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project theory 3

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الجمهورية الجزائرية الديمقراطية الشعبية
Algerian Democratic and Popular Republic
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Faculty of Civil Engineering and Architecture
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Pedagogical Polycopiés

Site study and urban integration

2nd year architecture degree

Completed by: TABAI Brahim

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General objectives of the subject:

The course content is primarily dedicated to the acquisition of design tools and methods where architecture is considered not as an isolated object, but within its physical, social, and cultural context. The course is an opportunity to raise awareness among second-year students about the reality of architectural production and the dualities they will have to face in their future profession. It primarily aims at understanding the dialectic of site/project, container/content, spaces/uses by focusing on the criteria for site perception, its morphology, as well as the natural and anthropogenic physical factors that characterize it (sun, winds, precipitation, natural landscape, urban landscape, etc.), and the way to approach an environment to implement an architectural project capable of providing comfort and well-being to its users.

Chapter One :

Chapter One

General introduction to the program

The majority of the world's population lives in cities, thus understanding how they operate is crucial to enhancing them and ensuring the prosperity and comfort of their residents. In order to address global issues like resource depletion and climate change, urban planning is crucial.

Effective urban planning and design may help to realize urban development in all of its economic, social, and cultural dimensions as well as help to create sustainable and livable cities. In general, urban studies are a significant field that may have a substantial influence on life quality the urban lifestyle.

This course aims to raise awareness among future students involved in urban projects and prepare them to understand the dialectic (site/project), whether it be at the level of contents, spaces, or usages, as well as instill a sense of responsibility. across the initial planning, final management, and intervention processes in urban projects.

A successful integration of an architectural project necessarily goes through two stages: the first, a phase of reading and analyzing the intervention site, while the second is the phase during which the best possibilities for integrating and inserting the future architectural project into its urban environment are sought.

In this handout, we will explore some possibilities for integrating the architectural project into its immediate environment with regard to urban, natural, and climatic constraints.

A good integration of an architectural project into its urban environment takes into account the strengths and problems presented by the site of intervention.

A well-thought-out urban integration allows for savings on various fronts and also preserves the natural aspect of the intervention site.

I. The Urban Environment:

1 The urban neighborhood:

1.1 Definition: An urban neighborhood is a planned or organically developed residential area within a city or suburb, characterized by a certain population density. It possesses infrastructure and public facilities (schools, mosques, markets, parks, etc.) and is typically subject to administrative and legal regulations that define its features and functions.

1.2 Characteristics of an Urban Neighborhood:

1.2.1 Integrated Residential Unit: Includes housing and structures (residential, commercial, administrative).

1.2.2 Clear Boundaries: Separated from other neighborhoods by main roads or natural landmarks.

1.2.3 Shared Services: Provides daily necessities for residents (transportation, sanitation, security).

1.2.4 Social Identity: May have cultural or demographic traits (working-class, upscale, historic district).

1.3 Difference Between Urban Neighborhoods and Unplanned Areas:

1.3.1 Urban Neighborhood: Planned according to urban standards and municipal laws.

1.3.2 Informal Settlements (Slums): Grow without formal planning, often lacking services.

This term is used in civil engineering and urban planning to describe the basic unit of urban settlements.

2 The Neighborhood Unit:

2.1 Definition: The neighborhood unit is an urban planning concept designed to organize residential areas in an integrated manner, ensuring that daily needs are met within a short distance (typically walkable), while maintaining a cohesive and safe community environment.

2.2 Importance of the Neighborhood Unit:

- Enhances quality of life by providing essential services near homes.
- Reduces dependence on vehicles, supporting urban sustainability.
- Promotes social interaction among residents.

2.3 Characteristics of a Neighborhood Unit:

2.3.1 Size and Boundaries:

- Designed for 3,000–5,000 residents (the size of one elementary school catchment area).
- Bordered by main roads or natural features (rivers, parks).

2.3.2 Service Center:

- Includes an **elementary school, health clinic, mosque/church, and local markets**.
- Located at the core for easy accessibility.

2.3.3 Street Network:

- Internal, low-traffic streets (for residents only).
- Arterial roads on the periphery to avoid through traffic.

2.3.4 Green Spaces:

- Scattered public parks within the unit.
- May include pedestrian and cycling paths.

2.3.5 Functional Distribution:

- 70% residential**,** 10% services**,** 20% roads and green spaces**.**

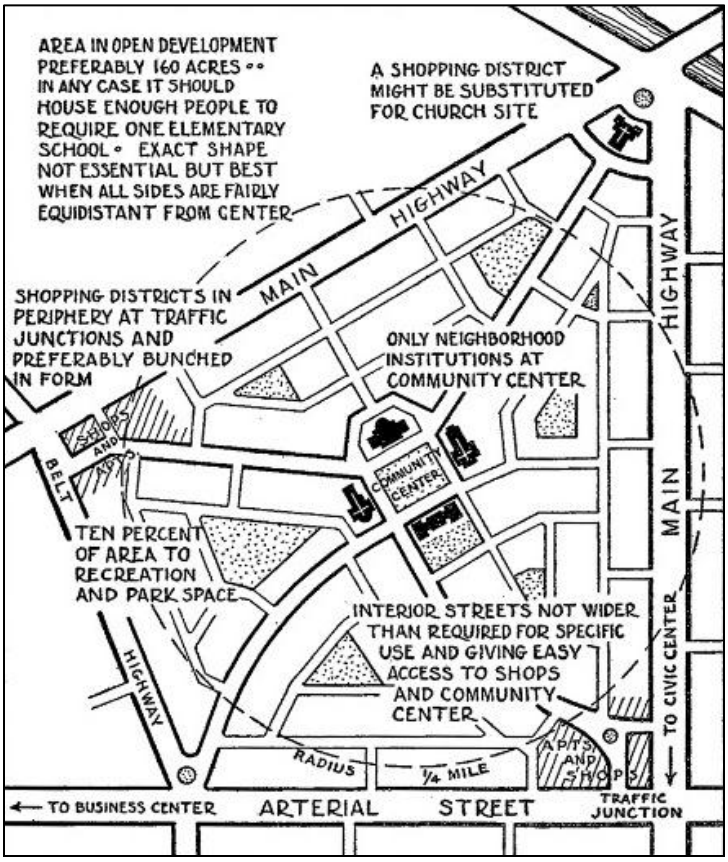
2.4 Difference between a Neighborhood Unit and a Residential District:

Criterion	Neighborhood Unit	Residential District
Scale	Smaller (pedestrian-focused).	Larger (may require transport).
Design	Planned per a specific theory.	Can be organic or planned.
Services	Centralized and integrated.	Variably distributed.

Tab 1: Difference between a Neighborhood Unit and a Residential District.
Source: author.

2.5 Modern Applications in Urban Planning:

- Used in smart cities and sustainable projects, such as:
  - 15-minute cities (e.g., Paris).
  - Car-free neighborhoods.



Tab 1: The Neighborhood Unit.
Source: **(Marchand & Meier, 2022)**

3 Housing Complex / Residential Compound:

3.1 **Definition:** A housing complex is a planned, enclosed residential unit consisting of a group of residential buildings (villas, apartment blocks, flats) constructed according to a unified design, with shared facilities and services exclusively for its residents. It typically has private management overseeing services and security.

3.2 Key Features:

3.2.1 Unified Design:

- Buildings with similar architecture and unit sizes (e.g., villa compounds or clustered apartment blocks).
- Landscaped green spaces and dedicated internal roads.

3.2.2 Privacy and Security:

- Perimeter walls or gated entry points.
- Surveillance systems (CCTV cameras, security guards).

3.2.3 Shared Amenities:

- Recreational facilities (swimming pools, gyms, sports courts).
- Parking areas, gardens, and sometimes on-site schools or retail shops.

3.2.4 Target Demographic:

- May cater to specific groups (corporate employees, military personnel, or defined income brackets).

3.3 Difference Between a Housing Complex and a Residential Neighborhood:

Criterion	Housing Complex	Residential Neighborhood
Ownership	Private or government-owned.	Public (municipal).
Access	Restricted to residents.	Open to the public.
Facilities	Exclusive to residents.	Shared public services.
Layout	Closed and highly organized.	May be organic or open.

Tab 2: Difference between a Housing Complex and a Residential Neighborhood.
Source: author

3.4 Types of Housing Complexes:

3.4.1 Luxury (Gated Communities):

- High-end amenities (clubs, spas).
- Spacious layouts and gated environments.

3.4.2 Affordable (Low-cost Housing):

- Targeted at middle-income groups.
- Simplified designs and limited facilities.

3.4.3 Smart Compounds:

- Advanced technology integration (IoT, automation systems).

3.5 Examples from the Arab World:

- **Saudi Arabia:** "King Abdullah Economic City" (gated compounds).
- **Egypt:** "Rehab City" (Cairo).
- **UAE:** "Dubai Holding Communities" (e.g., "Mirako" compounds).

3.6 Pros and Cons of Housing Complexes:

Pros	Cons
High privacy and security.	High maintenance/service costs.
Integrated amenities.	Relative isolation from community.
Organized and clean environment.	Architectural modification restrictions.

Tab 3: Pros and Cons of Housing Complexes.
Source: author

Note: The term "housing complex" is used in real estate development and urban planning, distinct from "informal settlements" or "organic urban growth".

Fig 2: King Abdullah Economic City.
Source: (مدينة الملك عبدالله الاقتصادية.. الدليل الراسخ على نجاح رؤية 2030, 2019)

4 Site analysis:

4.1 Definitions:

- ❖ It is the reading of the elements of the composition of the urban space of the site.
- ❖ Is a preliminary phase of architectural and urban design processes dedicated to the study of the climatic, geographical, historical, legal, and infrastructural context of a specific site.

The result of this analytic process is a summary, usually a graphical sketch, which sets in relation the relevant environmental information with the morphology of the site in terms of parcel, topography, and built environment. This result is then used as a starting point for the development of environment-related strategies during the design process. (Leidi, 2015)

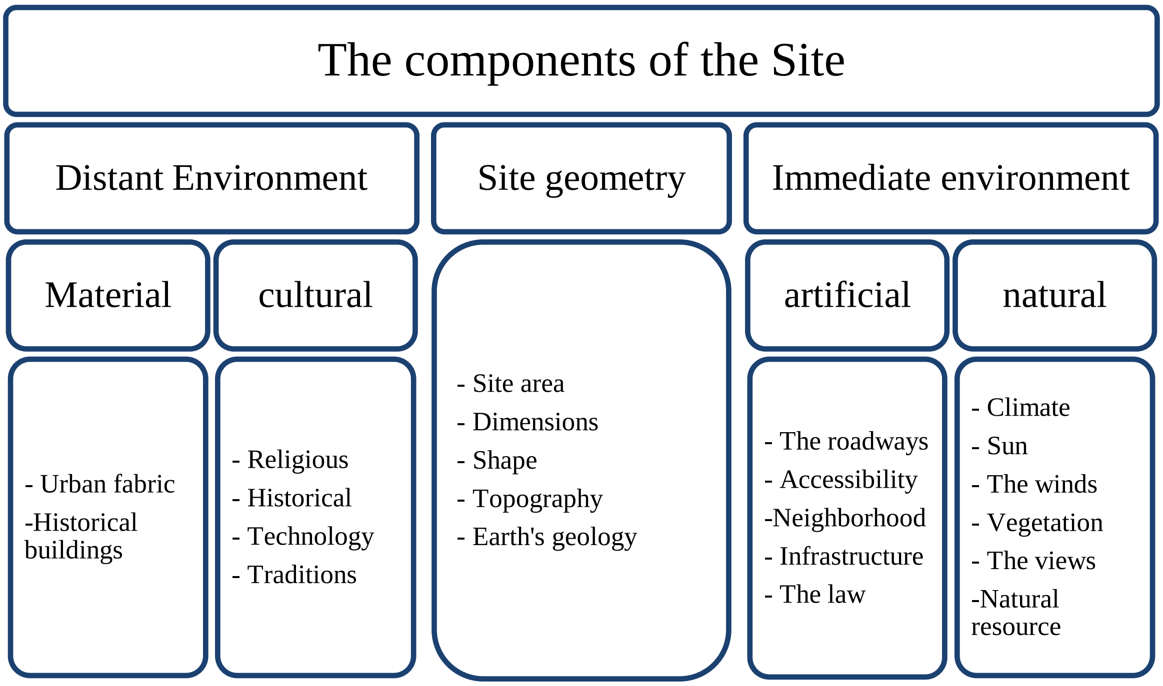


Fig 3: The stages followed in the design and preparation of the urban project.
Source: author.

4.2 Site analysis steps:

4.2.1 Situation: And it is of two (2) types:

- **The astronomical location:** The astronomical location is the specific place or site of a particular location or terrain based on the coordinates of latitude and longitude. It is also worth noting that the location of a place in terms of latitude determines its climate and the changes occurring within it, and it also contributes to the geographical changes and distribution of the country that lies within those lines.

The determination of locations on the Earth's surface is done using two angles: latitude and longitude, and the elevation of the location above or below sea level. The natural reference level on Earth is the equator, and the natural reference axis is the polar rotation.

- **The administrative situation:** It refers to the location of the studied city in comparison to the neighboring cities or other provinces.

The neighboring cities to the study site may belong to the same administrative region, or they may belong to another administrative region.

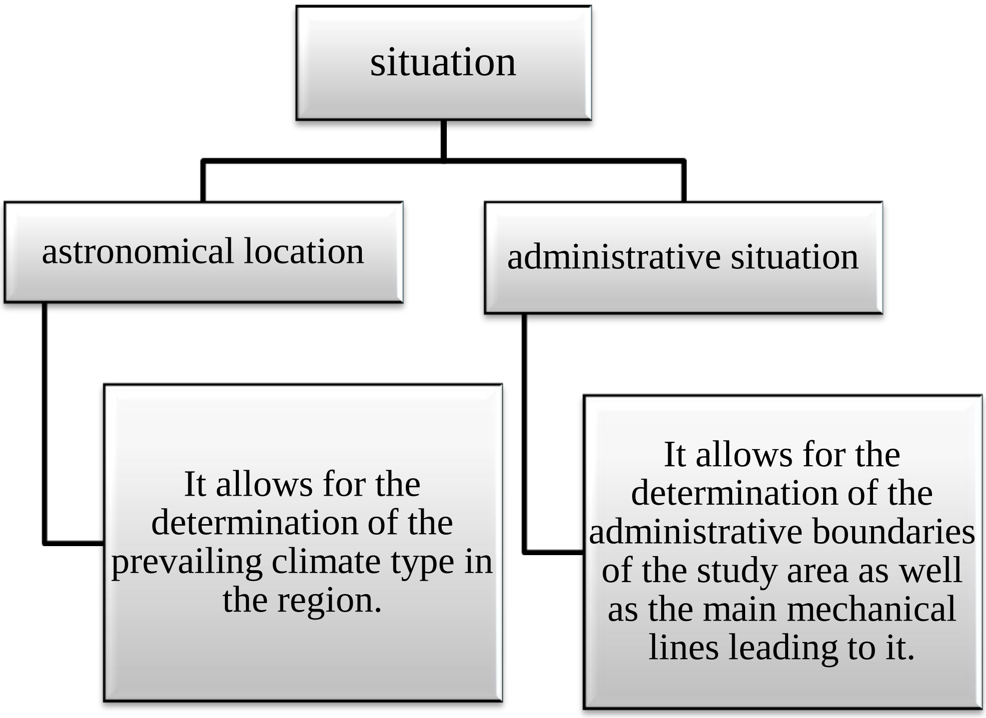
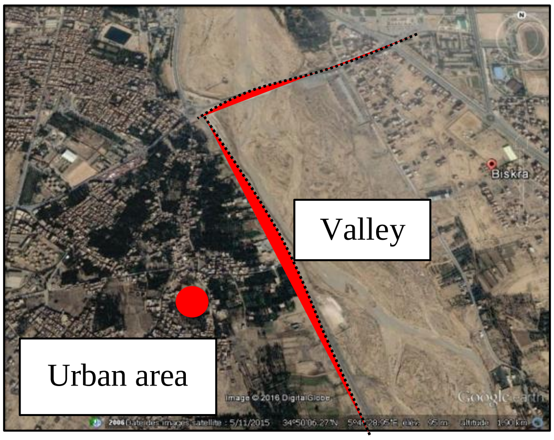


Fig 4: Determining the study location.
Source: author.

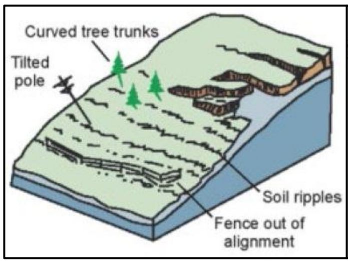
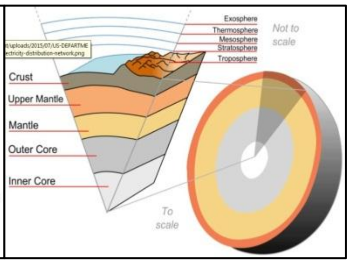
After determining the location of the city as a whole, the location of the intervention in relation to the city must be determined.

It should be noted that each point analyzed must be followed by the extraction of recommendations to be considered during the architectural design or urban planning process.

N°	Situation	Recommendations
1		- Identifying the main mechanical axes leading to the area under study. - Determining the nature of the area, whether urban or natural, to assess the suitability of the site for accommodating the planned project.

Tab 4: Determining the study location.
Source: author.

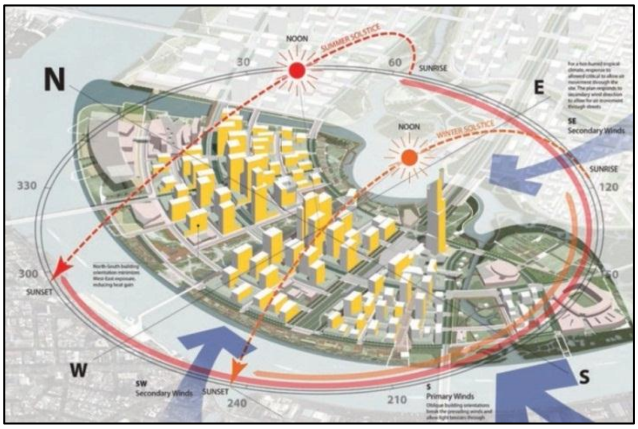
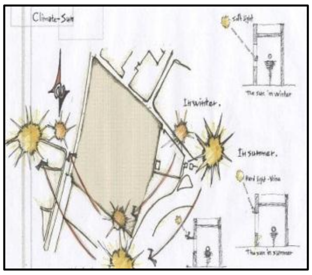
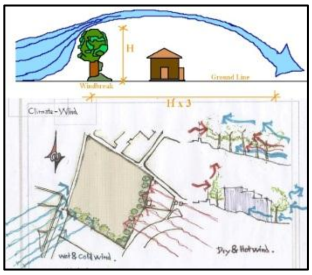
4.2.2 Study of the Mass Plan:

<table>
<tr><th>N°</th><th>Site geometry</th><th>Recommendations</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4"></td><td><u>Surface and dimension:</u> From it, the suitability of the ground to accommodate each project program is determined, as well as the number of floors the project can consist of, and an initial perspective on the building's orientation through the utilization of the ground dimensions is formed.</td></tr>
<tr><td><u>Site shape:</u> The shape of the site can affect the overall appearance of the final project.</td></tr>
<tr><td><u>The Topography</u>: The site's topography controls the determination of ground levels, the feasibility of excavation and filling operations, the hierarchy of the project's components, and the identification of the optimal path for rainwater drainage.</td></tr>
<tr><td><u>Earth Geology:</u> Through it, the number of floors that can be constructed is determined, the type of foundations is specified, and the extent to which the ground requires special stabilization treatments is assessed.</td></tr>
</table>

Tab 5: study of the mass plan.
Source: author.

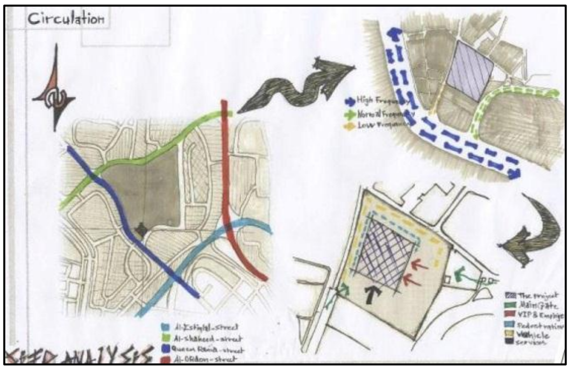
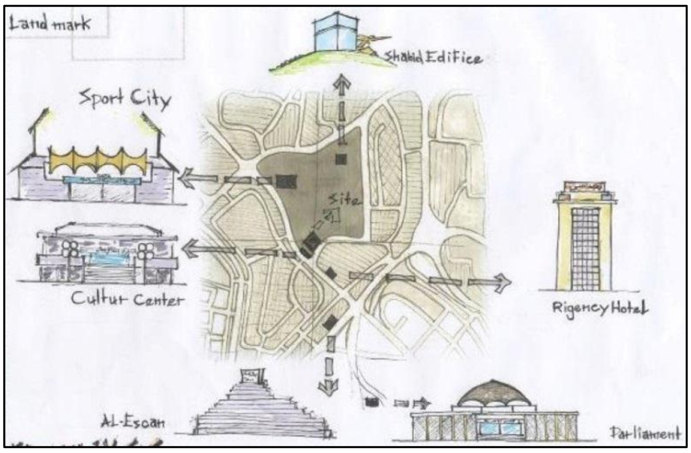
- **Distant Environment:** It is divided into two main parts:
  - **Material**: It is being studied to determine the possibility of drawing inspiration from the set of urban and architectural elements that make up the study area in a step aimed at achieving integration with the site.
  - **Cultural**: The intangible elements constituting the study community are studied to understand the cultural peculiarities, customs, and traditions that must be taken into consideration in the urban planning and architectural design process to avoid any interventions and changes to the built environment.
- **Immediate environment:** It is considered the most important part of the analysis process because it contains a set of elements primarily related to the intervention site, which have a direct impact on the project.

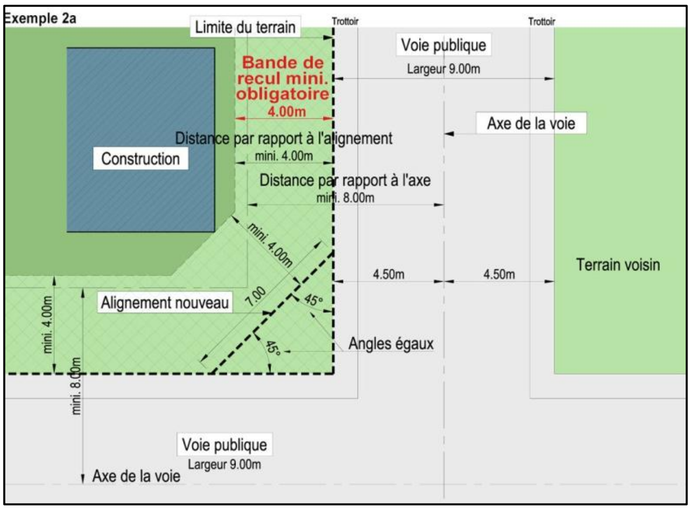
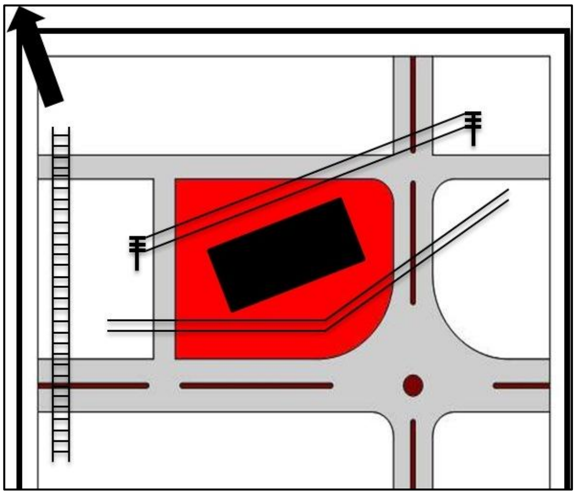
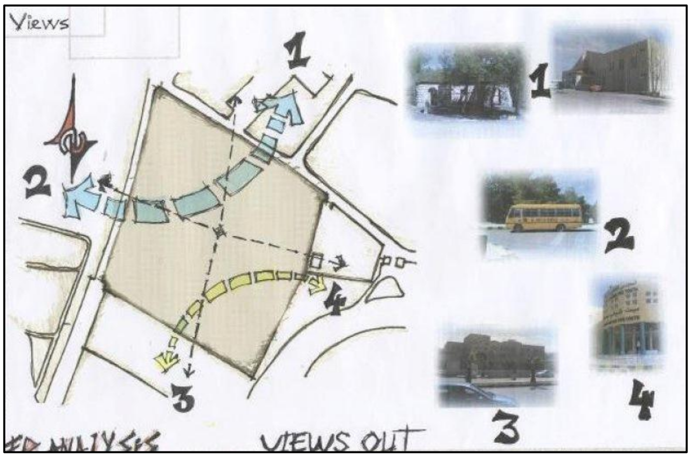
4.2.3 Natural element:

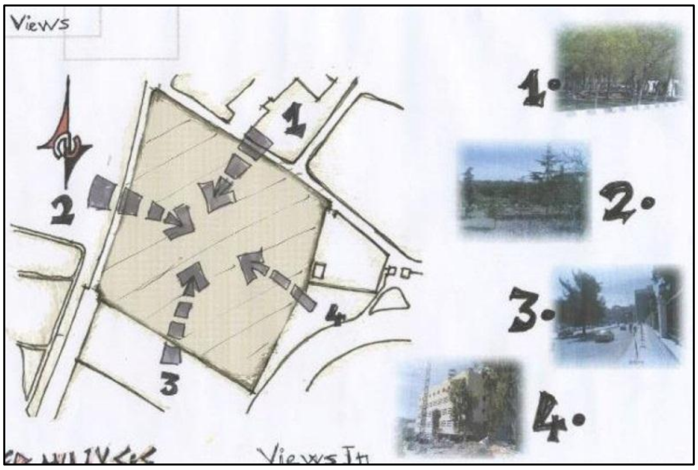
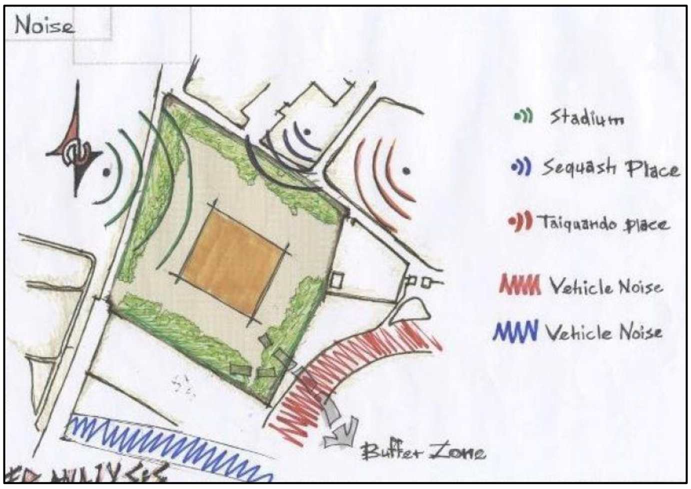
N°	Immediate environment (Natural)	Recommendations
1	  	**<u>Sunshine:</u>** After determining the sun's path at the intervention site, we can conceptualize the positioning of the project's components; identify built and unbuilt areas, and the methods of treating the facades. We can also determine the locations of green spaces and shaded areas to utilize them for seating or as parking lots, for example.
		<u>The Winds:</u> The path of the most important types of winds blowing on the intervention site is determined, which affects the shape and positioning of the project's components, how to address the mass plan, the distribution of built and unbuilt areas, the selection of the types of green spaces, and the locations of water bodies. It also contributes to the identification and incorporation of some architectural elements such as Malqaf and wind towers.
2		**<u>Vegetation and natural resources</u>**: Natural green elements are an indispensable design decision for many reasons and factors, such as adding beauty, achieving privacy, and protection from external environmental phenomena. At the same time, natural resources may pose obstacles that hinder construction processes.

