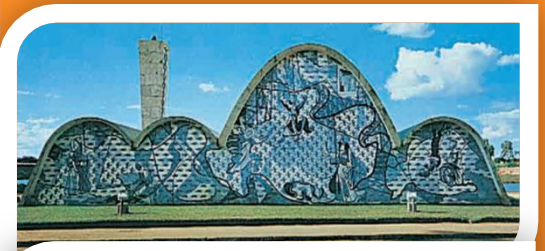

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التـعليم العالي والبحث العلمي

Democratic and Popular Republic of Algeria

Ministry of Higher Education and Scientific Research

University of Guelma on May 8, 1945

Faculty of Science and Technology

Department of Architecture

Course Handout

History of Architecture 3

Specialty: Architecture

Level: 2nd year –Architecture-

Established by:

Dr. DJOUAD Fatima Zahra

2026

Course Handout :

History of Architecture 3

Level: 2nd year Architecture

Subject information

Semestr 3

Teaching unit : EF4

Subject : History of architecture 3

Coefficient : 2

Eliminatory mark : Mark below 07/20

General objectives of the teaching subject

The subject covers a chronological span that begins with the Enlightenment and the advent of rationalism, then focuses on the events of the 18th and 19th centuries. The main aim is to understand the important contribution of philosophy and technical advances to architecture. On the one hand, the aim is to understand rationalism and the new values of beauty that distinguish it from the Vitruvian triad. On the other hand, it's important to understand the impact of the Industrial Revolution, not only on the technical side (materials, industrialization, standardization), but also on the social consequences and their repercussions in architecture, such as the creation of workers' housing estates or the hygienist movement. The technological leap of the Industrial Revolution also had an impact on the arts, which moved away from the figurative and romantic toward the abstract. Students should be able to understand the parallel and similar change in architecture with the advent of the modern movement.

Teaching content

- Renaissance architecture

- Baroque architecture

Rationalism and the utopians of the 17th century

- The contribution of philosophy

- The teachings of Blondel

- The visions of Boulée and Ledoux

The Industrial Revolution

Neoclassicism

Historicism and eclecticism

Avant-garde architecture :

- Art Nouveau

- The Chicago School

Reinforced concrete

- The contribution of materials to architecture

- The work of Pier Luigi Nervi

- Awareness of modern concretes

School : Architecture Department,

Evaluation method

Type of assessment	**Weighting in % Examination**
Exam	**60**
Continuous	**40**
Total	**100**

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Preface

This handout is designed for second-year architecture students, offering an overview of the course History of Architecture 3. The course focuses on the philosophical and technological influences that shaped architectural evolution. Students will explore rationalism and its distinct aesthetic values compared to the classical Vitruvian triad. The course also examines the impact of the Industrial Revolution not only in terms of technical advancements like new materials, industrialization, and standardization but also its social repercussions, such as the emergence of workers' housing and the hygienist movement. Additionally, it highlights how the artistic shift from romanticism to abstraction mirrored changes in architecture, paving the way for the modern movement.

The course presents two successive historical periods. The first, spanning from the Renaissance to the Industrial Revolution, is covered in four chapters each dedicated to a distinct architectural style: Renaissance, Baroque, Classical, and Rationalist. These chapters explore the ideological foundations, stylistic characteristics, and key projects of each movement. The second period, extending from the Industrial Age to the Modern era, is examined through five chapters. It presents the various architectural and urban movements that helped shape the mindset leading to the emergence of modern architecture.

Course I : Renaissance architecture

Introduction

Research, experimentation and renewed interest in classical culture characterize the beginnings of the Renaissance. This spirit of invention contributes to changing the perception of buildings while the harmony of proportions acquires absolute preeminence. The Renaissance is the period of history that begins after the end of the Middle Ages, in 1492 and ends with the death of Charles V in 1558, This is the period of European historyin reaction to the overload of Gothic architecture,or where a renewed interest in the arts and culture of Greco-Roman antiquity has emerged. The word Renaissance came to us from Italy, where people spoke of the Rinascita letters and arts from the end of the 14th century (the Italians today say Refreshment). The Renaissance was above all an urban phenomenon, originating largely in the cities of central and northern Italy, such as Rome, Florence, Ferrara, Milan and Venice. it will quickly transport itself to France then spread to a large part of Europe where it generally coexisted with Gothic architecture.

I.1. Humanism

Humanism privilegedpure mathematical forms and proportions. Architecture thus became an intellectual as well as a practical discipline. Filippo BRUNELLESCHI (1377-1446) is the first great protagonist of the new Renaissance style. Brunelleschi is also credited with inventing scientific perspective around 1415. There Division of tasks at the construction site level today is one of Brunelleschi's inventions (Melvin, 2011).

I.1.1. The dome of the Cathedral of Santa Maria DelFlower

The double-vaulted dome is a brilliant technical feat. Brunelleschi provides a technologically new solution to the problem of formwork for the vault of the dome, in such a way that the vault is self-supporting in all phases of its construction. He thus introduced the technique of herringbone brick masonry taken from the construction practice of antiquity. A model of the

dome was made beforehand, a practice that became widespread for the construction of major buildings (Benevolo, 1988).

Figure I.1 : Cathedral of Santa Maria DelFlower
Source : https://flawless.life/en/italy/florence/complesso-di-santa-maria-del-fiore/

I.1.2. Santa Maria Novella

Alberti used classical forms and orders to establish hierarchies, for example; the triumphal arch indicated the entrance to a church. Furthermore, the specific use of orders did not simply signal the importance of a building but also the respective statuses of its different parts (Evers & Thoenes, 2011).

I.1.3. Court of Urbino

Federico Montefeltro said of his court of Urbino one of the major centers of humanist education at the end of the 15th century and called upon Pieroof Francesca. The dynamism of herpatronageallows the creation of the Ducal Palace and its elegantly proportioned inner courtyard, designed by Luciano Laurana.

I.1.4. Saint Peter's Basilica

Donato Bramante was formed in this humanist environment of Urbino. His architectural works in Milan and Rome, where he began the reconstruction of St. Peter's Basilica and completed the tempietto from San Pietro in Montoriodeploy the most refined synthesis of classical teachingof the architectural renaissance (Melvin, 2011).

I.2. Idealism

Idealism favored a newdesign was juxtaposed with an older one, especially if it was a Gothic plan considered barbaric. Very few of them were able to achieve an "ideal city" but almost all of them favored isolated buildings, often with a central plan.

The first who hasdesigned an ideal city, it was structured by a converging network of streets and canals which methodically linked the squares, the palaces, the ramparts and the gates, also making them communicate with the rest of the territory (Charre, 1983).

1.2.1. The requoted from Pienza

Lit is cardinals were encouraged to build their palaces along the main street even if some natural curves "spoiled" the perfect character of prescriptive. The death of Piusllin 1464 put an end to the ideals of Pienza. The cardinals returned to Rome leaving their palaces unfinished by Bernardo ROSSELLINO.

1.2.2. The Sforzinda by Filarete

He comes to the conclusion that"Of all cities, the round city is the best.". The first plan for an ideal city, theSforzinda by Filarete (1464), is based on the circle with an incorporated star and a square with a centralized plan church in the middle.

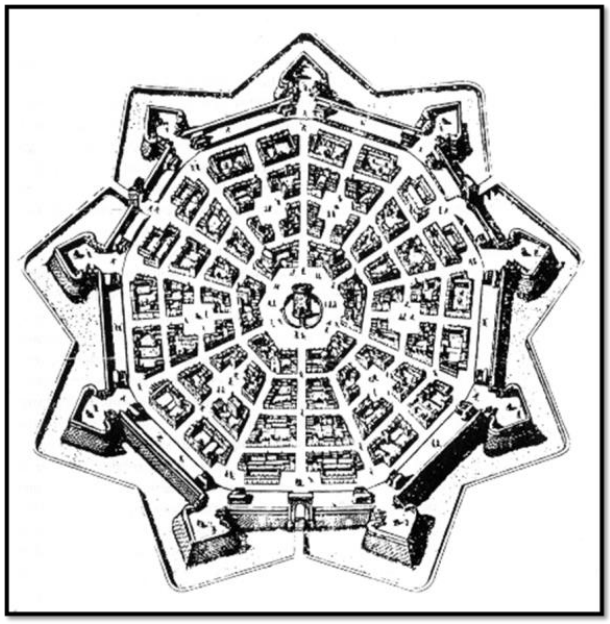


Figure I.2 : Plan of Sforzinda by Filarete
Source : https://es.slideshare.net/AndersonBlanco/sforzinda-la-ciudad-perfecta

I.3. Mannerism

In the middle of the 15th century, an intense theoretical production was deployed which led to Mannerism, a solution found by architects in order to comply with classical precedents and adapt them in form and detail, for visual impact.Heoriented humanist architecture, sober, intellectual and austere, towards the picturesque effect (Melvin, 2011).

1.3.1. Saint Peter's Basilica in Rome in 1547

The clarity of Bramante's original vision had already been lost in the many versions that had been added. Michel angelo inserted a second square at 45° to that ofBartender, creating a dynamic composition that allowed him to incorporate the open sides and create pillars large enough to support the drum and dome huge. He placed the long sides of the oblong windows horizontally and not vertically in the drum and surmounted them with a shell and an entablature, a good example of the Mannerist practice of mixing two compositional processes.

Source : https://www.voxmundi.eu/blog/why-you-should-go-on-a-st-peters-basilica-dome-tour

I.3.2. Plazzo del Te

The mixture of pilasters and bossage of arches and pediments creates an alternation of rhythms. If the palace has no architectural ornament, it is entirely decorated with a fresco representing giants overturning the classical order.

I.3.3. Palazoo Massimo of Rome

Confronted to the problem of an irregular site in which he had to fit a double palace intended for two brothers he curved the façade to follow the layout of the street. A series of trompe l'oeil is reinforced by the decorative theme introduction of a principle which would reach its peak in the Baroque period a century later.

I.4. Pietism

New religious orders, such as the Jesuits, were founded for missionary purposes and to enforce the Counter-Reformation. Moreover, the Council of Trent codified the doctrine and once again assigned art the role of "bible of the illiterate."

Painting and sculpture were to illustrate edifying biblical stories, while architecture was to provide the spaces needed for the new devotions. The result was a return to the medieval Latin cross plan, with a long nave, two transepts and an apse.

Spain with a large Jewish population and some of whose territories had been Islamized, became aware of the political force of the Counter-Reformation. In the field of architecture, this resulted in the brutal transformation of the magnificent Mosque of Cordoba into a cathedral, something that even its instigator, Emperor Charles V, ended up regretting (Melvin, 2011).

Figure I.4 : Mosque of Cordoba
Source : https://www.archnet.org/sites/20825.

1.5. The features stylistics of architecture of the renaissance

- The regular plan:rigorous lines, rectilinear facades, right-angle connections

- equality of spans:regularity in the rhythm of openings.

- Alignment of the bays :at the same level.

- Symmetry:similarity between the two halves of a building with respect to its median axis.

- The proportion:(ratio between dimensions) was one of the predominant concerns of the Renaissance: all the dimensions of a building, to be harmonious, had to be multiples of a basic module.

1.6. New techniques of constructions

The column characteristic element of ancient architecture, is brought back into the spotlight. Topped with a capital, it supported a horizontal entablature composed of three elements: an architrave, a frieze and a projecting cornice (Benevolo, 1983),

Figure I.5 : The column characteristic element
Source :https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.istockphoto.com%2Fillustrations%2Fcartoon-of-the-renaissance-architecture

-The domeon pendants constitutes novelties,

-The drum, the dome and the lantern:a cylindrical drum was placed between the pendentives and the dome, through the windows of which the transept could be illuminated.

-The pendentive vault: It is made up of the union of four pendants, which gives it the shape of a cap falling into a point at the corners.

-The ornament: based on geometric or naturalistic patterns.

-The bossage(the stone stands out in relief), which the Middle Ages had reserved for military architecture, was introduced into civil architecture.

-Use ofthe barrel vault with coffered ceiling“centered window” and “ribbed dome”

Conclusion

Antiquity becomes a reference and an unequalled model in the eyes of artists. The anonymity of creators specific to the Middle Ages disappears in favor of the highlighting of personalities, and the Renaissance establishes it self as the era of geniuses with well-defined characteristics:

- The emergence of a new concept based on autonomous practice
- Use of classical elements inspired by antiquity, without fulfilling its true function;
- A spatial and dynamic organization ensured by the play of opposing elements (longitudinal, central, circle, square plane);
- The superposition of architectural orders;
- Use of the barrel vault with “centered window” and “ribbed dome” box
- Use of decorative elements from antiquity (cornice, columns, pediment, statues, etc.).

Course II : Baroque architecture

Introduction

The word baroque is derived from a Portuguese jewelry term,baroque,which designates irregular pearls. It can be applied to a aesthetic and a worldview that spread from Italy throughout Europe at the end of the 16th century. It could have meant anything that is weird or uneven. It is an era in art history, the end from the 16th and the beginning of the 17th century. Baroque architecture marks a decisive break with the humanism and idealism of the Renaissance. Richer and more varied, the Baroque forms privilege illusion and spectacle more thanuseof the ideal purity offorms. They originate from the desire to strengthen religious doctrine. Beyond architecture, the Baroque covers concepts as diverse as political absolutism and mathematical discoveries.

II.1. Italian baroque: 1550-1800

Hewas launched by two great Roman architects of the 17th century, Gianlorenzo Berniniand Francesco Borromni. They created complex and fluid shapes:The central plan is increasingly in favor, its pattern stretches more and more towards the ellipse..They used sculpture and paintinganise that the elements architectonic: pilasters, cornices, wavy lines of the facade (Benevolo, 1983),.

Gianlorenzo Bernini used gesture and posture to convey human emotions. He often combined sculptural figures and painting to personalize and explain his architectural achievements. Thus in San Andrea alQuirinale, the representation of the soul of San Andrea leaving his crucified body and attended by putti (cherubs), rising towards the celestial light of a lantern at the top of the dome. Has knowledge of masonry acquired on family building sites, was added a deep understanding of geometry, which allowed him to create extraordinarily complex forms. His masterpiece San Carlogo FourFontane achieves a wonderful dynamic unity of circles and triangles interweaving the symbols of the Trinity and the omnipotence of the Church of Christ. Has knowledge of masonry acquired on family building sites, was added a deep

understanding of geometry, which allowed him to create extraordinarily complex forms (Melvin, 2011).

II.2. German baroque: 1550-1800

It illustrates the transition from the more severe longitudinal plan, of Italian inspiration, to the plan willingly oval, which is popular in southern Germany. This one also shows a predilection for the (twin) towers crowned with lanterns of great wealth of invention, and diverts from the classic to adopt facades and interiors with luxuriant decoration.

Figure II.1 : San Carlogo FourFontane
Source : https://www.alamyimages.fr/l-art-baroque-l-italie-rome-l-eglise-de-saint-charles-des-quatre-fontaines-1634-par-francesco-borromini-1599-1667-facade-image209609612.

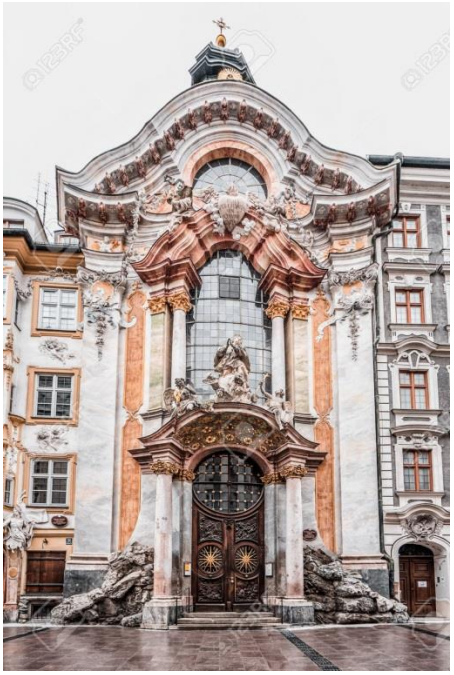


Figure II.2: St. John's Church Nepomuk from Munich
Source : https://www.google.com/url?sa=i&url=https%3A%2F%2Ffr.123rf.com%2Fphoto_162154821_fa%25C3%25A7ade-d-entr%25C3%25A9e html-avant-d-asamkirche-%25C3%25A9glise-baroque-tardif-%25C3%25A0-munich-bavi%25C3%25A8re-

II.3. French and spanish baroque 1580-1770

In France, Baroque is essentially the spectacular expression of the lifestyle of the court and the aristocracy. This is why it is more often present in the elegant castles as well as the large urban churches. Spanish Baroque is characterized by a profusion of ornament. churrigueresque which will be felt as far as the colonies of South America (Koch, 1997).

Figure II.3 : Obradoiro of Compostela
Source : https://www.google.com/url?sa=
i&url=https%3A%2F%2Farsartisticadventureofmankind.
wordpress.com%2F2023%2F09%2F30%2Fbaroque-architecture-in-
spain%2F&psig=AOvVaw2p8rvIM_5nDGfLaxvu
Xggr&ust=1752703708740000&source=images&
cd=vfe&opi=89978449&ved=0CBgQjhxqFwoTCOjz4Lnwv44DFQAAAAAdAAAAABAE

II.4. Rococo

ROCOCO style further increases the richness of ornamentation and the fluidity of forms introduced by Baroque architects. Closely associated with Catholic Europe, particularly the Holy Roman Empire and southern Germany, this architecture with its exuberant creativity emphasizes the mysterious and intuitive aspects of faith and gives rise to a multitude of churches, ecclesiastical institutions and residences intended for princes and bishop electors.

The term “rococo” comes from the word “rocaille”: use of motifs based on rocks and shells. He associates betweenthe abstraction of architectural principles based on form and geometry to the narrative effect of sumptuous pictorial ornamentation by flatter shapes, smooth surfaces

Has Fourteen Holy, Balthasar Neumann composed an extraordinary sophisticated plan of overlapping forms and fluid volumes where space, form and light combine with decoration to support the sensory impression of intellectual rigor (Gandon, 1844).

Figure II.4 : Sans-souci Castle
Source : https://loiclagarde.com/castle-sans-souci-heritage-global-unesco/

II.5. Urban dimension of architecture baroque

The straight line perspective replaces the curved line of medieval streets, Royal squares with ordered facadesserve as decoration for the troops.

Conclusion

The characteristics stylistics of baroque architecture are :

- Opulence: the association betweenLit istechnical progress, and ornamentation.
- Theatricality: puton stage the spaces and the decor of thechurches like a theater stage
- Creativity: Baroque is distinguis hed by innovation
- The overloaded interior decoration of the baroque style
- The movement:A baroque façade is not rectilinear, it can be undulating; the oval or elliptical plan is much more flexible in the case of churches.
- The structure: The use of supports in the form of large scrolls rolled up on themselves to connect two floors of different widths.
- The pediments triangular:sometimes associateto arcs ofcircle to breakregularity.

- The decoration of the facades by often sculpted elements and by the framing of the openingsby draperies of square or rectangular stone shapes with the circle or the oval (bull's eye).
- The light:The Baroque plays on the contrasts that animate the space. This is achieved by creating recessed volumes and projecting volumes.

