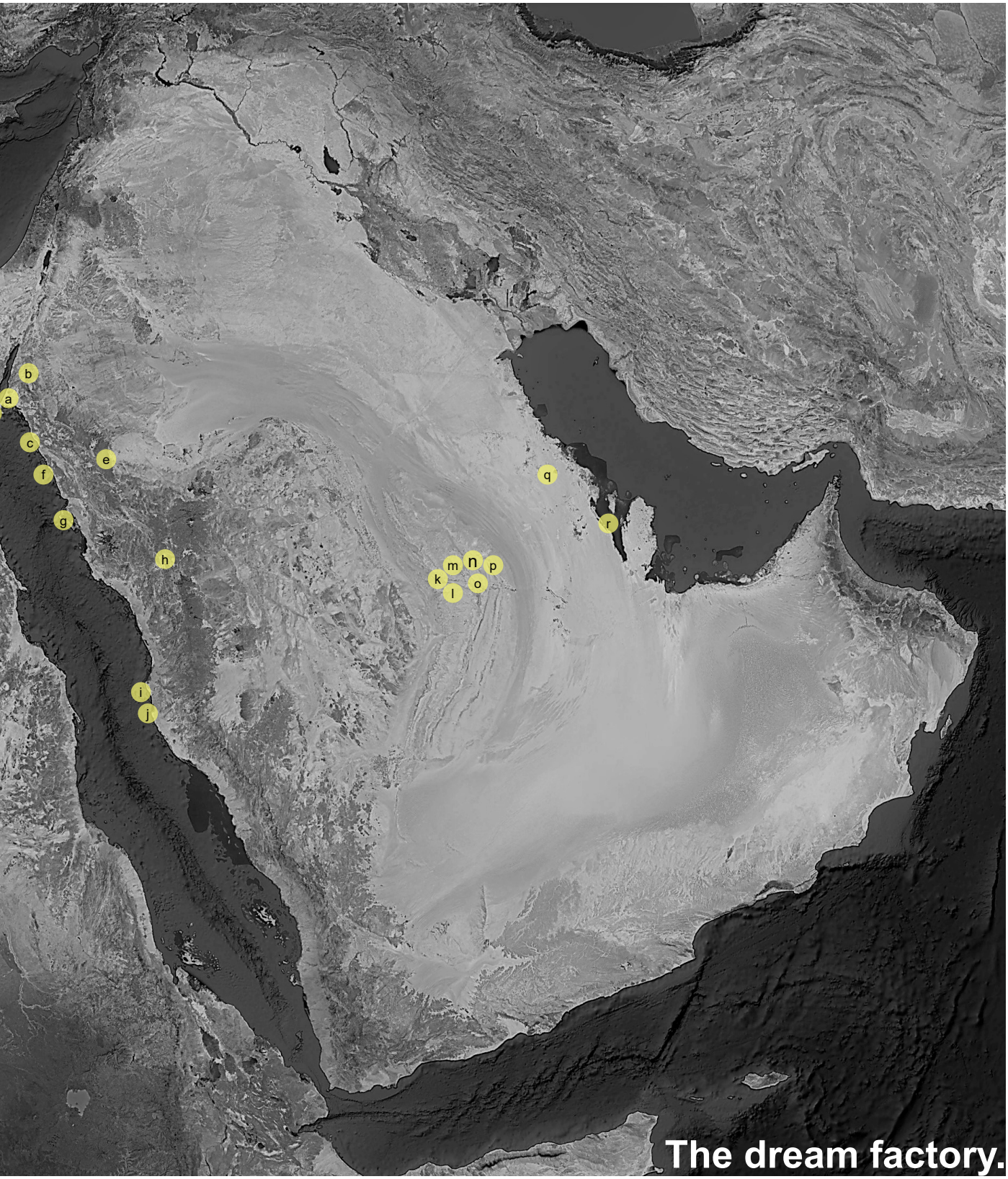
Analyzing the documents of the vision and the actions taken until now the message is clear, Saudi Arabia is transforming for not depending on an oil-based economy, taking advantage of their geographic location as the connection point between Europe, Asia, and Africa.



Source: Saudi Vision 2030 - | PIF - Public Investment Fund | PIF



This atlas shows a compilation of the main giga-projects announced in the kingdom, some on going, others stopped their construction, as the Jeddah economic city, but must of them has being just announced as what it seems just a marketing strategy.



Dreams are beautiful until they became nightmares…

Chapter 03 | The hospital

The project.

The project consists in the design and construction of the first public hospital in the region, this will provide state of the art treatment for the area of NEOM, thanks to his strategic location facilitating the access to the health services to the local population , and the workers on the construction site of the different projects such as The Line, Trojena, Oxagon, etc…

The flagship NEOM hospital is a project that comprises departments of diagnosis and treatment facilities, including an accident and emergency department, a large outpatient clinic, rehabilitative departments, and a Royal clinic. The Hospital will become the 3rd big infrastructure in the area just after the Neom international airport and the Sharma royal palace.

نيوم NEOM

General Scope of work:

- 50 hospital bed.* **19,925 m²**
- VVIP Suite.** **1,400 m²**
- Support and accommodation areas.* **16,025 m²**

Plot area: **100,389 m²**
Total plot to develop: **70,000 m²**

* Prefab / Modular construction system.
** Traditional construction system.

Areas Break down

Code	Zone	N° of beds	Area as per Program (m²)	Area as per Project (m²)
VVIP	Royal Clinic	1	1,392	1,398
ER	Emergency		1,364	1,764
OR	Operation Rooms & Intervention		2,766	3,067.9
ICU	Intensive care	14	3,760	2,420
DIA	Diagnostics		2,700	3,416
OPD	Out-patients Clinics		2,545	2,988
DU	Day clinical care unit		870	879.8
IPD	In-patient admission	35	5,918	5,607.9
SS	Support services		4,809.2	4,736
TC	Technical courtyard		165	176.84
A	Accommodation		11,050	9,616
	Total	**50**	**37,339.2**	**37,190.68**

Regulations & special requierments.

One of the most important requests on the brief was that the hospital will be only one level height and that the construction system to be consider will be based in prefabricate modules with the structural capacity of hold a future expansion to 2 levels. This for a fast construction process and the possibility to replicate the project along the region.

Also the flagship hospital most comply local and international code and standards such as:

•Saudi building code (SBC, 2018 edition)
•National fire protection association code (NFPA 101, life safety code 2018 edition).
•The American society of testing materials (ASTM)
•American disability association (2010 ADA standards for accessible design)
•ISO – International organization for standardization
•Architectural Graphic Standards
•American national standards institute (ANSI)
•International health facility guidelines (IHFG)

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But the most import of the requirements was to have completed the project in the tight time frame requested by the Crown Prince, the project must be done in 6 months.

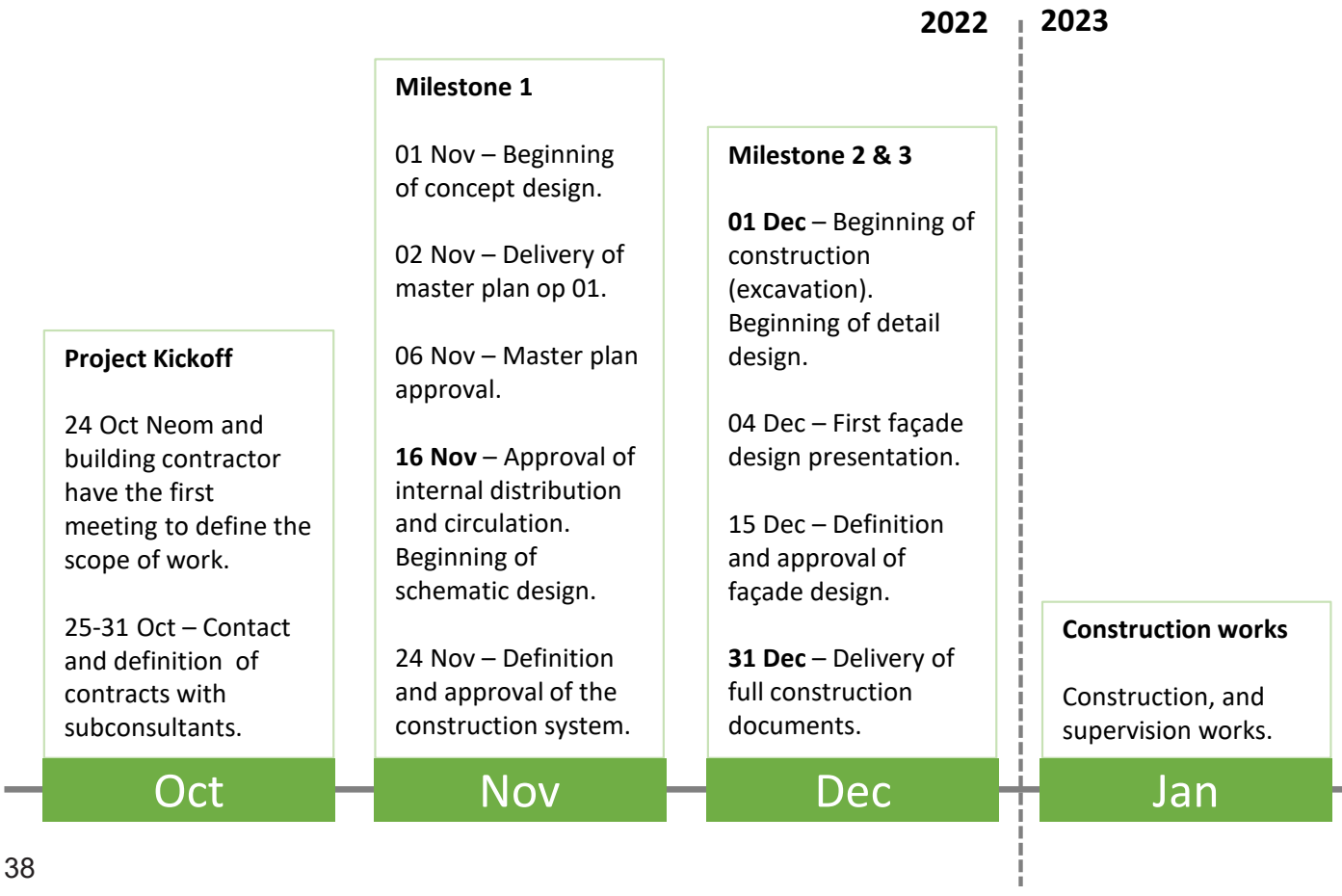
The objective:

Start date: 24 October 2022
Handover date: 21 April 2023

Methodology and work plan.

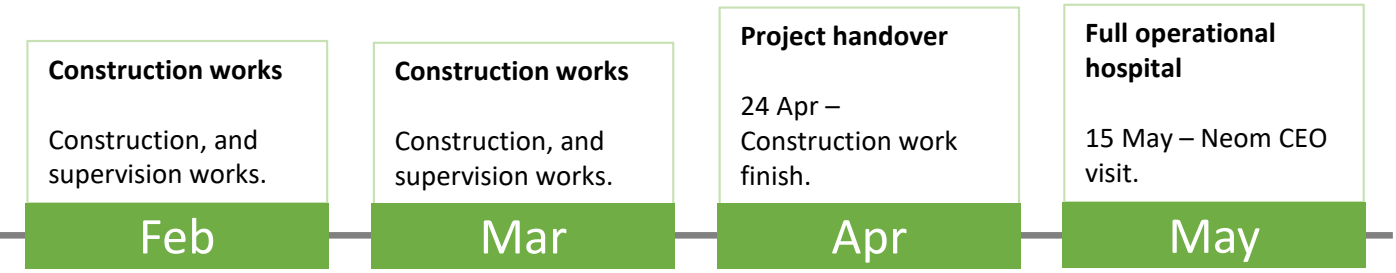
After understanding the challenge requested from the Crown Prince the methodology used was to work on a fast-track scenario, where all the disciplines work at the same time. The simultaneous work of the three phases requires a fast decision and solution making, because every delay will lead to a crashing scenario that everyone was willing to avoid. This meant that the pillar of the work must be the project management department from the 3 main actor, Neom representatives, the building contractor and the architectural & engineering company. After the kickoff meeting on 24th of October 2022 the work for define the calendar and milestones to ensure the success was completed in 7 days.

The first milestone to be achieve was to finish all the design phases of the project in 2 months starting the 1st of November, meaning that concept, schematic, detail design, and construction documents will be ready for the 31st of December. For this was stablished to deliver and present to a board meeting daily. The design department was a key part of the process since every decision taken had to be supported by constructive and feasibility considerations so all the other disciplines could focus on finding solutions to minor problems, the normal practice of going and coming with changes on de design, because engineering considerations were not taken, was something to be avoid as much as possible.

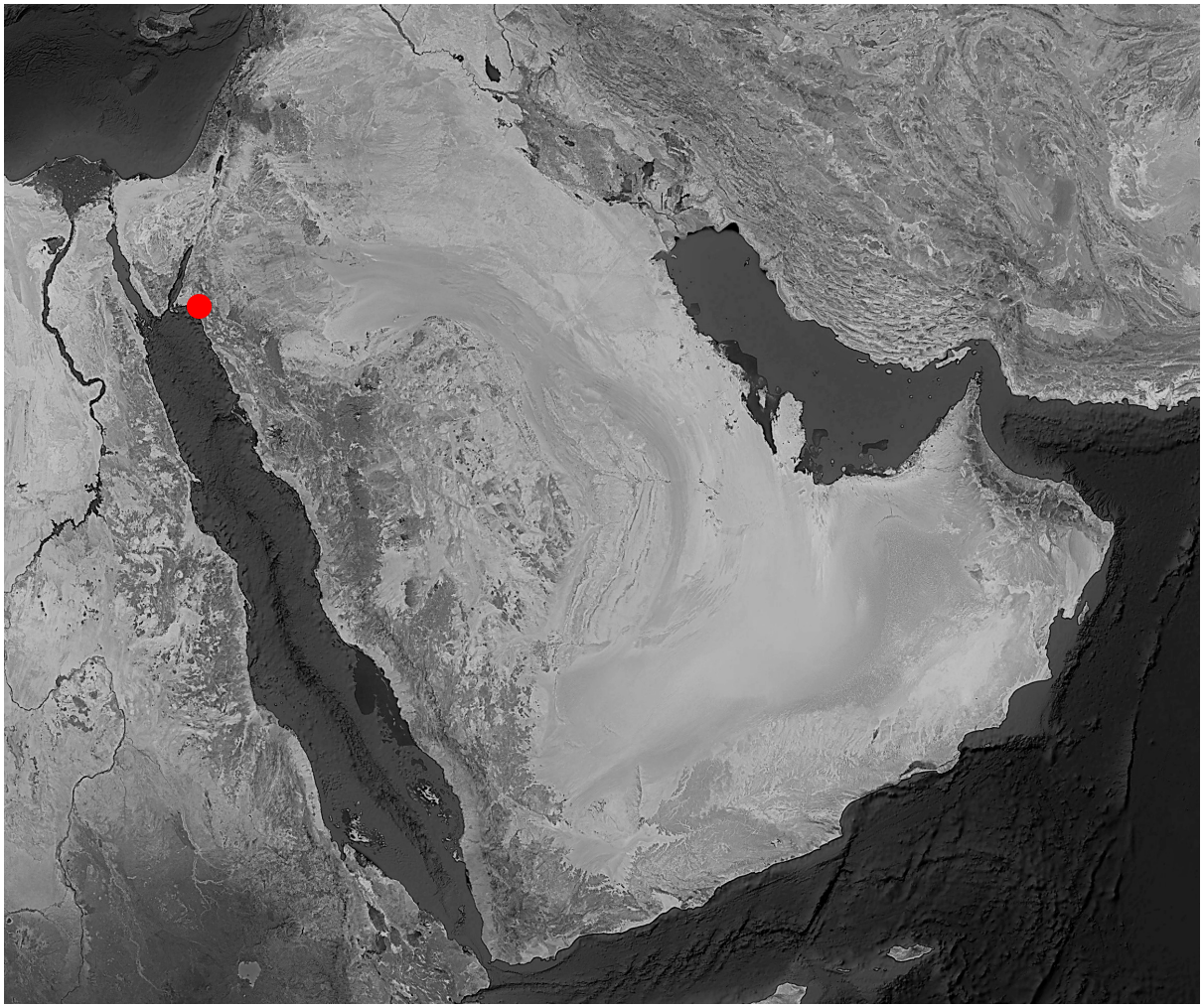


The project manager and the lead designer were the communication link between all the departments to find solutions and move forward the project to achieve the deadline for starting the construction.

As seen in the timeline the project was finished on the 24th of April 2023, just 3 days of difference from the original schedule, representing a minor loss in the project and permitting to the hospital to be fully operational the 15th of May 2023. The project required the work of all the different disciplines that were analyzed in the previous chapter of the dissertation, from this point it will be described and shown the work done by the author as lead designer of the project, not without recognize the tremendous effort that a lot of people do for the realization of the flag ship Neom hospital.