Tab 6: Immediate environment study (natural element).
Source: author.

4.2.4 Artificial element:

N°	Immediate environment (Artificial)	Recommendations
1		**<u>The Roads:</u>** The roads are studied according to four (4) basic elements: dimensions, directions, flow, and type of roads. These elements can be used to determine the proposed access points for the project, as well as the spatial organization of the project's components (to avoid noise from the roads according to the nature of the area).
2		**<u>The Neighborhood:</u>** The most important neighboring projects to the intervention area are being studied, as neighboring projects can affect the design of the new project according to the following points: - <u>The Architectural Style</u>**:** The possibility of drawing inspiration from the architectural style of neighboring projects. - <u>The Accesses</u>**:** The accesses are influenced by the functional relationships between the projects. - <u>Confidentiality:</u> to avoid the problem of face-to-face. - <u>Panoramic Views:</u> Openness and insight into aesthetically-oriented projects.
3		**<u>The Accesses:</u>** The project's accesses are determined based on several elements, the most important of which are: the project's function, the type of entrance (main, secondary, service, vehicle, pedestrian), the relationship with the neighborhood, the characteristics of the surrounding roads, and the traffic flow on these roads.

<table>
<tr><th>N°</th><th>Immediate environment (Artificial)</th><th>Recommendations</th></tr>
<tr><td>4</td><td>
</td><td><u>The Law:</u> a set of elements that affect the design process are determined by real estate law:
- <u>The setback:</u> It is the distance that the building must be set back from the street.
- <u>Surface limitation:</u> Based on the legal nature of the property (residential, agricultural, and industrial).
- <u>The number of floors:</u> To preserve the general character of the area.
- <u>The architectural style:</u> To achieve the greatest degree of integration.</td></tr>
<tr><td>5</td><td></td><td><u>The Servitudes:</u>
These servitudes are numerous, but the most important ones are the high-voltage power lines and the natural gas supply lines.
These easements require safe distances separating them from buildings used for human occupancy.</td></tr>
<tr><td>6</td><td>
</td><td><u>The Views (from Interior to Exterior):</u> The views and outlooks from the inside to the outside are determined based on the nature of the adjacent facilities and the practicality of opening up towards them, either to achieve stunning views or to demonstrate the functional connection between the neighboring buildings.</td></tr>
</table>

N°	Immediate environment (Artificial)	Recommendations
7		**<u>The Views (from Exterior to Interior):</u>** Focusing on making the project as visible as possible from the outside by relying on: - The flows. - Road width. - The knots.
8		**<u>Noise Pollution:</u>** Through the level of noise emitted from the surroundings, several points in the design process are determined: - <u>Land use mode:</u> The quiet areas are placed away from the noise. - <u>Mode of arrangement:</u> Parking lots, movement areas, and clusters of trees are placed as barriers to obstruct noise. - <u>Type of vegetation:</u> Dense-leaved trees are placed in patterns that block noise.

Tab 7: Immediate environment study (artificial element).
Source: author.

- **Note:** It is necessary to distinguish between the project's land and the project's site.
  - Project land: It is the actual area of land designated for the completion of the project, along with everything surrounding it, such as buildings, roads, servitudes, and infrastructure.
  - Project site: Project site: It is broader and more comprehensive than the project land, encompassing the project land with all its contents, in addition to the climatic, historical factors, and the customs and traditions of the region's inhabitants.

And this leads us to discuss an important term, which is the landscape.

II. The Climatic Environment:

The study of the climate and understanding its details and variables in the designated intervention area is one of the most important factors for the project's success in terms of integration, as it enables space users to perform their tasks to the fullest.

1 Definition of climate:

Climate is the average weather conditions for a particular location over a long period of time, ranging from months to thousands or millions of years. WMO uses a 30-year period to determine the average climate. **(WMO)**

The climate is defined as the set of meteorological phenomena: temperatures, atmospheric pressures, winds, precipitation, which characterize the average state of the atmosphere and its evolution in a given place. **(Larousse francais)**

2 The types of climate:

Climate is classified according to two parameters: based on astronomical position and based on extent and scale (geographical situation).

2.1 According to the Astronomical Situation: The climate is divided according to the astronomical location based on the lines of latitude, depending on the amount of solar radiation and the prevailing temperatures in different regions of the globe.

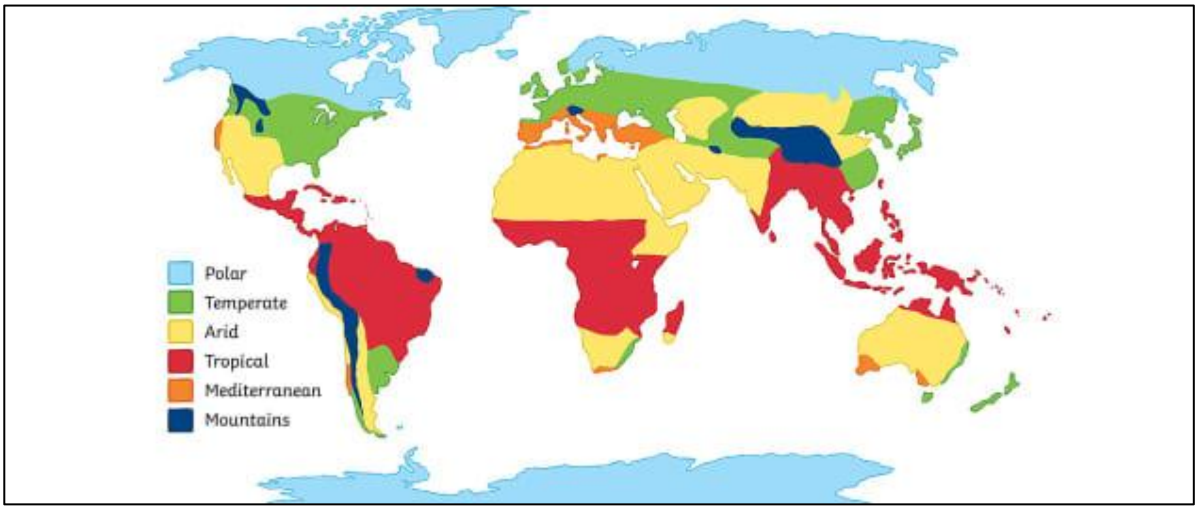


Fig 5: Climatic regions according to geographical location.
Source: (WMO)

So, according to the astronomical location, the amounts of sunlight reaching the Earth are determined, which affects the temperatures.
- The areas near the equator (0°) receive direct sunlight throughout the year, and therefore the climate is hot and humid.
- The areas near the poles (90°) receive slanted rays, and thus the climate is cold.

2.2 According to the Geographical Situation: Geographical location is one of the fundamental factors that modify the climatic characteristics of any region through a set of factors such as altitude, proximity to water bodies, topography, and ocean currents. Below is the scientific explanation of the impact of each element:

- **Elevation above sea level:** The higher the altitude, the lower the temperature (by

6.5°C for every 1000 meters). High-altitude areas have a cold climate even if they are close to the equator.

- **Proximity to water bodies (seas and oceans):** Coastal areas a moderate climate in summer and winter (due to ocean currents and high humidity). Inland areas a continental climate (hot in summer, cold in winter, with sharp fluctuations).
- **Topography (mountains, valleys, plateaus):** Mountains block moist winds, creating a rain shadow (dry areas behind the mountains). Valleys, on the other hand, are warmer due to air trapping.
- **Ocean currents:** Warm currents (like the Gulf Stream) raise the temperature of coastal areas. On the other hand, cold currents (like the Peru Current) cause a cold and dry climate even at the equator.
- **Wind direction:** The trade winds (from east to west) carry moisture to the eastern coasts of the continents. The westerlies (from west to east) affect the climate in Europe and North America.

- Therefore, it is necessary to combine the astronomical location with the geographical location characteristics to accurately determine the climatic region.
- One of the best classifications that integrated many variables to determine climatic regions is the Köppen-Geiger classification.

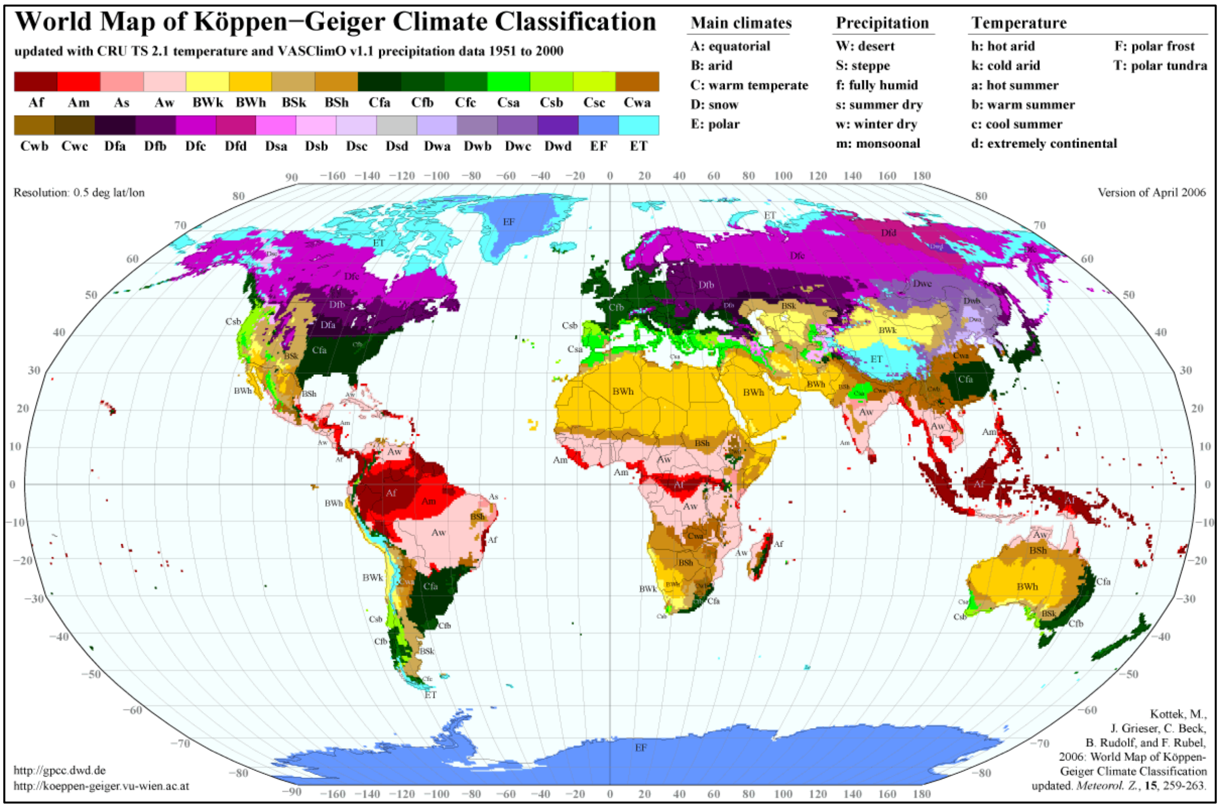


Fig 6: World Map of Köppen-Geiger Climate Classification.
Source: (https://en.climate-data.org/)

3 The Köppen-Geiger climate zones:

The Köppen climate classification divides Earth climates into five main climate groups, with each group being divided based on patterns of seasonal precipitation and temperature. The five main groups are A (tropical), B (arid), C (temperate), D (continental), and E (polar). Each group and subgroup is represented by a letter. All climates are assigned a main group (the first letter). All climates except for those in the E group are assigned a seasonal precipitation subgroup (the second letter). For example, Af indicates a tropical rainforest climate. The system assigns a temperature subgroup for all groups other than those in the A group, indicated by the third letter for climates in B, C, D, and the second letter for climates in E. Other examples include: Cfb indicating an oceanic climate with warm summers as indicated by the ending b., while Dwb indicates a semi-monsoonal continental climate, also with warm summers. Climates are classified based on specific criteria unique to each climate type. **(Kottek, Grieser, Beck, Rudolf, & Rubel, 2006)**

a) **Tropical climates:** have an average temperature of 18 °C (64.4 °F) or higher every month of the year, with significant precipitation. **(Beck, Zimmermann, McVicar, Vergopolan, Berg, & Wood, 2018)**

symbol	Equatorial climates (A)
Af	Climate of tropical rainforests
Am	Tropical monsoon climate
(Aw) Or (As)	Humid and dry tropical climate or Savanna Climate

Tab 8: The sub-climates of the Equatorial climate.
Source: author.

b) **Desert and semi-arid climates:** Desert and semi-arid climates are defined by low precipitation in a region that does not fit the polar (EF or ET) criteria of no month with an average temperature greater than 10 °C (50 °F). **(Peel, Finlayson, & McMahon, 2007)**

symbol	Desert and semi-arid climates (B)
BWh	Hot desert climate
BWk	Cold desert climate
BSh	Hot semi-arid climate
BSk	Cold semi-arid climate

Tab 9: The sub-climates of the Desert and semi-arid climate.
Source: author.

c) **Temperate climates:** have the coldest month averaging between 0 °C (32 °F) (or −3 °C (26.6 °F)) and 18 °C (64.4 °F) and at least one month averaging above 10 °C (50 °F). For the distribution of precipitation in locations that both satisfy a dry summer (Cs) and a dry winter (Cw), a location is considered to have a wet summer (Cw) when more precipitation falls within the summer months than the winter months while a location is considered to have a dry summer (Cs) when more precipitation falls within the winter months. This additional criterion applies to locations that satisfies both (Ds) and (Dw) as well. **(Peel, Finlayson, & McMahon, 2007)**

symbol	Temperate climates (C)
Cfa	Humid subtropical climate
Cfb	Temperate oceanic climate
Cfc	Subpolar oceanic climate
Cwa	Monsoon-influenced humid subtropical climate
Cwb	Subtropical highland climate
Cwc	Cold subtropical highland climate
Csa	Hot-summer Mediterranean climate
Csb	Warm-summer Mediterranean climate
Csc	Cold-summer Mediterranean climate

Tab 10: The sub-climates of the Temperate climate.
Source: author.

d) **Continental climates:** have at least one month averaging below 0 °C (32 °F) (or −3 °C (26.6 °F)) and at least one month averaging above 10 °C (50 °F).

symbol	Continental climates (D)
Dfa	Hot-summer humid continental climate
Dfb	Warm-summer humid continental climate
Dfc	Subarctic climate
Dfd	Extremely cold subarctic climate
Dwa	Monsoon-influenced hot-summer humid continental climate
Dwb	Monsoon-influenced warm-summer humid continental climate
Dwc	Monsoon-influenced subarctic climate
Dwd	Monsoon-influenced extremely cold subarctic climate
Dsa	Mediterranean-influenced hot-summer humid continental climate
Dsb	Mediterranean-influenced warm-summer humid continental climate
Dsc	Mediterranean-influenced subarctic climate
Dsd	Mediterranean-influenced extremely cold subarctic climate

Tab 11: The sub-climates of the Continental climate.
Source: author.

e) **Polar and alpine climates:** has every month of the year with an average temperature below 10 °C (50 °F).

symbol	Polar and alpine climates (E)
ET	Tundra climate
EF	Ice cap climate

Tab 12: The sub-climates of the Polar and Alpine climate.
Source: author.

3.1 The Köppen-Geiger climate zones for Africa:

Climate zones of Africa, showing the ecological break between the Sahara Desert (red), the hot semi-arid climate of the Sahel (orange) and the tropical climate of Central and Western

Africa (blue). Southern Africa has a transition to subtropical and temperate climates (green and yellow), and more desert or semi-arid regions, centered on Namibia, Botswana, and South Africa.

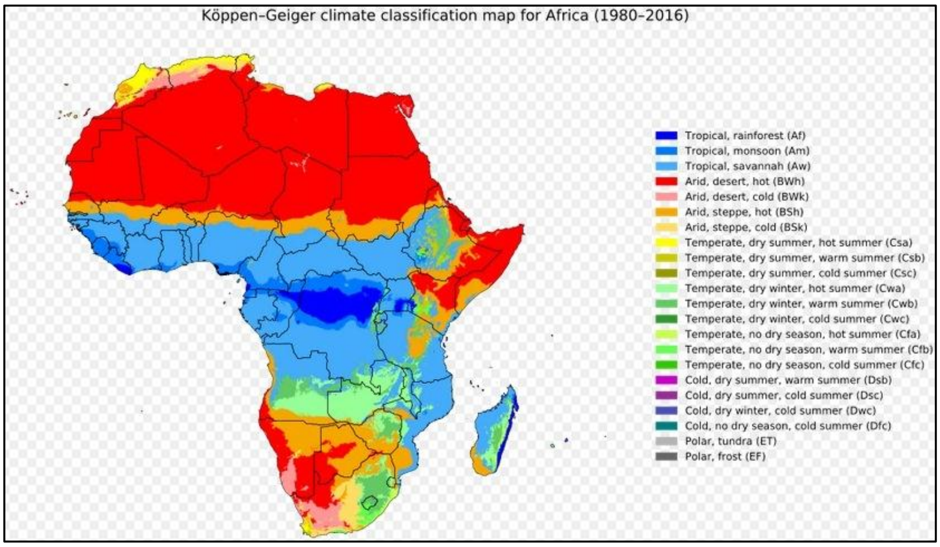


Fig 7: World Map of Köppen-Geiger Climate Classification.
Source: (Navarro, Merino, García-Ortega, & Tapiador, 2025)

3.2 The Köppen-Geiger climate zones for Algeria:

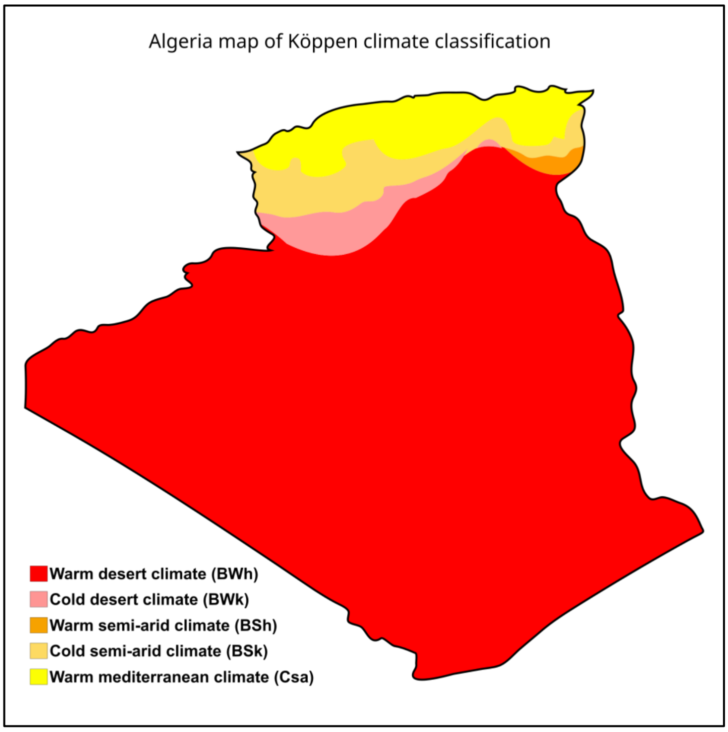
Northern Algeria is in the temperate zone and enjoys a mild, Mediterranean climate. It lies within approximately the same latitudes as southern California and has somewhat similar climatic conditions. Its broken topography, however, provides sharp local contrasts in both prevailing temperatures and incidence of rainfall. Year-to-year variations in climatic conditions are also common. This area, the most inhabited in Algeria, is commonly referred to as the Tell.

In the Tell, temperatures in summer average between 30 and 43 °C and in winter drop to 10 to 12 °C. Winters are not cold, but the humidity is high and houses are seldom adequately heated. In eastern Algeria, the average temperatures are somewhat lower, and on the steppes of the High Plateaus winter temperatures hover only a few degrees above freezing. A prominent feature of the climate in this region is the sirocco, a dusty, choking south wind blowing off the desert, sometimes at gale force. This wind also occasionally reaches into the coastal Tell.

In Algeria only a relatively small corner of the Sahara lies across the Tropic of Cancer in the torrid zone, but even in winter, midday desert temperatures can be very hot. After sunset, however, the clear, dry air permits rapid loss of heat, and the nights are cool to chilly. Enormous daily ranges in temperature are recorded.

Rainfall is fairly abundant along the coastal part of the Tell, ranging from 400 to 670 mm annually, the amount of precipitation increasing from west to east. Precipitation is heaviest in the northern part of eastern Algeria, where it reaches as much as 1,000 mm in some years. Farther inland the rainfall is less plentiful. Prevailing winds that are easterly and northeasterly in summer change to westerly and northerly in winter and carry with them a general increase in precipitation from September to December, a decrease in the late winter and spring months, and a near absence of rainfall during the summer months. **(Chapin, 1994)**

Fig 8: Köppen-Geiger climate classification map for Algeria. **Source: (Navarro, Merino, García-Ortega, & Tapiador, 2025).**



4 **The elements of the climate:** The first thing that must be accurately and firmly understood is the distinction between longitudes, latitudes, and elevation above sea level.

4.1 Latitude:

- **Definition:**
  - in astronomy and geodesy: In a spherical coordinate system, the angular distance of a point from the fundamental plane, measured from the fundamental plane, from 0 to ± 90°. **(Larousse francais)**
  - (opposite to longitude) Angular distance of a point on Earth from the equator. Paris is approximately 48° 5' north latitude. **(Le Robert)**
  - In geography, latitude is a geographic coordinate that specifies the north-south position of a point on the surface of the Earth or another celestial body. Latitude is given as an angle that ranges from −90° at the South Pole to 90° at the North Pole, with 0° at the Equator. Lines of constant latitude, or parallels, run east-west as circles parallel to the equator. Latitude and longitude are used together as a coordinate pair to specify a location on the surface of the Earth.