Course III : Classic architecture

Introduction

The Latin adjective classicus means "first class", for a citizen who belongs to the highest social class. In the literary sense,the classicsare the authors of the "first order", in other words, the models. What is called classicism, in the 17th century, is a literary and cultural movement, which advocates the imitation of the great ancient works, considered as references, and which establishes strict rules of artistic composition. In the 17th century in the countries of northern Europe and in France, the classical style flourished, borrowing its forms from ancient architecture (columns, friezes, pediments, etc.) (Koch,1997). The largest example is the castle of Versailles. He is defined by a set of values and criteria which outline an ideal embodied in the "honest man" and which develops an aesthetic based on a search for perfection, its key word is Reason unlike the Baroque which reserved a large place for imagination. In the narrow sense of the term, in Europe, the term "classical" refers to the style that prevailed between 1770 and 1870 and which took Greek rather than Roman antiquity as its model. In the narrow sense of the term, in Europe, the term "classical" refers to the style that prevailed between 1770 and 1870 and which took Greek rather than Roman antiquity as its model. The Sun King (Louis XIV) encouraged artistic effervescence in all areas and wanted to compete with the Italian Baroque. The cult of the ancient perfection of the "classics" thus joined the monarch's desire for grandeur and prestige. This artistic movement will develop for almost a century (from the 17th to the 18th centuries). It began during the thirty years of work on the Palace of Versailles (Ragon, 2010).

III.1. Absolutism

Absolutism appropriated the idea of the focal point, reinforced its symmetry of radiating motifs, mixed it with baroque scenography and deployed it on a large scale. Versailles extended over a marshy area. The land was drained and beyond the park axes were drawn which corresponded to the bridle paths. From the roundabouts large avenues were laid out and

the surrounding landscape became an integral part of these perspectives which had a castle as their centre and seemed to extend to infinity.

The design of the park echoed that of the entrance to the city from which three major axes departed. Thus everything converged towards the courtyard of honor. Versailles owes much to the Château de Vaux le Vicomte built from 1657 to 1661 for the superintendent NicolasFouquerbased on plans by Nicolas le Vau, decorated by Le Brun and whose gardens were designed by La Notre (Melvin, 2011).

Figure III.1 : Palace of Versailles
Source : https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.expedia.ca%2Fthings-to-do%2Fpalace-of-versailles-trianon-full-day-tour-with-lunch.a171378.activity-details&psig=AOvVaw136Pua2PwKA-iKiVYxbzvB&ust=1752704454562000&source=images&cd=vfe&opi=89978449&ved=0CBgQjhxqFwoTCNjZzKPzv44DFQAAAAAdAAAAABAV

The Palace of Versailles, which is influenced by the Baroque style in its decoration, nevertheless remains classical in its broad outlines. It bears witness to the typically French taste for large, harmoniously balanced masses as well as the importance of antique rigor. Located in the centre of the castle, the marble courtyard and the king's chamber (on the first floor) were essential places in the life of the Court.

III.2. Empiricism Anglican

Empiricism Anglican is an inventive version of the classic which appeared in England at the end of the 17th century. It shares with the Baroque this ability to adapt classical language to practical and political ends (Melvin, 2011).

III.2.1. The chapel from Pembroke College in Cambridge and the Sheldonian Oxfor Theatre

Lnigo Jones imagined, thanks to h knowledge of mathematics, an ingenious syste of roofing without resorting to the Gothic vau or intermediate columns.

Figure III.2 : Chapel from Pembroke College
source : https://www.cambridge-colleges.co.uk/pembroke-college/

III.2.2. The St. Paul's Cathedral from 1675

Her central plan project in the form of a Gree cross did not suit the clergy, who preferred longitudinal plan in the form of a Latin cros and after various compromises one of his plan was adopted.

Figure III.3 : The St. Paul's Cathedral
Source : https://www.britannica.com/topic/Saint-Pauls-Cathedral-London

III.2.3. Blenheim Palace and Castle Howard of Sir Christopher Wren

Audace et leur folle liberté vis-à-vis du classicisme attirèrent le colère des palladiens qui allaient révolutionner le gout anglais au début du XVIII siècle.

Figure III.4 : Blenheim Palace and Castle Howard of Sir Christopher Wren
Source : https://www.britainexpress.com/counties/oxfordshire/houses/Blenheim.htm

III.3. Palladianism

Considered as the great master of the synthesis of Greek and Roman classicism, the architect Palladio had great success in the West from the 17th to the 19th century.Palladianismarrived in England in the 17th century thanks to Inigo Jones. A century later, Lord Burlington and his architect friends adapted Palladio's principles to the English climate and social context. Thus; Palladianism became the main source of inspiration for the great era ofresidences18th century English (Melivin, 2011).

Burlington gathered the artists he patronized and commissioned them to remodel his Piccadilly mansion in London. The final result owed as much to his own vision as to that of the men of art. Soon tired of the rigidity of Campbell, he entrusted more responsibility to William Kent, who originally was a painter but would prosper as an architect under Burlington's tutelage and patronage. ButIt was to Palladio that all the admiration of the Burlington circle went. The rich lord undertook a second trip to Italy in order to study the work of the master and was greatly inspired by the cityRotundato buildChiswuck House.

Figure III.5 : The remodeling of the Piccadilly mansion in London
Source : https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.timeout.com%2Flondon%2Fnews%2Flord-byrons-dazzling-piccadilly-mansion-is-on-the-market-121323&psig=AOvVaw2FV_0WJlFM3w2P5IXvGJj-&ust=1752705532763000&source=images&cd=vfe&opi=89978449&ved=0CBgQjhxqFwoTCIiy6ZD3v44DFQAAAAAdAAAAABAE

Conclusion

The characteristics stylistics of classic architecture are :

- Inspiration from Greek architecture:Aesthetic elementsclassical architecture approaches the canonsgreeksrecognized as ideal references. It also draws its origins from elements of the Renaissance.

- Rationalism in proportions:Regularity in the overall design of the building. It is built from basic modules that are repeated according to rules of mathematical proportions. It is also seen in the concern to punctuate the openings at regular intervals.
- Symmetry, the balance of volumes in relation to a median axis.
- The architectural elements:the semicircular arch, the barrel vault, the pediment, the column, the pilasters, the cornice...

Course IV : Rational architecture

Introduction

Synonymous with art by Vitruvius, architecture is defined as"an art of building" (Battista Alberti L.,1553), which raises the fundamental question of whether/ architecture is an art or a science? The motivation of the architects of this time was not to copy but to try to establish new theories of architecture, based on the principles of ancient architecture (Daly, 1896).

IV.1. The contribution of the philosophy to architecture

IV.1.1. Vitruve

Of Architectura is not just artistic,Vitruvius addresses the questions constructive with a luxury of details that cannot leave indifferent all those who admire ancient monuments for their solidity that seems to defy the centuries (Houcke & Taddei, 2002). Through the discoveries made on the ancient cities, the theories of Vitruvius which were incontestable for classicism, were called into question by:

- JD Leroy : Only Greek architecture was the origin of the true style.
- GBPiranesi : The Etruscans, their Roman successors, had outstripped the Greeks in raising architecture to a high level of refinement.

IV.1.2. Aristote

Thought that beauty obeyed the laws of reason, the basis of the form of objects. He emphasized : the measure, the proportion, the suitable to respect for the laws of numbers and determination, the revelation of the essence of the object to Features that characterize its purpose.

IV.1.3. Saint-Thomas d'Aquin (1225-1274)

"To reason is to go from one object of intelligence to another, with a view to grasping the intelligible truth."

IV.1.4. Descartes (1596-1650)

With the reign of reason truly began. The geometry of the ancients seemed to him the model and the instrument of all knowledge of all demonstrative knowledge. Mathematics offers well-linked and certain truths. By following the same methods, it seemed possible to found a rational science on any subject. The world of objects could be subjected to the rules of protocol experimentation, a principle of intervention intended to reveal the universal laws of nature (Ragon, 2010).

IV.2. The influence cartesian theories in the field of architecture

The principles of Descartes' rationalist thought probably have their sources in references to architecture and urban planning. He probably did not appreciate the urban planning of medieval cities whose buildings were:

- The product of several trades and several project managers, a task accomplished by a single hand is more perfect.
- The picturesque irregularity of medieval towns with their winding and dark streets makes a village become a town in a disproportionate way.

He preferred new fortified towns such as Nancy (1588) and Charleville (1605) methodically designed by a single designer over existing cities with their winding layouts and dark, narrow streets.

Descartes will arrive at a certain number of principles by which he will order his doctrine:

- The invention of analytic geometry which states that the position of a point in space is expressed in three dimensions. The coordinates aregenerally called“Cartesian”.
- This solution method which is based on the decomposition, there fore analysis, of a problem into elements is one of the fundamental principles of Descartes' rationalism.

IV.3. The integration of reasonin the field of architecture

IV.3.1. Abbé Cordemoy: the questioning of ornament

He questioning Vitruvian Theories, with a doctrine that prefigures anti-decorative functionalism :

- Order and Distributionconcerned the correct use of classical orders in terms of proportions and arrangement; towards a mechanistic view of composition.
- Proprietyintroducing the notion of suitability (harmony)with which Cordemoy gave a warning against any erroneous application of theclassical or honorary elements to domestic or commercial buildings.

IV.3.2. Marc Antoine Laugier: a universal and natural architecture inspired by the primitive hut

He affirms his loyalty to Cordemoy's ideas by advocating a "universal and natural" architecture . This primary form is the basis of Gothic structures where there is no arch or formal articulation and where the intervals between the columns allow for as much transparency as possible.

VI.3.3. Claude Perrault: positive and arbitrary beauty.

It was Claude Perrault who first questioned the validity of Vitruvian proportions. He developed his own theory on:

- "Positive beauty" having a normative role of standardization
- "Arbitrary beauty" having an expressive function.
-

IV.4. Architectural styles

IV.4.1. Neo-classism

Neoclassicism arose from the belief that movements such as Baroque and Rococo were moving architecture too far away from its original sources. Rational thinking, dominant from the Enlightenment, and archaeological discoveries, favored this quest for origins.
If the neoclassical current was formed from the knowledge on ancient architecture acquired through archaeological discoveries made on sites of classical antiquity, it also had a significant theoretical dimension (Colquhoun, 1965). The Stylistic features are :

- The abandonmentdit isdetailsof the stylebaroque to ensure that the whole would have an essential function.

- The columns haverecovered their original supporting function and clean lines once again replaced dramatic curves.

- Symmetry, balance and the return to the basic and geometric forms of antiquity give neoclassical buildings a monumental appearance, with that typical atmosphere of Greek and Roman temples that the architects sought to recapture.

Figure IV.1 : Neo-classic
Source : Encarta.fr

IV.4.2. Expression of the sublime

Expression of the sublime During the 18th century, with thisdisciplinenascent that is a esthetics, we begin to wonder about the impact that associations of forms and styles havearchitecturaltraditional. In seeking to understand how art elicits emotionssensoryand intellectual, aesthetics also expands the expressive potentials ofarchitecture (Ragon, 2010).

- The institutionalization of architectural education

Francois Blondel found his own school in 1743. He devoted himself to teaching the theories of Cordemoy while adhering to the principles of JGSoufflot. Above all, he was the master of a generation of visionary and revolutionary architects. Like JacquesGondoin, Pierre Pâte, Claude Nicolas Ledoux and Etienne Louis Boullée

- Crushing; expression; control; grandiose; reason; Enlightenment.

The famous distinction of Edmund Burke established betweenThe sublime and the beautiful resonated in all artistic fields at the end of the 16th century : « The contemplation of ordered and regular objects, that is to say beautiful, was to induce an impression of serenity, while the

vision of the unfinished, the irregular and the animated, that is to say the sublime, was to provoke feelings of respectful fear or even terror ».

- Barrier from the Villette, Paris, France

Claude Nicolas Ledoux is forgea a style extremely personal, multiplying the raffinely and decorative finds, seeking picturesque effects while interpreted- both freely the Greco-Roman orders, showing a growing predilection for simplified volumes, bare walls, sharp edges, effects of mass. Before the revolution of 1789, Ledoux designed a series of toll pavilions to collect royal taxes on goods entering Paris. There he experimented with revolutionary architectural designs; for example, at the Barrière de la Villette, he placed a cylinder above a Greek cross. The absence of ornamentation reinforces the purity of the volumes, as if it were generated by brute force.

- Cenotaph to Newton (1784)

Etienne Louis Boullee developeda symbolism inreportwith revolutionary ideals andpronaan aesthetic based on the imitation of architecture antique and the adoption of forms geometric inspired by the nature. Her Cenotaph to Newton (1784), never completed, reflects his interest in science and reason and the neoclassical conviction that pure natural forms were the means to express it.

Figure IV.2 : Barrier from the Villette
Source :https://www.alamy.com/stock-photo /barriere-de-la-villette-paris.html

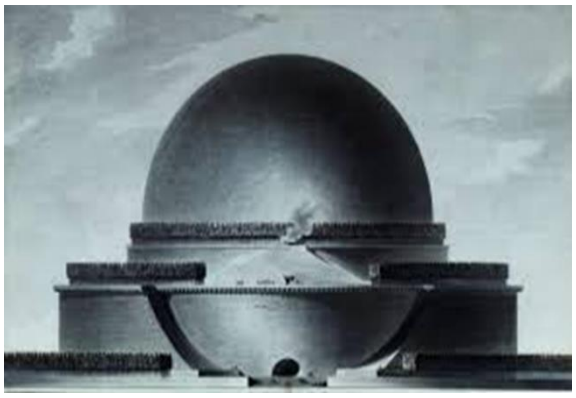


Figure IV.3 : Cenotaph to Newton
Source : https://www.archdaily.com/544946/ad-classics-cenotaph-for-newton-etienne-louis-boullee

IV.4.3. Rationalism

Rationalism; logic; reason, The rationality and scientificity introduced into the design of architectural structures perfectly responded to the effort of clarity advocated by the Enlightenment (Melvin, 2011).

- Form/function – Structure /ornamentation

Her Cenotaph which taught at the École Polytechnique in Paris - the first modern scientific school - from its foundation in 1795, Jean Nicolas Durand took rationalist doctrines a step further by asserting that the intellectual basis of architecture rested not on a mythical past but on science. He advocated the adaptation of elements to their function and was a supporter of a practical and solid architecture with simple and symmetrical forms.

- National Library of France

She constituted a new synthesis. The use of iron and cast iron allowed the French architect, Henry Labrouste, to lighten the supports of the reading room as much as possible. As for thedecoration, although discreet, she did not breaktotallywith a certain classicism and conveyed an extremely symbolic interpretation of the building's library function.

Figure IV.4 : National Library of France
Source : https://www.francetraveltips.com/four-national-library-of-france-sites/

- Restoration of buildings

Viollet-le-Duc insisted as for him on the obvious filiation between the structural principles and the Gothic. We owe him the restoration of many civil and religious buildings of the Middle Ages.

Conclusion

Rational architecture thus made it possible to pose the foundations of structural rationalism and, later, of the modernism architectural.

Course V : Supremacy of materials

Introduction

The industrial revolution transforms construction technology by : first, better use of materials with the calculation of their resistance and the mechanization of construction. Second, the development of geometry which allowed the production of very precise drawings of all the details of the building. The growth of public functions requires larger and more numerous public buildings, accompanied by the emergence of new types of construction adapted to the industrial economy: factories, depots, warehouses, ports. The realization must be done in a short time. The rules of descriptive geometry were developed by Gaspard Monge (1746-1818). He provided designers with a universal process for determining, through drawing, the different arrangements of construction elements. In 1790, Talleyrand proposed adopting a unified system. The decimal metric system was proposed in 1795. The adoption of a unified system facilitates the dissemination of knowledge and exchanges as well as extreme precision of measurements (Benevolo, 1988).

V.1. Iron and the glass like materials of construction

Were iron and glass materials worthy of use when the canons of architecture had been evolving for millennia around stone and wood, or did they offer opportunities that had to be exploited without reference to tradition? It isto these questions that some architects from the middle of the19th century tried to respond as new buildings, such as train stations, hotels or exhibition halls led to aevolvedtion significant in architectural research, on a morphological and typological level (Ragon, 2010).

Iron's ability to provide efficient structures had been demonstrated as early as 1779 with the construction of Abraham Darby's iron bridge at Coalbrookdale. But this achievement was a time bomb hidden under conventional architectural theories based on traditional building forms and materials.

Figure V.1 : Darby's iron bridge at Coalbrookdale
Source :https://www.google.com/url?sa=i&url=
https%3A%2F%2Fageofrevolution.org%2F200-object%2Fthe-iron-bridge%2F&psig=AOvVaw34e4y8Ma9gR5xMuGmaTVat&ust=1752706450635000&source=images&cd=vfe&opi=89978449&ved=0CBgQjhxqFwoTCNCRi9H6v44DFQAAAAAdAAAAABAE

V.2.Visions on iron like material of construction

Iron have three vision :

- The Romantic medievalists boycotted the iron.
- Others attempted with varying degrees of success to find a balance between the use of iron and traditional architectural conventions
- A little oneminority recognized in this material its capacity to create a new genreof architecture.

The art critic John Ruskin decreed that although the use of iron for truly architectural purposes would eventually become established, this was not the case in 1850.

V.3. Innovative projects

V.3.1. Bridges

- Cast iron Sunderland Bridge

Sunderland Bridge, built in 1783 over the River Wear near London, was a daring undertaking at the time; Sunderland Bridge consists of a single arch spanning 79 metres. The structure is composed of six ribs made of hollow wrought

Figure V.2 : Sunderland Bridge
Source : https://www.tandfonline
.com/doi/full/10.1179/1758120615Z.00000
000065

iron elements. Each rib was made up of 105 elements.

- Suspension bridges in chaînes

Clifton bridge pres from Bristole, England Isambard Kingdom Brunel, a 214 m bridge every porteand built between 1824 and 1864.

Figure V.3 : Suspension bridges in chaînes
Source : https://structurae.net /fr/ouvrages/pont-de-clifton

- Suspension bridges has cable

The first bridge has cable aeterealiseby the franthisais Marc Seguin in 1814 to cross the Rhone. The manufacture of wrought iron chains capable of resisting greater forces would prove very expensive and so the chains would be replaced by cables. Even today, the most daring bridges have been built according to Séguin's principle of twisted and continuous cables, unrolled along the entire length of the construction((Benevolo, 1988).

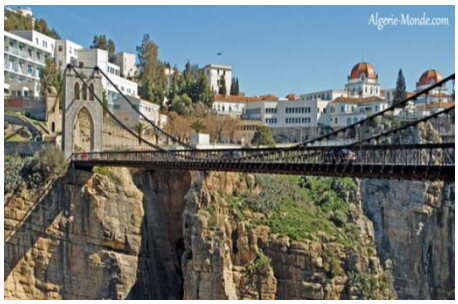


Figure V.4 : Suspension bridges has cable
Source :https://en.m.wikipedia.org/wiki/File:Les_Ponts_suspendus_%C3%A0_Constantine.jpg

V.3.2. Hall

The Grandes Halles of Paris (1853) designed by Victor Baltard were a veritable megastructure, characterized by immense spans of 80 meters but which will be demolished at the end of the 1960s to be replaced by the center cultural from Beaubourg.

Figure V.5 : The Grandes Halles of Paris
Source : https://fr.m.wikipedia.org/ wiki/Fichier:Halles_de_Paris,_1863.jpg

V.3.3. Crystal London Palace

The first, the immense Crystal Palace in London, was built in 1851 by Joseph Paxton with speed and efficiency, from prefabricated elements.

Figure V.6 : Crystal London Palace
Source : https://www.reddit.com/r/ Tartaria/comments/vuyxny/crystal_palace_london_ constructed_1851_destroyed/

V.3.4. Palm House

The second, still in London, was the Palm House (greenhouse) at Kew Gardens, designed by Decimus Burton and Richard Turner, where the logic of manufacturing and construction overrode architectural convention.