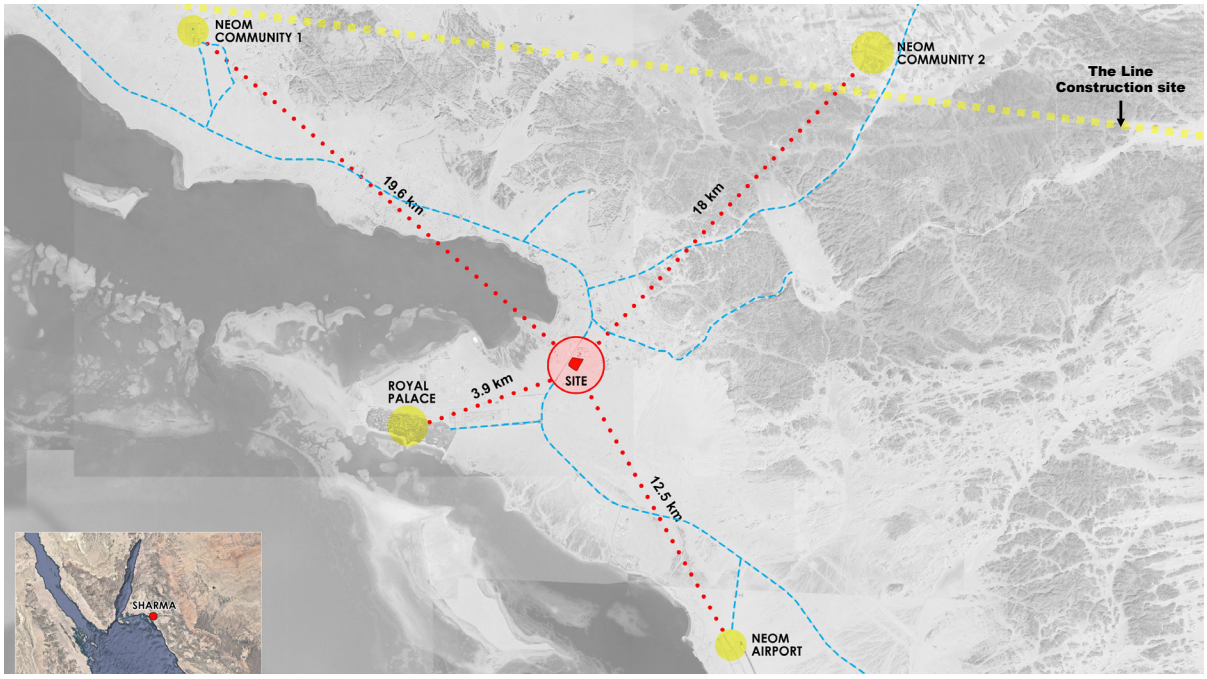


Site analysis.

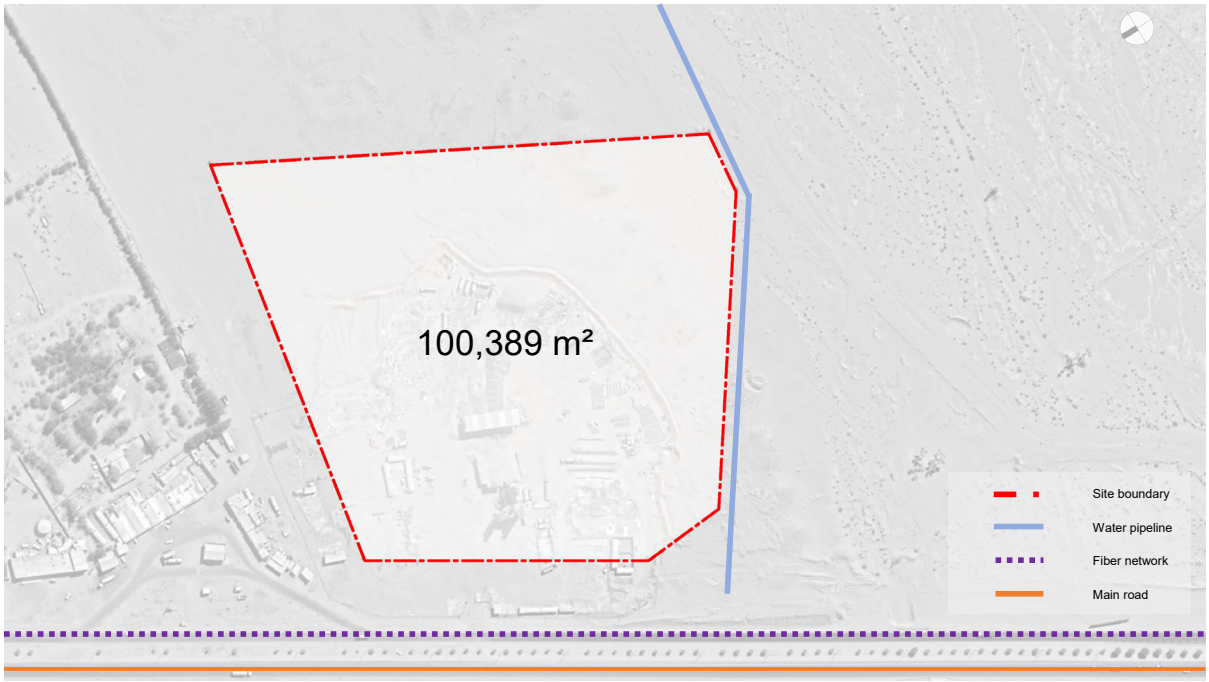


The site is in the north of Saudi Arabia in the region of Tabuk in the city of Neom. Tabuk is a region with a population of 968,414 and an extension of 136,000 sq Km. The whole region is located on a strategic position, just in front to the gate to the Suez Canal and counts with a better weather condition than other regions in the country with at least 10 Celsius degrees less in comparison during the whole year. Because of this the region has been selected as the new emergent economy of the kingdom hosting most of the giga-projects such as Neom, Amaala and the Red Sea development.

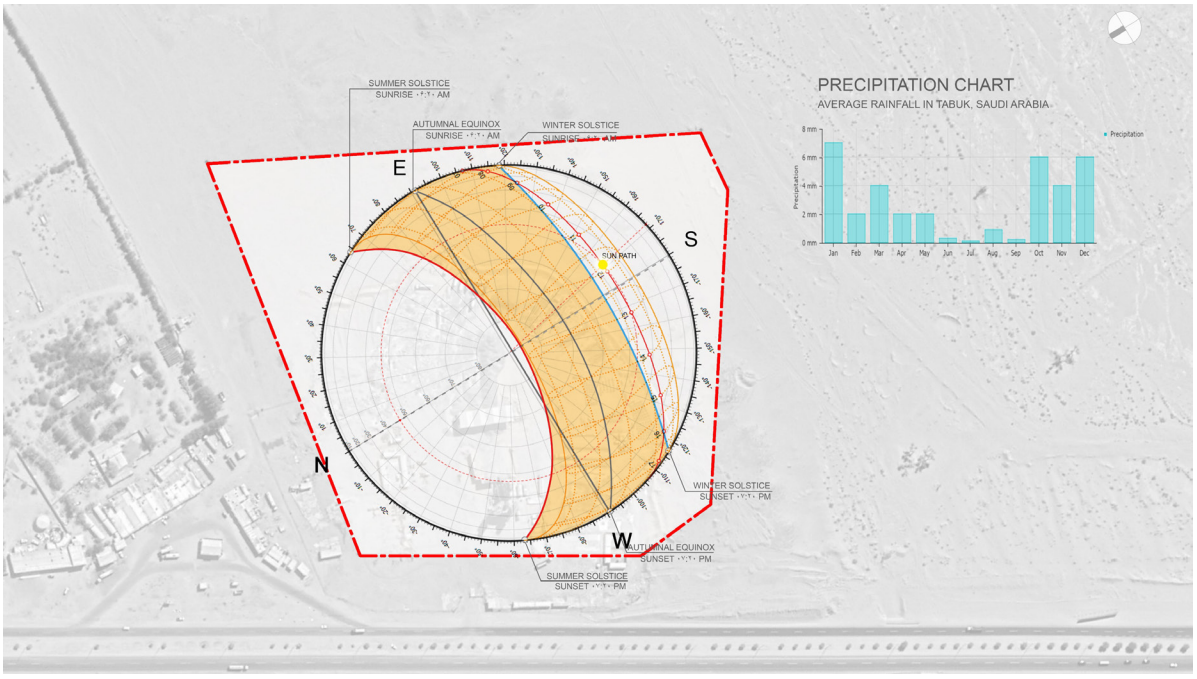
The site is in a strategic location in between the Sharma palace, the Neom international airport, The line construction site and the workers communities, also it is well connected thanks to be situated over the main highway that connects all the region. The plot has an area of 100,389 m², the front of the plot is oriented to northwest, the predominant wind comes from the northwest and southwest, making the northeast the best location for the services and technical areas. The climate is desertic and the topography of the site is regular with a difference on levels of 5 m from the front of the plot to the back of it, there is only one area with a significant change of levels located in the south border corner of the plot with 15 m of difference from the highest point.



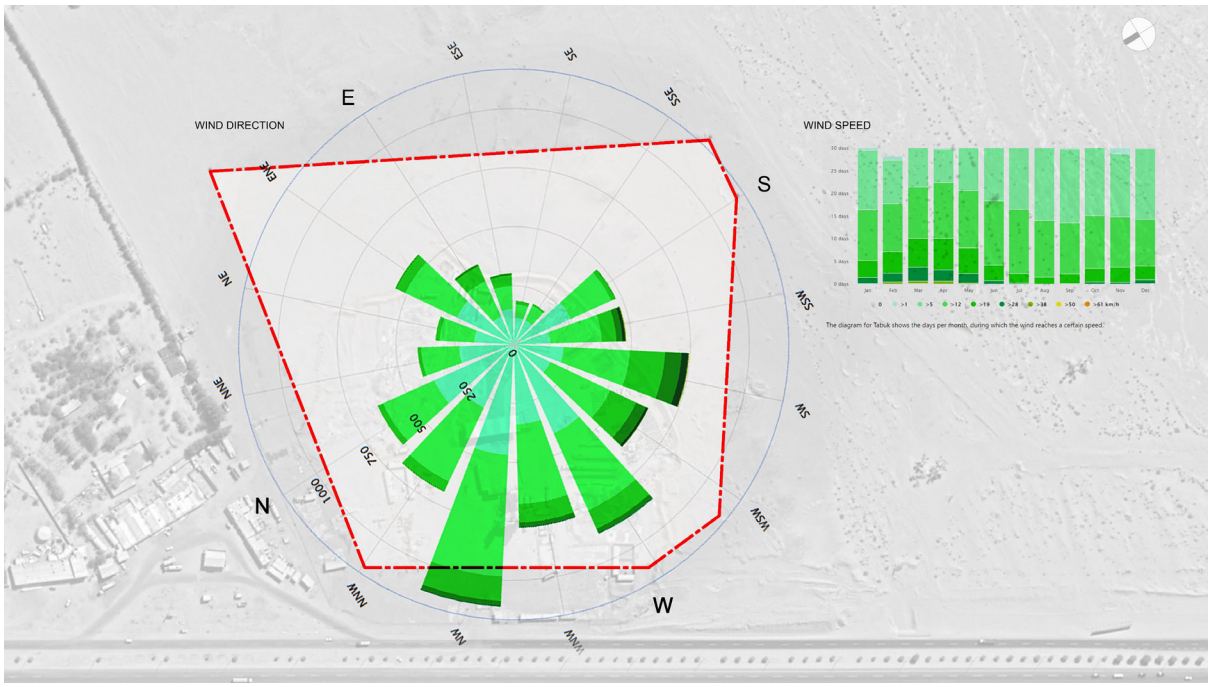
Strategic location in the area.



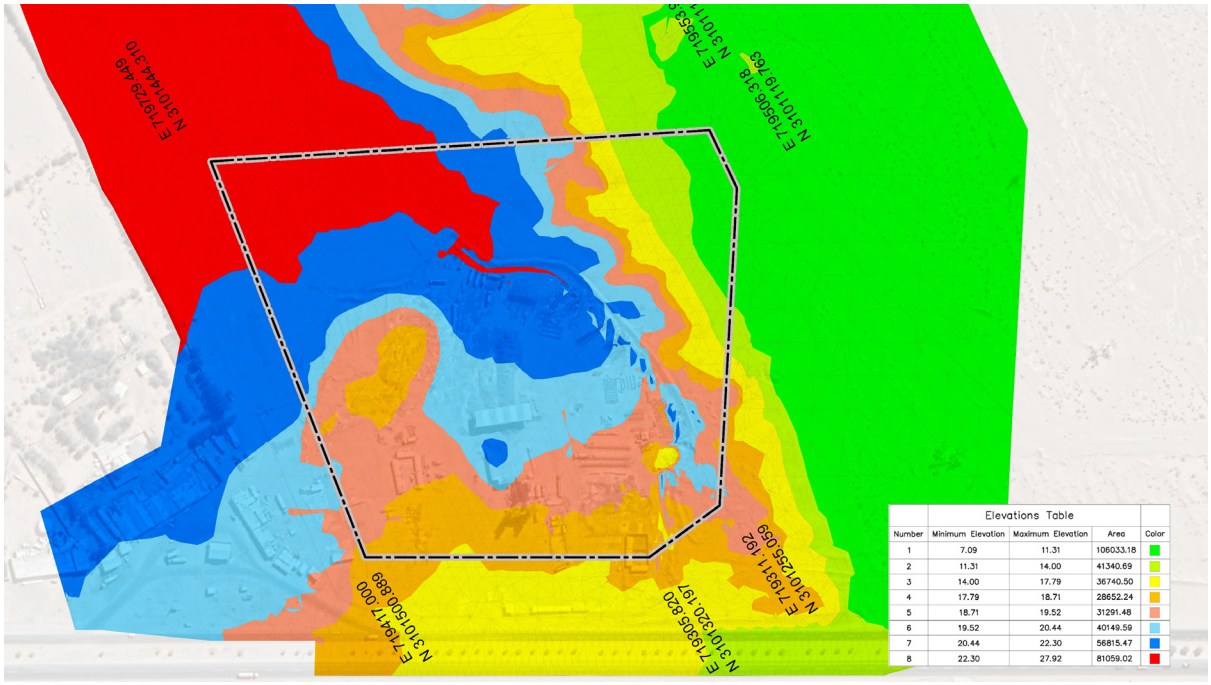
Surface and boundaries.



Solar & presipitation studio.

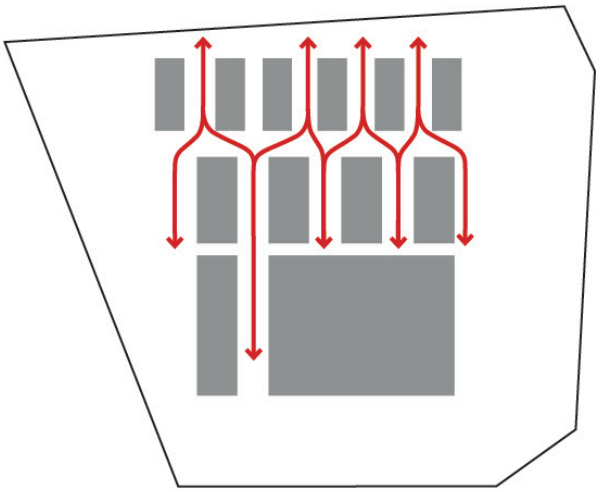


Predominant wind studio.



Topographic analysis.

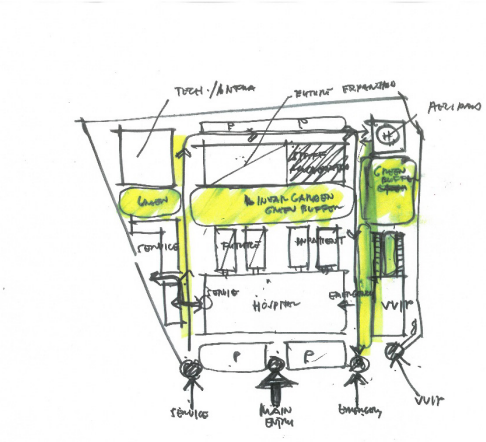
Design process.



INTERLOCKING BLOCKS

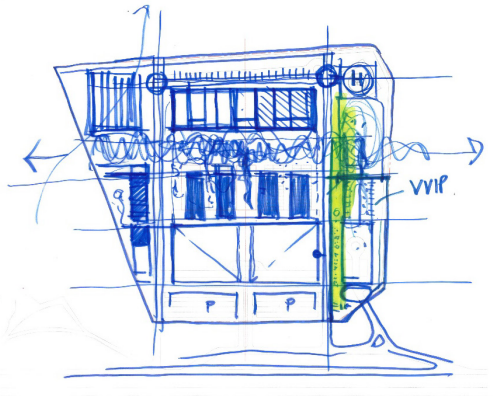
The bonding hands that hold and protect was the concept of the master plan, from this it was developed an abstract distribution of the building and green pockets that represent the fingers on an interlocking relation in between them, the result is the infrastructure merging with the site.

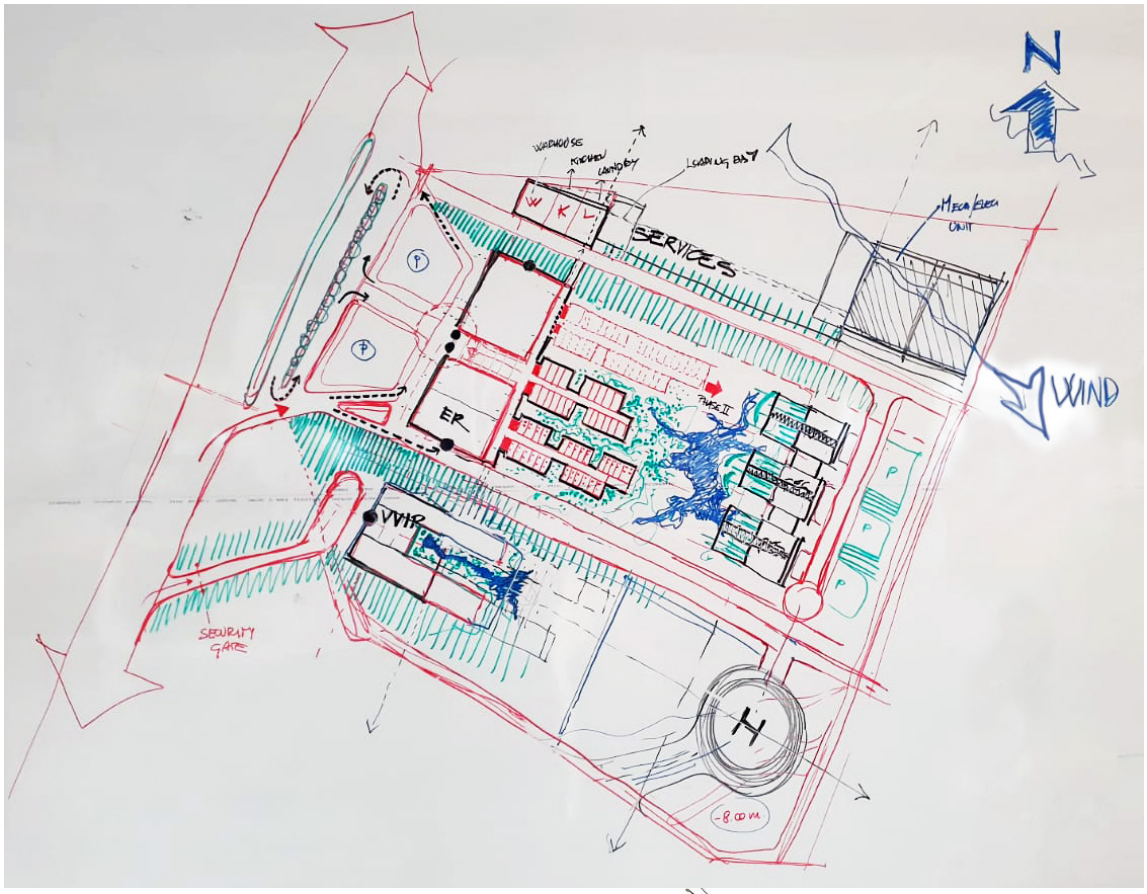
Once the master plan distribution was decided the design exploration started on defining the best location of the different areas of the program with the approximated sqm requested so the masterplan could start to have his final shape.