On its own, the term "latitude" normally refers to the geodetic latitude as defined below. Briefly, the geodetic latitude of a point is the angle formed between the vector perpendicular (or normal) to the ellipsoidal surface from the point, and the plane of the equator. **(Kher, 2020)**

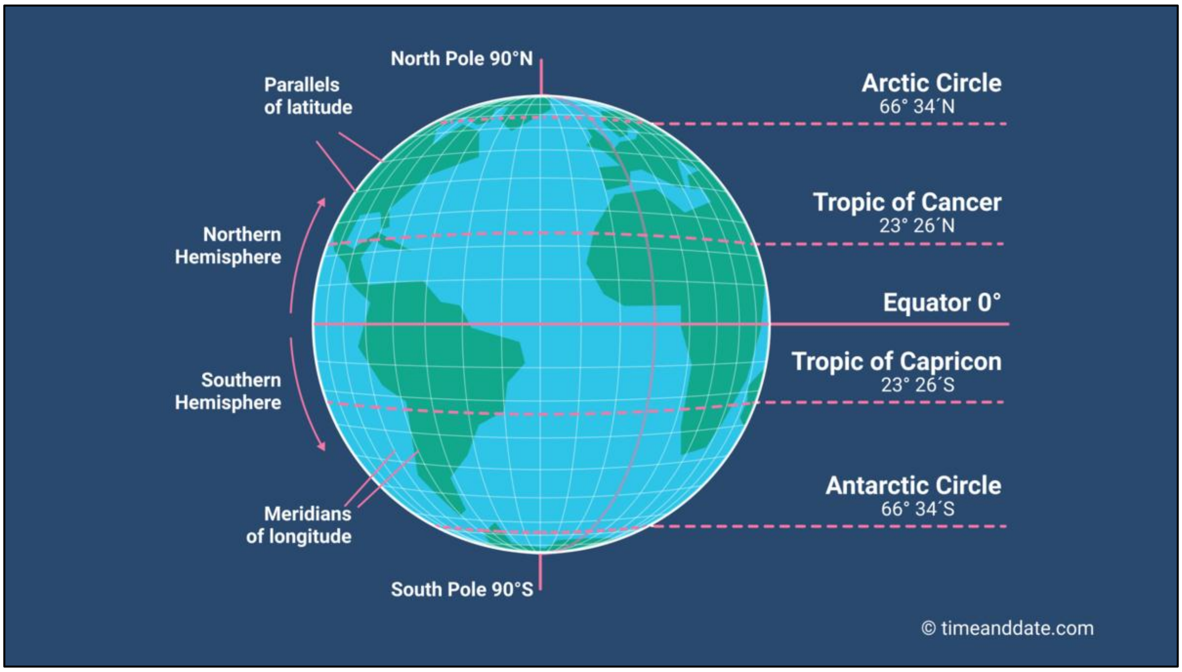
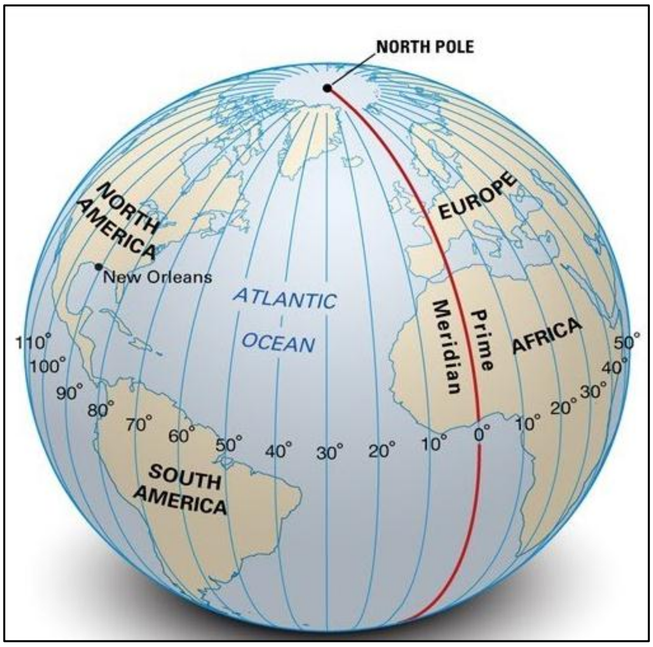


Fig 9: The major latitudes and longitudes.
Source: (Kher, 2020)

4.2 Longitude:

- **Definition:**
  - A given longitude, represented by a circle called a meridian, is the angle formed between the plane of a location's meridian and the plane of the Greenwich meridian (prime meridian, at 0 degrees longitude). It varies from +180 degrees to the west to -180 degrees to the east. **(Larousse francais)**
  - Angular distance from a prime meridian, either east or west. **(Le Robert)**
  - Longitude is a geographic coordinate that specifies the east-west position of a point on the surface of the Earth, or another celestial body. It is an angular measurement, usually expressed in degrees and denoted by the Greek letter lambda **(λ)**. Meridians are imaginary semicircular lines running from pole to pole that connect points with the same longitude. The prime meridian defines 0° longitude; by convention the International Reference Meridian for the Earth passes near the Royal Observatory in Greenwich, south-east London on the island of Great Britain. Positive longitudes are east of the prime meridian, and negative ones are west. Because of the Earth's rotation, there is a close connection between longitude and time measurement. Scientifically precise local time varies with longitude: a difference of 15° longitude corresponds to a one-hour difference in local time, due to the differing position in relation to the Sun.

Fig 10: The major longitudes.
Source: (Siddiqui, 2024)



4.3 Geometric aspect of the sun: The position of the Sun in the sky is a function of both the time and the geographic location of observation on Earth's surface. As Earth orbits the Sun over the course of a year, the Sun appears to move with respect to the fixed stars on the celestial sphere, along a circular path called the ecliptic.

Earth's rotation about its axis causes diurnal motion, so that the Sun appears to move across the sky in a Sun path that depends on the observer's geographic latitude. The time when the Sun transits the observer's meridian depends on the geographic longitude.

Earth orbits the Sun at an average distance of 149.60 million km, or 8.317 light-minutes, in a counterclockwise direction as viewed from above the Northern Hemisphere. One complete orbit takes 365.256 days (1 sidereal year), during which time Earth has traveled 940 million km. Ignoring the influence of other Solar System bodies, Earth's orbit, also called Earth's revolution, is an ellipse with the Earth–Sun barycenter as one focus with a current eccentricity of 0.0167. Since this value is close to zero, the center of the orbit is relatively close to the center of the Sun (relative to the size of the orbit). **(NASA, 2015)**

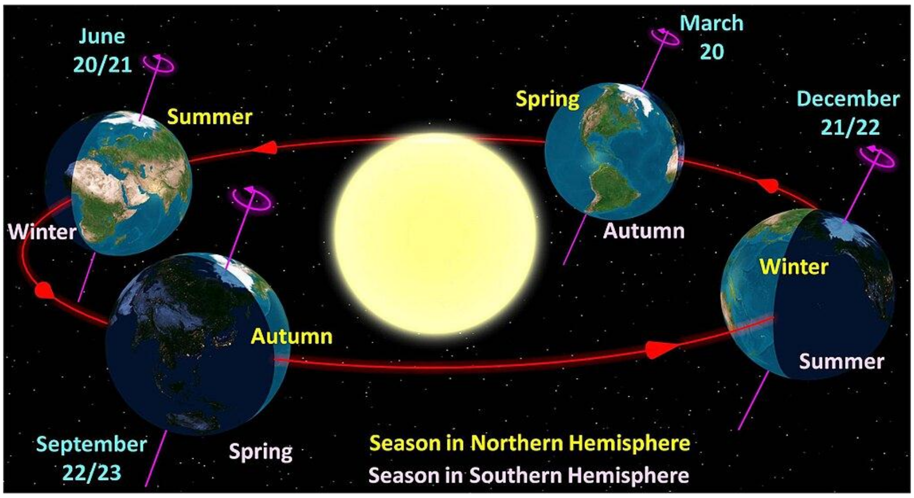


Fig 11: Earth at seasonal points in its orbit.
Source: (NASA, 2015).

Note: marking that the orbital extreme points (apoapsis and periapsis) are not the same as the four seasonal extreme points (equinox and solstice) - see fig 50- **(Laskar, 2001)**

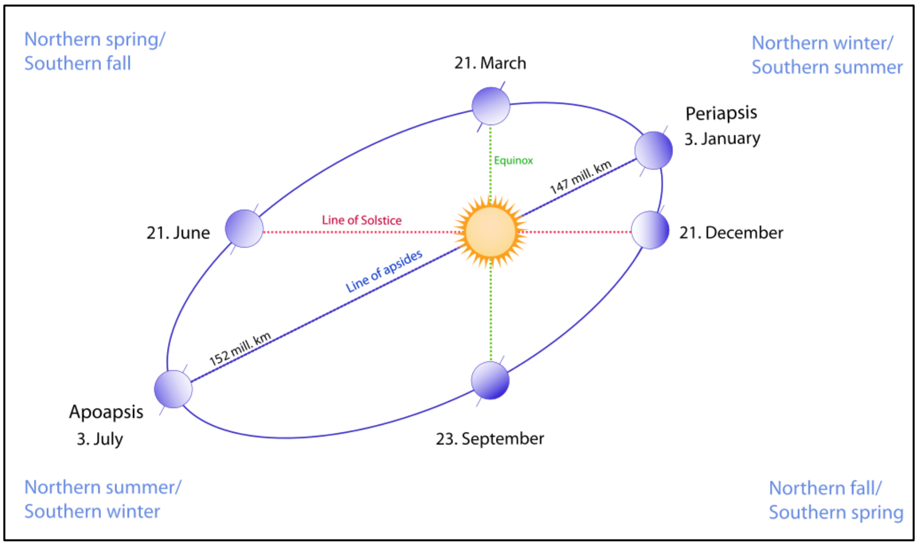


Fig 12: The difference between the orbital extreme points (apoapsis and periapsis) and the four seasonal extreme points (equinox and solstice).
Source: (Laskar, 2001).

4.4 Solar coordinates: The sun follows a path in which each point is determined; in a place, by its angular height and its azimuth. this height is maximum at the summer solstice, minimum at the winter solstice.

Knowing the sun's inclination (the angle of the sun's elevation above the horizon during different seasons) is extremely important in the field of architecture, as it helps engineers and architects design sustainable buildings that are thermally and visually comfortable. It can be summarized in the following points:

Passive Solar Design:

- **Utilizing thermal energy:** Windows and openings can be oriented to capture winter sunlight (when the sun is low) for natural heating, while avoiding summer sunlight (when the sun is high) to prevent overheating.
- **Reducing energy consumption:** Minimizing reliance on artificial heating in winter and air conditioning in summer.

Building Shading:

- **Designing shading elements:** Such as louvers or extended roofs, which block summer sun while allowing winter sunlight.
- **Calculating shadow angles:** Using horizontal projections designed based on the sun's elevation in summer and winter.

Building Orientation:

- **Buildings in cold climates:** It is preferable to orient the main glazed facades toward the south (in the Northern Hemisphere) to maximize sunlight exposure.
- **Buildings in hot climates:** It is best to minimize windows on the east and west facades to avoid intense direct sunlight.

Material and Coating Selection:

- **Reflective colors and materials:** In hot regions, light-colored materials that reflect sunlight are used.
- **Thermal mass:** Such as concrete walls that absorb heat during the day and release it at night in cold climates.

Urban Planning and Public Spaces:

- **Building distribution:** To avoid blocking natural light between structures.
- **Street and plaza design:** To ensure natural ventilation and adequate shade for pedestrians.

Renewable Energy:

- **Solar panels:** Their tilt is calculated to maximize energy absorption throughout the year.
- **Solar heating systems:** Such as solar water heaters that rely on seasonal sun angles.

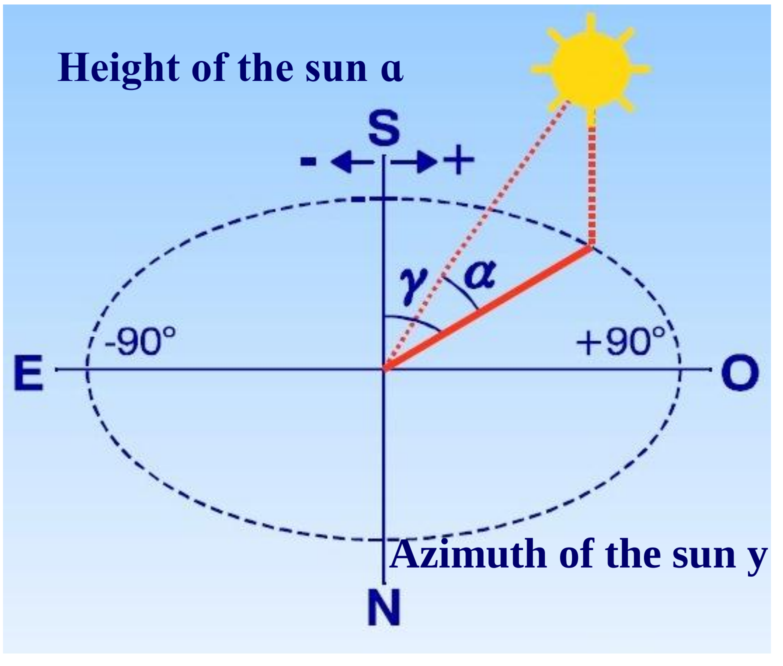


Fig 13: Solar Coordinates.
Source: (Liébard & De Herde, 2004)

And to extract the coordinates of the sun at any hour and any day of the year, we can use the solar diagram.

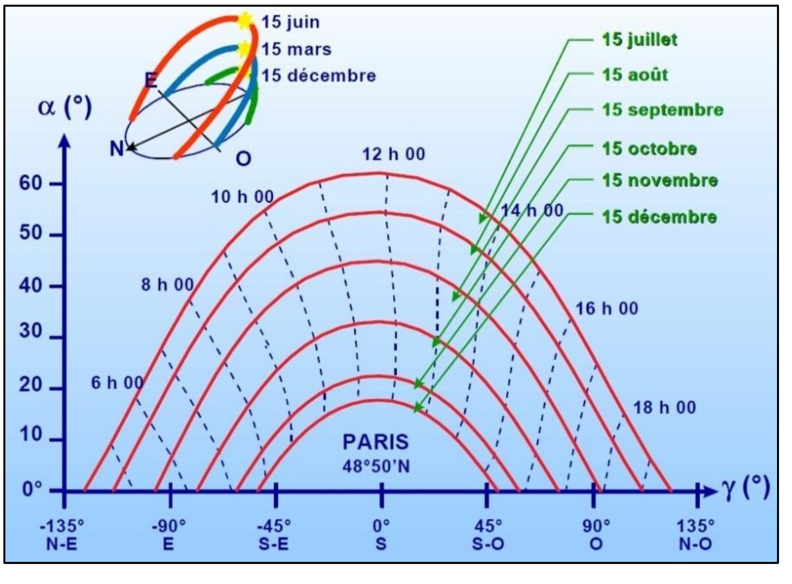


Fig 14: The solar diagram.
Source: (Liébard & De Herde, 2004)

4.5 Construction of solar diagrams: The solar diagram represents the apparent paths of the sun in the sky, the position of the sun being defined by two angles: the azimuth and the height above the horizon. Solar diagrams generally provide these paths for each month (on the 21st). Some intersperse the ten-day courses, particularly between March and September.

The solar diagram is obtained by projecting the angular positions of the sun (azimuth, altitude) onto a simple 3D geometric support (cylinder or better, hemisphere) which is then unfolded onto a 2D plane. As in a planetarium, all celestial objects can be represented by points belonging to the same finite sphere, which is called a fictitious sphere. The apparent courses of the sun fall into this category of celestial objects.

The vertical projection of the fictitious hemisphere thus gives a circle whose center represents the (zenith) and the circumference (the horizon).

On this projection, which is referred to as spherical, the azimuths are therefore seen in true scale, like on an architect's plan.

For altitudes, the horizon (h = 0°) and the zenith (h = 90°) being already known, all intermediate altitudes are necessarily between the circle and its center. By convention, the iso-heights (generally every 10°) are represented by equidistant concentric circles, which is why these diagrams are called equidistant spherical diagrams.

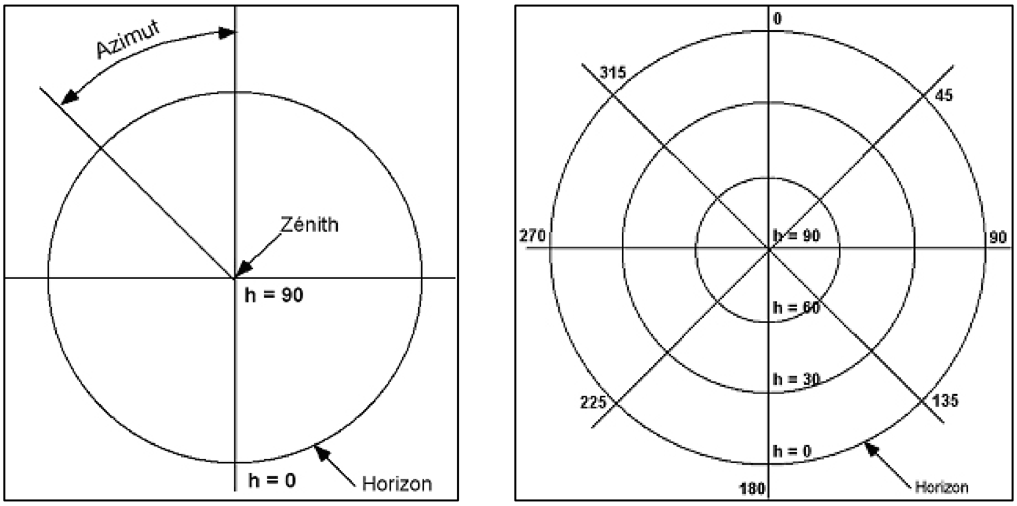


Fig 15: The basics of spherical projection: Azimuth indicator rays and concentric circles bearing iso-height.

Source: (IZARD, 2006)

It should be noted that solar diagrams vary depending on the astronomical location of the region, as the movement and intensity of the sun change according to the location. The differences can be identified in the following points:

4.5.1 Near the Equator (0°):

- The sun is nearly vertical most of the year, with slight seasonal variations.
- Shadows are very short at noon.
- Sun path diagrams appear almost symmetrical throughout the year (semi-circular).

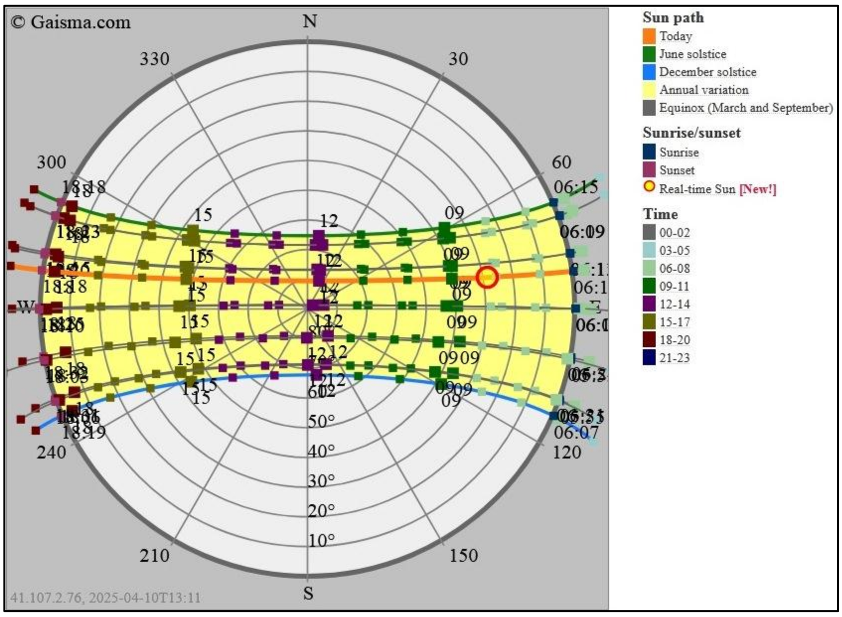
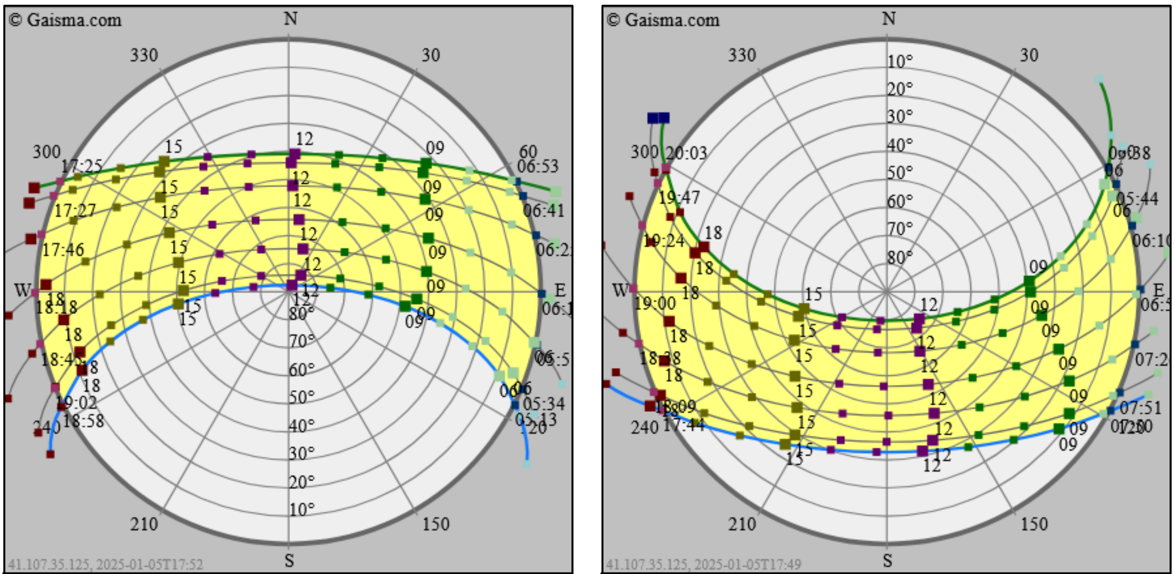


Fig 16: the solar diagram of the city of Ambato, Ecuador - on the equator -
Source: (Gaisma)

4.5.2 Temperate Zones (30°-50°):

- The sun is high in summer and low in winter.
- Solar diagrams show clear seasonal differences (summer sun paths are longer than winter ones).



South of the equator	North of the equator

Fig 17: The solar diagram of the city of Laghouat, Algeria – Temperate Zone -
Source: (Gaisma)

4.5.3 Polar Regions (Above 60°):

- Midnight sun in summer, and no sunlight in winter.
- The diagrams show the sun's path close to the horizon or absent.

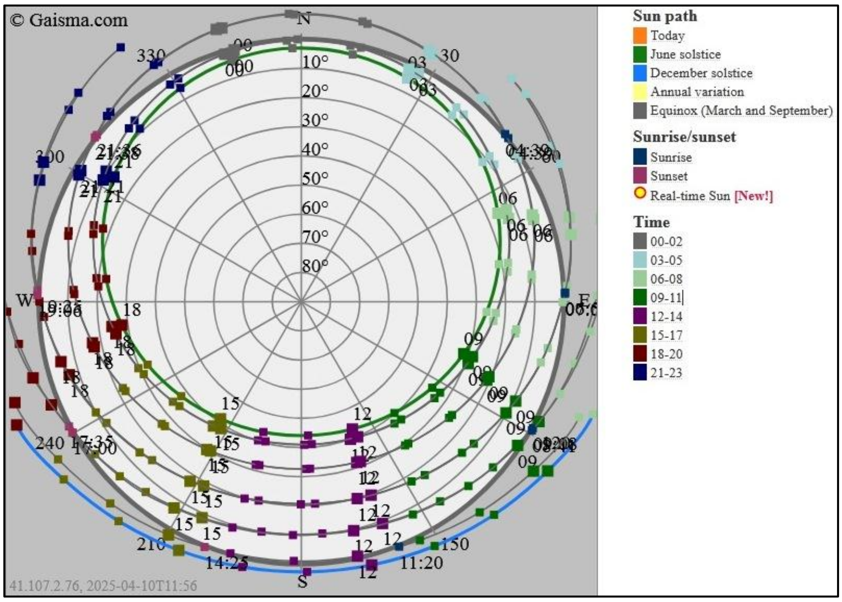


Fig 18: The solar diagram of the city of Norilsk, Russia - polar zone -
Source: (Gaisma)

Note:

It is worth noting that the angle of the sun's elevation changes with the seasons, reaching its highest point in summer, which makes it easier to block sunlight, and it drops to its lowest point in winter, allowing the maximum amount of sunlight to enter the spaces through the openings.

Just as the annual seasons are opposite in the two hemispheres, if it is the winter solstice in the northern hemisphere, it will be the summer solstice in the southern hemisphere, and if it is the spring equinox in the southern hemisphere, it will be the autumn equinox in the northern hemisphere.

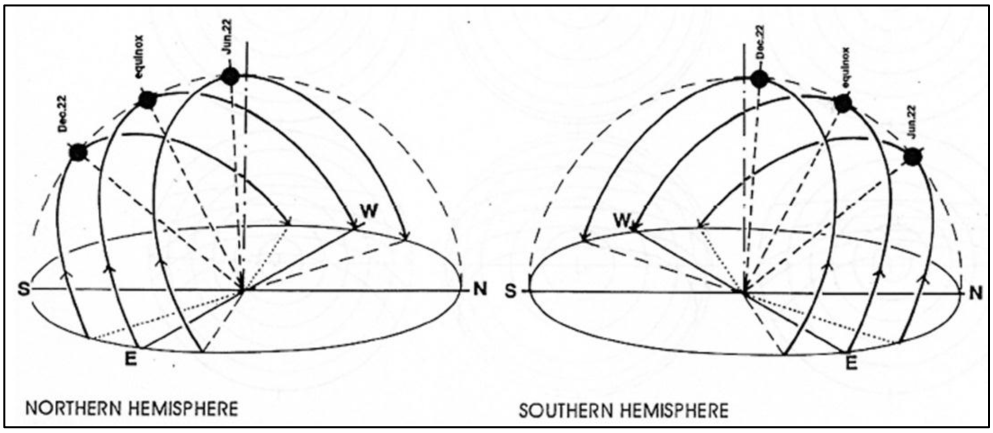


Fig 19: Opposite seasons between the two hemispheres.
Source: (Chamara & Beneragama, 2020)

After thoroughly determining the solar path, the architect can optimally control the orientation of the building, which aligns with its purpose: the needs for natural light, the benefit of using solar radiation to heat the building, or conversely, the need to protect against it to avoid overheating, the presence of winds that can cool the building in winter or refresh it in summer, are all important factors in choosing the orientation.