Figure V.7 : Palm House
Source : https://www.visitliverpool.com /listing/sefton-park-palm-house/825801/

V.3.5. Station of Saint-Pancras in London

Saint-Pancrasin London marks the end of attempts to unite traditional styles and the use of new materials.

Figure V.8 : Station of Saint-Pancras in London
Source : https://www.tripadvisor.fr/Attraction _Review-g186338-d214631-Reviews- St_Pancras_International_Station- London_England.html

V.3.6. Natural History Museum

This museum was designed by Thomas Aclandas a natural history catalogue. The Gothic-style iron cover placed above a quadrilateral bears witness to the dichotomy between scientific progress and stylistic representation.

V.3.7. Eiffel Tower, 1889

The plan to build a tower 300metershigh was conceived as part of preparations for the World's Fair of 1889. Bolting the joint of two crossbowmen Bolting the joint of two crossbowmen. The wager was to "study the possibility of erecting an iron tower on the Champ-de-Mars with a square base, 125metersacross and 300meterstall". Selected from among 107 projects, it was that of Gustave Eiffel, an entrepreneur, Mauritius Koechlin and Emile Nouguier, both engineers, and Stephen Savestre, an architect, that was accepted (Jacqmin, 2000).

Figure V.9 : Eiffel Tower
Source : https://www.1jour1actu.com/france/cest-quoi-lhistoire-de-la-tour-eiffel

Conclusion

Innovative projects on iron led to a evolution significant in architectural research, on a morphological and typological level.

Course VI: The precursors of modern urban planning

Introduction

The Industrial Revolution placed invention and production as society's priorities, creating social and spatial segregation. The bourgeoisie created industrial and mining towns. The rural exodus stifled and shattered the traditional city beyond its walls, creating industrial suburbs.
In seeking security in the city, the bourgeoisie demanded that order be restored to the city by widening roads, closing blocks, etc. The first consequence of this policy was spatial segregation. Workers occupied suburban houses in peripheral (less expensive) municipalities. The second consequence of this policy was the birth of urban planning law, to organize the creation of housing estates (Siegfried law of 1894, Loucheur law of 1928, etc.) (Kamon, 2005).

The industrial cities created from scratch by employers around raw materials and energy are a testament to this organization. The city is structured around the factory and the home. The services created are intended to create a reliable hereditary workforce.

VI.1. Haussmann and regulatory urban planning

"that no law could make an unelected body anything other than a commission... Paris, which was no longer the exclusive domain of the Parisians, this city, belonging less to them than to France, could not have a purely municipal administration" "the municipal organization of Paris could not be established on election like that of the other communes of the Empire... If Paris is a great city... it is above all the capital of a great empire, the seat of all the bodies by which the public power of France is exercised... That is why it is a prefect of the Empire who occupies the Hôtel de Ville and who fulfills there the administrative functions that a mayor exercises everywhere else; that is why it is the Emperor who appoints the municipal council" Extracts from speeches given by Haussmann[1].

[1,2]http://www.driea.ile-de-france.developpement-durable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle04119f.pdf

VI.1.1. Old Paris

- Problems and proposed solutions

In 1850, Paris, with its problems of unsanitary conditions, narrow streets, thermal comfort, lighting, drinking water supply and sanitation, led to devastating epidemics. Reshaping the city, by developing wide avenues with squares, parks and woods, and installing a modern sewer system and gigantic works to supply Paris with drinking water were the challenges to make Paris a pleasant city.

- Decisions and outline

The two main men of this large urban operation are:

- Charles Louis Napoléon Bonaparte, known as Louis-Napoleon Bonaparte then Napoleon III, was born in Paris on April 20, 1808, and died in Chislehurst in the United Kingdom on January 9, 1873. He was the first president of the French Republic, elected on December 10, 1848 by universal male suffrage, before being proclaimed Emperor of the French on December 2, 1852 under the name of Napoleon III.

- Georges Eugène Haussmann, born on March 27, 1809 in Paris where he died on January 11, 1891 (at the age of 81), was Prefect of the Seine from June 23, 1853 to January 5, 1870. In this capacity, he directed the transformations of Paris under the Second Empire by deepening the vast renovation plan established by the Siméon commission which aimed to continue the work undertaken by his predecessors at the Seine Prefecture Rambuteau and Berger.

To carry out major works, the State covers the majority of the expenses by resorting to borrowing through theWorks Fund[2].

Napoleon III sketches in color the main outlines of the work, on a plan placed on his desk.

Figure VI.1: Napoleon III and Hausmann
Source :https://www.napoleon.org/histoire-des-2-empires/paintings/6-napoleon-iii-and-haussmann

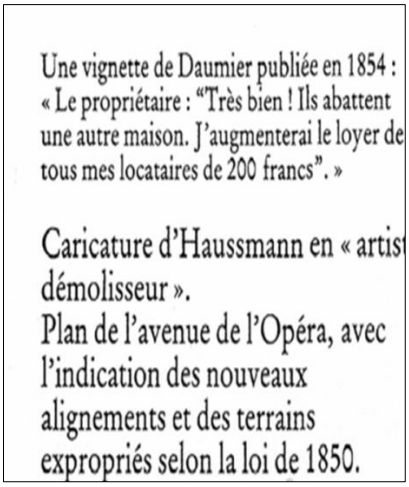


Figure VI. 2: A vignette by Daumier.

Source: http://www.driea.ile-de-france.developpement-durable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle04119f.pdf

VI.1.2. Haussmannian breakthroughs

30The city of Paris underwent transformations before Haussmann's arrival, through the construction and planning of a series of breakthroughs.

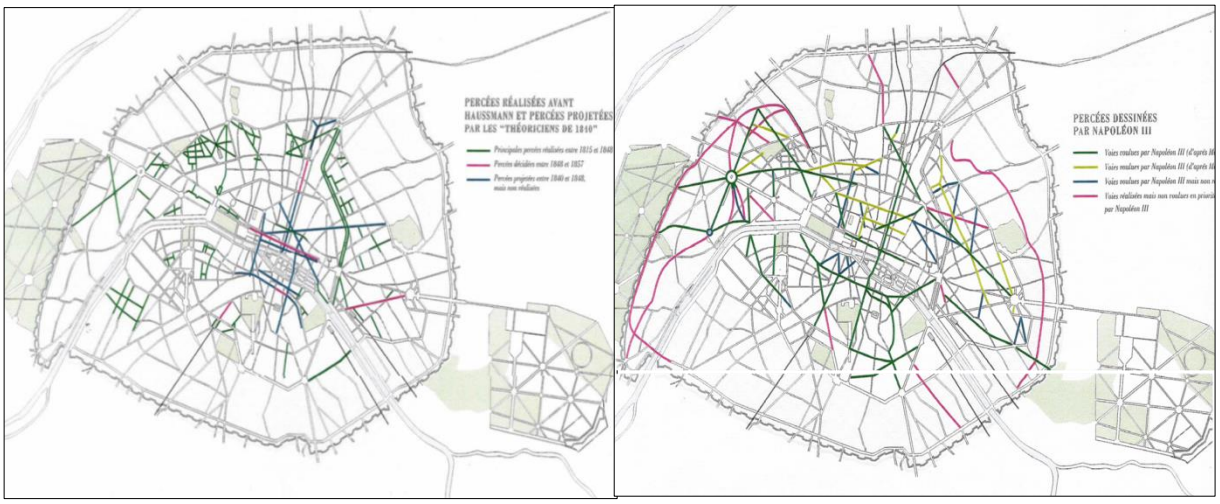


Figure VI. 3: the Parisian breakthroughs.
Source :http://www.driea.ile-defrance.developpementdurable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle04119f.pdf

- The mechanics of the Parisian breakthrough

The major works of remodeling Paris were carried out b
Haussmann, who took full responsibility for destroying th
old fabric to transform the French capital into a city
well-being, cleanliness, and beauty.

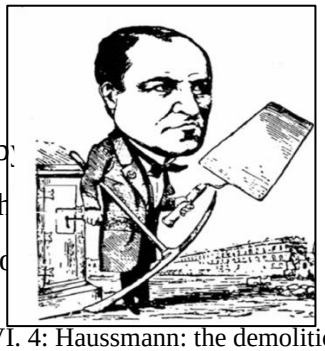


Figure VI. 4: Haussmann: the demolition artist.
Source: https://commons.wikimedia.org/wiki/File:Haussmann_as_%22Artiste_D%C3%A9molisseur%22.jpg

Figure VI. 5: The renewal of Paris.
Source :Camille Pissaro, 1898.

-Crossing: is the first operation to create a breakthrough, it is based on the destruction of all or part of a building or monument to make an avenue pass.

-Reconstitute: is the second operation of the mechanics which was to re-establish the volume and the shape of the block and unify the size of the buildings.

-Repair: is the operation of reconstruction and finalization of blocks and buildings.

-Enhancement: is ensured by the architectural quality of the building and the social class of its users.

- The Haussmannian block

The Haussmannian block is the main tool in the regularization of the city plan. Each block has a particular shape of three to six sides, with a continuous facade, and voids inside constituting the patios (Panerai, 1997).

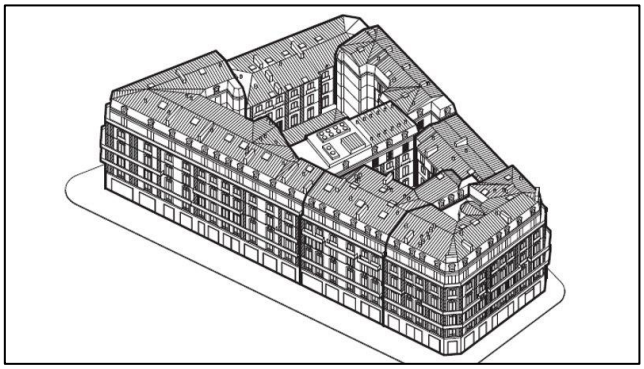


Figure VI. 6: The Haussmann island.
Source: https://chroniques-architecture.com/paris-haussmann-modele-de-ville/

- Haussmannian tunnel networks

Three main networks determine the characteristics of the Haussmannian opening:

-The first network was built between 1854 and 1858 and was supplemented by other breakthroughs, in particular the rue de Turbigo to serve the Halles district. It was structured around the intersection of Place du Châtelet, the east-west axis, Rue de Rivoli and its extension, and the north-south axis, Boulevard de Sébastopol – Boulevard Saint-Michel.[3].
-*the opening of the rue de Rivoli:* The decree of December 23, 1852 declared the opening of the Rue de Rivoli from the Rue de la Bibliothèque to the Rue des Poulies or Place du Louvre

[3]http://www.driea.ile-de-france.developpement-durable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle04119f.pdf

to be of public utility, with the purpose of erecting uniform buildings with arcades along the edge. As well as the enlargement of the Place du Louvre and Place Saint-Germain-l'Auxerrois with the destruction of the Church of Saint-Germain-l'Auxerrois.[4].

Figure VI. 7: Rue de Rivoli.
Source: https://www.la-croix.com/France/Circulation-Paris-rue-Rivoli-moins-voitures-velos-2017-06-30-1200859338

-*The widening of the Town Hall square:*The decree of February 19, 1853 declared the widening of the Place de l'Hôtel de Ville, now called Place de Grèves, to be of public utility.

-*Monuments:* are located at intersections of avenues and in squares, to play the role of a symbol and spatial reference.

Figure VI. 8: The monuments of Paris.
Source: https://blog.pariscityvision.com/fr/top-5-monuments-paris.html

[4]http://www.driea.ile-de-france.developpement-durable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle0119f.pdf

-The second network was built between 1858 and 1860, with the aim of extending traffic from the center: around the future Place de la République, Rue de Rome, Étoile, Chaillot, the École Militaire, Montagne Sainte-Geneviève.

Figure VI. 9: Rome Street.
Source: https://fr.wikipedia.org/wiki/Rue_de_Rome_(Paris)

-The third network was created after the annexation of the neighboring communes in 1860: boulevard Ornano, rue Jeanne d'Arc, rue de Patay, later rue de Tolbiac, rue d'Alésia...

VI.1.3. Green space and commerce

Under the direction of Adolphe Alphand, the Bois de Boulogne and Bois de Vincennes were incorporated into the city limits, and parks, gardens, and squares were created throughout the city of Paris. As a new form of commerce,Baltard built new market halls in the center of Paris to meet the food needs of the Parisian population.

Figure VI. 10: The park of Bologna.
Source: https://www.vanupied.com/bologne/parcs-bologne/

Figure VI. 11: The market halls of Paris.
Source: https://www.unjourdeplusaparis.com/paris-reportage/photos-halles-paris

VI.1.4. The sanitation network

In 1854, the city council approved the Paris sanitation program proposed by Haussmann and the director of the water service, Belgrand, the implementation of which lasted until 1924.

- Drinking water supply

All water previously distributed in Paris is deemed undrinkable.

The distribution networks are separate: raw water for public places, spring water for the private needs of the population.

Water is collected in storage reservoirs and then transferred to the city via large aqueducts.

Private connections are installed to bring drinking water to the domestic space. These connections are subject to a paid subscription.

- Wastewater disposal

Discharge wastewater far downstream from the city.

The elementary sewers flow into secondary collectors which join the main collectors.

The network is unitary.

Pumping plants to raise water from the low-lying districts of Paris, which cannot naturally reach the network.

VI.1.5. Annexation of neighboring municipalities

In 1860, the city of Paris annexed 18 communes, which brought about a major spatial and social transformation that doubled the city's surface area.

Figure VI. 12: The communes of Paris.
Source: http://www.driea.ile-de-france.developpement-durable.gouv.fr/IMG/pdf/Chapitre2_de_Breve_histoire_de_amenagement_de_Paris_DREIF_Auteur_Claude_Cottour_cle04119f.pdf

VI.1.6. Transportation

Means of transport have accompanied the transformations of the city.

1.6.1. The railway

In 1850, Paris's transport system was revitalized by the construction of a railway network of eight lines, connecting five Parisian stations. Parisian stations played a major role in this program, with expansion and construction projects launched to accommodate a greater number of trains and passengers.

1.6.2. Urban transport

The decree of February 22, 1855 declared the foundation of the General Omnibus Company.

In 1856, there were 25 bus lines in Paris and 11 in the suburbs. Steamboats were the other means of transport that ensured mobility in Paris.

Figure VI. 13: The Paris omnibuses.
Source: http://paris1900.lartnouveau.com /paris00/les_tramways.htm

Figure VI. 14: The boats of Paris.
Source: https://www.pinterest.fr/pin /565835140662274596/

VI.1.7. Critics

From 1860 onwards, the financial situation deteriorated, the regime was criticised, and as a result Haussmann was dismissed in 1970.

- The population is demanding that the work take a long time, more than 20 years, and that it is costly.
- Parisians accuse Haussmann of having made major inroads in order to maintain order in the city instead of enacting laws to control the revolts.
- Some accuse him of destroying important monuments and reserving the center only for the bourgeoisie, driving the poorest to the outskirts of the city.

VI.2. Cerdà and planned urban planning

Cerdà is known for two particular works. The first was his text that carried his urban planning reflection around the construction of a practical science for the city: The General Theory of Urbanization in 1857, published in 1867, coining the word urbanism. And the second was the project for the development of the urban extension of the city of Barcelona: the Eixample from 1860.

VI.2.1. Old Barcelona

- Problems and proposed solutions

Barcelona was a city surrounded by walls, with narrow streets. The strong population growth increased the population density to 890 inhabitants/ha, compared to 90 in London, 350 in Paris and 380 in Madrid. This phenomenon was the result of the immigration of peasants in search of work in factories, which provoked a popular protest movement: "Abajo lasmurallas" ('Down with the walls!') (Michonneau, 2007).

- Decisions
-

The wall was demolished in 1854, following the orders of Governor Pascual Madoz, who entrusted Cerda with the city's expansion plan. At the same time, the Barcelona City Council entrusted the same work to the architect Antonio de Rovira y Trias. In 1859, the King intervened, imposing Cerda's proposal.

The Ministry of Public Works commissioned Cerdà to carry out a topographical study of the Barcelona plain. Cerdà drew up a topographical map determining the non-buildability of a large area for strategic reasons (Michonneau, 2007).

11. Plano general del proyecto del Ramblar Colector de L. Serraliach, 1865 *(Real Academia de Bellas Artes de San Fernando)*

Figure VI. 15: Topographic map of the Barcelona plain.
Source: https://lcabcn2016uo.wordpress.com/background/

VI.2.2. The general theory of urbanization

- Presentation of the theory

In this book Cerdà defines urbanization as: "a set of actions aimed at grouping buildings and regulating their operation, as well as the set of principles, doctrines and rules that must be applied so that buildings and their grouping, far from repressing, weakening and corrupting the physical, moral and intellectual faculties of social man, contribute to promoting his development as well as increasing individual well-being and public happiness" (Paquot, 2013). Through this definition Cerdà rejects the notion of the city and replaces it with the "urbe" to define any agglomeration without taking into consideration its size or shape.

The general theory consists of two texts: the first is the dissertation on the preliminary project: the theory of city construction applied to the project of reform and expansion of Barcelona. The second is the statistical monograph of the working class of Barcelona, thus introducing the principles and stages of urban planning.

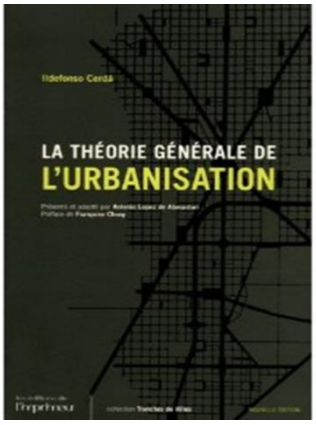


Figure VI. 16 : The general theory of urbanization
Source : https://www.eyrolles.com/BTP/Livre/la-theorie-generale-de-l-urbanisation-9782915578737/

- Results of the analysis

The existing city is incapable of supporting technological development (economy, transport, etc.) and also of welcoming a new urban civilization influenced by this development.

A new city must be created for a new urban society, reconciling the contradictory demands of a complex agglomeration.

This new city is an “integral and egalitarian city” combining urban and rural values: Ruralize the urban, urbanize the rural.

VI.2.3. Barcelona Extension Plan

In his approach to the project, Cerdà tried to apply his ideas around the integral city, in the form of principles for planning the extension of Barcelona.

- The principles of planning

-An egalitarian and functional city through its urban framework: An orthogonal framework which gives coherence and homogeneity to the city. The Catalan writer Josep Pla defined the Eixample as "chaos on a chessboard"[5].