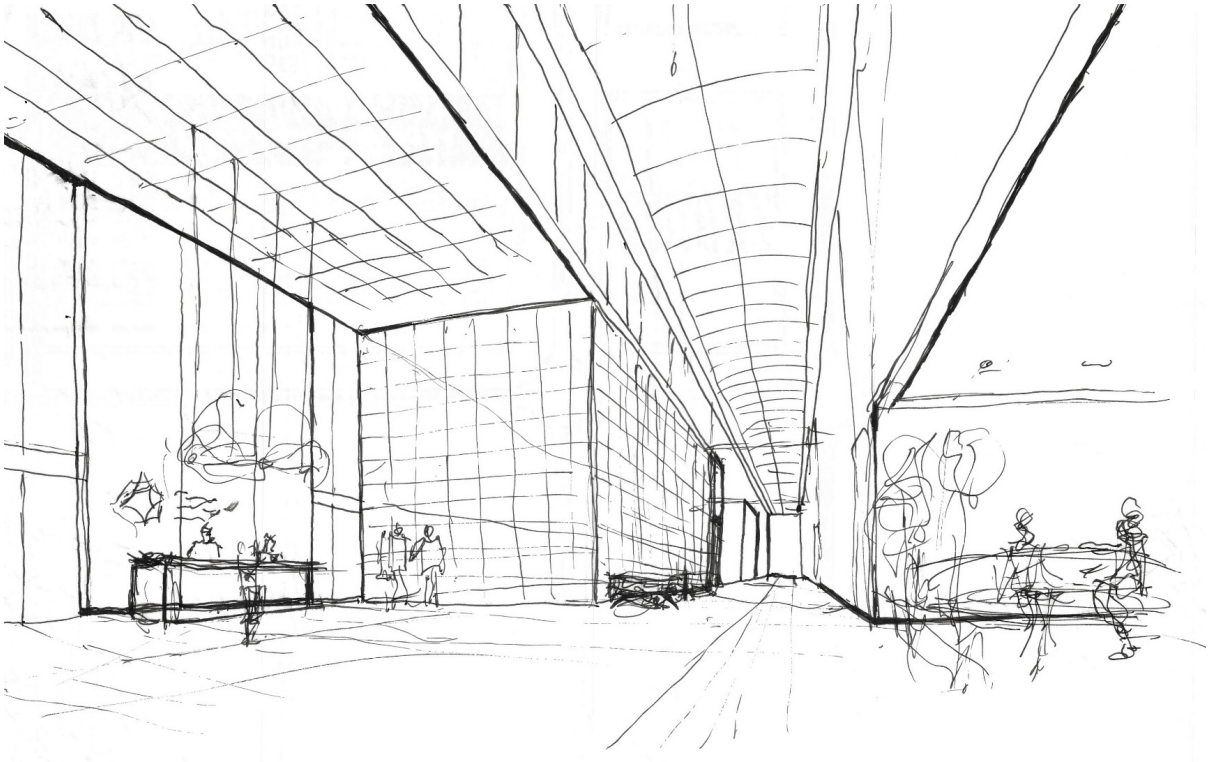
Master plan design exploration.

The design of the hospital starts from the exploration of the main corridor in section and perspectives of how it will look, this because with the acknowledgment that the construction system will be modular units the main corridor will work as an axis where the distribution and connection of the modules will start, so the design has the chance to variate from the typical module to a space more open and flexible to reflect the hierarchy of it.

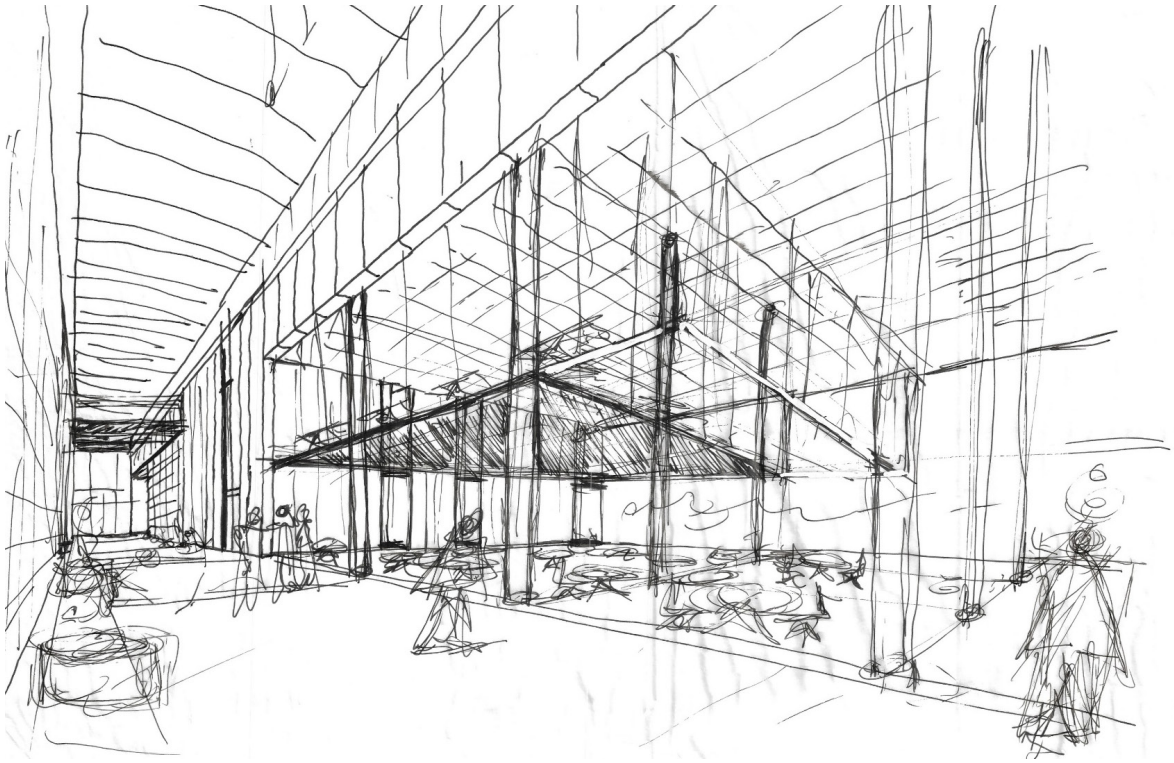




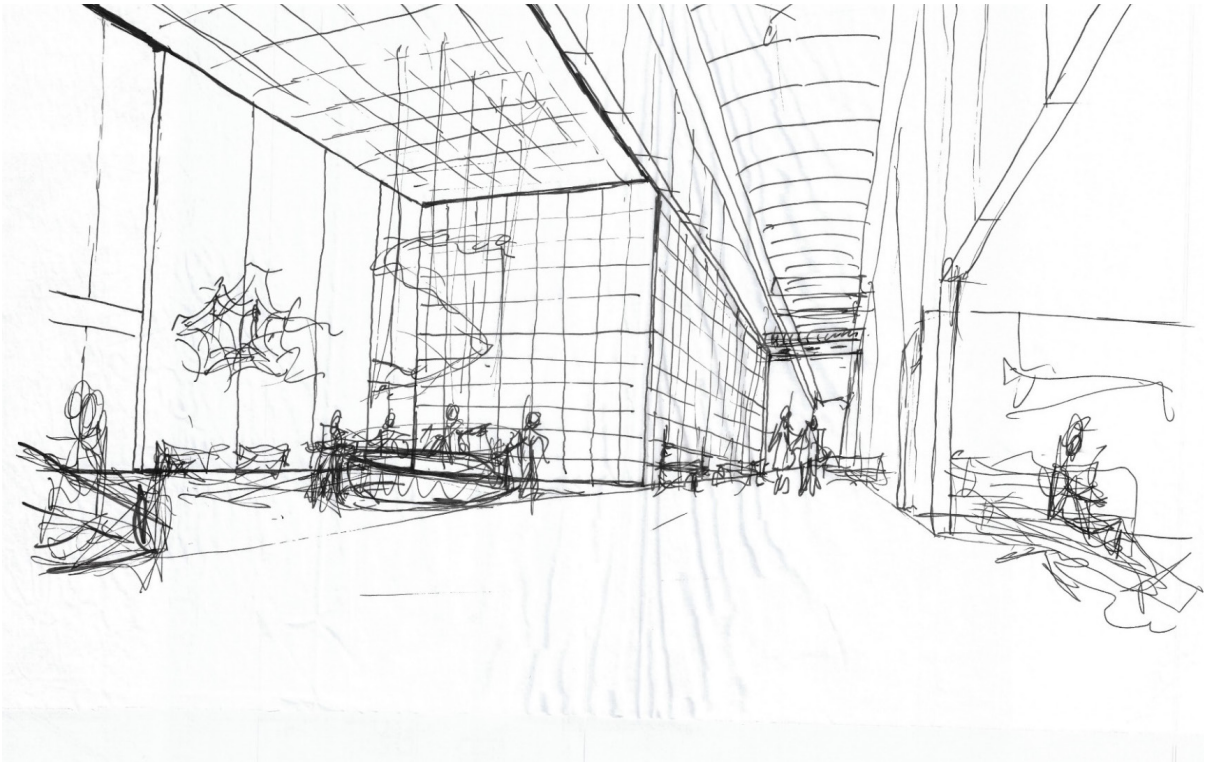
Master plan design exploration.



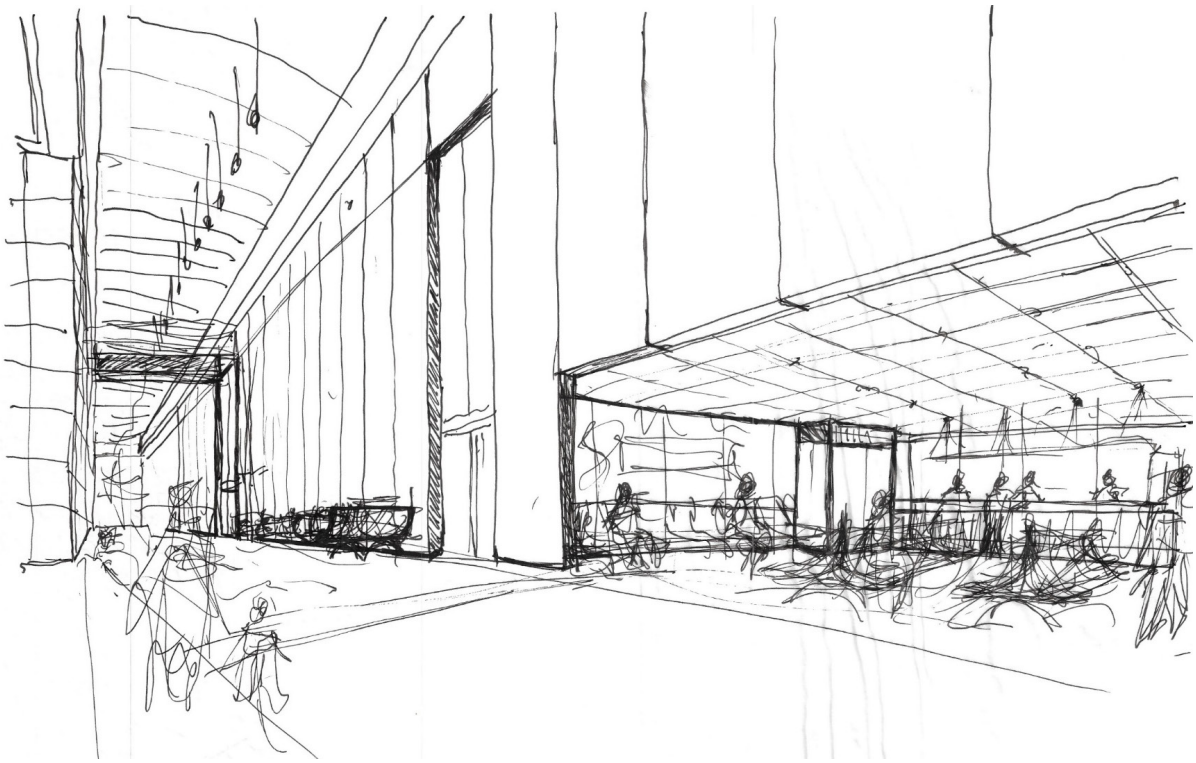
Interior view design exploration.



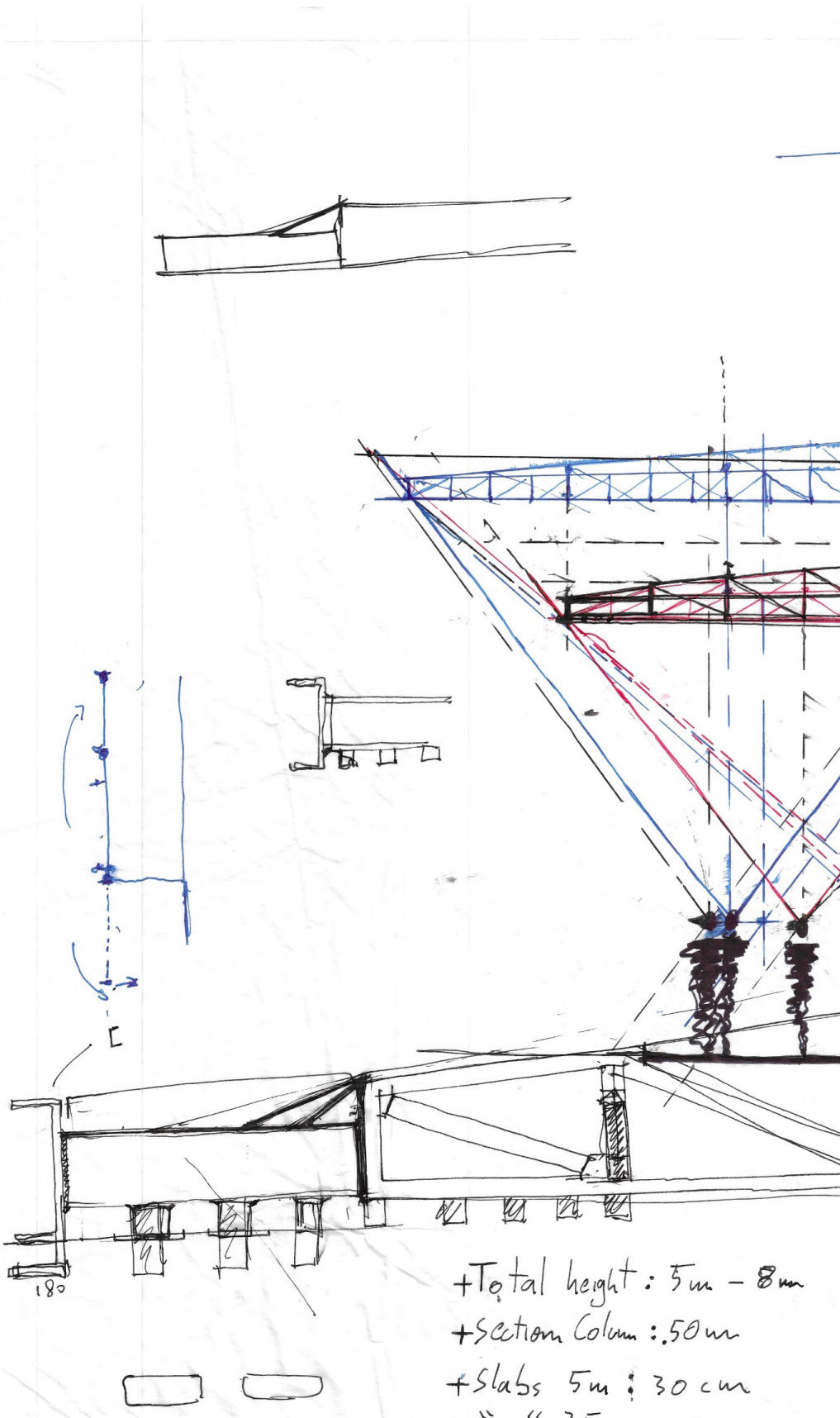
Interior view design exploration.