5 Meteorological phenomena that constitute the climate:

5.1 The temperature:

- Set of atmospheric conditions, variable, subjectively translated into relative sensations of heat and cold, and whose exact assessment is provided by the thermometer.
- Degree of heat of a place, a substance, a body: The temperature of an oven.
- Degree of internal heat of the human or animal body: Take your temperature. **(Larousse francais)**

When studying temperature, specialists typically deal with three types of measurements:

- **Maximum temperature (High)**: The highest temperature recorded over a specific period (day, month, year). It is usually measured during the day, particularly in the afternoon or later. It is influenced by direct sunlight, clear weather, and high-pressure systems.
- **Minimum temperature (Low)**: The lowest temperature recorded over a specific period (day, month, year). It is usually measured at night or just before sunrise. It is affected by clear skies, lack of clouds, and the presence of cold air or calm winds.
- **Average temperature**: This is the mean of the maximum and minimum temperatures.

The **daily temperature range** (the difference between the two) is calculated by subtracting the minimum from the maximum, and it is an important indicator in meteorology for understanding climatic fluctuations.

Temperature analysis helps define thermal comfort ranges (cool, comfortable, or hot), enabling designers to develop appropriate intervention strategies that ensure user satisfaction and optimal thermal well-being.

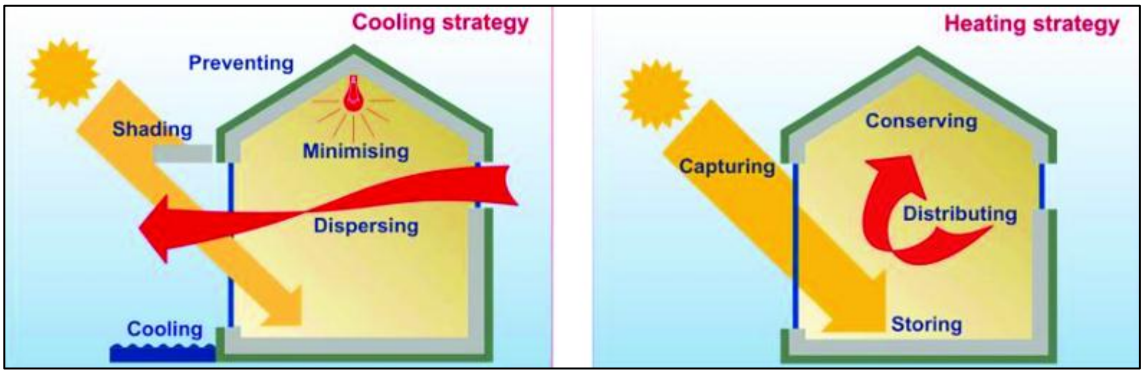


Fig 20: Different strategies for dealing with temperature.
Source: (Chayaamor-Heil & Hannachi-Belkadi, 2017)

5.2 The precipitation:

In meteorology, precipitation is any product of the condensation of atmospheric water vapor that falls from clouds due to gravitational pull. **(Glossary of Meteorology, 2009).** The main forms of precipitation include drizzle, rain, Rain and snow mixed ("sleet" in Commonwealth usage), snow, ice pellets, graupel and hail. Precipitation occurs when a portion of the atmosphere becomes saturated with water vapor (reaching 100% relative humidity), so that the water condenses and "precipitates" or falls. Thus, fog and mist are not precipitation; their water vapor does not condense sufficiently to precipitate, so fog and mist do not fall. (Such a non-precipitating combination is a colloid.) Two processes, possibly acting together, can lead to air becoming saturated with water vapor: cooling the air or adding water vapor to the air. Precipitation forms as smaller droplets coalesce via collision with other rain drops or ice crystals within a cloud. Short, intense periods of rain in scattered locations are called showers.

a) **Measurement:**

- **Liquid precipitation:**

Rainfall (including drizzle and rain) is usually measured using a rain gauge and expressed in units of millimeters (mm) of height or depth. Equivalently, it can be expressed as a physical quantity with dimension of volume of water per collection area, in units of liters per square meter (L/m^2); as $1L = 1dm^3 = 1mm{\cdot}m^2$, the units of area ($m^2$) cancel out, resulting in simply "mm".

- **Solid precipitation:**

A snow gauge is usually used to measure the amount of solid precipitation. Snowfall is usually measured in centimeters by letting snow fall into a container and then measure the height. The snow can then optionally be melted to obtain a water equivalent measurement in millimeters like for liquid precipitation. The relationship between snow height and water equivalent depends on the water content of the snow; the water equivalent can thus only provide a rough estimate of snow depth. Other forms of solid precipitation, such as snow pellets and hail or even rain and snow mixed can also be melted and measured as their respective water equivalents, usually expressed in millimeters as for liquid precipitation.

b) **The impact of precipitation on architecture and design:**

Precipitation (such as rain, snow, hail, and others) has significant effects on architecture and urban design, as it is taken into consideration when planning buildings, selecting materials, and even in the aesthetic form of structures. Here are some key impacts:

5.2.1 The Impact of Rain on Architecture:

- **Roof Design and Slopes:**
  - Roofs are designed with slopes (inclination) to quickly drain rainwater, especially in areas with heavy rainfall.
  - Sloped roofs (such as gabled roofs) are common in rainy regions, while flat roofs are more typical in dry areas.
- **Drainage Systems:**
  - Gutters (drainage channels) and downspouts are added to prevent water accumulation and wall damage.
  - In traditional architecture (like Islamic architecture), domes and muqarnas are used to direct water away from walls.
- **Water-Resistant Materials:**
  - Examples include glass bricks, waterproof coatings, and sealed concrete.

5.2.2 The Impact of Snow on Architecture:

- **Steep Roof Design:**
  - In snowy regions (like Switzerland or Alaska), sharply pitched roofs prevent heavy snow buildup that could cause roof collapse.
- **Thermal Insulation:**
  - Thick walls and high-quality insulation (as seen in Nordic architecture) reduce heat loss and prevent snowmelt from forming ice.
- **Frost-Resistant Materials:**
  - Some concrete and bricks can crack due to freezing water inside, so special materials like frost-resistant concrete are used.

5.2.3 The Impact of Hail and Freezing Rain:

- **Protecting Glass Facades:**
  - In skyscrapers, reinforced glass is used to withstand strong hail impacts.
- **Canopies and Windbreaks:**
  - Awnings or windbreaks are added over entrances to protect people from sudden snow or hail.

5.2.4 The Impact of Precipitation on Urban Design:

- **Street and Sidewalk Design:**
  - In snowy cities, streets are designed with slopes to drain melted water.
  - Non-slip materials (like rough tiles) are used on sidewalks.
- **Underground Heating Systems:**
  - Some cities (like Oslo) use under-pavement heating systems to automatically melt snow.

1. **Aesthetic and Cultural Influences:**

Traditional architecture often reflects adaptations to precipitation:

- Extended overhanging roofs in Japan protect homes from monsoon rains.
- Domes and narrow openings in desert architecture minimize exposure to rare but heavy rainfall.

c) Modern Challenges:

With climate change and the increasing intensity of storms, architecture is now placing greater emphasis on:

- **Flood-resistant buildings:** (e.g., elevated homes on stilts).
- **Green roofs:** that absorbs rainwater and reduces surface runoff.
- **Smart materials:** like self-cleaning coatings that prevent dirt buildup from rain.

In short, precipitation shapes architecture in terms of form, function, and durability, driving engineers to innovate smart solutions for weather challenges!

5.3 The Humidity: is the concentration of water vapor present in the air. Water vapor, the gaseous state of water, is generally invisible to the human eye. Humidity indicates the likelihood for precipitation, dew, or fog to be present.

Humidity depends on the temperature and pressure of the system of interest. The same amount of water vapor results in higher relative humidity in cool air than warm air. The amount of water vapor needed to achieve saturation increases as the temperature increases. As the temperature of a parcel of air decreases it will eventually reach the saturation point without adding or losing water mass.

5.3.1 Types of Humidity:

- **Absolute Humidity:**
  - It is the mass of water vapor (in grams) present in a unit volume of air (cubic meter).
  - Its equation:

$$\text{Absolute Humidity} = \frac{\text{Mass of water vapor (g)}}{\text{Volume of air (m}^3\text{)}}$$

- **Relative Humidity (RH):**
    - It is the ratio of the actual amount of water vapor in the air to the maximum amount the air can hold at the same temperature (saturation point).
    - Its equation:

$$\text{Relative Humidity} = \frac{\text{Actual water vapor content}}{\text{Water vapor capacity at saturation}} X\ 100$$

- **Specific Humidity:**
    - It is the mass of water vapor (in grams) compared to the mass of moist air (in kilograms).
    - Its equation:

$$\text{Specific Humidity} = \frac{\text{Mass of water vapor (g)}}{\text{Mass of moist air (kg)}}$$

d) Average, Maximum, and Minimum Humidity: Humidity plays a fundamental role in determining climate and weather conditions, and is typically measured using three main indicators: average, maximum, and minimum. These values help in understanding daily and seasonal humidity variations and their impact on the environment and human health.

a) Average Humidity (Mean Humidity): This represents the average relative humidity values over a specific period (day, month, year), usually calculated by taking multiple readings throughout the day and then averaging them.

- **Importance:**
- Used in climatic studies to determine weather patterns in a region.
- Aids in agricultural planning (e.g., scheduling irrigation).
- Affects human comfort, especially in hot and humid areas.

b) Maximum Humidity: This is the highest recorded relative humidity value over a specific period (day, week, month).

- **Importance:**
- Indicates the peak concentration of water vapor in the air, which can lead to:
    - Fog or dense clouds.
    - Discomfort due to heat stress (especially in tropical regions).
- Used in weather forecasts to warn people of dangerously humid conditions.

c) Minimum Humidity: This is the lowest recorded relative humidity value over a specific period.

- **Importance:**
- Indicates dry conditions, which may cause:
    - Dry skin and eyes.
    - Increased risk of wildfires in desert regions.
    - Negative effects on crops that require high humidity.
- Used for early drought warnings.

Type	Definition	Impact	Applications
Average	Mean value over a period	Long-term climate analysis	Climate studies, agriculture
Max	Highest recorded value	Oppressive, foggy conditions	Weather alerts
Min	Lowest recorded value	Drought, fire risks	Drought monitoring

Tab 13: Comparison between Average, Maximum, and Minimum Humidity.
Source: author.

- **e) Givoni Bioclimatic Diagram:** It is a diagram used to analyze the relationship between temperature and relative humidity in a specific area, and to determine appropriate design strategies for achieving thermal comfort without excessive reliance on mechanical heating or cooling systems.
- **a) Main Components of the Chart:**

- **Horizontal Axis:** Represents Relative Humidity.
- **Vertical Axis:** Represents Dry Bulb Temperature.
- **Colored/Zoned Areas:** Display thermal comfort zones and required strategies (e.g., ventilation, shading, evaporative cooling, etc.).

b) Architectural Applications:

The diagram helps identify:

- **Optimal strategies:** to enhance thermal comfort based on local climate:
  - Natural Ventilation*:* When temperatures are moderate and humidity is acceptable.
  - Shading*:* In hot and arid regions.
  - Thermal Mass*:* For heat/coolness storage.
  - Evaporative Cooling: In dry climates.

- **Building design efficacy:** during pre-construction evaluation.

c) How to Read the Diagram:

- Input local climate data (temperature and humidity).
- Plot the data points on the chart.
- Determine point locations within strategy zones (e.g., if points fall in the "Ventilation" zone, the design should prioritize effective natural ventilation).

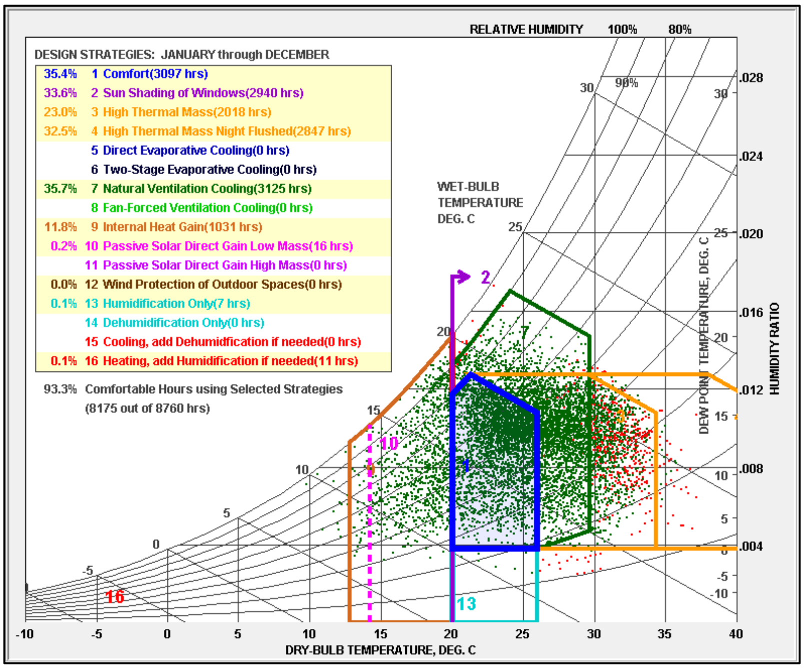


Fig 21: Psychrometric chart (Givoni Bioclimatic chart).
Source: (Alagaw & Yonas, 2021)

5.4 **The Winds:** is the horizontal movement of air from areas of high pressure to areas of low pressure, resulting from uneven heating of the Earth by the Sun. Its speed and direction depend on several factors, the most important being:

- **Pressure gradient:** (the greater the pressure difference, the higher the wind speed).
- **Earth's rotation:** (the Coriolis effect, which deflects winds to the right in the Northern Hemisphere and to the left in the Southern Hemisphere).
- **Topography:** (mountains and buildings alter wind paths).

Wind speed, frequency, direction, and temperature are fundamental factors in studying atmospheric dynamics and influence weather, climate, and many practical applications such as renewable energy and navigation:

5.4.1 Wind Speed:

- **Definition:** The rate of horizontal air movement, typically measured in:
  - ***Meters per second*** (m/s) (SI unit).
  - ***Kilometers per hour*** (km/h) or knots (1 knot ≈ 1.852 km/h).
- **Influencing Factors:**
  - ***Terrain****:* Winds are faster over smooth surfaces (e.g., seas) compared to mountainous areas.
  - ***Atmospheric Pressure:*** Greater pressure differences between regions increase speed.
  - ***Altitude****:* Speed increases with height due to reduced friction (e.g., **jet streams** at high altitudes).
- **Applications:**
  - ***Wind Energy:*** Turbines require speeds of **5–25 m/s** for efficient electricity generation.
  - ***Weather Warnings:*** Winds exceeding **17 m/s** (≈ 61 km/h) are classified as storms.

5.4.2 Wind Frequency:

- **Definition:** How often winds blow from a specific direction or at a certain speed over a period (e.g., a month or year).
- **Measurement Tool:** Analyzed using a **Wind Rose**.
- **Importance**:
  - **Navigation**: Identifying prevailing directions for flight or maritime routes.
  - **Pollution Control:** Determining the spread direction of pollutants from factories.

5.4.3 Wind Direction:

- **Definition:** The geographic origin of wind (e.g., a "northerly wind" blows from north to south).
- **Measurement Tools:** Wind vane or anemometer.
- **Types by Direction:**
  - ***Trade Winds:*** Blow east-to-west near the equator.
  - ***Westerlies:*** Blow west-to-east in mid-latitudes.
  - ***Monsoons:*** Seasonally reverse direction.

5.4.4 Wind Temperature:

- **Definition**: The temperature of the air mass carried by wind, affecting thermal perception.

- **Influencing Factors:**
  - ***Wind Source**:* Polar winds are cold; desert winds are hot.
  - ***Wind Chill**:* Cold winds make the air feel colder than the actual temperature (e.g., -10°C with 30 km/h winds ≈ feels like -20°C).
- **Impacts:**
  - ***Agriculture**:* Hot, dry winds may cause drought.
  - ***Health**:* Cold winds increase the risk of frostbite.

5.4.5 Relationships Between These Elements:

- **Speed + Direction**: Determine storm intensity.
- **Temperature + Direction**: Shape air masses.
- **Frequency + Direction**: Used in airport planning (runways align with prevailing winds).

5.4.6 Measurement Tools:

- **Anemometer:** Measures speed.
- **Wind Vane:** Measures direction.
- **Barometer:** Measures air pressure linked to wind movement.

5.4.7 Wind Rose: is a graphical tool used in meteorology and navigation to illustrate the prevailing wind directions at a specific location over a defined period (e.g., a month or year).

- **Features of a Wind Rose:**
  - ***Shape:*** Resembles a flower or star, where each "petal" represents a wind direction (north, south, east, west, and intermediate directions).
  - ***Length**:* The length of each petal indicates the **frequency of winds** from that direction.
  - ***Colors**:* Often used to denote **wind speed** (e.g., blue for light winds, red for strong winds).

- **Applications:**
  - ***Energy**:* Assessing wind turbine potential for power generation.
  - ***Aviation/Maritime Navigation**:* Understanding favorable or hazardous wind patterns.
  - ***Urban Planning:*** Determining optimal locations for airports or buildings to minimize air pollution.

- **Example:**

If the wind rose shows a long petal pointing northwest, it means winds **most frequently** come from that direction.

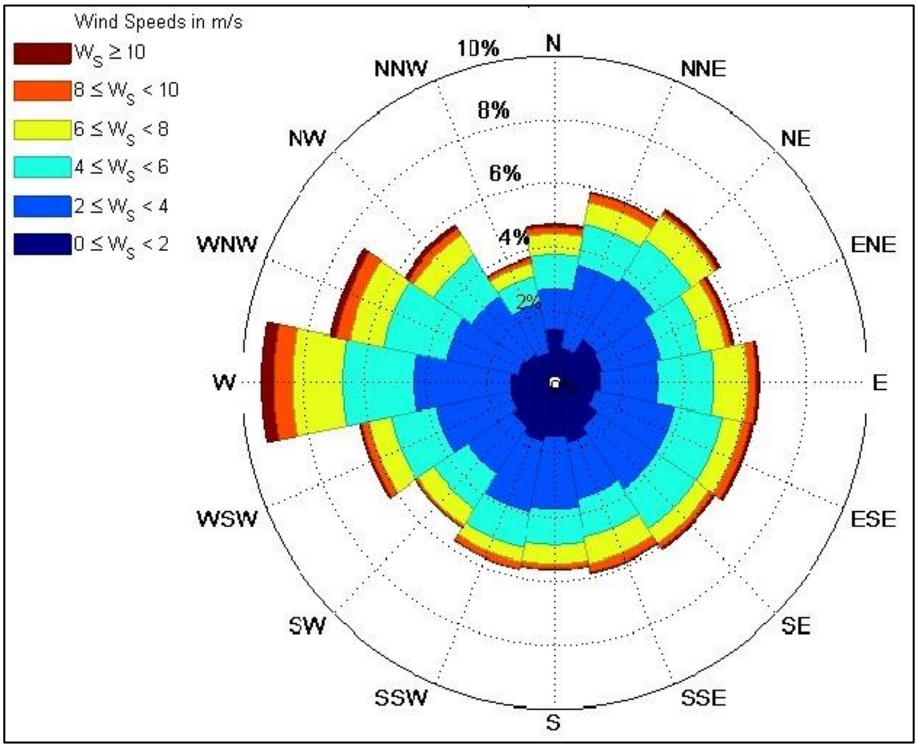
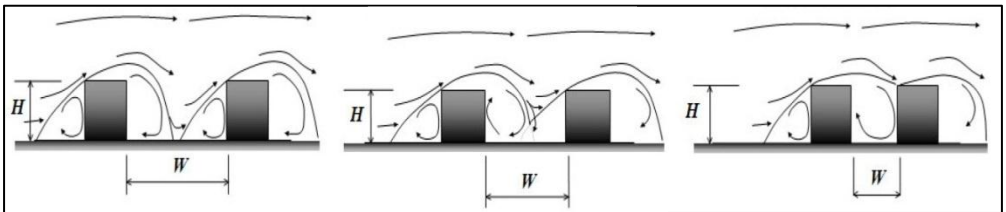


Fig 22: Wind Rose**.**
Source: (Ahrens, 2009)

5.4.8 Winds in urban areas: The impact of urbanization on winds is complex. The city modifies the speed of the winds and their direction through its roughness, by channeling the winds in the streets, but also by the influence of the urban heat island, which gives rise to thermal winds. Thermal breezes, caused by air convection, appear throughout a city or neighborhood, particularly when the winds are weak. This phenomenon increases when the heat island intensifies.

Buildings model the flows through their shape, dimensions, and juxtaposition. The movement of air is affected by the length, height, and type of roofs of the buildings, which influence the characteristics of the wind and have a significant impact on the microclimate around the buildings. However, in a dense fabric, aerodynamic accidents can occur at the base of tall elements. On the other hand, old fabrics, due to their density and low height, create a protective effect.

a) At the street scale: the three types of flows defined for a city-stream wise, wake interference, and isolated roughness-can also be identified.

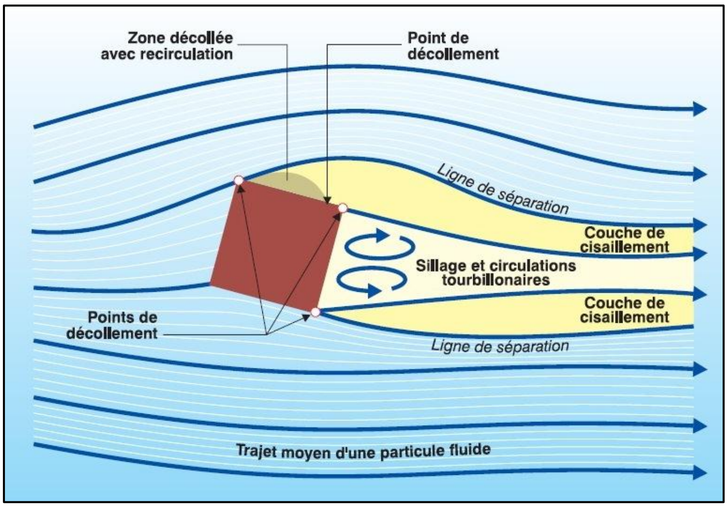


Flow with isolated	Wake interference flow	Shear flow

Fig 23: Canyon-type street with an aspect ratio W / H.
Source: (Bozonnet, 2005)

b) **At the scale of buildings:** When the prevailing wind flows around the buildings, perpendicular to one of the facades, different disturbed zones can be distinguished: on the windward facade a zone of overpressure, on the sides and the upper part a detachment and a turbulent boundary layer, on the leeward facade a turbulent depression zone**. (Bozonnet, 2005)**

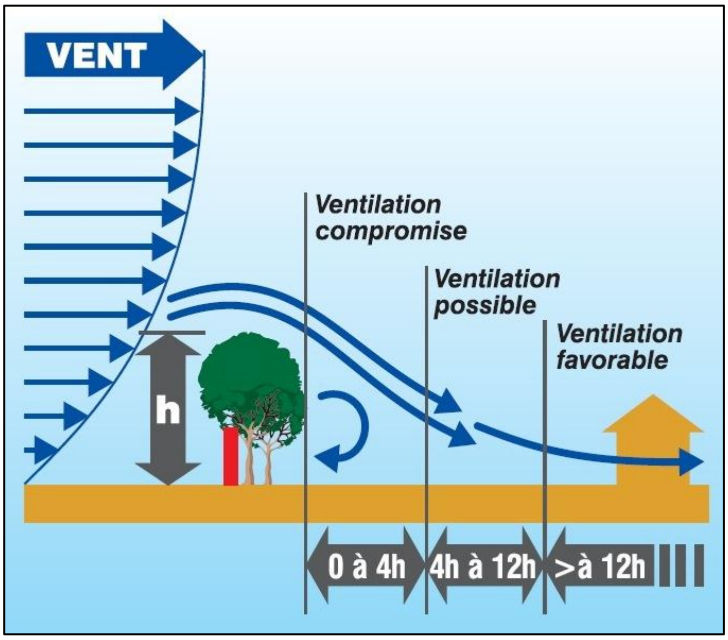
Fig 24: Top view of the phenomena of a turbulent flow encountering a rectangular building.
Source: (Liébard & De Herde, 2004)



5.4.9 Aerodynamic obstacles: For ventilation to be effective, the wind must be able to reach the areas surrounding buildings directly without being excessively obstructed by obstacles. The impact of an obstacle can be felt at a distance of 4 to 12 times its height. This distance depends on the engineering characteristics of the obstacles, their orientation relative to the wind, their location, and their porosity.

A vortex area is created directly behind any obstacle. The ventilation potential of a house located in such an area is significantly reduced because the wind-exposed facade is no longer under excess pressure. The presence of a certain distance from the obstacles, allowing the wind to regain its "laminar" characteristics, ensures a favorable ventilation area. In hot and dry regions, the shading provided by the obstacles outweighs the reduction in ventilation potential.