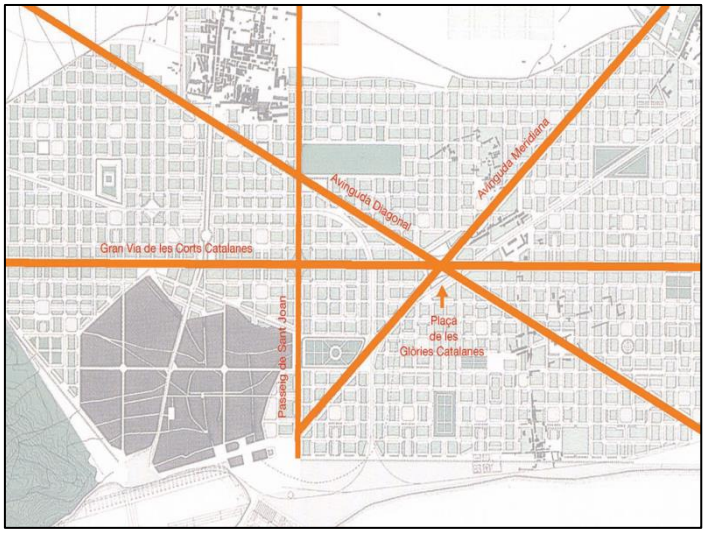


Figure VI. 17: The urban network of Eixample.
Source: https://chairecoop.hypotheses.org/files/2013/02/cerda-Barcelona.pdf

The streets in Eixample are twenty meters wide (through lanes: Gran Via, Diagonal and Meridiana) connecting the city center to the extensions. They are divided equally between pedestrians (two five-meter sidewalks) and cars (one ten-meter carriageway). At street intersections, the surface area of the roadway is doubled to facilitate mechanical traffic.

Figure VI. 18: The streets in L'Eixample.
Source: https://fr.dreamstime.com/plaque-rue-passeig-gracia-%C3%A0-barcelone-espagne-image110405801

[5]https://chairecoop.hypotheses.org/files/2013/02/cerda-Barcelone.pdf

-Cerdà Island:a square shape cut into the corners to facilitate circulation, with a large (empty) courtyard inside to ensure thermal, acoustic and visual comfort for the occupants.

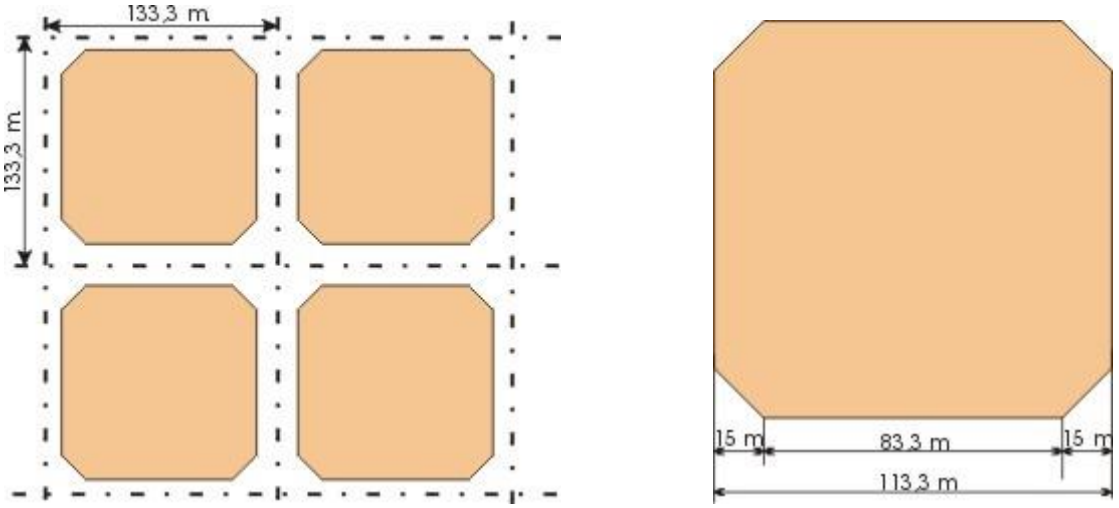


Figure VI. 19: Cerda Island.
Source: https://achatenespagne.fr/eixample-naissance-de-la-barcelone-moderniste/

-An egalitarian city through its urban void: In the middle of the buildings, the green space is arranged in the large interior courtyard like a well to take advantage of the saddle and natural light for all the inhabitants. It occupies a percentage of 63% of the total surface area.

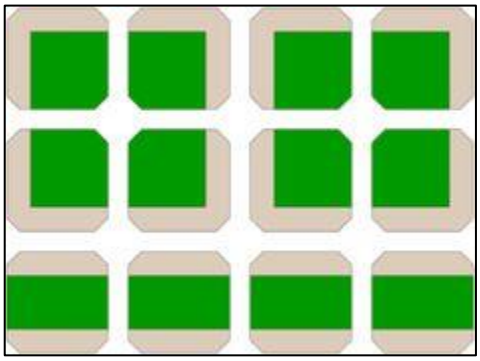


Figure VI. 20: The green space at Example.
Source: https://www.pinterest.fr/lpeltier6342/%C3%AElots-cerda/

-An egalitarian city through its urban core: Cerdà's concern was to ensure a legal distribution in the built space: housing or equipment.

-*Integrated housing*: Cerdà has invented a new model of housing; seeking to reconcile the two urban and rural worlds: housing integrated into a building and not into a "house"[6].

-*The equipment*: established in an equitable manner in each housing entity, occupying an entire block (hospitals, schools, markets, churches, etc.)

[6]https://chairecoop.hypotheses.org/files/2013/02/cerda-Barcelone.pdf

Figure VI. 21: The Example.
Source: https://www.pinterest.fr/lpeltier6342/%C3%AElots-cerda/

- Parks and green spaces

In the same interest of ensuring equality among the city's inhabitants, Cerdà proposed the development of squares and green spaces in the urban area in an equitable manner, with each neighborhood having a large square that measures 10 x 10 of the block's surface. He also plans to develop two large parks at the edges of the city.

Figure VI. 22: Parks and green spaces in Example.
Source: https://chairecoop.hypotheses.org/files/2013/02/cerda-Barcelona.pdf

VI.2.4. Transport

Mindful of the challenge of building continuity and a link between the old fabric and the new extension, Cerdà plans an underground railway network that connects the stations and the port to ensure traffic and mechanised transport.

VI.2.5. Project financing

Cerdà consolidated his project not only with a theoretical study, but also with legal and economic bases inspired by the German technique of parcelling out, which would allow the plan to be financed: the randomly distributed rural plots would be transformed into urban housing estates and the historic paths into a regular grid of streets, which is, even today, highly efficient for pedestrians and cars.[7].

VI.2.6. Critics

- Monotony: The first criticism targets the formal aspect of the plan; all the blocks have the same shape. Cerdà objects that diversification in form remains the responsibility of the architect.

- Costs: are very high due to the urbanization of a virgin and depopulated land, in addition, the large surface area of public spaces was considered a waste of land.

-Modifications: Cerdà has made modifications by densifying the blocks, but without affecting the graphic representation.

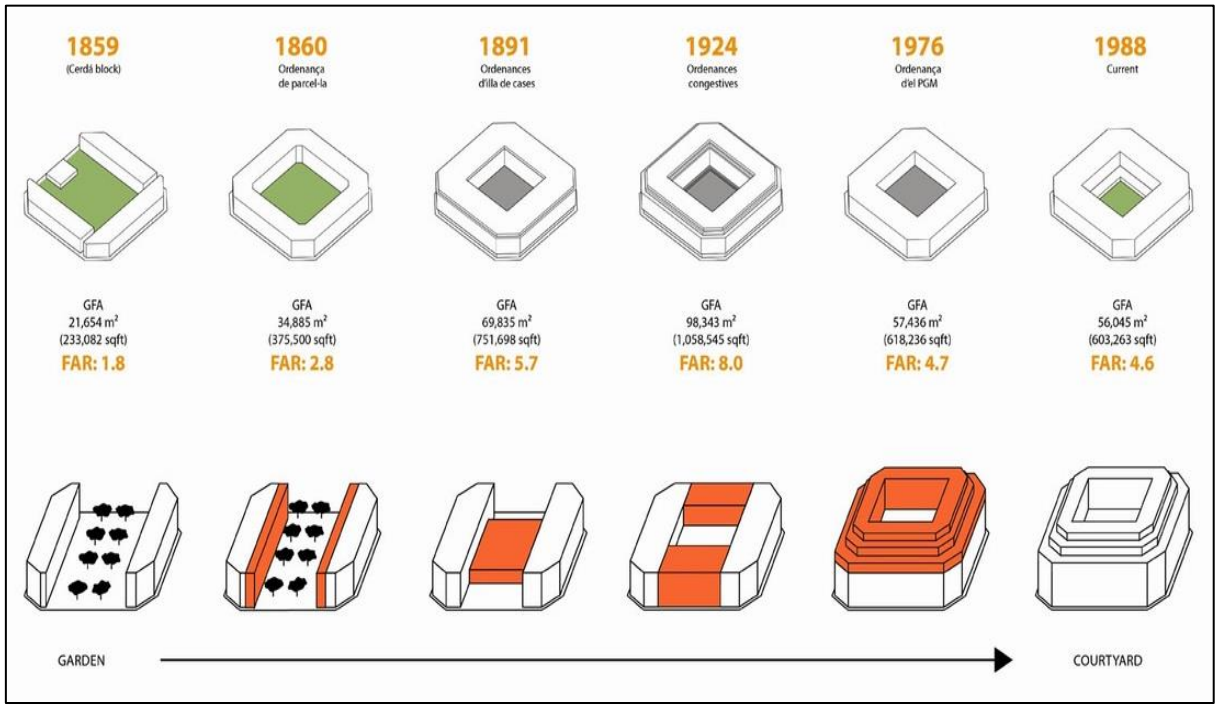


Figure VI. 23: The modifications made to the Cerda block.
Source: http://acacarriatactualites.blogspot.com/2016/04/voyage-barcelone-2-petite-histoire.html

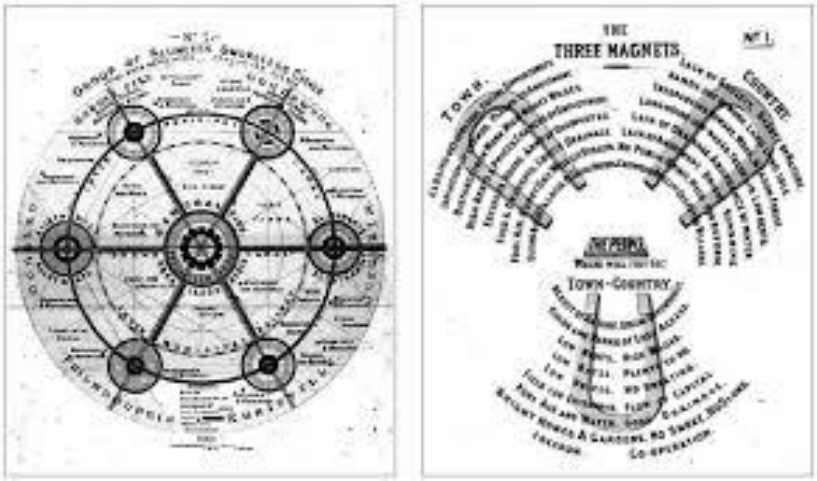
[7]inspired by the German technique of parcelling out, which will make it possible to finance the plan: the parcels

VI.3.Howard, Unwin and the Garden City

At the end of the 19th century, and with the degraded situation of life in the city, Ebernerez Howard (1850-1928) tried to reconcile the urban and natural worlds by innovating a new urban planning model, theorized in a work published in 1898: "Tomorrow: a peaceful path of real reform" (Tomorrow: a peaceful path towards a real reform), republished in 1902 under the title Garden cities of tomorrow. This work develops the theory of garden cities and satellite towns, based on diagrams and their descriptions, whose number of inhabitants would be strictly limited, as a response to the problems of housing in the city in the industrial era.

VI.3.1. The principles of planning a garden city

"A garden city is a city designed to provide the population with healthy living and working conditions; the dimensions must be just sufficient to allow the full development of social life; surrounded by a rural belt, the land being entirely public property or administered in trust on behalf of the community.» (Ebenezer, 1919) - The radioconcentric plan: a circular shape resulting from the projection of Howard diagrams, with a radius of a little over a kilometer, a limited size (4 km² at most), in the center of a territory of about 20 km² of agricultural space.



Source: https://books.openedition.org/pur/30184

-Six districts delimited by penetrating boulevards represent the urbanized sector.

- In the center, Howard is developing a park surrounded by services available to the population.

-The proposed model is surrounded by a railway line and an agricultural area.

-The city has a limited population size (the population must not exceed thirty thousand people).

VI.3.2. Unwin's Principles

His thinking is based on the analysis of the existing: "the study of ancient cities and their construction system is valuable in supporting the modern art of building agglomerations. But we must retain from this study only that which meets modern conditions and the realization of which does not deviate from the means available today. For example, the picturesque beauty which results from the natural and probably unconscious development of the city in the Middle Ages can inspire the highest admiration, but we must understand that this beauty was produced by living conditions which no longer exist and which we would be ill-advised to try to reproduce."(Unwin, 2012).

Unwin classifies cities according to their urban form into three categories: spontaneous city, planned city, and open city. He values urban and natural voids (gardens and squares) as a structuring element of the urban and landscape composition of the city.

VI.3.3. Examples of garden cities

-Letchworth Garden City: Founded in 1903, Letchworth was the prototype for the garden cities designed by Ebenezer Howard. The plans were drawn up by the architects Parker and Unwin.

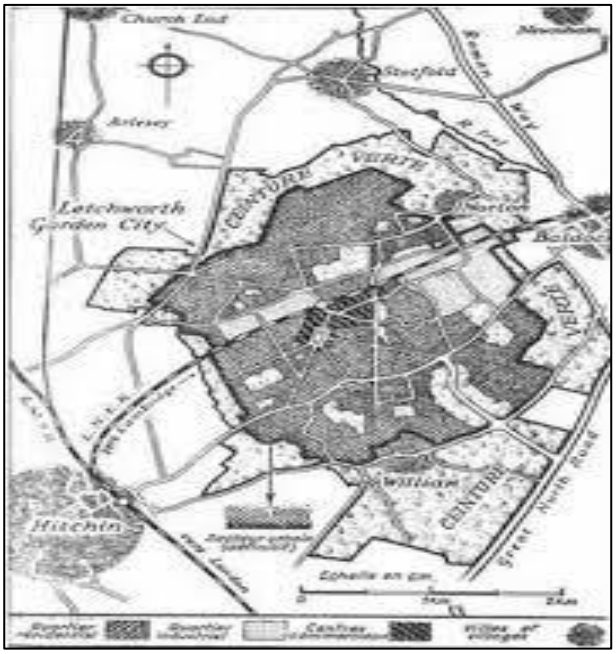


Figure VI. 25: The garden cityof Letchworth.
Source: http://www.carnetdesentier.com/media/pdf/Letchworth_pdf_ok.pdf

-Welwyn Garden City: After the First World War, Raymond Unwin, in collaboration with a classically trained architect (Beaux-Arts in Paris), the Frenchman Louis de Soissons, drew up the plan for Welwin Garden City, which was started in 1919 but never actually finished.

A "close" is a group of dwellings or pavilions grouped around a central, private or semi-private space. It is accessed through a porch or portico, most often included in a built frontage on the street, or through a service road ending in a dead end on the central space. This type of housing was developed and used by R. Unwin in his design of garden cities.

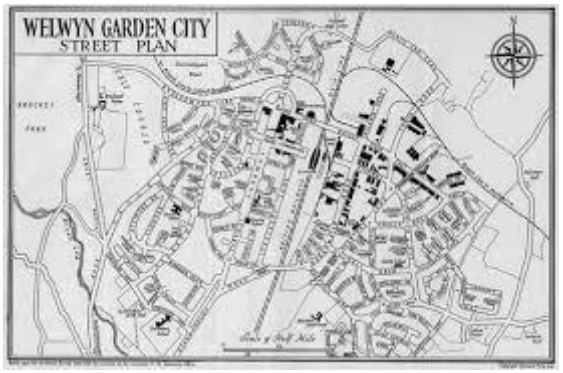


Figure VI. 26: The garden cityfrom Welwyn. Source: https://theswedishparrot.com/cites-jardins-de-la-campagne-anglaise-a-la-banlieue-de-paris/

-The garden city of Stains: built between 1921 and 1933 by the architects Eugène Gonnot and Georges Albenque. It is located on the 26 hectares of the estate of the former Château de Stains, whose architects took up the layout of the roads to create a spider's web-shaped plan.

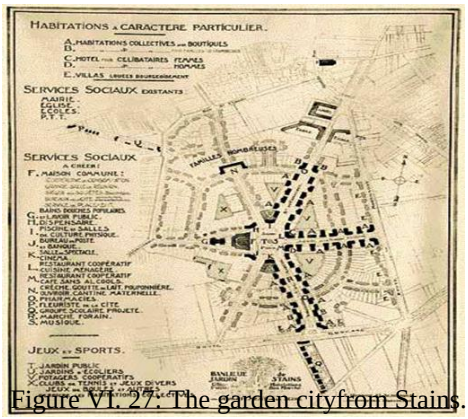


Figure VI. 27: The garden cityfrom Stains. Source :http://www.stains.fr/divertir/culture/ garden city/

VI.4.Soria Y Mata and the linear city

In 1880, the Spaniard Soria y Mata proposed his model of the linear city. Adopting a linear axial structure, Soria y Mata envisioned his city to be dynamic, independent, structured on a single communication route (in this case the railway) approximately 500 meters wide and whose length could reach Brussels, Saint Petersburg or Beijing, ensuring "a perfect integration between the urban and the new mode of transport."(Laterrasse, 2018).

According to Soria, the structure of cities transforms spontaneously, adapting to successive advances in means of transport, because the form of cities derives from the form of transport. Cities will necessarily have to take on the elongated and linear forms of railways. (Laterrasse, 2018).

-A symmetrical and axial plan 500 meters wide (the railway line), and 53 km long.

-regularization of the urban layout and form (blocks and plots). Orthogonal blocks occupied by residential and commercial activities, public buildings, public spaces, etc.

-The city is surrounded by a strip of vegetation.

- individual houses with plots of approximately 400 m2.

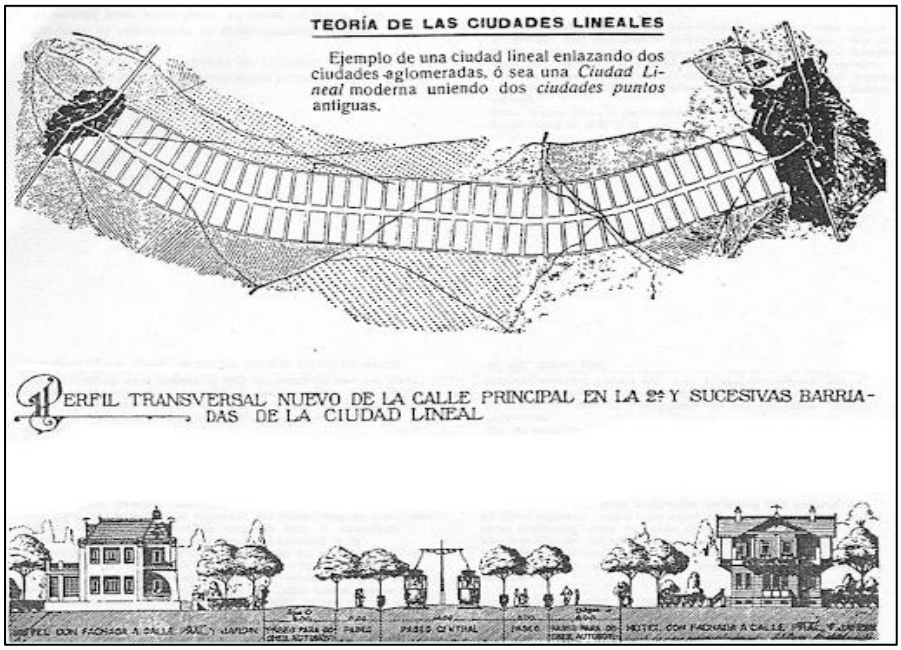


Figure VI. 28: The linear city of Soria.
Source: http://archivesdelimaginaire.epfl.ch/collection/detail_collection.php?collection=217

The city of Soria was built on a very modest 5 km site, along a 40 m wide road.