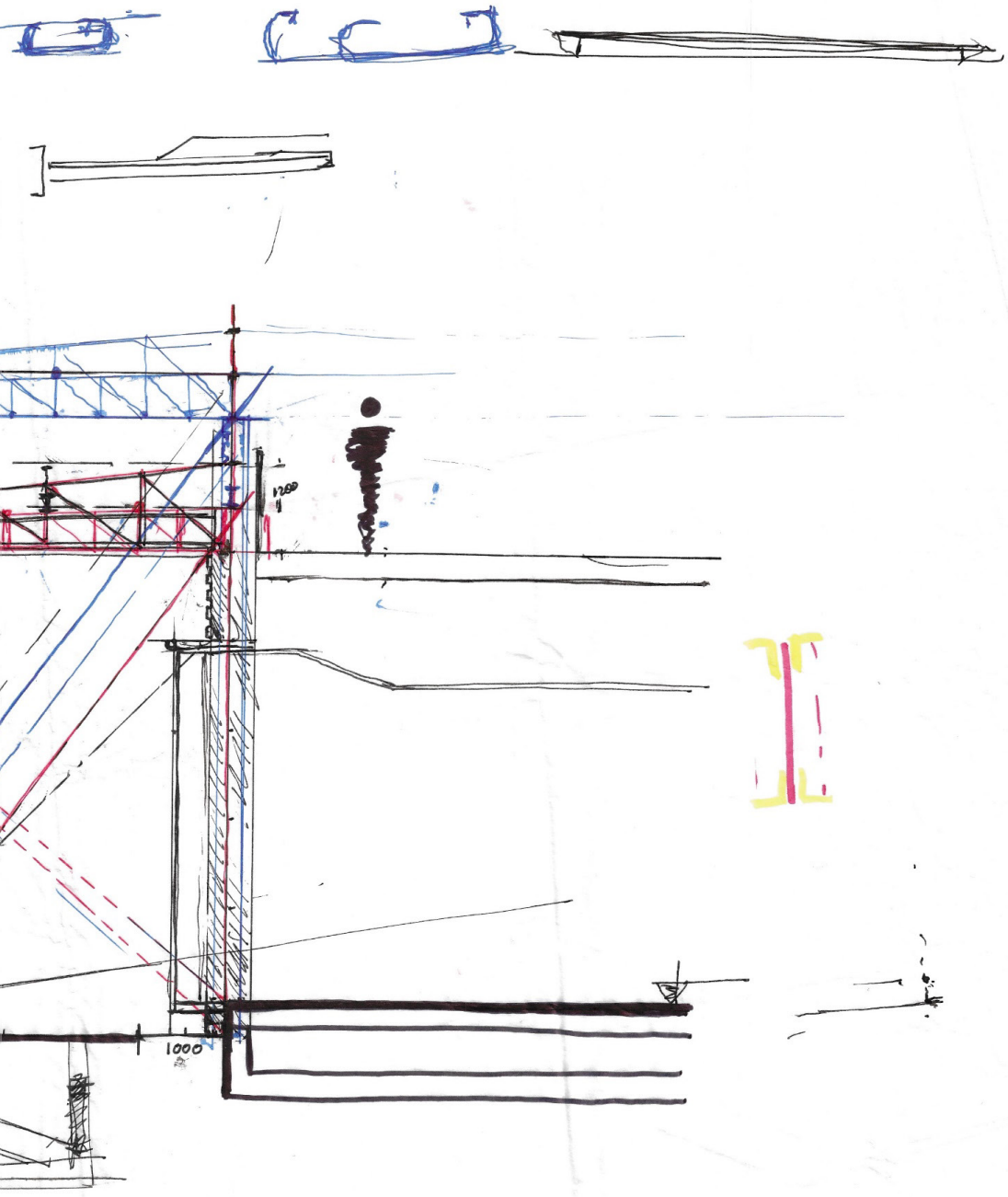
Interior view design exploration.



Interior view design exploration.



Main access facade section studio.

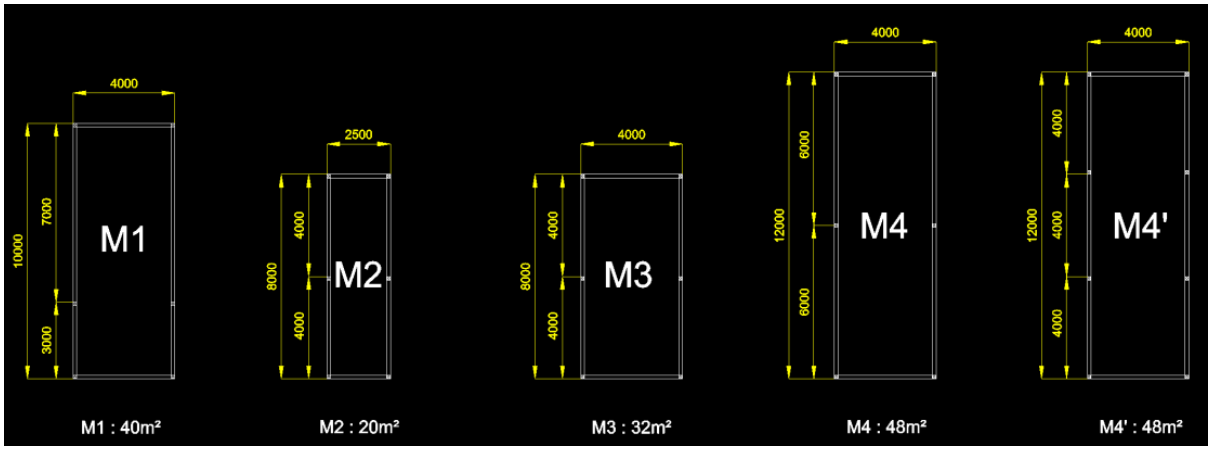


+ level Hospital int. : 30 cm
+ Wards Height: 30cm + 5 m no texa.
+ Axis of Column : check
+ Boundary of hospital: check
+ Height of Parapet: ~~1.05m~~ 1.20m.

Design strategy.

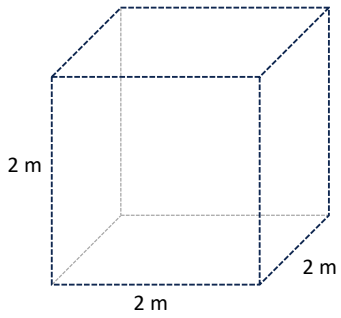
A general grid based on the proportions of the modular system selected was the base for planning and design all the spaces of the hospital. The company selected for providing the modules gave a list of the modules that has to be use, these were 5 modules of 40 to 48 m2 having a standard width of 4 m and variable length as shown in the figure 1.5.

For matching the proportions of all the buildings, even if they were built with traditional construction systems, the unit of the grid was set in a 2 x 2 x 2 m network. This decision helped to coordinate the preliminary constructions works to start one month sooner than expected.



1.5 Standarized Modules frames.
Source: Newfab compay catalogue.

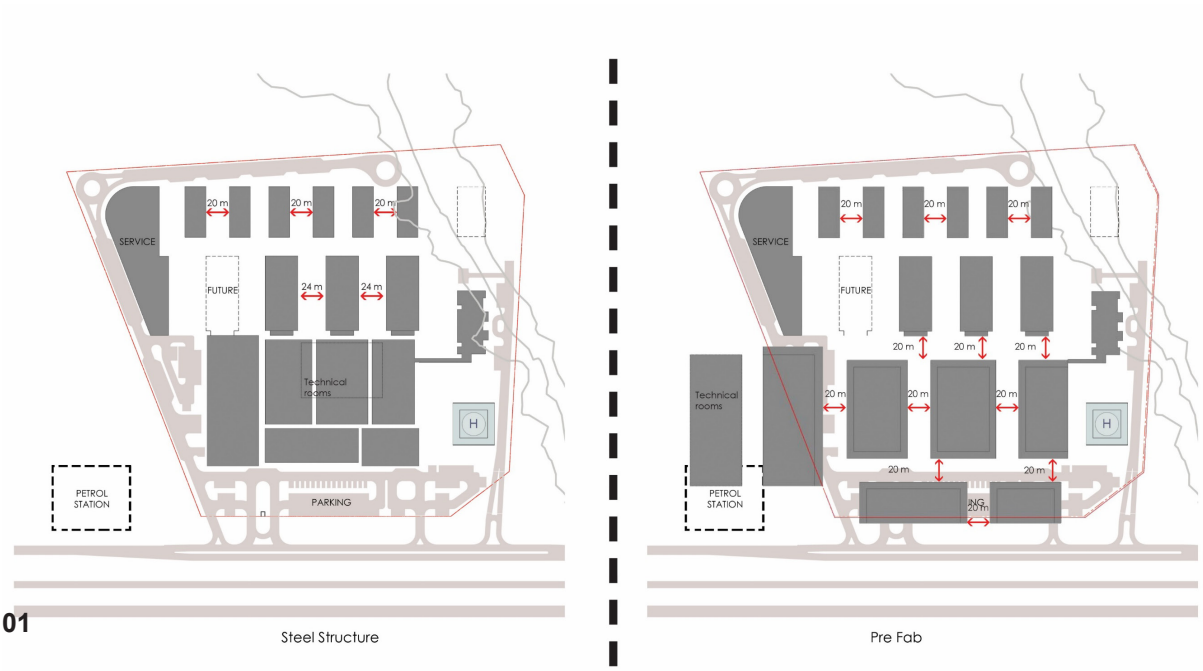
UNIT:



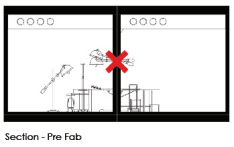
Challenges, solutions, and decisions.

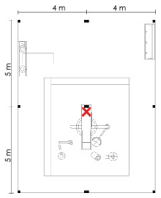
Even all the cautions and preliminary studios that were taken for not slowing down the process the challenges and problems appear. This, mainly because the modular system was not flexible at all and what at the beginning was an idea to save time and be efficient showed the reality that the limitations that has in terms of planning, structure

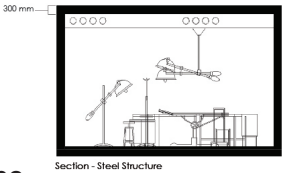
and constructability will represent a mayor cost in time and money leading the project to fail. The decision taken was to switch the building technique to a traditional steel structure, thanks to the previous action of stablish everything in the project to fit to the grid of 2 by 2 this didn't represent a major impact. From a 90% prefabricated construction now was completely the opposite making the project to be 80% traditional construction.



01

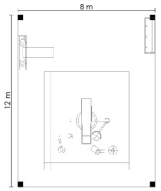

Section - Pre Fab

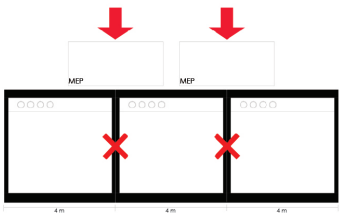




Section - Steel Structure

02





03

Diagrams in this page:

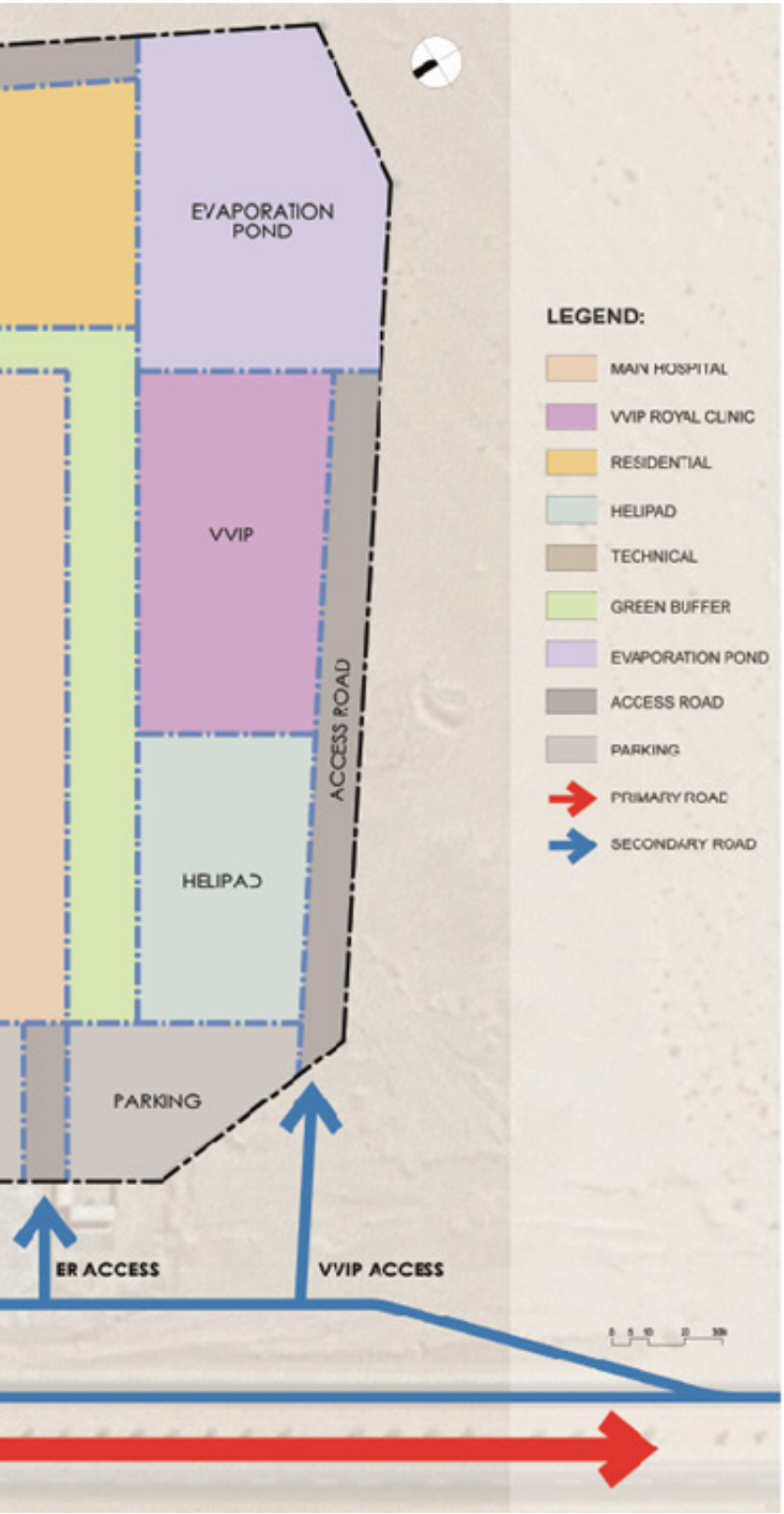
01.- Impact on the master plan of the needed cranes for positioning the prefabricted modules.

02.- Impact of the prefabricated modules structure in the operation rooms.

03.- Structural failure becuse of the weight of the HVC and MEP equipments.


ACCESS ROAD
RESIDENTIAL
TECHNICAL
GREEN BUFFER
MAIN HOSPITAL
PARKING
PARKING
PARKING
SERVICE ACCESS
MAIN HOSPITAL ACCESS

Zoning.

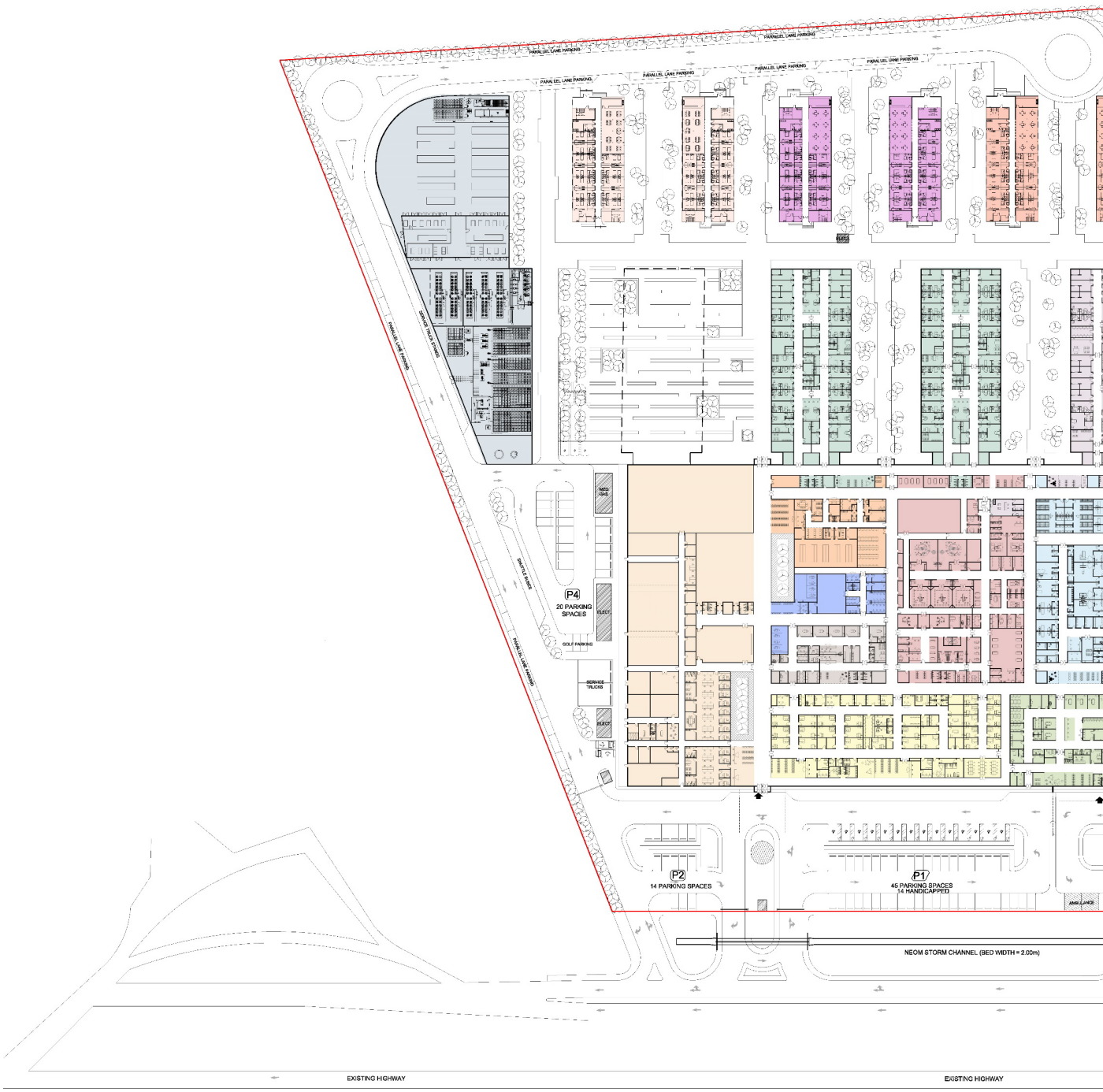


The general zoning of the project was maintained just with a minor change of switching the helipad position to the front of the plot so it could provide service to the Hospital and the VVIP clinic. The area where it was before was decided to be used as an evaporation pond taking in consideration that because of the topography of the site that will be the natural discharge of the rainwater.

