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ARCHITECTURE
Notes

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CHAPTER 1

ARCHITECTURE AND CONSTRUCTIONS - GENERALITIES

1.1 Definition

The word "ARCHITECTURE" derives from the Greek word ***"architekton"*** (in Latin "architecton") which means "construction master".

According to the Neologisms Dictionary [33], ARCHITECTURE is ***"the science and art of constructing buildings, according to some proportions and rules determined by the character and destination of the buildings"***, but there are many other definitions given by dictionaries, specialists or even by outstanding personalities of human kind, definitions with more or less technical expressions and sometimes even "poetical".

Therefore, Novalis says that *"architecture is solidified music"*, V. Hugo writes that "*architecture is the Great Book of Human Kind"*, and G. Călinescu defines architecture as *"one of the purest arts, next to music and poetry".*

Actually, in relation to the other creation activities of humans, architecture is a more complex process that requires the knowledge and blending of the elements of science, technique and art.

One of the modern definitions of architecture, [16], is that of *"...synthesis discipline that succeeds to accomplish a consensus between function, structure and form within the constructed space, in which human life may develop in an organized manner".*

As a science, architecture has suffered over time substantial transformations and completions, because of the progress of society, of the appearance of some modern technologies and of some construction materials with superior performances, as well as because of the appearance of some functional necessities far different in relation to those of the constructions of the past centuries.

Therefore, if the distinctive sign of old architecture was monumentalism and decorative abundance, that of modern architecture is generally linear and volumetric simplicity, the expression of function and rationalism [37].

From here results the reluctance of certain people to consider contemporary architecture an artistic creation, although any construction, regardless of its destination and functionality is able to produce emotional reactions by plastic composition, by expression, by accomplishing a perfect symbiosis between aspect and functionality.

With all the transformations that intervened over time regarding the content of architecture as science, the fundamental characteristics, the "laws" and basic principles of architecture are kept and remain true.

Therefore the fundamental attributes of a construction that architecture must ensure are: *utility*, *solidity* and *aesthetics* [16].

These fundamental attributes, valid ever since antiquity evolved, though, along with society, with the material and spiritual demands of people, the extent to which they interfered in the conception and formation of buildings being strongly influenced by these demands.

The neglect of some attributes and exaggeration of others led to the coming up of passing architectural trends, among which: ***"constructiveness", "aestheticism", "functionalism"***, etc., trends by which there were created constructions that do not satisfy human expectations from all points of view.

The changes in architecture, considered by some "the most conservative of human arts and sciences [46]", were, are and will be mainly quantitative and less qualitative and their premises have a main motivation - demographic growth and the general tendency of people to live in urban settlements and in conditions that are as comfortable as possible.

1.2 Short history of constructions evolution

The beginning of the art and activity of construction is lost in time immemorial because "constructing" is the oldest conscious activity of man after the one of gathering food.

The first "constructions" were of course the *shelters* that man has accomplished in order to protect himself against the elements of nature (cold, heat, wind, rain, etc.), against animals and even against his own kind.

The first shelters were natural ones (grottos, caves), "improved" by the action of man but where the natural configuration of the land did not make possible the existence of caves, man built shelters like *"nests", "huts", "tents"* etc. using materials that were readily available, such as: branches and leaves, clay, stone, ice (the *"igloos"* from the frozen areas).

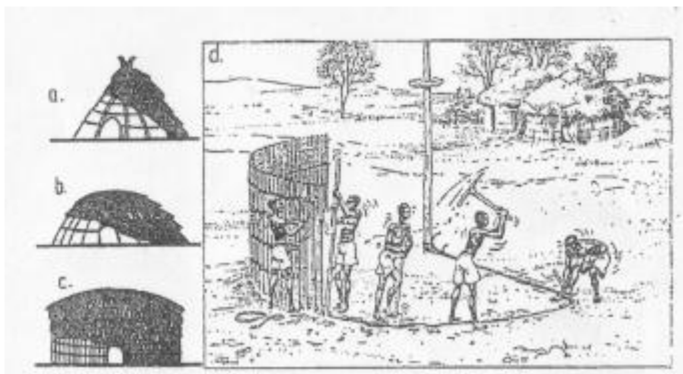


Fig. 1.1 - Hut - shelter
a, -b, -c- hut types; d - the construction of the hut [57]

The huts, for example (fig. 1.1), were built thousands of years ago according to principles that were, for the better part, kept and are being used nowadays as well, by peoples in the undeveloped areas of the planet.

Taking any form (conical, semispherical, cylindrical etc.), the huts were made by binding together wooden beams stuck into the ground and covering them with leaves, grass, animal skins, clay, etc.

The evolution of society, science and technology, allowed the passing, over approximately 6 - 7.000 years, from the shelter - hut to the modern, collective shelter of the ***"skyscraper"*** type, passing through many intermediary phases of volumetric, dimensional and form conception (fig. 1.2).

Therefore, using traditional materials (wood, stone, etc.) processed and combined with art, houses were built (family or collective ones) with more rooms with various functions, then the collective buildings of the "apartment house" type, built using classic materials and classic technologies (brick masonry, monolith concrete or prefabricated concrete), and nowadays very tall buildings, of the "*tower*" or "*blade*" type, built using materials with superior characteristics (steel, aluminum, glass, plastics etc.) and modern building technologies.

The *shelter*-buildings are the most widespread but represent only one of the functions that the existent constructions have, because the progress of society led, over the centuries, to a strong diversification of these functions.

In this way, (see chap. 1.5) the public constructions (administrative, of culture and art, sportive, religious etc.) appeared, for transports, industrial, agricultural, military, special, engineering etc. the execution and functionality principles of which have also evolved along with society.

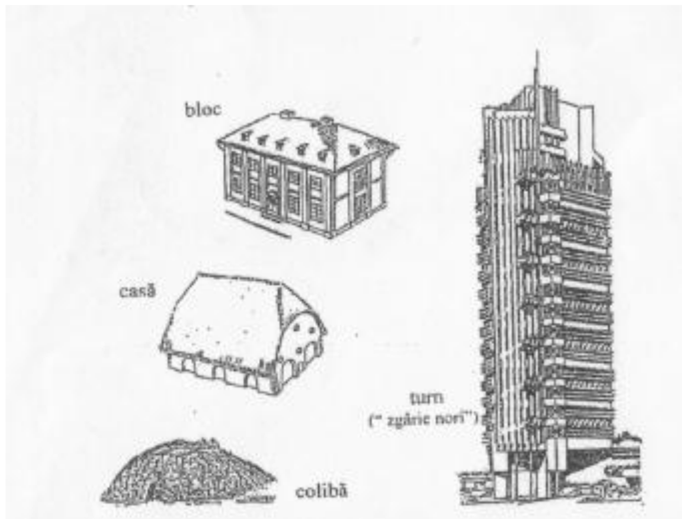


Fig. 1.2 - The evolution of human shelter in time

It is interesting to see the point of view of work [44], where Leland M. Roth presents a "diagram" of the main relative components of functionality for different types of buildings (fig. 1.3), in which the share of the two main components of the function of a building - ***utility*** and ***symbolism***, is represented in percentage, marked by the diagonal from the figure.

It is noticed (for instance) that if for factories and garages, *utility* represents approximately 90% and *symbolism* only 10%, at the other end there are monuments (commemorative constructions), whose utility is only of 10% while the symbolic function rises to 90%. Modern living buildings are situated at the middle, having the same proportion of utility and symbolism.

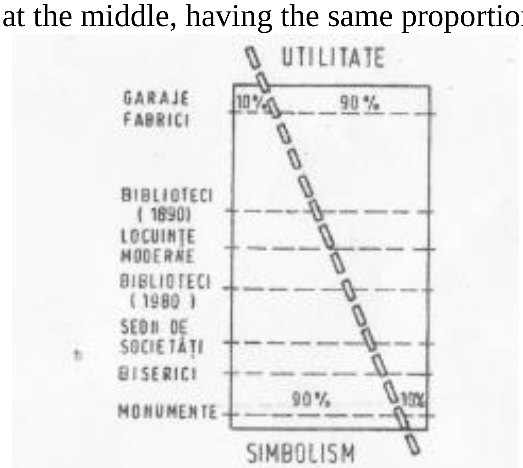


Fig. 1.3 - Utility - symbol ratio for different types of buildings

The diagram also highlights the evolution in time of the ratio between the two components of the function in the case of *libraries*, for which the ratio between *utility* and *symbolism* decreased dramatically during approximately 100 years because of the appearance of some more modern and efficient ways of information than reading.

Obviously, the presented diagram refers to the present times, for any past or future period this being able to have another aspect. Likewise, this kind of diagram may look different for other types of buildings, respectively for different inhabited areas of the planet.

Some of the antique buildings made by humans have resisted against the action of time for thousands of years because of their *massiveness*, because of the *durability of the material* of which they were made of (natural stone) and because of the applied *execution technologies* (technologies that are not completely known, some of them are only supposed).

Among the constructions that attest by their existence after millenniums since they were built, the art and skill of the ancient civilizations, the most representative are: ***- the pyramids, the aqueducts, the temples,*** etc. (fig. 1.4).

- *pyramids* - monumental funerary constructions, built 2500-2700 years BC had the function of “houses for the afterlife” of pharos and kings of Egypt, Mesopotamia, Persia, India, Mexico, etc.

The most famous pyramids are those of Egypt, on the valley of the Nile, among which the highest is the pyramid of Cheops (148 m high, 232 m base side, approximately 6.5 million tons in weight).

- *aqueducts* - antique constructions made of stone (discovered in Italy, France, Spain, etc.) having the utilitarian function of *water adduction*, made under the form of arcades (generally with semicircular arches) rested on “piers” and developed on one or more levels.

- *temples* - religious constructions, with the symbolic function of “house” for god and worship place for its followers, made of stone, with the structure formed of walls, columns and systems of girders.

The temples (massive in ancient Egypt, or with more ample spaces in ancient Rome and Greece) constituted one of the most important architectural programs of antiquity because of the huge influence of religion over the antique people and, as consequence, because of the economic power of the religious system of all times.

The examples of constructions given above, famous through their architectonic value and their age, were and are still studied by many specialists (architects, engineers, archeologists, historians etc.) from the entire world, who elaborated a number of theories regarding the methods and technologies that were used for their construction and regarding the significations that can be assigned to the shapes and dimensions of these constructions.

But these are not the only types of constructions that became famous for their age and architectural value, because a number of objectives remained witness of human genius in the field of constructions, in the different parts of the planet and in different eras of development of the civilizations.

Therefore, there is a huge number of constructions spread in the entire world that illustrate the technique and art of some antique civilizations extremely developed, such as the civilizations from the Mediterranean Basin, Asia Minor, Extreme Orient, Latin America, etc.

In his work “Monumental constructions” [7], D. T. Constantinescu classifies the human significant constructions in three great *“generations”*, characterized by the types of the used structures, by the main execution technologies and by the main used materials, as well as by a great variety of architectonic styles.

Therefore, according to the work [7] the constructions may be classified as it follows:

- *the constructions of the* ***first generation*** - comprise a great variety of architectural objectives, beginning with the first stable settlements appeared in Jericho in Jordan, continuing with the megalithic constructions from Bretagne (approximately 3000 BC), with the great pyramids of Egypt, with the Great Chinese Wall form Ancient China, with the "ziggurats" of Mesopotamia, with the palaces of Babylon and of ancient Persia, with the Hindu temples of India, with the pagodas and imperial palaces of China and Japan, with the monuments and temples of pre-Columbian, Maya and Inca civilizations and culminating with the monumental temples of Ancient Greece.

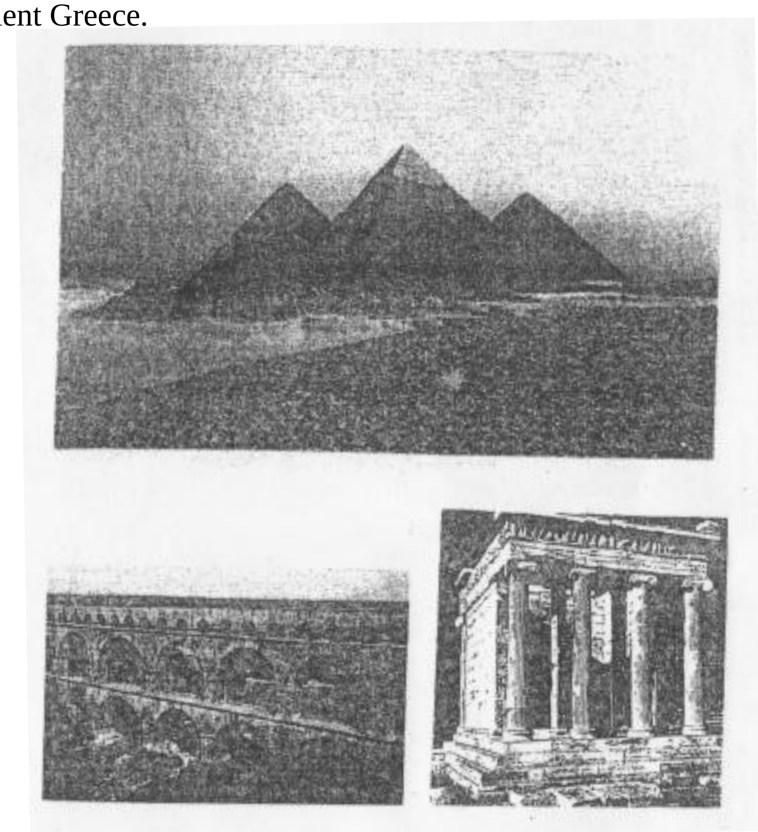


Fig. 1.4 - Antique monumental constructions
Cheops, Kefren, Mykerinos Pyramids of Giseh - Egypt, 2680 - 2560 BC
Pont du Gard Aqueduct - France - 25 BC
Athens Temple - Nike, Athens - 420 BC

In the same generation are included the ***Dacian strongholds***, constructions of whose vestiges prove the superior development on all fields of the Getae-Dacian civilization, including the field of constructions.

The use of the configuration of the terrain, the technique of reinforcement by constructing massive walls of stone according to an original technologic method denominated ***"murus dacicus"*** and the construction of strong defense towers in strategic points, confirms the constructive genius of the Getae-Dacian people.

For instance, the massive defense walls "murus-dacicus" (fig. 1.5) were made of two walls of stone blocks, "tied up" together with hardwood logs (girders) and having the space between the two walls filled with hammered clay. By the method of processing of the ends, the wooden girders assured the stability of walls against lateral pushing given by the filling of clay and stone between them, as well as the co-operation between these.

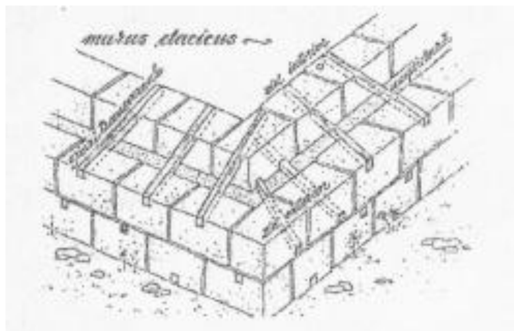


Fig. 1.5 - The Getic-Dacian defense wall “murus dacicus”

The large thickness of these walls (1.5 – 3.5 m), the characteristics of the used materials and the working technique assured their efficiency in protecting the Dacian strongholds and their durability in time.

- *the constructions of the* ***second generation*** - comprise the constructions made on one hand by using (besides the natural traditional materials: stone, wood, clay) some artificially created construction materials, with superior characteristics (brick, concrete, etc.) and on the other hand constructions made with new constructive techniques, based on a true science of construction mechanics, on the discovery of some methods and constructive systems that allowed a large diversification of the types of constructions and of the architectural styles.

It is considered that, the second generation of constructions is born along with the antique Roman civilization, a civilization to which is attributed a number of reference accomplishments, such as:

- the use of artificial construction materials (brick masonry, “concrete” and Roman cement obtained of cove and volcanic ashes);
- the use of new structural elements (arches, canopies, wooden farms, etc.);
- the rise of the height and opening of constructions by using the above mentioned materials and structures;
- the large diversification of the functionality of the constructions;
- paying an increased attention to architectural composition, to interior comfort and aesthetics of constructions.

The diversity of the constructions from the second generation is explained also by the variety of architectural trends developed in different geographic areas and in different periods of the evolution of society.

Therefore, in this generation are included the *Byzantine* monumental constructions (churches, military constructions, palaces etc.), that introduced a new architectonic element - *domes on pendants* (domes with large openings, rested on massive masonry arches, respectively on canopies constituted of concave spherical triangles (fig. 1.6), *Arabian* and *Ottoman* constructions (mosques, palaces, etc), *gothic* and *Romanic* constructions (cathedrals, churches, basilicas, palaces, fortifications, etc.), *Slavonic* constructions (cathedrals, churches, palaces, etc.), *Renaissance* constructions (based on the use of some construction mechanics knowledge), *baroque* and *classicism* constructions using elements of renascent influence (curved line, respectively the severe classic line), are also aligned according to [7] in the category of the constructions from the second generation.

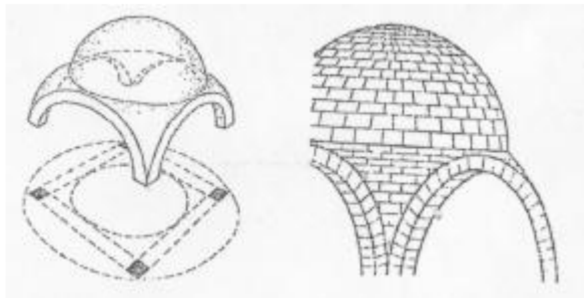


Fig. 1.6 - Byzantine domes on pendants

Notice the fact that the great variety of characteristics of the constructions from the second generation refers not only to technology, to the constructive system, to function and general architectural plastic but also to the details and forms of the nonstructural elements of the constructions.

Therefore, elements such as the shapes of the embrasures in the walls (doors and windows), the shape of the columns, of the arches, canopies, decorative elements, etc. are suggestive.

For exemplification, in the figure 1.7 are presented some forms of the portals or windows that are characteristic to some architectonic trends from those mentioned above.

The original architecture of *Middle Ages* Romania (a period situated in the second generation of constructions) was influenced by the architectural trends of occidental Europe and of the Orient and created valuable constructions, in which the architectural composition methods that were take over were combined with local traditional elements and with own execution technologies.

In this way, the strongholds, monasteries, churches, mansion houses, palaces, countryseats etc. are testimonies of the artistry of constructors - Romanian architects and engineers from past centuries.

- *the constructions of the* ***third generation*** - are the results of scientific and technical advances in general and of the technique and art of building in particular, advances which appeared at the beginning of the 19th century, being characterized by:

  - the use of new materials with improved features, which were produced by the construction industry (cements, reinforced and prestressed concrete, quality steels, aluminum, glass, ceramic and plastic materials etc.)
  - the introduction of new procedures, by using advanced technologies based on typification, precasting, modulation etc.
  - the use of new structural systems- frames, suspended roofs, thin curved surfaces, geodesic domes, hard core structures etc.

  These elements had allowed a change in the concept of shape and size of buildings (a change which had been imposed by the need to *increase the size of buildings* as a result of a growth in population and a decrease in the space suitable for construction) by reducing the sections of structural elements, by using light materials that are both solid and durable, by eliminating heavy architectonic and ornamental elements and by obtaining an architectural appearance based on shape and color.

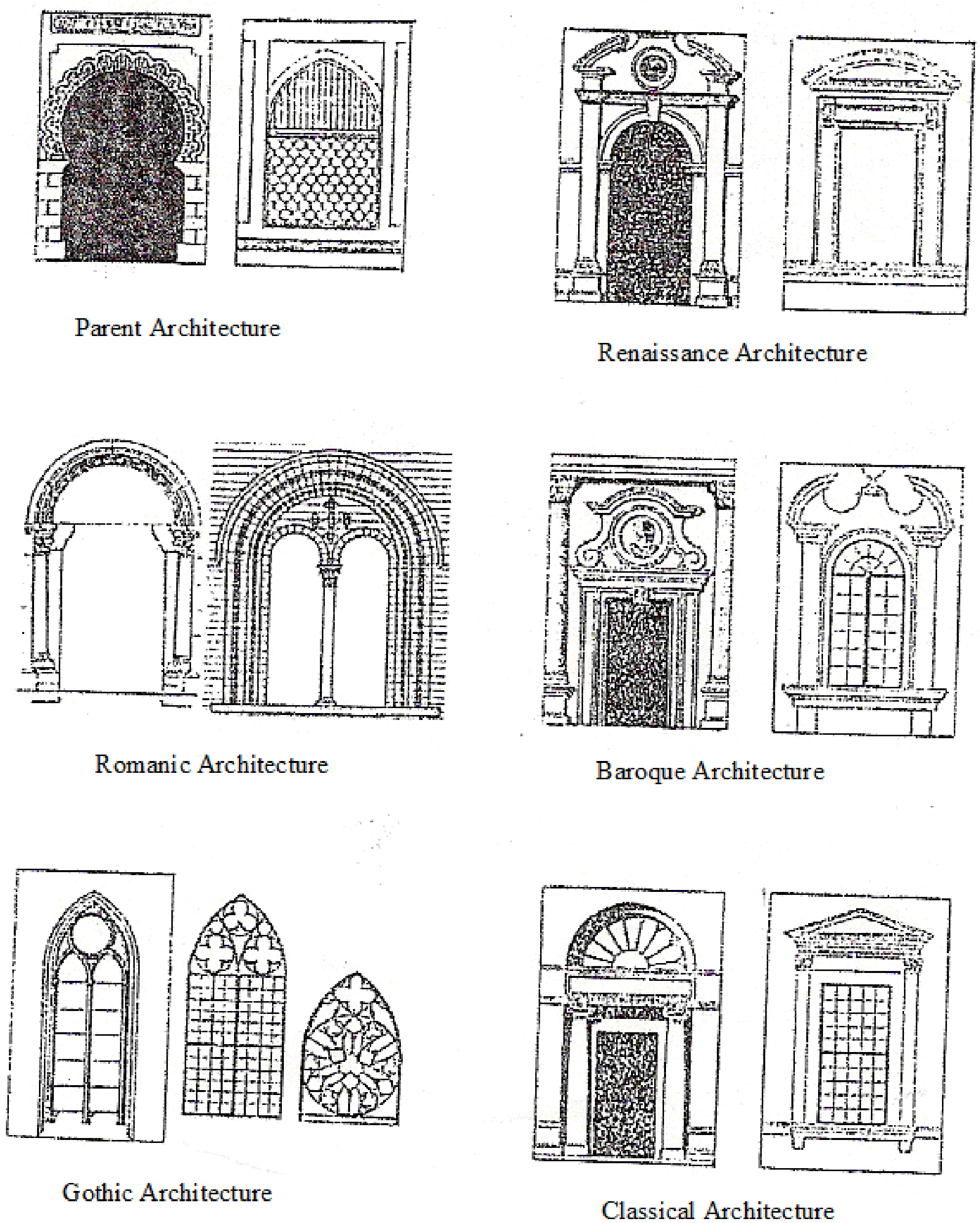


Fig. 1.7- Porches and windows in architectural currents

Figure 1.8.a presents an evolution of the heights of buildings from the times of Ancient Egypt to present days, and image 1.8.b presents a chart with the decrease in the true specific weight of the building tops on a square meter, according to the development [7].

Apart from the "building" constructions, a large number of constructions with various uses and purposes appear, depending on the lives and activities of people, on their needs.

These constructions (civic, industrial, agricultural, special, etc.) are not only different in functionality, but also in structure, shape, size, materials, location, color, building technology, and some details of construction are greatly, sometimes completely, different from those of early constructions.

Many famous architects and engineers, artists and scientists have participated in the realization of these constructions, revolutionizing the building technique. It is difficult to choose only a few of them, but some engineers, physicians and architects can be mentioned, such as: Newton, Hooke, Bernoulli, Navier, Euler, Juravski, Şuhov, Cremona, Eiffel, Leonhardt, Timoşenko, Freyssinet, Le Corbusier, Gropius, Maillart, Nerv, Perret, Frank Lloyd Wright, etc.

Alongside these there are some great Romanian creators worth mentioning, engineers and architects, who have either had or still have a great role in the scientific and artistic development of constructions, such as A. Saligny, Emil Prager, A. Beleş, C. Avram, M. Hangan, D. Pavel, R. Priscu, Şt. Bălan, P. Mazilu, D. Mateescu, V. Popescu, A. Caracostea, C. Lăzărescu, I. Mincu, D. Marcu, H. Creangă, G. M. Cantacuzino, O. Doicescu and many others, all of them standing for the past, present and the future of constructions in Romania.

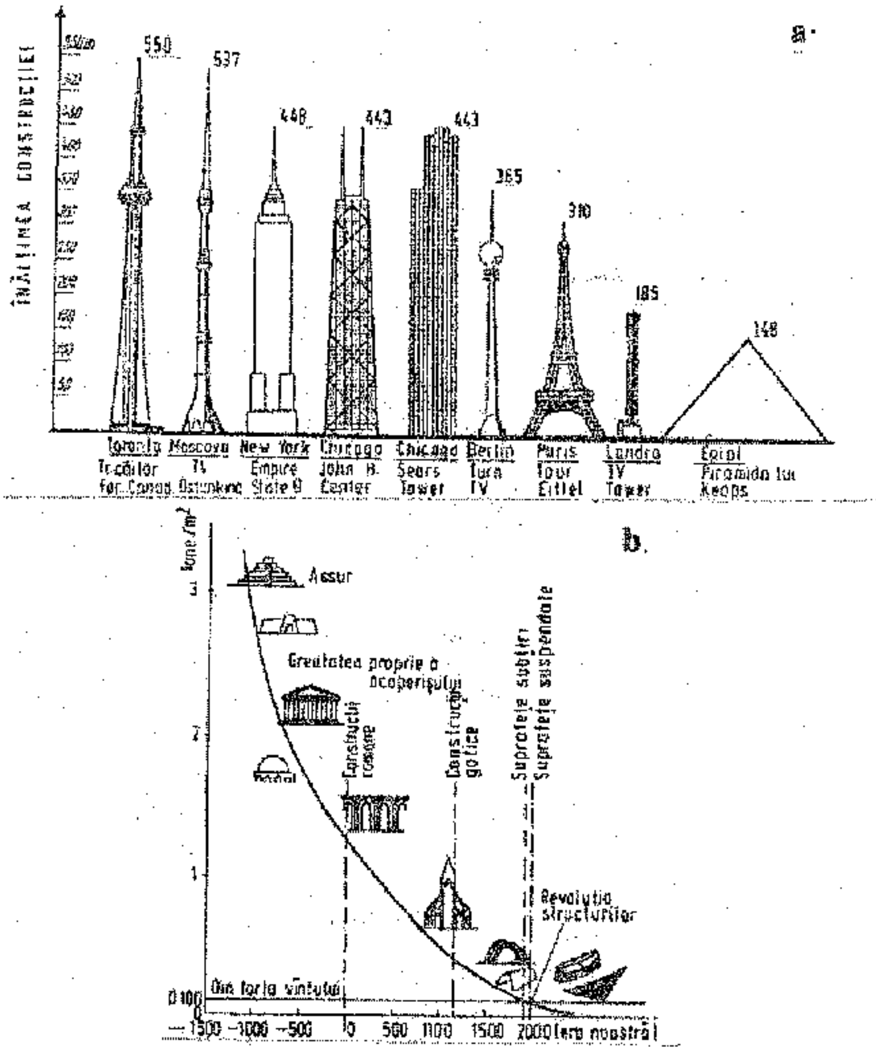


Fig. 1.8- The evolution of building height **(a)** and the decrease in the true specific weight of the building tops **(b)**

1.3. The influential factors in architectural concepts

Constructions as a whole are made my man, are used by man and are placed in the environment under the influence of natural factors. This is why one can state that MAN and NATURE are the two decisive factors that influence the way constructions are planned.

a) MAN- influences the way in which building is planned through his *dimensions* as well as through his *activities and necessities*.

There is a long history behind the studies on human *dimensions and proportions*, starting about 5000 years ago with the old Egyptians, continuing with ancient Greece and Rome, and later Japan, France, etc., and the old saying ***"Man is the measure of all things"*** applies perfectly to the field of constructions.

An accurate scale of constructions can only be settled if one starts from the proportions of the human body. These sizes (fig. 1.9) were settled and divided in many ways, according to different "modules": - *length of the middle finger* (Diodorus, 1st century BC), *length of the sole, height of the head* (Polykleitos, 5th century BC, Lysippos, 4th century BC) etc.

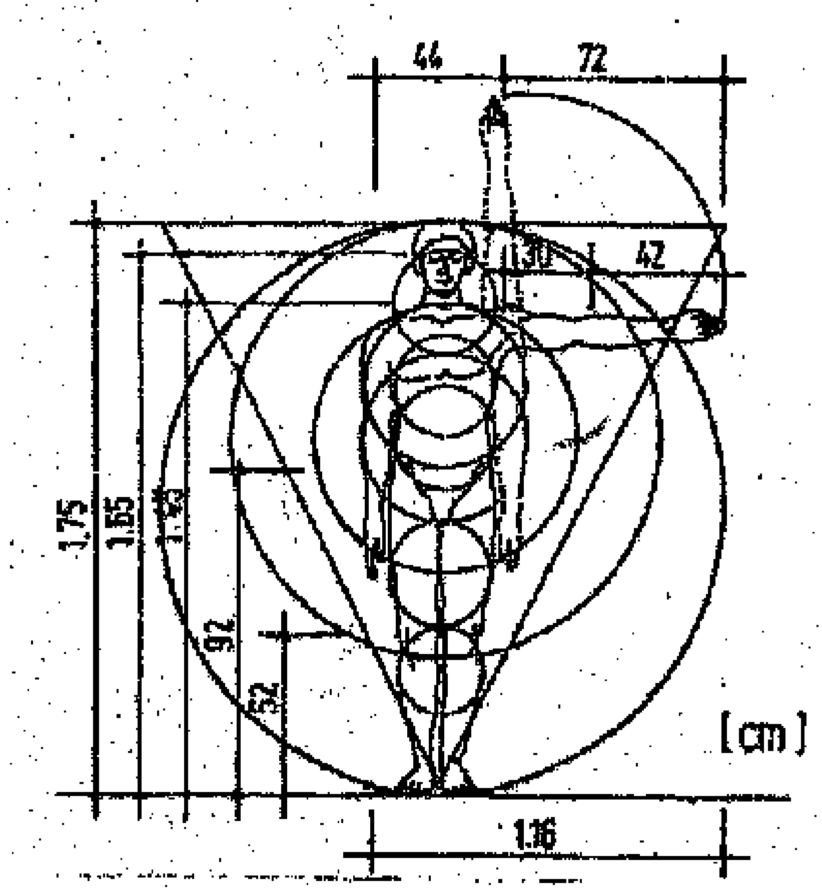


Fig. 1.9- Dimensions of the human body

Knowing the proportions of human body and of the space a person takes in different positions, used generally while walking or standing, allows constructors to determine the perfect sizes for the spaces they build, for the furniture used and for the placing of this furniture within the building. Figure 1.10 presents an example of space dimensions needed by a person in various situations [59], [41].

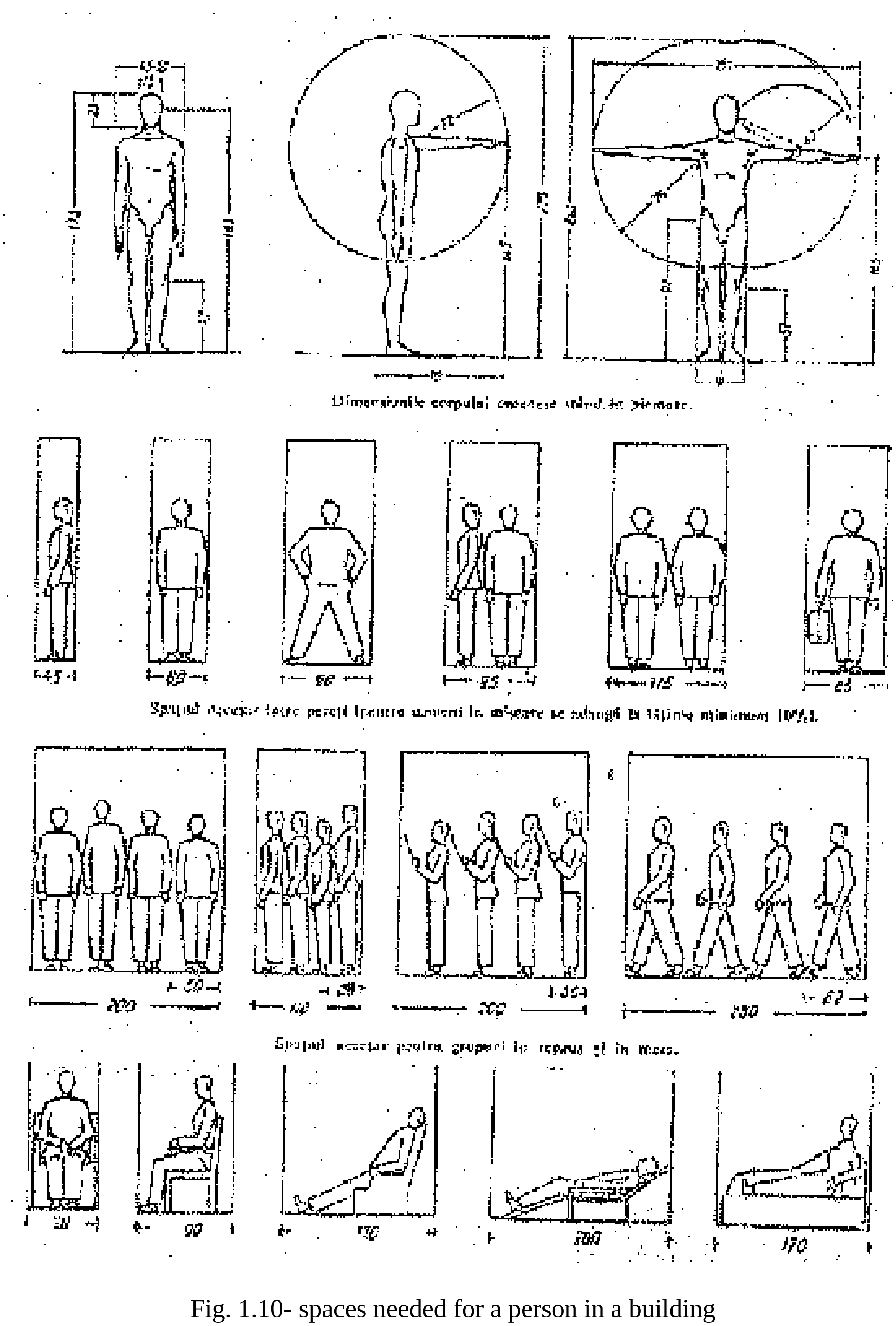


Fig. 1.10- spaces needed for a person in a building

A person determines the functionality and the sizes of a building not only through his/her proportions, but also through *activities* that are undertaken and through physiological *needs*.

Therefore, the standards that any building must reach are determined by the level of *comfort* a person needs in the space being built:

- temperature and humidity within a closed space;
- phonic (acoustic) sealing of the interior space;
- fresh air required for breathing;
- natural and artificial illumination of spaces;
- possibility to maintain hygiene within the built space;
- aesthetic factor, meaning the harmony of shapes and colors.

Certainly, a building can be used even if it does not meet all the requirements above, yet, this will mean that it will not offer people enough comfort to lead a normal life in all aspects.