VI.5. Sitte and the artistic principles of the city

In 1889, Camillo Sitte published his ideas on urban aesthetics in a famous theoretical work: "The Art of Building Cities", where he gave more importance to the quality of urban space and not to its architectural form (Sitte, 1980).

Sitte's thinking revolves around the following points:

- A low analysisee on the aesthetic sensitivity.
- A critique of regularity and the exaggerated order of the newsplaces.
- A critique of the positioning of monuments and churches isolated.
- A review of orthogonality theory and symmetry ofcities.

- Urban planning should not be a mere technique, withoutnone involvement artistic.

In an attempt to stop the linearity of the new boulevard, Sitte proposed modifications to the Ringstrasse (a ring-shaped boulevard bordering the historic center of Vienna), to capture the space along its length (Blau, 2008).

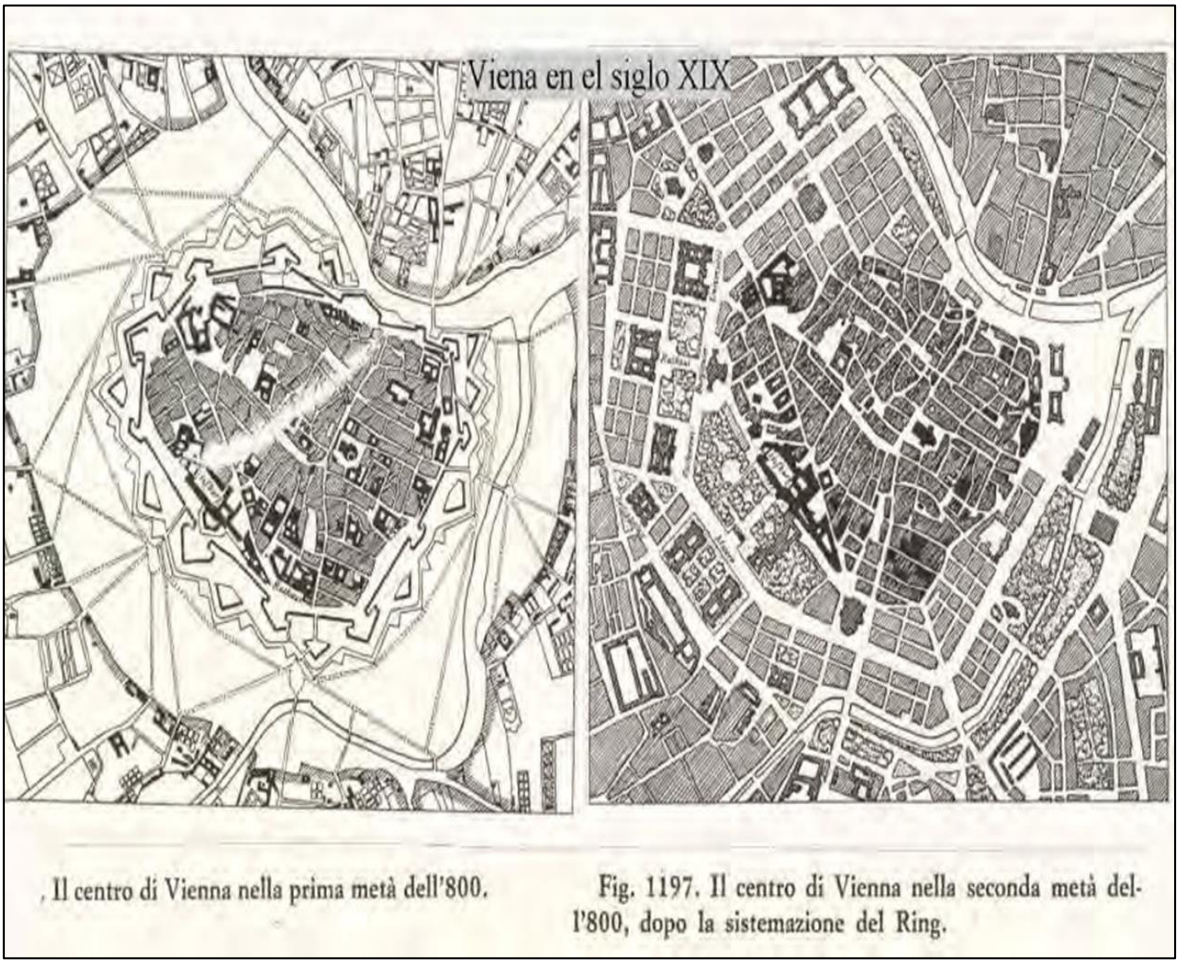


Figure VI. 29: Sitte's proposals for the Ringstrasse boulevard (Vienna).
Source: https://www.pinterest.fr/pin/451626668862621244/

VI.6. Hénard and the motorized city

In 1903, the number of vehicles in Paris reached more than 2,000. A situation that began to hamper traffic, and which attracted Hénard's attention: if the number of vehicles, bicycles, automobiles, increases further, and if their quantity doubles in 50 years, traffic will become almost impossible in Paris around 1950. Modern activity requires wider outlets, more direct

passages... future squares will tend, more and more, to become centers of intensive traffic. (Lemas, N. 2013)

His theory is based essentially on traffic in the city: its fluidity is ensured by the separation between cars and pedestrians.

VI.6.1. The principles of planning the motorized city

- The principle of Zoning

The surveillance zone: The installation of a 500-meter-high orientation tower in the center of the historic city, and eight towers of 250 to 300 meters, in key locations along the compass rose, the objective of which was to demarcate the zone prohibited to aviators. The installation of surveillance posts on the outskirts of the city, 150 to 200 meters high, to draw a boundary between the city and large aircraft.

The residential area: 2 to 3 km wide, reserved for houses with flat roofs.

The industrial zone: it is intended for factories

VI.6.2. The city plan

The piercing of the city by wide radiating roads occupied by raised platforms, with the development of large parks, gardens, rest centers, in the city.

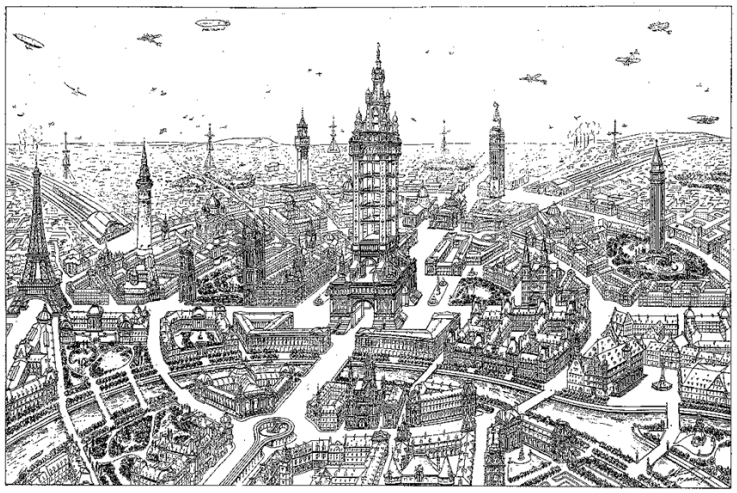


Figure VI. 30: The motor city of Hénard.
Source: https://twitter.com/loouisfernandes/status/885747498345783296

VI.6.3. Habitat

- -The height of the buildings is equal to the width of the street

- -Impose the roof terrace, because it is more resistant and offers the possibility of creating terrace gardens.
- large elevators to bring cars from the underground garage to the elevated street and airplanes from the garage to the roof.
- Provide electricity, petroleum gasoline and oxygen, liquid air and radiators for cold and heat.

VI.1.4. Traffic

- -The multi-story street: divided into two parts, the upper part is reserved for pedestrians and light vehicles and the lower part, reserved for sanitation networks and heavy transport.
- -The sidewalks and roadway are built 5 meters above the natural ground.
- The installation of a series of service conduits and electrical cables.
- Beneath these pipes is a free space 2.25 meters high. Then there are four railway tracks: the two central ones are reserved for long-distance transport and the two lateral tracks for the formation of trains (connected to the private tracks penetrating the houses by turntables).

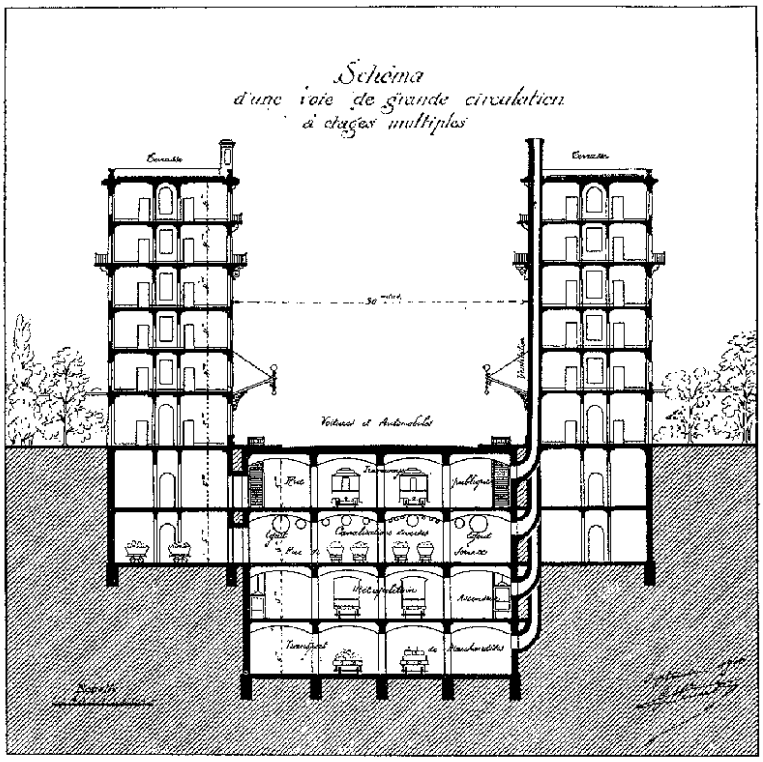


Figure VI. 31: Traffic in the motorized city.
Source: https://fr.slideshare.net/bibaarchitecte/4-lurbanisme-moderne

VI.7. Tony Garnier and the industrial city

In 1917, Tony Garnier published his theory in a collection entitled "An Industrial City. A Study for the Construction of Cities." This work is considered the first precursor to modern urban planning. Tony Garnier's thinking focuses on human habitation and the spatial organization of the city, the typologies of constructions and the structure of buildings (Ragon, 2010).

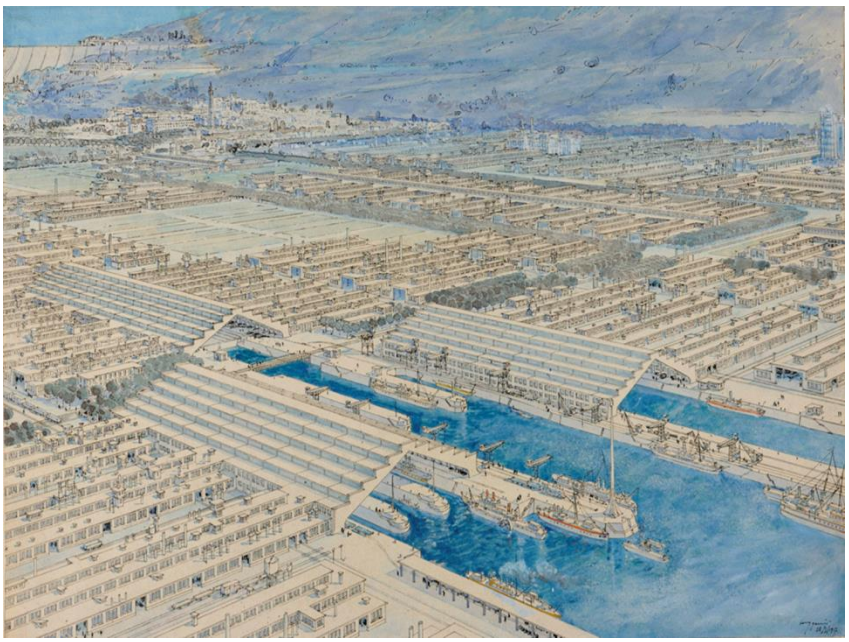


Figure VI. 32: The industrial city of Garnier.
Source: https://fr.wikipedia.org/wiki/Fichier:GARNIER-Tony_Une-cite-industrielle-usine-metallurgique.jpg

VI.7.1 Principles of industrial city planning

- The situation

The imaginary site of his city has two hills, and is on the edge of a river.

- Zoning

Industry: Industrial activities are located at the bottom of the valley.

Administrative services and public facilities: occupy the city center.

The living quarters: are located on a south-facing plateau.

- The road network

The layout of this ideal city is regular with wide roads.

- .Habitat

Houses with a standardized architectural composition, with a cubic shape, and an interior courtyard open to the light.

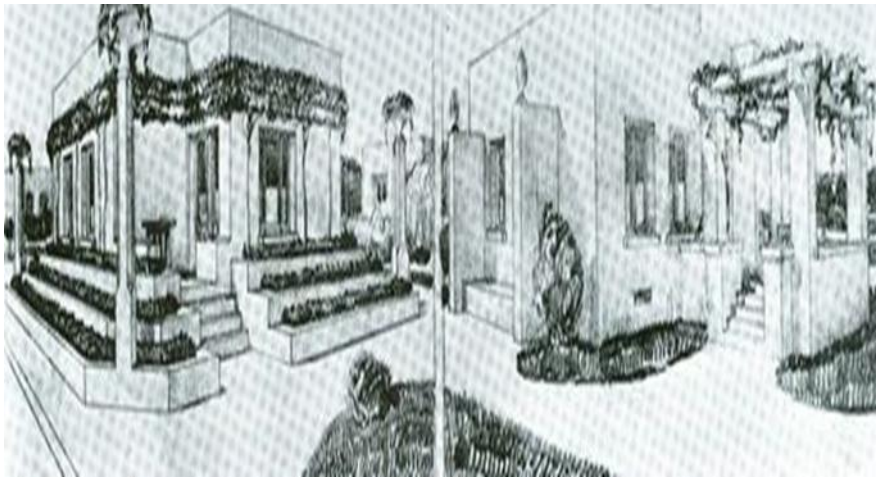


Figure VI. 33: Housing in the industrial city.
Source: https://tr.pinterest.com/pin/518617713324880479/

- The green space

At the same time, Tony Garnier thought of a city model: "the industrial city" (published in 1917) which seeks to preserve the presence of nature from a hygienic perspective where workers must benefit from contact with beneficial natural elements: air, sun, greenery.

Figure VI. 34: Green space in the industrial city.
Source: https://alchetron.com/Tony-Garnier-(architect)

VI.7.2. Materials and urban landscape

In the introduction to his work, Garnier wrote that all major buildings are almost exclusively constructed of reinforced concrete...who also sees that the use of such materials allows, better than ever, to obtain large horizontals and large verticals, suitable for giving buildings that air of calm and balance which harmonizes them with the lines of nature (Garnier, 2009).

VI.7.3. Critics: The industrial city is a sick city

- The non-separation of industry and urban space.

- -A spatial expansion of cities: a strong migration of populations towards the city in search of work.
- The increase in illnesses, particularly respiratory and neuropsychiatric illnesses, is due to air pollution and also to the stress of the complexity of social life.

Conclusion

Haussmann succeeded in making the city's urban image more attractive through its architecture, avenues, parks, and monuments. He introduced several innovative principles in urban planning: the reconstruction of the city on itself, the reduction of urban densification, the facilitation of mechanical circulation, in and around the city, the integration of the concept of hygiene in his project, the installation of facilities in the urban space and the expansion of the old city into an urban agglomeration.

Cerda's project is considered the precursor of modern urban planning. He established the stages of urban planning, from analyzing the existing to estimating the projected. He developed a new method for building a new extension or a new city. Equality was the slogan of his work, translated into a checkerboard pattern, in all distribution in terms of equipment, green space, etc. Comfort was one of the major concerns of his thinking to ensure the well-being of residents.

The garden city introduced new concepts on: modern urban composition, the new city and the city/nature relationship. In this model, Howard and Unwin do not systematically reproduce the past, giving importance to the size of human groups.

The linear city would be regional, unlimited and even "continental", as Soria y Mata calls it, "a locomotion backbone" made up, in addition to transport, of the essential services of the modern city (running water, gas, electricity) compatible with the needs of industrial production.

For Sitte, modernitymust not be limited to the formal aspect of space or to changes in means of transport. It must include profound emotional and cultural changes.

Through his theory, Hénard gave importance to the street and its use in the city, innovating a new circulation system based on the clear separation between pedestrian and motor, initiating two fundamental principles of modern urban planning: zoning and circulation.

Tony Garnier initiated the birth of a reasoned urban planning with simplified forms and industrial materials, thinking of well-being, hygiene, and green space as major elements of his urban utopia.

Course VII : Industrial and decorative art

Introduction

The transformation of machines into instruments capable of regularly ensuring mass production of everyday utility objects. Therefore, all areas related to crafts will enter into unequal competition with industry. Thus, around 1850, the opposition between crafts and industry took the form of a conflict (Benevolo, 1988).

VII.1.Vision of Ruskin

Ruskin and his followers reacted with a favorable attitude to a return to the past, to the architectural forms of Gothic (cathedrals) as well as the careful work of the craftsman. Ruskin and his followers acted by a ban on factories considered as a source of ugliness, misery and nuisances (Ragon, 2010).

VII.1.1.Arts and Crafts Movement

After the limits of this spirit of historical renewal were revealed, the influence of Pugin and Ruskin's influence made itself felt in the Arts and Crafts movement. Crafts English who committed architecture to the path of craftsmanship in response to the standardization that industrialization, by its nature, required (Ragon, 2010).

VII.1.2.Historicist architecture

Augustus Pugin, a devout Catholic and prolific architect, argued that the cure for the social ills caused by industrialization was to be found in the values of medieval society. It was therefore important, he believed, to accurately reproduce medieval architecture. In France, Viollet-le-Duc took up the theories ofPugin. But it was the Victorian art critic John Ruskin who expounded this moral line most eloquently. He argued that the adaptability of Gothic made it an extension of nature and, therefore, of the work of God. The scope of this morality extended to the use of buildings and their construction, because the freedom of self-expression that Gothic offered to workers and craftsmen freed them from the diffuse vulgarity

of the industrial productivist logic determined by economic efficiency alone (Frompton, 1985).

- Royal Courts of Justice,London,England

This Street building succeeded in reconstructing the most scholarly and convincing neo-Gothic building after the Houses of Parliament. It was thought to have didactic qualities appropriate to an institution intended to symbolise contemporary England and improve the administration of justice.

VII.1.3. Eclectic Architecture

Between Catholicism of Pugin and Ruskin's evangelical Christianity, The High Anglican Ecclesiological Society recommended the alteration of old churches and restrictions on new projects. Under these combined influences, most public buildings in Britain adopted a more or less Gothic form, from Parliament to the Royal Court of Justice (Melvin, 2011).

- All Saints, Margaret Street, Londres, Angleterre.1850/1859

This church was the showcase of the Ecclesiological Society, a group of clergymen and architects who believed that spiritual renewal could be achieved through the proper use of renewed architecture, furnishings and liturgy. Although William Butterfield did not share these beliefs, Butterfield was original in the proportions and composition of this building to fit a cramped urban site.