Fig 25: ventilation potential of a building based on the distance from an aerodynamic obstacle.
Source: (Liébard & De Herde, 2004)



The impact of airflow barriers depends on a set of separation distances between these masks as a function of their size and spatial distribution. The shorter and deeper the buildings, the smaller the distance that must be maintained between them. Air barriers placed at high locations allow the wind to pass underneath them. Thus, trees with slender trunks allow the wind to pass at human height. Additionally, constructions on stilts and those with roof overhangs are also preferred because they have a much lesser impact on the ventilation of the ground plan.
The optimization of the mass plan involves developing air mixing mechanisms and channeling airflows while considering the nature of wind regimes.

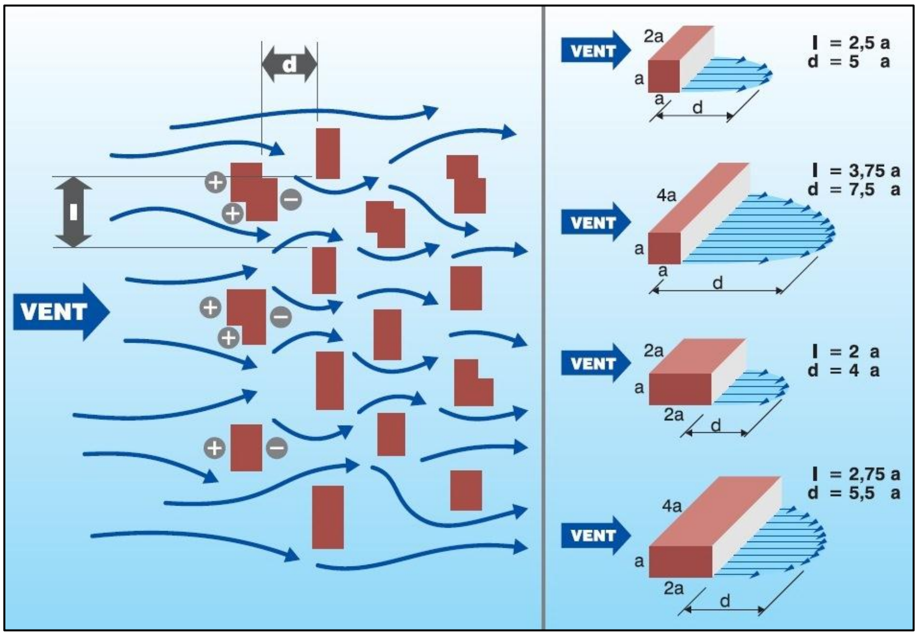


Fig 26: ventilation potential of a building based on the distance from an aerodynamic obstacle.
Source: (Liébard & De Herde, 2004)

5.4.10 Typical effects caused by the wind: In built environments, shelter and exposure situations are very variable because they directly depend on the distribution of pressure fields around buildings.

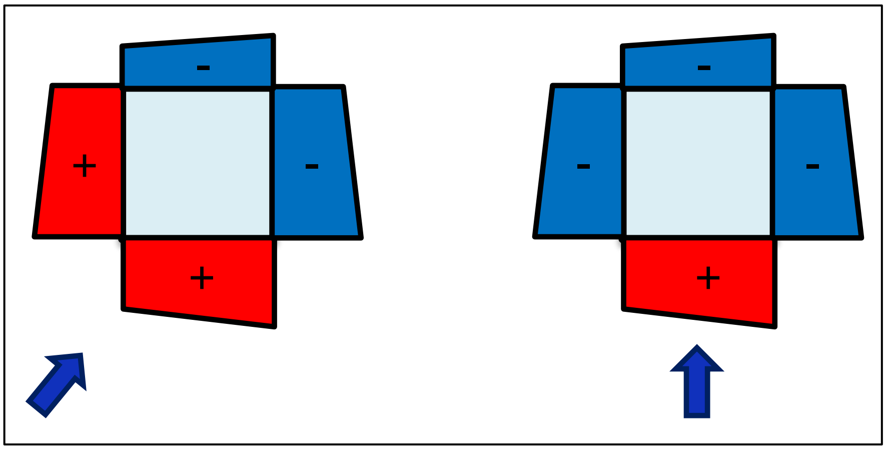
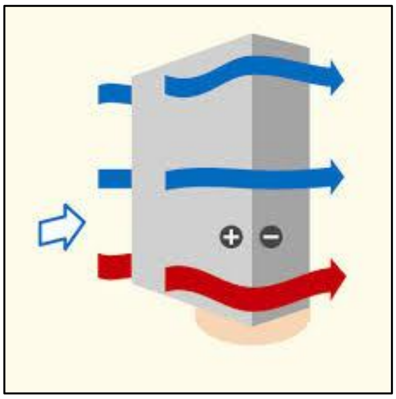
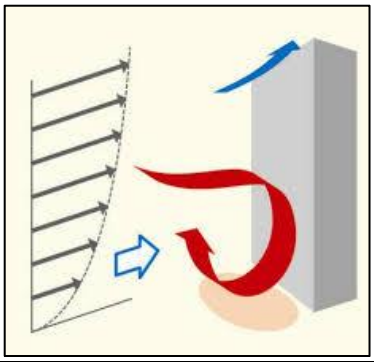
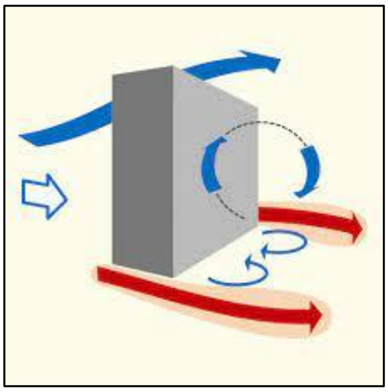
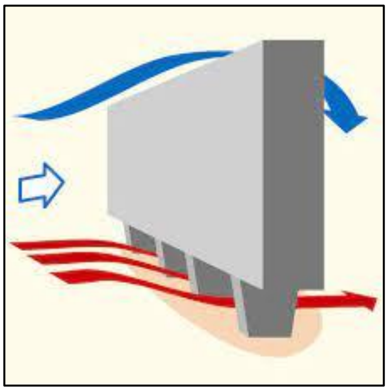
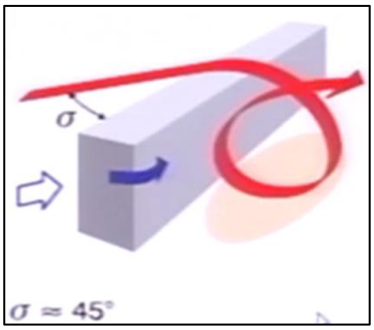


Fig 27: ventilation potential of a building based on the distance from an aerodynamic obstacle.
Source: (Guyot)

The effects resulting from its collision with buildings vary depending on the shape of the building, its height, and the pattern of its assembly with neighboring buildings.

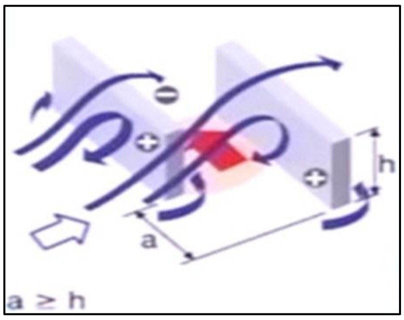
a) The isolated forms:

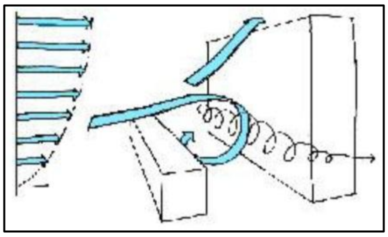
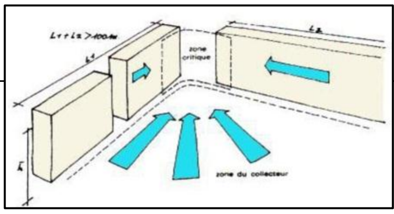
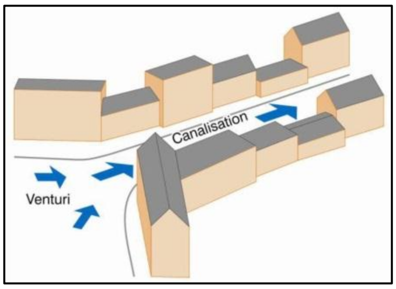
Name	Esquema	Description
Corner effect		Localized acceleration phenomenon at the corner of a building, due to a very high gradient of the pressure field over a limited space between the exposed facade and the one located in depression. <u>Evaluation of the effect:</u> the effect is proportional to the height of the corner of the building: the speed can increase from 1.2 to more than 2 times its initial state for buildings of a few levels to high-rise towers (R+30).
Upstream vortex effect		Phenomenon of swirling air movement, with a vertical component, plunging onto the facade directly exposed to the wind. <u>Evaluation of the effect:</u> minimal for low-rise buildings, significant for buildings higher than R+5. (Acceleration of 1.5 in the case of a 20-story building.
Wake effect and downstream roll		Phenomenon of vortex air movement on the windward facade and plunging on the leeward facade. <u>Evaluation of the effect:</u> the phenomenon is proportional to the surface area of the building that opposes to the main flow of the wind. low speed at the center. The flow separation zone at ground level is unsteady and is located at a distance of one to two times the height of the building.

Hole effect or passage under a building		When a building with a minimum height of more than 15m is elevated on columns, Holes or piles, the air passes through them. It's a phenomenon that connects the front of the building in overpressure and its rear in under pressure. The solid-shaped piles play a role guiding blades while the holes under the building are more sensitive to the direction of the wind incident. The taller the building, the less comfortable it is.
Bar effect		It is a helical deviation of the wind flow when passing over a bar at an angle close to 45°. This phenomenon may occur in the case of a height H < 25 m, and a minimum bar length L > 8H. Isolated bars, or grouped and aligned without a large spacing, also experience the same effect.

Tab 14: Adverse effects of wind on isolated buildings.
Source: author.

b) The associated forms:

Name	Esquema	Description
Effect of connection between different pressure zones between buildings		Offset arrangement of 2 buildings creating a corridor between them related to the existing pressure field between the leeward facade of the upstream building and the windward facade of the structure. <u>Evaluation of the effect:</u> The value of the excess speed ranges between 1.2 and 1.6 for constructions between 12 and 35 meters in height. Between 2 towers of 100m in height, the value of the coefficient can reach 1.8.

Wise Effect		The association of buildings of different sizes and parallel placement maintains a vortex with a vertical component resulting from the downstream vortex or wake effect of the upstream building combined with the upstream vortex of the building located downstream. <u>Evaluation of the effect:</u> when the association is between 10 and 30m, the coefficient takes the value 1.5. For an association between 15 and 90m, the value is 1.8.
Effet venturi		This phenomenon resembles that of fluid dynamics where gaseous or liquids are accelerated due to a narrowing of their circulation area. In this phenomenon, the opening facing the wind and the angled arrangement of buildings having a average height H > 15 m and a minimum length of the two arms (L1 + L2 > 100 m), form a kind of wind collector channel. This angle is the most critical area in terms of comfort. aerodynamic because the airspeed there is considerable.
Channeling effect		This corresponds to a classic configuration of a street bordered by continuous buildings on each side. This arrangement maintains and extends any phenomenon located at the beginning of the street. <u>Evaluation of the effect:</u> the phenomenon is maintained for a distance of 2 times the average height of the street.

Tab 15: Adverse effects of wind on associated buildings.
Source: author.

Summary:

Climate studies are a fundamental element in architectural and urban design, as the climatic characteristics of a site (such as temperature, humidity, wind, and rainfall) determine the optimal design approaches to achieve thermal comfort and energy efficiency. For example, in hot and dry regions, architects rely on thick building masses, small openings, and internal courtyards to reduce heat, while in humid regions, natural ventilation and shading are preferred.

In urban planning, these studies help in orienting streets to maximize or minimize ventilation as needed, selecting materials with heat-reflective properties, and integrating green spaces to mitigate "heat islands." Additionally, renewable energy systems (such as solar power) contribute to enhancing sustainability.

Thus, climate studies play a vital role in architectural and urban design, influencing building efficiency and sustainability. Designers can select appropriate materials and orientations to achieve thermal comfort and reduce energy consumption. Climate-responsive design improves quality of life and reduces harmful emissions. In urban planning, these studies help determine street layouts and green spaces to enhance natural ventilation and alleviate "heat islands," supporting sustainable cities.

Chapter Two :

Introduction:

The site is one of the fundamental factors that determine the success of any architectural or urban project. It's geographical, topographical, climatic, and cultural characteristics play a pivotal role in shaping building design and functionality. The site does not merely serve as the surrounding framework for a structure but also influences the choice of construction materials, the optimal orientation of spaces, and even the long-term sustainability of the building.

For example, soil composition and land slope affect foundation systems and construction costs, while climate determines window placement and thermal insulation systems. Additionally, the social and economic factors of a location, such as proximity to services or urban centers, contribute to the building's investment value and its suitability for users' needs.

Therefore, understanding the integral relationship between location and buildings is a design necessity that helps achieve a balance between aesthetics, functionality, and sustainability. This enhances architecture's role in serving both people and the environment.

I The Natural Environment:

Project site: Project site: It is broader and more comprehensive than the project land, encompassing the project land with all its contents, in addition to the climatic, historical factors, and the customs and traditions of the region's inhabitants.
And this leads us to discuss an important term, which is the **landscape**.

1. **Landscape:** Are the visible features of an area of land, its landforms, and how they integrate with natural or human-made features, often considered in terms of their aesthetic appeal. A landscape includes the physical elements of geophysically defined landforms such as mountains, hills, water bodies such as rivers, lakes, ponds and the sea, living elements of land cover including indigenous vegetation, human elements including different forms of land use, buildings, and structures, and transitory elements such as lighting and weather conditions. Combining both their physical origins and the cultural overlay of human presence, often created over millennia, landscapes reflect a living synthesis of people and place that is vital to local and national identity. **(New Oxford American Dictionary)**

It is result of the actions of men adapting to their natural environment throughout history. Not just a set of possible views, it's also practices, cultures, a memory.

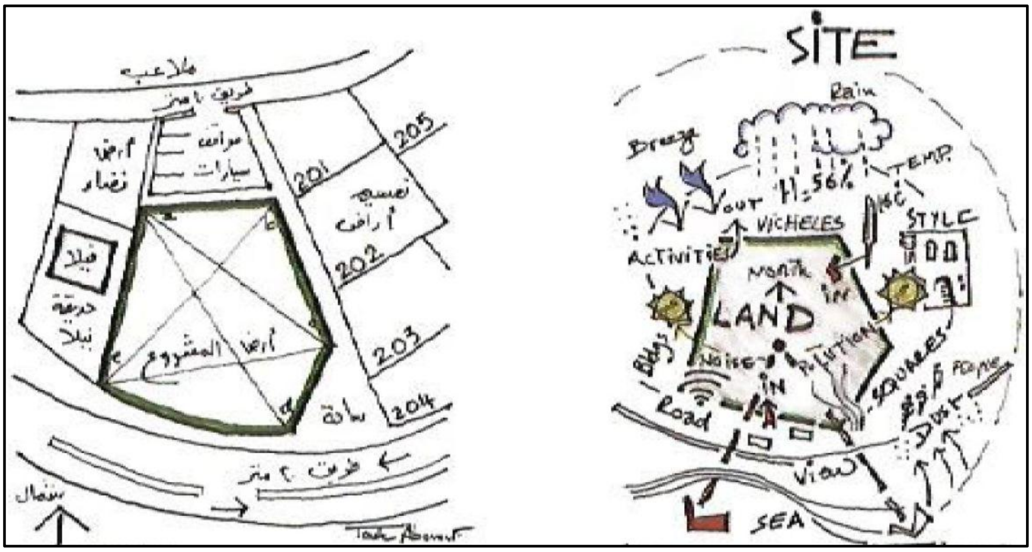


Fig 28: The difference between the project site and the project land.
Source: author.

Fig 29: Pictures showing part of a landscape.
Source: author.

1.1 **The landscape; Stability and changeability:** Landscapes may change over time due to human activities or natural processes such as fires, natural disasters, or the changing of the seasons. Changes occurring in the structure of the landscape can be documented using data derived from aerial photographs or satellite images and new technologies such as remote sensing and geographic information systems.

Fig 30: A picture showing the effect of seasonal changes on the landscape.
Source: author.

2 **Morphological approach:** Integration with topographic data. And more precisely, it means the design and construction on sloped lands.

A geomorphological study of the terrain is essential in order to determine the type of relief and its various slopes. The topographic map is the tool that helps us identify the three-dimensional shapes of a site in its natural state. It is produced at a precise scale that varies according to the extent of the site being studied. the relief is represented by contour lines indicating the altitude.

And here a very important term emerges, which is **altitude**.

- ✓ **Altitude**: Altitude (from Latin: altitudo) is historically a geographical concept that refers to the vertical geometric height between a point and an altimetric reference, most often sea level. In geodesy, it also expresses the distance of a point from the geoid.

Absolute altitude is measured relative to sea level. Relative altitude (elevation difference) expresses the difference in altitude between the summit of a landform (mountain or plateau edge) and the absolute altitude of the neighboring regions (plains, valleys).

The landforms vary with altitude, and they have different names depending on their elevation, shape, and area.

2.1 **The different types of slope:** The relief can be considered as a set of slope systems that combine to give elementary forms of relief (embankments, hills...). In turn, these forms combine to create the major types of relief (plains, plateaus, mountains...).

- ✓ **A slope:** it is an inclined surface overlooking the bottom of a valley. The shapes of the slopes are determined by the variations in gradient. It is the fundamental element of relief (mountain, plain, plateau…).

The slope is made up of an inclined surface whose steepness varies.

A = The Upper Slope.
B = The Mid-Slope.
C= The Downstream of the Slope.

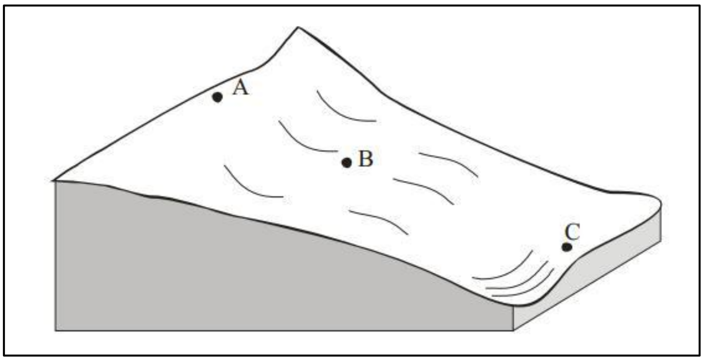


Fig 31: Image showing the main points of the slope.
Source: author.

Its shape, which can be concave, convex, straight, or concave-convex. Consequently, we distinguish between two types of shapes: simple shapes and composite shapes. Among the simple forms, we have:

- ✓ The straight slope: constant gradient, constant spacing of contour lines on the map.

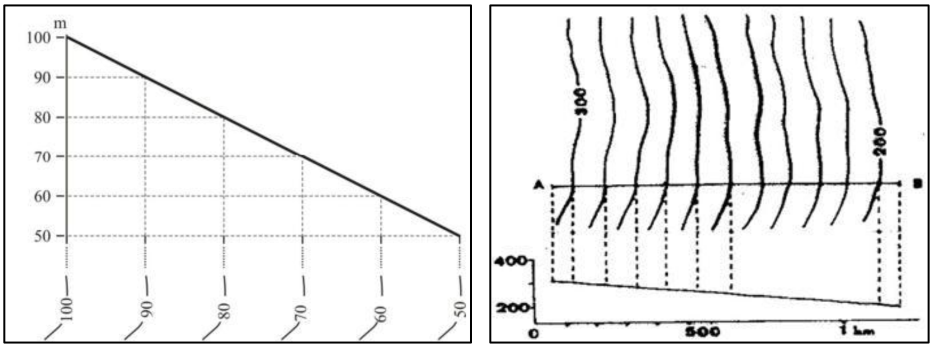


Fig 32: The straight slope.
Source: author.

- ✓ The concave slope: the slope constantly decreases (the gap increases downward).
- ✓ The convex slope: the slope constantly increases (the gap decreases downward).

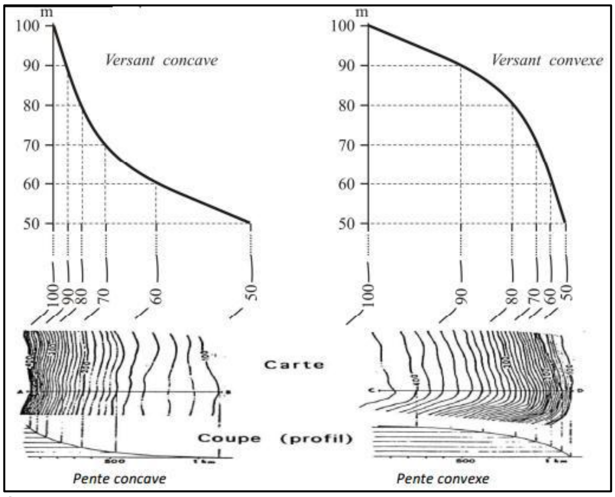


Fig 33: The concave and convex slope.
Source: author.

Among the composite shapes, we have:

- ✓ The convex-concave slope: (point of inflection).
- ✓ The convex-straight-concave slope.
- ✓ The cornice slope: the upper part with a steep incline overlooks the lower part with a significantly gentler slope.

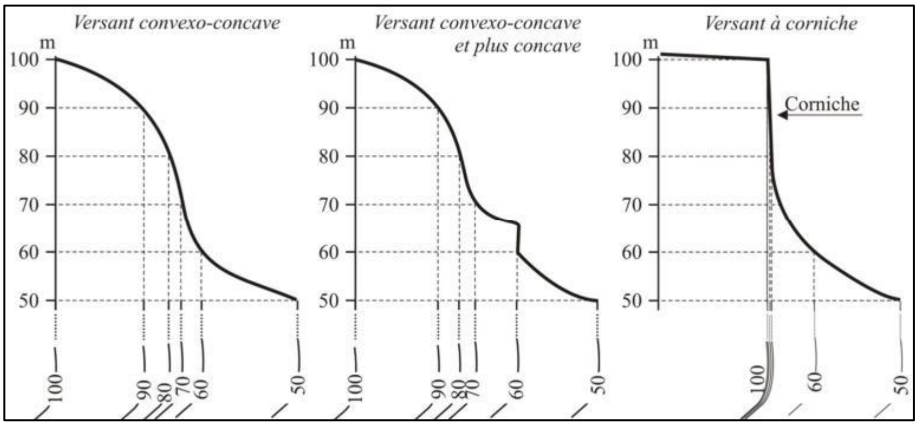


Fig 34: the composite shapes of the slope.
Source: author.

2.1 Slope break: The slope break is seen through the contour lines that suddenly diverge or converge.

- ✓ Flat area: gentler slope between two steeper slopes.
- ✓ Summit: it's the highest point of a relief.
- ✓ The ridge line: is the line that connects the highest points of the terrain. It is also the line that connects the slopes and their peaks, and it is also the watershed line. The contour lines are concentric; the central point has an altitude higher than that of the surrounding lines.
- ✓ A basin: it is a closed depression towards the bottom of which all the slopes converge. In other words, the basin is a depression in the terrain with no outflow to the outside.

The contour lines are also concentric, the altitude of the central point is lower than that of the surrounding contour lines, and sometimes an arrow indicates the center of the depression (sometimes occupied by a lake).

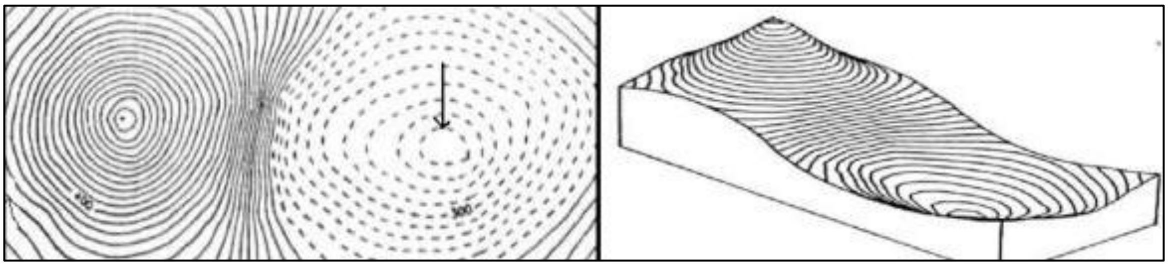


Fig 35: The basin in nature.
Source: author.

- ✓ Hill: small elevation with a gentle slope.
- ✓ Mound: hill with a flat top and steeply sloping sides, generally concave.

A Hill **A Mound**

Fig 36: The difference between a Hill and a Mound.
Source: author.

- ✓ The plateaus: A plateau is a flat or slightly undulating surface in which rivers are embedded. A plateau is characterized by its altitude, its inclination, the embedding and shape of its valleys and the more or less extensive dissection of its surface by the hydrographic network.
- ✓ The plains: A plain is a flat or slightly undulating surface on which rivers flow at ground level. The elevations are therefore very slight and the slopes minimal. A plain is characterized by its altitude, its inclination, and its more or less great flatness resulting from the density of the hydrographic network.
- ✓ Escarpment: the state of something that is on a steep slope, the steep slope of a mountain.
- ✓ Mountains: These are elevated regions with significant elevation changes that vary constantly along the same slope, long and steep slopes connecting high peaks to deep valleys.