If we are to look only at certain aspects of the needs of the human body, particularly those referring to the temperature, humidity and fresh air in closed spaces, we could show that normally, due to water vapors and carbon dioxide that a person releases during activity periods or while sleeping, it is a must to respect the following:

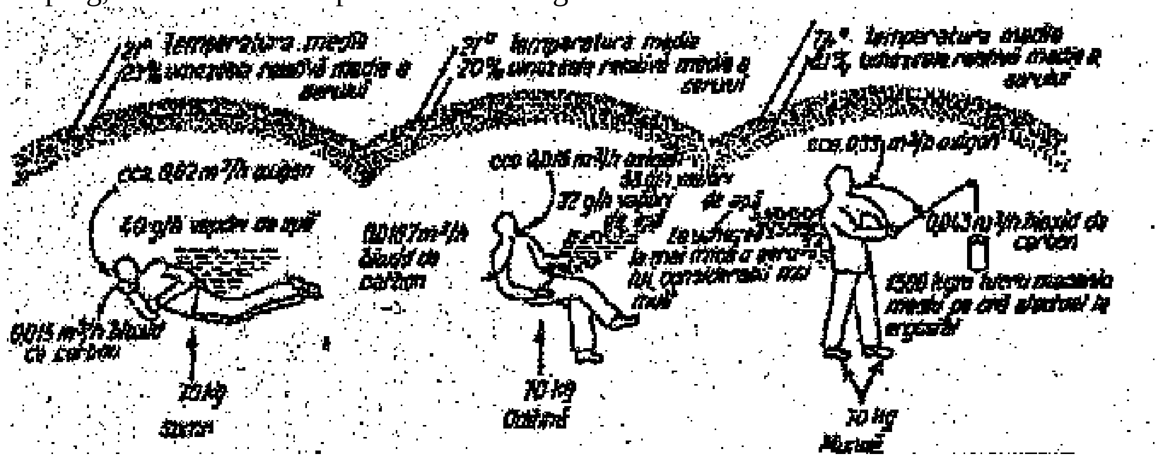


Fig. 1.11- Water vapors and carbon dioxide releases of a person

- the ideal temperature of rooms where human activity is undertaken, or where people rest, should be around 18-22 degrees Celsius;
- the relative humidity of the air in the rooms should be about 50-60%;
- the fresh air exchange must ensure at least 0.02-0.03 cubic meters of oxygen per hour for a person of average height.

Respecting the minimum requirements of comfort of a person or not can have serious effects on the person's work efficiency and health.

b) NATURE is the second important factor that influences the shape and size of a building, through the *action of climate factors*, through the *characteristics of the ground of the foundation*, through the *intensity of the gravitational and horizontal forces* (e.g. wind, earthquake), etc.

MAIN FACTORS IN CONSTRUCTIONS DESIGN:

1. MAN:

- dimensions and proportions
  - -dimensions of the human body
  - -the space a person takes while moving or in rest

- physiological needs
  - -temperature, humidity
  - -lights, aesthetics
  - -fresh air, hygiene, etc.
- human activity
  - -work, training
  - -rest, entertainment
  - -health, etc.

2. NATURE:

- construction factors
  - -mechanical, physical
  - -chemical, biological, etc.
- geographical conditions
  - -hydrographic landscape
  - -climate (wind, temperature, rainfall)
  - -fauna, flora
  - -raw material deposits
- geotechnical conditions
  - -field geology
  - -geomorphology
  - -seismicity

Fig. 1.12 – The Factors that determines the Conception of Construction

Through its components, nature can decisively influence the overall size and shape of constructions, and sometimes it even influences the way in which they are placed in an environment, so as to meet the technical requirements needed to properly function and serve in time (see point 1.4).

The chart in figure 1.12 is a result of systemizing the elements through which man and nature determine how buildings are designed and placed (according to [21]).

What also holds a major importance in designing a construction are the *materials* and *technology used in the building process.*

The *construction material*, through its physical and mechanical properties and through its aspect, may determine the overall shape and size of the construction or of the elements it is built of, as well as the overall aspect of the construction.

The same can be said about the *technology* used, which can be a decisive factor in the design of the construction, when the specific technology is needed due to certain natural factors (landscape, climate etc.) or due to economic factors (cost, productivity etc.)

1.4 Technical conditions in constructions

Regardless of its purpose, any construction must meet certain *technical conditions*, [21], which ensure a normal durability and efficiency, and which confer the necessary comfort for people to perform normally.

These main conditions can be either indispensable (mandatory) for the existence of a building (the *capital* and *mechanical* conditions), or not mandatory for the proper functioning of a building, this, however, meaning that buildings cannot be used normally.

Figure 1.13 systematically presents the main technical requirements that a construction must reach.

As it can be seen, the requirements mentioned above are determined by the factors that influence the constructions, and the standards set for meeting these requirements are put together in a series of *technical regulations for constructions: standards, normative measures, technical instructions, special technical requirements, standard projects, technical cards, internal regulations*, etc., and respecting these requisitions is mandatory for every draftsman, constructor or building user.

THE PRINCIPAL TECHNICHAL CONDITIONS FOR CONSTRUCTIONS:

- Capital
  - durability (resistance to: humidity, physical, chemical and biological agents)
  - fire resistance
- Mechanical
  - carrying capacity
  - deformations
  - stability
  - ageing
  - cracks
  - stamina, etc.
- Physical and Hygienic
  - thermal
  - ventilation
  - acoustics
  - illumination
  - hydro isolation
  - hygienic, etc.
- Architectural-Esthetics
  - aspect (plastic and architectural composition)
  - settlement
- Economical-Organizational
  - Cost price

- Productivity
- Energy consumption
- Class
- Modulation
- Typification
- Industrialization

Fig. 1.13- Technical conditions for constructions

1.5 Constructions classification

The built space includes an extremely large variety of constructions types, whose functions, shapes, volumes, structures etc. are directly connected to satisfy human exigencies and necessities and to natural conditions from the area where the construction is placed.

There are many criteria to classify building types, such as:

- destination or functionality of the buildings;
- type of the resistance structure of buildings;
- the technology of building a construction;
- the materials used to realize the building;

but the current work refers only to the classification after the criterion of *"building's destination"* (see the scheme from figure 1.14).

In this way, we can say from the start that generally there are two main types of constructions [21]: ***-buildings;***
-engineering-constructions.

CONSTRUCTIONS:

1. BUILDINGS

- ➢ CIVIC BUILDINGS

  -homes
  - Individual
  - Collective

  -social, cultural and touristic
  - hospitals, cinemas
  - schools, kindergartens
  - libraries, theaters
  - sports halls
  - hotels, log cabins, etc.

  -public and administrative
  - commercial
  - judicial
  - administrative
- ➢ INDUSTRIAL BUILDINGS

  -production
  - factories

- workshops

-for production supply

- warehouses, silos
- thermal power stations
- electric power stations
- reservoirs

➢ AGRICULTURAL AND ZOOTECHNICAL BUILDINGS

-animal shelters

- stables
- winter stables, etc

-storage rooms for agricultural products

- barns, warehouses
- silos, etc.

- vegetable storage rooms

- propagators
- greenhouses, etc.

-storage rooms for agricultural equipments

- sheds
- storehouses, etc.

➢ TRANSPORTS- AND TELECOMMUNICATIONS- BUILDINGS

-for transports

- railway, automotive
- aerial, naval, etc.

-for telecommunications

- postal, telegraphic, telephonic;
- radio-TV

2. ENGINEERING-CONSTRUCTIONS

➢ Means of communication and attached art constructions
 -bridges, tunnels
 -viaducts, etc.

➢ Hydrotechnical constructions

➢ Power lines as means of electricity transportation

➢ Gas, water and fuel pipes, canals;

➢ Special constructions: towers, chimneys, etc.

Examples of different types of construction:

Hospital Building

Alabama Judicial building

McLaren factory

Warehouse

Lekki TV building. Nigeria

Buildings are a type of construction that is used to shelter people, animals, materials, machines, human activity, products, etc. in a generally enclosed (either totally or partially) space.

Depending on their purpose (or function) there are several types of subcategories (civic, industrial, agricultural and zootechnical, transportation buildings, etc.), which in turn can be divided according to the field of activity they belong to (see the classification presented before).

Engineering constructions refer to all the other types of constructions, which are of a different nature (there are no special enclosed spaces for sheltering people, animals, materials, machines, etc.) such as: *means of communication* (roads, railways, etc.) and the *attached art constructions* (bridges, viaducts, tunnels, etc.), *hydrotechnical and territorial improvement constructions* (dams, breakwaters, irrigation canals, etc.), *power lines as means of electricity transportation, pipes* (for gas, water, fuel, drainage, etc.), *special constructions* (chimneys, water towers and television towers, antennas, tanks, etc.) and others.

1.6. Structure and subdivision of buildings

Although the importance of architecture in the building of ***engineering*** constructions can be minimized (only being a part of placing the building within the environment and of setting the shape, size, color, etc. of the building), it is hard to avoid or disregard the importance of the architect's involvement in the construction of *buildings*. This is why it is necessary to introduce a few basic elements in the *general structure* of buildings and their *subdivisions*, both horizontal and vertical.

The structure of a building refers to the elements that build up the construction, which can be grouped [21] according to several categories (purpose, material, location, the importance they have in the building, etc.)

According to the main criterion- the *purpose* or *importance* in the service life of a building, the elements can be grouped (see fig. 1.15) in the following categories:

a) -*structural* (or *main*) elements, without which the building in itself could not exist, or could not be used.

Amongst these there are first of all the *supporting elements* (exclusively) which ensure strength and stability to the building (and which transmit the actions to the foundation) and secondly some supporting elements that also have purposes other than that of sustaining the building (closing, subdivision, circulation, etc.)

BUILDING COMPONENTS:

- ➢ STRUCTURAL ELEMENTS
  - foundations
    -isolated
    -continuous
  - vertical elements
    -walls
    -pillars
  - horizontal elements
    -platforms
    -beams
  - special elements
    -domes
    -cables
    -arches, etc.
  - roofs
    -roof trusses
    -flat roofs
  - staircases, banisters

- ➢ NON-STRUCTURAL ELEMENTS
  - subdivision elements (interior walls)
  - closing elements (exterior walls)
  - finishing
    -ground coats
    -coverings
    -paintings
    -revetments, wallpapers
    -floors
    -doors, windows
  - ditches
  - ducts

- chimneys
- coverings
- isolating elements
  -hydro-insulators
  -thermal insulators
  -acoustic insulators

➢ TECHNICAL EQUIPMENT ELEMENTS (INSTALLATIONS)

- water supplying
- used water disposal
- heating
- ventilation
- electric (illumination, power)
- warnings, telecommunications
- garbage disposal
- mechanical transportation
- combustible gas supplies

Fig. 1.15 –Component elements of buildings

b) -*non-structural* (or *secondary*) elements have a well-determined and important purpose in the building, but their presence is not a deciding factor in the building process (without them a building can be constructed, but cannot ensure the functionality needed by a person).

Amongst these there are *subdivision and closing* elements, *finishing and decorative* elements, elements *for ventilation and natural illumination*, as well as elements of *isolation and protection* (against humidity, cold and heat, noise, fire, corrosion, etc.).

c) -*technical equipment elements* (or *installations*) are meant to ensure comfort for the lives and activities of people working in the building.

This includes installations for power and illumination, heating, water and gas supplies, ventilation, garbage disposal, fire-proofing, telecommunications, etc.

Figure 1.16 (according to paper [21]) might explain the construction of a building more thoroughly.

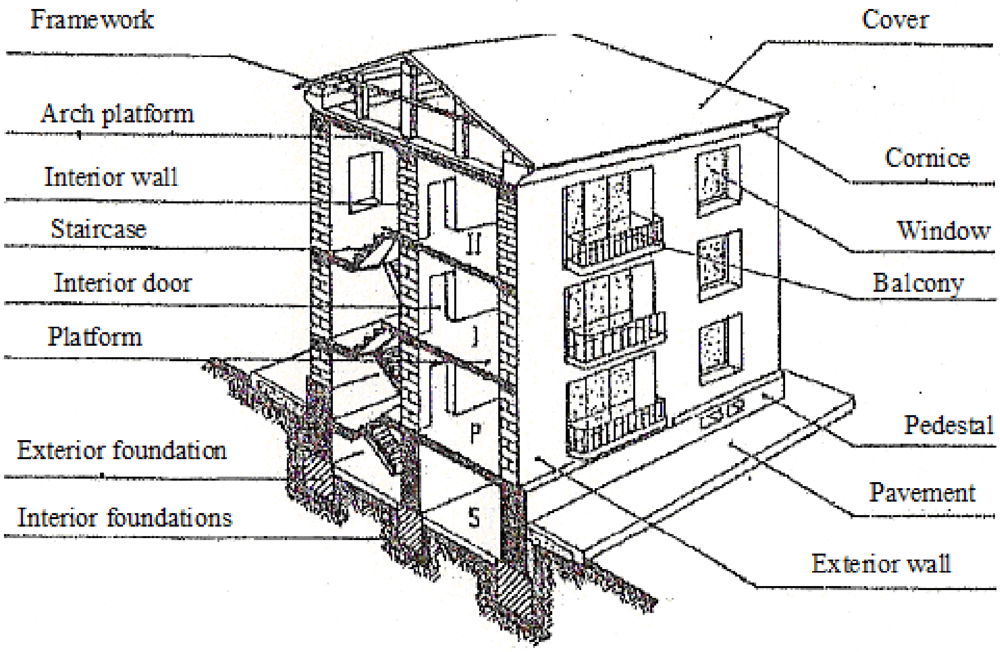


Fig. 1.16- example of building construction purlin

The subdivision of buildings (dividing or assigning interior space) is done both horizontally and vertically [21].

The horizontal subdivision of a building (within each storey of the building) is done by vertical closing and subdividing elements (walls), into spaces called “rooms” or “chambers”, and passing from one to another is done through blank spaces in the walls (doors), while the ventilation and natural illumination is achieved through empty spaces in the exterior walls (windows).

The horizontal subdivision system- the conceptual construction of the storey depends on many factors (also see chapter 3, point 3.3, about the architectural space and its components), but first of all it depends on the purpose and structural frame.

In image 1.17 there is an example of how to horizontally subdivide the floor of a building (*ground floor* plan) to serve as an apartment.

The vertical subdivision of a building determines its *levels*, which are divided through horizontal elements- platforms, so that a level is the section of a building (vertical) located between the marks of two consecutive platforms.

Basically, a building is a complex spatial structure, made out of several components, which are grouped according to their position from ground level in two large categories: *infrastructure* and *superstructure* (fig 1.18)

The infrastructure is usually located below the natural ground level (usually below the ground mark of the building ±0.00), and it includes the foundations and the basement or the semi-basement of a building.

The superstructure is located above the natural ground level (above mark ±0.00) and it includes the ground floor, the mezzanine, the storey, the attic and the roof (the purling or the platform) of the building.

Usually a building has the following levels:

- *basemen*t (B)- located under the ground mark of the building (±0.00) and is partially or completely placed under the natural ground level;

- *semi-basement* (B_s)- when the basement has a high functionality (apartment, laboratory, warehouse, etc.) which need ventilation and natural illumination through windows, it will be partially located above the natural ground level, and it will be named semi-basement;

- *ground floor* (F_g)- is the first level located above the ground mark of the building, and it usually includes the main place of access into the building.;

- *stories* (S_1... S_n) are superposed levels, located above the ground floor, and the height of a storey (H_{storey}) is the distance between the finished floor of the storey platform and the finished floor of the storey above (fig. 1.18).

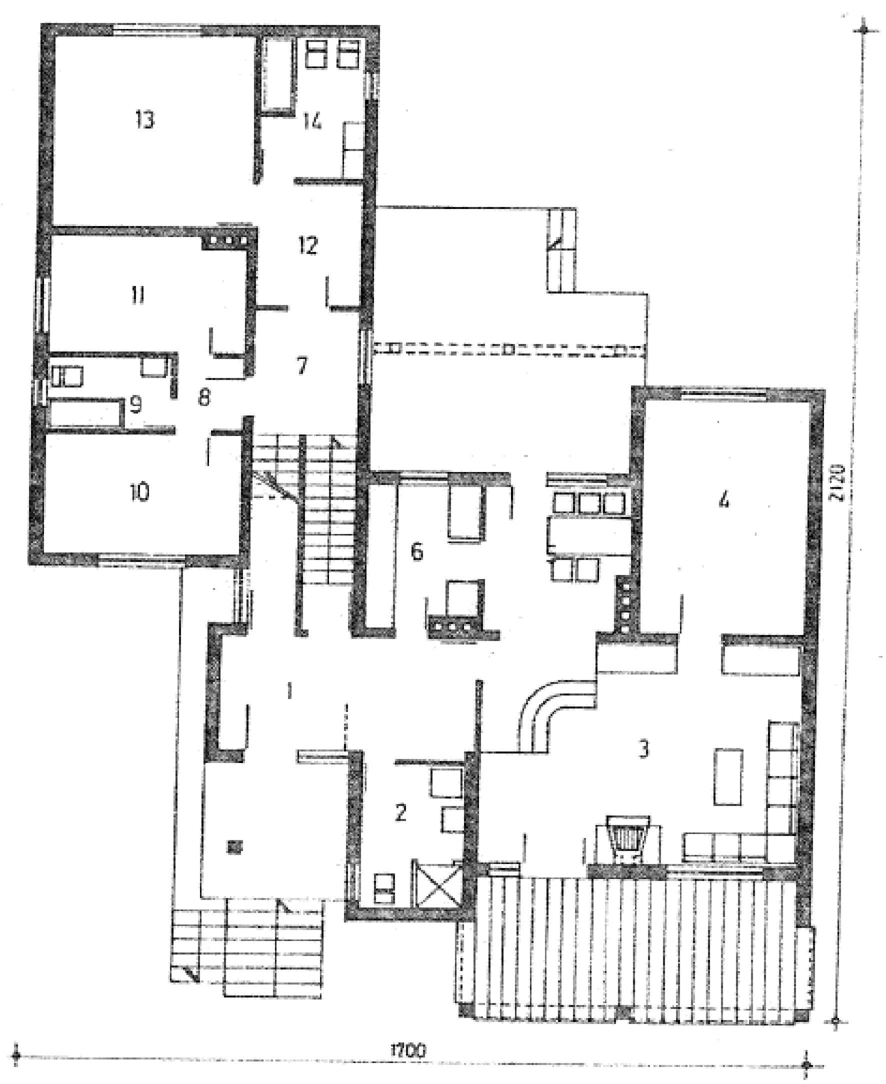
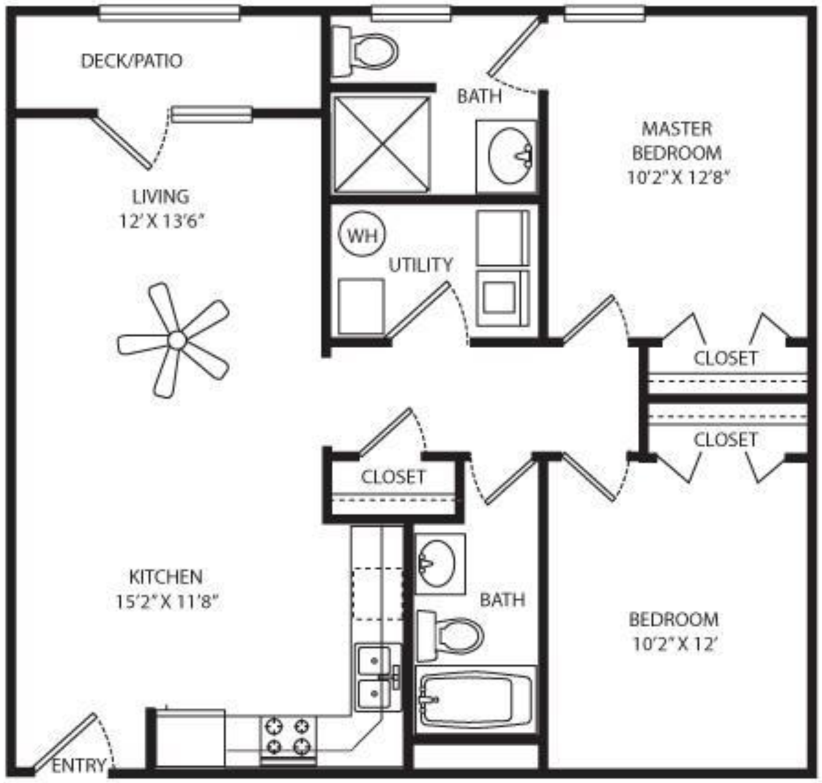


Fig. 1.17 – Subdivisions of the ground floor of an apartment building
1- access hallway: 2, 9, 14 - toilettes, 3- living room, 4, 10, 11, 13 - rooms, 5 - dining room, 6- kitchen, 7- staircase, 8- interior hallway, 12- passage room



2 Bed 2 Bath

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- the *mezzanine* (M) - if the ground floor of the building is located on a high underground floor, or if between the ground floor of the building and the first storey there is another floor which is not as high as any of the two (the height is obtained by vertically subdividing a high ground floor by an intermediary platform), then that level is called mezzanine;

- the *roof* (R) - is located on top of the last floor and has various purposes, mainly related to protecting the upper part of the building from climate factors, but sometimes having other uses.

The roof can be built with a low pitch (7-9%) - this being the *flat* type- or with a high angle- the *pitched* type. With the pitched type, the space between the last platform and the cover of the building is called *loft*.

- the *attic*- if the loft of a building with a pitched roof has a large enough free height, it can be arranged functionally as a living environment or a working place, naturally illuminated and equipped with all utilities, then the space can be referred to as an *attic*.

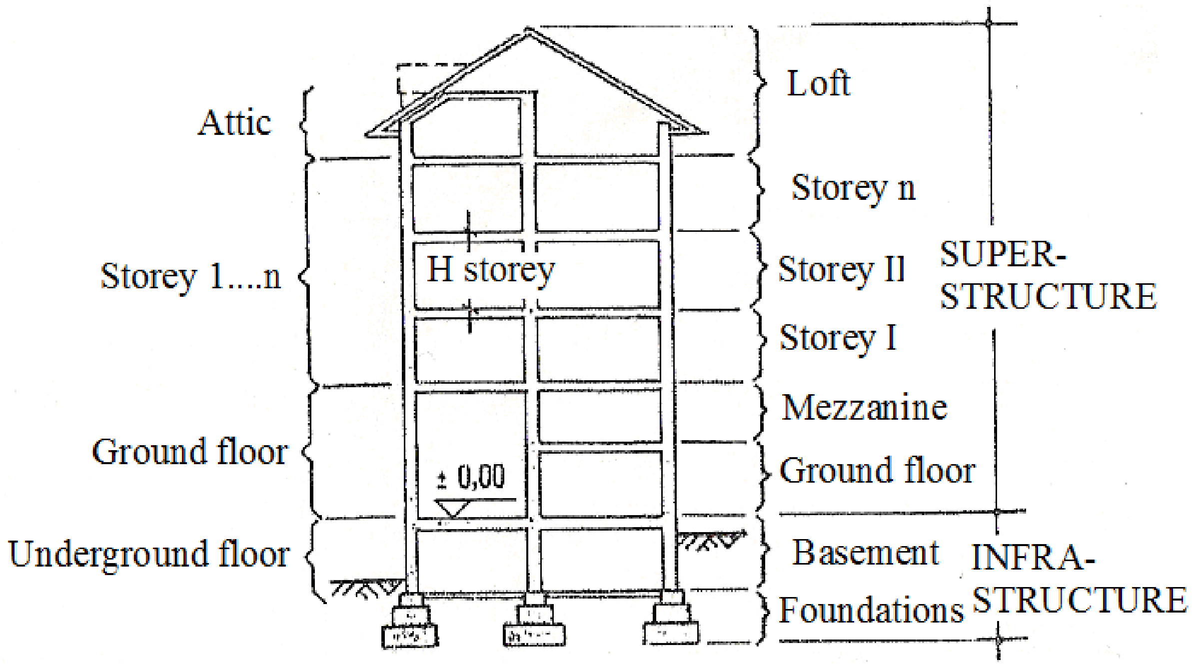


Figure 1.18- vertical subdivision of buildings

CHAPTER 2

ARCHITECTURAL STRUCTURE- BASIC PRINCIPLES

2.1. Generalities

It is obvious that, whatever we choose to accept as a definition for *architecture* as a science (see chapter 1, point 1.1), we have to accept its aesthetic and artistic meanings, and to try to understand its means of expression.

As opposed to other arts, architecture deals with shapes, material sizes and accurate techniques, the results of architectural endeavors being *finite objectives* that have to be "*useful, durable and aesthetic"* (according to Vitruvius [62]).

This can only be achieved through a complex creative process which requires, apart from the technical and artistic knowledge of the architect, psychological implications, intuition, imagination and talent.

THE CONSTRUCTION is the result of an architectural creation and must suit (through the functionality of the designed space, through its dimensions and proportions, through its shape and decorations, through integration in the built environment) the needs of man, his life and activity.

The multitude of human interests, generated by the economic boost of modern times, has led to an extraordinary variety in the dimensions and shapes of buildings, both in the inside and in the outside, so that nowadays it is increasingly difficult to accept the existence of an architecture specialist (regardless of how well-trained and capable he/she is) who could come up with and design any category of constructions or architectural projects that can best fulfill the requirements of the vitruvian "trio" [62]: - ***utility*** (efficiency and functionality), ***firmnesss*** (strength and durability), ***aesthetics*** (beauty and expression).

This is why it is not only understandable, but also encouraged, that architects tend to specialize on a relatively narrow area of architectural practice and design, where the results of their work can be optimized from the point of view of quality and economics.

2.2. Characteristics of architecture

In order to fully satisfy a man's needs and the requirements that buildings must reach (see chapter 1, points 1.3 and 1.4), *architecture* needs to ensure the following basic characteristics for these:

SOLIDITY, UTILITY, AESTHETICS, ECONOMY

The first three "attributes" of architecture [16], [17] have been mentioned by Vitruvius, ever since the 1st century B.C., whereas the fourth, the one regarding *economics*, appears only later and is demanded by the progress of society and by the understanding of the fact that the material resources of mankind are fewer and fewer by the day.

SOLIDITY - was defined by Vitruvius as *"a depth in foundations reaching a solid layer and wisely choosing, without miserliness, the materials."* And this expresses what today we call *the ability to withstand the effects of time-* ***durability*** *and the pressure of gravitational and horizontal charges-* ***resistance*** *or* ***bearing capacity*** *and* ***stability***.

- ***durability*** - the characteristic of a building to withstand in time the action of natural factors (physical, chemical, biological, etc.), and it can be expressed through the *lifetime* (time of usability) of the construction, which can sum up to tens or even hundreds of years, depending on the type of building, on the material used for the construction and of the building's importance;
- ***mechanical resistance*** (*bearing capacity*) - is valued according to the endurance level of the *structure* or of its elements (foundations, walls, pillars, beams, platforms, staircases etc.) under normal functioning to the simple or combined charges that are applied on the building.
- ***stability*** - is the structure's, and its elements' ability to maintain their shape and position (therefore, soundness as well) under the effect of various actions (horizontal or gravitational charges, strains, movements, etc.)

In the Antiquity and the Middle Ages (see chapter 4), the solidity of buildings was ensured by the use of *massive construction elements* and the *durability of the main building material*-stone, while the modern buildings of today are made durable through an *advanced construction technique*, through *quality of the constructing process* and through *the superior properties of modern construction materials.*

UTILITY- was defined by Vitruvius as *"a correct division that allows for an easy use of the rooms and a fair and measured allotment of any structure according to its purpose"*, and can be seen as the *quality of a building of corresponding entirely to the purpose for which it was created*. In other words, the *ideal effectiveness* and *functionality* of the built space defines its *utility* and can be judged by:

- -the placement and orientation of the rooms in a building, as well as of the structures' in the building site;
- -the way in which certain issues have been handled, such as connecting the rooms and making sure there is easy access both horizontally and vertically throughout the interior of the building;
- -the degree to which the interior space respects the physical and hygienic conditions requested of the constructors (see chapter 1, image 1.13) and the *utility functions* (working, sleeping, relaxing, going about, shelter, food preparation, hygiene, storage, etc.)

Although utility is not always considered a fundamental attribute of the constructions (since it is not a *capital* condition, without which the building could not exist), it is nevertheless necessary to underline the major role that utility plays in any construction, since a building that does not conform to the function for which it has been constructed will not only lack a justification to exist, but can also be a hindrance for man, as to what his life and activities are concerned.

AESTHETICS - Vitruvius' definition *"...when the way a construction looks is pleasing and elegant, and the size ratio of the components will correspond to the proper rules of symmetry"*, illustrates *the degree by which the building reaches the beauty and expression standards*, which are ranked according to appearance and architectural structure (the lights and shades works, the interchange between full and hollow structures, combining shapes and sizes, decorating and finishing, etc.).

Aesthetics are also not fundamental to the construction of a building, but they are fundamental to man, because ***"beauty" is part of the human spirit and it is always associated to pleasure*** [16], while "the hideous" is associated to discomfort.

Beauty in architecture (according to human sensitivity) can bring inner peace, calmness, joy, and can even contribute in an increase of work efficiency (this is confirmed by studies made in the field of working psychology), while "the ugly" (expressed through shape, color, decorations of a certain space, etc.) can lead to fear and discomfort, discontent and inhibitions, these in turn leading to no material or spiritual fulfillment.

ECONOMY- this is a new feature of architecture, because for a long time saving on materials in constructions has been considered a sign of poverty and was therefore associated to a lack of means and materials, which meant that architecture was to neglect the beauty and aesthetics of building.

Also, the absence of economy and the tendency to waste have sometimes led to certain buildings being constructed with spaces and proportions that were exaggerated and with an excess in decorations, which in turn led to dysfunctional and unaesthetic solutions, either because of the architect or because of the uninformed recipient.

The aesthetic qualities of a construction, its beauty and expressiveness depend on the means of expression, imagination and talent of the architect, and not on the excessive use of construction materials or on their intrinsic value, which is why it can easily be stated that *economy is a feature of modern architecture*.

The exaggeration of one or more of these architectural features while neglecting others has in time created some architectural currents (which did not last too long and which were not too influential, whose name dictate the very feature that had been exaggerated: ***"formalism", "constructivism", "functionalism", "aestheticism"*** etc. – chapter 4, point 4.13)

Of course, the ideal is to create a building that can reach all demands stated above, specifically firmness, usability, aesthetics and economy, but this purpose is not easy to reach, and it will remain a constant challenge to every architect, both of the present and of the future.

2.3. Architectural space and rules of architectural geometry

2.3.1. Elements of the architectural space

The architectural space is *"a void bordered by planes",* according to C. Jurov in paper [27], and this short-spoken, yet, suggestive definition can be put into an example quite easily: built spaces (which build the architectural shapes) are encompassing a useful space, which in turn can be split by the construction elements (walls, platforms, pillars, arches, domes, etc.) into elements such as volumes and spaces, corresponding to functional and technological needs.

Space in itself is an immaterial element that can only be highlighted by "bordering" or "closing" it between palpable, material elements whose shapes and locations determine the shape and functionality of the construction.

The architectural space can be expressed in various ways, according to the "degree of closure" it has, or the way in which it is perceived by man. Therefore, according to the Constructions and Architecture Lexicon [60], between the interior space (architectural ambient) and the exterior one (natural environment) one can define the following "special configurations" for the degree of closure of the space (image 2.1)

- - **zenithal space** - the space above what man can perceive

- - **parietal space** - directions forward- backward and left- right
- - **supporting space** - the horizontal plane of the supporting ground.

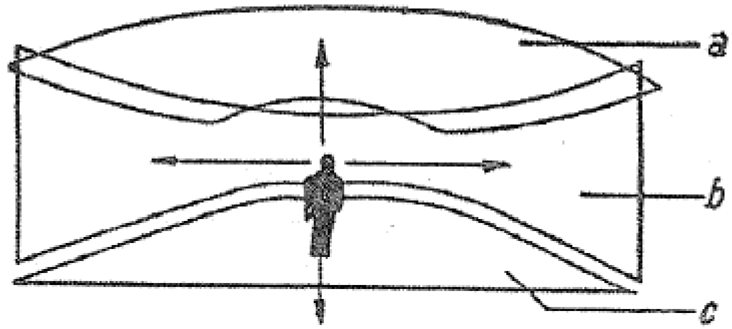
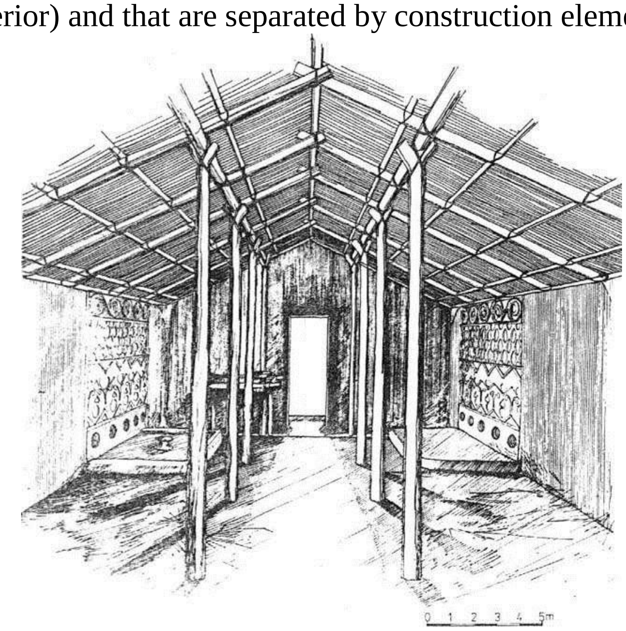


Fig. 2. 1 - Configurațiile spațiului arhitectural
a - spațiu zenital ; **b** - spațiu parietal; **c** - spațiu portant

On the other hand, between the two "extremes" of the closure degree of the space- *"total interior"* and *"total exterior"*- there is a series of "scale marks" of the closure and perception of space by people, called *"typical spatial situations of the anthropologic space*" in [60] (Fig. 2.2).