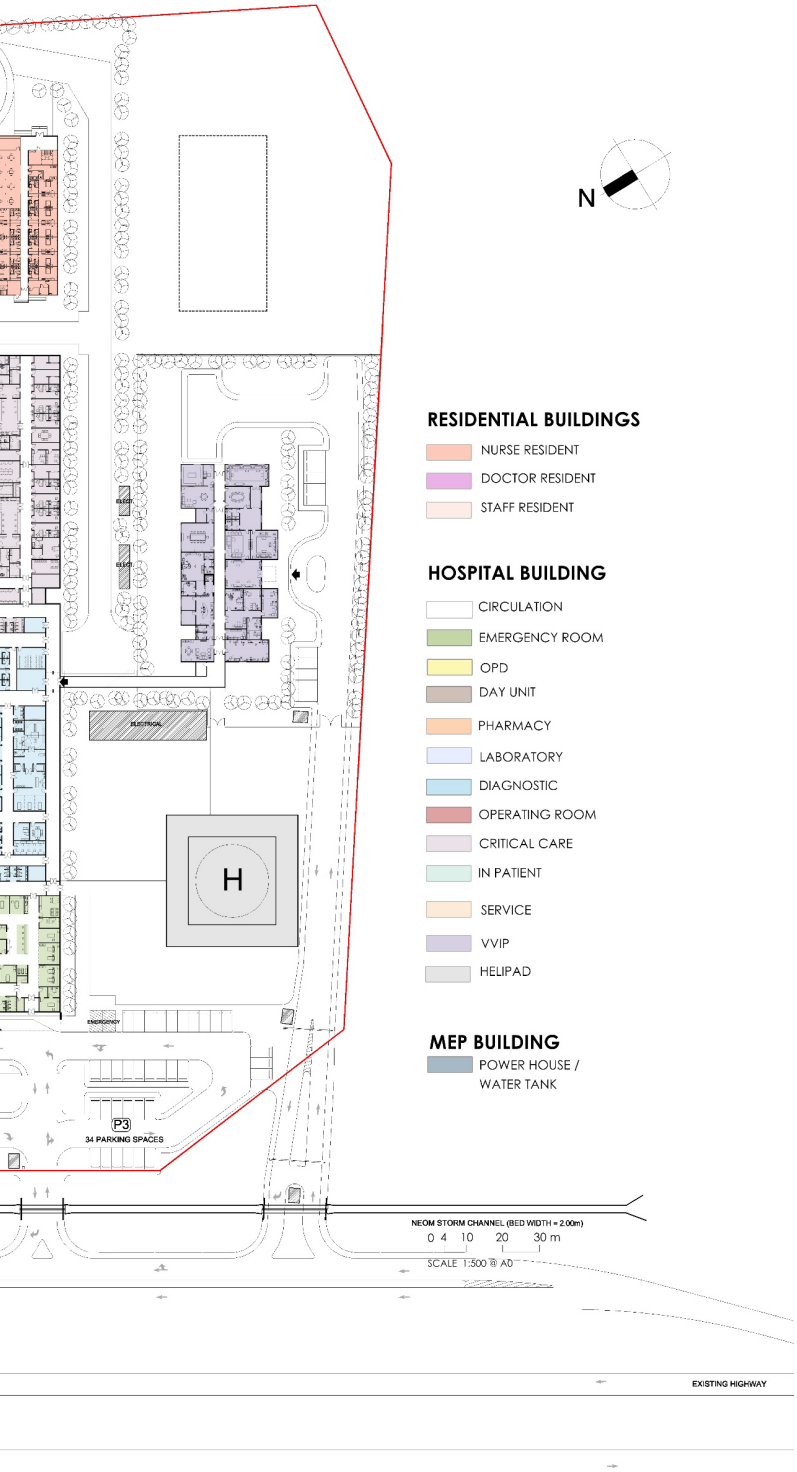

STP
Power House
Fuel Tank
Trans.
Chiller Yard
Water Tank
Medical Gas
Staff Res.
Staff Res.
Doctor Res.
Doctor Res.
Nurse Res.
In-Patient
In-Patient
PHARMACY
LABORATORY
OR
DIAGNOS
SERVICES
DAY UNIT
OPD
ER
P4
23 PARKING SPACES
SERVICE ENTRANCE
MAIN ENTRANCE
P2
14 PARKING SPACES
P1
45 PARKING SPACES
14 HANDICAPPED
SERVICE ACCESS
MAIN ACCESS
NEOM STORM CHANNEL (BED WIDTH = 2.00m)

Master plan.

Final master plan where it can be appreciated the initial intention of the concept with the interlocking blocks and the green pockets working as a buffer from the residential area and main hospital.


PARALLEL LANE PARKING
SERVICE TRUCK STAND
P4
20 PARKING SPACES
GOLF PARKING
SERVICE TRUCKS
ELECT.
P2
14 PARKING SPACES
P1
45 PARKING SPACES
14 HANDICAPPED
AMBULANCE
NEOM STORM CHANNEL (BED WIDTH = 2.00m)
EXISTING HIGHWAY
EXISTING HIGHWAY

Detail zoning.



In the detail zoning of the hospital can be appreciated the impact that represents to have a Royal clinic in the project. This change the normal circulation flow of a hospital because it is considered as the more important area of it. Normally diagnostic department must be in direct contact with the outpatient department, the operation rooms, and the emergency unit, when the royal clinic is involved, this must be in direct contact with diagnostics and the operation rooms in case any of the VVIP patient needs a quick intervention from these areas, providing a short path connection that can be secured and locked by the royal guard.

Also, the different constructions systems can be notice showing how the residential and the inpatient wards are the only areas that follow the modular system meanwhile the rest of the buildings don't.

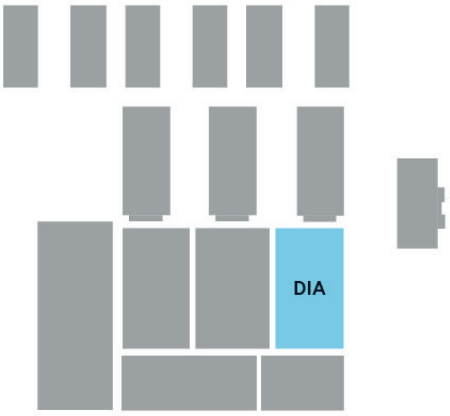

WALKWAY
CIRCULATION
EMERGENCY ROOM
OPD
DAY UNIT
PHARMACY
LABORATORY
DIAGNOSTIC
OPERATING ROOM
CRITICAL CARE
IN PATIENT
SERVICE
VVIP
HELIPAD
MAIN
ER DROP OFF

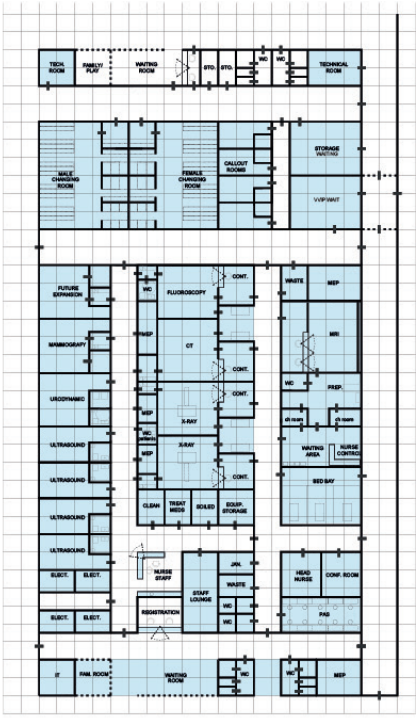
The hospital.

The internal distribution of the hospital is based on the main axis proposed from the conceptual design, working as the main connection between the departments but also as a separation from the services areas.

The ER department is in the lower right corner of the building for having an individual access for ambulance and to the helipad, also has the possibility to be locked down in case it exists a contingency that requires it without stopping the functionality of the rest of the hospital.

It is important to notice that with the implications that the Royal clinic factor it was decided that the transport of delicate materials, such as food and contaminated products will be done from outside with shuttles, it was evaluated that the risk it represents was less than have an internal transportation of them.



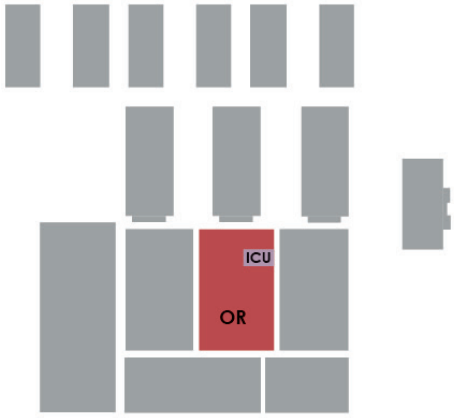


Diagnostic

The department counts with the following areas: Fluoroscopy, X-Ray, Mammography, CT, MRI, Ultrasound, laboratory, Blood Bank, Urodynamics, Electro diagnostics Lab, Clean Store, Soiled Store, Treatment & Meds room, Head Nurse Office, Nursing Station, Nursing Lounge, family room, conference room, waiting rooms and washroom sets.

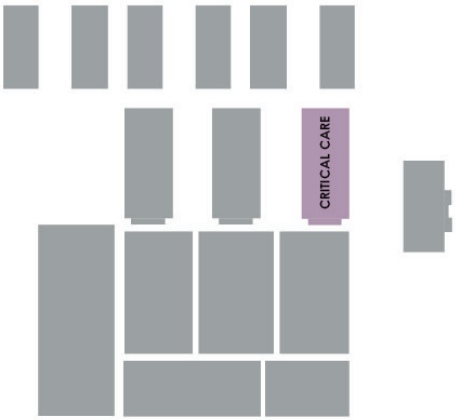
Emergency room

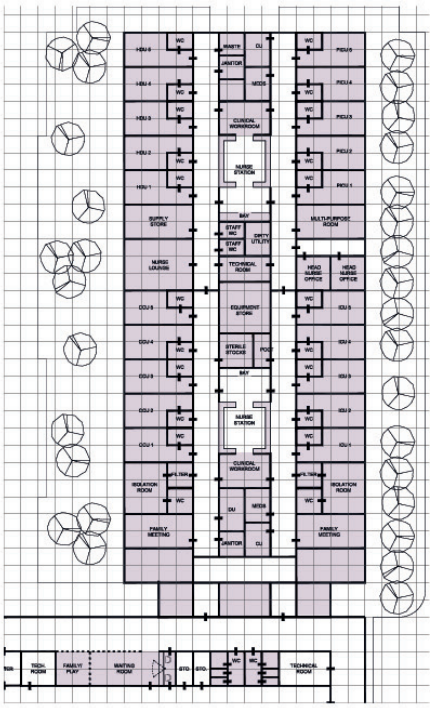
The department counts with the following areas: ER Beds/rooms, Triage Room, Resuscitation Rooms, Isolation rooms, ER Reception Area, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, Ortho Gypsum Room, Conference Room, Waiting Rooms, Washroom sets, On Call Doctor Room with washroom, Security Office, and Service room.



Operating room

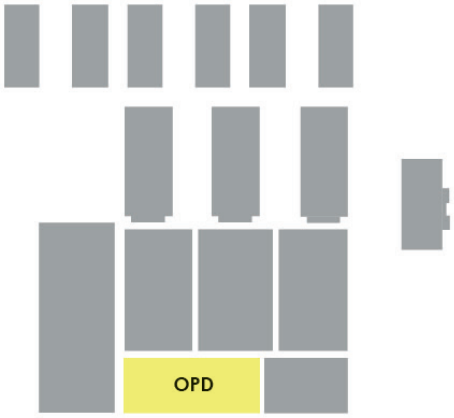
The department counts with the following areas: Regular Operation Rooms, Hybrid Neuro & cardiac EP Lab & OR, OBGYN OR, Delivery Units, Interventional Radiology Suite, Endoscopy Unit, Recovery & Pre-Procedure Room, Procedures/OR Reception, Procedures/OR Storage, CSSD, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, Ortho Room, Conference Room, Waiting Rooms, Washroom sets, Anesthesia unit, Medical gas room, and a surgical equipment.





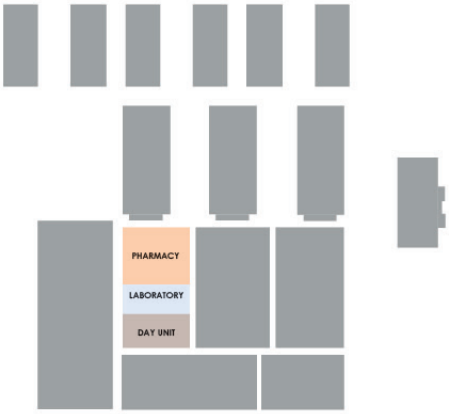
Critical care

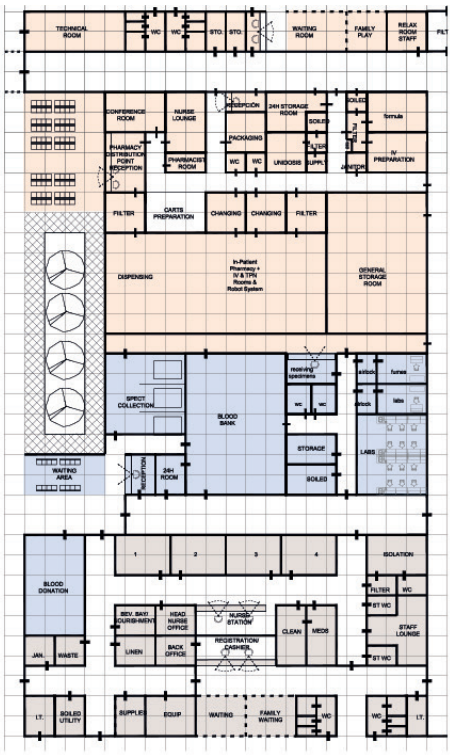
The department counts with the following areas: Adult ICU Beds/rooms, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, PT & OT Room, Conference Room, Waiting Rooms, Wash-room sets, CCU (5 Beds/rooms), PICU (5 Beds/rooms), NICU (5 Beds/rooms), High Dependency Unit HDU (5 Beds/rooms), and Filing Room.



Outpatient department

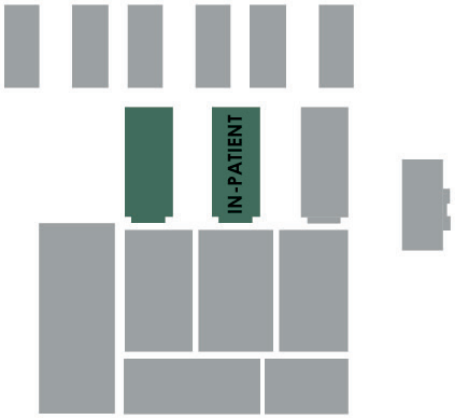
The department counts with the following areas: OPD Clinics Suites, Clinic Rooms, Vitals Room, OPD Clinics Suites OBGYN, OPD Clinics Suites Ophthalmology, OPD Clinics Suites ENT, OPD Clinic Suite 7 Dental Clinics, Dental X-Ray Room, Out-Patient Pharmacy, Robotic Dispenser, Pharmacist Office, Supplies Storage, Waiting Rooms, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, Play Room, Conference Room, Waiting Rooms, Washroom sets and PT & OT Room.

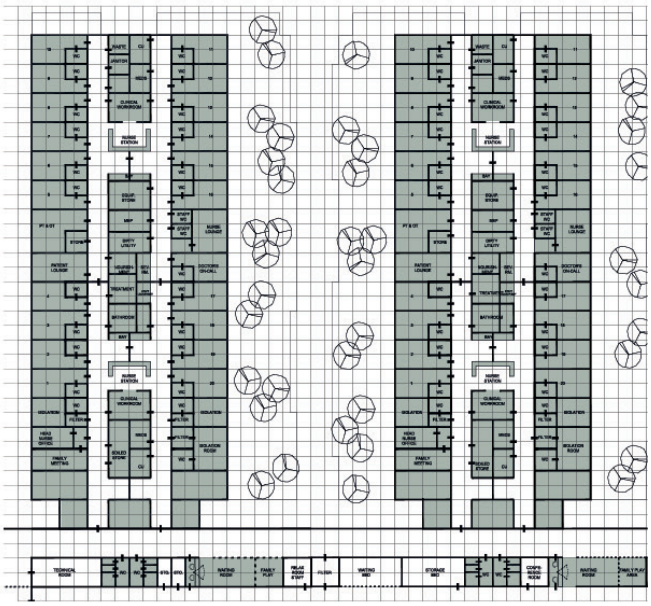




Laboratory, pharmacy & day unit

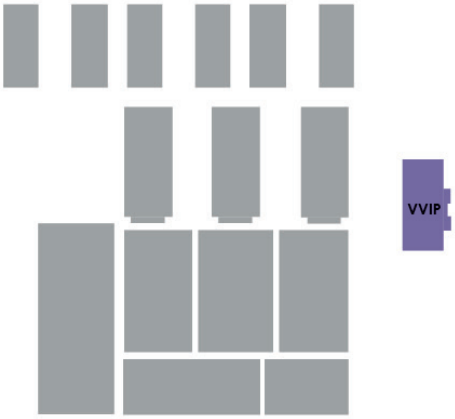
The department counts with the following areas: Laboratory, pharmacy and Day Clinical Care Unit, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, PT & OT Room, Conference Room, Waiting Rooms and Washroom sets.

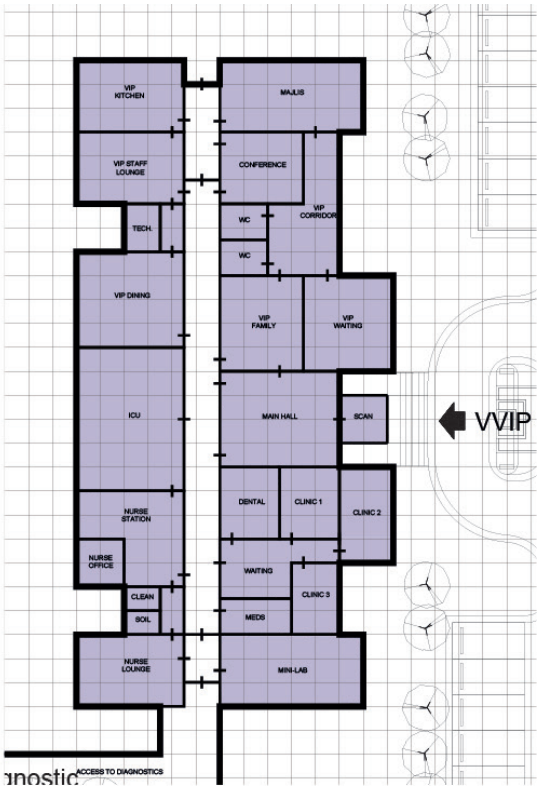




Inpatient department

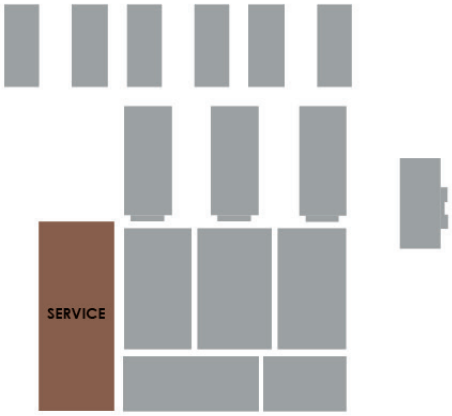
The department counts with the following areas: In-Patient Pharmacy + IV & TPN Rooms & Robot System, Storage, Pharmacist Office, Pharmacy Lounge, TPA Room, IV Preparation, Conference Room, Waiting Rooms, Washroom sets, Adult Admission Wards, Patient Rooms, Clean Store, Soiled Store, Treatment & Meds Room, Head Nurse Office, Nursing Station, Nursing Lounge, Family Room, PT & OT Room, Conference Room, Waiting Rooms, Washroom sets, Adult Admission Wards, Admission Ward 3 Pediatrics, Admission Ward OBGYN, Nursery and Admission Ward Psychiatry.