A mountain is characterized by its altitude, its ventilation, that is to say both the width and depth of the valleys, by the orientation and shape of its ridges, and by the arrangement of its hydrographic network.

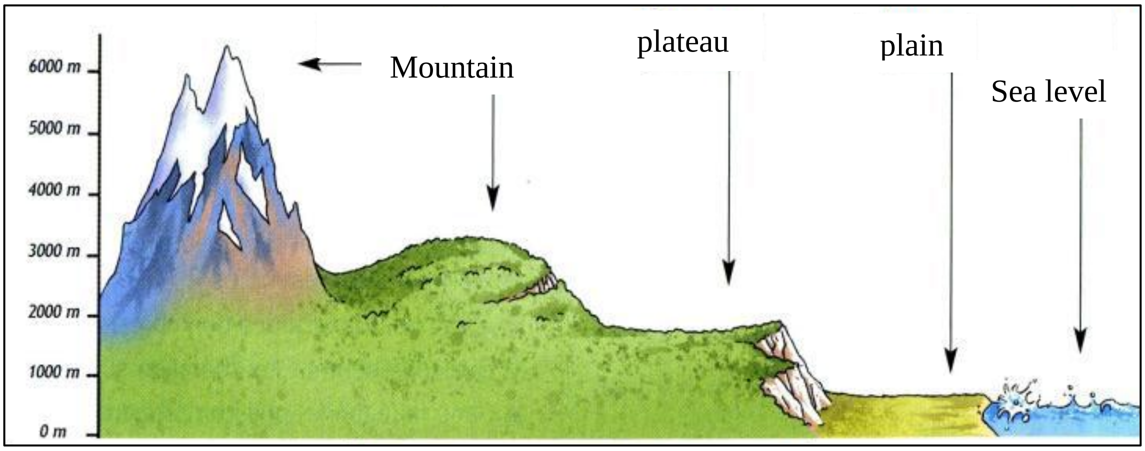


Fig 37: Landforms in nature.
Source: author.

- ✓ The valley: The valley is a more or less deep groove resulting from the intersection of two opposite slopes that converge downstream along a line of low points.

It should be noted that the wadi line consists of several parts and is considered an area unsuitable for construction due to the risk of flooding.

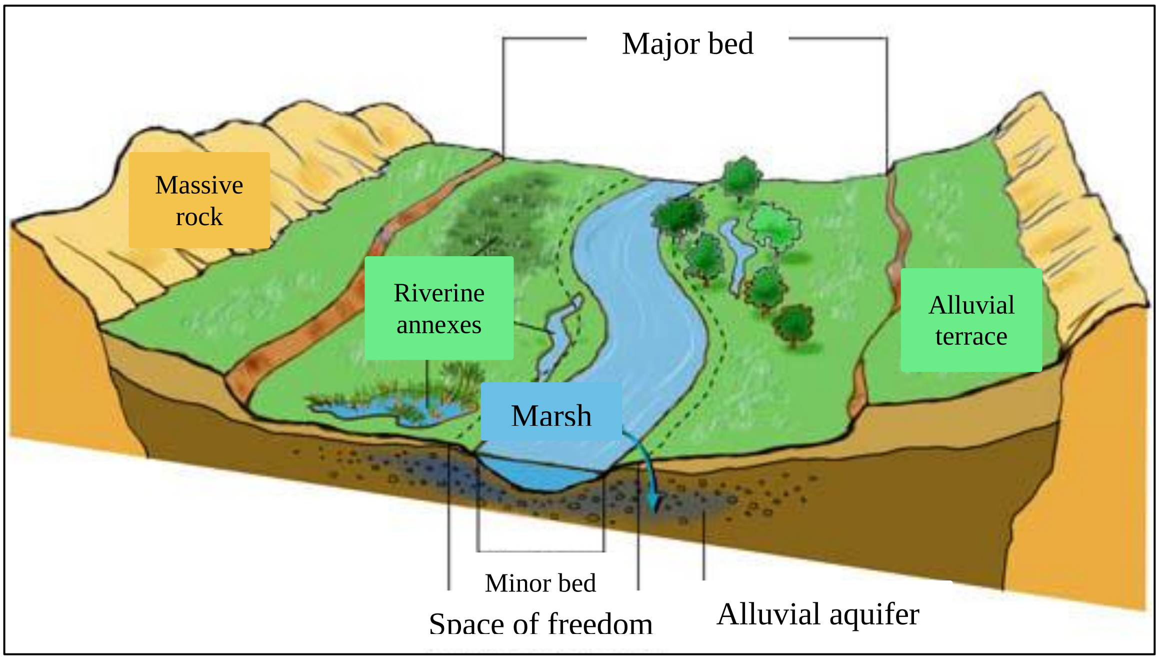


Fig 38: Components of the valley.
Source: author.

II The Built Environment:

The built environment encompasses all human-made elements designed to meet societal needs, such as buildings, roads, bridges, parks, and infrastructure. Key aspects of studying the built environment include building heights, the interplay between void and solid (empty and filled spaces), and the skyline.

1 Building Heights:

Building heights significantly influence a city's urban character and are determined by several factors:

- **Regulations and Zoning Laws**: Many cities impose height restrictions to preserve visual identity or due to aviation constraints.
- **Population Density**: In high-density areas (e.g., city centers), buildings tend to be taller to accommodate more residents and functions.
- **Function**: Skyscrapers are often used for offices or luxury hotels, while residential buildings are typically mid-rise.
- **Visual and Environmental Impact**: Tall buildings can block sunlight or create an "urban canyon" effect, affecting ventilation and natural light.

Fig 39: Building heights in the city of Dubai.
Source: (برج خليفة مُفسر: رحلة إلى أطول مبنى في العالم، 2024).

2 Void vs. Solid:

This concept describes the relationship between mass (buildings and structures) and void (open spaces like streets and plazas):

- **Solid**: Represents physical structures occupying space (e.g., buildings).
- **Void**: Represents unbuilt spaces enabling movement and social interaction, such as:
    - Public squares.
    - Parks and green areas.
    - Streets and sidewalks.
- **Balance**: Good urban design balances voids and solids to:
    - Prevent overcrowding.
    - Ensure ventilation and visual openness.
    - Enhance quality of life (e.g., Barcelona's *Eixample* grid balances built and open spaces).

Fig 40: The Void and the Solid in the urban center - the city of Tirana, Albania -.
Source:)Salah(2025 ،

3 Skyline:

The skyline is the visual silhouette of a city's buildings when viewed from a distance, acting as its "fingerprint." Influencing factors include:

- **Height Variation**: Landmarks like Dubai's Burj Khalifa create focal points.
- **Architectural Harmony**: Some cities (e.g., Paris' historic core) enforce height uniformity, while others (e.g., New York) embrace diversity.
- **Geographic Context**: Coastal cities (e.g., Chicago) have skylines accentuated by water views.
- **Cultural Identity**: Skylines may integrate heritage elements (e.g., Istanbul's mosques or Bangkok's temples).

Fig 41: The Skyline in New York City - USA -.
Source: (Sunset cityscape from the skyline of downtown New York City).

4 The Facades:

4.1 Definitions:

- The facade is an element of the city and its architecture.
- It is both an expression of the habitat (interior space) and a figure of the urban form (exterior space). It is both an expression of habitat (interior space) and a figure of urban form (exterior space).
- The facade is therefore the place of transition between these two contradictory spaces. The facade is therefore the transitional space between these two contradictory areas.

4.2 Characteristics of interfaces:

- Morphologically, the facade constitutes a thickness, which varies from the section of a glass to that of a wall and beyond to a depth of an entire space.
- A facade is generally composed of a number of fairly distinct levels that enhance the surface of the facade bordered by the various boundaries.
- - These can also be either distinct from this surface or an integral part of it.
- On the surface of the facade, a play of various elements is established, including openings (windows, doors, other types of openings), texture, and decoration.

Note: The facades are studied according to three main components: boundaries, thickness, and distinctive architectural elements.

4.2.1 Facade Limits: The facade: a geometric figure with precise, somewhat precise, or imprecise boundaries**.**

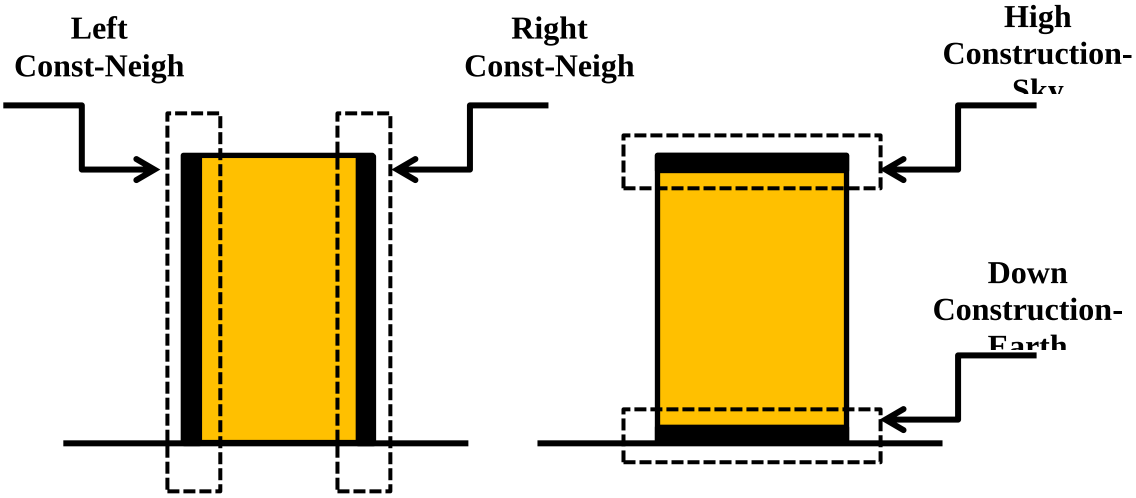


Fig 42: The Facade limits.
Source: author.

a) Presence of boundaries between the figures:

Limit	Example	Abstract
Joint		**Where the building limit is shared with the contact.**
Separation		**The building limits are completely Separate of the neighboring ones.**

Autonomy		**The building limits are completely independent of the neighboring ones.**
Lightness		**Limits have a subtle effect on the viewer, either due to building materials or colors.**

4.2.2 Thickness of the facade: The thickness of the facade (or "vertical facade section") varies depending on the type of structural system, the materials used, and the required function.

The thickness of the facade could be a thin layer of glass or it could be a wall with some embedded pieces, and it might extend to form a fully exploitable area.

❖ **Factors Affecting Thickness Determination:**

a) Structural Factors:

- **Dead Load**: Stone facades require greater thickness to support their own weight.
- **Wind Resistance**: Skyscrapers need thick facades (30+ cm) to withstand wind pressure.

b) Environmental Factors

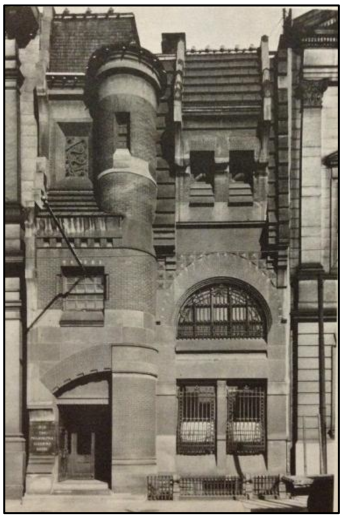
- **Thermal Insulation**: In Gulf countries, 10–15 cm of insulation is added within the facade.
- **Sound Insulation**: Buildings near airports require facades with 25+ cm thickness for noise reduction.

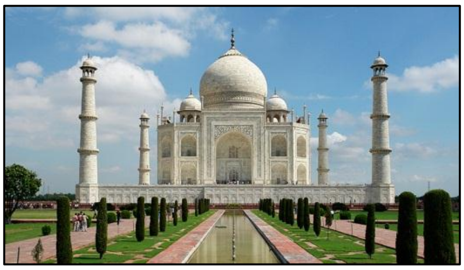
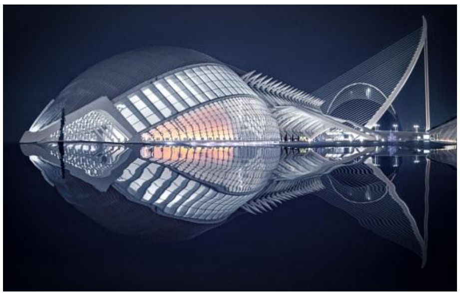
c) Aesthetic Requirements

- **Monumental Appearance**: Some designs (e.g., Nazi architecture) use large thicknesses to convey strength.
- **Lightweight Appearance**: Modern glass facades aim to minimize thickness as much as possible.

4.2.3 Relations between the elements of the façade: And we mean the relationships between the blocks and architectural elements that make up a single facade.

Relation	picture	definition
Gradation - progression		It's the rhythm where the repetitive structure offers the elements and intermediate intervals a change in shape, number, dimension, and orientation. The difference thus alters the resemblance without hierarchy.
Hierarchy		- It is a more complex order due to the combination of elements in relation to a scale of importance. - It is created through the variation of relative dimensions and/or the arrangement and uniqueness of the form in relation to a context (centrality, axiality…).
Contrast		- Contrast is a source of tension that governs the different parts of the architectural object through its power to oppose two elements of contrary nature (light-dark, big-small...). - A very sure way to achieve this is for the contrasting element to dominate the other elements by its mass, size, color, or to stand out by its shape. A very sure way to achieve this is for the contrasting element to dominate the other elements by its mass, size, color, or to stand out by its shape.

Contradiction		- This is the case where there is a meeting of incompatible elements without them necessarily being of contrary nature. - The adapted contradiction, which is flexible in that it achieves a compromise or an adjustment between contradictory elements.
juxtaposed contradiction		which is shocking given the superposition and the close proximity of contradictory elements in the same work.
Complexity		This is the case of a formal object that contains several coordinated and superimposed formal structures. The elements are grouped in such a way as to offer the observer several interpretations.

Symmetry	 	- Symmetry provides the eye with a total sense of balance as everything is organized in pairs on either side of an axis. - Subsequent developments were made to this principle of composition, leading to the creation of symmetries based on operations of translations, rotations, reflections, and their combinations. Subsequent developments were made to this principle of composition, leading to the achievement of symmetries based on operations of translations, rotations, reflections, and their combinations.
Asymmetry		Inspired by other fields of art such as painting and sculpture, asymmetrical balance was introduced in architecture to address the obviousness of symmetry as a source of complexity and richness.
Series and alignment		It is the simplest form of repetition. However, a certain degree of complexity can be introduced by the arrangement in stacked rows of identical elements varying from one row to another.

III Site and site integration:

1 The Site:

The natural site and the urban site are two important concepts in geography and urban planning, used to describe the characteristics of places and their relationship with the surrounding environment. Here's a simplified explanation of each:

1.1 Natural Site: Refers to the original physical and geographical features of a place before human intervention, such as:

- **Topography**: Mountains, plains, valleys, rivers, or coasts.
- **Climate**: Hot, cold, dry, humid, etc.
- **Vegetation**: Forests, deserts, grasslands, etc.
- **Natural Resources**: Water, fertile soil, minerals, or energy sources.

1.2 Urban Site: Refers to a place developed by humans to become a residential, industrial, or commercial area, taking natural factors into account but dominated by human influence. Its features include:

- **Infrastructure**: Roads, bridges, sewage systems, etc.
- **Human Uses**: Housing, factories, offices, markets.
- **Environmental Impact**: Pollution, changes in terrain, resource depletion.

1.3 Difference Between Them:

Natural Site	Urban Site
Shaped by natural factors (e.g., erosion, climate).	Shaped by human intervention (e.g., urban planning).
Focuses on resources and environmental conditions.	Focuses on population density and services.
May be unsuitable for habitation (e.g., harsh deserts).	Designed to accommodate human life.

Tab 16: Difference Between Natural Site and Urban Site.
Source: author.

1.4 Interaction Between Them:

- The natural site influences urban development (e.g., building cities near rivers).
- The urban site can alter the natural site (e.g., draining swamps to build cities).

Interest in the field of architecture will always be in the designated construction sites proposed by official authorities.

2 Designated Construction Sites (Buildable Sites):

These are lands or areas officially allocated for urban development, whether for residential, commercial, industrial, or service purposes, based on technical, legal, and environmental criteria. They differ from natural or agricultural lands as they are planned to meet the needs of urban communities.

2.1 Types of Designated Construction Sites:

2.1.1 By Primary Use:

- **Residential Sites**: Used for building houses or residential complexes.
- **Commercial Sites**: Designated for shops, offices, or commercial centers.
- **Industrial Sites**: For constructing factories or warehouses.
- **Service Sites**: Such as schools, hospitals, or parks.

2.1.2 By Official Planning:

- **Zoned Land**: Designated by the government in urban plans.
- **Developable Land**: Requires infrastructure (electricity, sewage).
- **Raw Land**: Suitable for construction but lacks utilities.

2.2 Criteria for Designating Construction Sites:

- **Geotechnical**: Soil stability and absence of landslides or floods.
- **Legal**: Availability of construction permits and no ownership disputes.
- **Infrastructure**: Access to roads, water, electricity, and sewage systems.
- **Environmental**: Avoidance of protected areas or environmental hazards (e.g., earthquakes).

2.3 Difference Between Buildable and Non-Buildable Land:

Buildable Land	Non-Buildable Land
Legally permitted for construction.	Construction prohibited (e.g., reserves, agricultural land).
Supported by infrastructure.	May lack basic utilities.
Relatively higher prices.	Lower prices (unless convertible).

Tab 17: Difference Between Buildable and Non-Buildable Land.
Source: author.

3 Limits of intervention:

- At the waist level: The greatest level of urban involvement in a second-year license is at the parcel, neighborhood, or élot level.

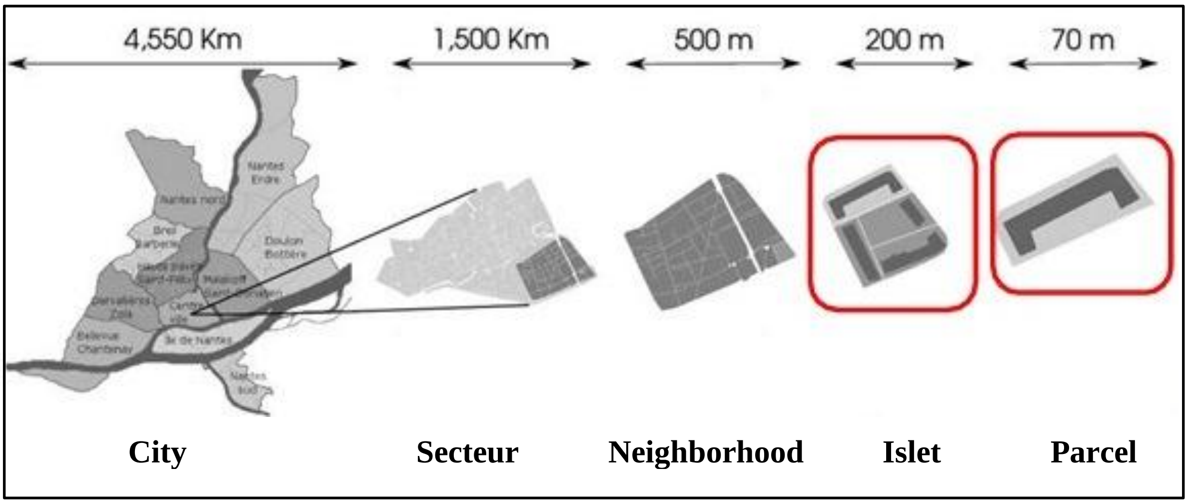


Fig 43: A chart illustrating the urban parts of the city.
Source: (Keskas, 2021)

- At the element level: The intervention takes place at the level of the four systems that make up the urban fabric:
  - The parcellaire system: which divides the territory into parcels or land units.
  - The road system: a system connecting the territory, it is the structuring axis.
  - The built system: consists of all the masses that make up an urban form, regardless of their size or purpose.
  - The system of empty areas: consists of all unbuilt portions of the urban structure, whether they are public or private.

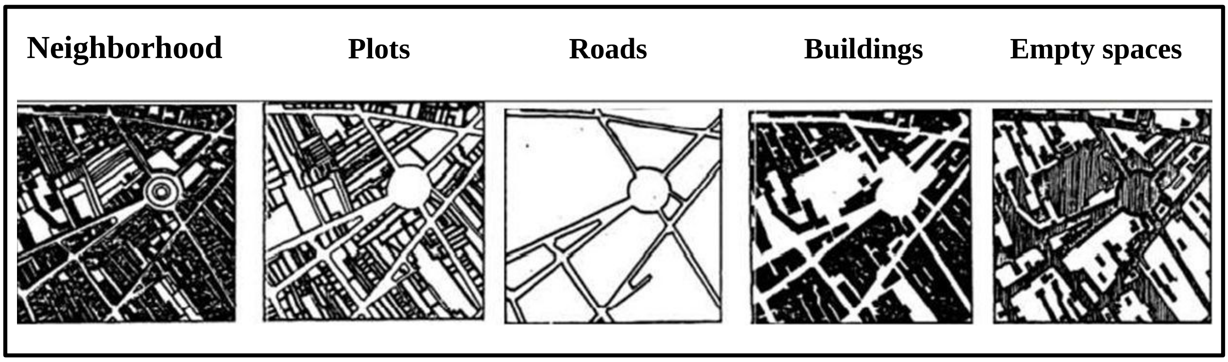


Fig 43: A chart illustrating the urban components of the city.
Source: (Keskas, 2021)

❖ **Note:** These four elements that make up the overall site are interconnected in a specific pattern. Therefore, it is wise to make a decision regarding the type and nature of the relationship that will be established between a new building and the surrounding urban environment when introducing it into an urban setting.

4 **The design stages of a project:** We outline below the necessary steps to take and all the information that needs to be available to begin an architectural or urban project that is integrated into its urban environment.

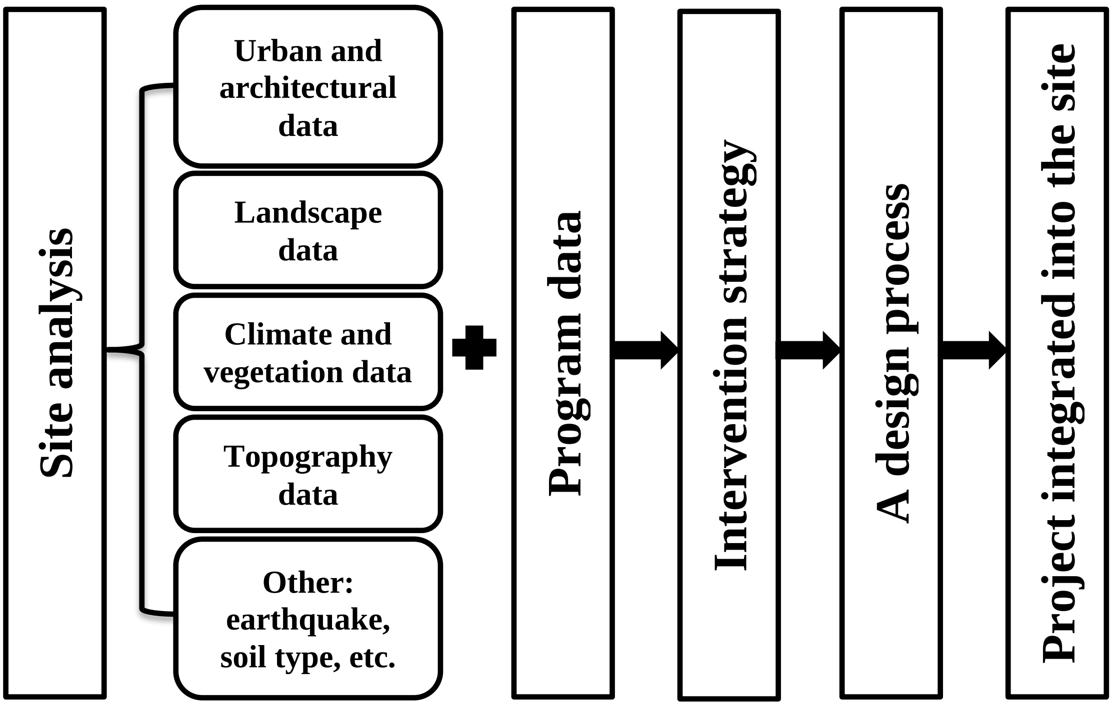


Fig 44: The stages followed in the design and preparation of the urban project.
Source: (Kezzar, 2021)

Urban integration relies on studying and understanding two essential elements: the location and the project to be integrated:

- **The site (The reception area): mastering:** discovering the characteristics and data of the site.

- **The element to be integrated (the construction):** identify the characteristics.

5 Integration into the site (relationship of the building to its environment):

Considering the relationship of the project to the overall external perspective, we can divide urban integration into two main types: integration from the external perspective and integration from the internal perspective:

- Integration with the external perspective.
- Integration with the internal perspective.

5.1 Landscape approach:

Study of sites and ways to preserve them as best as possible during an urban planning process. The landscape is approached linearly by its users. Whether on foot, horseback, or by car... we move linearly through the landscape and thus perceive it along the route: the movement and the rhythm it induces are therefore the foundations of landscape perception. **(FAYE, 1974)**
This approach aims to integrate the project with its environment at different levels, each level defining a specific type of elements that are identified and observed by the human eye. These elements are known as the Scalar Levels.