These *"typical spatial situations",* which represent the way in which the environment is perceived by man, are:

- - ***the exterior space*** (total) - where movement and perception are total on all directions (see fig. 2.2.a);
- - ***the curved space*** - which connects areas that do not communicate directly (interior- exterior) and that are separated by construction elements (Fig. 2.2.b)



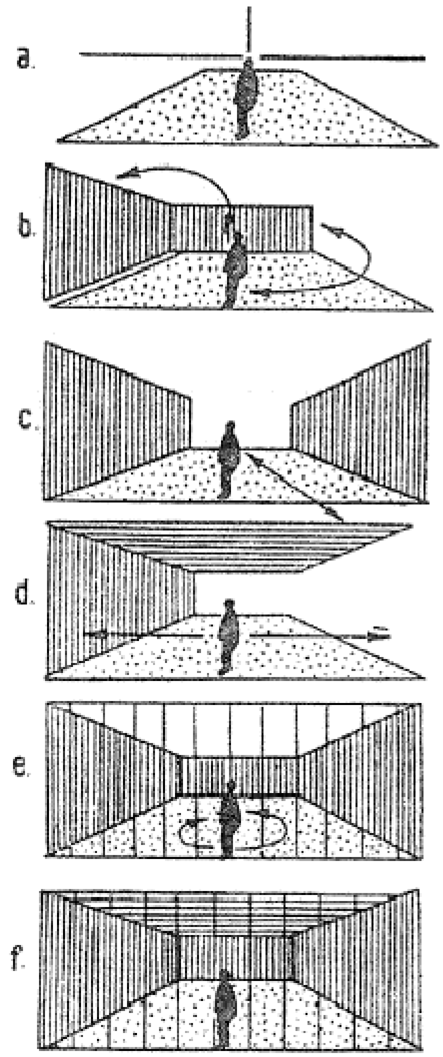
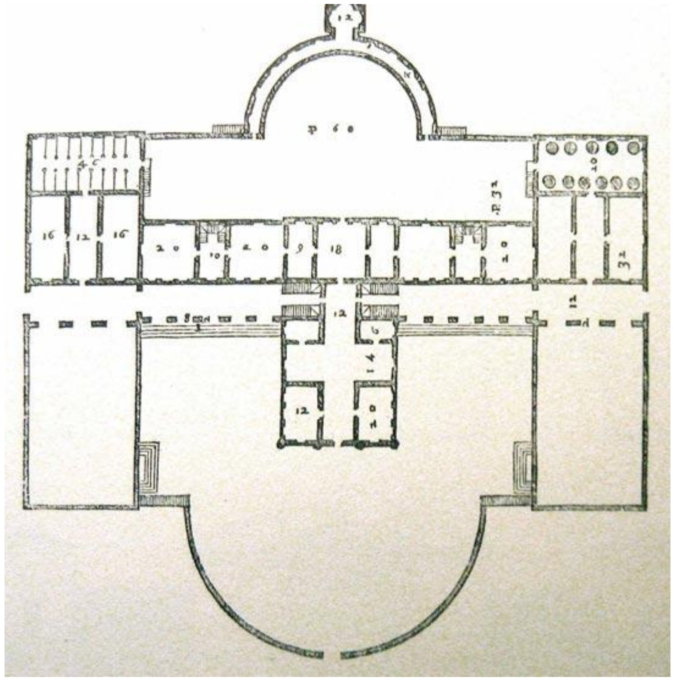


Fig. 2. 2 - Situațiile spațiale tipice ale spațiului antropologic
a - exterior; **b** - curb; **c** - tensionat; **d** - tranzitiv; **e** - circular; **f** - interior

- ***- the tense space*** - where movement is allowed on one direction: forward- backward or left- right (image 2.2.c)
- ***- the transitive space*** - it gradually leads from the interior to the exterior (lodge, terrace, porch, etc.- image 2.2.d)
- ***- the circular space*** - bordered in the parietal space and open in the zenithal space (patio, enclosures, squares, etc.- image 2.2.e)
- ***-the interior space*** (total) - movement is controlled and bordered in all directions by construction elements (rooms, chambers, etc. image 2.2.f)



Basically, in any building, regardless of its “functional plan” (number, shape, size and location of rooms), the architectural space can have the following components:

- - ***the access space*** - that connects the interior to the exterior (lobby, entry, entrance hallway, etc.);
- - ***the passing space*** - ensures the passing between rooms that have different or similar functions and has at least two entrance-exit points;
- - ***the collector-distributor space*** - has many entrance-exit points and it ensures the passing to and from several rooms (hallway, corridor, foyer, etc.)
- - ***the terminal space*** - it only has one exit-entrance point and its purpose is based on “stationary” activities (office, bedroom, bathroom, laboratory, etc.).

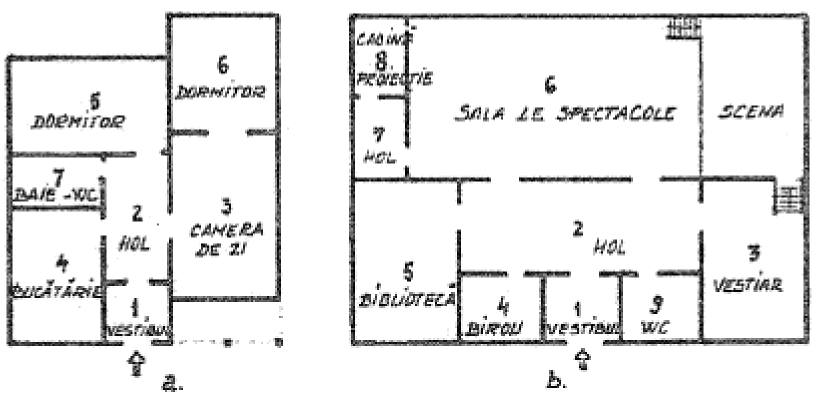


Fig. 2. 3 - Componentele spațiului arhitectural interior
a - locuință (1- spațiu de acces; 2 - spațiu distribuitor; 3 - spațiu de trecere; 4-5-6-7 - spații terminale); b - casă de cultură sătească (1 - spațiu de acces; 2 - spațiu distribuitor; 3-6-7 - spații trecere; 4-5-8-9 - spații terminale)

In figure 2.3 there are two examples of how to assembly elements of the architectural space for an apartment and for a social and cultural center.

Depending on the requirements of the functional program and of the positioning of the rooms in relation to the access space, there are:

- ***-separate*** entrance rooms, that are accessed directly from the access space (entrance hallway, etc.)
- ***-connected*** rooms, that are not accessed directly, but through an intermediary passing space that can also hold "stationary" activities (living room, office, etc.);
- ***-semi-connected*** rooms, which are not accessed directly but through an intermediary space that does not hold "stationary" activities (interior hallway, etc.)

In figure 2.4 there are presented three usual examples of functional solutions for division in space of apartments of block of flats with two rooms, having the room arrangements as ***separate (a), semi-connected (b)*** and ***connected(c).***

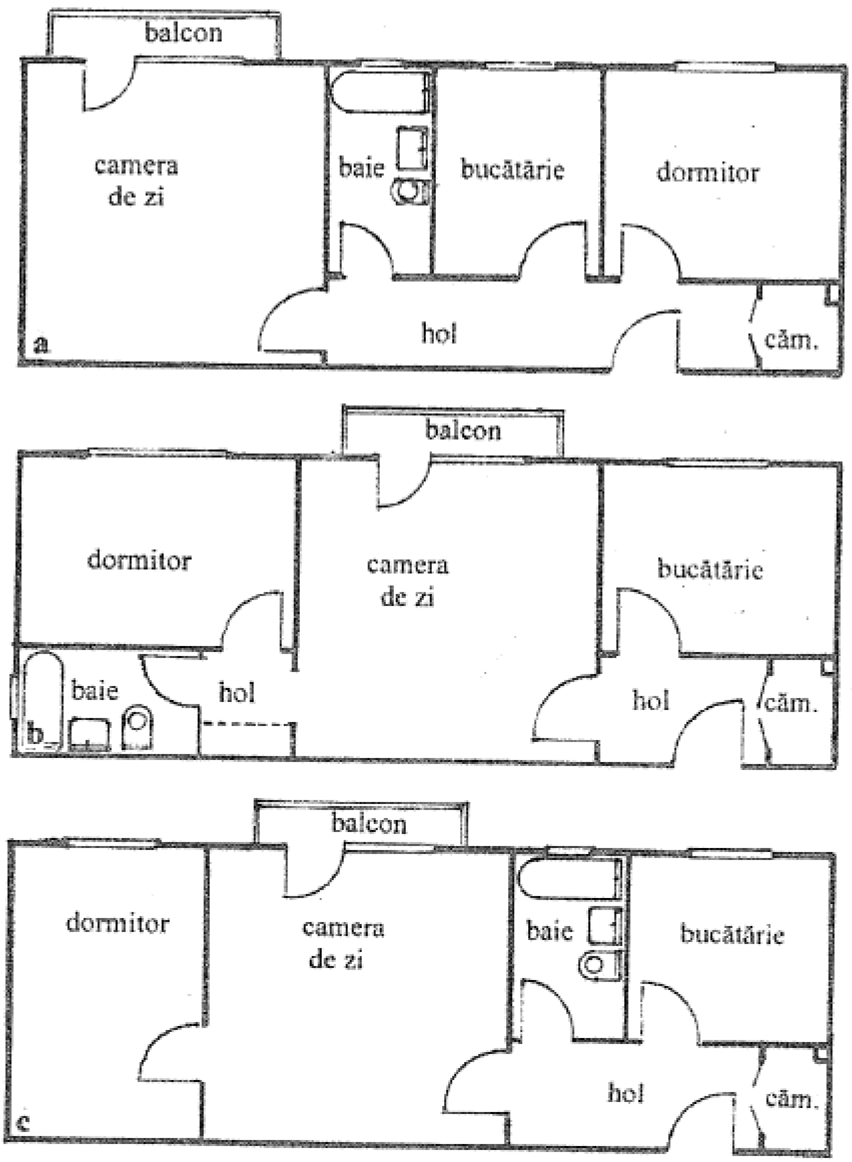


Fig. 2.4 – Example of a flat with two rooms

a- *separate* system; **b**- *semi-connected* system; **c**- *connected* system

The circulation structure inside a building (within an assembly of rooms) is underlined by the "intercommunication scheme" between the rooms (of an apartment, for instance) and it can be:

- an ***arborescent*** *structure* (figure 2.5.a), where the terminal rooms are connected through passing and distributor rooms;
- a ***net-like*** *structure* (figure 2.5.b) where some terminal rooms are connected, while some are separate-entrance (with direct access to the access space)

Obviously, net-like structures are better from the point of view of circulation, but the passing rooms offer less comfort to the users.

From the point of view of the ***directions*** where the interior architectural space develops there are ***two main directions***:

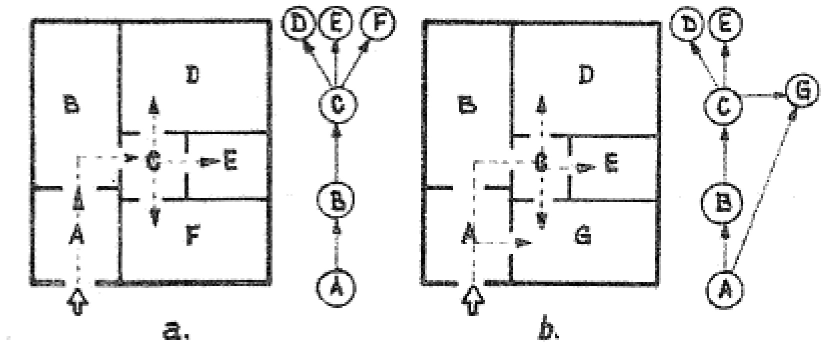


Fig. 2.5. The structure of intercommunication in a building
a- arborescent; b- net-like; (A-access space; B- passing space; C- distributing space; D,E,F- terminal connected spaces; G-terminal separate space)

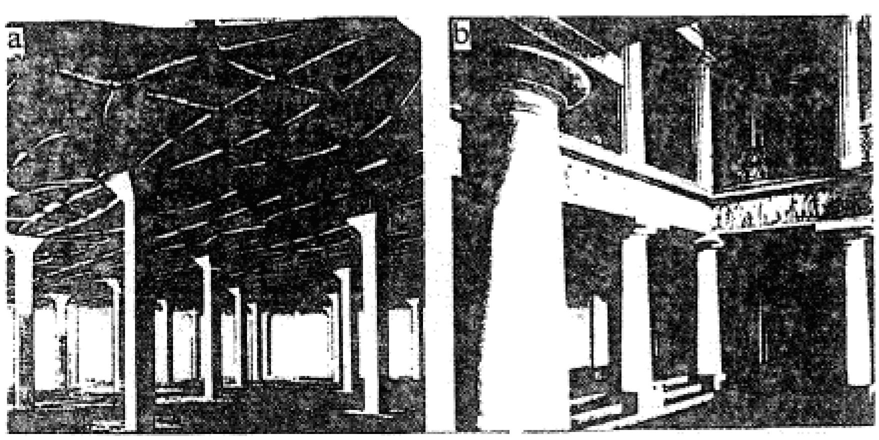


Fig. 2.6 The development of the space on horizontal **(a)** and on vertical **(b)**

a - the ***horizontal space*** (on the ground floor or on the floors of a building- image 2.6.a), being quite low in height (depending on the plane size of the space). These spaces are usually practical, they are the result of functional or technological needs, and they are used in several functional programs: apartments, commercial spaces, hall rooms and exposition pavilions, industrial warehouses, laboratories and education spaces, social-administrative buildings, cultural buildings, etc.)

b - the vertical space (image 2.6.b), specific to certain special functional programs, which require a heightening of the rooms: monumental hallways that take many floors (such as with hotels, banks, administrative buildings, etc.), staircases that are visible throughout the building's height, the main hallway in buildings where traveling services are handled, main halls in stores that take up more than one level, theater halls (theater, opera, etc.) that are surrounded by several levels of galleries, etc.

In another approach, by analyzing the types of spaces that are frequently used, the way in which they are *developed on the interior,* and their *connection with the exterior* and *the constructive system*, C. Jurov states in paper [27] that the most frequent types of architectural spaces are:

a. ***central*** spaces, based on using central balanced shapes (circle, square, regular polygon, etc.) that are "static", which minimizes the importance of architectural elements and focuses the attention on the activities that take place inside the main functional space (theater halls, main halls in hotels and restaurants, clubs, etc.);
b. ***deep*** spaces, which hold a "dynamic" characteristic due to their display, and which are developed on a single direction, usually horizontally. Examples: theaters (where the hall, foyer, the main hall and the stage are all on the same line), covered passages, underground stations, etc.
c. ***front*** spaces, which are perpendicular on the viewing direction and which are "honest" and accessible. It can be oriented towards the access area, the opposite side to the access area, or in both directions. The front space is usually used to design public buildings (such as for train or bus stations, cultural buildings, libraries, expositions, stores, hallways, etc.);
d. ***free*** spaces, which are not based on fixed, rigid geometrical shapes, and which are only conditioned by the abilities and intuition of the architect, so that the way in which rooms are placed is strictly functional;
e. ***compound (or complex)*** spaces are the result of simultaneously using more types of architectural spaces in an orderly mixture, where one of the types is considered the main one, and the other ones used are secondary.

2.3.2 Elements that influence the architectural space

As shown in chapter 1 (point 1.3), the architectural design of a building is influenced by two main factors: *human* (through size, activities and needs) and *nature* (through natural factors that define the location).

Obviously, the architectural space (interior and exterior) is directly influenced by the same two factors (and these greatly influence the size and shape of the architectural space, the distribution of volume and the relation between these, etc.) but sometimes the architectural space can be also influenced by an important technical factor: *the load carrying frame of the structure* of the building. How? Look how:

-when the structure of a building is imposed by certain natural conditions of the terrain or of the placement zone, the size, the shape, and the placement of the interior space components (of rooms) are influenced or even imposed, enclosing the architect's freedom of creation.

Example: -placing a building in a highly seismic region imposes the utilization of a structure with higher resistance to horizontal loads -*structure with bearing walls*, which compels the designer to choose a relatively ordered and symmetrical shape of the planar projection of the building, and also to a vertical "monotony" (dimensions and the placement of the building elements and hollows) and in consequence it imposes a strict functional plane and a monotonous architectural space.

The architectural space is also influenced by some "special", immaterial elements, like the ***light*** (electro-magnetic radiation which has the property to impress the human eye) and one of its attributes, the ***color***.

LIGHT- has a very important role in the conception and reception of the architectural space from functional as well as from graphical point of view, because by its decomposition in colors and by its variation in intensity (resulted from the rooms' orientation with respect to the cardinal directions), interesting effects are obtained to the architectural space.

From the point of view of the generating source the light can be:

- ***natural*** *light* (daylight), with the unique source the sun, having a continuously varying intensity depending on the season, hour, meteorological conditions, geographical position (according to the angle formed by the incident rays and the surface of the Earth), atmospheric pollution level, etc.

- ***artificial*** *light*, having artificial sources, with possibilities for adjusting the intensity, duration and direction of the light.

Because artificial sources of light can be controlled and adjusted according to human desire (of the designer or of the beneficiary of the architectural space), the main problem remains *the possibility of optimal exploitation of* ***natural light***, by measures, methods and means close to the designers options (in the designing phase of the construction):

- orientation and placement of the building and its rooms
- exploitation of relief and vegetation, etc.

In order to choose the buildings' placement and orientation, some *"rules"* must be known:

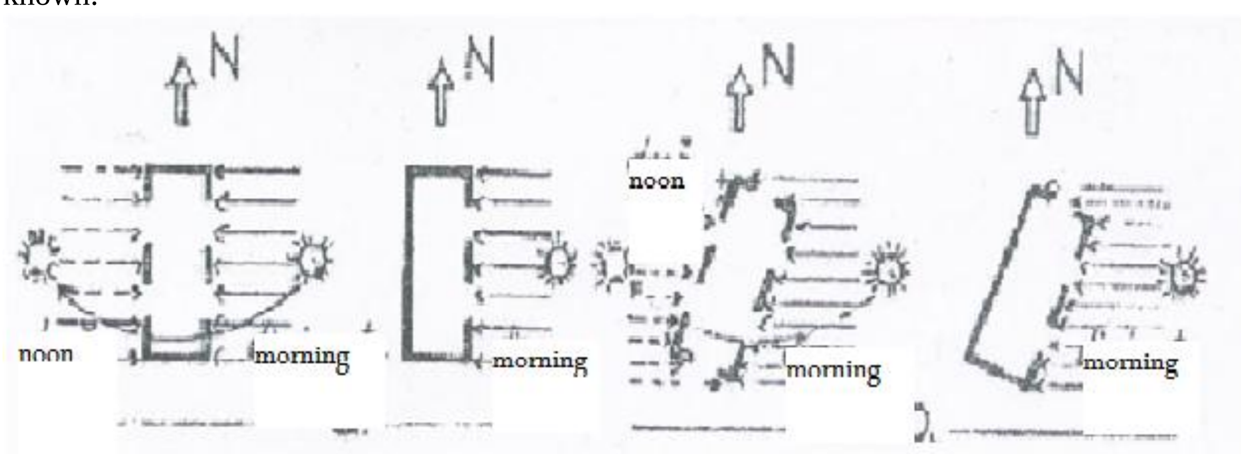


Fig 2.7- Buildings' orientation according to the geographical orientation
a - buildings with windows placed on one or two opposite faces (the first 2 drawings);
b - buildings with windows placed on adjacent faces (the last 2 drawings);

-in order to obtain at *least three hours a day of sunlight* in the rooms where people live and work, the building orientation with respect to the cardinal directions must be made taking into account the positioning of the main rooms (the most important for human activity) with the windows placed on one or more faces of the building (fig. 2.7).

The fact that the rooms with the windows placed on the north facades have no sunlight (in the north hemisphere) it’s explained due to the orientation of the Earth towards the Sun, by its movement round the Sun, and the movement around its own axis.

All these elements with respect to the problem of exploitation of natural light explain the existence of a *permanent shaded zone (*marked with A in fig2.8) the size of which depends on the dimensions of the building, its planar projection, and also of its orientation with respect to the cardinal directions.

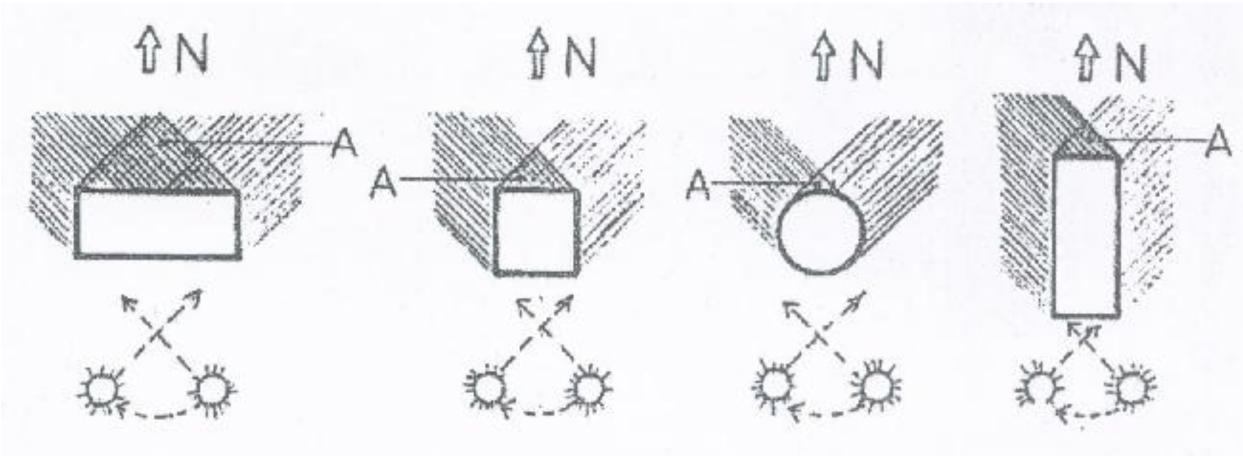


Fig 2.8-The size of the permanent shaded zone

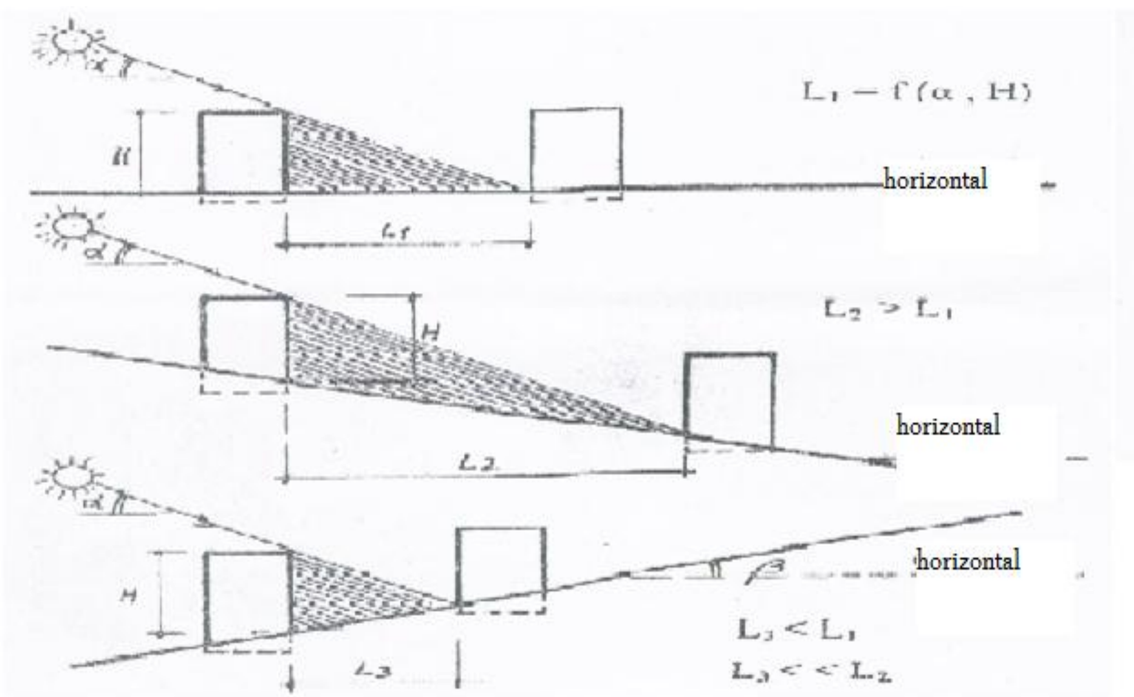


Fig2.9-Choosing the distance between buildings

- to avoid *mutually shading*, choosing the distance between adjacent buildings must take into account the *orientation and the slope of the placement terrain*-fig 2.9 (the height of the terrain reported to the sea level must also be considered).

You can see in fig 2.9 that this distance can be reduced pretty much when the slope of the terrain is orientated in the *opposite* direction with respect to the prevalent direction of the sun rays.

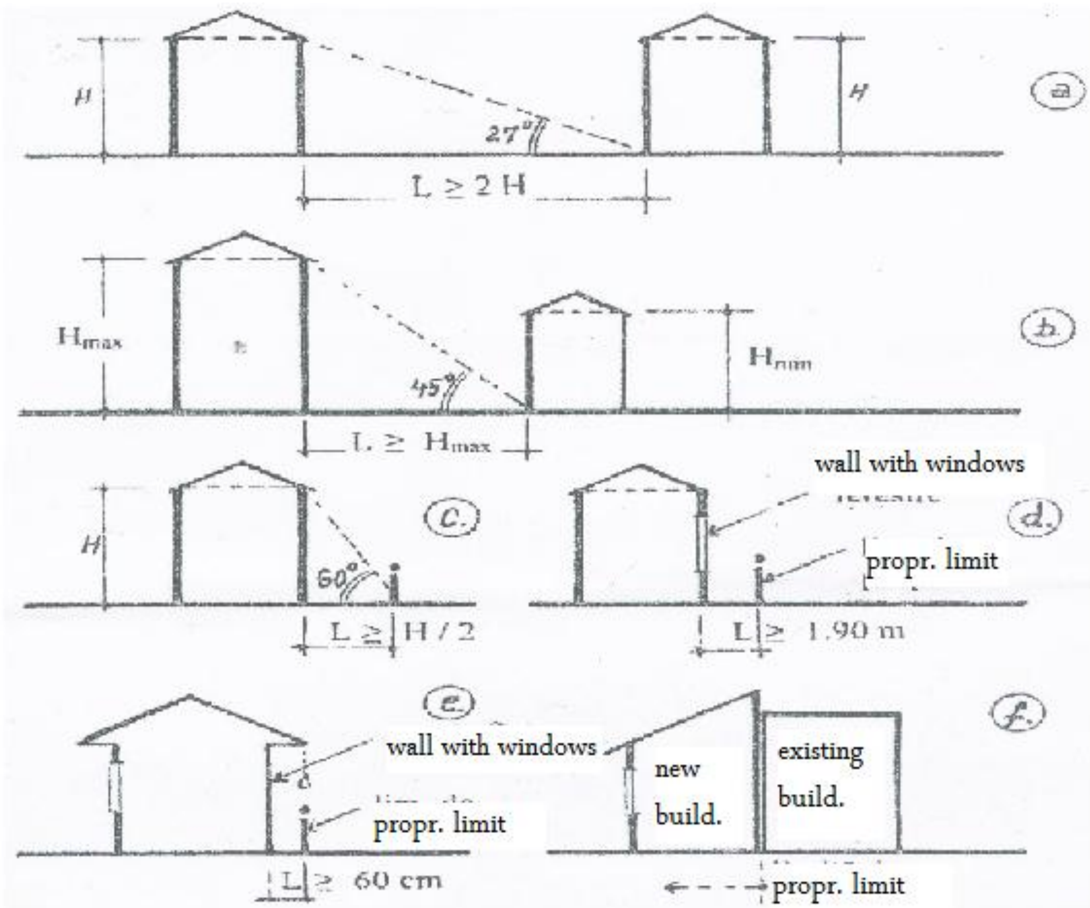


Fig2.10- Minimum distances between nearby buidings
a-buildings with the same height; **b**-buidings with different heigths; **c**-distances between buidings and enclosure; **d**-distance between window and nearby property; **e**-avoiding water dropping on nearby terrain; **f**-joint buidings

-the minimum distance between buildings can also be determined considering the *fire protection terms* (L_{min}=6…15m depending on the fire resistance level of each building) or in function of *their height* (fig2.10)

At the same time with the norms which assure the natural illumination by respecting minimum distances between structures, there are also national or local *"norms"* (issued by the urban administrative structures) which conditions the reciprocal placement of buildings in the urban terrain in function of some other criteria:-avoiding water dropping on the nearby terrain; avoiding the sight towards the nearby property through the windows facing it, etc.

In fig 2.10 are presented some of these terms, generally accepted by the urban norms presented above.

The orientation problems of the building and its rooms according to the geographical position it's also important from the point of view of the thermal comfort, because the illumination is obviously coming with the warming of the space (phenomenon accepted in winter but undesired in summer). This is why the orientation and the placement of the buildings must take into account the necessities of natural illumination as well as the necessities of assuring the internal thermal comfort.

As it is known ([21], [43]), in case of global positioning of Romania (in the northern hemisphere) the natural condition "offered" in function of the geographical positioning are totally different:

- The EAST is characterized by powerful illuminated mornings, with pleasant warming in the summer, but with powerful and fast cooling in the winter;
- The WEST is characterized by an aggressive illumination in the afternoon, in the summer the almost horizontal sun rays becoming disturbing;
- The NORTH is considered an inauspicious direction for most of the rooms, the light being uniform but reduced in intensity the hole year (the zone being not so sunny), and the predominant cold winds make the north direction cold and uncomfortable in the winter;
- The SOUTH represents the best orientation for the main rooms of the buildings because here the illumination lasts much longer. In the summer, the sun is high on the sky during noon (having maximum declination) therefore the illumination is reduced, while in the winter when the sun is lower on the sky the effect of the sunshine (including thermal one) is favorable (fig 2.14).

Specialty literature [34], [41], [43], presents recommendations regarding *optimal orientation* for rooms depending on their destination.

For example in fig 2.11 these recommendations are presented, after [21] and [43], for the most common building types (flats, social-administrative buildings etc.).

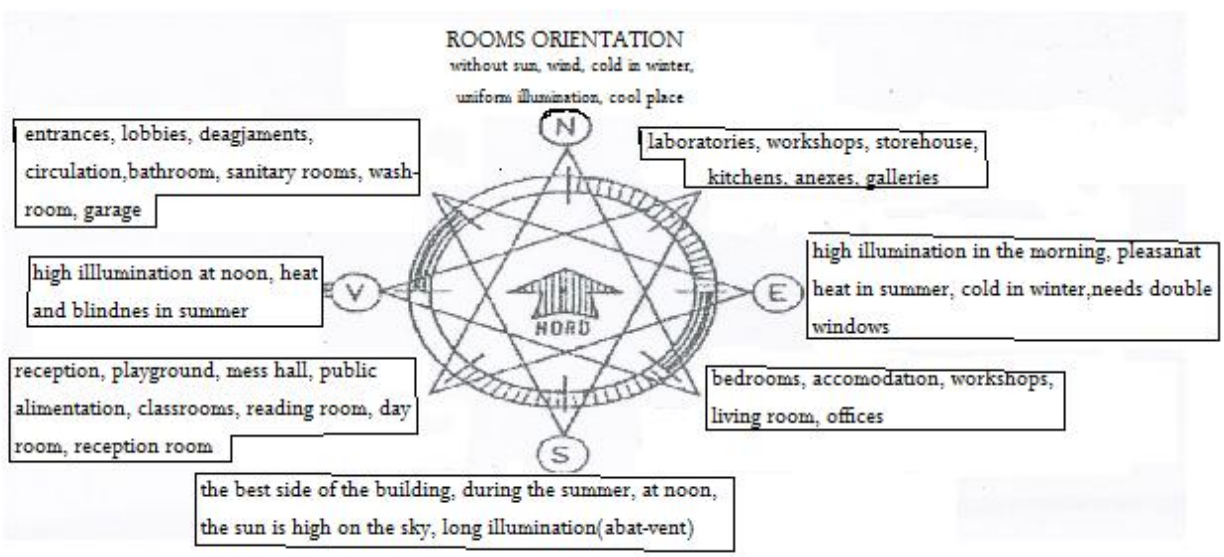


Fig 2.11-Recommendations regarding the optimal orientation of the rooms

The natural illumination of the interior space has the disadvantage that *the light intensity is variable in the room*, the space near windows being much more illuminated than the rest.

The illuminating rate of the rooms depends on the windows' size (length and wide) but also by the distance between the floor and the window.

In fig 2.12 it is presented (after [34]) the relation between the *natural illumination intensity* of the rooms, the *position of the window* (the height of the beam of the window-h_0 according to the working level of the room) and the *distance from the window* (depth of the room). In case of some windows (with the same height) situated high above the working level the illumination level is low, but relatively constant on the room's depth (case **a**), while in the case of low positioned windows (case **e**), the illumination level is high near the window but decreases with the distance. This conclusion conducts to the recommendation that in case of rooms' orientation towards low illuminated directions, bigger surface windows shall be used and also lower window parapets.

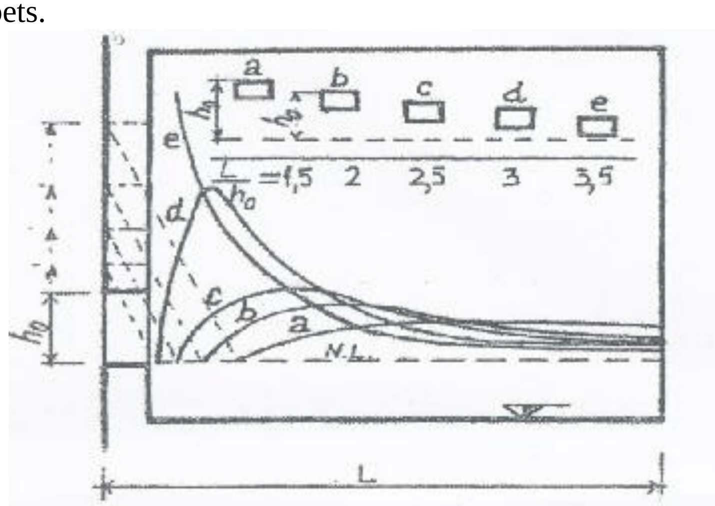


Fig 2.12-Natural illumination intensity regarding the position of the windows

Some norms state the optimal reports between the windows' surfaces (S_f) and the room's surface (S_C), necessary for assuring proper natural illumination in the interior in function of the type of the building:

- -for living rooms: S_f/S_C=1/6-1/8
- -for reading rooms: S_f/S_C=1/5-1/6
- -for classrooms: S_f/S_C=1/3-1/4
- -for laboratories, workshops: S_f/S_C=1/3-1/4

noticing that these informative ratios must take into account the position of the window, its orientation, etc.

To assure optimal illumination it is also important the *ratio between the width, height and depth (length)* of the room. So, the recommendation of paper [34] is that *the depth of a room* (the distance between the window and the opposite wall) *must be smaller then twice its width or height* (fig 2.13).

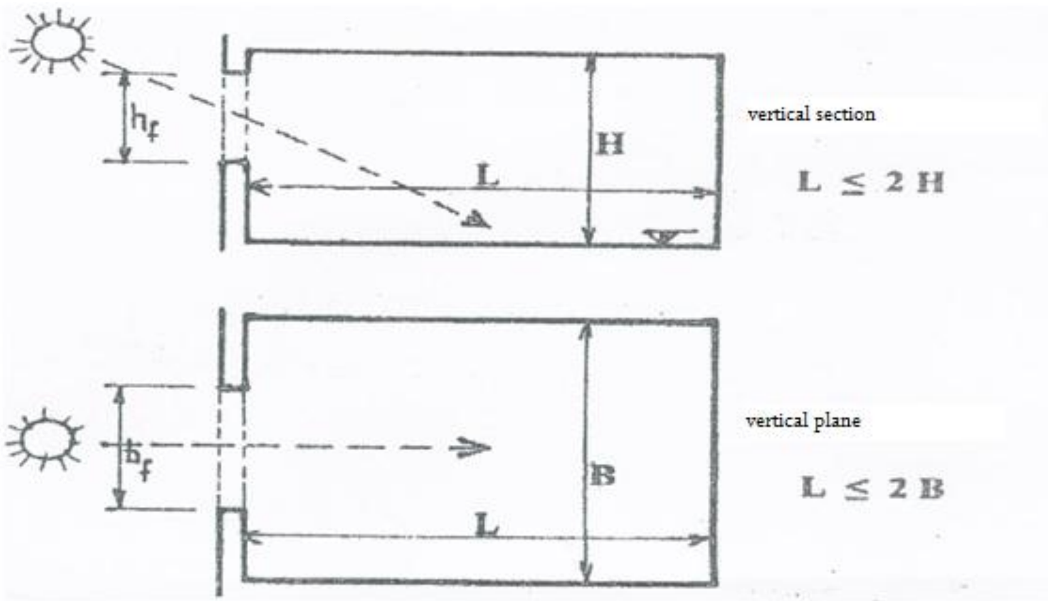


Fig 2.13-Recommendations regarding the depth of the rooms

A recommendation for normal natural illumination of the room (or protection against excessive sunlight during the summertime) is *choosing some building systems with balconies on the facades with the orientation towards the highly illuminated direction* (loggias, that reduce the strong sunshine in summertime, when the sun has more declination, but still permit it in wintertime, when the declination is smaller – fig.2.14.a) *or the avoidance of using loggias and balconies on the facades oriented towards reduced sunshine,* not to reduce even more the natural illumination of the rooms (fig2.14.b).