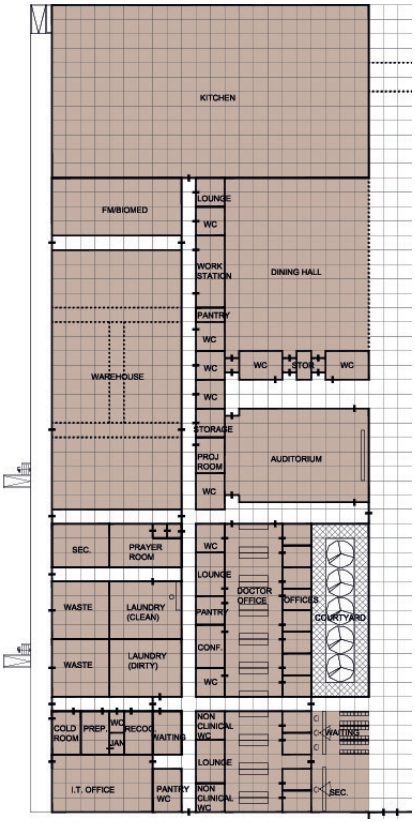




VVIP clinic

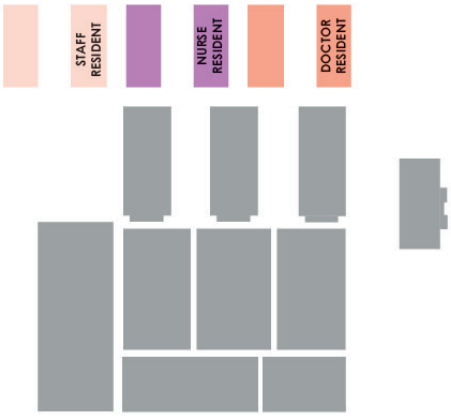
The department counts with the following areas: VIP ICU 1Royal Suite (including 1 Patient ICU Room, 1 main bathroom, 1 dressing room connected to all VIP amenities, Nursing Station, Head Nurse Office, Nursing Lounge, Family Room, Waiting Rooms, washroom sets, Clinic (2 Rooms + 1 multipurpose diagnostic 1 Dental room), Conference room, Staff lounge, Mini Lab, Lounge Majlis, Dining Lounge, Treatment & Meds Room, Mini Kitchen, Clean Store and Soiled Store.

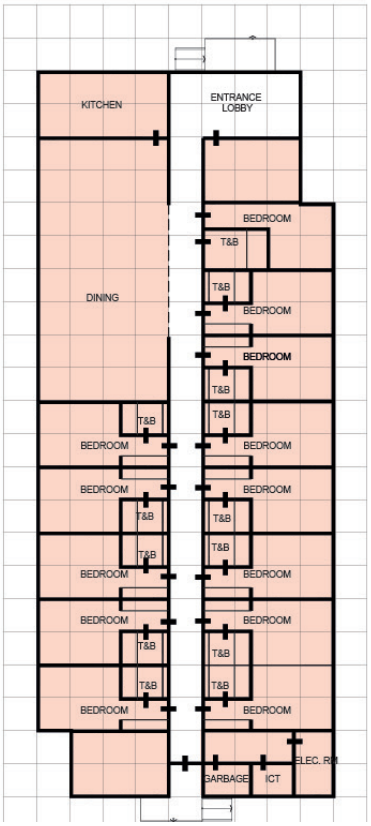




Services

The department counts with the following areas: Warehouse, Central Kitchen, Kitchen Store, Dinning Hall, Washroom sets, General Staff Lounge, Auditorium, Security Control Center, Laundry, IT Servers Storage, Staff Offices Suite, Washroom sets, Conference Room, Waiting rooms and Mortuary Room.





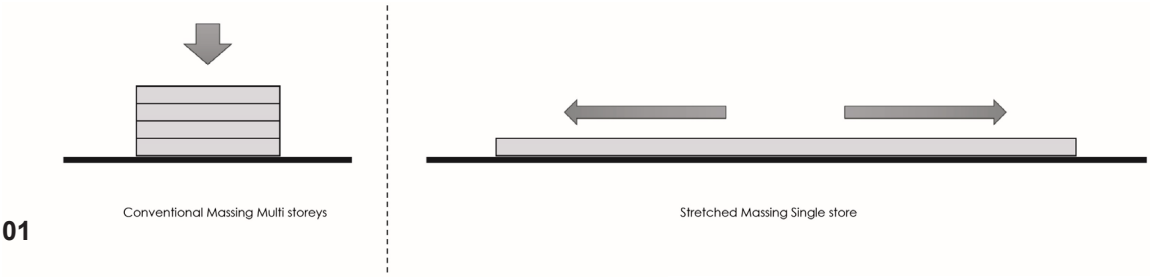
Residential buildings

The residential units count with the following areas: 24 single rooms, share kitchen, dining room and a business center. The master plan counts with 6 residential buildings giving a total of 144 rooms.

Main façade analysis.

The design of the main façade represented a challenge because of the geometry and proportions of the building. The conventional massing of general hospitals is mostly solved in a multistorey building, in the case of the Neom hospital the massing was a thin and long line out of conventional proportions with a height of 8 m and a length of 182 m. With this proportions there were two actions to do, break the long façade into sections with better proportions or highlight the longitudinally of it, it was decided to follow the second option creating a game of contrast between light and shadow.

To achieve this it was proposed first to highlight more the proportion with a setback of the mechanical areas on the roof so it will be perceived that the height of the first plane of the façade was reduced to 6 m. Another action was to propose the use of a curtain wall with a tinted and fritted glass of a vivid color to accentuate the contrast between the desertic landscape and the building. Using a glass façade transform the light from inside of the building into an architectural feature during the night time but the inconvenient of using this material was that during the day time the glass will be completely exposed and the interior will be affected by the solar radiation and the extreme high temperature of the desert, to reduce the impact of it was proposed a canopy with a 8 m cantilever along the glass façade that will be seen as a blade that generate a clean cut of shadow between the building and the horizon.



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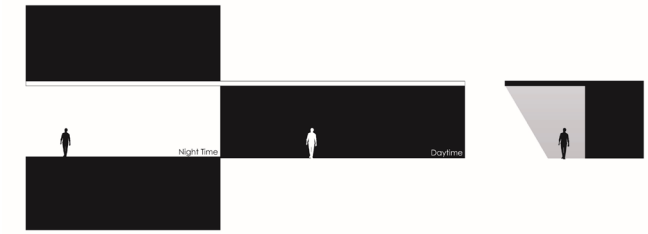
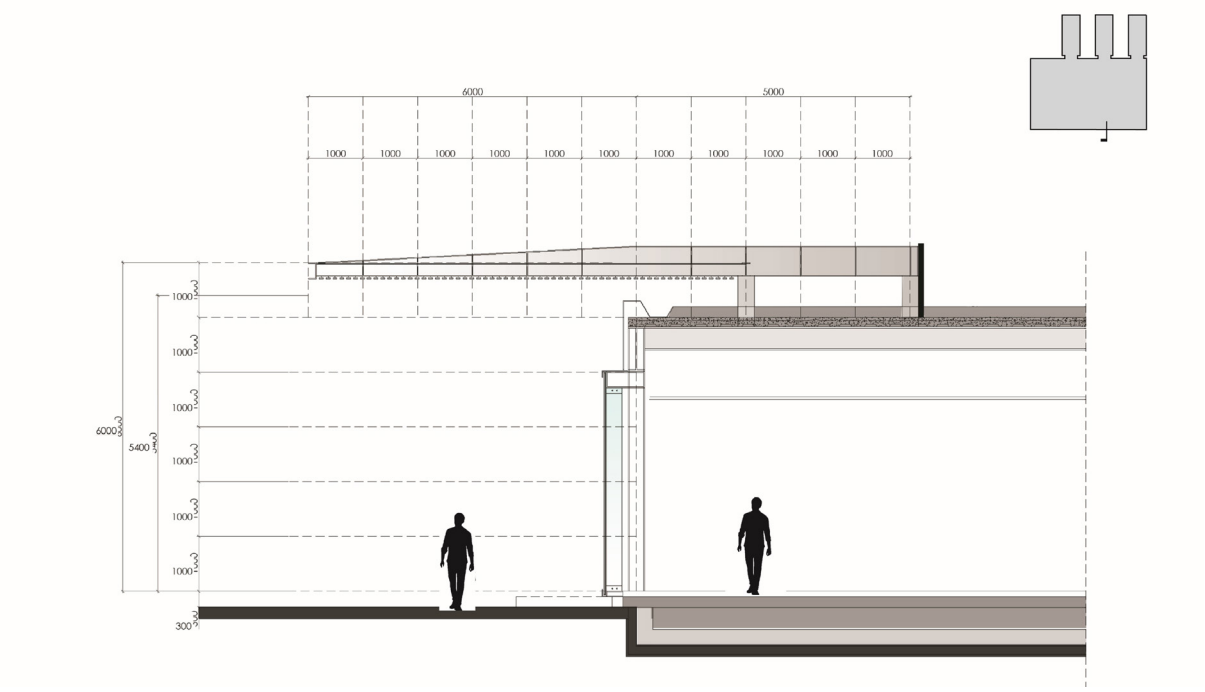


02

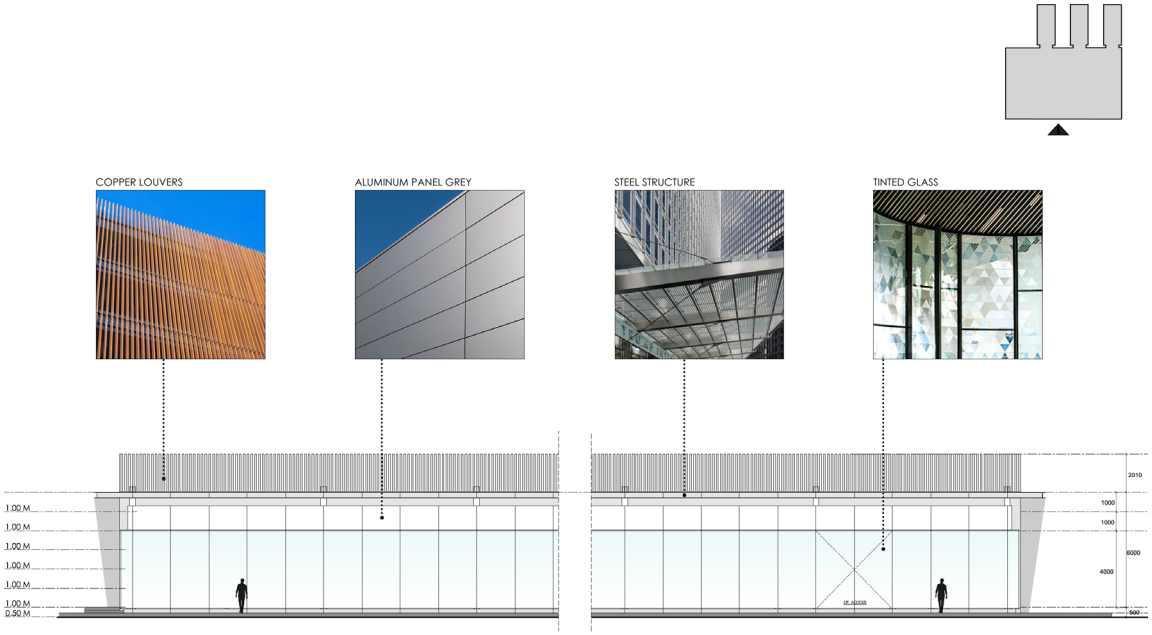
Diagrams in this page:

01.- Facade proportion.

02.- Light and shadow contrast.



Main façade section



Main façade section materials proposal

Geometrical studio.

One of the requirements of the client was that the face should show the identity of Neom reflecting the futurist, high-tech and modern technology, and values that it is based on, but still it has to be taking into acount that the budget for it was already given and the solutions should not pass it.

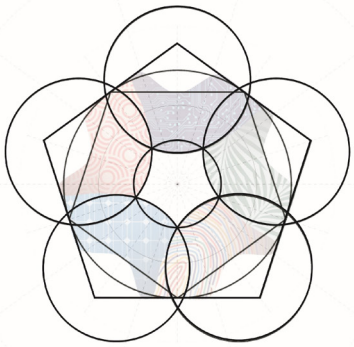
The solution to this was to create a fractal geometry with solid, translucid and transparent elements on it, to form a network of volumes that give the impression of a tridimensional texture by creating the ilusion that the objects were in different planes deeper than they really are.

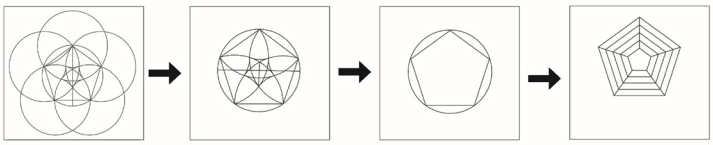
The logo of Neom was the base of the design and as a first action was to decompose and understand the geometry so it could be synthesized into an abstract geometrical form, a pentagon divided in 5 sectors that gradualy arrive to a center.

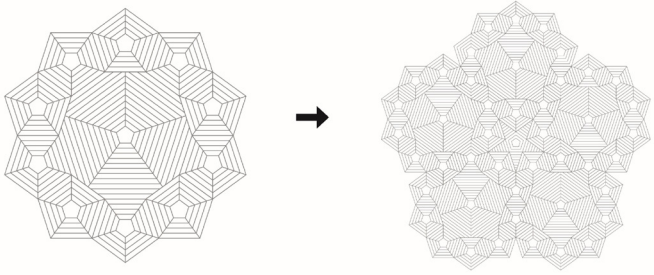
This pentagon with its divisions, was used to create a geometrical pattern replicating it in a radial distribution over a central penthagon to form a 10-point star to create a modern version of a traditional Arabic composition. The next step was to create a penthagon with the 10/point stars so we come back to the original shape of the logo keeping the same proportion.

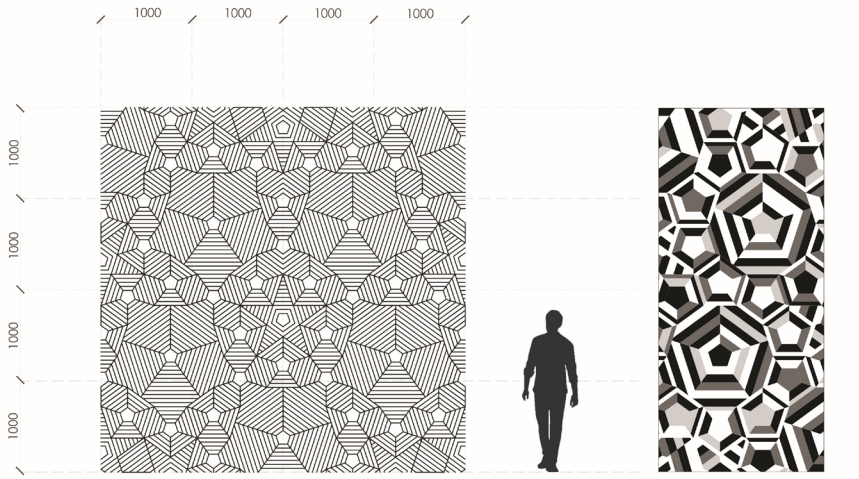
Once with a defined geometry, this was applied to the curtain wall panels to fit into the construction system, and taking advantage of the symmetry of the geometry it was scale considerating the proportion it will have with the human scale. Also, this action helped to reduce the number of different panels requiered into just to 2 so the production will not become more complicated.

The last step to achieve the effect desire was to set an aleatory texture of solid, translucid and transparent using a green palete defined by the color of the Saudi arabian flag.