- **The plot:**
- ➢ Set of threads stretched on the loom and passing transversely between the warp threads, to form a fabric.
- ➢ Thread made for this use, generally less twisted than the warp thread.
- ➢ Literary. What constitutes the background against which significant events stand out: The framework of a narrative.
- **Synonyms:**
- ✓ Canvas - carcass - framework
- **In architecture:**
- ➢ Mesh, grid of an architectural or urban planning map. **(Larousse francais)**
- ➢ Framework: what constitutes the texture or structure (of something). **(Encarta)**
- ➢ The urban fabric: refers to the network of circulation routes in a city. It is **characterized by:**
- ✓ The streets, which are defined by their layout (what they connect, what they cross), their connectivity, their width, their usage.
- ✓ The blocks, whose size and shape are defined by the assembly of the different streets.
- ✓ The parcels, which correspond to the division of the block into different pieces intended to accommodate buildings.

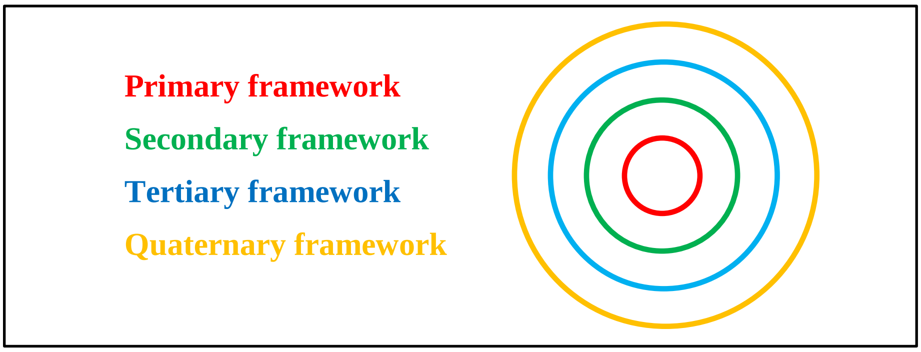
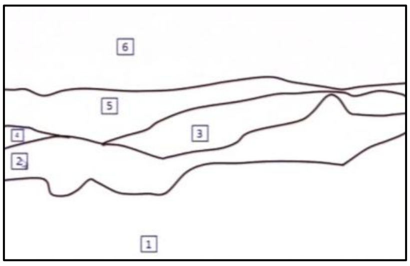
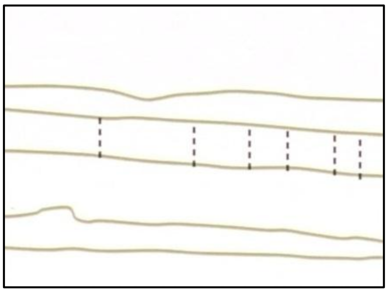
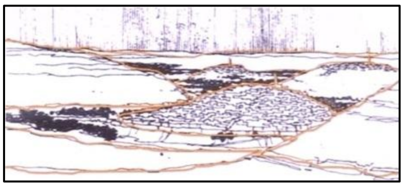
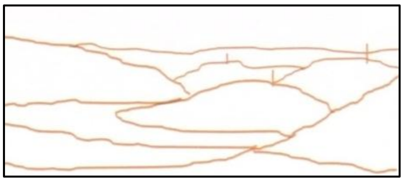


Fig 45: The different site analysis frameworks - the Scalar Levels.
Source: author.

- **Primary framework:** The lines of force understood at the primary framework level can be constituted by:
  - The hydrographic network.
  - The guidelines that mark the corresponding planes: either to repeated layers of geological structure or to planes of discontinuity (faults, etc.) or to superficial drainage traces.
  - The guidelines that delineate surfaces with certain homogeneity in terms of observable landscape elements (network mesh, slope shape, vegetation cover).
  - The guidelines that locate punctual or local phenomena whose distribution or repetition are particularly significant.

		Surfaces with specific colors and textures.
		The guidelines that mark the plans corresponding to the repeated layers of the geological structure.
		The guidelines that locate punctual or local phenomena whose distribution or repetition are particularly significant.

Tab 18: The lines of force at the primary framework.
Source: author.

- **Secondary framework:** The lines of force are the same as those described earlier but seen up close and with more relief.

At this level, one can distinguish the orientation of the gables, the slope and proportions of the roofs, and the height of the buildings.

Primary framework	Secondary framework	The difference
		The shapes of the roofs and the heights of the buildings appear, the colors of the facades stand out, and their edges are defined more precisely.
		The areas of the built and unbuilt spaces are defined, and the details of the buildings and internal courtyards are revealed.
		The edges of the facades are defined, and the empty and filled parts become visible.

Tab 19: The difference between the primary network and the secondary framework.
Source: author.

- **Tertiary framework:** The lines of composition, the openings, the arrangements, and the detailing of the facades. It means that due to the proximity, the details of the site and its components are clearer, leading to greater integration with the surroundings.

Primary framework	Secondary framework	Tertiary framework
		

Tab 20: The difference between the primary; secondary and the tertiary framework.
Source: author.

- **Quaternary framework:** It will be the texture, the skin of materials with which the constructions are covered. It means accessing the details of construction materials and the fine details.

Fig 46: Details of the Quaternary framework.
Source: author.

In summary, this approach is fundamentally based on a gradual understanding of the site's details from the general to the specific, so that the project is integrated into its surroundings from various aspects and with greater harmony with the site.

- **Some general rules:**

➢ A building located at a break in a line of force will be difficult to integrate (example of a building on a hill).

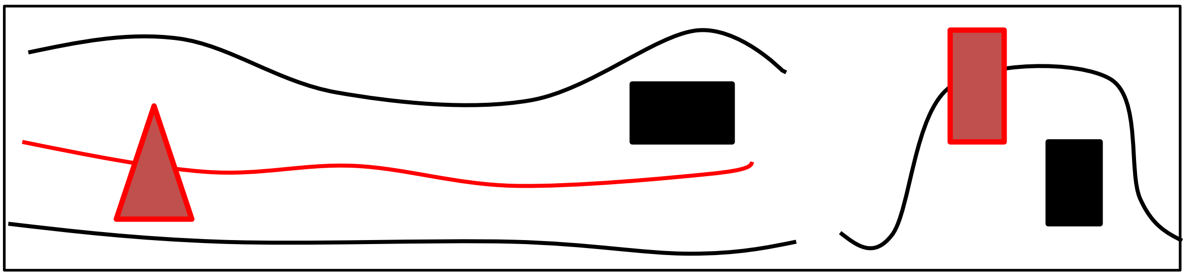


Fig 47: Difficulty integrating a building that intersects with the lines of force into the site.
Source: author.

➢ A pivotal building between two surfaces or two relatively homogeneous volumes will be more visible than a building within one of the two volumes.

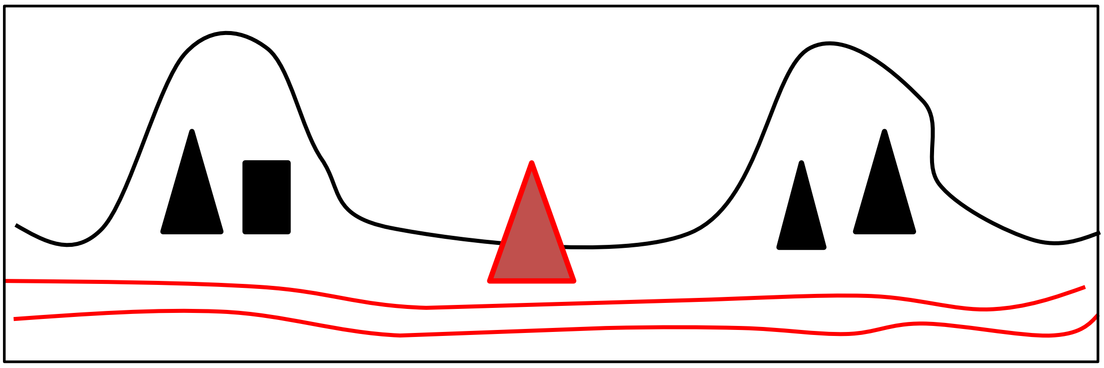


Fig 48: Show and dim buildings on site.
Source: author.

- The study of the building from multiple viewpoints is the only guarantee of good landscape integration.

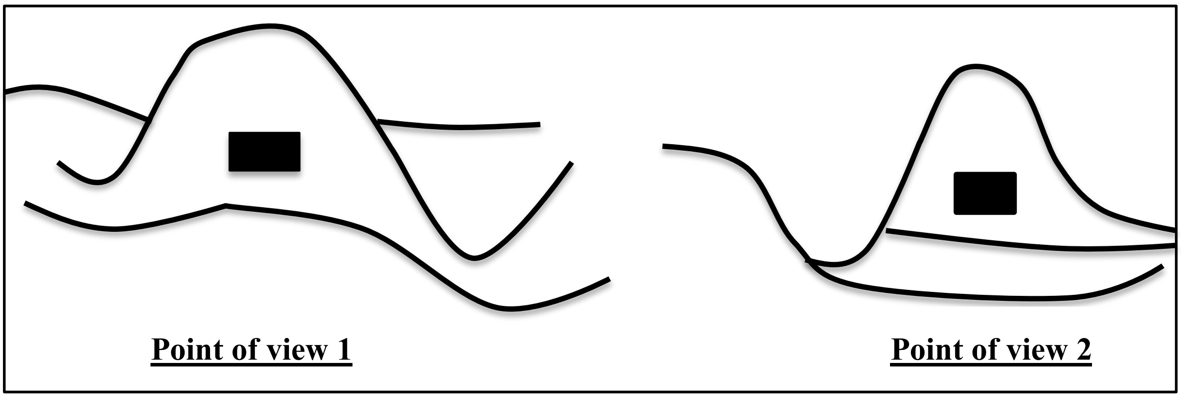


Fig 49: Study the building from multiple perspectives to achieve good integration with the landscape.
Source: author.

- It is possible in some cases to integrate a building located on a power line, but it must then be adapted to the structure. (Shape of the force line).

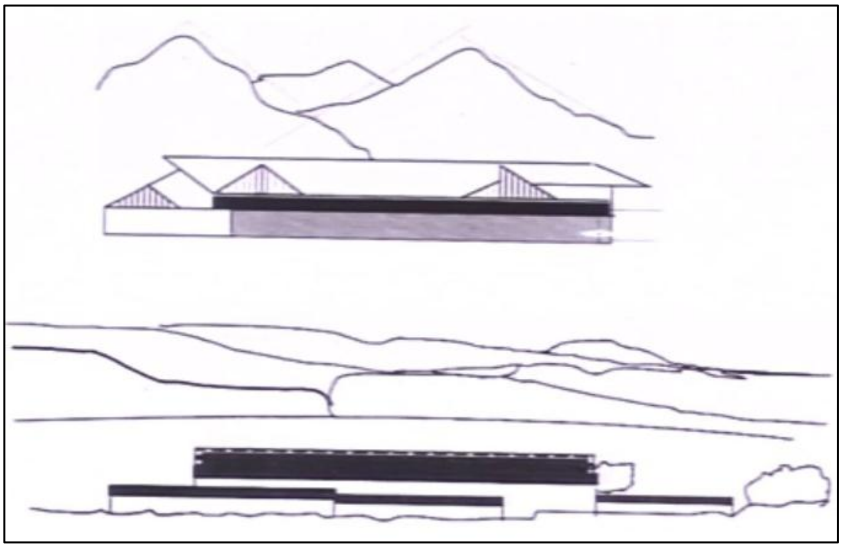


Fig 50: integration example.
Source: (Mazouz, 2021)

5.2 The Scenographic approach: is a method of designing and arranging space that draws inspiration from techniques used in theater, cinema, or exhibitions to create immersive and narrative atmospheres. It aims to stage a place, an object, or an experience by playing with light, colors, materials, spatial arrangements, and sensory effects to evoke emotions and guide the audience. **(Plummer, 2016)**

"Today, urban scenography refers to both permanent and ephemeral arrangements that renew the forms of theatricality present in the city." (Gangloff, 2016)

a) Key elements:

- **Narration:** The space tells a story.
- **Immersion:** The visitor is immersed in an atmosphere.
- **Interaction:** Possibility to touch, participate, or experience a multisensory experience.

b) Areas of application:

- Architecture & Interior Design: Staging a space (store, hotel, and restaurant) to strengthen a brand's identity or create a memorable customer experience. Use of dramatic lighting, visual pathways, or artistic installations.
- Museums & Exhibitions: Designing narrative paths through educational or emotional scenography (e.g., interactive museums, temporary exhibitions).
- Event & Show: Creating temporary decorations for concerts, fashion shows, or trade fairs.
- Urban Planning & Landscape: Staging public spaces with light installations or interactive setups.

c) Elements of architectural scenography:

- Light and illumination: manipulating natural and artificial light (example: "Notre Dame du Haut" – Le Corbusier).

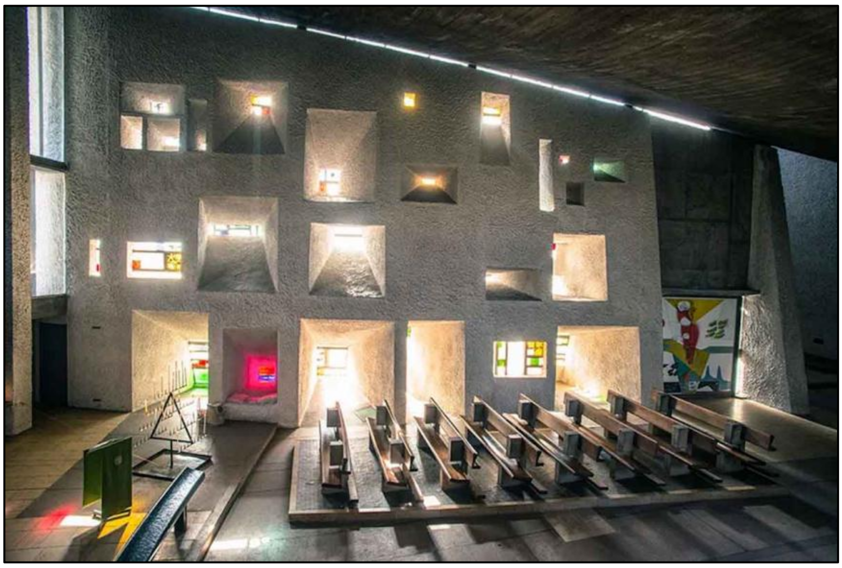


Fig 51: manipulating natural and artificial light.
Source: (church, 2018)

- Materials and texture: Using materials with a sensory impact (such as wood, perforated metal, or fabric in the "Japanese Pavilion at Expo Milano").

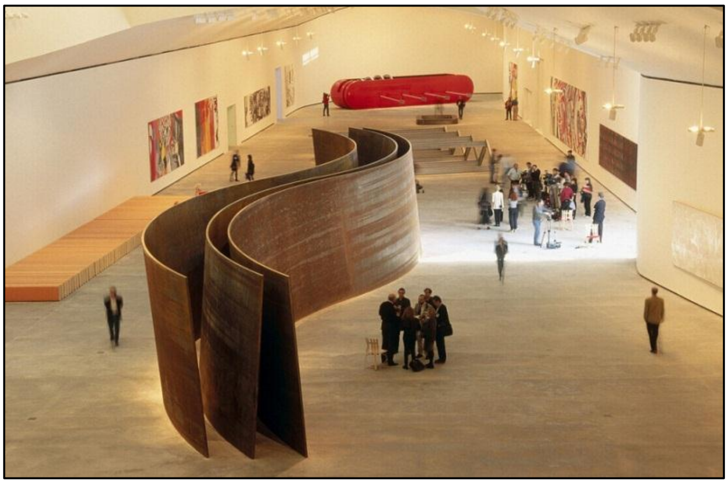
Fig 52: Using materials with a sensory impact.
Source: (Le Japon à l'exposition universelle de Milan, 2015)

- Sound and motion: Some buildings are designed to interact with the wind (like the "Pavilion in Korea" which produces musical sounds when the wind blows).

Fig 53: Sound and Motion.
Source: (Bak, 2011)

- Visual sequence: Designing paths that resemble "stages" in theater (like the "Guggenheim Museum Bilbao" – Frank Gehry).

Fig 54: Visual Sequence: Gradual Paths.
Source: (Snake by Richard Serra. Fish gallery. Guggenheim Museum. Bilbao. Biscay. Basque Country. Spain)



- Architectural scenography transforms a building from merely a functional space into a visual narrative that interacts with visitors. Whether in museums, public spaces, or even religious buildings, this approach enhances the emotional value of architecture and makes it more impactful.
- "Scenography is not exclusive to theater or exhibitions; it extends to architecture and construction, where it is used to transform buildings and spaces into immersive narrative experiences that engage the senses through light, materials, and movement. This field is sometimes referred to as 'Architectural Scenography' or 'Event Architecture.
- The exterior space can also be utilized and visually connected to the interior volume to create visual continuity. This approach reinforces the built environment's connection to its urban context, achieving deeper integration.

d) View of the landscape: an interior scene:

This phrase expresses a prevalent design philosophy in modern architecture, whereby: The building is designed to act as a 'frame' for the external view, as if the natural landscape becomes part of the interior décor.

This design approach can be realized through the following strategies:

- **Open up:** It is realized by fully opening at least one interior boundary to the external domain, establishing enhanced connectivity with the exterior context. Such openness may encompass multiple boundaries.

Fig 55: Full openness to achieve integration with the outside perspective**.**
Source: (Kezzar, 2021)

- **Frame:** Where the opening is partial in the wall and limited in the form of a frame. The frame could be in the wall, or it could be part of a large opening.

Fig 56: Partial openness to the outside perspective.
Source: (Kezzar, 2021)

- Underline: The openings in this style take a linear form, as an attempt to focus on a specific part of the external perspective.

Fig 57: partial longitudinal opening to the outside perspective.
Source: (Kezzar, 2021)

- **Viser:** The openings outward take different shapes and positions with the aim of focusing on a specific element within the external environment.

Fig 58: focusing on a specific element within the external environment.
Source: (Kezzar, 2021)

Focusing on a specific element of the surrounding environment may suggest a strong functional or historical connection between the built elements that make up the overall view.
Look at the figures below: The new museum visually connects with the historic temple in the city, making the visitor feel as if the external element is one of the internal exhibits of the museum.

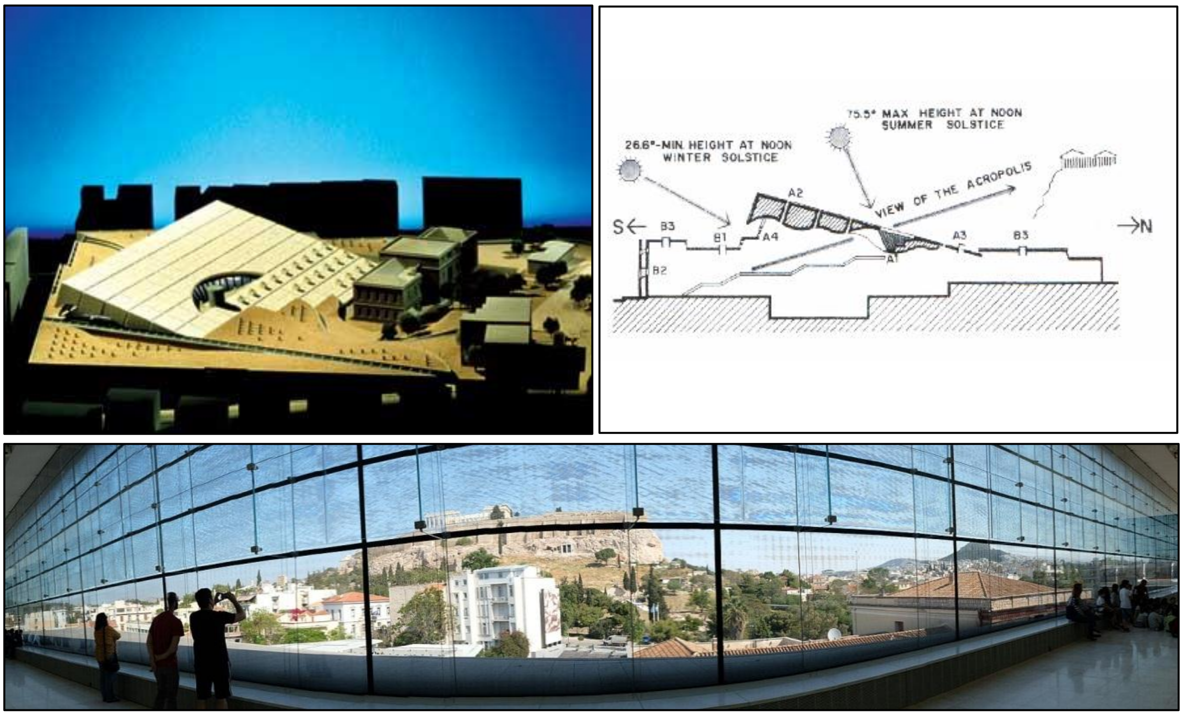


Fig 59: Direct visual contact with the historic temple.
Source: author.

- Introduce: Some elements of the external environment are incorporated into the interior space to enhance the sense of belonging and integration with the site.

This principle is strongly adopted in traditional architecture, where the interior spaces are organized around a central courtyard (housh) that is open to the sky and includes green elements and water features.

Fig 60: Introducing elements of the external perspective into the interior.
Source: (Kezzar, 2021).

6 Incorporation into the relief:

6.1 typical development scheme and integration on sloped terrain:

The method of utilizing slopes and constructing on them varies according to the nature of the population, their density, and the level of development of construction methods and techniques.

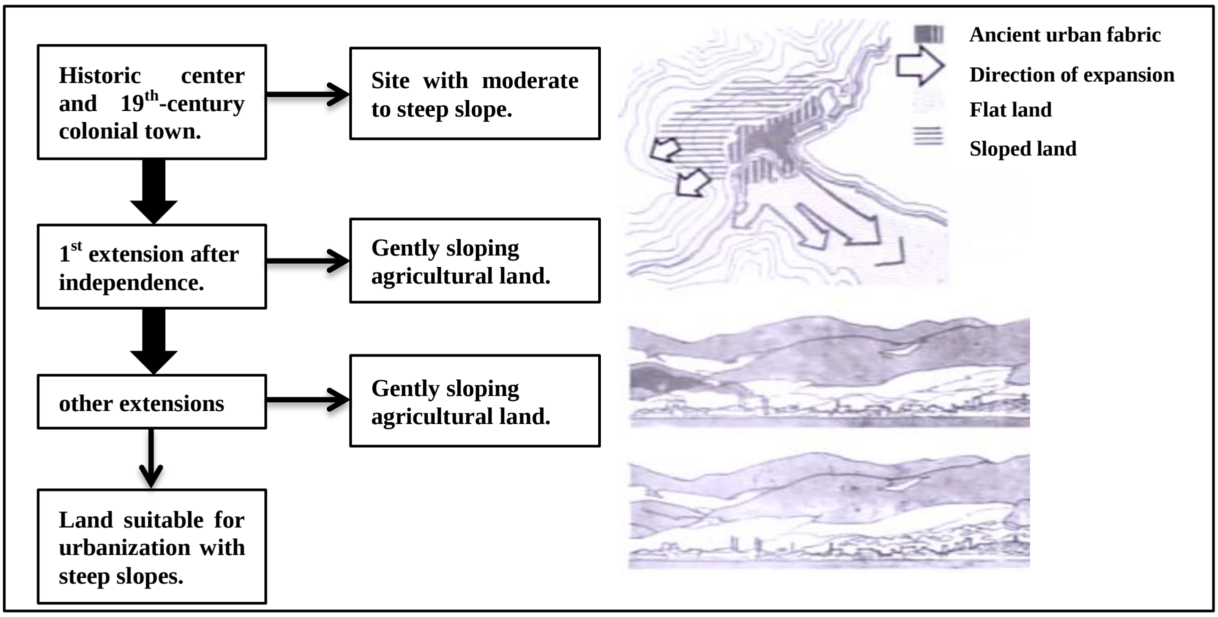


Fig 61: typical development scheme and integration on sloped terrain.

Source: author.

In ancient times, construction and building were carried out on the tops of hills and elevated areas to ensure maximum security and adequately fortify the site, meaning that the emphasis was on the defensive aspect. Then, urban settlements developed along the ridge lines connecting the summits or low plains.

Although the construction was done using traditional methods and simple resources, the adaptation to the site was remarkable in terms of form, environment, and function.

The current development continues parallel to the roadway. The road network follows the ridges and connects the villages where it forms the axis of activity. The very steep slopes and narrow ridges force the adaptation of the terrain for the establishment of activities through extremely significant earthworks. The consequence: disruption of nature, resulting in massive earthworks and fill. Negative element: the destruction of the vegetation layer.

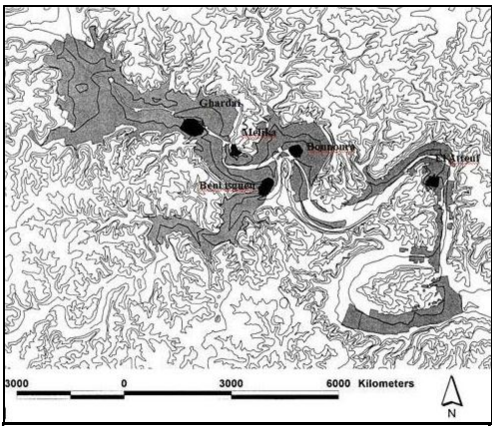
	
The old reconstruction strategy	**Modern exploitation of the slopes - City of Constantine –**

Fig 62: The difference between the old strategy and the modern strategy in exploiting slopes.
Source: author.