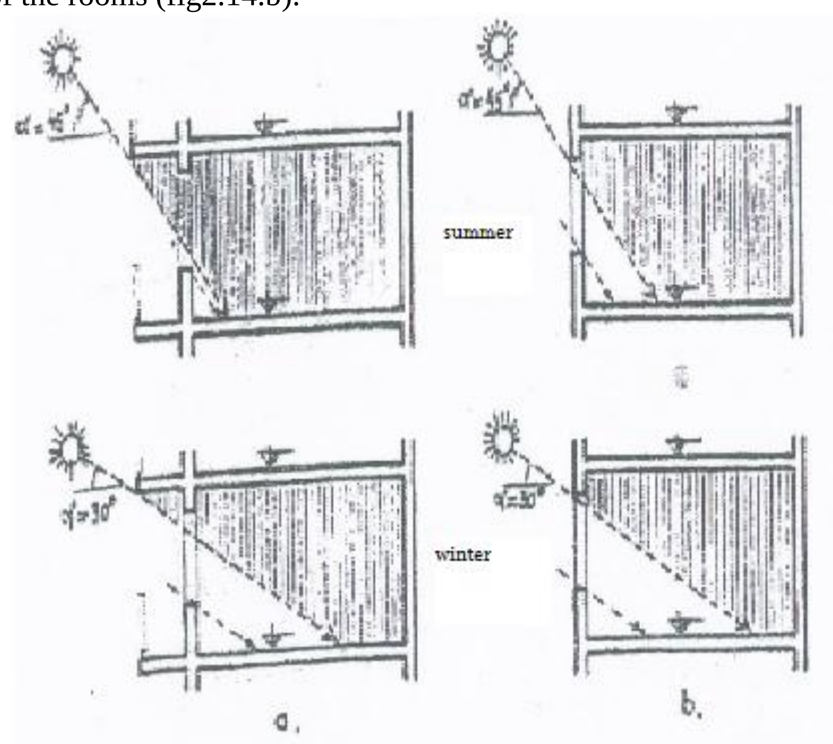


Fig 2.14-Influences of the balconies on the rooms' illumination

Of course, it is difficult to construct buildings in which all the rooms are optimally illuminated (taking notice of the other criteria on which relies the building placement), but the buildings' orientation can be made so that the rooms with the basic functions (in which people spend most of their time, through work or recreation) to benefit from proper light.

In this sense *the concept for the function of the building* is very important (the way the rooms are placed in the functional plan), concept that depends in great measure of the skills and professionalism of the designer.

If assuring direct illumination of rooms is sometimes difficult (for the reasons above presented-related to orientation), avoiding excessive illumination, or avoiding direct hit of the sun rays on the work field its easier to obtain from *using some constructive elements for facades protection* (lamellas, anti-solar elements, etc.).

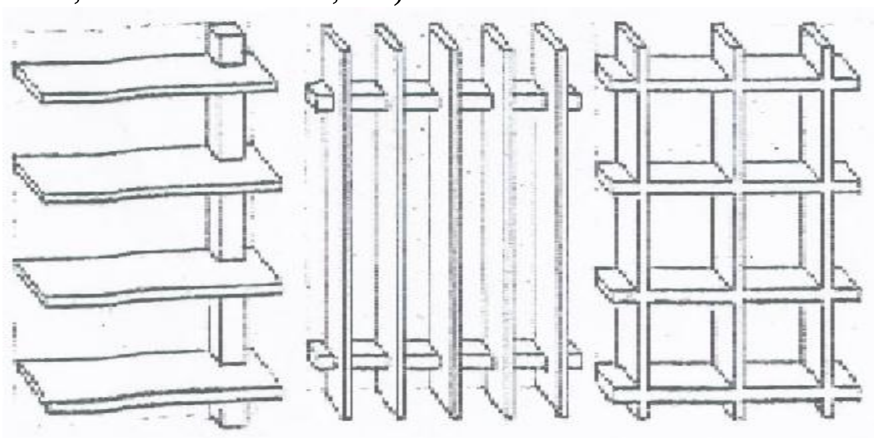


Fig 2.15- Anti-solar construction elements of facades

With the introduction of these un-structural elements in the concept of a building, it's realized at the same time the modification of the traditional aspect of the façades of the building and the creation of a modern architectural frame.

Anti-solar elements (blades) can have different shapes – straight, splayed, twisted, corrugated, etc. and can be placed horizontally, vertically or combined in the shape of caissons (fig.2.15).

Elements of anti-solar protection can be realized from *armed concrete*, *metal* or *plastic materials*, can have different colors and textures, and can be *fixed* (tied to the structure) or *mobile* (with variable position depending on the angle under which the sun rays "fall" on the building).

COLOR, is also an important element which influences the architectural space and in consequence, the comfort and the state of mind of the people, that's why it is a factor available to the designer for the creation of a suitable ambient in residential buildings, industrial ones or in any other type.

The colors distinguished by man are, [34]:

- **simple colors**: *red, yellow, blue*;
- **complex colors**: obtained by combining simple colors (in different proportions resulting different hues and intensities);
- **neutral colors**: *white and black.*

The effect of colors on man is psychological, and colors can give people different sensations, according to their sensibility.

Therefore some colors can give the sensation of heat and intimacy and are called "*warm*" colors (red, orange, yellow and variations) while others can give a cool sensation, being considered "*cold*" colors (blue, green and variations).

The characteristics of a few of the colors that are most frequently used (simple, complex and neutral) are:

- red - live and "exciting" color (very intense perceived with yellow and less intense with blue), but with tiring effect on human eye;

- yellow - a "light" calming color, giving the sensation of brightness, calmness and joy;

- blue - "cool" color, visible even in poor lighting conditions and attenuates the red;

- green - calming effect on man (doesn't excite the vision), gives a feeling of coolness and of freshness and contrasts strongly with red;

- purple (complex color) - gives the feeling of "weight" and "massiveness" to the elements of construction, reduces the luminosity of the spaces and creates the feeling of shrinkage of the room;

- black – light absorbing color, gives the feeling of sobriety and seriousness having a "gloomy" effect on man. Black gives a "depth" effect of the rooms, of "distance" of construction elements and intensifies the contour of nearby colors (especially the family of red). It is considered a cold color;

- white (contrast of black) – is also a "sober" and "serious" color, with no intimacy, but has a positive effect on the space, increasing luminosity and giving a feeling of expansion. White reduces the intensity of the colors which are near (except black).

Taking into account the "characteristics" of the colors described, a few *recommendations* are used in the decoration of the outdoor and especially the indoor of the building:

- - using some "warm" colors for North orientated façades, reducing the cold feeling of this orientation;
- - use of "reflective" colors (white in different intensities) which do not absorb the sun rays, at façades strongly lighted (West and South-West);
- - use of "contrasting" colors with the ambient green – vegetation (when you wish to accentuate the construction) and of "attenuating" colors (when the wish is to merge the building into the environment);
- - using light and warm colors at the inside of rooms poorly lit, and of dark, cold colors in rooms with strong lighting;
- - using light colors in rooms with small spaces, and darker colors in big spaces;
- - accentuation of some elements of construction, machines and installation (in industrial buildings) by using vivid, intense colors with the purpose of informing-warning and "cheering up" the interior space (psycho-sociological research of work in some advanced countries – Japan, USA, Germany, etc. have shown the positive effect of the use of "happy" colors – with a studied intensity - over the human mind and in consequence, on the productivity of work, on the recovery of the work capacity and its recreation, or on the contrary, the unfavorable effect of an inadequately colored environment).

For exemplification, in the case of *homes*, the recommendations from above would convey like this (taking into account the destination of the rooms):

- for *dining and living rooms* light, pastel, soothing colors;
- for *bedrooms* warm, relaxing colors with studied intensity taking into account the orientation of the bedroom;
- for *workrooms* and *kitchens*, light hues of cold colors is recommended;
- for *bathrooms* and *sanitary groups*, light, pastel, warm colors;
- for *hallways* and *vestibules* (especially the ones with no natural lighting) are recommended light, luminous colors.

As a conclusion of the above, it can be underlined the important role the colors have in the definition of the architectural interior and exterior space and so in the work and life of man. This role is accentuated with the *combination of the colors together with the lights and the shadows*, and the relations between *color, lighting and texture of construction materials,* relations which can modify substantially in a negative or positive way, the esthetic or even more, the practical values of a construction.

2.4. Architectural composition – laws and basic rules

The basic rule of the architecture phenomena, defined in work [16] as "*the assurance of the satisfaction of some decisive material and spiritual needs, that have appeared by necessity along the historical development of the society*", reveals the fact that, unlike other human activities which satisfy human material or spiritual needs, *the architectural creation is one of the few human activities which has to satisfy both material and spiritual needs of the man.*

This complex characteristic of the architectural creation phenomena obliges the architect to be a creator of beauty, a man of art, but in the same time a good technician, because the product of his work – the construction has to have all the four fundamental attributes (mentioned in chapter 2.2.): *firmness, utility, esthetics and economy*.

To satisfy their requirements, the architectural creation is based on "*laws"* and "*rules"*, which properly applied, guarantee a work of art.

2.4.1 The laws of architectural composition

The fundamental laws of architectural composition considered by work [16] are – ***causality, necessity and legitimacy***:

- **- *causality*** – expresses the cause-effect interaction, putting into focus the fact that at the base of the architectural phenomena there is always a cause: -the need of man to be protected by exterior factors, by sheltering in built spaces;
- **- *necessity*** – accentuates the truth, that the apparition of the architectural phenomena is the effect of human need, a need which also contoured the fundamental attributes of architecture;
- **- *legitimacy*** – expresses the fact that the architectural creation is based on knowing and applying *laws of architectural composition*, which are reflected in each architectural creation.

Architectural composition, appreciated by [16] as *"the process of elaboration of an architectural work according to the fundamental attributes and the laws of the architectural phenomena*", assumes actually a process of complex creation which must end in a work of unitary architecture, with the component part harmoniously linked and of which the shape corresponds with the function.

In other words, architectural composition must create *esthetic shapes* which reflect the content, and can be realized within the economic limits, and constitutes a unitary ensemble and to fit into the environment.

The architectural shape is (according to [47], *"a system which united the totality of spatial elements corresponding to the side of function called spirituality".* Even though you might assume that spirituality is the only factor determining the shape of the work of architecture, it is obvious that we can not neglect the material element – the structure and the fact that the shape is *"a reflection of the structure"* [16], and that its must "suggest" the content.

The architectural composition uses *esthetic forms* which reflect the content of the architectural work, and these shapes can be linked in a unitary ensemble by respecting the ***laws of architectural composition****: - law of unity, balance, contrast, order and dominance* [16].

UNITY in architectural composition expresses the idea that all of the component elements (shapes) of an architectural work have to be correlated in such a way to result a unitary composition that creates a linked and esthetic harmonious ensemble.

The reciprocal tights between the component parts of a whole can't realize the unity of the ensemble unless these tights are realized between elements of different nature, position or role [16].

Work [27] shows that "*unity mustn't be mistaken with monotony*" and exemplifies so: - a building made of identical objects close to each other doesn't express unity, or a building monotonously developed horizontally or vertically (by the repetition of identical construction elements) doesn't form a unity unless by the intercalation or the introduction of some accentuated elements (shape or color) or by the "rhythm" of the distribution of the construction elements.

According to the facts mentioned above, the unity of an architectural work can be realized by making use of the *"variety"* and the *"contrast*" of some elements having reverse impressions: - vertical elements opposite to horizontal ones, special void shapes inserted into rows of identical voids of the buildings façades, accentuated colors or materials introduced in a monotonous surface, etc.

The BALANCE of an architectural work is realized most easily by *symmetry* (the rule according to which the shapes, volumes and masses of an architectonic ensemble are distributed equally with respect to an axis or a point of reference), but sometimes balance can be realized without the perfect symmetry of the component elements, too.

Architectural balance can be obtained, either visually of *the whole composition*, either by the point of view of detailed elements. This way you can realize *a balance of mass* or *volume*, *balance of colors* or *shapes*, *balance of materials*, etc.

In the same time, architectural balance can be realized by the placement of different visual elements in a way which would suggest harmony, order and unity, without the use of a rigorous symmetry.

According to the work [27], the planar shape of a construction assuring architectural balance mostly is the central static space, based on rigid and balanced planar shapes: *circle, square, regulated polygon,* etc.

In this system a lot of architectural objectives are realized around the world, with different functions as: bank headquarters and commercial companies, social-administrative and cultural (theaters, cultural halls, clubs, museums, exposition galleries, etc.) buildings, as well as buildings from the field of transportation (train stations, bus stations, airports, etc.) and others.

In fig 2.16 is presented an example of such and architectonic ensemble (the Dacca National Assembly Headquarters – arch. *Louis Khan*), in which the architectonic balance starts from a static central space of the conference room, around which complementary spaces are developed, in partial symmetry.

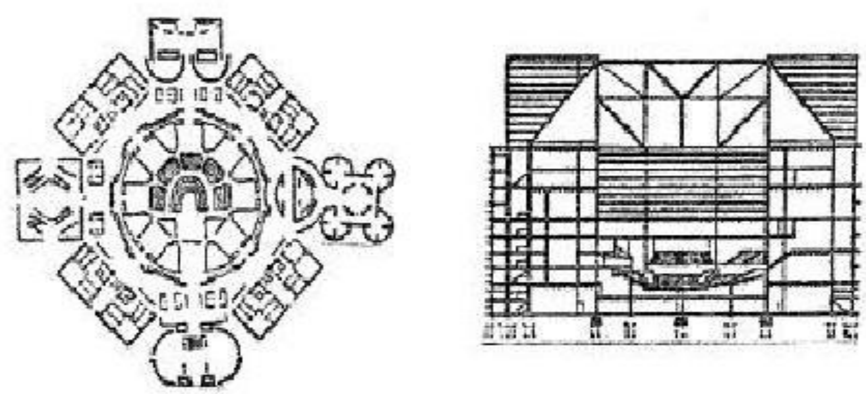


fig. 2.16 National Assembly Hall - Dacca (plan and section view)

The CONTRAST in architectural composition is also one of the means the architect has for the creation of an architectural work.

The law of contrasts (*law of contraries*) works the same way in nature (warm-cold, light-darkness, noise-silence, big-small, beautiful-ugly, etc.) being one of the fundamental objective laws of the existence of matter and human spirit. It is normal so, that one of the basic activities of man -the construction and architectural creation- uses this law of contrasts.

Contrast in architecture is used to emphasize (accentuate) the traits of an architectural work compared to another one (or to the environment), or of a component part of an architectural objective compared to other parts of the same objective.

The principle on which the law of contrasts is based is that the emphasis of an element is done using another element as a comparison, in such way that between the two contrastive elements one is "*dominant*" and the other is "*dominated*". In this way, the characteristics of a component element are accentuated basically by comparison with other elements, which don't have the same characteristics (shape, size, color, etc).

The opposite of contrast is *identity*, and between the obvious *contrast* and *identity* can be intermediary situations called *shades* [16].

The *Contrast, identity* and *shade* are basic elements in architectural composition, and can be applied on shapes, volumes, masses, colors, distances, etc. (examples of contrast in architecture: full-empty, flat-curve, horizontal-vertical, big-small, massive-light, close-distant, white-black, tall-short, thick-thin, ugly-beautiful, etc.).

In fig 2.17 below is presented a simple graphic example for the understanding of the significance of contrast, identity and shade, by the dimensional comparison of the two component parts (the Echinus and the Abacus) of the capital of three Doric columns.

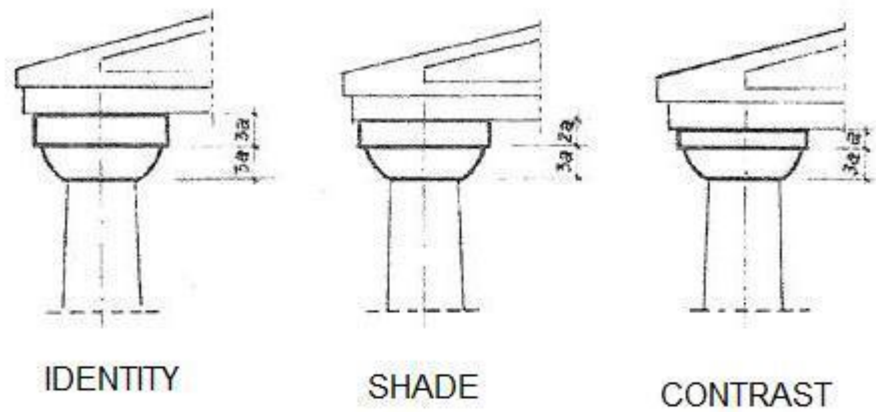


fig. 2.17 Identity, Shade and Contrast in architecture

Contrast is so a frequently used process in architectural composition, being a means of offering dynamism and preventing monotony, but the contrast must be graded in such way that it does not create dissonant elements or situations in which the contrast between the proportions, volumes or masses of the elements becomes overwhelming (and even ridiculous) for some of them.

Likewise, contrast doesn't have to be repeated until exaggeration in an architectural composition, because the effect can be contrary of the desired one: it becomes monotonous, and affects the architectonic work's unity. This principle is perfectly shown in work [16], according to which "*contrast is a maximum variety realized in the limits of unity*".

The ORDER in architecture was known since antiquity, being one of the most frequently used laws of architectural composition applied for the construction of the famous enables in Ancient Greece and Rome, although its application was made instinctively, using commons sense and artistic talents of the "architects".

The law of architectural order implies the use of logical succession of construction elements (horizontal and vertical) or parts composing the architectural ensemble, while the architectural order can be obtained in 2 ways:

- using the *rule of identity*, according to which the architectural order can be obtained by the use of successions of *identical* architectural elements (shapes, volumes, details, plenums, voids, etc.);

- using the *rule of similitude*, according to which the architectural order can be realized by repeating in the composition some architectural elements that are similar (but not identical).

So, the law of architectural order can be respected either by *uniformity* (using identical compositional elements), or by *variety* (using similar elements). For a better understanding of the principle stated in fig 2.18, there are presented two other simple examples of creation of architectural order by the method of identity (**a**) and similitude (**b**).

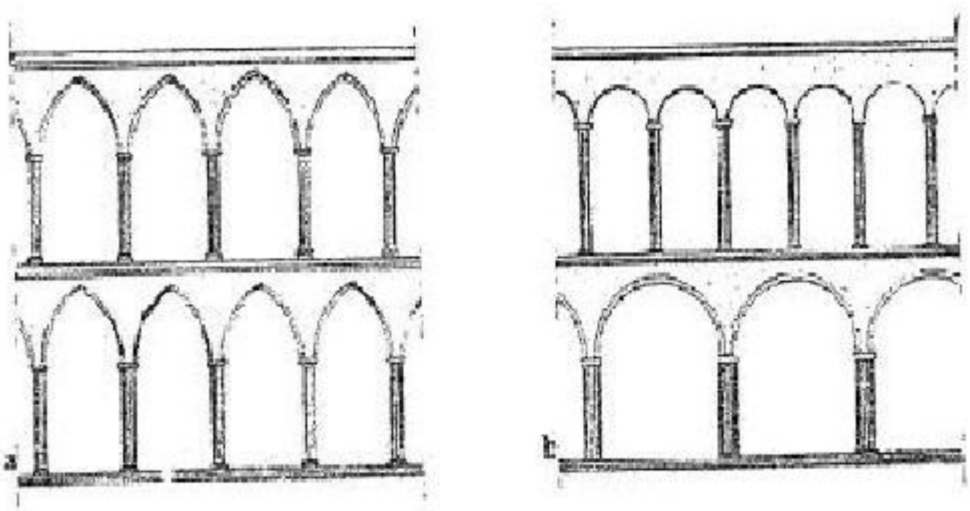


fig 2.18 Architectural equilibrium using identical or similar elements

DOMINANCE, one of the essential laws of architectural composition is defined in work [16] as being "*the satisfaction of the need for a clear and direct expression of the principal ideas by the importance of their size, direction, treatment, in order to subordinate all other elements of the architectural composition based on just distribution"*.

In other words, starting from the idea that the unity of a architectural work can be realized only with the help of variety and graded contrast, it can be understood that the realization of an element or a dominant part of the architectural ensemble with respect to the other parts constitutes an architectural process meant to eliminate the monotony of the composition, to assure variety and (in the same time) its unity.

Dominance, in an architectural composition can be realized either by intervention in the shape, volume, size, color, etc. of a part or an element of the ensemble and represents usually the functional dominance of the interior space of the building.

For example, in ancient architecture, dominance is most often represented by volume and proportions of a built assembly (e.g. dominant domes of the church and Byzantine basilicas, dominant towers, and dominant towers of Gothic Catholic cathedrals, etc.) and in modern architecture the most frequently used domain for the application of the law of dominance is the one of social-cultural, sports and administration buildings (among many others), at which dominance is dictated by the basic functional component of the building (e.g. boardroom, auditorium, exhibition hall, gym, etc.).

Around this compositional dominance, functional elements are developed, which are subordinated to the primary functional program.

Fig.2.19 represents an example of utilization of the law of dominance in an old architectonic assembly (**a** - Florence Cathedral with Brunelleschi's dome) and in a contemporary one (**b** - Novosibirsk Theater).

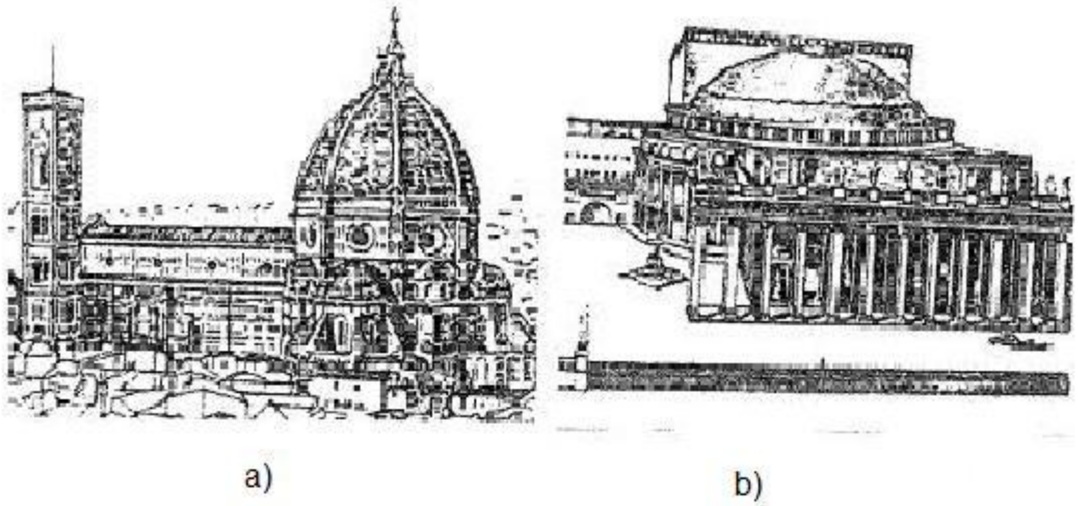


fig. 2.19 Dominance in architectural composition
a) Florence Cathedral b) Theater in Novosibirsk

According to work [16] dominance in an architectural composition can be put in evidence by several methods:

a – by *volumetric clarity* – when to the corresponding volume at least two (or more) faces are perceptible;

b – by *expressing the volume in relation to light*, so that there is a contrast between the volume faces by the effect of the light and shadow;

c – by *division of the dominant mass and surface*, with the help of horizontal and/or vertical elements;

Together with these methods, the architect can use other ones also, with the condition that the contrast degree between the dominant element (dominance) and the rest of the built assembly not being exaggerated - that would definitely lead to failure of unity and equilibrium of the architectural composition.

2.4.2 Basic rules of architectural composition

Before describing them and finding out what do these rules consist in, it is necessary to present briefly the principal *elements of the architectural space*, which the architect works with in the course of the compositional act.

These elements are: the LINE, the SURFACE and the VOLUME, being generally used grouped in ***series, motifs*** or ***assemblies:***

- ***Series*** – formed by a group of similar or identical elements orderly arranged in a composition (see fig.2.20);
- ***Motif*** – represented by a type of element which is repeated in a series (see fig 2.20);
- ***Assembly*** – composed of a group of elements between which there are different relationships (similarity, identity, variety, etc.), that can suggest the unity of the whole assembly.

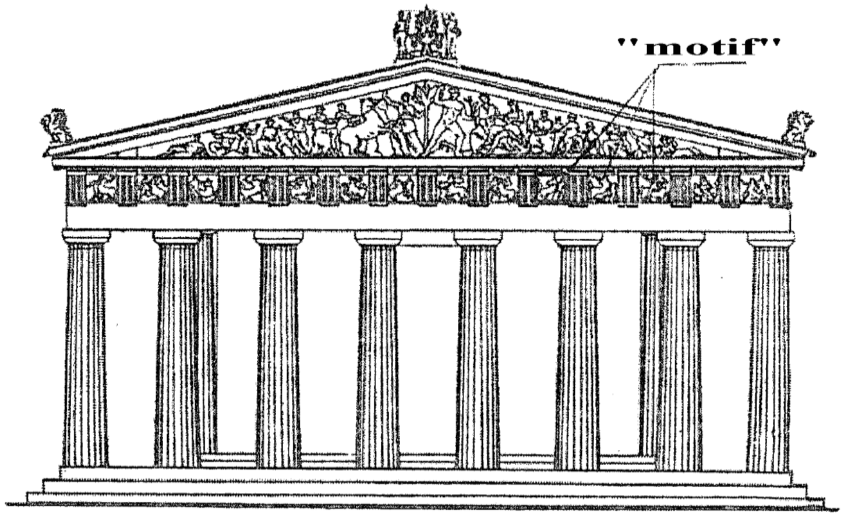


Fig. 2.20 Architectural space group elements

The LINE – is one of the most used elements in architectural creation, and it can be:

-***straight*** line*: horizontal, vertical* or *inclined (oblique)*;

-***curved*** line.

Horizontal line – offers a calm and quiet atmosphere, because the main activities of human are developed in horizontal plane, with minimum physical effort (movement, work, rest, etc.).

In architectural works horizontal lines are realized with the help of some constructional elements (wall cornices, parapets, friezes, limits of the stories and terraces, etc.) and it is put in value by different methods: periodic interruption, with shadow, etc.

Vertical line – suggests aspiration, nobility, force, litheness, infinity, etc., but it is deceptive to human eye, because its real size, depending on the viewing angle and the horizontal from the eye, cannot be determined, only approximated.

The most utilized vertical architectural elements are columns and pillars, used not only for their structural role, but also for realizing architectural scale and volumetric equilibrium of the built assembly.

In renaissance architecture, vertical line was used for the emphasis and dynamism of the village's silhouette, viewed from distance, accentuated by the verticality and height of all towers of churches and cathedrals, in relation to the relatively horizontal mass of the remaining buildings.

Likewise, the verticality of modern buildings ("skyscrapers") from modern architecture "stimulates" and "individualizes" some urban agglomerations or some zones of these agglomerations.

In the interior architectural space, the vertical line seen near influences the human mind, sometimes dominates and "overwhelms" man, making him feel "small" and "unimportant" in relation with the building and even in the relation with its holder (person, institution, organization, etc.).

This powerful feature of indoors vertical was much exploited in ancient and medieval religious architecture, where large height of the cathedrals' "naves" in relation with their surface (height underlined by the columns' suppleness, that supported arches and roofs' vaults) become overwhelming for humans, urging him to humility and submission (see ch.4).

Inclined line – in architecture it may have special meanings, according to the sense or degree of inclination towards the vertical plane [27].

Thus, (see fig. 2.21) for example, if the line which outlines the façade of a building is in the plane of the left vertical (fig 2.21a), then it means descent and pessimism, and if the line is in the plane of the right vertical (2.21b), then it suggest ascent and optimism. On the other hand, if the line is more inclined towards the vertical (under the "equilibrium" line situated at 45° - fig. 2.21c) may suggest a feeling of instability or collapse of the building.

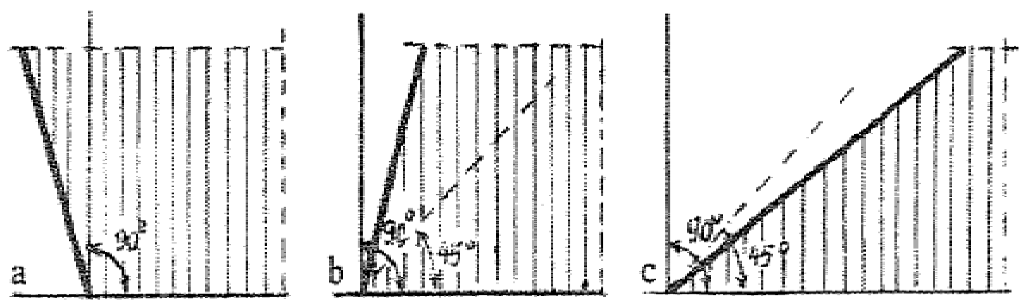


Fig.2.21 The signification of the inclined line in the architectural composition

In a multitude of some straight, intersected and randomly directed lines, the presence of a vertical or horizontal line is an emphasis and it represents a beginning of order (fig.2.22.a), as in a horizontally and vertically ordered lines network, an arbitrary line (inclined one) becomes emphasis and disturbs monotony (fig.2.22.b), offering in this way dynamism and mobility.

Curved line – suggests (used in some proportions) flexibility, indecision, fragility, decorative value, pleasure and femininity. The curved line used in excess in baroque architecture (see ch.4.10) contributed to creating a rich decorative architectural style, that is however leaden sometimes.

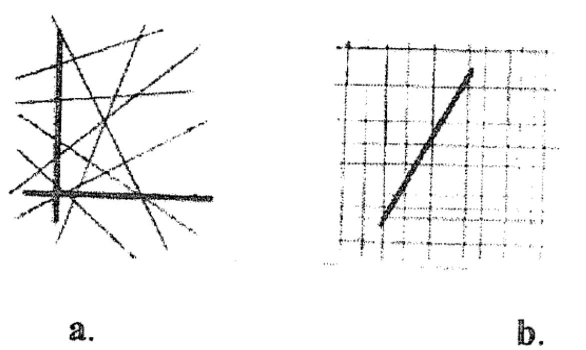


Fig. 2.22 – The influence of a line in a network of different lines

In modern architecture curved line is used especially in the horizontal plane, but sometimes also in vertical plane at a profile with large cover openings (domes, vaults, thin curved sheets, light suspended roofs, etc.).

SURFACE – architectural space element with two comparable size dimensions and it can be of the following types:

- *plane* or *curved* (regarding its form in space);
- *horizontal, vertical* or *random* (regarding its position in space); each of these types having some significations and suggesting different impressions to the beholder.

These impressions are influenced by many factors, such as surfaces form, method of joining, materials which are composed, colours and dimensions, etc.

In this way the used surfaces in an architectural composition may suggest to the beholder different feelings: *insecurity* (when the surface voids are greater than those of "fullness"), *force and stability* (when the elements are full or they have fewer voids), *power and weight* (when the elements are composed of tough and resistant materials: rock, concrete, etc.).

VOLUME – the three dimensional element of the architectural space which can be (in terms of shape):

- *simple* (having regular geometrical forms – sphere, cube, prism, cone, pyramid, etc.);
- *complex* (composed of combinations of geometric volumes);
- *random* (shape without geometric characteristics).

Volume may also suggest the viewer different sensations and impressions in an architectural composition, depending on proportions and dimensions, on materials and colours, on the way of joining of the surfaces, on line routes and their joining.

Thus, there may be volumes which can be seen as: *solid, rigid, flexible, balanced, transparent, elegant, bright, austere, varied,* etc.

Of course that in a complex architectural composition (architectural assembly) a great diversity of lines, surfaces and volumes are used. Depending on the way in which these are assembled, and related to the architects' talent and professionalism, it will transmit his wanted feelings.

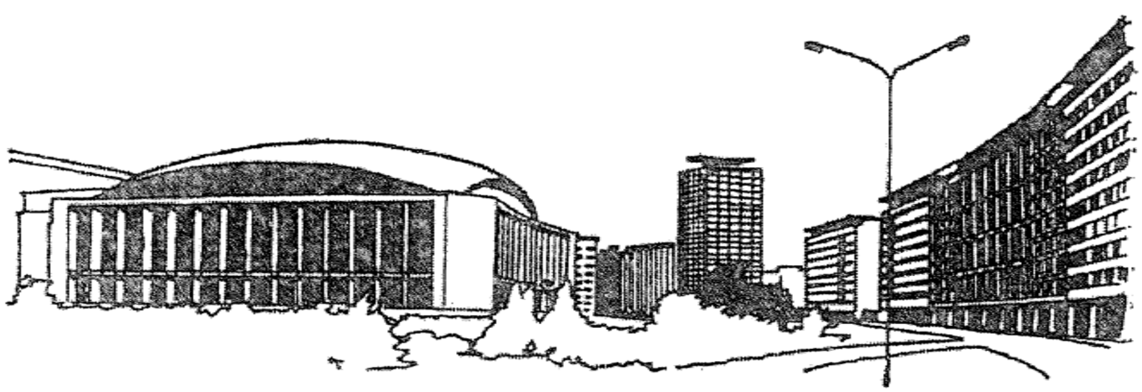


Fig. 2.23 Assemble market of the Hall Palace – Bucharest

For example, fig. 2.23 presents a sketch -elevation (after [27]) of “Hall Palace” market in Bucharest, whose architectural framework is composed of lines, surfaces and volumes of different shapes and dimensions, and where the ordering of the multitude of lines is made by polarizing the sight to an “accent” provided by the verticality of the tower of block of flats, asymmetrically positioned in the background ensemble.

Study [27] presents a “synthesis” regarding the “abstract significance” of lines, surfaces and volumes, in architectural compositions (the feelings they confer on the viewer):

- - *straight line* - suggests determination, strength, rigidity, boldness;
- - *curved line* - hesitation, flexibility, decorative value, delicacy, feminity, sliding;
- - *spiral* - the symbol of ascension, detachment from the ground;
- - *circle* - balance, control, focus of the interest;
- - *ellipse* - mobility, search, restlessness;
- - *cube* - the symbol of integrity, safety and determination;
- - *sphere* - perfection, finality.

The significances above depend, of course, on the position that the elements of the architectural composition are viewed from, but even more on the sensitivity and artistic taste of the viewer, with the obvious possibility of an uninitiated, insensible or careless viewer to remain indifferent to an appreciated architectural creation.

Besides the laws of the architectural composition enunciated in 2.4.1, the architect can appeal to a series of “rules” and principle “methods” for expression in the creative actions.

According to study [16] these rules, that coupled with the talent and the imagination of the architect can provide the value of an architectural composition, are the following*: limiting the use of series of identical elements; axial void; avoiding duality; order; disposition; proportion; eurhythmy; cadence; rhythm; harmony; symmetry; asymmetry; axial composition.*

LIMITING THE USE OF SERIES OF IDENTICAL ELEMENTS - is a rule used for preventing the monotony in an ordered succession of identical architectural elements and to ensure the unity of the architectural ensemble (that presumes a certain variety and contrast elements).