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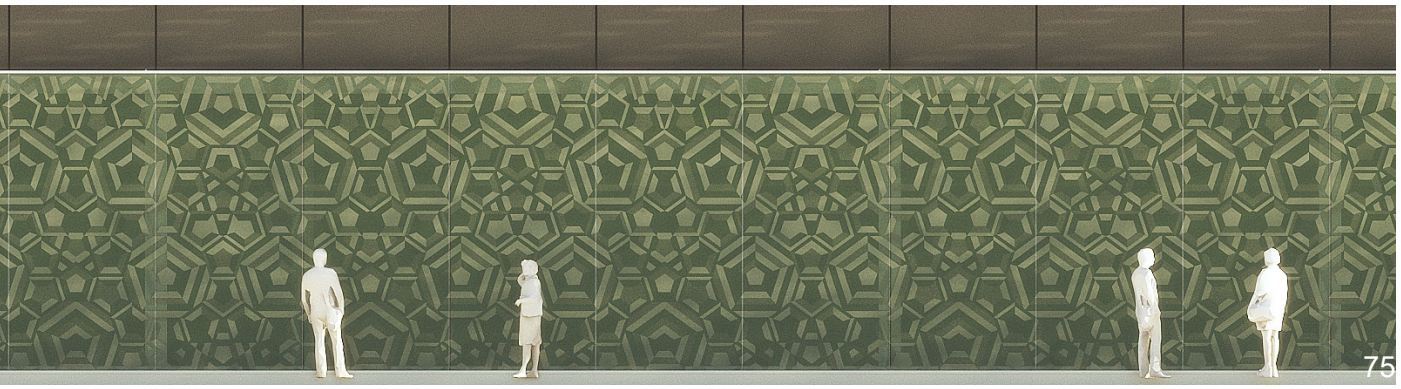


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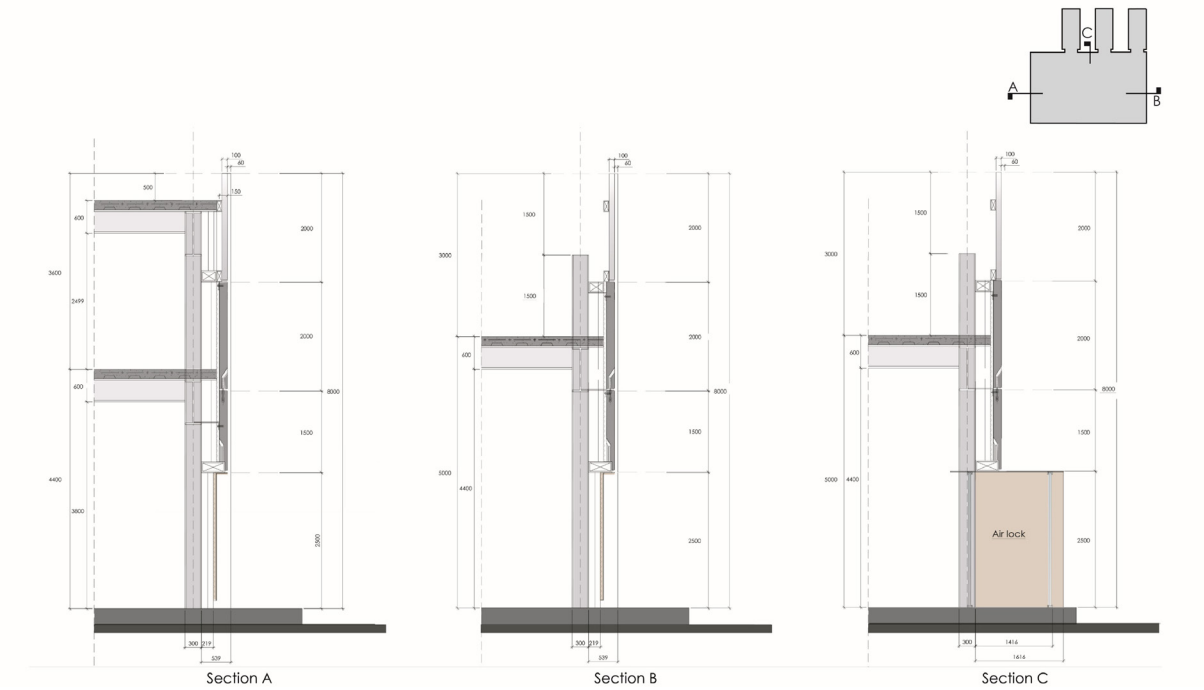
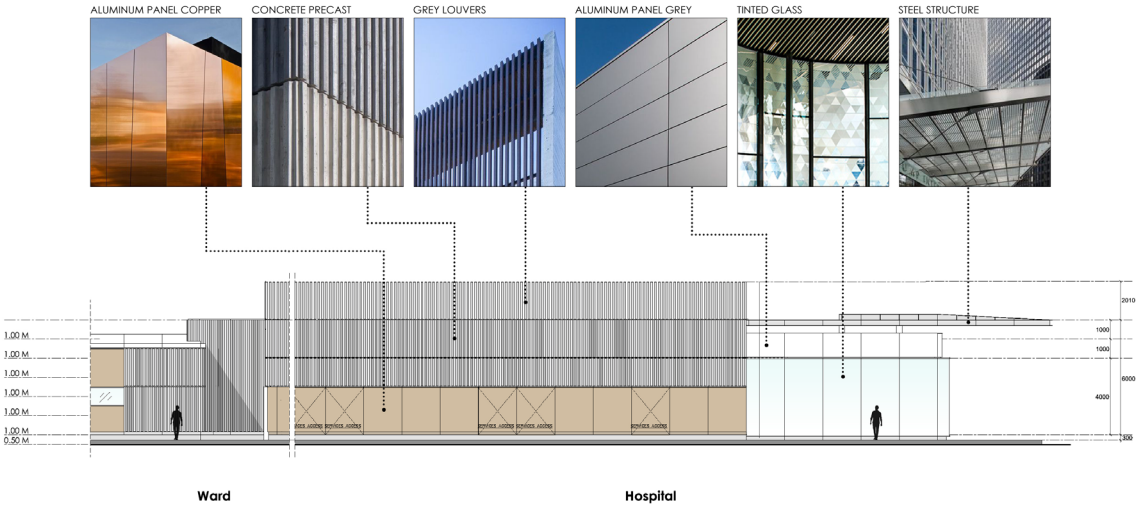
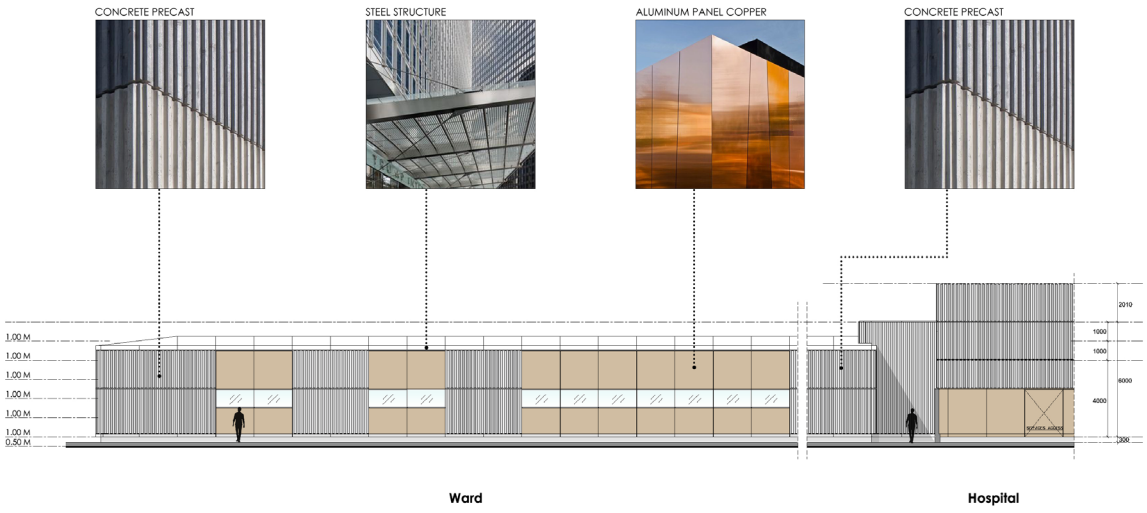


The lateral and back façade of the hospital was defined by creating three typical sections that will be applied all along the perimeter of the main body of the hospital. Section A used in areas of indoor mechanical equipment, section B in areas of open-air mechanical equipment, and section C in areas with accesses.



Lateral façade section materials proposal

The façade of the wards was design with the modular system requirements, and were reduced to only two typologies, a full closed façade, and a window unit façade, using the same materials as the main body of the hospital so the design line was continuing even the construction system have changed.



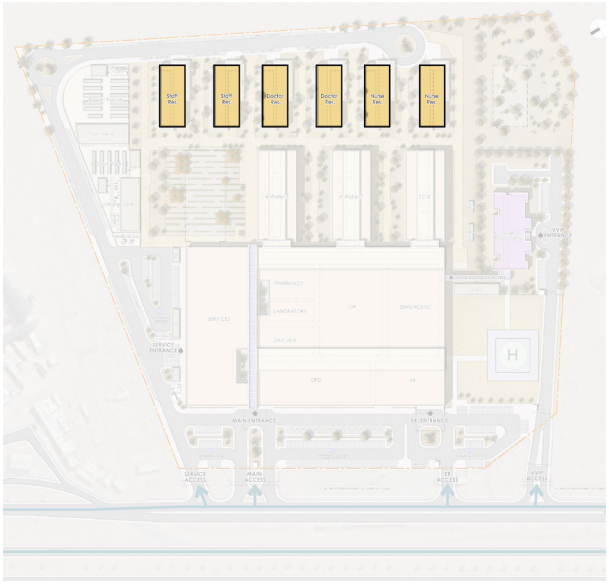
Wards façade section materials proposal

Residential façade analysis.

The residential façade was the one that must be simpler on its design, because it was necessary to follow the modular system, the material proposed was a multi-layered panel with external finish of cement and various finishes on the interior depending of the function of the module.

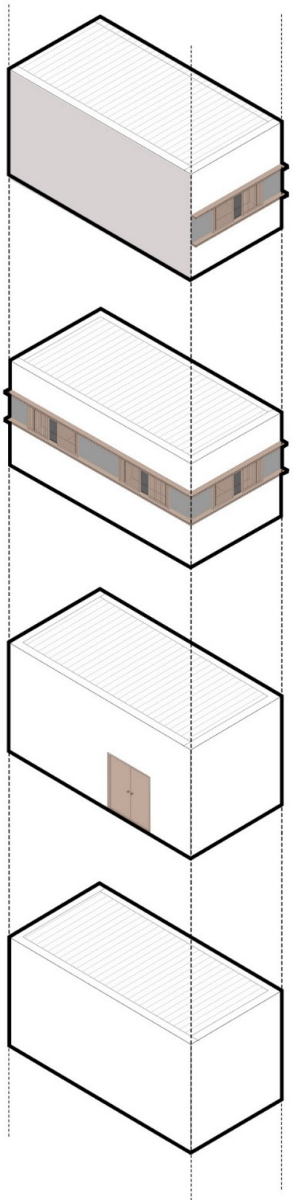
The total number of modules, based on the geometry and the façade, where 4, a central unit that has a window opening, a corner unit with window openings, an access corner unit, and a close corner unit.

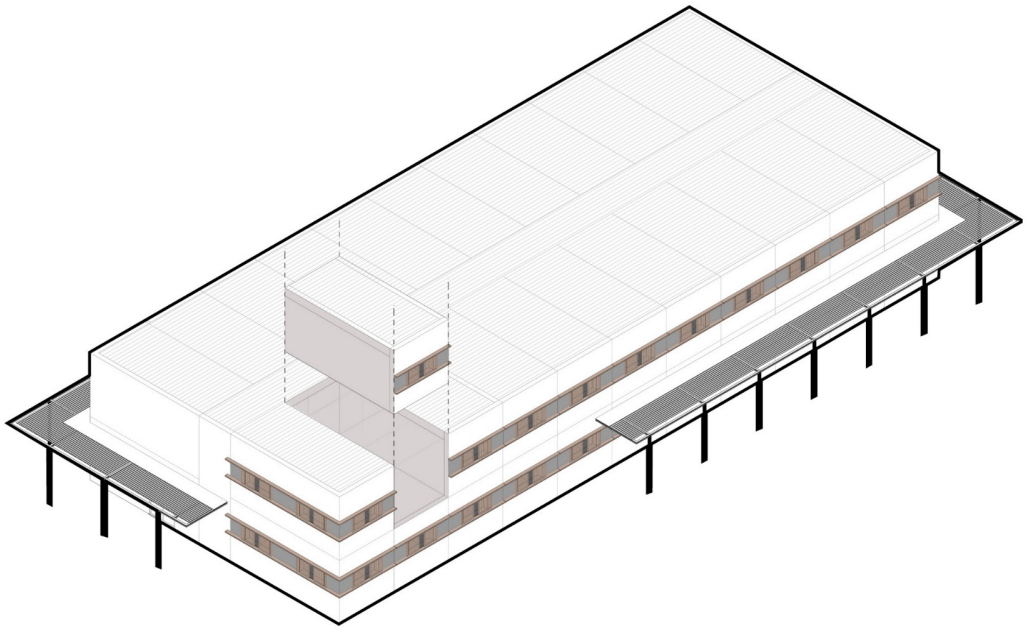
These modules could host the different functions inside the residential building as shown in the floor plan diagram.

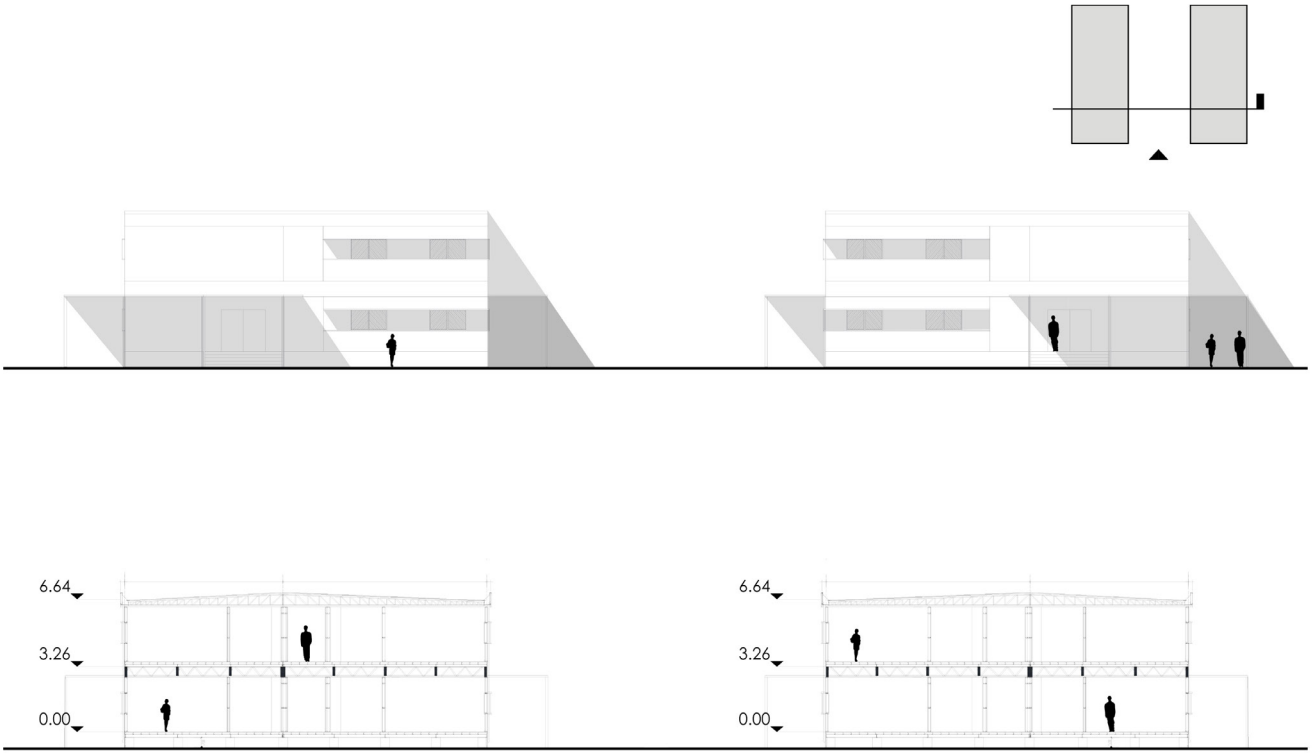


GROUND FLOOR

FIRST FLOOR


Central Unit
Corner Unit
Entrance Unit
Close Corner Unit

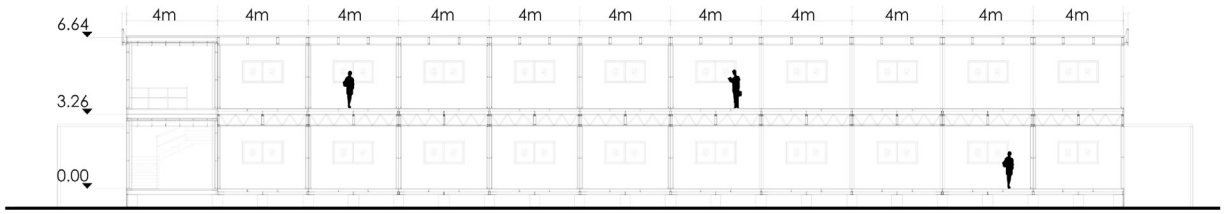




Short façades and transversal sections

In the sections it is marked the structural reinforcements that the prefabricated modules needed to be used for a two-level construction. The big remark that can be made about the construction system is that it is no flexible at all, and the reality is that only the structure is modular only if the designer doesn't stress the system out of the limits that the producer set. The interior and exterior of the modules depends on the use they are designated for, therefor they became a special production for every project.

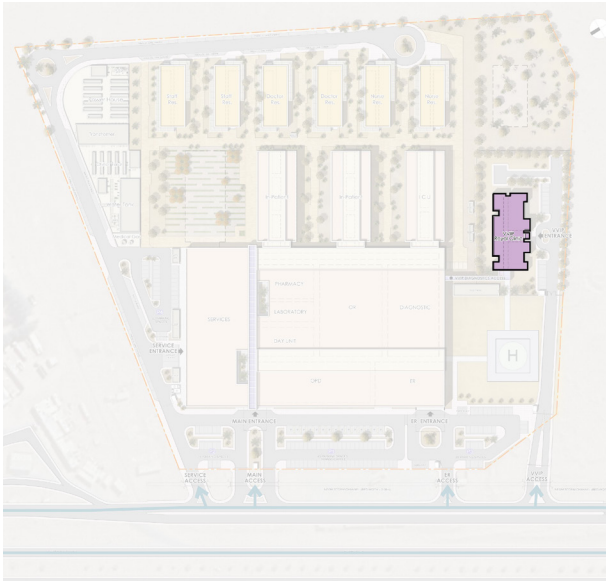
It is true that the modular construction is fast and reduce costs but only for specific typologies of projects and if the design is not out of the guidelines, if not the original advantage turns down to a low construction because of the specific planification and high cost because the uinic prizes that has to be done separately breaking the production line of the factory.