In addition to the defensive aspect provided by the terrain, it now plays an important role in achieving environmental sustainability by controlling the time factor, that is, the speed or delay in the exposure of buildings to solar radiation.

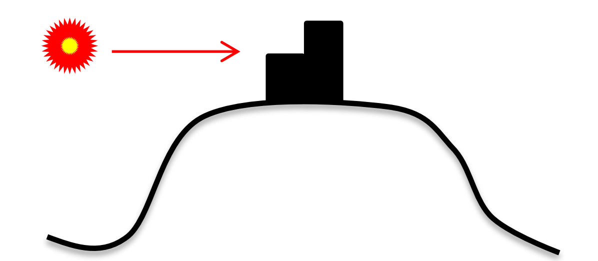
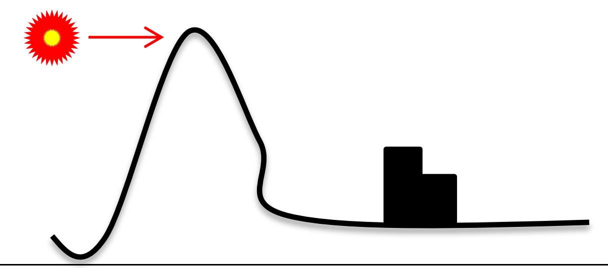
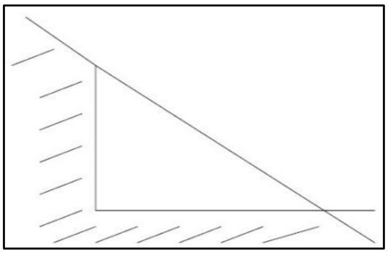
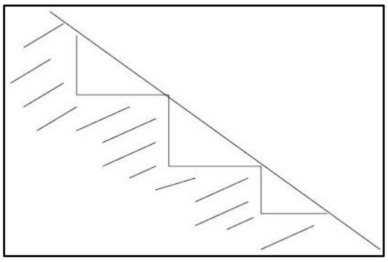
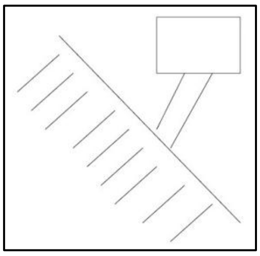
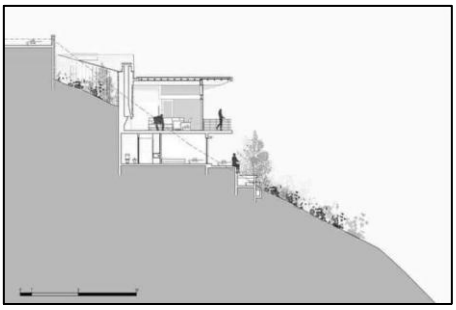
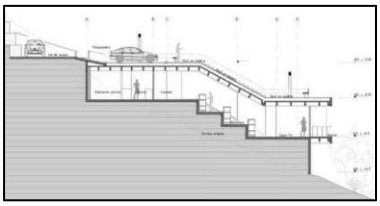
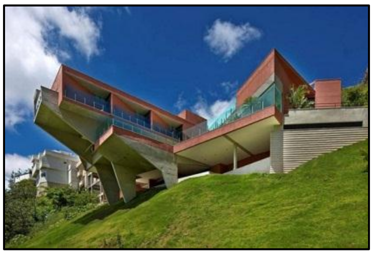
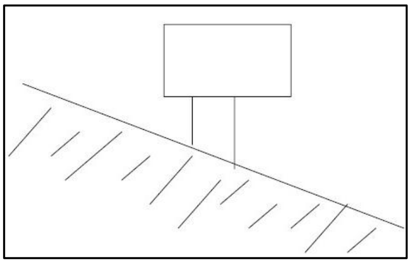
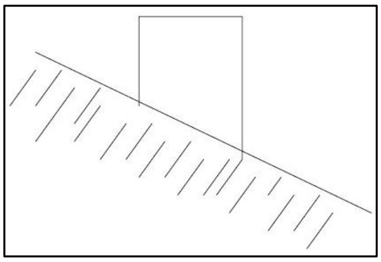
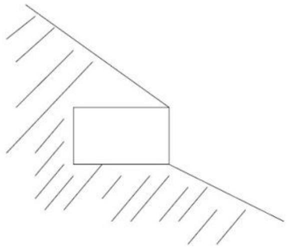
Cold regions	Hot regions
	
Placing buildings on elevated areas exposes them to the sun earlier and for a longer period.	Placing buildings below the heights protects them from sunlight, so they are exposed to the sun later and for a shorter period.

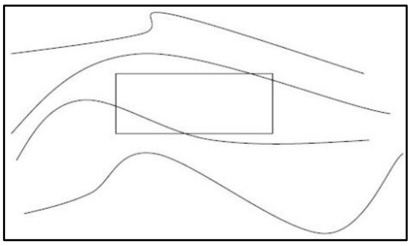
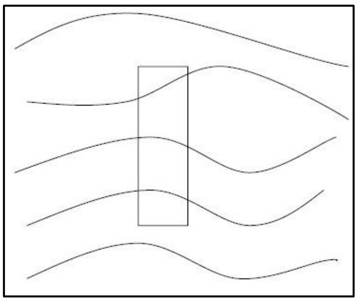
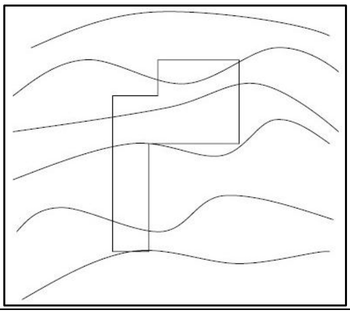
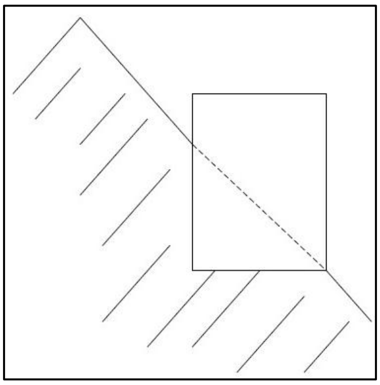
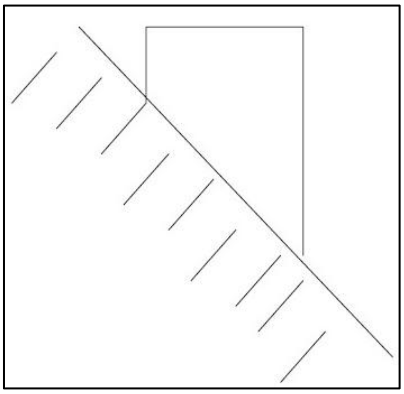
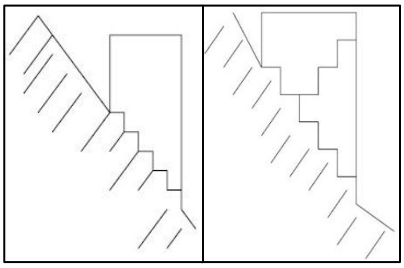
Fig 63: The impact of slopes over time.
Source: author.

6.2 Methods for designing buildings in hilly terrain:

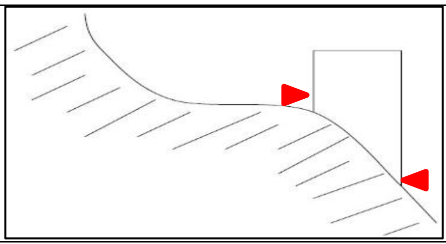
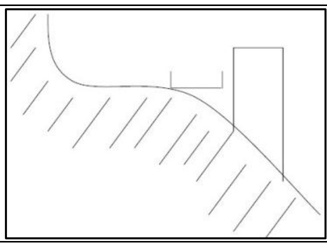
6.2.1 At the cutting level: it is the image that is created between the building and the floor in the event of a section being made.

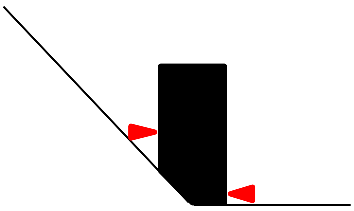
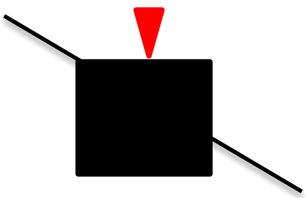
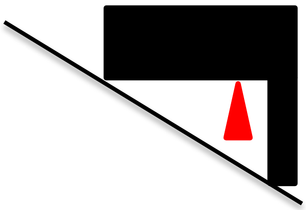
Soil treatment		
		
		
Cutting into the terrain: Leveling.	Etager le terrain: Epouser la pente.	Preserve the soil: Raise the building.
Contact with the ground		
		
		
Touch the ground.	Settle on the ground.	Bury oneself in the ground.

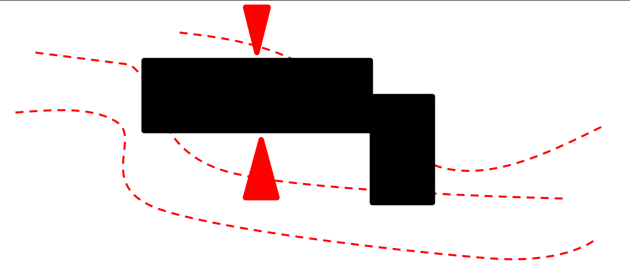
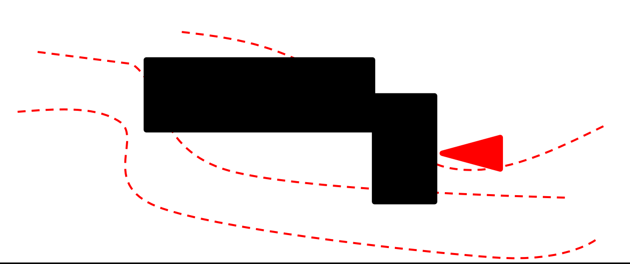
6.2.2 **At the level of the plan:** It means the relationship that the project boundaries have with the contour lines.

Position relative to the slope		
		
Parallel to the contour lines (with the slope).	perpendicular to the contour lines (against the slope)	combined (with and against the slope)
Profile to reveal		
		
Amputation	Sliding	Notching (single or reverse)

6.2.3 **Opposition of the faces of the construction:** It means how to access the project and the relationship of the outlets with the external environment.

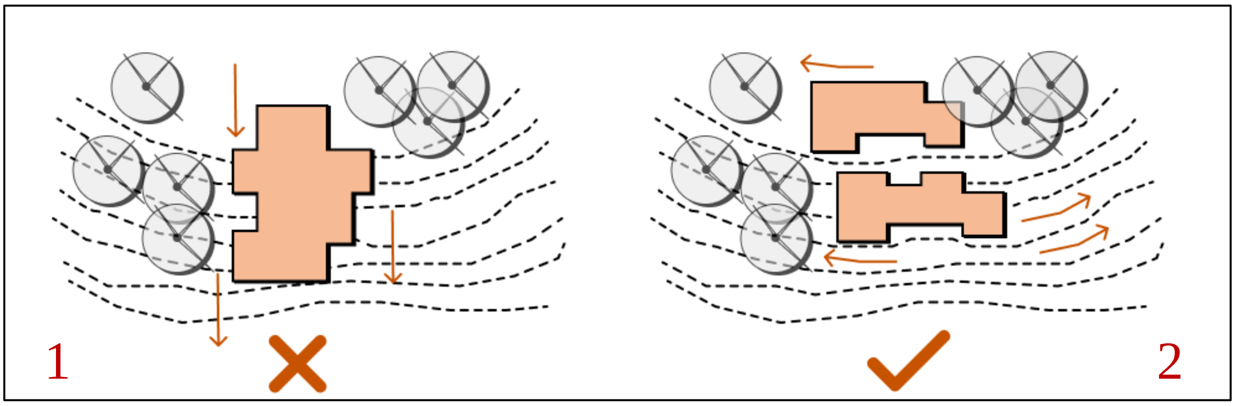
Connection of access with the ground	
	
Direct	Indirect (pontoon; bridge)

Position of the accesses		
		
Up - Down	Above	Below

Access orientation	
	
Frontal	Lateral

6.3 General recommendations for construction on slopes:

6.3.1 Orientation of the building:



1- across the contour:
Involves excessive cut and fill; not environment friendly; expensive.

2- along the contour:
Less cut and fill; division of masses; less footprint and economical.

Fig 64: The optimal orientation of buildings on slopes.
Source: author.

6.3.2 Placement of the building:

Recommendations:

- Buildings tucked into the hillside without harming it.
- The location of the building minimizes grading.
- Preserve natural drainage courses and existing trees.
- Less distance from the main road to minimize footprint.

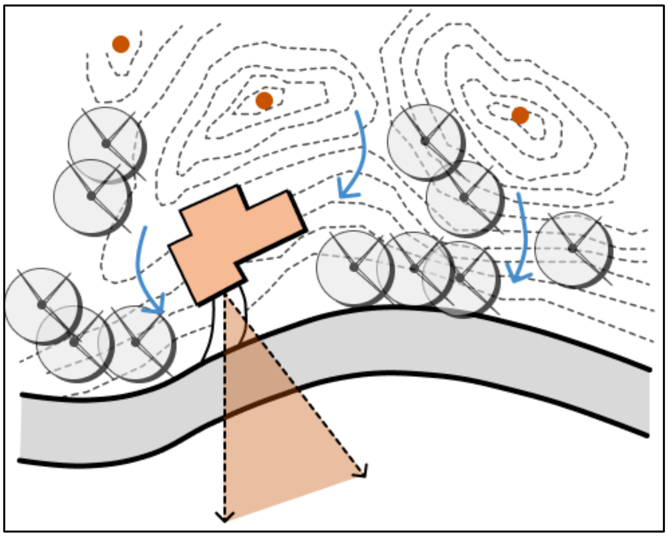


Fig 65: Optimal positioning of buildings on slopes.
Source: author.

6.3.3 Types of forms: To ensure the safety of the structure, it is important to choose the right kind of form for the building. There are various types of forms that can be used for building on sloping terrain, depending upon the site conditions & building requirements.

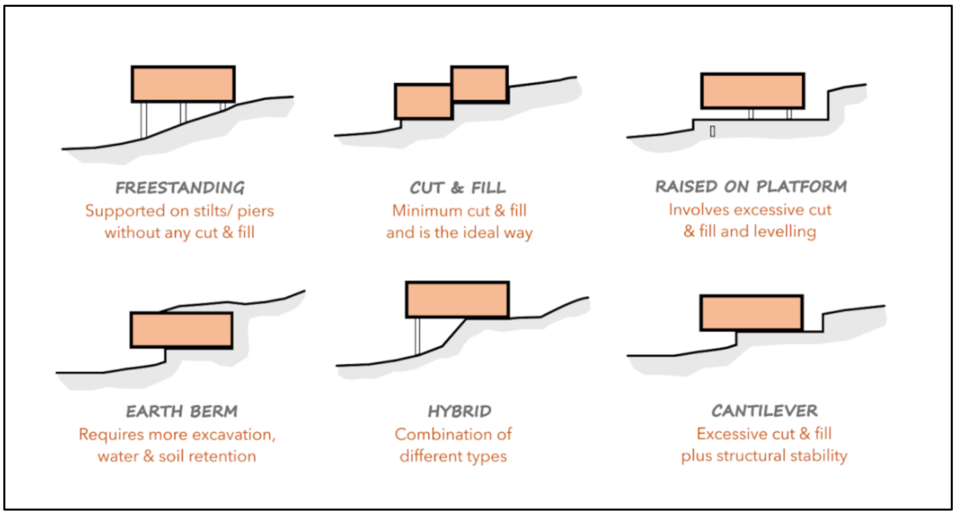
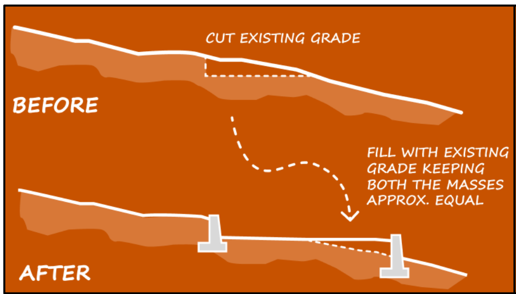
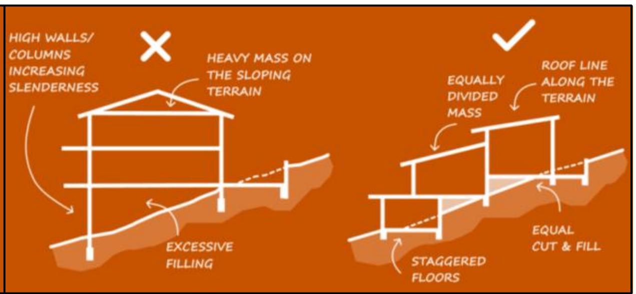


Fig 66: Optimal forms for building safety on slopes.
Source: author.

6.3.4 Cutting & Filling of Site: Cut and fill is a process that involves cutting into the ground to create a level surface for construction, as well as filling in areas with soil or other materials to bring the desired height of the building up. This process is often used in construction projects where there are large differences in ground levels, such as when constructing roads or houses on hillsides. Cut and fill is an important step in creating a safe and structurally sound building, and it requires careful planning and execution.



Terracing of the slope.



Massing on sloping terrain.

Fig 67: Excavation, backfilling and leveling for building construction on slopes.
Source: author.

6.3.5 Types of Sloping Sites: It is important to understand the different types of slopes and how they impact the construction process. Depending on the type of slope, different approaches may be required when building on them. Retaining walls may need to be built in order to stabilize the soil, and foundations may also need to be adjusted in order to accommodate for any changes in elevation.

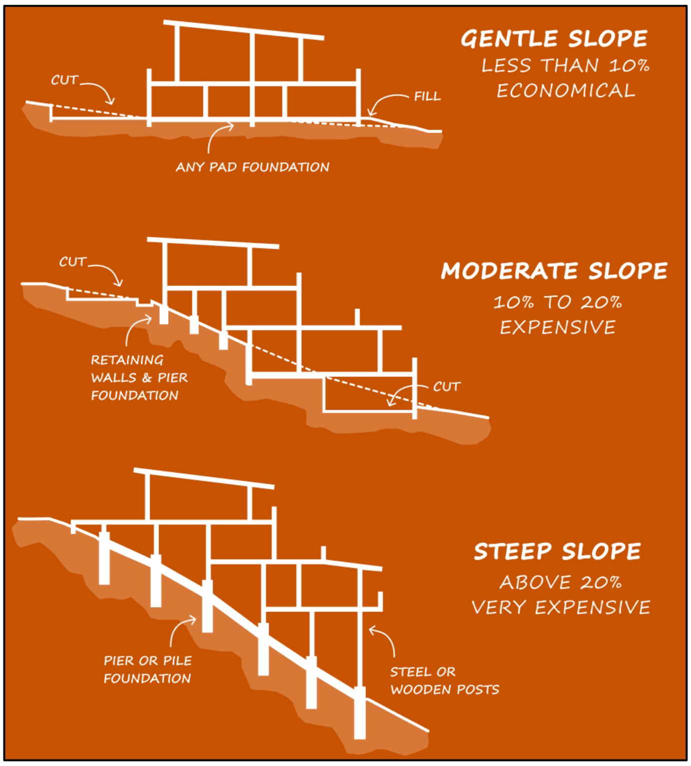


Fig 68: Types of Sloping Sites.
Source: author.

6.3.6 Retaining walls: Retaining walls are structures that are used to hold the slope of a hill or mountain in place. They are built in different forms in both uphill and downhill scenarios, depending on the grade of the hill.

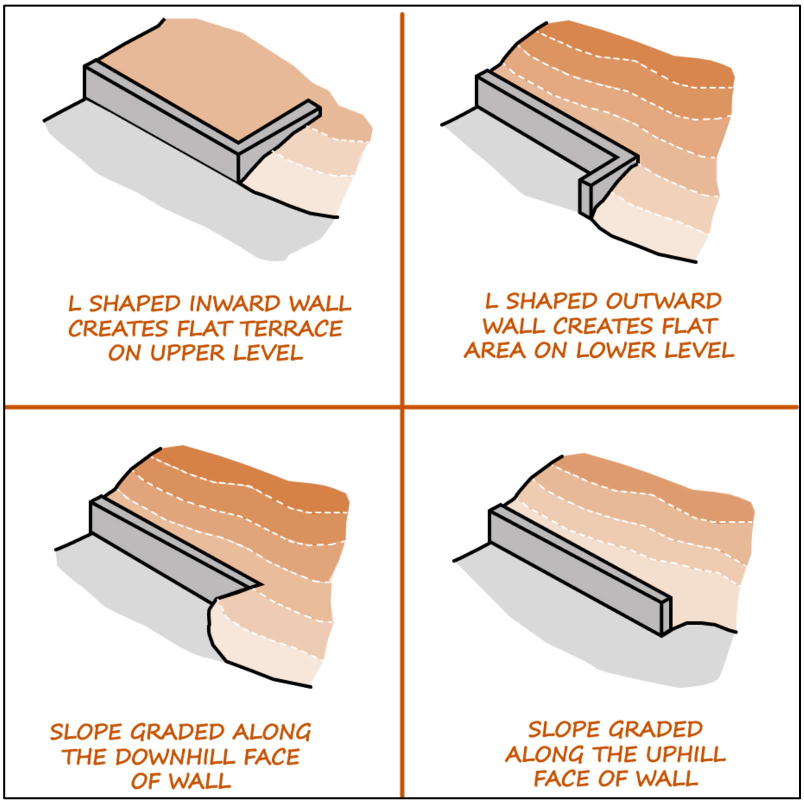


Fig 69: Retaining walls.
Source: author.

6.3.7 Foundation and Drainage: Strong foundation & efficient drainage is necessary in case of sloping sites to tackle sedimentation and surface water runoff. It varies according to the grade of the slope and the form of the building.

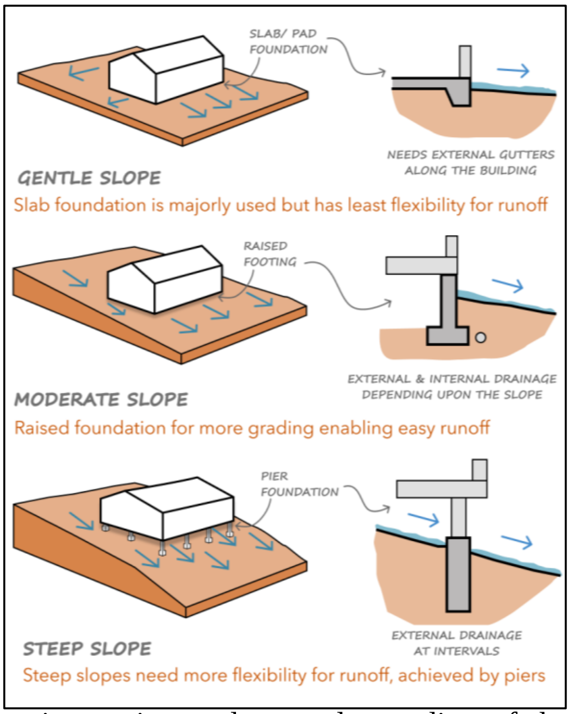


Fig 70: Foundation and Drainage.
Source: author.

Designing and constructing buildings on hilly terrain requires a deep understanding of the site's topography, climate, and structural requirements. Architects must carefully plan the placement, form, and orientation of the building to minimize environmental impact and ensure safety. Techniques like cut and fill, retaining walls, and strategic foundation planning are essential in creating stable structures on slopes. By preserving natural elements such as drainage and vegetation, and adhering to building codes, construction on hilly terrain can be both sustainable and secure. Proper planning ensures that these projects enhance the landscape without compromising safety or functionality.

Conclusion:

In conclusion, designing and constructing buildings requires a deep understanding of the site's topography, climate, and structural requirements. Architects must carefully plan the placement, form, and orientation of the building to minimize environmental impact and ensure safety. Techniques like cut and fill, retaining walls, and strategic foundation planning are essential in creating stable structures on slopes. By preserving natural elements such as drainage and vegetation, and adhering to building codes, construction on hilly terrain can be both sustainable and secure. Proper planning ensures that these projects enhance the landscape without compromising safety or functionality.

General summary:

The **urban site** is a fundamental element in urban planning and design, influencing the visual and functional identity of cities and urban areas. The site interacts with a range of natural and climatic factors, such as topography, soil, wind direction, rainfall rates, and temperature, requiring planners and architects to consider these factors to ensure the project integrates seamlessly with its environment.

Climatic conditions directly impact buildings' thermal performance and energy consumption, as well as the choice of construction materials and natural ventilation systems. For example, in hot, arid regions, materials with high thermal mass and shaded spaces are preferred, while in humid areas, cross-ventilation is prioritized to reduce humidity.

On the other hand, **urban analysis** plays a pivotal role in achieving architectural and urban integration by examining the relationship between built masses, public spaces, infrastructure, and socio-economic activities. Through this analysis, seamless integration between new projects and the existing urban fabric can be achieved while preserving environmental sustainability and local identity.

In short, a comprehensive analysis of the urban site and climatic data contributes to creating integrated urban environments that balance aesthetic, functional, and environmental aspects, promoting sustainable urban development.

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