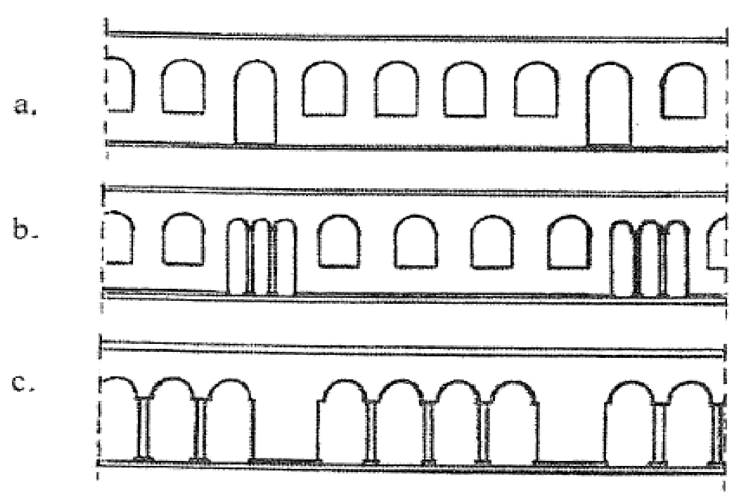


Figure 2.24- Limiting the use of series of identical elements
(by the use of the accent - **a**, **b** or of the gap – **c**)

Interrupting a series of identical elements can be accomplished by inserting *accents*, or *gaps* in the respective series.

The ***accent*** can be represented by a similar element to the ones in the series, but having different dimensions (see the big void in figure 2.24.a) or can be totally different from the elements of the series (se the thin voids in figure 2.24.b).

The ***gap*** in a series of identical elements, has the same effect of breaking the monotony and it consists in the gradual insertion of a “filled” (when the series’ elements are voids, columns, porticos, etc. - figure 2.24. c) area which represents a gap in the series.

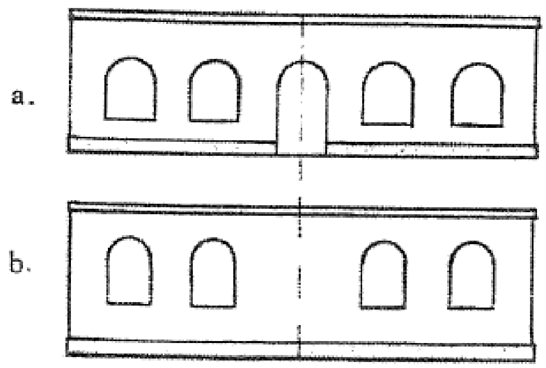


Figure 2.25- the axial void rule

THE AXIAL VOID - is one of the rules known and applied starting from the ancient ages in designing the façade of buildings (temples, churches, etc.) and in designing an odd number of voids (openings, holes) in the façade, such that the axial void confers unity on the building (figure 2.25.a), without the sensation of equal division of the whole (figure 2.25.b).

AVOIDING DUALITY - is one of the composition rules of architecture which, if it is not applied, affects the unity of the ensemble. But what is in fact duality?

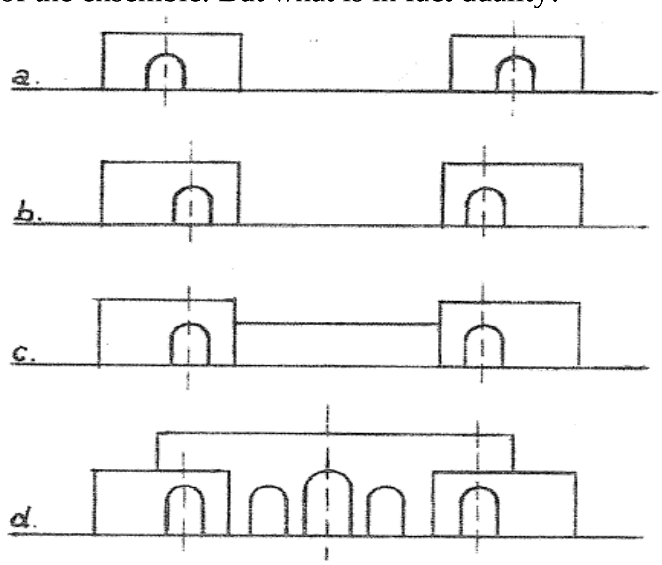


Figure 2.26-Avoiding duality in architectural composition

Duality appears when two identical architectural elements (forms, volumes, etc.), are set side-by-side, without a connection element between them (different regarding its position, nature, size or purpose) helping to form a unitary architectural composition (see figure 2.26, case **a**).

In the case of a duality, each of the two elements forms unity separately, preventing an ensemble architectural unity.

In figure 2.26 (according to study [16]) we are given a method for avoiding duality, or diminishing it gradually (**b** & **c**) and for obtaining a unitary architectural composition (**d**) using a contrasting connection element (a dominant element).

The duality effect can be diminished in another way also, without introducing a new element in the ensemble (figure 2.26, case **b**).

For example, the *different approach* to the building levels, introducing some architectonic elements (arcs, columns, vaults, fillings, balconies, loggias, covers) can supply the unity of the building in its ensemble, removing the duality effect existent when the levels are treated identically.

ORDER - is the rule that defines the proper *size ratio* of the parts (of an ensemble) with respect to each other and the whole structure.

The rule of the order is based on the organization and ranking of the components of the architectural ensemble according to their sizes (volume, dimensions), such that the contained matter of the composition reflects the architect's idea.

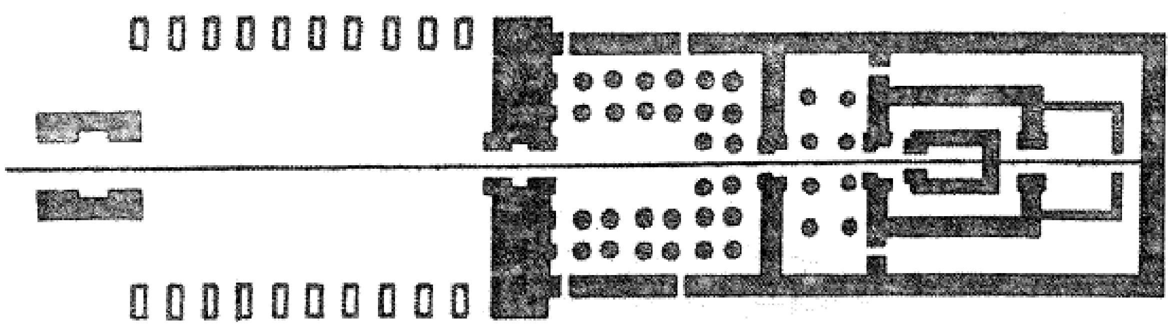


Figure 2.27- Order of the elements in an Egyptian temple
(The Karnak Temple Complex - Egypt)

Study [16] exemplifies the rule of order applied in the ancient times for the construction of old Egyptian temples (figure 2.27), in which the order of the elements (from the exterior to the interior) was realized to manifest a strong effect of human domination.

So the gradual passing from the intermediary open space to the interior space made up from smaller and smaller and darker spaces (up to the sanctuary accessible only for the servants of the temple) managed to impress the man stimulating him to submission and belief.

If in the above example the application of the rule of order had determined the limitation of the human spirit, in most cases the order in architecture brought satisfaction and pleasure to man, the order of architectonic spaces and elements in the palaces and villas (see chapter 4.9) of the Renaissance or the Classical architecture (see chapter 4.11) prove this.

DISPOSITION - is considered the establishing rule of the logical succession of the components of an assembly (of logical adjustment of those) in function of the characteristics of their *qualities* (destination, importance, etc.).

The dependency and subordination of the rooms in a building, the logical succession of the construction elements in a structure, the arrangement of the detailed elements on a facade, etc. are just some examples of the application of the is rule of *disposition* in the elaboration of the architectural composition of a constructed assembly.

It is clear that the *disposition* rule is connected to the *order's* rule (completing and influencing each other), both having the same aim: the increase of the functional and esthetical value of the architectural composition, and realizing its equilibrium and unity.

PROPORTION **-** is a rule of architectural composition taken from the laws of mathematics (of geometry), which works with *qualitative* (artistic) and not *quantitative* values (dimensions).

We can say that the proportion in an architectural composition is realized by *"the harmonious rapport of the architectural elements with respect to each other and the whole architectural assembly"* [16], but it must be outlined, that the *proportion* is closely related to the *order* and the *disposition*, meaning that in an architectural composition each of the three rules have its purpose:

- ***order* -** establishes the size rapport between the elements;

- ***disposition* -** establishes the logical qualitative succession of the component elements of the assembly;

- *proportion* - determines the artistic value of the architectural composition by the realization of the harmony of proportions.

One of the known examples of proportional harmony is that of the *geometrical proportion,* called "THE GOLDEN SECTION", whose rules (established by Euclid) are:

- "*Let us divide a straight line such that the surface of a rectangle formed by the entire line and of the smaller segment to be equal with the surface of a square having its side length the bigger segment"* and:

- "*Divide a line in mean and extreme ratio*".

With other words the rule of the **"golden section"** can be expressed as: - the division of a line into two segments, such that *the ratio between the size of the smaller and the bigger segment to be equal to the ratio of the size of the bigger segment and the entire line.*

If we transpose graphically this rule in fig 2.28, it might be expressed mathematically as:

$$b / a = a / (a + b) \qquad (2.1)$$

from where it results:

$$(a + b)\, b = a^2 \qquad (2.2)$$

According to this rule, considering the size of the integer (the total size of the line) *having a unit length:*

$$(a + b = 1) \qquad (2.3)$$

the ideal proportion in which the line should be divided results:

a = 0,6180339
b = 0,3819611

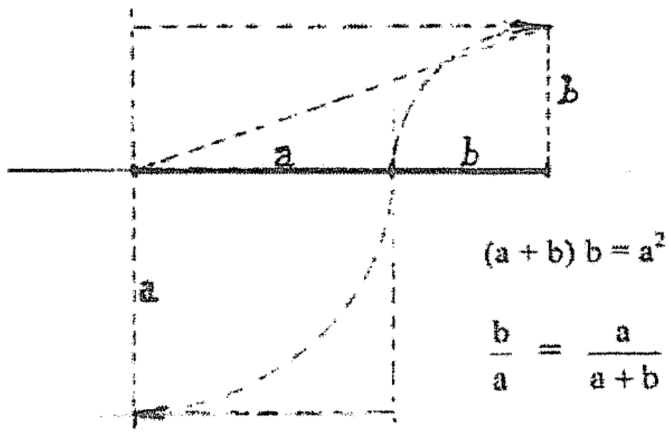


Fig. 2.28 –“Golden section”

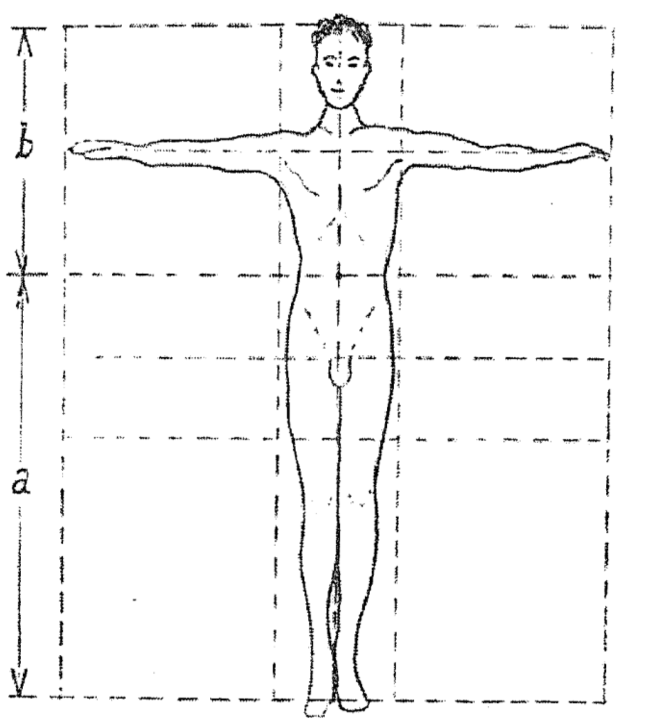


Fig. 2.29 – The proportions of the human body

The researches made from the XIX-century regarding this problem (of the “Golden Section”) concluded that that rapport is in fact *the natural rapport between the human umbilical position and the normal height of a mature man* (fig 2.29), respectively *the rapport in which the umbilical divides in two parts the normal height of the human body* (the upper part in reference to the lower part).

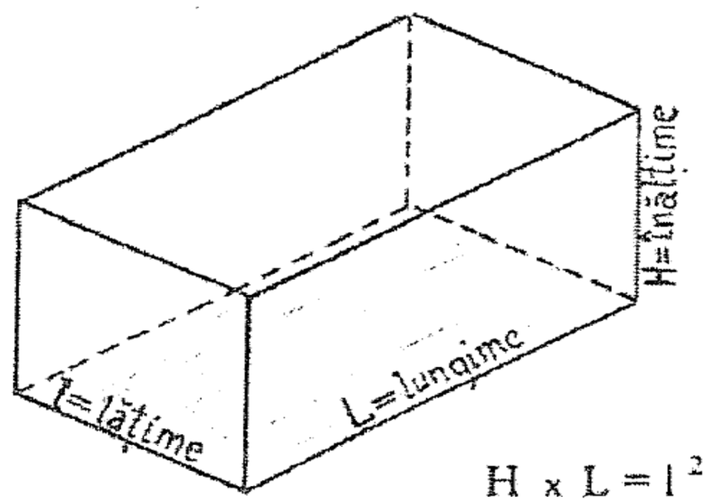


Fig. 2.30 –“the golden norm” of the room dimensions

In the architectural creation the principle of the “golden section” is usually used to determine the optimal proportions between the sides of the rectangle (with the greater side=**a** and the smaller side=**b**) used for determining the surface of the room, the walls, etc.

Applying the above mentioned rule to the inner space, it can be concluded that the ideal ratios between the dimensions of a room with sides noted with **L**-length, **l**-width, **H**-height (see figure 2.30) is:

$$1/L = H/l \ (=b/a) \qquad (2.4)$$

Hence the “ideal” relation within the room dimensions:

$$\mathbf{H*L = l^2} \quad (\text{“golden norm”}) \qquad (2.5)$$

Of course, in modern architecture the proportions of rooms, architectural assemblies and their component parts are conditioned by a lot of factors: - *destination of the building, lighting conditions, elements of comfort, structural conditions*, etc. and the optimum values of these proportions depend on the architect’s professionalism and talent.

EURHYTHMICS - is a term of Greek origin and in architecture it signifies *a harmonious combination of architectural elements, an ordering of them so as to confer beauty to the disposition* (logical qualitative succession of the elements).

Eurhythmy is called that rule of arranging the parts of an architectural composition, *"which is able to produce in man a state of delight, an artistic emotion, as do succeeds music, dance or painting"* [16].

It is what some of the great architectural ensembles of the Antiquity, Middle Ages, Renaissance, Classicism and the contemporaneous architecture manage to suggest.

CADENCE - is the rule, on which the composition of rows or series of architectural elements in a built object (constructional and decorative details, goals, pillars, porticos, arches, etc.) is based, and consists of a *successive listing of items or groups of architectural elements with equal intervals between them.*

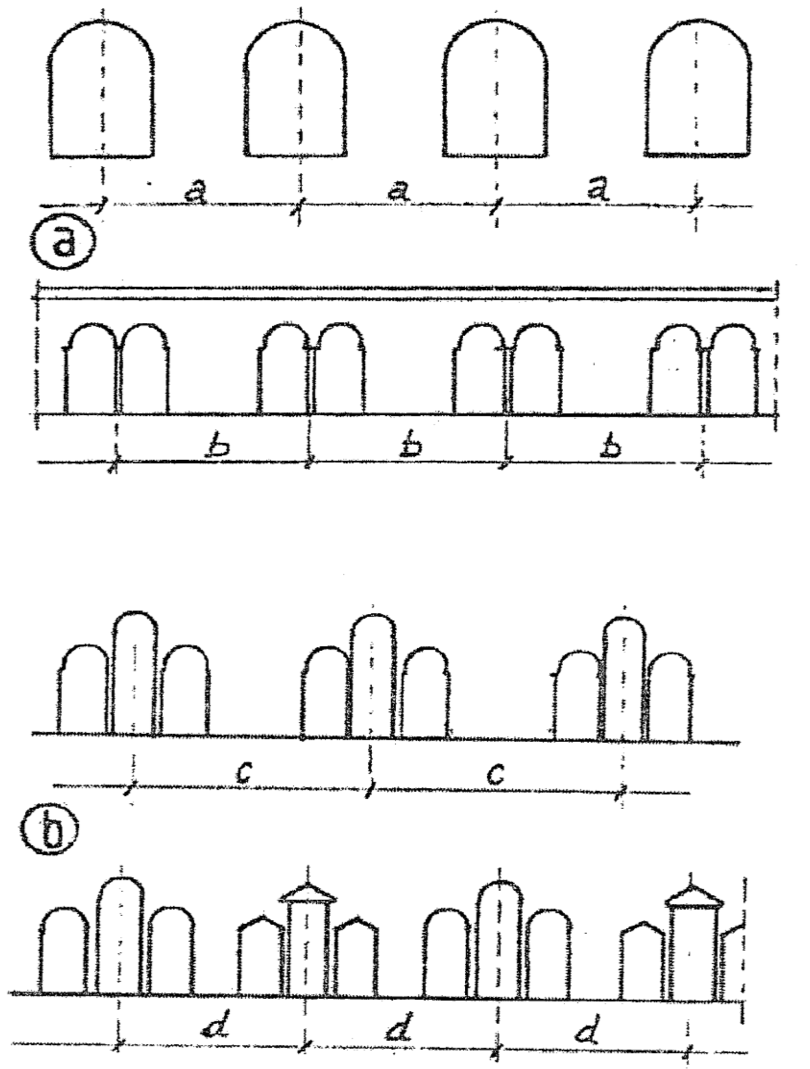


Fig. 2.31- Cadence in architecture;

a - equal cadence; **b** - rhythmic cadence

Cadence (expression used also in music and dance for the repetition of sounds, movements or groups of them) may be in architecture, of two types:

- *equal cadence* (fig. 2.31.a), when the sequence is formed out of identical elements or groups of elements arranged at equal intervals (see fig 2.20 referring to the grouping of the architectural space elements);

- *rhythmic cadence* (fig. 2.31.b), when the groups of elements that are repeated at intervals, themselves are rhythmic in the group (featuring a variation of the shape or size).

In figure 2.32 it is presented an example of the rule of the application of the *equal cadence* applied to the main building of the "H. Coandă" airport (Otopeni) from Bucharest.

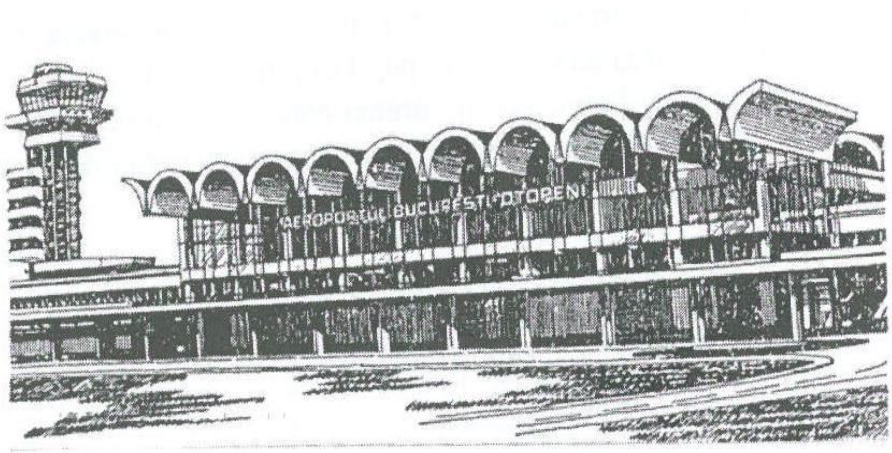


Fig. 2.32 Example of equal cadence at "H. Coandă" airport

Fig. - "H Coandă" airport

Fig. - "H. Coandă" airport - equal cadence effect at night

The cadence is a widely used rule in the architecture of all times both at the composition of the interior and exterior architectural space (by the location of the construction elements which delimitates the space), and especially at the composition of the construction elements themselves (of the facades, of the structure, etc.) and it is closely related to another architectural rule: ***-the rhythm***.

THE RHYTHM - in architecture has similar meanings with those of the musical rhythm, with the difference that if in music the succession is that of some intangible elements (sounds) and it occurs in time, in architecture the succession is that of some material elements and it occurs in space.

This similarity still determined some architecture theorists to consider this as being "solidified music" (see chapter 1. 1).

Because the rhythm suggests movement and dynamism, and the architectural composition is a "static" item, the understanding of the rhythm and of the mobility of the architectural space is related to the aesthetic sense and to the mobility of the human thinking.

The architectural rhythm comes from the shape and the proportion of the architectural elements - structural or decorative, from the relation between fullness and emptiness and between colors, from the balance of light and shadow, from the alternation of the volumes constructed with the intermediate spaces, etc., all of them suggesting movement (in an aesthetic sense) in a smaller or bigger measure, in function of the intuition and the architectural genius and of the sensitivity of the viewer.

The *rhythm* in architecture made the object of study of many specialists from all over the world and there exist many attempts of defining it and even of coverage in some "patterns", of classification and of ordering. Although the space of this work do not allow a development of the theme, still a few approaches of the problem in general can be said.

So, the work [27] tries to define the "architectural rhythm" and even a classification of it. Making an analogy between the rhythms of the human body, the rhythms of the nature, of the music and the *architectural rhythm*, C. Jurov says that this represents "*the repetition at certain intervals of some architectural shapes in a sequence of alternatively distributed plenums and voids*" and he considers that the rhythm is based on mathematical and proportional rules, resulted from a long architectural experience.

C. Jurov also shows that the rhythm in architecture is based on a *"metric" order* (a sequence of equal elements at equal intervals) and on a *"rhythmic" order* (a consecutive variation of the elements from the group which repeat themselves, in function of some rules) and the types of the rhythm are:

- - *spatial rhythm* - realized in function of the shape of the space (frontal, deep, central, complex, horizontal, vertical, etc.);
- - *functional rhythm* - determined by the order in sequence of the interior spaces and of the elements which separate them;
- - *rhythm in progression* - at which the rhythmic order is established by the axial disposition of the plenums and voids, with a variation obtained by the modification of the plenums' dimensions ratio (maintaining the interval between the axes) or by the modification of the ratio between axes.

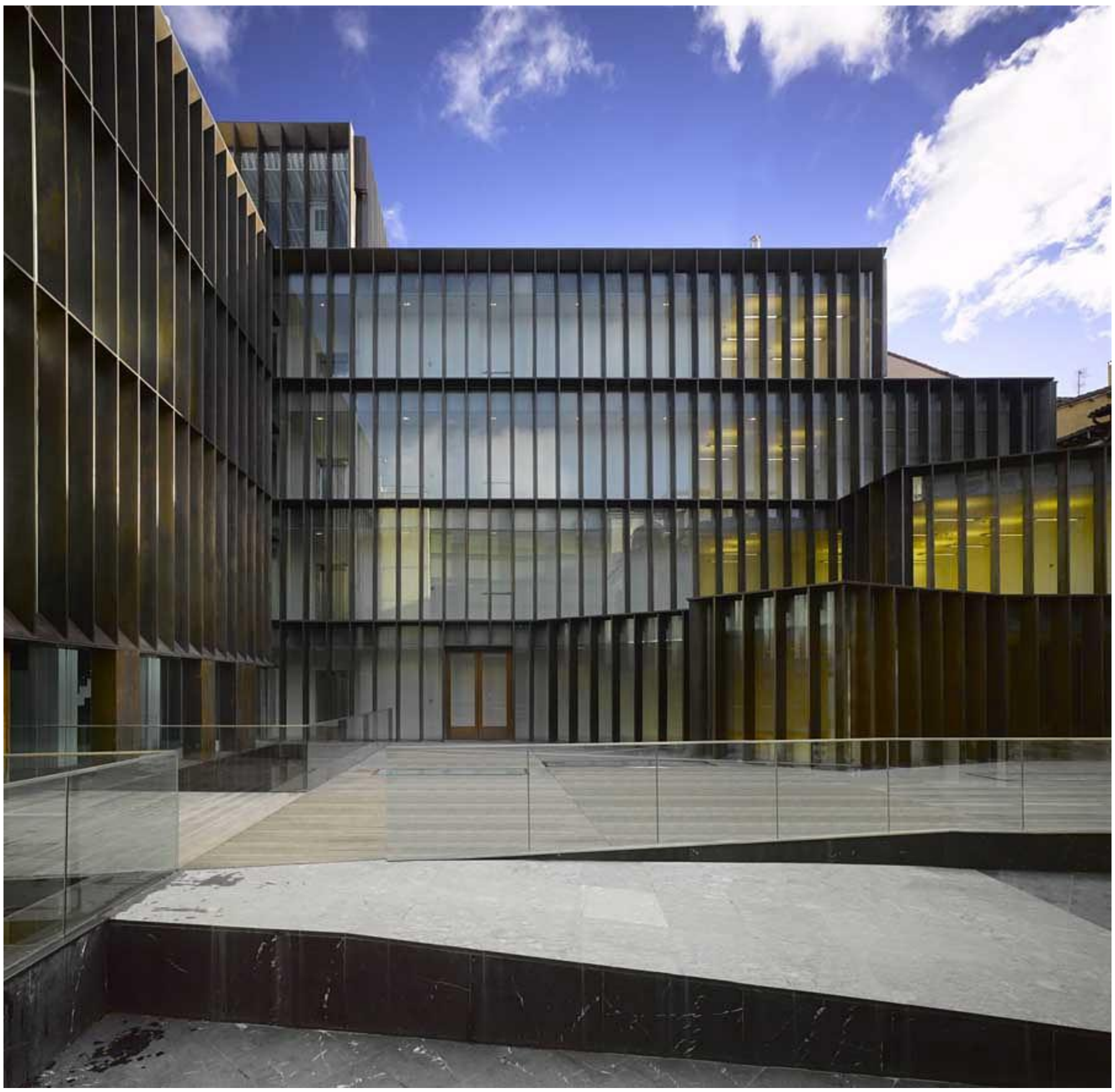


Fig. - example of application of the architectural rhythm to an office building

In an architectural ensemble can exist more strings of rhythmical order (with different cadence) vertically overlapped, and the unity and equilibrium of the ensemble can be obtained only by introducing a *"contrast item"*.

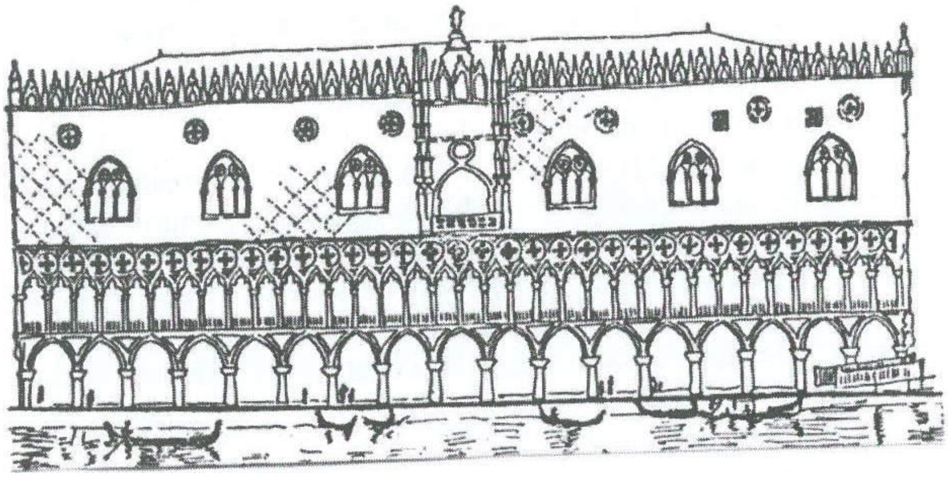


Fig. 2.33 - Facade of Doges Palace from Venice

Fig. - Doges Palace from Venice

In figure 2.33 is represented a facade sketch of the Doges Palace from Venice, whose overlapped differentiated rhythms are "unified" by the introduction of the "accent" given by the canopy which marks the central zone of the ensemble, giving it unity and equilibrium.

In another work [37], J. Monda marks the compositional meaning of the architectural rhythm, he defines it starting from the "*the shape and the buildings elements proportions*", from "*the mutual relations between plenums and voids, between lights and shadows and between colors*" and from "*the grouping mode of the constructed volumes and their ratio with the intermediate spaces*".

Fig. - Detail of Doges Palace - example of rhythm

So, J. Monda considers in [37] that the rhythm in architecture can be:

- - *two-dimensional rhythm* - resulted from the cadence of the surface items (of the facades, floors, plans, etc.)
- - *three-dimensional rhythm* - generated by the ratio between the constructed volumes and by the relation between the motives and the volumetric items;
- - *quadratic rhythm* - obtained mostly in the case of the facades divided into rectangular or squared boxes through profiles in relief ("quadratic" facades);
- - *radial rhythm* - due to the radial development of some items around a center (case of the "rosettes" with stained glass from the gothic cathedrals' facades - see chapter 4.8).

In his work J. Monda also mentions *composed*, *mixed*, *crossed*, *counter pointed*, *syncopated* architectural rhythms, but their analysis can not be the subject of this work.

S. Gavra approaches also in his work [16] the problem of rhythm in architectural composition, of its connection with the other "rules" of composition, showing that *"the movement in architecture is nothing else but the wise disposal of the architectural masses"*, and *"the rhythm has the particularity of having the string or the sequence elements in continuous increase or decrease, or with unequal growing or decreasing alternations"*. Giving examples of elements that generate rhythmicity (curved line, ellipse, parabola, spiral, ionic volute, etc.), S. Gavra considers the architectural rhythm as being *"a succession of harmonious inequalities "*.

THE HARMONY - is a rule of architectural composition resulted from the combination of other two rules (mentioned before) *the proportion* and *the rhythm*, in the meaning that if the proportion determines the artistic value of the composition and results from *"the harmonious ratio of the architectural elements between each other and with the architectural ensemble"* [16], the rhythm results from the architectural elements' ratios and from the relation between them.

So we can say that *the harmony of an architectural composition is the harmonious and rhythmic organization (ordering) of the component elements' proportions between one another and with respect to the whole,* and the ***architecture*** itself *represents the science and art of harmonization of the architectural elements in an equilibrated and unitary, useful and esthetic composition.*

Fig. - example of architectural harmony on **'Aura' Istallation by Zaha Hadid and Patrik Schumacher, at Foscari Villa, Venice, Italy, 2008**

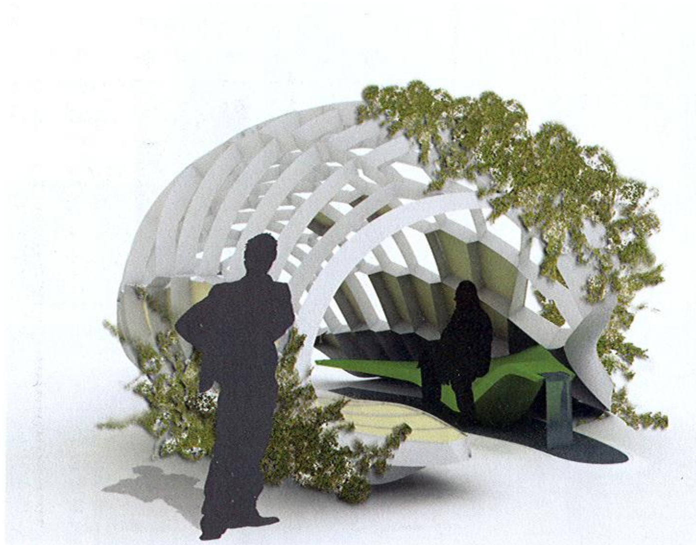


Fig. - Example of application of the architectural harmony

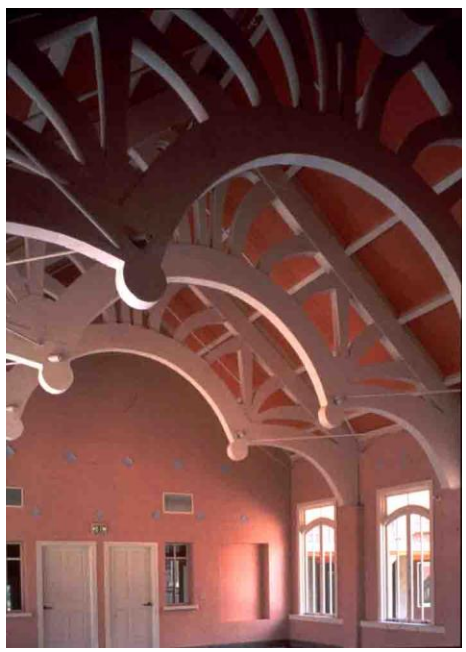


Fig. - Application of the architectural harmony on beams

THE SYMMETRY - is one of the most direct and simple methods of realizing the equilibrium of an architectural creation, consisting in *the placing of the shapes, the volumes, the colors, the fullness, the plenums, the voids or of the elements of detail, in an equal way on both sides of a "symmetry" axis.*

But the symmetry does not always realize *the unity* of the architectural creation too, because many times the symmetry generates monotony (which is not compatible with the unity), but sometimes symmetry has been used for giving to some architectonic ensembles a touch of grandeur and monumentality (the ensembles of the Egyptian temples, of the palaces of Renaissance and Classicism, etc.).

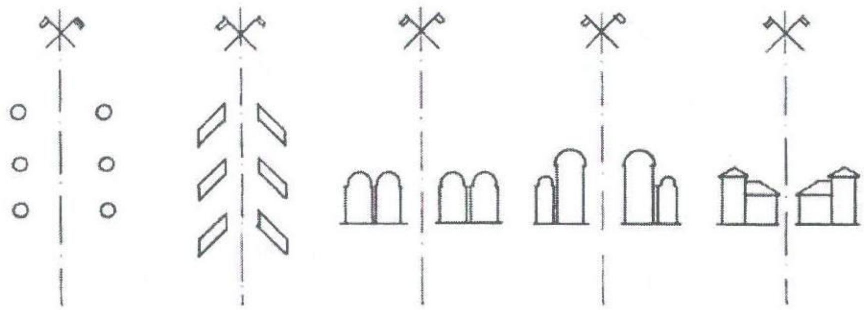


Fig. 2.34 - Examples of symmetry with respect to an axis

Fig. - Akshardham Temple, Delhi, India

Fig. - Example of architectural symmetry

In the modern acception (in the architectural design) the symmetry means: *the exact but reversed repetition ("in mirror") of one item or more with respect to an axis* – called "symmetry axis"(fig. 2. 34).

The regular geometric forms present a special characteristic: - *they have many axes of symmetry,* all passing through a point called *center of symmetry* (fig. 2. 35).

It is remarkable in fig. 2. 35 that the main regular geometric forms used sometimes in the architectural design *have as many axes of symmetry as many sides*:

- the equilateral triangle - 3 axes of symmetry;
- the square - 4 axes of symmetry;
- the pentagon - 5 axes of symmetry;
- the hexagon - 6 axes of symmetry;
- the circle - an infinite number of axes of symmetry.

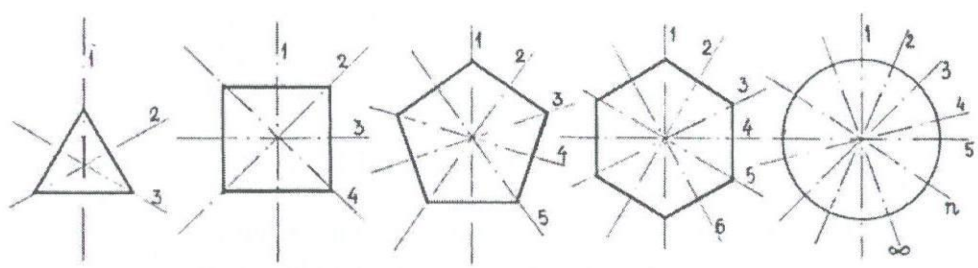


Fig. 2. 35 - The symmetry of regular geometrical forms

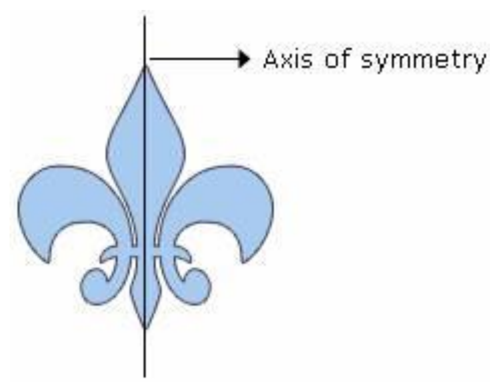


Fig. - Symmetry axis

In what concerns the regular geometric elements (tetrahedron, cube, octahedron, dodecahedron, icosahedron, sphere, etc.) used relatively rarely as shapes of the architectural objectives, they have a spatial symmetry axes system (all the axes meeting in a point named the *center of the body*), axes of which number evolve proportionally with the number of facades of the body, reaching infinite in the case of sphere.