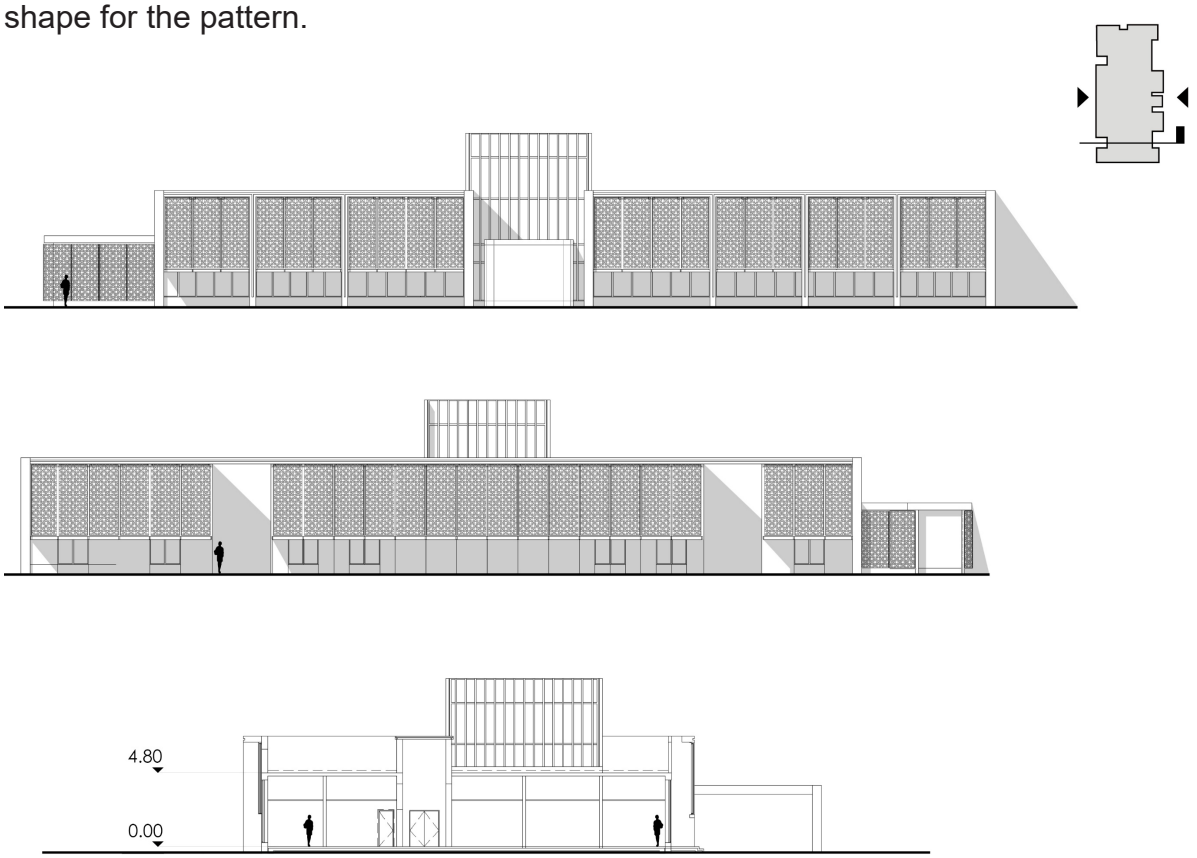
Long façades and transversal sections

VVIP clinic façade analysis.

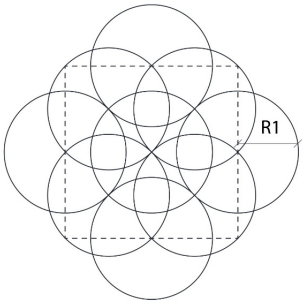
The Royal clinic building has a façade design based in a contemporary interpretation of the Hejazi architecture. This architectural style can be found along the coast of the red sea, it has Yemeni and Egyptian influence, the most notorious characteristic is the use of the Roshan. The Roshan is a bay window covered with a mashrabiya, this consists in a wooden panel with geometric patterns that provide privacy, natural ventilation, and shading.



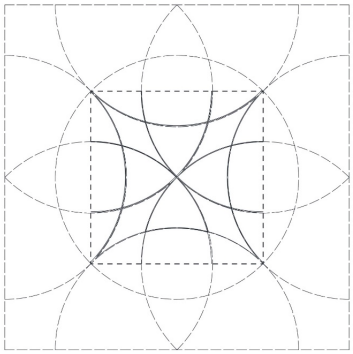
The Roshan element was the one used as base of the design creating a contemporary version of it following the same process of synthesis and abstraction as in the hospital main façade, with the difference of instead of using a rectilinear shape it was decided to use a circular shape for the pattern.



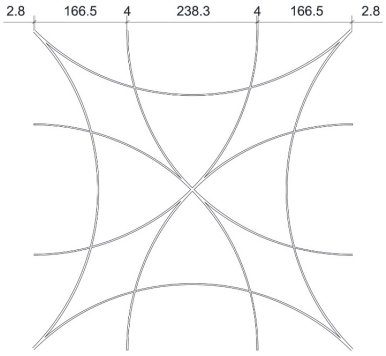
Façades & section



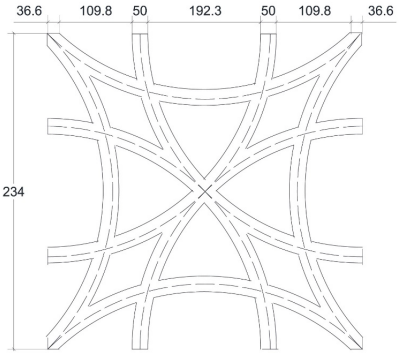
Circular Geometry



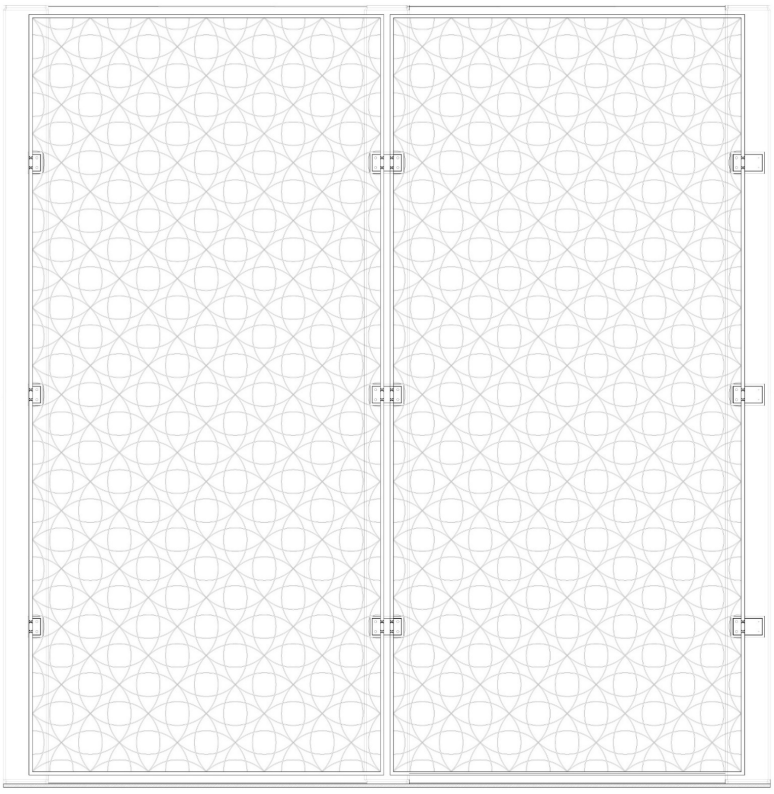
Circular Geometry Component



ALUMINUM OPTION



GRC OPTION

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Conclusions

In the big picture of the marketing strategy created to attract investment and tourism to the Kingdom of Saudi Arabia, the flag ship NEOM hospital is just a little consequence of the giga projects that are release month by month in social media and news broadcasts. The flag ship hospital it may not be the line, trojena, oxagon, sindalah, leyja or epicon, but is a key part of the city behind the cities of the “future”, and the most important part is that is real.

The future of this paradoxical network of infrastructure that is continually built for building the cities of “the future” in the Kingdom of Saudi Arabia is uncertain, there are two scenarios and neither of them seems to be promising. The first is, what if the giga projects are completed? This means that the probabilities of them to become slums where people that can’t afore to live inside the utopia will occupied them or they will be demolish and abandoned leaving scars on the landscape as reminder of the cost of the so call future. The second is, what if the giga projects are not completed? That will lead us to the same result, even it is known that people appropriate the spaces the question is, which people? on a scenario where the plan to increase the density of the country fail, the possibilities turn back to the same result as in the first one, slums and modern ruins. It just rests to work and wait, remembering that in architecture there is no correct answers but there is a lot of wrong ones, there is a lot of responsibility that needs to be taken into account. At the end, time will be the one that show the results of the Saudi Arabian dream.

The case study presented also show how the combination of the disciplines of the practice is needed to achieve its construction; it is undeniable that architecture is not a one-person practice, and no matter the point of view of the architect the fact is that each person is a key part of the process, and because of that they have the responsibility of taking into account every stage of knowledge. For this, the academia has now a days, as always, an enormous challenge maintaining and reinforcing the core of the practice, but at the same time evolving and incorporating new process and techniques. Both actions have to be done because the market and technology is forcing more and more the architectural practice to a cliff of software and tools that can’t be avoid, and if they are not used with solid foundations the architects will get stuck into an infinite helix of filling gaps of ignorance, there are not short cuts in the creative process, there are not short cuts in architecture.

From the designer point of view, with the experience of being involved in the Saudi Arabian environment, and with a Mexican and Italian architectural education, full of tradition, the questions of what architecture and architects are doing rise in every project developed and seeing the direction that the Arabian architectural dream is heading questioning this and everything about it became more a responsibility than a consequence. It must be known that the only way to be a better architect is doing architecture, understanding "doing" as, drawing, reading, writing, building, and living it…

Si, l’architettura è una bella contraddizine….
Si, la arquitectura es una hermosa contradicción….
Yes, Architecture is a beautiful contradiction…

Bibliography

Books

- Cuff, Dana. *Architecture: The Story of Practice.* Cambridge: MIT, 1991.
- Deamer, Peggy. *The architect as worker: Immaterial labor, the creative class and the politics of design*. London; New York: Bloomsbury ACADEMIC, 2015.
- Vitruvius, Pollio. *The Architecture of Marcus Vitruvius Pollio : In Ten Books.* England: Priestley and Weale, 1826.

Articles

- Blas, Perla. *Casas chicas, problemas grandes (reportaje).* Aristegui noticias. June 19, 2015. https://aristeguinoticias.com/1906/mexico/casas-chicas-problemas-grandes-reportaje/.
- Cuff, Dana. *Historical License: Architectural History in the Architectural Profession.* Journal of the Society of Architectural Historians 76, no. 1 (2017): 5–9. https://www.jstor.org/stable/26418963.
- De la Rosa, Tomas. *Muere un gigante, aplican eutanasia a casas Geo.* Eje central. November 22, 2018. https://www.ejecentral.com.mx/muere-una-gigante-aplican-eutanasia-casas-geo/.
- Dovey, Kim. *Journal of Architectural and Planning Research 13*, no. 3 (1996): 261–64. http://www.jstor.org/stable/43029222
- Goudeau, Jeroen. *The Matrix Regained: Reflections on the Use of the Grid in the Architectural Theories of Nicolaus Goldmann and Jean-Nicolas-Louis Durand.* Architectural Histories, 3(1): 9, pp. 1-17, 2015.
- Küreli Gülpınar, Ece. *Laugier vs Durand: Revisiting Primitive Hut in the Classical Architectural Discourse.* 111-120. 10.17484/yedi.60302. 2016.
- Mayo, James. *Journal of Architectural Education (1984)*, Vol. 46, No. 1. (Sep., 1992), pp. 61-62.
- Walid Fouad, Omar. Professor, Department of Architecture, Faculty of Fine Arts (2018) *"Zero Carbon City- Masdar City Critical Analysis,"* BAU Journal - Health and Wellbeing: Vol. 1: Iss. 3, Article 1. DOI: https://doi.org/10.54729/2789-8288.1053

Websites

- Arcadis IBI group. *Saudi Arabian national spatial strategy & planning act.* IBI Group. Accessed November 24, 2023. https://www.ibigroup.com/ibi-projects/saudi-arabia-national-spatial-strategy-planning-act/.

- Chung, Jackson. *Saudi Arabia's Public Investment Fund Introduces "THE RIG," an Offshore Oil Platform Turned Theme Park.* Techblog. October 27, 2021. https://www.techeblog.com/saudi-arabia-public-investment-fund-pif-the-rig-offshore-oil-theme-park/.

- Dar. *News JCDC appoints Dar to master plan and design phase 1 of the transformational $20bn Jeddah central project.* Dar. June 2, 2022. https://www.dar.com/news/details/jcdc-appoints-dar-to-master-plan-and-design-phase-1-of-the-transformational-$20bn-jeddah-central-project-?org=news.

- Dar. *Work, Jeddah economic city.* Dar. Accessed November 24, 2023. https://www.dar.com/work/project/jeddah-economic-city.

- Forian, Maria – Cristina. *Saudi Arabia unveils design for the Mukaab, a large-scale cube-shaped skyscraper in Riyadh.* Arch daily. February 24, 2023. https://www.archdaily.com/997014/saudi-arabia-unveils-design-for-the-mukaab-a-large-scale-cube-shaped-skyscraper-in-riyadh.

- Getamap. *Sharma.* Getamap. Accessed November 24, 2023. https://www.getamap.net/maps/saudi_arabia/tabuk/_sharma/.

- Indeed editorial team. *12 essential architect skills for success in 2023.* Indeed. September 18, 2023. https://uk.indeed.com/career-advice/career-development/architect-skills.

- Invest Saudi. *Tabuk region. Invest Saudi.* Accessed November 24, 2023. https://www.investsaudi.sa/en/meetTheKingdom/province/tabuk.

- LatLong. *Sharma, Saudi Arabia. LatLong.* Accessed November 24, 2023. https://www.latlong.net/place/sharma-saudi-arabia-25208.html.

- Macrotrends. *Italy population 1950-2030. Macrotrends.* Accessed November 24, 2023. https://www.macrotrends.net/countries/ITA/italy/population.

- Macrotrends. *Mexico city, Mexico metroarea population 1950-2030.* Macrotrends. Accessed November 24, 2023. https://www.macrotrends.net/cities/21853/mexico-city/population.

- Macrotrends. *Mexico population 1950-2030.* Macrotrends. Accessed November 24, 2023. https://www.macrotrends.net/countries/MEX/mexico/population.

- Macrotrends. *Saudi Arabia population 1950-2030.* Macrotrends. Accessed November 24, 2023. https://www.macrotrends.net/countries/SAU/saudi-arabia/population.

- METenders. *Sports complex project – Al Qiddiya entertainment city.* METenders. Accessed November 24, 2023. https://metenders.com/project_cms/project/sports-complex-project-al-qiddiya-entertainment-city.

- New Jersey institute of technology. *10 essential skills needed to be an architect.* New Jersey institute of technology. November 3, 2022. https://www.njit.edu/admissions/blog-posts/10-essential-skills-needed-be-architect.

- Phillpott, Siôn. *15 essential skills needed to be an architect.* CareerAddict. February 12, 2021. https://www.careeraddict.com/architect-skills.

- Pintos, Paula. *Maraya / Giò Forma Studio Associato S.r.l.* Arch daily. March 12, 2019. https://www.archdaily.com/913006/maraya-gio-forma-studio-associato-srl?ad_medium=gallery.

- Ravenscroft, Tom. *Everything you need to know about Saudi Arabia's 14 "giga projects".* Dezeen. September 19, 2023. https://www.dezeen.com/2023/09/19/saudi-arabias-giga-projects/?li_source=LI&li_medium=bottom_block_1.

- Ravenscroft, Tom. *Foster + Partners designs Coral Bloom resort on Saudi Arabian island.* Dezeen. February 11, 2021. https://www.dezeen.com/2021/02/11/coral-bloom-resort-foster-partners-red-sea-development-company-saudi-arabia/.

- Ravenscroft, Tom. *Saudi Arabia set the host Asian winter games at Neom "in the heart of the desert".* Dezeen. October 5, 2022. https://www.dezeen.com/2022/10/05/trojena-saudi-ski-resort-neom-asian-winter-games-zaha-hadid-unstudio/.

- Ravenscroft, Tom. *Saudi Arabia unveils plans for Octagonal floating port city in Neom.* Dezeen. December 21, 2022. https://www.dezeen.com/2022/12/21/oxagon-floating-port-city-neom-saudi-arabia/.

- Ravenscroft, Tom. *Sindalah luxury island set to be first completed element of Neom.* Dezeen. December 2, 2022. https://www.dezeen.com/2022/12/06/sindalahl-luxury-island-neom-luca-dini/.

- Sette, André. *The line: cidades lineares não fazem o menor sentido.* Arch daily. November 05, 2022. https://www.archdaily.com.br/br/990910/the-line-cidades-lineares-nao-fazem-o-menor-sentido?ad_medium=gallery.

Government communications

- Amaala. *Amaala appoints Foster + Partners as architectural advisors.* Amaala. March 1, 2020. https://www.amaala.com/en/newsroom/amaala-appoints-foster--partners-as-architectural-advisors.

- Diriyah gate development authority. *News, Diriyah giga-project awards usd $311 million transportation works contract to Nesma.* Diriyah gate development authority. March 10, 2022. https://dgda.gov.sa/media-center/news/news-articles/205.aspx.

- Kingdom of Saudi Arabia. *Saudi Vision 2030, overview.* Vision 2030. Accessed November 24, 2023. https://www.vision2030.gov.sa/en/vision-2030/overview/.

- Ministry of municipal and rural affairs. *Furas projects. MOMRAH.* Accessed November 24, 2023. https://furas.momra.gov.sa/opportunities.

- Public Investment Fund (PIF). *Saudi Giga Projects.* PIF. Accessed November 24, 2023. https://www.pif.gov.sa/en/Pages/OurInvestments-GigaProjects.aspx.

- Royal commission for Riyadh city. *Sports Boulevard project.* Royal commission for Riyadh city. Accessed November 24, 2023. https://www.rcrc.gov.sa/en/projects/sports-boulevard-project.

- Rua Al Madinah. *Rua Al Madinah Project. Rua Al Madinah.* Accessed November 24, 2023. https://ruaalmadinah.com/en/rua-al-madinah-project/.

- Spark. *King Salman energy park.* Spark. Accessed November 24, 2023. https://www.spark.sa/page/single_album/2617.

- United Nations. *Saudi Arabia, National spatial strategy 2030.* United Nations. August 31, 2021. https://www.undp.org/saudi-arabia/blog/national-spatial-strategy-2030.