VII.2. Vision of Henry Cole

Henry Cole favored a reconciliation between art and industry. He believed that Machinism could lead to a much better situation than a mechanical multiplication of traditional forms. Cole also saw in machinism and industrialization a possibility of producing objects with original forms using new materials.

From the end of the19 century, the architects became aware that the materials industrially produced not only allowed the creation of shapes and structure sunprecedented, but also to develop a new decorative language. Encouraged by new theories, this ability to breathe a spirit or artistic content into inanimate and otherwise impersonal products opened the way to a synthesis between physical objects and ideas.

VII.3. New art

It was born on the one hand from the reaction against historicism in art, academic architecture, classical furniture and on the other hand against the banality of forms resulting from the machine.

- Themes used

Decorative motifs can be abstract with a linear and "geometric" tendency. But most often they are figurative. They draw their source from nature and are charged with symbolic content. The fluidity of the curve, the undulation and the arabesque characterize the ornament of Art Nouveau.

- Colors

They are tender, delicate, pastel tones are used (blue, pale green, gray, pink, mauve, beige), especially in bricks and ceramics.

- Representation of nature

Marine vegetation: water lilies, algae, stems, almost devoid of leaves, refined or not flowers: orchids, irises, daffodils.

Animals : dragonflies, butterflies, birds, snakes, lizards, seahorses.

- Materials used

Glass: Stained glass windows, large bay windows, glass doors in entrance halls, interior glass roofs allowing lighting with natural light, glass roofs in certain metro entrances.

Iron work :Iron, steel, bronze and cast iron: the metal is worked into ribbons, twists and volutes. Cast iron has the advantage of being able to be molded. It was used for window and balcony railings,

Cut stone and brick : Expensive cut stone had limited use, so bricks of very varied colours: pastel, beige, pinkish grey, red etc. are widely used.

Ceramics: Unknown to the general public, ceramic facades have blended into the banality of everyday life, catching neither the eye nor the attention of passers-by.

VII.3.1. New art in Germany

Peter Behrens, advisec artistic director for the industrial firm AEG, knew how to move away from the outdated tradition and renovate the decorative arts by establishing relationships between the various artistic disciplines, architecture and industrial production. A pioneer of modern architecture in Germany, he advocated strict functionalism; visibility of the structure, systematic use of concrete, iron and glass, stripping down of forms, as evidenced by the AEG turbine factory.

VII.3.2. New art in Belguim

Victor Horta incorporated fluid lines, evoking plant tendrils, which moved away from therigiditiesof t classicism of the Fine Arts. his project tassel Hotel bu between 1893 and 1894 owes its originalitye ha fathiswe think about it'architecture allhasnews.In the'T spatial organization of this house Horta removes t traditional corridor by replacing it with an octagonal ha servinghasthe time of'transition and distribution space higher levelselaughing. This form of'organization of t plan will break with the old practice of'stacking ofestag level by level.

Figure VII. 1 : Tassel Hotel
Source :https://fr.wikipedia.org/wiki/H%C3%B4tel_Tassel

An art theorist, Henry Van de Velde embraced novelty and the mass production of art objects. He created several private houses with their furnishings. At this level of Practice, this architect tended towards the simplification of lines which were less loaded than Possible.

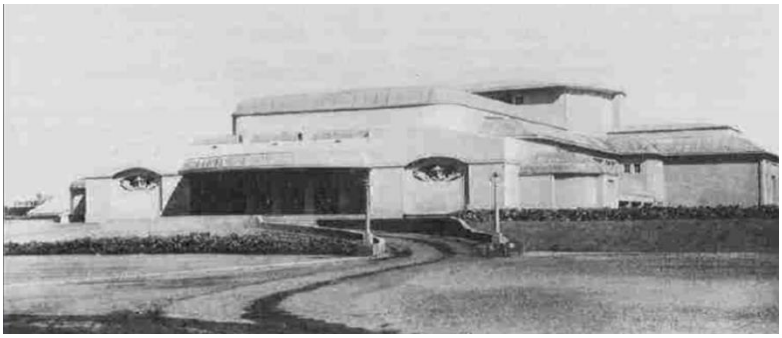


Figure VII. 2 : The WERKBUND Theatre in Cologne
Source : https://www.theatre-architecture.eu/en/db/?theatreId=392

VII.3.3. New art in Spain

Antonio Gaudi, an intensely religious spirit, was marked by symbolism and demonstrated his conviction that the curved line was of divine essence in his cathedral of the Sagrada Family where the curves, far from being merely decorative, are an integral part of the structure.

We thus find in all his works, the logic of the medieval conception of art and architecture and nature with a close link with certain living forms, as a reference for its decorative details, such as bones, muscles, bird wings, flower petals (Ragon, 2011).

Figure VII. 3 : Sagrada Familia
Source : ;https://www.britannica.com /topic/Sagrada-Familia

VII.3.4. New art in Scotland Great britain

Charles Rennie Mackintosh is a brilliant English artist, in his works he does not make much reference to the past although his works (villas) remain of Gothic inspiration and there the influence of the artist Morris is to be recalled. His social formation, which remains very traditionalist, is linked to the formation of English society which, through these particular achievements, sought a certain singularity of the nation within Europe.

Figure VII. 3 : Hill House
Source : https://fr.wikipedia.org/wiki/Hill_House

Figure VII. 4 : Adolf Loos House
Source : https://www.google.com/url?sa= i&url=https%3A%2F%2Ffr.wikipedia.

Adolf Loos puts forward a new idea that raises a lively controversy: architecture according to this architect must place itself on the side of utility and that which has a purpose of use cannot be considered as part of the domain of art. In the field of construction, his achievements are the first to emerge from rationalism, according to a stripped-down and simplifying linear architecture. In terms of his ideas, he opposes tradition to modernity and art to utility (Benevolo, 1983)

VII.3.5. New art in Austria

Otto Wagner, opposing academicism, created his masterpiece, the Postsparkasse (Postal Savings Bank), giving priority to the structure over the decor It brings a big change in the scenery and projects equipment, churches and metro stations.

A disciple of Wagner, Joseph Maria Olbrich proposed new forms and new arrangements of materials which thus highlighted the new techniques acquired. In view of his Réalisations, he was the first to be somewhat freed from the rigid and massive forms of classicism. He built a country house for a wealthy industrialist that was so appreciated that it was compared to a palace but which does not offer any symmetry of assembly on its facade. In this way, he will have anticipated rationalism.

Figure VII. 5 : Postal Savings Bank
Source : https://www.google.com/url?sa=i&url=https%3A%2F%2Fsmarthistory.org%2Fotto-wagner-postal-savings-bank%

VII.3.6. New art in France

New art in France will be representedesent by the works of'Hector Guimard. Guimard debute in the yearseIt is 1890 his careerere d'architect bythe design of private mansion owhere he putsh as profit the thison Viollet-le-Duc:has exteThe building's projections reflect the ameinternal swimming elaughing, while the dothisade is animated and the symeclassic sorting

is rejectione he knowsthisor also offurniture fatee hass'fully granthas architecture. The essential principles of'Guimard's art are: logic; l'harmony; and feeling.

Architecture and art of decorative projects must meet everyone's program, using modern industrial resources and applying the progres of science of all branches of the'activity human.

Influenced by Japanese art, Guimard seeks has express the characterere veritable of the morningere used for its buildings and not has the dissimilare (terracottaemail, red brick, painted iron, cut stone…)

- Breaking with rigidity Haussmannian
- The building multiplies the dehooks
- The matériels polychromes
- Guimard leaves the masts visible materials, especially the iron structure.
- Graphic innovation.
- The curved line rhythm and typically new art anime also the furniture.

VII.4. Decorative art

It is a style that is an extension of Art Nouveau, it takes its name from The international exhibition of modern decorative and industrial arts. The shapes of this style are geometric, sanctifying the straight line even in naturalistic decorative elements.

Conclusion

The end of new and décorative arts marks the beginning of a new movement: " comes mainly from its luxury bias, the modern movement whose main driving force is Le Corbusier then takes the same bases, including Art Deco, but by making it accessible to all"(QuerierT.,2004, p94)

Course VIII : American city

Introduction

The urban models that emerged in the United States in the 19th century for some, an adaptation to transatlantic conditions of English experiences and European urban planning prefigured the future morphology and landscape of cities around the world.

VIII.1. Factors in the emergence of the modern American city

VIII.1.1. Development of transport

The territorial scale. the railway linesand electric tramways, which were introduced in major American cities in the 1850s, were the earliest and most significant. This is also true for the automobile development that followed, and its impact on the territories.

VIII.1.2. Company towns

"We hoped to escape in this way from the machinations of the anarchists and socialists, who even at that time were spending their time stirring up discontent among our workers and inciting them to strike. They seemed to be targeting us, and we thought that if we could avoid any contact between our workers and these men, as well as with other tempters of the city in the working-class districts, they would be happier and their lot would be better." Steinway piano manufacturer.

VIII.1.3. Influence of European culture

The convergence of interests on the role played by utopias and the great European capitals of the early 20th century, which occurs every time we try to explain the birth of modern urban planning, contains extremely restrictive historiographical limits.

VIII.1.4. Economic development

Economic development as a whole and urbanization on a territorial scale are closely linked.

VIII.2. The birth of the modern american city

VIII.2.1. Paterson

The origin of the phenomenon is to be found in the attempt made by Alexander Hamilton to set up in Paterson, through his "Society forEstablishing UsefulManufactures", an urban planning scheme developed by Charles L'Enfant and N. Hubbard (1791-1792).

VIII.2.2.Washington

The plan of Washington drawn in 1791 byrock Charles the Child, constitutes an attempt to introduce visual concepts (baroque) into the traditional uniform network, subordinating the composition of two axes and numerous radial arteries that converge on the sides of the White House and the Capitol, which cut the grid diagonally.

Thomas Jefferson (1743-1826), the father of American democracy, is a statesman and architect, knowing Europe well, he is ambassador to France from 1774 to 1779, and adheres to classicism and appreciates the properties of the technique, convinced that they will play a role in the future American architecture. His problem is simple:adapting classical forms as material data to functional necessities,

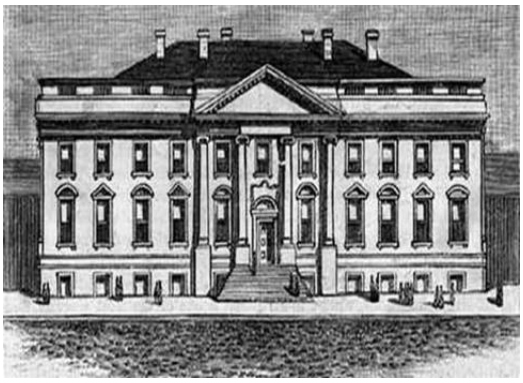


Figure VIII. 1 : The White House by Jefferson
Source : http://www.tysto.com/special/renovation-1801.htm

Figure VIII. 2 : the villa of Monticello
Source : https://www.wikipedia.fr

VIII.2.3. Lowell

This is the town of Lowell which was built on the banks of the Merrimack from 1823, by the director of the MerrimackManufacturing,CO, Kirk Boot. . Lowell's urban design thus rigidly reproduces the composition of the labor force used in industry.

VIII.2.4. Cairo

the city of Cairo, organized according to the usual grid-like layout, architecturally ennobled by the plan drawn up by William Strickland between 1838 and 1840.

VIII.2.5. Tacoma

The company towns railways are proliferating, in competition with each other and with no other logic than that of profit: we will mention in particular the cities created by the "NorthPacificRailroad", like Tacoma - for which F. LawOlmsteddeveloped a plan in 1873, which was never implemented.

VIII.2.6. Chicago

Near Chicago stands the company town the most representative of the spirit of American capitalism in the second half of the 19th century: Pullmantown, an experience that marks both the height and the decline of laissez-faire. Its urban plan, designed in 1880 by SolonBemanand Nathan F.Barretat the request of railroad magnate GM

VIII.3. Chicago: The advent of the skyscraper

Chicago architects to found new architecture in creeant a new type of'buildings n'having no modethe historical ; 'is what will essentially make up the center of this city of Chicago.

A new architectural typology and a new urban morphology will born to be with incredible speed to form the new center.

The Chicago city development will be realised has two essential elements directly related to high-rise construction:

- the improvement of the elevator.
- The cast iron frame of Bogardus taken over by William the Baron Jeney has from 1889 in its entire structure metals.
- first have ete eriges office buildings to house commercial businesses, companies'insurance, everything related to production and consumption.
- the city has resorted to has construction of the same scale for relayhasd'other needs in rebuilding large hotels, large cultural and administrative buildings.

In addition, Chicago is experiencing construction has bigescale of income buildings at the same rate as theecommercial buildings. The reasone was that aftere the great city fire, there

was a tendency has abandon of private house and wood en building materials has the structure reproof metale and more securite.

VIII.3.1. The innovations of chicago school

- post-beam frame and curtain wall (curtain-wall).
- For high-rise construction, load-bearing walls made of mathisonnerie offered no possibility.
- The architects of the Chicago School Developed a New Type of framework: a framework steel post-beam, highty and easy to assemble which will bear the name of"Chicago-Construction».
- With the replacement of load-bearing walls by‘ frame memetal, exterior walls laughers will not playenow that'a role of'protective cover: it is the"curtain wall », although we see that the use of stone will still persist, but exclusively to treat the bases of buildings
- post-beam frame and free plan.
- This functional advantage will be exploited has special purposes eculatives guide.It is by taxes ceratives of profit ability of the space. In velaughse, this is the reason for to be of'a tall building.

In traditional load-bearing wall structures, windowse were relatively limited and vertical position. In this new type of construction, architects will introduce openings a new genre, horizontally wider, it is the"Chicago-window ».

Figure VIII. 3 : Chicago-window
Source : https://www.wikipedia.fr

William Le Baron Jeney had published a laugh of works in a book "Principles and paracticein architecture".

VIII.3.2. First Leader building

In its first new constructions,Jeney had employed approach to mixed structures composed It is pillars in composition are pillars in mythistr on neries spaces has extelaughing and Amounts memetals has intelaughing ; it'is the case of the first" Leader Building» completed in 1879.

- Home Insurance Building

In the"Home insurance building»(1885), Jeney ensures stability of this building by a more advanced iron frameee, but the exterior walls laughers are always carriers. He hasetedemolie in 1931.

VIII.3.3. Second Leader Building

It'is in the second" Leader Building »and the "Fair Building»,completed in 1889,how here Jeney completely removes load-bearing walls. With the second LeaderBuilding especially, to purity of the construction seemed to have Found here equivalent in the architecture, reaching an expression of pouille of all reference to historical styles.

- Manhattan Building", completed in 1890

To give an animation by a long of 120 m, Jeney divides it into large unites simple by notches legers portes by frame memetal. Jeney acheve the "Manhattan Building", completed in 1890.

Figure VIII. 4 : Home insurance building
Source : https://www.wikipedia.fr

Figure VIII. 5 : Manhattan Building
Source : https://www.wikipedia.fr

VIII.4. Characteristics of the American city

VIII.4.1. Road network

In the United States, the orthogonal road grid that developed with the Land Act of 1785 became the tool for the systematic design of urbanized territories and reflected "order and culture in a territory perceived as wild" (Ghorra-Gobin, 1998). The absence of references to a historic center marks a landscape in which "the void is constantly reborn" (Cattan et al.,1999).

VIII.4.2. Urban structure (5 concentric zones)

- Central area: downtown

The central area, the downtown, includes the central business district (CBD), i.e. the command centre of economic life, office buildings, administrative buildings, theatres, hotels and shops, as well as the area of wholesale fruit and vegetable markets, shops and warehouses. In large cities, each of these functions corresponds to specialized sub-districts. When the city is located on a waterfront, its port functions can be combined with its functions of warehouses for goods. Often, the waterfronts have been partly redeveloped into leisure areas during the 1990s, in the part closest to the CBD.

CBD is recognizable to its skyscrapers of steel, glass and concrete which, all things considered, are not far from the poor neighborhoods (ghettos where communities of different ethnic origins gather).

- Skid row

Skid row corresponds to an area of degradation, poverty and crime, a space where finds individuals (and not families) who live on the margins of the economic system. It is there for a zone transitional where furnished hotels represent the most typical type of land use.,

- Ethnic ghettos

The majority of city dwellers middle class, born in the United States, lives in zone 4, that is, residential neighborhoods whose landscape is characterized by the detached house and the garden.

- Area of daily migrations

A ring of small towns (whose function was essentially residential until the middle of the 20th century)ecentury) forms the area of daily migrations and extends in the form of more or less dispersed nuclei.

VIII.4.3. Edges cities

In zone 5 central places appear, combining shopping centers, leisure centers, high-tech industries and high-level services. These new centers are called theedge cities, developed on knots motor ways most often.

VIII.4.4. Urban landscape

A sudden shift from the verticality of the centers to the horizontality of the peripheries in the United States.

Conclusion

The cities of Europe and the United States have been the subject of numerous comparative approaches, which highlight the contrasts in densities (low in the United States, higher in Europe), in the forms of road networks (rather orthogonal in the United States, radioconcentric in Europe), in urban landscapes (abrupt transition from the verticality of the centers to the horizontality of the peripheries in the United States, more regular gradient in Europe).

Course IX: Reinforced Concrete

Introduction

Reinforced concrete is a special material, the result of an invention with a dual origin: on the one hand, it is an industrial production consisting of the assembly of two already transformed products, steel and cement; on the other, an intellectual production, born from the idea of associating these two very dissimilar materials. The history of reinforced concrete is summarized in the following three major stages:

- 1850-1890: concrete, an economical material.
- 1890-1900: concrete, a construction material.
- From 1900: concrete, an architectural material.

XI.1. Concrete, an economical material

In 1828, Louis Vicat built a cement suspension bridge over the Corrèze River in Argentat, demonstrating the quality of his material. In the years that followed, Vicat traveled throughout France to discover more than three hundred quarries capable of supplying this hydraulic lime and published lists of them in the Annals of Bridges and Roads.

The first developments in concrete took place in the 1930s. Thus, in the 1830s, the architect François-Martin Lebrun of Montauban built a three-story concrete house in Albi, a Protestant church in Corbarieu, and then a bridge in Grisolles, near Montauban. This architect would also write two treatises on this technique: Practical Method for the Use of Concrete, in 1835, and The Art of Building in Concrete, in 1843.

Coignet came from Lyon, a city where formwork mortar was a traditional technique. Taking over his father's chemical company, he founded a subsidiary in Saint-Denis in 1851.

The construction of the new premises was the occasion for the discovery of "agglomerated concrete", mortar pounded into formwork which formed a mass as hard as stone that he called "endless stone". Following this first patent, Coignet acted as an industrialist seeking to capture

markets and limit competition: between 1855 and 1859, he filed a series of patents (hydraulic concrete, plastic concrete, artificial stone, etc.) (Simmonet 1994).