In plane symmetry can be *unidirectional, bidirectional, three-directional,* etc. (until the *multidirectional* symmetry – in function of the number of symmetry axes) and the elements of a symmetric plane can be related to a *point* (named center of symmetry), to a *line* (axis of symmetry) or to a *surface of symmetry* (see fig. 2. 36).

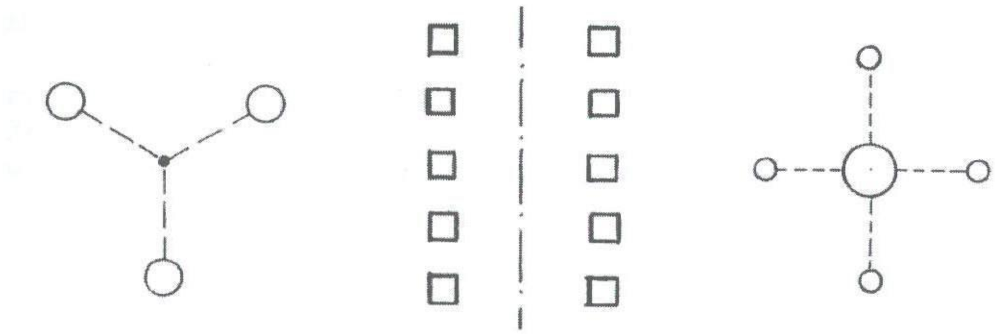


Fig. 2. 36 - The symmetric displacement of the architectural elements

Fig. - Symmetry of a diamond

The symmetry rule was (and is) often applied in the architectonic concept, going as far as (for example) in the ancient Roman and Greek architecture *the symmetry was associated in an unconditional way with the beauty and perfection*, this is why many of the ancient temples are realized on symmetric planes at least with respect to a direction (unidirectional symmetry).

Fig. - Eiffel Tower - example of symmetry

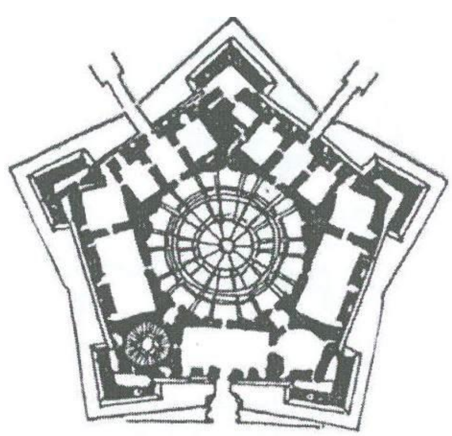


Fig. 2. 37 - Caprarola Villa

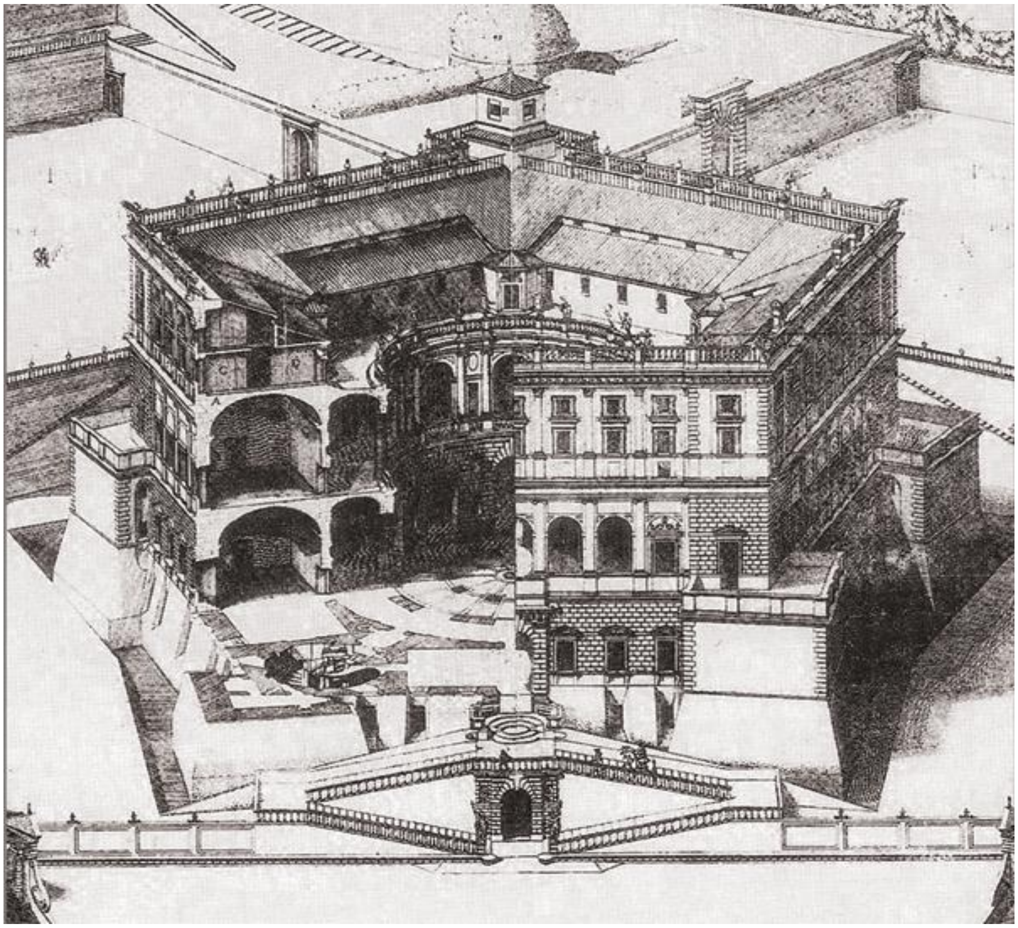


Fig. - Caprarola Villa

Fig. - Vignola's Villa Caprarola - sky view

Fig. - Vignola's Villa Caprarola - front facade view

In the architecture precursory to modern architecture there exist few constructions with an absolute symmetry (multidirectional symmetry) because such an approach may lead to forced, non-functional architectural compositions (e.g. - the plan of Vignola's Villa Caprarola-fig.2.37).

But in all architectural currents of history there are a lot of construction plans with a relative - unidirectional symmetry.

In fig. 2. 38 there are presented (after [16]), for instance, two horizontal plans of famous architectural works from different epochs (the St. Constantine church of Rome – **a** and Saint-Julien cathedral in France – **b**) with a relatively unidirectional symmetry.

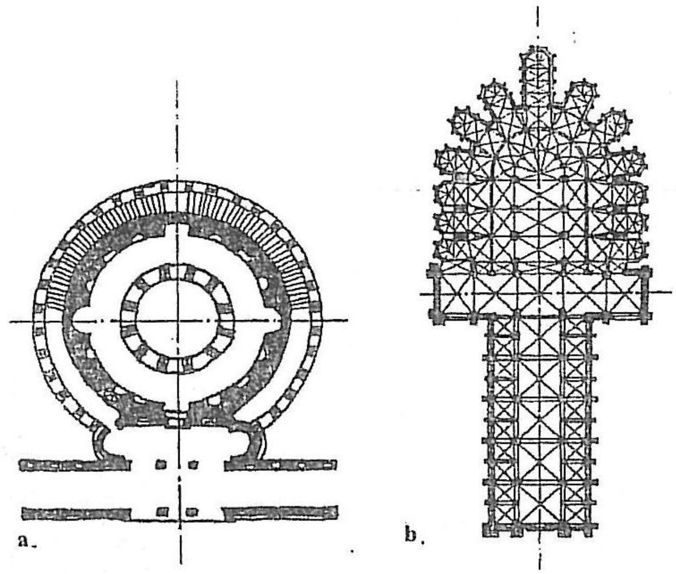


Fig. 2. 38 – Examples of symmetrical plans of famous buildings
a – St. Constantine church of Rome; **b –** Saint-Julien cathedral in France

Although the symmetry in the architecture may suggest sometimes order and discipline, strength and perfection (if used professionally), the symmetrical plans of buildings still present an obvious stiffness and a lack of operational freedom that can damage an architectural composition which function implies the freedom of expression.

This is the case of architectural assemblies built on large surfaces, of organic compositions, of objectives with asymmetrical function (social-administrative buildings, exhibitive and multifunctional complexes, architectural assemblies of education, culture, art and sports, etc.).

ASYMMETRY – is a rule of architectural composition which characterizes especially the contemporary architecture, because the functional complexity and the variety of sites of modern constructions sometimes involve different development both vertically and horizontally and therefore all symmetry is removed.

It comprises mainly industrial buildings, hotel complexes, assemblies of school buildings and cultural, sports and exhibition halls, etc.

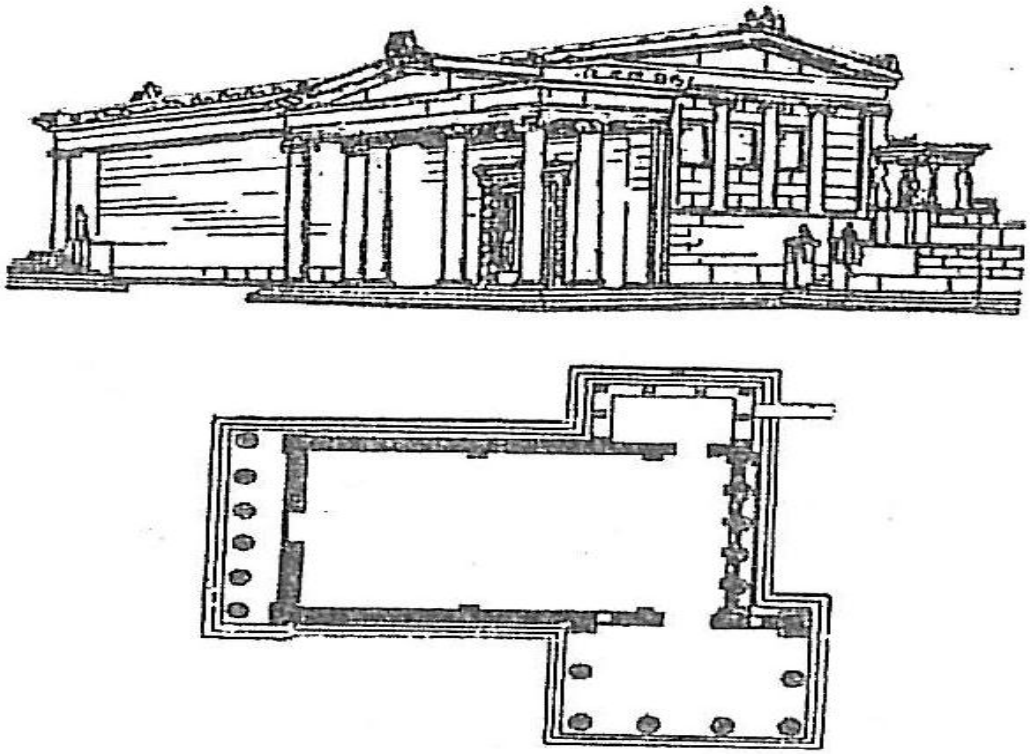


Fig. 2. 39 – Example of asymmetrical composition
(Erechtheum in Athens – side view and plan)

Asymmetry does not necessarily involve architectonic „imbalance”, because it allows the obtainment of a functional expressivity, spontaneity and liberty of creation that can be comforting.

An asymmetrical architectural composition may be particularly successful applying the principle of „*barycentricity*” or *„gravimetry”* [27], according to which the composition of volumes and of architectural details should be made such that the *mass balance is ensured,* so the masses have the same *„weight”* in relation with the axes, even if the volumes are contrasting (e.g. – an assembly consisting of several bodies – primary volumes, each having its own axe of symmetry, the assembly being asymmetrical because the variation of the distances of these axes from the principle axis, but getting balanced through the masses of the component bodies).

One of the most famous examples of non-symmetric construction, but in perfect equilibrium, is the *Erechtheum* on the Acropolis in Athens (fig. 2. 39 and fig. 4. 33 from chapter 2. 4. 2 and 4. 4), whose facades have been solved by the principles of symmetry, but the assembly presents a brilliantly resolved global asymmetry.

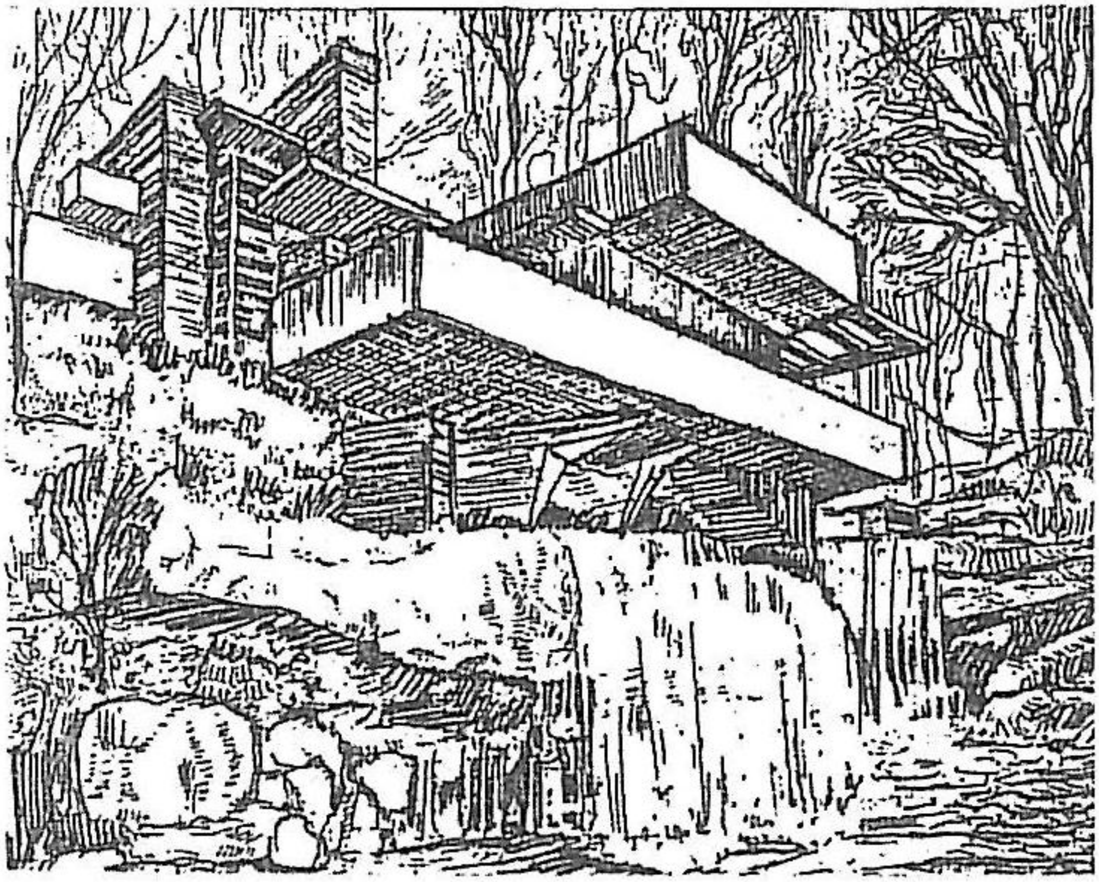


Fig. 2. 40 – Modern asymmetrical composition (The House on the Waterfall- F.L. Wright)

An example of asymmetrical composition (also well known in architecture) making part of modern architecture (an organic architecture of the free plan) is the *„The House on the Waterfall"* (designed by arch. Frank Lloyd Wright – fig. 2. 40), at which the spatial composition, structure and functionality are unpredictable, but well fused, the result being a unitary and harmonic architectural work.

AXIAL COMPOSION – is a rule of expression in the creative architectural activity that can be exemplified by the fact that any architectural composition, symmetrical or not, is developed around imaginary lines called *axes of composition.*

The axes of composition are defined in the work [16] as *„imaginary lines of reference, ordering lines of the disposal in plan, sections, facades...around them and in their sense it develops the compositional series of volumes, architectural surfaces and elements which compose the building".*

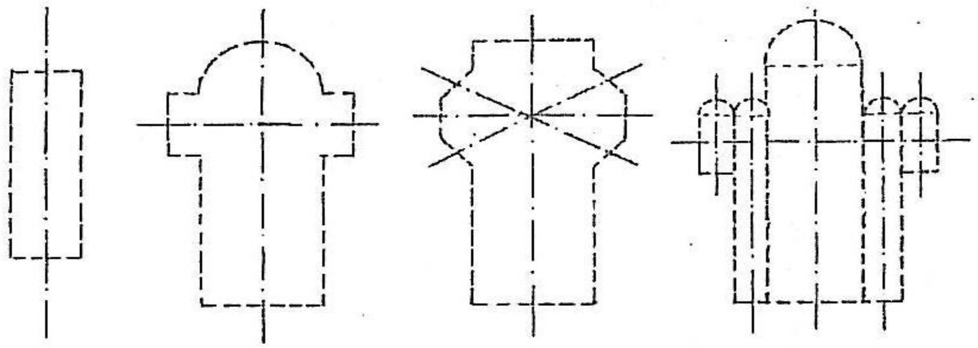


Fig. 2. 41. – Axes of composition of architectural buildings

A built assembly may have one or more axes of composition (fig. 2. 41), but there is always a main axis of composition (on which is usually placed the main building entrance), the other secondary axes being subordinate to it.

The axes of composition can be *parallel* or *perpendicular* to each other, or *multidirectional*, at the intersection of the axes being a centre of interest (a central dome, the main hall, etc.). Sometimes the composition can be developed according to a system of spatial axes, comprising one or more vertical axes of composition also (fig. 2. 42 – work [16]).

In case of more complex compositions the system of axes of composition is also more complex, being derived from combinations of parallel, perpendicular or multidirectional axes (e.g. – architectural composition of Roman and Gothic cathedrals with more ships, or Byzantine basilicas).

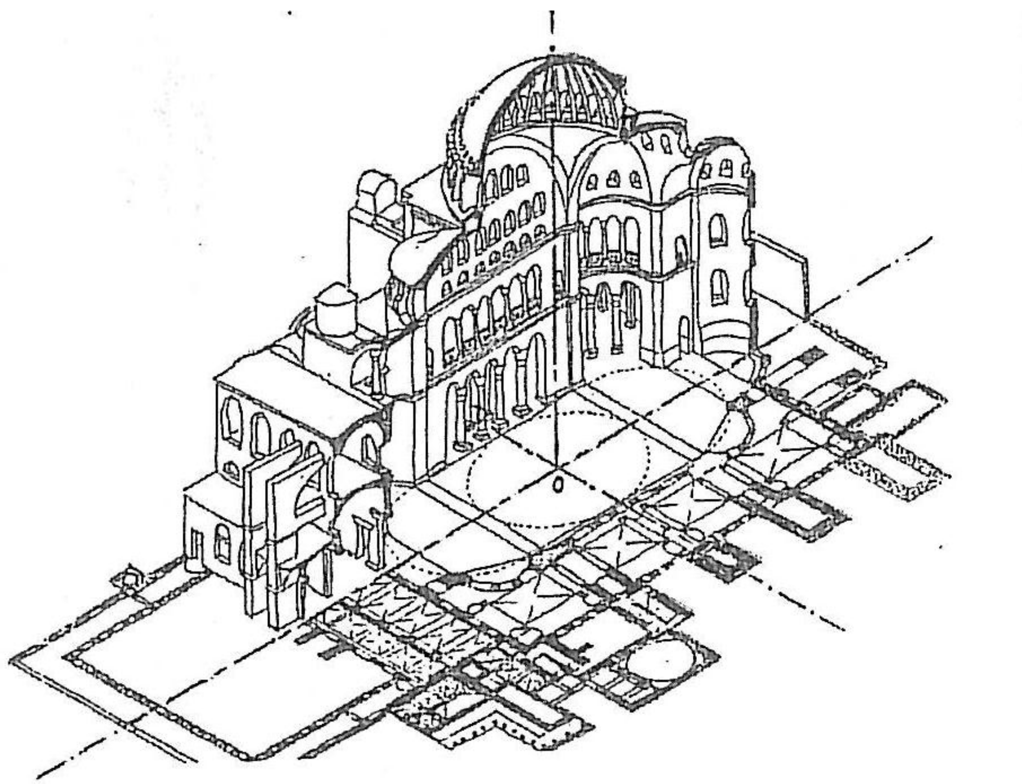


Fig. 2. 42 – Spatial system of compositional axes

(St. Sofia Cathedral of Constantinople)

The axes of such a composition usually point to the direction of development of the composition, while the intersection of axes marks the „*gravity centre*" of the masses of the architectural assembly.

In asymmetrical compositions the positioning of some axes of composition can be variable and random, but they must exist, because the compositional balance of the whole architectonic assembly can be achieved only through a proper arrangement of volumes and masses in relation to their function and importance in the assembly.

2. 4. 3 Means of expression in architectural composition

To meet the laws (see pt. 2. 4. 1) and basic rules of the architectural composition (see pt. 2. 4. 2) in order to realize constructions which satisfy all the structural, functional and aesthetic conditions, the architect has at his disposal some *means of expression*, among which the most commonly used are (according to work [16]): *form, sincerity, truth, laconism, variety*, etc.

The application of these means (means of expression) in architectural creation is closely linked to the personality of the architect, and it depends on the building's destination, the place of its location in the environment and what effect are wished to be obtained.

Expression by FORM – it starts from the need to obtain *a unity between the content and form of the architectural work*, being known that by *form* the architect expresses the content, giving it aesthetic value.

The problem is reduced (according to work [16]) to „give *form* to a *content*" so that to exist a balance between them, without favoring one of the two components (the form or content).

The form of the built assembly or of the parts of it may suggest contradictory feelings, such as:

- forms developed on the *horizontal* are rational and stable, allowing accurate assessment of volumes and masses, thus providing a fairer balance of the composition;
- forms developed on the *vertical* give a feeling of infinity, limiting the volumetric clarity of the object and making more difficult to obtain a balanced composition;
- the ordered *geometric* forms provide order and stability for the architectural assembly, facilitating the obtainment of compositional unity;
- the *random* forms complicate the understanding of the content of the assembly and suggests indecision and relative balance.

The most important feature of the built forms is their *artistic expressivity*, a feature through which the architectural work manages to „communicate" with the viewer and "inform" him, provoking some emotional states.

The expression by SINCERITY and TRUTH – is a mean to express the content and functionality of architectural work by form, by volume and proportions or by the treatment of surfaces.

Truth and sincerity can be also means of achieving the *aesthetics* (depending on the mastership of the architect), the most accessible and „open" architectural space through sincerity is the „*front*" space (see pt. 2. 3. 1) used especially in designing public buildings for a great affluence of people: buildings for travelers, sports and exhibition complexes, commercial and cultural centers, etc.

The *"sincere"* expression in the exterior architecture of the interior content (function) does not imply the neglect of aesthetics of the architectural forms, in time the method of „sincerity" allowed the achievement of outstanding architectural works.

But the exaggeration of *„sincerity"* in expressing the content of the interior (of function) has sometimes led to the emergence of contested architectural currents (e.g. - „functionalist" architecture - see chapter 4. 13).

The opposite of sincerity in architectural expression is obviously the *"deception"* or *„insincerity"*, that is though often even necessary in the architectural composition (examples: - strongly glassed facades and *„curtain"* walls that mask the structure - although do not reflect the content, they permit the achievement of a unitary and balanced modern architecture - or the use of false supporting elements sometimes in the ancient architecture – *atlantes* and *caryatids*, allowed the achievement of valuable and aesthetic architectural compositions.)

„Insincerity", however, can often produce many damages to architectural composition, reducing its aesthetic value and making it ridiculous. Examples: the use of *„blind"* windows and doors (only the frame of the recess, that is in fact walled up), of imitations in the decoration and finishing of buildings of ancient architectural elements (columns, porticos, fronts, etc.) in modern architectural compositions (see *neoclassical* architecture, chapter 4. 12).

The LACONIC expression in architecture means the expression of the content and message the architect wants to transmit through his creation by means of a few simple methods. As a form of expression *„laconism"* involves craftsmanship, talent and a good handling of architectural composition rules, and the *Romanian folk architecture* is a good example for this, although its creators (commonly *folk masters* without a proper training in architecture) relied more on "common sense" of proportions and intuition than on the knowledge of architectural composition.

Significant in this sense are the examples presented in fig. 2.43, referring to *a country house* (with ground floor and semi-basement) from the Subcarpathian zone (**a**), and a religious residence – the church of the Moldoviţa Monastery (**b**), where the simplicity and the purity of the form, the harmony of proportions and the laconism of decorations assured the success of the architectural composition.

The harmony of proportions, the purity of the form and the function, the simplicity and "poverty" of decorative elements are the main characteristics of *laconism in architecture*, and many times it results in a harmonious creation, with great aesthetic value.

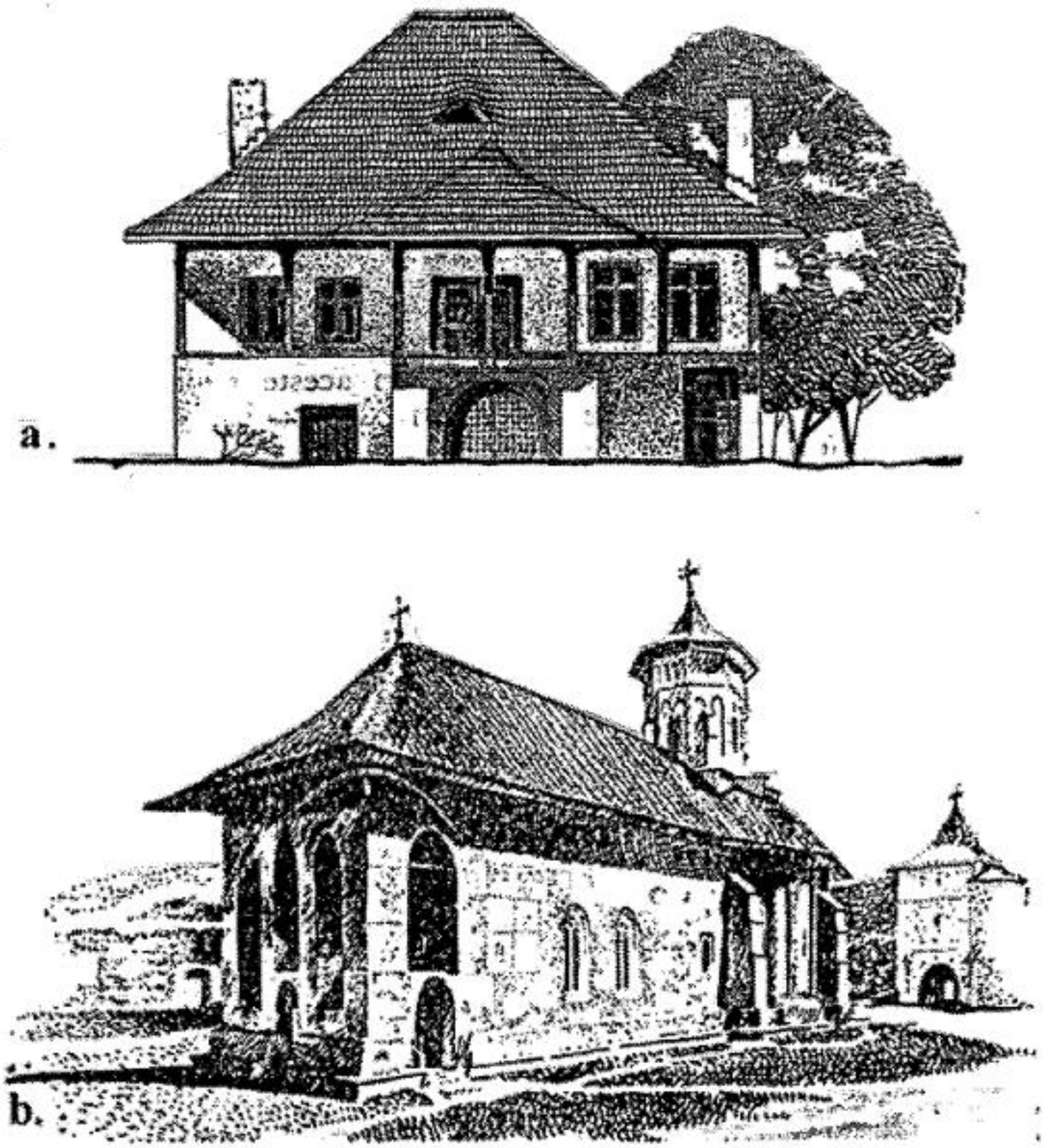


Fig. 2. 43 – Laconic expression in the Romanian architecture

VARIETY, as a way of expression in architecture, anticipates the use of *diversity* and *contrast* with the scope to avoid the monotony or uniformity of the architectural composition.

As way of expression in the concept of a construction, variety can refer to shapes, volumes, colours, constructive details, etc. but it must not be exaggerated because it can easily lead to lack of unity and balance in an architectural composition.

2.4.4 The character of the architectural creation

Through the CHARACTER of a building (or of an architectural ensemble) we understand that fundamental particularity (or distinctive feature) which makes it outstanding from the buildings with the same function, and even from the buildings with different functions.

The *character* of an architectural composition can be expressed by shape, size, color, style, age, beauty, etc. and it results from the impression the composition produces on people, from the feelings and sensations it "awakes" in someone.

According to paper [16], from the point of view of the *reference area*, character in architectural creation can be of the following types:

- *specific character of a functional program* – pointed out by the general characteristics of a large functional program (housing, educational and cultural buildings, commercial buildings, social buildings, industrial and transport buildings, etc. The specific character differentiates buildings belonging to different functional programs: school from theater, house from factory, train station from museum, etc.);
- *peculiar (individual) character* – pointed out by the characteristics of buildings from the same functional program, "individualizing" each building by size, volume, shape, structure, color, etc. (even if they have the same destination);
- *character of the epoch* - given by the architectural conceptions and ideas generally expressed in a certain epoch (see chap. 4)

A building can also be classified from the *impression* it makes on the viewer:

- *monumental character* – the result of a large, symmetric composition with clear and solemn, sober and well balanced feeling. It is the case of the great architectonic achievements of antiquity (the Parthenon, the Pantheon, the Colosseum, etc.), Gothic Age, Renaissance, Baroque, Classicism and contemporary age (see examples in ch.4);
- *picturesque character* – expressed through variety and richness of colors, forms and details (baroque architecture), through diversity, movement and rhythm, free, unsymmetrical compositions – imposed by nonuniformity of field (e.g. Erechtheum - see fig. 2.39);
- *bizarre character* – opposed to picturesque (called "strange" picturesque [16]);
- *exotic character* – the same like unusual bizarre, exciting (Arabic, Chinese, Japanese architecture, etc.);
- *graceful character* – expressing fragility, fineness, delicacy obtained from using supple and elegant shapes and fine composition details, delicately proportioned (e.g. the decorative "rocaille" and "rococo" from the French Baroque – chap. 4.10)

The character expressed by a building's outside can sometimes reproduce the character of the architect, the character of a building often being compared with the human one. That's why there are used [27] expressions like: *silent*, *happy*, *refined*, *vulgar*, *slender*, *solid*, *agitated*, *sad*, *strange* building.

2.4.5 The scale in architectural composition

One of the most important problems of architectural creation is the one of optimal dimensioning of construction elements, of interior and exterior spaces and the proportions of architectural objects, such that they all fit perfectly in the surrounding ambient (built or natural), to respect the demands of a certain building (see chap 1.4), not to "shock" to viewer with its disproportion.

Any built object is viewed and compared with others of the same (or different) type, with elements from nature or with the human himself, and the *architectural scale* is exactly that element that can assure the success of an architectural composition.

It is known that the principal comparisons made in theoretical and practical architecture determine "the architectural scales" used:

- *the human scale* – it results from the comparison between the building or the component elements with the human body or its proportions;
- *the proportional scale* – as a result of the comparison between buildings or between building elements;
- *physical scale* – its elements result from structural calculus [27] (from the principles of structural mechanics) and from conditions of functional dimensioning (which can not be neglected under no circumstances)

THE HUMAN SCALE - is based on the idea that the *architectural space is designed for humans*, so it is influenced by human *dimensions* and *activity* (see chap. 1.3).

The study on dimensions and proportions of the human body, on positions and space that he occupies in his activity has begun thousands of years before (in ancient Egypt), and have been developed in antiquity (Policlet, Lisip, Vitruvius), Middle Ages (Leonardo Da Vinci, Albrecht Durer) and carried on in modern times (le Corbousier).

Le Corbusier introduces with his paper "Le Modulor" (published in 1948) *a conventional **modular system***, through which he defines the basic dimensions of the human stature (the standard is considered an adult man with the average height of 183 cm) and the proportions existing between the body parts (see fig. 2.44).

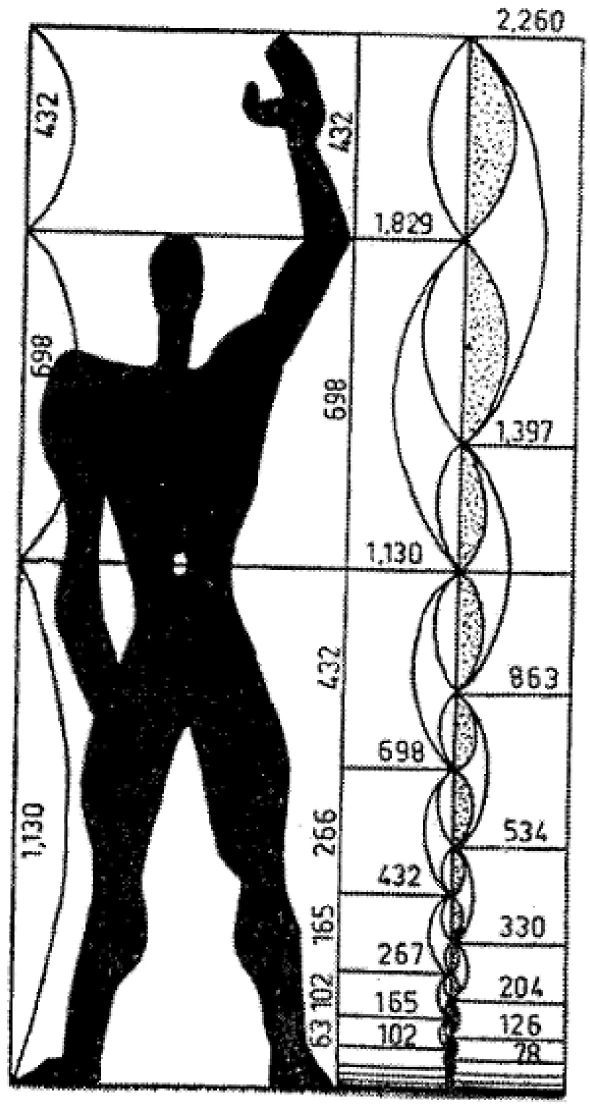


Fig. 2.44 – The proportions of the human body according to Le Corbusier

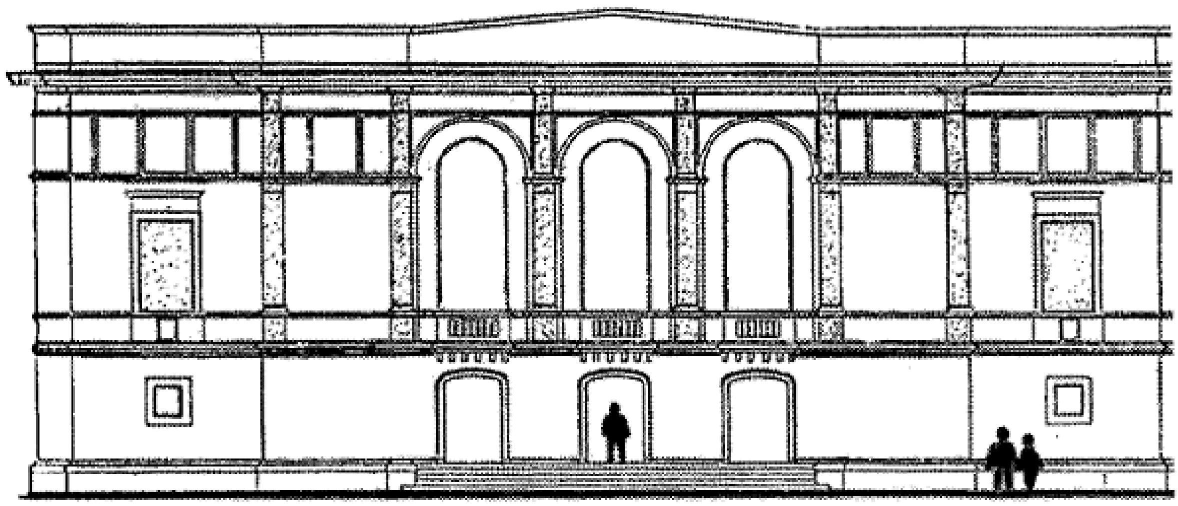


Fig. 2.45 – The size of a building in reference to the human dimension

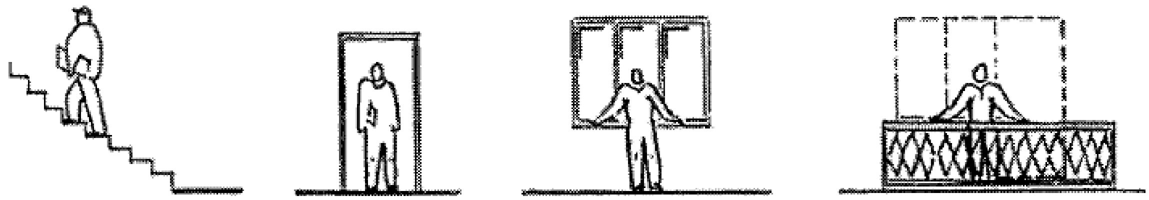
The researches on human dimensions (anthropometric research) are applicable not only in the design of the architectural space but also in the manufacturing of furniture, ready-made clothes, tools, goods, etc. [34].

The dimensions of the human body and the positions he takes in the time of his activity or rest (see chap 1 fig. 1.9 and 1.10) were and still are the main elements the architect must take in consideration when designing the dimensions of the architectural space and its elements.

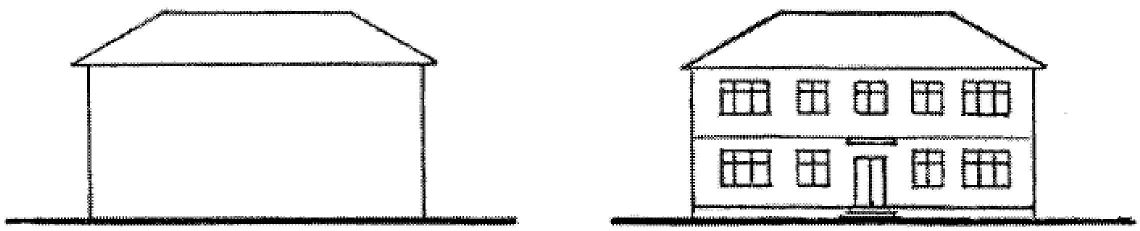
The first way to dimension a building to human scale is the ***comparison of the ensemble with the human figure*** in architectural drawing (facades, perspectives, etc.) in this way resulting the size of the building with respect to the human body (the comparison of the façade from fig. 2.45 with the human figure describes the proportions of the building in a very suggestive way).

Another way to dimension an object with respect to the human scale is the one that doesn't use the human figure, but the comparison appears with some ***composing elements*** of the building, that can function as references for the proportions of the assembly, since they are commonly used.

For example, ***the staircase, doors and window parapets, balustrades of balconies***, etc. are elements of dimensions compared directly to human size (fig. 2.46.a) that can suggest proportions and size of the building in its ensemble. In fig. 2.46.b we remark that a building of *undetermined size* can become of *determined size* just by representing the doors and the windows in the façade (although it is designed at the same scale as the first one).



a.



undetermined size **determined size**

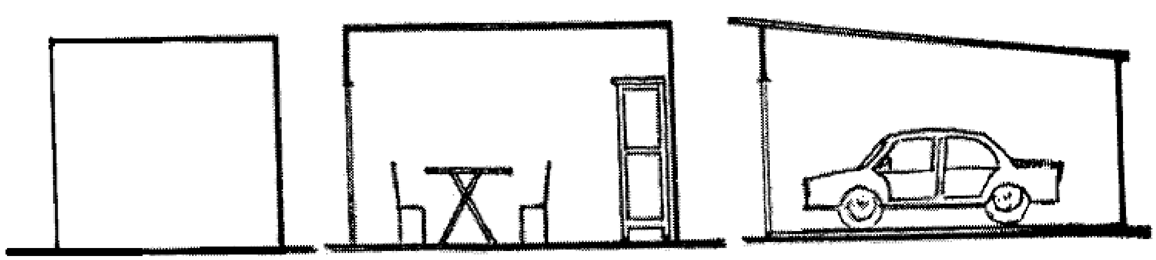
b.

Fig. 2. 46 – The constructive elements and the human scale
(stairs, door, window, balustrade of a staircase)

Finally, the third way to dimension an object with respect to the human scale used in architectural design is comparison with items used by humans daily: furniture (table, chair, bed, closet, etc.), car, tools, clothing, etc.; the simple presence of these can suggest the proportions of houses or rooms (fig. 2. 47).

It is impressive how the most different objects used by humans can suggest the size of a space or of a construction element.

In this sense it is suggestive to compare a figure of the same size (a rectangle in fig 2.48) with the human silhouette, or with items used by humans, so that the figure "receives" a very large range of dimensions (from a shoe box to a block of flats).



room of undetermined size rooms of determined size

Fig.2. 47 – The usual objects and the human scale

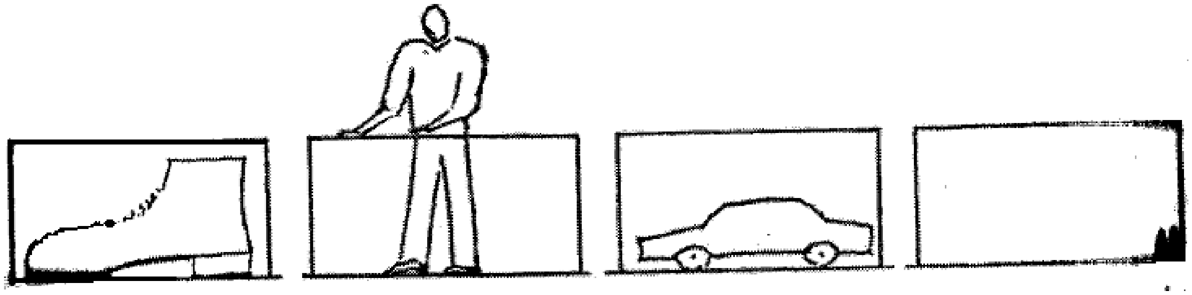


Fig. 2. 48 – the dimension of a figure (rectangle) with respect to the human scale

THE PROPORTIONAL SCALE – refers to the establishment of the plastic composition of an ensemble using some *proportioning systems* between different parts of the ensemble [27].

These proportioning systems (based on the concept of a “fundamental mathematical order of the Universe” or the concept of “identification of human perfection with regular geometric shapes”) appeared in antiquity, and the best known in European architecture (and not only) have been Euclid’s “golden section” and Le Corbousier’s “Modulor” (previously noted), whose principles have been used to “harmonize” parts of buildings or the dimensions of interior spaces.

THE PHYSICAL SCALE – results from the functional and structural dimensioning of buildings and it refers to the impression made on the viewer by the dimensions of some elements compared to others’ of the same type.

For example, designing poles too slim to sustain a body (even if they have the adequate strength and stability) makes that body look heavy and over dimensioned, or adversely, too massive poles will suggest that the body is too little and does not fit the poles. The optimum solution in this case is to adopt a correct *physical scale*, so the size of the poles will be equilibrated with the size of the body they sustain, leaving the impression of reasonable and normal.

Regularly, in architectural design, *the dimension of the construction elements* (walls, poles, beams, platforms) *comes from strength and static calculus*, and *the dimension of the space delimited by these elements* (rooms) *results from functional conditions*, but in accordance with the building system and the mechanical characteristics of the materials used.

To obtain a visual equilibrium, a perfect physical scale, *the dimension of the elements and the distances between them must be established according to the materials they are made from*. So:

- the *resistant* materials (steel, reinforced concrete, etc.) can be associated with slim elements and with large openings;
- the *massive* materials, or *least resistant* to complex solicitations (rock, masonry, timber) are associated with solid elements and with smaller openings of rooms;

The physical scale of a building is determined by the hierarchy of the composing elements’ dimensions and of the ensemble and it has to be clearly expressed.

The categorization in a hierarchical order of functional and constructive dimensions of buildings lead to some technological principles, like *modulation* and *typification*, principles that have been used since antiquity (at the bay between the temple’s columns, modulating the columns of the architectural orders, at the gothic bolts system, etc.).

In another approach of the architectural scale problem, C. Jurov [27] introduces the notions of *traditional scale, the scale of typical conditions, biological rhythm scale, proximal distances scale.*

THE TRADITIONAL SCALE – refers to the comparison of buildings sizes specific to different traditional cultures, from this comparison resulting that *the human scale was and it is considered a variable element* that depends on the architect's conception about diverse factors (of the environment and the sense that people assign to it, of the culture and civilization of the society, of the building material's characteristics, etc.).

This can be pointed out comparing the proportions of some buildings with the same function, but belonging to different cultures, and the example given in paper [27] (see fig. 2.49) is suggestive to illustrate the traditional scale and refers to the comparison between facades of some buildings with religious character from gothic architecture (cathedrals) and from antiquity (temples).

THE SCALE OF TYPICAL CONDITIONS – is determined by *the typical conditions of existence* of a society or region (social, climatic, spiritual, etc.).

These conditions are reflected especially in the architecture of buildings designed for living (especially in the collective buildings) and the example offered of interior and exterior architecture of "mass living" building is the Romanian block of flats (small useful surfaces, cheap finishing, modest equipment) is significant.

THE BIOLOGIC RHYTM SCALE – is given by the analogy of the *human scale* with the *biological rhythm* of humans or of the "cell of society", the family. The result lead to the "*biomorphic*" architecture (based on the relations between the functions of the dwelling and the evolution of the family) and an "*organic*" architecture (based on the relation of buildings with the environment).

THE PROXEMIC DISTANCES SCALE – is given by the way in which the built space creates psychical and behavioral states on humans. *Proxemics* or *the science about ambiance* is an important side of contemporary architecture and it focuses on human quality of indoor equipments, on the aesthetic quality on the interior and the buildings façade and on the quality of urban and architecture ambiance.

The proxemics deals with two categories of spaces: - *fix spaces* (space models specific to a culture) and *semi-fix spaces* (realized with the help of furniture or mobile modeling) from this category taking part *psychological-proxemical distances* (intimate, personal, social and public) characterized by certain optimum values between objects and people, to stimulate relations between them.

The extents of this work doesn't allow the development in detail of the complex problem of the *scale in architectural composition*, depending on lots of factors, so what should me memorized is, that *the perception of a building's image depends on the clarity of its components* (form, volume, color) *and the sensibility of the viewer* and that ***the human body** remains the etalon for determination of the sizes of the buildings and of its components.*

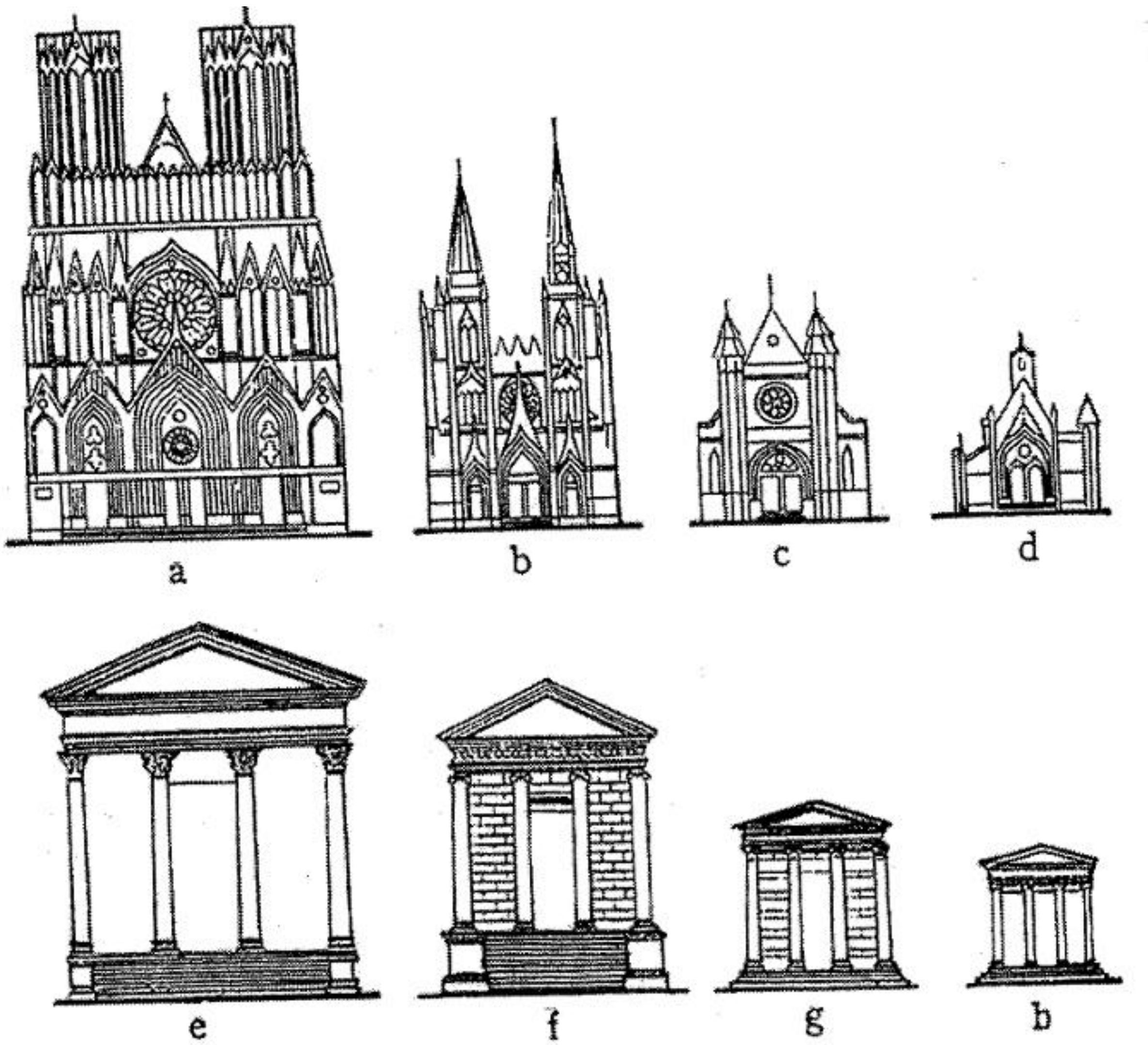
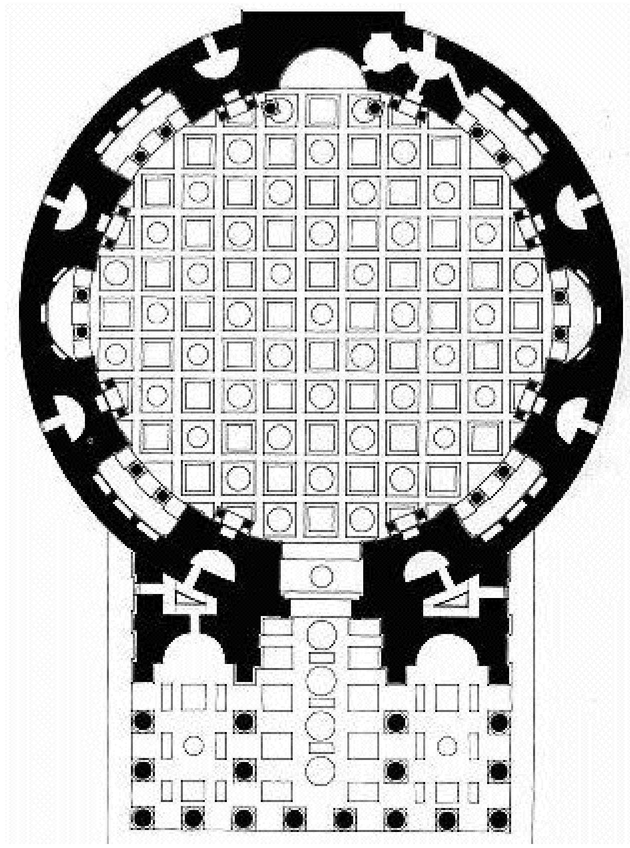


Fig. 2. 49 – The traditional scale (at the gothic cathedrals and antique temples)
a- the cathedral from Reims; **b**- the Notre Dame from Chalones-sur-Marne;
c- San Antion church from Compiegne; **d**- the Notre Dame from Bordeaux;
e- Jupiter's temple; f- the temple of Virilis Fortune; **g**- the temple of Zeus from Magnezia;
h- the temple of Nike from Athena

Symmetrical plans of famous buildings



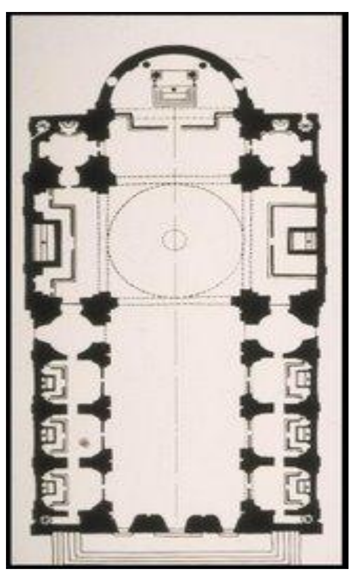
A floor plan of the Pantheon in Rome. It is considered one of the finest examples of Roman Architecture still in existence.

Facade of Saint Peters (1626)

The largest concern in the creation of the façade was not masking the dome created by Michelangelo. Moderno created a rectangular-shaped facade that almost has a palace-like effect in its rectangular, three-storied plan. This effect is mitigated by the presence of the dome, which acts almost like a pediment above the palace-like façade. Moderno used monumental orders to match the orders used on the rest of the building, setting them around larger and smaller windows and niches. The center of the building is built up and layered in a new way, with the rhythm following the receding and projecting cornice. The central cornice seems to project forward in a way that insinuates a classical portico. The cornice is low, so it does not cover the dome, but it does overlap the attic story, which travels around the entire building.

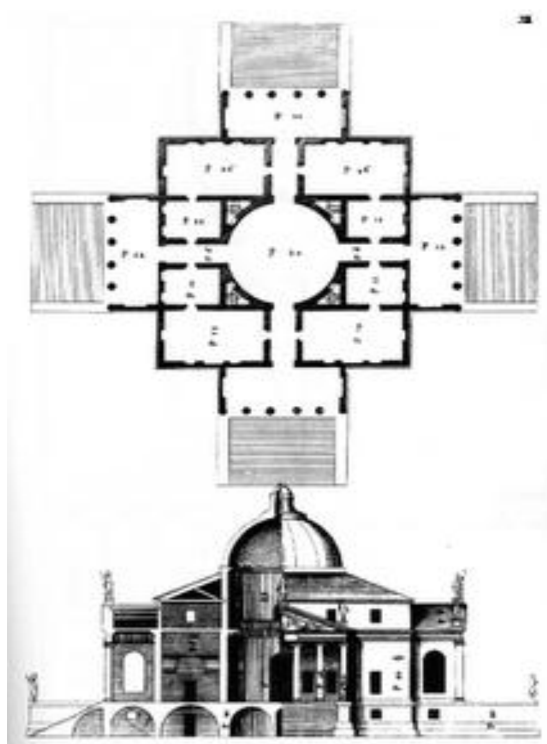
Il Gesu (1568-1575)

The plan of the building is interesting in the way that the architects dealt with the transept and side aisles in such a way as to make the overall shape of the building less ungainly. The transept is very large (its width is as large as the dome of the building), but suppressed, as are the side aisles, to make a basilica-shaped church. The chapels are carved into the side of the church with a passage in between them.

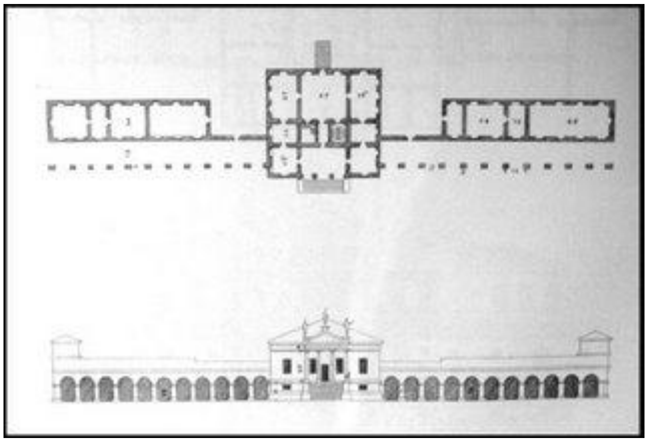


Villa Rotonda,Vicenza (1552-1555)

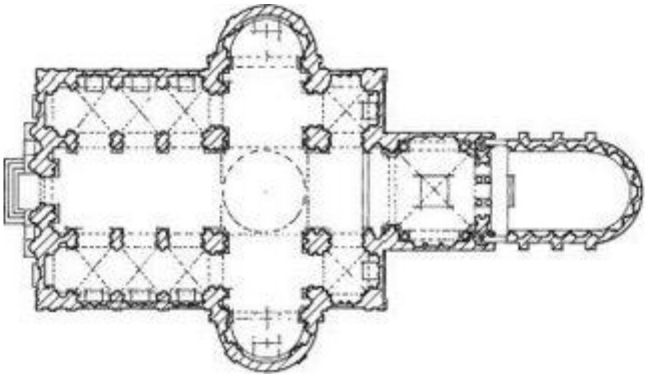
The plan for the building is a circle in the square, which recalls Vitruvius. The proportion of each room is also bilaterally symmetrical, with each room a direct proportion of another room. This is probably one of the most influential buildings of Palladio's life.



Villa Emo,Fanzio (1564)

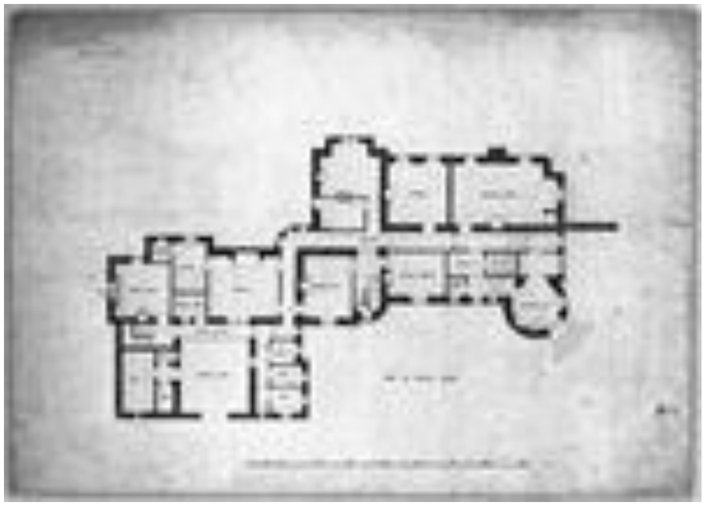


San Giorgio Maggiore, Venice (1560-1580)



Asymmetrical Compositions

Threave House, designed in 1871



Ground floor plan, Peddie & Kinnear, 1871

CHAPTER 3

ELEMENTS IN ARCHITECTURAL DESIGN

3.1 Design of constructions – generalities

The *project* of a building (construction) is made out of several elements (architecture, durability, installations, structure and technology, etc.), which can be, depending on the scale of the construction, independent projects, whose unitary coordination must be supervised by the person who designs the general concept of the building - the architect.

For the project to be materialized (the actual building of the construction) it is mandatory to obtain a *building license* from the local, county or (rarely) national administrative authorities, and the license is the only document that allows for the actual building to begin (according to the law [67], [68], [69]).

The contents of the documents needed in order to obtain the *building license* is quite similar for all types of constructions, yet, containing elements that are specific for each category (functional types).

For example, in the case of "*residential buildings*", in accordance with the Law 50/ 1991 [67] about "licensing construction building and certain measures for residential building", *the content of the project* needed to obtain the *building license (PBL)* is the following:

Written pieces:

- *list with the signatures* of the designers involved;
- short *report* for each field;
- *geotechnical notice* (for constructions with a certain degree of complexity);
- *notices from the utilities suppliers* (for the construction efficiency);
- references regarding an *examination of the project* (according to the performance standards required for the building);
- *specific licenses* regarding the *location* of the building- from various commissions or departments (historical monuments, the environment, national security, regional urban planning, commerce and tourism, etc.);
- *specific licenses for the functioning* of the building (environment, health, national security, commerce and tourism, etc.);
- *licenses for land occupancy (*permanent or temporary) from the public or private domain (for alleyways, joints, branch pipes, etc.);
- other *specific licenses* mentioned in the *Urbanism License* (technical examinations, the state inspections for constructions, detailed urban planning- DUP);
- data and indices for the construction.

Drawn pieces

- *plans for land positioning* (on various scales);
- *site plan* for the apartment, with accurate indication of the existing elements, if there are any, and of the ones proposed;
- *plans for the foundations* (which show that the requirements in the geotechnical study or license are met);

- *plans for each level of the construction* (with mentions of the function, size and heights of the rooms);
- *vertical sections* through the construction (with mentions of the heights of each level, of each room, of the roof, etc.);
- *the plan for the cover,* with the declivity and bench mark on the three dimensions;
- *all the fronts* (with mentions of the finishing materials, of the colours and of the heights);
- *the street exposure* of the construction;
- *the organization project* for the construction (OPC) with the licenses needed for the technological part of the constructing process (for small constructions, the organization elements of the construction can be inserted in the site plan);
- *other drawn* (or written) *pieces* which are considered necessary by the designer, or which are required through the Urbanism License.

Observation*: it should be noted that, even though the building license allows the start of a construction in accordance with the laws and regulations in force, the actual constructing will be done according to the project and the tables that contain* construction details *of the components, tables which are to be examined by a certified investigator.*

3.2 Graphic methods of architectural design

Architectural design means handling and materializing in a project the constructive, functional and esthetic ideas that the designer (architect) has for an architectural site.

The general concept of a building (represented through its project) depends most of all by two important factors:

- *the program-theme for the construction,* (put together by the beneficiary) which contains the building purpose, location, technical, economic and functional indices, the dates in which the building is to be ready for usage, special construction requirements, usage conditions for the building, etc.);
- *the professional training* and *the talent of the designer* (the intuition, imagination, sensitivity, artistic and technical abilities of the architect).

Apart from these two, there still are a great number of specific factors that can influence the view on a building's design or on a built assembly, and taking these into consideration when architectural designing is again dependent on the professional abilities of the designer.

Despite the fact that *architectural design* handles the general concept of the construction and it is materialized through the elaboration of "*pieces" of architecture* (plane views, vertical sections, fronts, perspectives, constructive details, etc.), it has to follow certain regulations imposed by the structural concept (durability) of the building, by the characteristics of the location's ground, by the options and preferences of the promoter or investor.

Designing the drawn pieces (sketches) of architecture is based on the classical principles and methods of architectural designing, which are known through the rules of technical drawing in architecture and constructions, and through those of descriptive geometry and drawing in architecture is *the graphic means of expressing ideas and concepts about architectural constructions.*

The plane graphical representation (orthogonal), which is normally used by architects, is not always capable of conveying the spatial image of the construction or of its components, which makes it a necessity to use some graphic means that are to make *the visual spatial perception* of the building clear.

These methods are based on descriptive geometry and they use the principles of **projection, shadow** and **perspective.**

In the following lines we will present a few generalities regarding these methods.

3.2.1 Projection in architectural drawing

The projection is the geometrical operation that schematizes the process of visual perception and it stands for *the accurate plane representation of the constructions in space* (interchangeable).

There are several types of projection:

a - cylindrical *projection* - which corresponds to an *infinite* vision (the projection center is at an infinite distance) and which leads to *conventional perspectives* and to an inclined or orthogonal projection.

In the cylindrical projection, which is obtained through *stereoscopic* (with both eyes) view, the parallel edges of an element in space (for example, a prism in image 3.1.a.) remain parallel in the drawing, and the "projections of the centers of the edges are the centers of the edges' projections" [62];

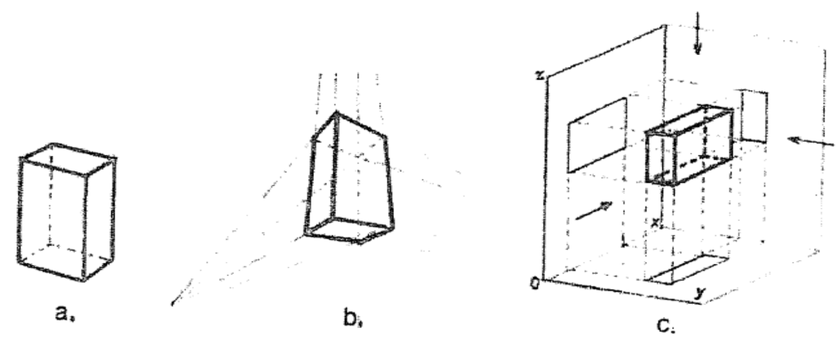


Image 3.1 – Cylindrical projection (**a**), conic projection (**b**) and orthogonal projection (**c**) of the rectangular prism

b - conic *projection* - corresponds to a *limited* distance view (the projection center is at a limited distance) and is obtained through *perspective* view (with one eye).

In the case of the conic projection, the sight distances become *projecting lines*, and the plane image of the element is the geometrical result of the intersection of the sight distances of all its points with a plane located between the observer and the object (image 3.1.b). In this case, the parallel edges in space have a vanishing point, and the projections of the centers of the edges are no longer the centers of their projections [62].

Both the *cylindrical* projection (*slanted* or *orthogonal*, depending on whether the direction of the projection is oblique or perpendicular on the projection plane) and the *conic* projection deform the lengths and angles in space, but maintains the congruence relation, the tangent and angles of plane curves, without, however, being though unable to separately delimit a tridimensional object in space.

c - the double orthogonal projection - allows correction of the fact that a single projection (cylindrical or conic) does not determine a tridimensional object in space, but a plane object.

For example, in the case of a rectangular prism being projected on a plane that is parallel to one of its surfaces, the perpendicular of the prism is lost (image 3.1.c), but if a second orthogonal projection is introduced on a plane parallel to it, the perpendicular is visible. In this case there is a *double orthogonal projection* (called *descriptive geometry* and defined by [62] as being "the method used to represent, with *reciprocity*, the objects in space on a plane, through a *double orthogonal projection*, followed then by the displacement of one plane on the other one, which allows for a graphic solution to any problem of spatial geometry done on a *working drawing*".

Observation - *not determining a single orthogonal projection on a horizontal plane can also be corrected by writing down the coordinates (positive or negative) of the points in space, on the projection plane, next to the projections themselves (this method is mainly used in topography, but also in architecture - "elevation").*

3.2.2 Shadows in an architectural drawing

The shadow-drawing method (used mostly with building fronts) shows volumes and the relations between them, emphasising the "depth", thus creating a more plastic image of the presented elements.

There are two types of shadows, which correspond to the two types of projections, generated by two light sources:

- the *cylindrical* projection is linked to a *shadow at* "*sun"*(with a light source that is at an infinite distance - the sun);
- the *conic* projection is connected to a *shadow at a* "*candle*" (the source of light is a point, and it is located at a limited distance- light bulb, candle, etc.).

The exterior contours of the figure from images 3.1.a and 3.1.b are the shadows at "sun" and at a "candle", respectively, of the rectangular prism.

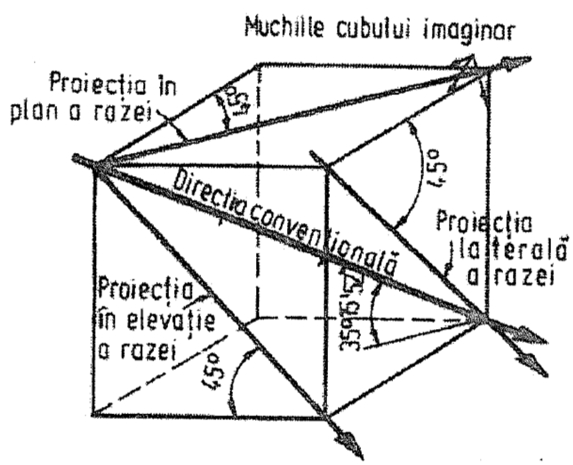


Image 3.2. – Direction of the conventional shadow in designing

(Edges of the imaginary cube; plane projection; conventional direction, lateral projection; elevating projection.)

In order to emphasise the shapes and volumes of the elements of a building, architects usually prefer *the "sun" shadows* (in orthogonal projection) and the *conventional light direction* is *at a 45 degree angle from the ground level line* and *towards it, from left to right* on both projections (plane and elevated), and corresponds to the diagonal of a cube (see image 3.2).

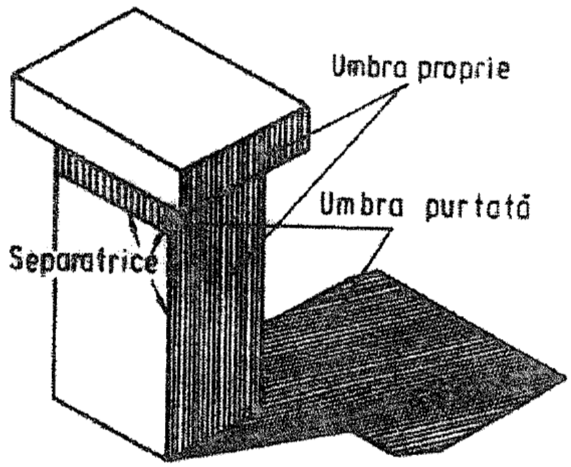


Image 3.3. The shadows of an element in space- separators; self-shadow; projected shadow.

The shadow of a spatial element (fig. 3. 3) is made of:

- surfaces that receive no light and thus have a *self-shadow;*
- surfaces whose access to light is blocked by other surfaces and thus have a *projected shadow* (which actually is the projection of the object).

The lines that separate the surfaces of the element which have light from those which do not are called *separators* and are the projection of the contact curve of the element with the "light tube".

The theoretical side of shadows in architecture for shapes and volumes cannot be tackled here (due to its complexity and lack of typographic space), and it is presented in detail in speciality works with the help of descriptive geometry.