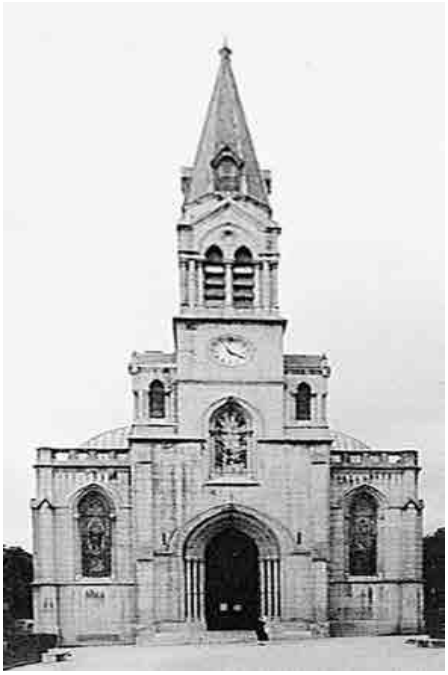


Figure IX. 1: François Coignet, church of Vésinet, 1862.
Source: CT-B90A.pdf

In traditional architectural histories, the invention of reinforced concrete may seem sudden and miraculous. It stems from Joseph Lambot's "rot-proof boat" in 1847 and then from Monier's horticultural box in 1867.

At the end of the 18th century, the introduction of reinforcement in mortar was in the air and many proposals emerged. Thus, in 1774, Loriot suggested incorporating iron into the mortar. In 1792, Loudon recommended the use of a floor composed of a lattice of iron rods embedded in cement, an idea taken up by Fleuret around 1807, then by Raucourt in 1824. Around 1830, Labrouste, the architect of the Bibliothèque nationale, used a combination of plaster on a metal lattice to create the vault of the Sainte-Geneviève library. In 1844, Fox and Barret patented a system in which joists were embedded in lime concrete. Coignet also used this principle. In 1878, Monier finally filed a patent for a beam and then, in 1886 – nineteen years after his invention – he proposed a "construction system for houses, fixed or portable, hygienic and economical in cement and iron".

The number of these patents demonstrates the success of reinforced concrete: the material is beginning to penetrate the construction world and more and more contractors are converting to this technique.

In 1889, Paul Cottancin (1865-1928), a graduate of the École Centrale in 1886, introduced a system of “Cement work with metal framework” allowing the creation of very thin walls.

Upon Viollet-le-Duc's death in 1879, the architect Anatole de Baudot (1834-1915) succeeded him as leader of the rationalist school. As soon as he discovered Cottancin's reinforced cement around 1891, he became passionate about this construction system because he saw in the monolithism of reinforced concrete the opportunity to open a new path to structural rationalism. Like Gothic architecture, it allows the descent of loads to be staged within masonry designed according to a principle of structural unity. At Saint-Jean-de-Montmartre, the vaults are thin, composed of two seven-centimeter-thick walls separated by a clinker. They are reinforced by buttress-thorns which, like the ribs of Gothic architecture, stage the path of the forces (Treuttel, 1993).

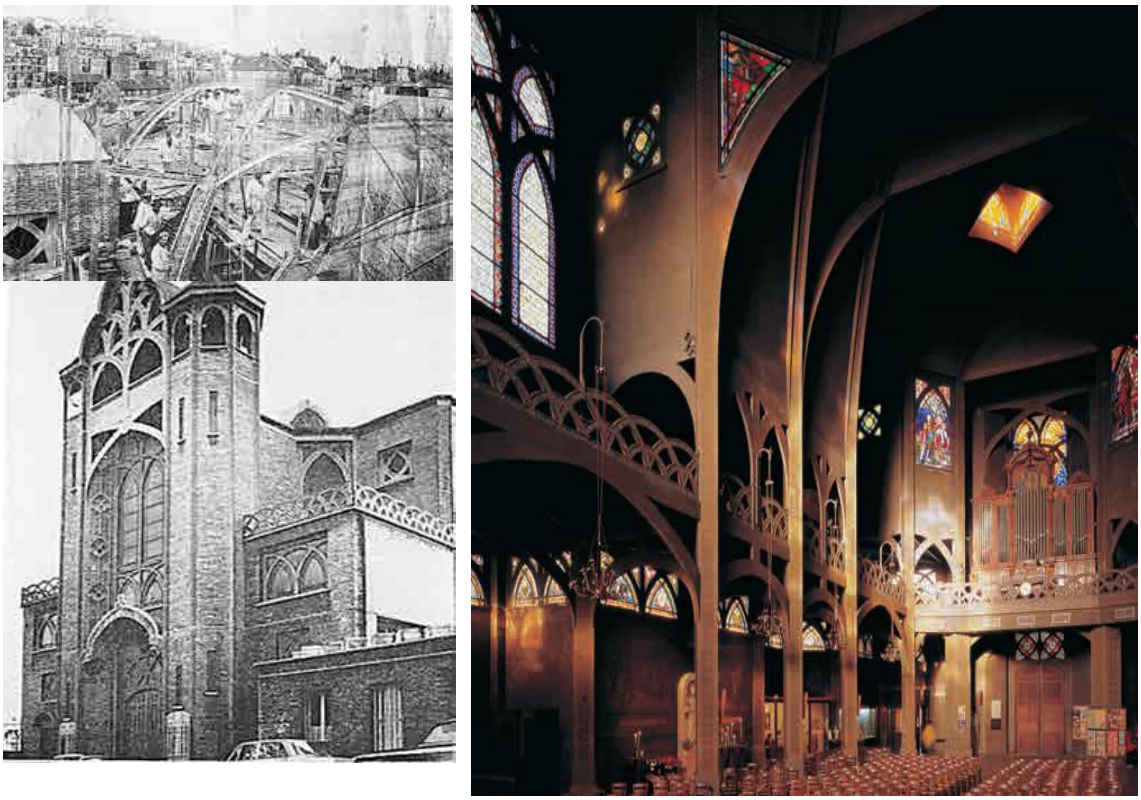


Figure IX. 2: Anatole de Baudot, architect. Cottancin system in reinforced concrete. Church of Saint-Jean de Montmartre, Paris, 1894-1904.
Source: CT-B90A.pdf

Between 1895 and 1910, the Hennebique company tended to exercise a monopoly on reinforced concrete construction. Local contractors had a label, a technical guarantee, and they participated in the dissemination and rooting of reinforced concrete techniques at the

local level: the number of concessionaires increased rapidly; in 1902 it was 290, spread across many countries: France, Belgium, Switzerland, Italy, Egypt, Russia, colonies.

Thus, at that time, reinforced concrete was neither an engineering science nor a worker's skill; it was a contractor's technique that extended the traditional activity of masonry.

It requires few calculations, no "hands-on" craftsmanship, but requires work organization, precise equipment management and, above all, monitoring of the proper execution of operations, which are the responsibility of the company. Because even "Hennebique concrete", which is easy to handle, remains dependent on the company. Even subsequently, the most precise strength calculations remain worthless if meticulous execution of the work does not follow.

The implementation of the first reinforced concrete is well known thanks to the first books that describe it in detail: creation of the formwork, installation of a first layer, tamping, installation of the steel bars, then pouring of the concrete in successive layers, each time tamped with iron bars curved at their ends. In fact, reinforced concrete changes the raw materials and skills, but not the principle of the construction site. Its trades and skills are simply redefined: the mixer, the concreter, the woodworker, and the ironworker succeed the stonemason, the layer, and the mason. The new material therefore fits naturally into the existing productive fabric. Moreover, the producers of materials, organized industrially, take over from the inventors, to support their production. They create a materials distribution network, which allows the new standardized products to spread.

From 1880-1890, cement packaged in bags or barrels, calibrated steel, and wire mesh were readily available in trading posts throughout France. Logically, the expansion of the use of reinforced concrete was concomitant with the development of the distribution of its components (Simonnet, 1994).

IX.2. Concrete, a construction material

Reinforced concrete disrupted age-old notions of statics and baffled engineers who saw that it worked, but didn't understand how it worked. For a long time, engineers refused to admit the serious nature of these hybrid constructions. Thus, the Belgian engineer Arthur Vierendeel

(1853-1940), inventor of the beam that bears his name, claimed that it was a "paradoxical invention that baffles scie ve thought of it."

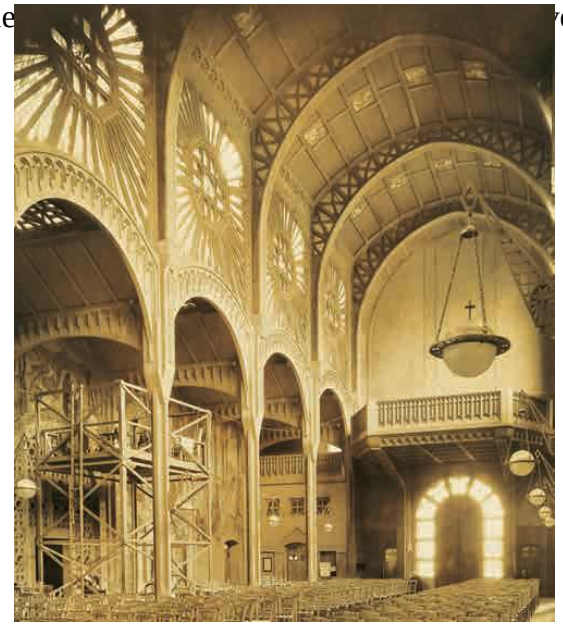


Figure IX. 3: Charles-Henri Besnard, Saint-Christophe church in Javel, 1921-1898.
.Source: CT-B90A.pdf

At first, few engineers ventured into the difficult theoretical question of how it worked. Two major points blocked the discussion: the question of the equivalence of the expansion coefficients of the two materials: masonry/metal, and the question of the adhesion of the two materials.

The adhesion between the two materials is highly debated. Some engineers, such as Cottancin and Matrai, do not believe it. The question of the equivalence of the expansion coefficients of two such dissimilar materials is not self-evident. It was only through a series of scientific experiments that this reality emerged. In the United States, Thaddeus Hyatt conducted experiments in 1877 on around fifty beams with various loads and variously distributed reinforcements.

It was only in 1889 that Paul Cottancin put forward the hypothesis of the identity of these coefficients and in 1890, that the laboratory of Bridges and Roads tested reinforced cement slabs to validate their resistance capacity.

It was not until around 1890 that engineers began to invest in the field of reinforced concrete by seeking to define the tools for its calculation. Symbolically, Charles Rabut inaugurated the first course in reinforced concrete at the École des Ponts et Chaussées in Paris in 1897. Then two important theoretical books were published in 1902: Le béton armé et ses applications by Paul Christophe and La construction en ciment armé by Berger and Guillerme.

In the 1920s and 1930s, two approaches opposed each other: that of the traditionalist architects (the majority), who used concrete as a neutral technical means and left it to the company to determine the location of the load-bearing points which would ultimately be hidden, and that of the innovative architects, who used the structure to lay the foundations of a new aesthetic.

For the latter, concrete would become a favorite material, the symbol of modernity. With them, concrete became a major issue in the renewal of architecture, which focused on the aesthetic and doctrinal issues of the different movements: concrete "liberates" the plan and "liberates" the forms...

Implementation tools are also evolving with a dual objective: to simplify and achieve industrial quality. The concrete mixer, like Edmond Coignet's mixer in 1898, regulates the batches and homogenizes the concrete paste.

Prefabrication, which avoids formwork on the construction site and ensures the quality of the objects, is also an important area of research. The creation of prefabricated elements, beams, floor elements, allowing implementation without formwork or shoring, appeared very early. In 1891, Edmond Coignet seems to have been the first to develop prefabrication for beams

during the construction of the Biarritz casino. In 1896, Hennebique produced the first mass-produced prefabricated houses for railway guards. A truly industrial scale was reached between 1925 and 1930 when Ernst May used prefabrication to build large social housing estates in Frankfurt and Walter Gropius, with the Bauhaus he led, built a prefabricated housing estate in Dessau, starting in 1925.

In France, Eugène Beaudouin and Marcel Lods were the first to apply this principle on a large scale during the construction of the first two "grands ensembles": the Cité du Champ des Oiseaux in Bagneux and the Cité de la Muette in Drancy in the early 1930s. In these projects, the walls were made of prefabricated concrete panels mounted on a metal frame.

IX.3. Concrete as an architectural material

Until the beginning of the 20th century, concrete was a substitute material, a useful, economical material, used mainly for foundations, pipelines and industrial buildings: factories, hangars, silos. During the last decade of the 19th century, its use in building structures remained hidden under stone or brick cladding; or it mimicked the stone it replaced, with a certain effectiveness, moreover.

Most architects then considered it an ugly material that could only be seen in utilitarian buildings. At the 1909 London Architects' Congress, it was further concluded that: "if (its) poor appearance is hardly suitable for facades, it could become a material of the future for economically constructing the framework of low-cost housing."

It was only around 1900 that architects began to appropriate the material, asking the question of a specific aesthetic, which was not a simple replica of the past.

IX.3.1. The Domino House

Moldable and monolithic, reinforced concrete has no a priori form. Designed in 1914 after the first destructions of the Great War by Charles Édouard Jeanneret – who was not yet called Le Corbusier – the Dom-ino house clearly expresses the aesthetic indeterminacy of concrete.

It is a prefabricated construction project based on three elements: posts, floor (joists and slabs), and staircase. No facade, no envelope. Dom-ino is not yet architecture; it is a flattening for a constructive renewal, the affirmation of an architectural break. This type of framework is not entirely innovative: it is found, for example, in a project presented in 1906 by Augustin Rey, architect who won the HBM competition at the Rothschild Foundation in Paris. But what Le Corbusier adds is the fundamental idea of the "freedom" of the plan: the facade and the partitioning become independent of the framework.

Few architects, like Anatole de Baudot in 1894 during the construction of the Saint-Jean-de-Montmartre church in Paris, or Tony Garnier for his theoretical project of the Industrial City in 1901, or Auguste Perret and Henri Sauvage in Parisian buildings in 1903, attempted to give concrete its own plastic expression. In most buildings, concrete is still hidden or molded into the clothes of other materials.

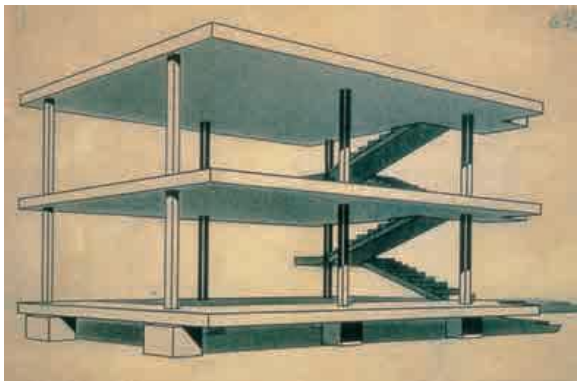


Figure IX. 4: Dom-ino House, 1914.
Source: CT-B90A.pdf

Figure IX. 5: Project for the large hall, 1914.
Source: CT-B90A.pdf

IX.3.2. Rationalism

Around 1905-1910, a rationalist school of reinforced concrete existed, composed of about ten architects. Many of these architects made their careers in the administration, which explains their limited presence in architectural histories, even though a few projects did see the light of day (Melvin, 2011).

IX.3.3. Historical monuments

Henri Deneux (1874-1969) thus used the reinforced cement system for the reconstruction of the framework of Reims Cathedral after the First World War: he developed a framework composed of small prefabricated concrete elements according to a system invented by the Renaissance architect Philibert Delorme (or de l'Orme / 1510-1570).

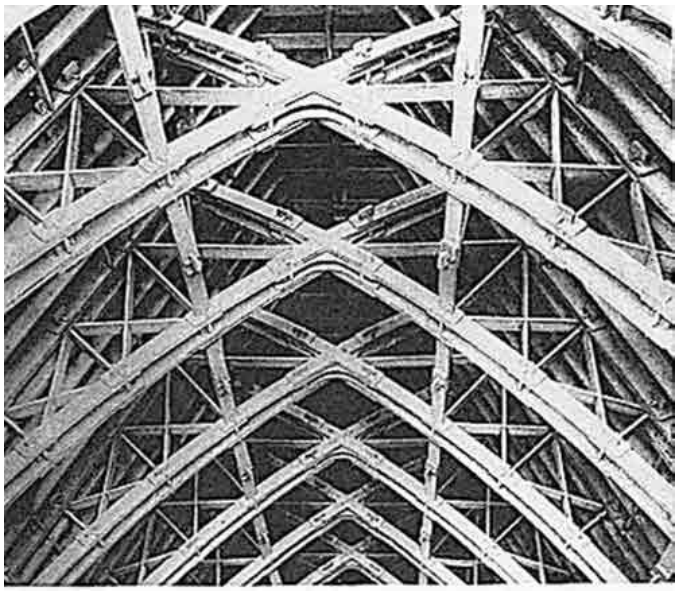


Figure IX. 6: Reinforced concrete framework, Reims Cathedral, 1920s,
Source: CT-B90A.pdf

IX.3.4. Structural rationalism

In his last work, the Camille-Sée high school in Paris, built in 1934, Le Coeur continued his research on texture by introducing pink granite and marble grains into the aggregates to modify the color of the bush-hammered concrete. It is important to emphasize the consistency of the approach to the material, which applies to all details, from the facades to the interior spaces. The roof is composed of independent cement slabs, addressing the problem of expansion. This project also saw the introduction of an escalator for the use of students for the first time.

As the young Le Corbusier put it, Auguste Perret, entrepreneur and architect, "made reinforced concrete." He adopted an approach similar to that of François Le Coeur, developing a structural rationalism that led him to create a classical, modernized, and French formal vocabulary specific to reinforced concrete. In the building on Rue Franklin in Paris, which he built in 1903, Perret emphasized the structural forms. But he concealed the texture of the concrete under ceramic tiles whose floral patterns recalled the influence of Art Nouveau (Simmonet, 1994)..

The constructive rationalist approach is very visible in church projects, such as that of Notre-Dame-de-la-Consolation in Le Raincy in 1922-1923.

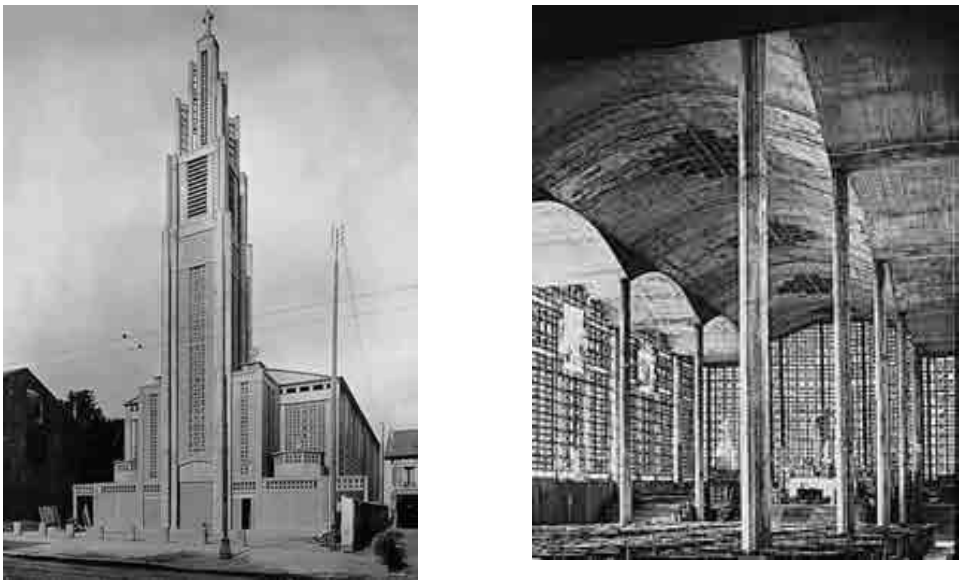


Figure IX. 7: Our Lady of Consolation, Le Raincy.
Source: CT-B90A.pdf

The new classicism was born during the construction of the Théâtre des Champs-Élysées in 1911-1913. Called in as a specialist reinforced concrete contractor by architect Henri van de

Velde, Perret took a leading role in the design and transformed the project as it adapted to the material. Concrete is everywhere: pillars, columns, coffers, ceilings, floors, balconies—everything is made of reinforced concrete. It composes the space as much as it supports the building. It is one of the first architectural "performances" of reinforced concrete: simultaneously static, distributive, and decorative, except for the stone-covered facades.

IX.3.5. The skeleton as an aesthetic expression

Alongside the inclusion of reinforced concrete in previous doctrines (rationalism and classicism), structural rationalism will take a more radical form, that of an expressionism of the framework which magnifies the constructive truth of the building.

The enhancement of the framework can take two main forms: either a direct enhancement of the structure which makes up the facade, or by its enhancement behind a fully glazed facade which acts as a showcase.

This is why the structure is often the only decoration on the facade of many production buildings. This plastic solution can extend to the entire spatial definition, as evidenced by the Perret brothers' projects for the Ponthieu garage in Paris in 1907 or the Esders factory in 1919.

One of the most symbolic examples of this approach is the Fiat factory at Lingotto in Turin, built by Mattè Trucco in 1926-1928, where the facades consist only of the grid.

floor/post, and are largely glazed. This building has the value of a symbol of the new architecture and was very visited, in particular by Le Corbusier who would draw inspiration from its test track on the roof for the urban projects he would develop in the 1930s and 1940s in Algiers and Rio de Janeiro (Simmonet, 1994).

IX.3.6. The silo model

To explain his articles aimed at regenerating the forms of industrial architecture, Walter Gropius asked, around 1913, a Canadian architect to send him images of reinforced concrete silos to illustrate his new conception of the factory.

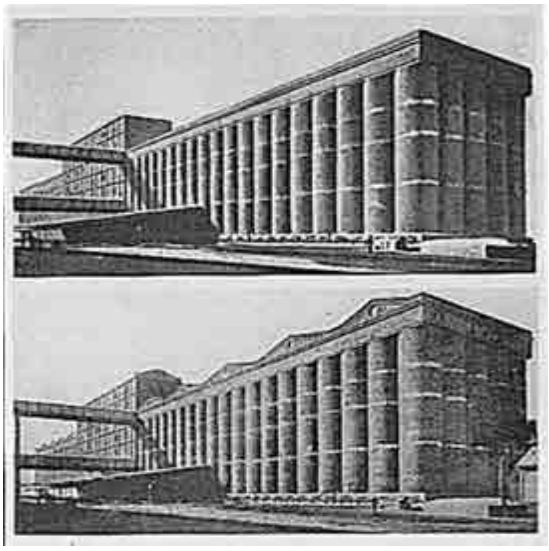


Figure IX. 8: American silos, published by Gropius in 1914 (bottom) and Le Corbusier in 1923.
Source: CT-B90A.pdf

IX.3.7. Civil engineering structures: crossing more with less material

This expression of the truth of calculation translates perfectly into engineering projects, where the span is essential. The Swiss engineer Robert Maillart (1872-1940), inventor of the mushroom floor, built many of them in reinforced concrete. The finesse of the taut lines allows him to reveal the landscape, as with the Salginatobel bridge in 1929. Inventor of prestressed concrete (in 1933), Eugèn Freyssinet (1879-1962) also uses reinforced concrete for crossings and increases the spans, seeking to push the limits of the material, as with the bridge over the Elorn at Plougastel in 1926-1929 which has three spans of 172 m.

Figure IX. 9: Cement Pavilion, Zurich, Switzerland, 1939.
.Source: CT-B90A.pdf

Figure IX. 10: Basilica of Lourdes
Source: CT-B90A.pdf

Figure IX. 11: Annibale Vitelozzi, architect, PL Nervi, engineer, Small Sports Palace, Rome, 1957.
Source: CT-B90A.pdf

IX.3.8. Hulls, high-tech buildings from the 1930s to the 1950s

The aesthetics of "calculating truth" also applies to buildings. The first monument to apply it is the Hall of the Century in Breslau (Poland), designed by Max Berg and the engineers Trauer and Konwiarz in 1913. It is a vast circular dome with a span of 65 m, supported by five massive pendentive pillars whose arches accommodate tiers of seating.

The thin sail hull also became the symbol of mechanical and material perfection, the "high-tech" of the time. A few examples illustrate the plastic quality of these new projects: the roof of the Madrid racecourse in 1935 by Torroja, which used thin vaults; the concrete pavilion, by Maillard, at the Swiss National Exhibition in Zurich in 1939; the Palazzeto dei Sporti by Pier Luigi Nervi in Rome or in Mexico City, the church by Felix Candéla which follows a very poetic path in which hulls and sails hold an important place and which will build all his work on this research. This is also true of the Royan market by Louis Simon, André Morisseau and René Sarger and of course the structure of the Basilica of Saint-Pie, for which the architect Pierre Vago put Nervi and Freyssinet in competition, which he finally chose (Simmonet, 1994).

Figure IX. 12: Louis Simon, André Morisseau, architects, René Sarger, engineer, Royan market, 1955.
Source: CT-B90A.pdf

However, the limit of the formal freedom offered by concrete is that of its implementation. When the forms induce excessive complexity of the formwork, the building becomes expensive and therefore irrational. This is why engineers introduce the question of construction logic into their formal reasoning.

Among the latest technical achievements, one of the most important is the cantilever it allows. Whereas previously, the cantilever existed only thanks to ingenious and progressive overhangs, concrete gives it a completely new freedom that transforms the value of the horizontal plane in space: it no longer needs to rest on solid and clearly visible foundations, but can "float."

The plastic potential of formwork traces began to be seen: this is how the pillars of the Swiss pavilion at the university campus in 1930-1932 reveal the imperfections of the molds. After the war, the trace would become an obsession of Le Corbusier's architecture.

It was also after the war that modern avant-garde architects abandoned the abstract purity of white architecture to invent a new plastic expression in which the material of concrete could express itself. A new plastic program very present from 1945 in the Marseille housing unit that he implemented (Simmonet, 1994).

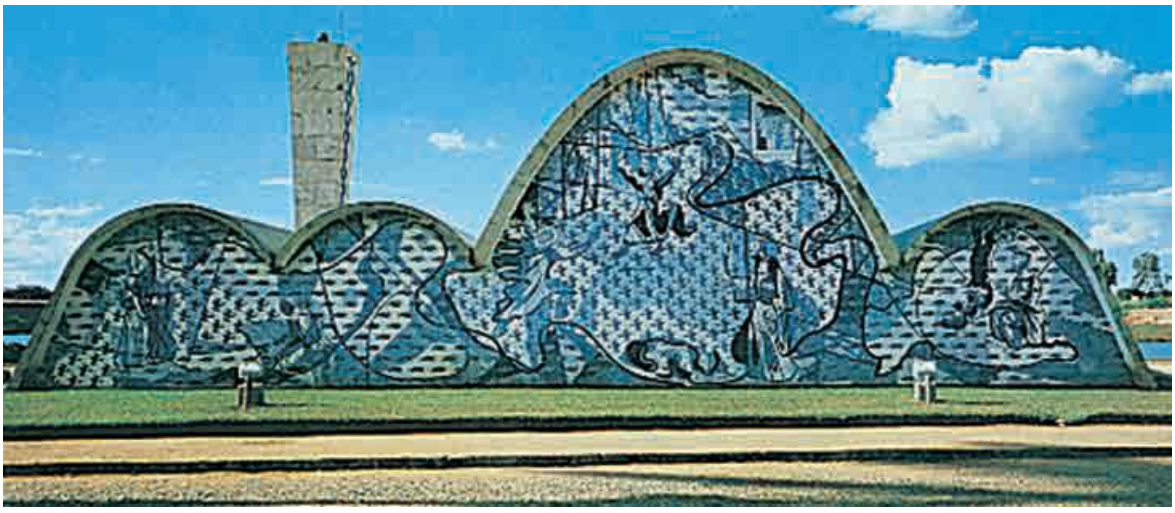


Figure IX. 13: Oscar Niemeyer, architect, Church of Saint Francis of Assisi, Pampulha, Brazil,1943.
Source: CT-B90A.pdf

Figure IX. 14: Eero Saarinen, architect, TWA terminal, Kennedy Airport, New York, 1956.
Source: CT-B90A.pdf

Conclusion

Modern architecture continues the paths opened by pioneers, often renewing them. But one might imagine that with the recent evolution of concrete, new, totally innovative plastic avenues could emerge.

General Conclusion

Renaissance architecture, which emerged in Italy during the 15th century, marked a revival of classical Roman and Greek styles. It emphasized symmetry, proportion, geometry, and the regularity of parts, reflecting humanist ideals. Architects like Filippo Brunelleschi reintroduced elements such as columns, domes, and arches, aiming for harmony and balance in design. This style gradually spread across Europe, shaping iconic buildings with a sense of grandeur, clarity, and rational structure contrasting the ornate and vertical emphasis of Gothic architecture.

Baroque architecture, which flourished in Europe from the late 16th to the early 18th century, is known for its dramatic, grand, and emotionally charged designs. Unlike the balanced clarity of Renaissance buildings, Baroque structures often feature curved forms, opulent decoration, bold contrasts, and a theatrical sense of movement. Architects like Bernini and Borromini used light, space, and ornament to create awe-inspiring experiences especially in churches and palaces. This style aimed to impress, overwhelm, and express power, especially during the Counter-Reformation, when art and architecture were used to evoke spiritual devotion.

Classical architecture refers to the architectural styles derived from ancient Greece and Rome, emphasizing order, proportion, and harmony. It is distinguished by the use of the classical orders Doric, Ionic, and Corinthian each with its own column design and decorative elements. Buildings often feature pediments, domes, columns, and symmetrical layouts, reflecting a deep respect for mathematical precision and timeless beauty. Revived during various periods including the Renaissance and Neoclassicism, classical architecture remains influential, symbolizing stability, elegance, and cultural heritage.

Rationalist architecture is a design philosophy that treats architecture as a science based on logic, structure, and function. Rooted in the ideas of Vitruvius, who believed architecture

could be understood rationally, this approach emphasizes clarity, simplicity, and geometric order. It gained prominence during the Enlightenment and later evolved through movements

like Neoclassicism, Structural Rationalism, and Modernism. Architects such as Étienne-Louis Boullée, Jean-Nicolas-Louis Durand, and Eugène Viollet-le-Duc championed the idea that buildings should reflect reason, purpose, and material honesty, often avoiding excessive ornamentation. In the 20th century, Rationalism influenced the International Style and was notably embraced in Italy during the Fascist era, where it merged logic with monumental form.

The introduction of iron and glass revolutionized architecture in the 19th century, marking a shift from traditional masonry to more open, light-filled structures. Iron, with its strength and flexibility, allowed for larger spans and innovative forms, while glass brought transparency and natural light into buildings. This combination enabled the creation of iconic structures like the Crystal Palace in London (1851), composed of thousands of glass panes supported by an iron framework. These materials became central to industrial architecture, such as train stations, markets, and exhibition halls, and later influenced modernist design, emphasizing function, lightness, and minimalism. The development of mass production techniques made glass and iron more accessible, transforming them into symbols of progress and modernity.

Georges-Eugène Haussmann, appointed by Emperor Napoleon III, radically transformed Paris between 1853 and 1870 through an ambitious urban renovation project. His goal was to modernize the city by replacing its overcrowded medieval neighborhoods with wide boulevards, uniform building facades, and improved infrastructure. Haussmann introduced the iconic Haussmannian architecture, characterized by cream-colored stone buildings with wrought iron balconies and mansard roofs, creating a cohesive and elegant cityscape. He also developed parks, squares, and a modern sewer system, enhancing public health and hygiene. While his work improved traffic flow and beautified Paris, it also displaced many working-class residents and faced criticism for erasing historical areas. Despite the controversy, Haussmann’s legacy remains deeply embedded in the visual and structural identity of Paris today.

Cerdà, a visionary Catalan engineer and urban planner, designed the Eixample district of Barcelona in the mid-19th century to address overcrowding and poor living conditions in the old city. His plan, approved in 1859, featured a grid layout with wide streets, octagonal blocks, and chamfered corners to improve visibility and traffic flow. Cerdà emphasized sunlight, ventilation, green spaces, and social equality, envisioning a city where all residents—regardless of class—could enjoy healthier, more spacious living. Though many of

his ideals were compromised over time due to speculative development, the Eixample remains a landmark of modern urban planning and a defining feature of Barcelona's identity.

Ebenezer Howard was the visionary behind the Garden City movement, a revolutionary urban planning concept introduced in the late 19th century. In his 1898 book To-morrow: A Peaceful Path to Real Reform (later reissued as Garden Cities of To-morrow), Howard proposed a new kind of city that would combine the best aspects of urban and rural life. His idea was to create self-contained communities surrounded by greenbelts, with balanced areas for housing, industry, and agriculture.

Welwyn Garden City, founded in 1920, was Howard's second major experiment after Letchworth Garden City. Designed by Louis de Soissons, Welwyn embodied Howard's principles: it featured wide boulevards, green spaces, and a layout that promoted health, efficiency, and social harmony. These cities were not just suburbs they were meant to be independent towns with their own economies and infrastructures.

Howard's influence extended far beyond the UK, inspiring urban developments around the world and laying the groundwork for modern planning concepts like green belts, zoning, and sustainable communities.

Arturo Soria y Mata was a Spanish urban planner who introduced the concept of the Linear City in 1882 as a response to the challenges of overcrowding, poor sanitation, and inefficient transportation in Madrid. His vision, known as Ciudad Lineal, proposed a city organized along a single, elongated axis with a fixed width and unlimited length. Along this central boulevard, he arranged zones for housing, commerce, public services, and green spaces, all intersected by perpendicular streets to maintain connectivity. Soria believed this layout would promote healthier living, better access to nature, and more efficient infrastructure. Although

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the full plan was never realized, parts of it were implemented in Madrid and later inspired other planners, including Soviet architects like Nikolay Milyutin, who adapted the idea for industrial cities. The Linear City remains a fascinating example of utopian urban planning that sought to harmonize human needs with rational design.

Camillo Sitte was an Austrian architect and urban theorist who profoundly influenced city planning with his 1889 book City Planning According to Artistic Principles. In this work,

Sitte criticized the rigid, geometric layouts of modern cities especially those emerging in Vienna during the 19th century, and advocated for a more aesthetic and human-centered approach to urban design.

His ideas were shaped by his observations of historic European cities, particularly their irregular street patterns, intimate public squares, and the way architecture framed urban space. Sitte believed that cities should be experienced like works of art, with attention to visual harmony, scale, and organic development. He opposed the wide, symmetrical boulevards of Vienna's Ringstrasse, which he saw as sterile and disconnected from the city's cultural heritage.

Although Sitte proposed alternative designs for parts of Vienna, including more enclosed plazas and curved streets that encouraged social interaction and visual interest, his plans were never fully implemented. Still, his theories sparked a lasting debate and influenced generations of planners who sought to balance functionality with beauty in urban environments.

Eugène Hénard was a pioneering French architect and urban planner who envisioned the motorized city in the early 20th century, anticipating the transformative impact of automobiles on urban life. Between 1902 and 1909, he published a series of studies proposing innovative solutions for traffic circulation, public health, and urban aesthetics. Hénard introduced the concept of circular intersections, or rond-points, to facilitate smoother traffic flow, and imagined multi-level streets that separated pedestrian and vehicular movement ideas that foreshadowed modern overpasses and underpasses. He also advocated for functional zoning, dividing the city into distinct residential, commercial, and industrial areas to improve efficiency and reduce nuisances. His radial and concentric road networks aimed to connect the

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city center with peripheral zones, while integrated green spaces served as vital lungs‖ to promote health and well-being. Viewing the city as a living organism, Hénard's vision embraced adaptability and technological progress, influencing later urbanists such as Le Corbusier and shaping foundational principles of modern city planning.

Tony Garnier was a visionary French architect and urban planner who developed the concept of the Cité Industrielle‖, an ideal industrial city, between 1899 and 1917. Conceived during his time at the Villa Medici in Rome, this utopian project imagined a city designed to harmonize

industrial progress with social well-being, reflecting Garnier's socialist ideals and belief in rational urban organization.

The Cité Industrielle was planned for 35,000 inhabitants and featured zoning by function, separating residential, industrial, public, and agricultural areas. Garnier emphasized sunlight, hygiene, and green spaces, with low-rise housing, wide streets, and buildings made of reinforced concrete and glass materials chosen for their modernity and affordability. He excluded prisons, churches, and courthouses, believing that a just society would render them unnecessary. The city's infrastructure included a hydroelectric dam, a central railway station, and public facilities like schools, hospitals, and cultural centers, all designed to be accessible and integrated.

Though never built, Garnier's Cité Industrielle profoundly influenced 20th-century urbanism and inspired later planners, including Le Corbusier. His work remains a landmark in the history of modern architecture and city planning, blending technical innovation with humanistic vision.

New art emerged in the late 19th century (circa 1890–1910) and is known for its organic, flowing lines, inspired by nature think vines, flowers, and insect wings. It emphasized handcrafted detail, asymmetry, and a sense of movement. Architects and designers like Victor Horta, Antoni Gaudí, and Hector Guimard created buildings and interiors that felt like living organisms, with intricate ironwork, stained glass, and curving forms.

Decoratif art, which followed in the 1920s and 1930s, was a response to the ornate softness of Art Nouveau. It embraced geometric shapes, symmetry, and modern materials like chrome, glass, and concrete. Influenced by Cubism, industrial progress, and ancient civilizations (Egyptian, Aztec), Art Deco celebrated luxury, glamour, and speed. Iconic examples include the Chrysler Building in New York and the Palais de Tokyo in Paris.

The Chicago School of architecture refers to a group of architects and engineers active in Chicago during the late 19th and early 20th centuries, who pioneered the development of the modern skyscraper. Following the Great Chicago Fire of 1871, the city became a laboratory for architectural innovation. These architects embraced steel-frame construction, which allowed buildings to rise higher than ever before, and they favored large plate-glass windows, minimal ornamentation, and a clear expression of structural elements.

The style, also known as the Commercial Style, often featured the iconic Chicago window a large fixed central pane flanked by two smaller operable sash windows. Buildings were typically organized like classical columns: a distinct base, a repetitive shaft, and a decorative capital. Key figures included William Le Baron Jenney, Louis Sullivan, Daniel Burnham, and John Root, whose work laid the foundation for modern urban architecture. Though the term , Chicago School‖ suggests a unified aesthetic, the buildings actually displayed a variety of styles and techniques, all united by their embrace of new materials and urban functionality.

Reinforced concrete, or béton armé, is a composite material that revolutionized architecture and engineering from the late 19th century onward. It combines the compressive strength of concrete with the tensile strength of steel, allowing for structures that are both durable and flexible. The concrete encases steel bars (rebar), which absorb tension forces that concrete alone cannot withstand. This synergy enables the construction of long spans, cantilevers, thin shells, and high-rise buildings that were previously impossible.

Invented by Joseph Monier, a French gardener, and later developed by engineers like François Hennebique, Auguste Perret, and Pier Luigi Nervi, reinforced concrete became the backbone of modernist architecture. It allowed architects like Le Corbusier and Oscar Niemeyer to explore bold, expressive forms while maintaining structural integrity. Despite its versatility, béton armé has also been criticized for its overuse in mass housing, sometimes leading to monotonous urban landscapes. Nonetheless, it remains a cornerstone of contemporary construction, valued for its fire resistance, thermal inertia, and economic efficiency.

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