For a more detailed explanation, however, we will show you some practical examples of using shadows of spatial elements (surfaces and geometrical objects or parts of a construction) according to [15], [19], [25], [62].

Therefore in image 3.4 there are a few examples for the representation of:

- the shadow of a straight line on the horizontal plane (A);
- the shadow of a straight line on both projection planes (broken shadow - B);
- the shadow of a triangular surface (C);
- the shadow of a volume (parallelepiped - D);
- the shadow of a cylinder (E)
- the shadow of a cone (F)

and in image 3.5 there is a detailed view on drawing shadows for some elements in a construction:

- the shadows of a front (A);
- the shadows of arches (B);
- the shadows of a parapet of stairs (C);
- the shadows of a front arch window (D).

3.2.3. Perspective in an architectural drawing

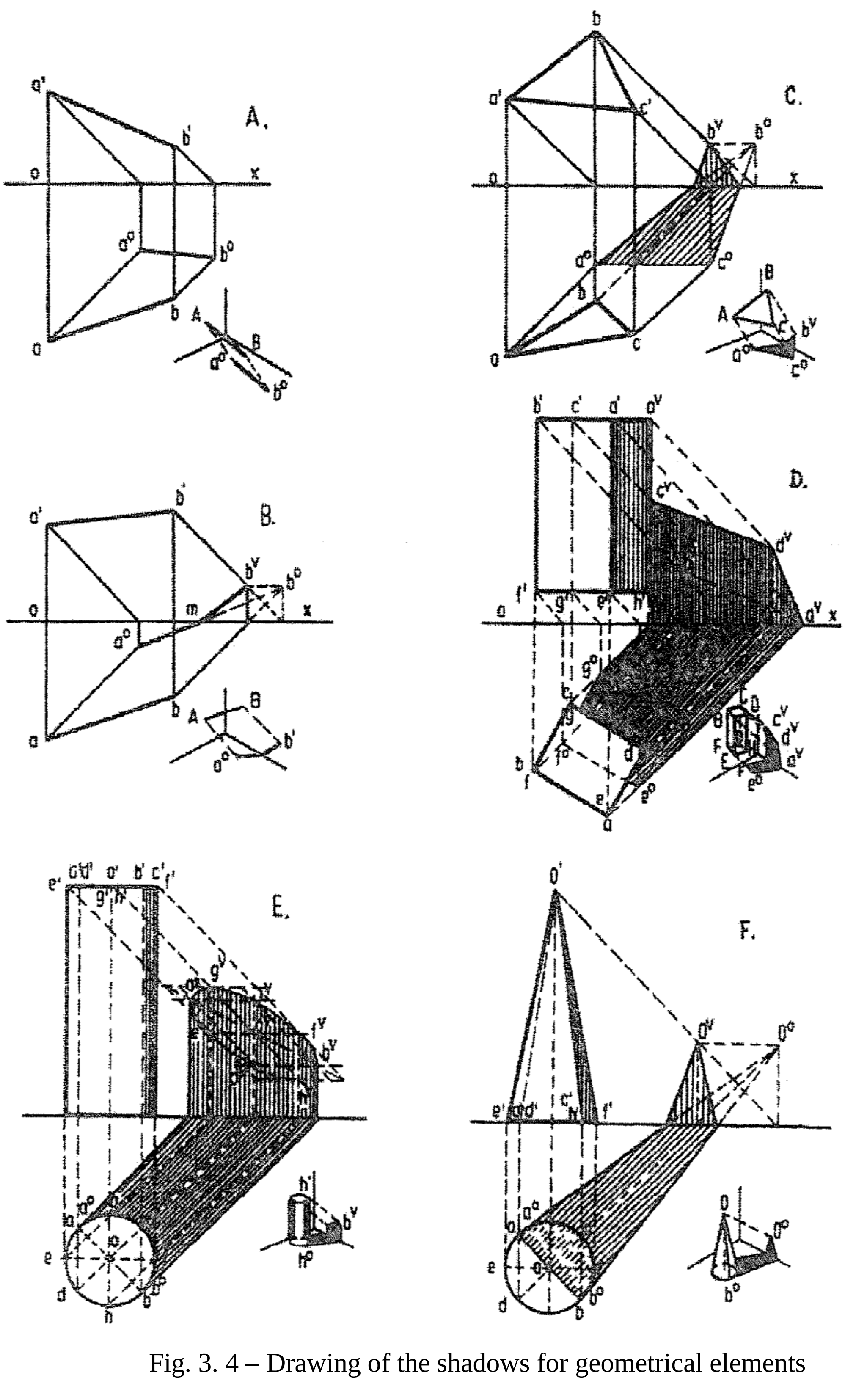


Fig. 3. 4 – Drawing of the shadows for geometrical elements

The perspective is "*the science that conveys the graphic means of representing objects in space on a plane, as they are seen"* [62], or "the science of conveying the tridimensional image of an object or of a set of objects in space, on a plane surface, through the conic (linear) or parallel (axonometric) projection". [64]

The perspective representation on volumes or objects can be done in two ways: from an *axonometric perspective (in axonometry)* or in *linear perspective.*

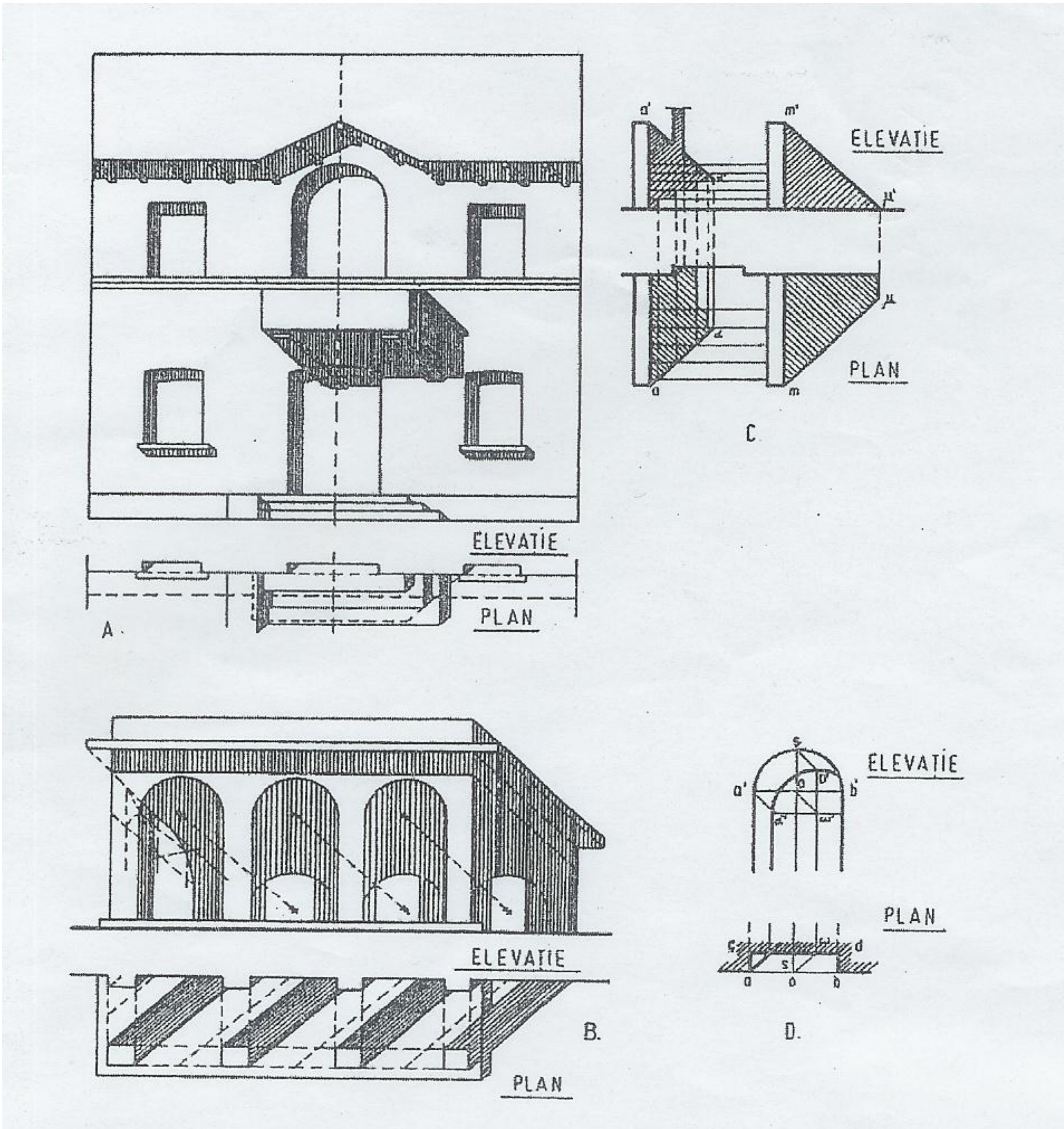


Fig. 3.5 – Drawing the shadows for architectonic elements (examples)

The axonometric perspective (axonometry) – is based on *parallel* projection of the bodies over a plane, together with their axis of coordinates, the dimensions remaining constant on the given direction, no matter how deep they are situated (fig. 3.6.A).

Linear perspective – is based on *conic* projection method, the equal dimensions of the objects from the space getting smaller in the projection as they are getting further from the position of the viewpoint (as the "depth" of the perspective is rising – fig. 3.6.B).

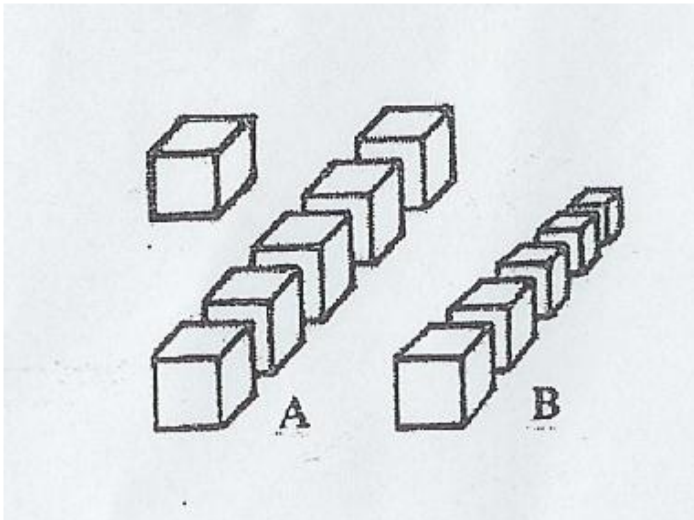


Fig. 3.6 – Perspective of the cube
A – axonometric perspective; B – linear perspective

AXONOMETRY is frequently used (in the architecture design) in order to present details and constructive elements, being more accessible, and depending on the projection system (or depending on the position of the reference system with respect to the projection plane) it can be:

a – *orthogonal axonometry*, when the angle between the projection plane and the projection direction is 90° (right angle);

b – *oblique axonometry*, when the value of the same angle is between 0° and 90°. Within the oblique projection, when the projection plane is parallel with one of coordinates' plane, the axonometry is named *frontal* or *equine* and it has the advantage of projecting in natural size the figures parallel with the projection plane;

c – *conical axonometry*, which, in certain conditions' orientation and position of image projection towards the spatial reference system, has the character of a linear perspective.

Within the practice of projection sometimes it is used a method of reproducing the axonometric perspective of a building *"from up to down"* view, so that the axis direction is arbitrary and there is no deformation of the unities (because the design is drawn measuring at scale on the three directions all the sizes adequate to the volume). This perspective is named *military perspective* (fig. 3.7.a).

In case the perspective of the building is made according to the same principle (measuring at scale on three directions all the sizes adequate to the volume) but with the *"down to up"* view, it is named *perspective from frog position* (fig. 3.7.b).

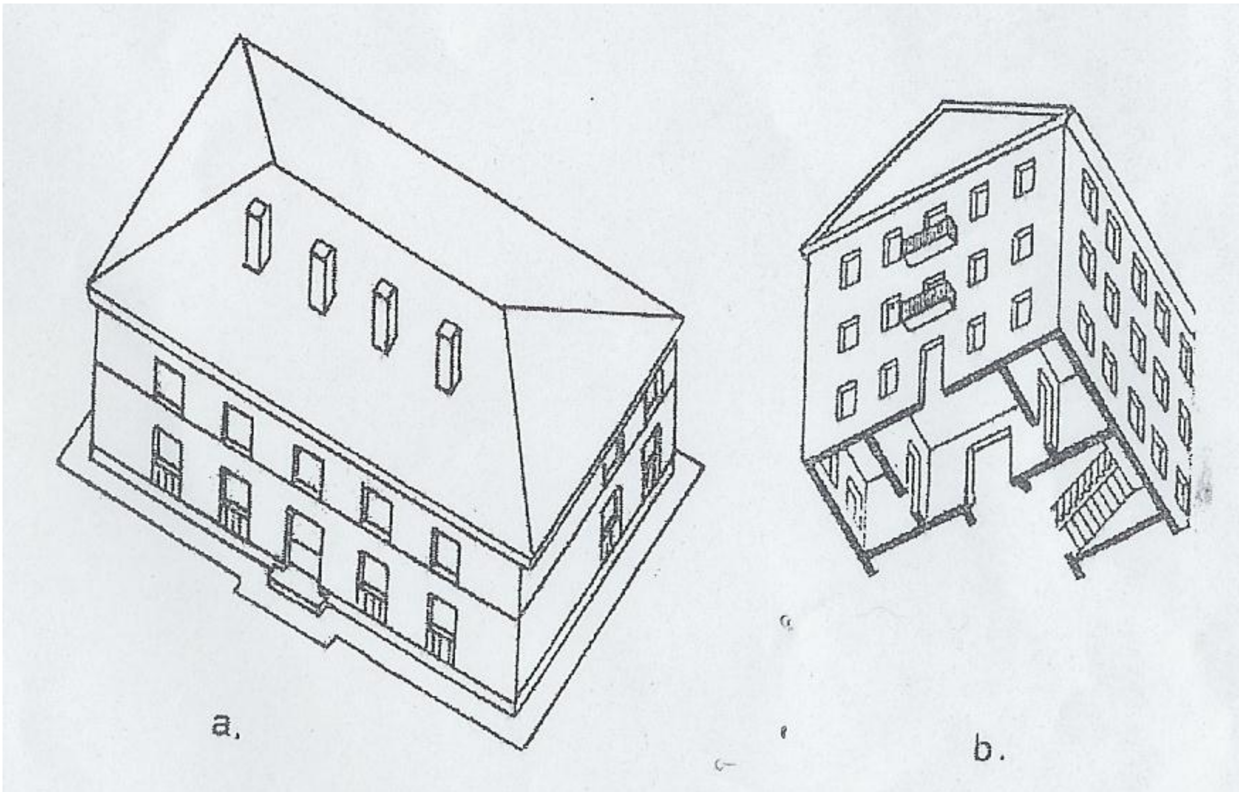


Fig. 3.7 – Axonometric perspectives
a – military perspective; **b** – perspective from frog position

LINEAR PERSPECTIVE – is creating an image close to the usual view, actually suggesting the reality through respecting the real optical-physiologic perceiving conditions of human view.

Normally, the *conditions* of obtaining a good perspective are:

- fixing a *principal direction of the sight* (directing the optic axis of the eye towards the geometrical centre of the object);
- fixing the *position of the point of view*, so that the image would contain all the elements that are of interest. From practice results that *the optimal distance of the point of view* is *twice the maximum apparent dimension of the object* (fig. 3.8, after [19]) resulting in this way an optimum angle between the visual extreme rays of 28;
- choosing the right way of the *perspective picture*, which can be (according to [25]): *plane* (horizontal, vertical or incline), *cylindrical* or *spherical*;
- setting of the *vanishing points* (towards which the parallel lines from space will converge on the two directions);
- fixing *the level of the point of view* or *the horizon line* (the line resulted from the intersection of the visual horizontal plane with the picture of perspective plane).

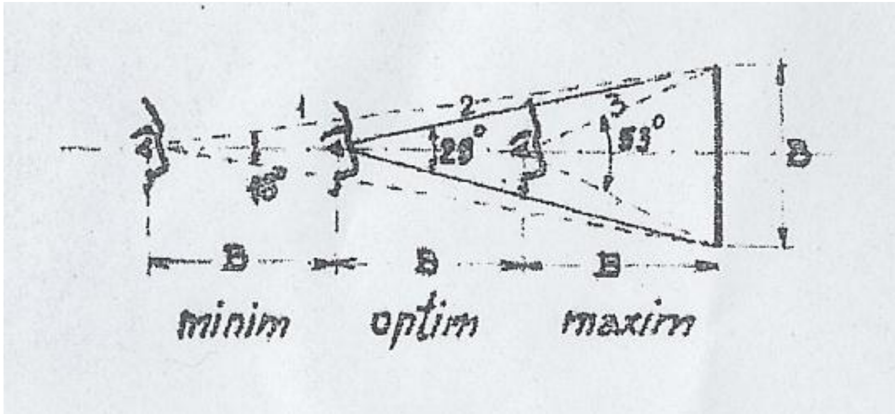


Fig. 3.8 – Position of the point of view in perspective

Depending on the *position of the horizon line* with respect to the represented object, the linear perspective can be:

- *horizontal perspective* (fig. 3.9.a), when the horizon line is at the medium height of the eyes' position (1,60-1,70 m) and *the principal point – P* (orthogonal projection of the point of view on the given picture) falls *on* the horizon line;

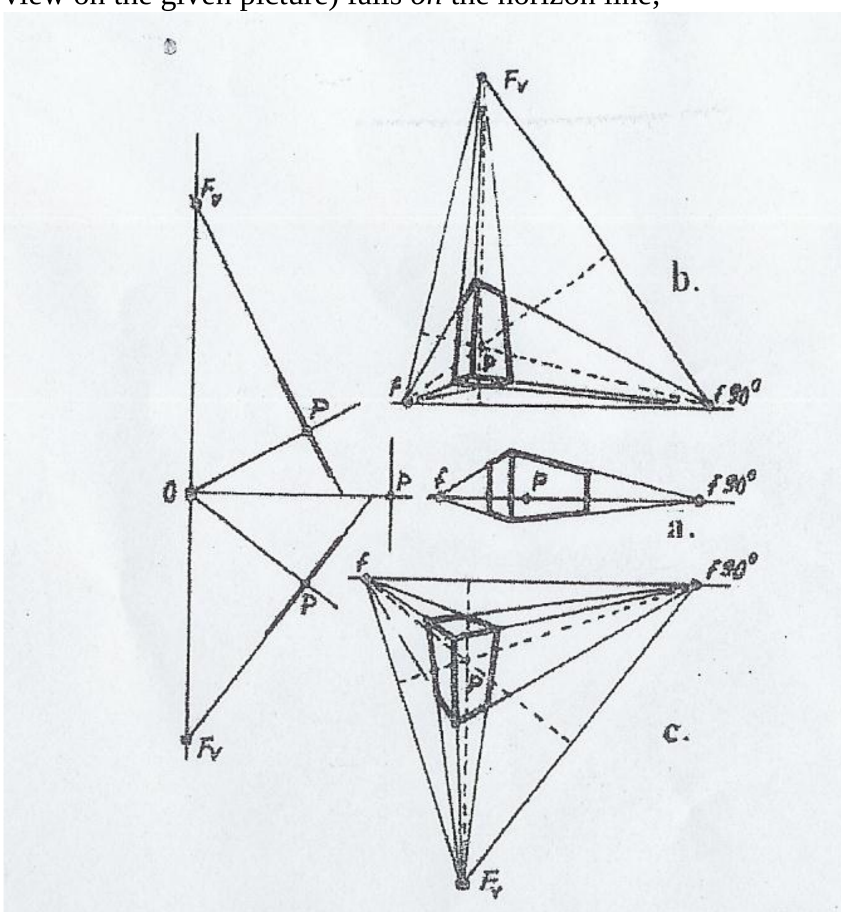


Fig. 3.9 – Perspective of the straight prism depending on the horizon line

- *ascending perspective* (fig. 3.9.b), when the horizon line is fallen under the base quota of the object (resulting a “*down to up*” view) and the principal point (P) falls *above* the horizon line;
- *descending perspective* (fig. 3.9.c), when the horizon line is over-heighten with respect to the object (resulting an “*up to down*” view) and the principal point (P) falls *under* the horizon line.

The *horizontal* perspective is most frequently used in the architectural design, the *ascending* one being used especially for high buildings, for ceilings, arches, etc. and the *descending* one is the perspective used especially in urban assemblies’ projection.

In fig. 3.10 is presented an example of horizontal (**a**), ascending (**b**) and descending (**c**) perspective for a different building each.

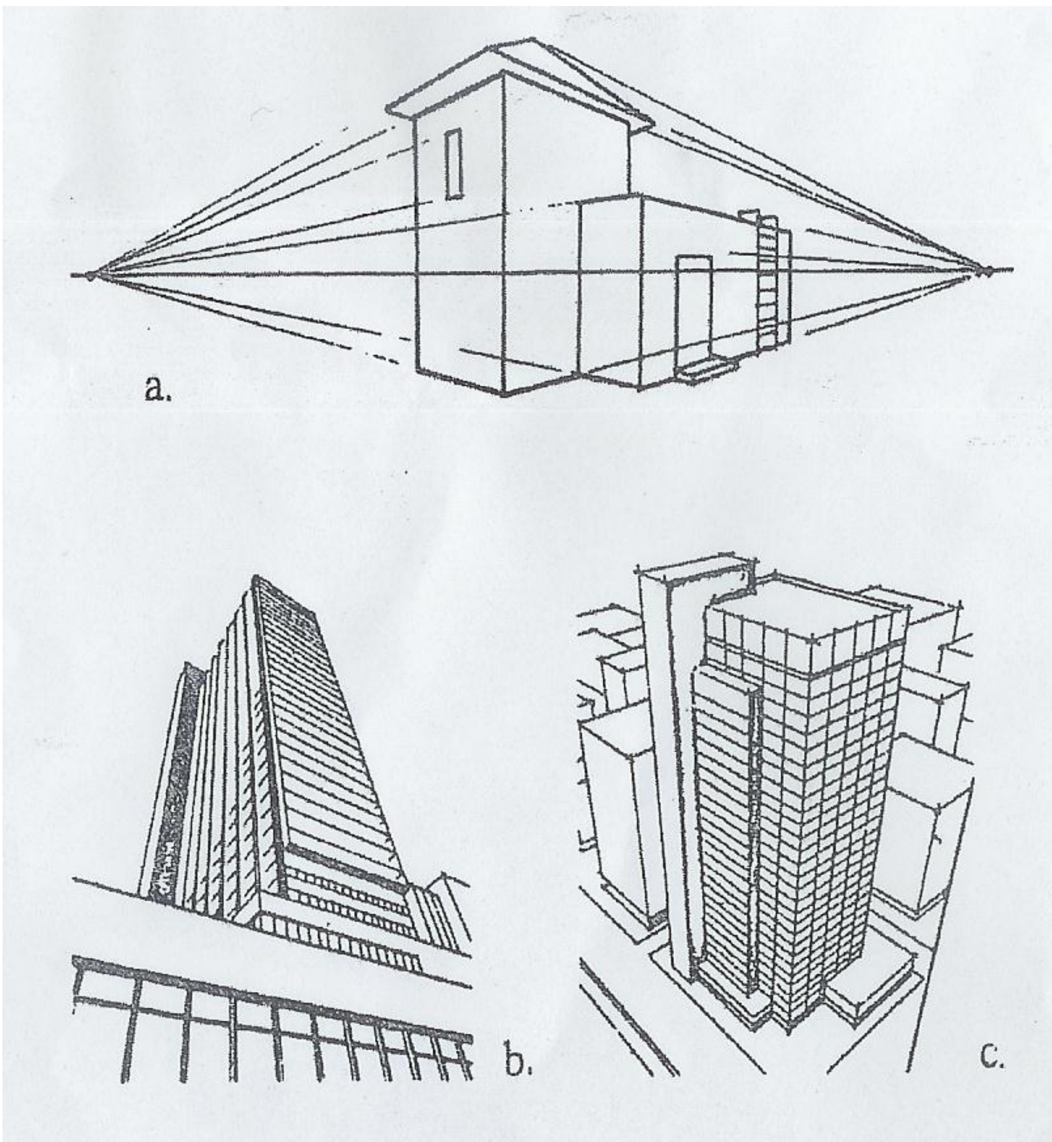


Fig. 3.10 – Examples of perspective
a – horizontal; **b** – ascending; **c** – descending

SHADOWING IN PERSPECTIVE is one of the procedures from the architectural projection practice through which the representations in perspective of the buildings are making obvious better and clearer the proportions between volumes, realizing a closer image to the reality.

The method of shadowing in perspective is used both in *axonometry* (fig. 3.11.a) and in *linear perspective* (fig. 3.11.b).

In *axonometry*, the self-shadow or the one used of the object can be obtained depending on the light ray direction and it is *parallel* when the plane which the shadow falls is parallel with *separatetricy* or it is *inclined* when the plane on which the shadows falls is perpendicular on the straight line of separation of the enlightened face from the shadowed one (separatetricy).

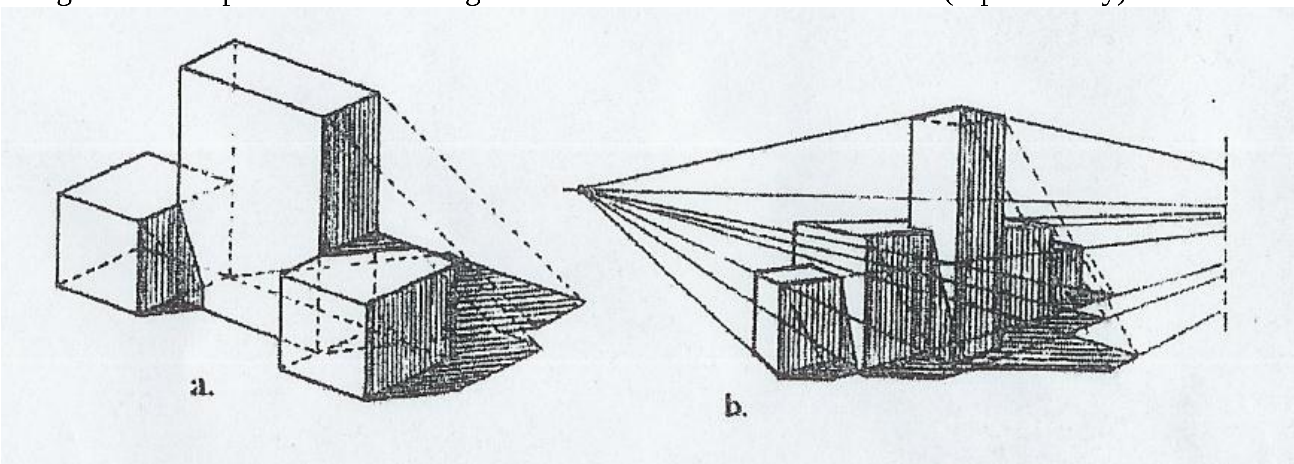


Fig. 3.11 – The shadowing of the perspectives
a – in axonometry; **b** – in linear perspective

In *linear perspective*, the principles of drawing the shadows are the same, but the shadow of a horizontal straight line on a parallel plan with it will still be a parallel straight line, converging towards the same point with the straight line which wears the shadow, and the vertical straight lines give vertical shadows on the plans parallel with them [19].

3.3 Circulation in the inside architectural space

Circulation in the inside space of the buildings is determined by their functionality, and it influences the functionality scheme, because on the logical and economical solving of the circulation depends the good functioning of human life and activity which takes place into the built space.

Within any building peoples' circulation is taking place both *on horizontal* and *on vertical*, and the optimum bondage between these ways of circulation assures the access, distribution, work conditions and evacuation of the people who are using the building.

The composing elements of the architectural space, which assure the circulation in a building, are:

- for *the horizontal circulation* – windfang, vestibule (anteroom), hall, connecting room, corridor;
- for *the vertical circulation* – stairs (fix or mobile), ramps, elevators.

3.3.1 Horizontal circulation elements

WINDFANG – is a “tampon” space (an isolation lock) with thermal isolation role, situated between the outside of the building and the vestibule (fig. 3.12).

The name of “windfang” has German origin (translated it means “catching the wind”) and its dimensions are conditioned by the size and the type of the building, by its base functioning, by the sense of the opening doors, by the intensity of people flux, etc.

In fig. 3.12 are presented several types of “windfangs” used especially at civil and industrial buildings.

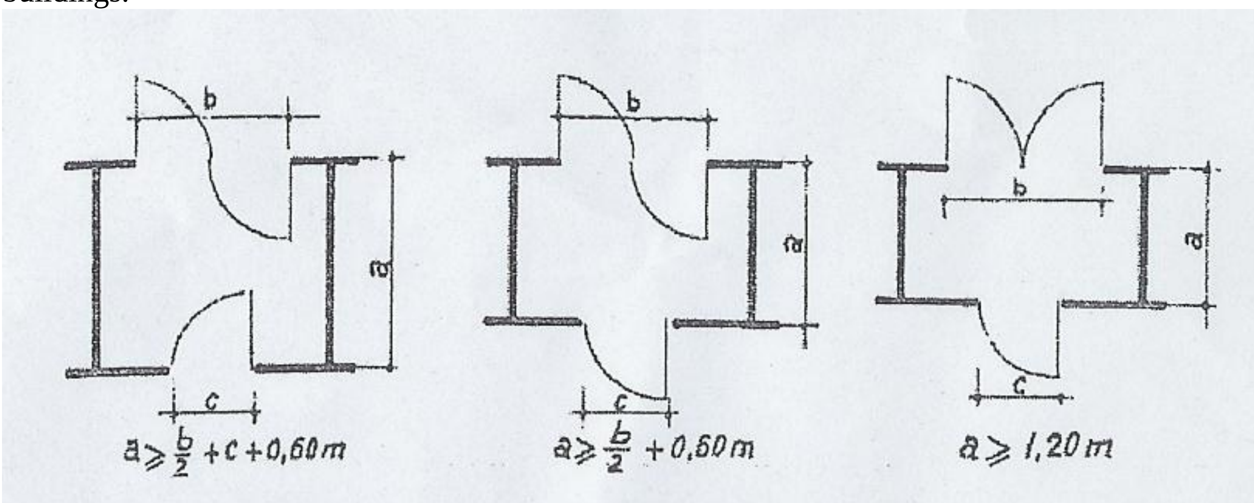


Fig. 3.12 – Types of windfangs at buildings

VESTIBULE or *the anteroom* – is the access space within the building, sometimes taking the windfang’s role (fig. 3.13), sometimes having the function of distributing the circulation in different directions in the building.

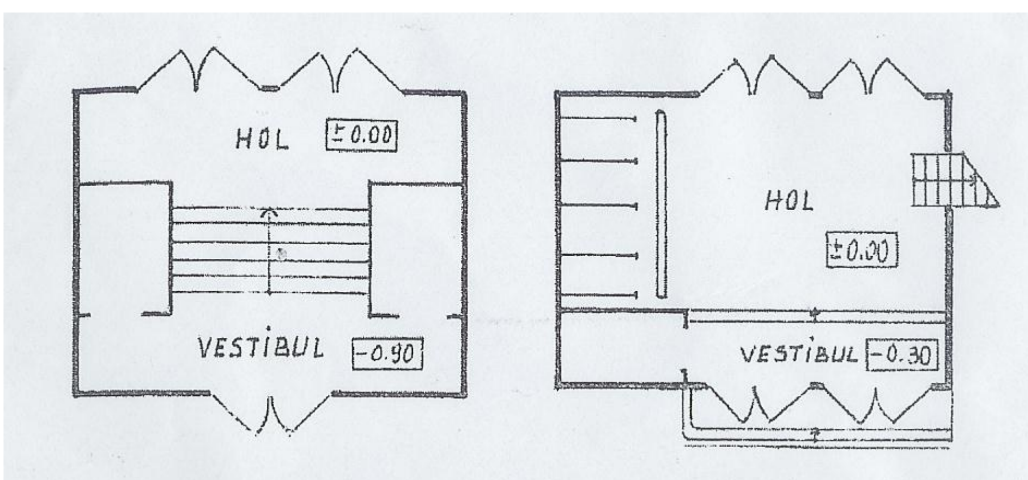


Fig. 3.13 – Location of vestibule (anteroom) within the buildings

The vestibule can sometimes have an uneven floor (with stairs), it can fulfill the functioning of a waiting room and it can have a direct connection with the rooms that serves the public (box-offices, wardrobes, luggage rooms, door keeper rooms, information offices, toilets, etc).

HALL – is the space which has the role of distributing the circulation on horizontal and vertical and sometimes it is the "nodal point" of this circulation within the buildings (fig. 3.13). As it is in the vestibule, the hall can assure the access towards different rooms for public and sometimes it can have spaces that are outside the circulation flux – for resting and waiting.

Halls can be classified in this way:

- according to *the location*:
    - *entrance* halls (ground floor);
    - *level* halls (floors);
    - *unity functioning* halls (apartment, etc.);
- according to *the importance*:
    - *secondary* halls (intermediary, passing and distribution);
    - *principal* halls with complex functioning (at public buildings, building for transportation – train stations, airports, etc);
    - *monumental* halls (multiple functioning, large spaces and decorative character – at public, administrative, cultural, social buildings).

CONNECTING ROOM or *chamber* – is a room that serves as communicating space between the rooms of an apartment or a public building (see fig. 3.14), having reduce sizes and sometimes fulfilling the function of a "tampon" space between the rooms with different temperature, smell, humidity, noise level, activities, etc.

Usually, the connecting rooms don't have windows and so are not natural enlighten and ventilated (only artificially, with the help of specific installations).

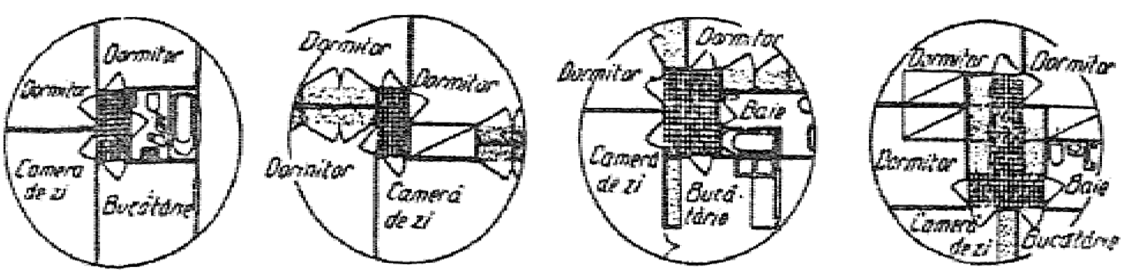


Fig. 3. 14 – Examples of connecting rooms in flats

The size of the chamber is determined by number, function, size and location of the rooms it serves end on the needs of movement and auxiliary needs (storage, etc.), which it must fulfill.

THE CORRIDOR (*hallway, lobby*) is a space generally long and narrow, which serves as passage and link space between rooms in a building and representing the most wide-spread type of the space for horizontal circulation in the civil buildings (in particular in buildings with public functions, for education and culture, social, health, etc.).

Corridors are used in buildings in which functional units which have certain independence in the frame of a uniform system are repeated: desks, classrooms, laboratories, rooms and rooms or units of housing, etc.

The width of the corridors in buildings (fig. 3. 15) can be determined according to several factors including:

- the intensity of circulation of persons (related to the function of the building);
- the opening direction of doors on the corridor;
- the number of access channels served (one or two ways of circulation);
- the evacuation conditions imposed by the standards of protection against fire; etc.

In this respect in the architectural design regulations in force and in the technical literature there are given the minimum values recommended for the width of corridors, depending on one or more factors (of the above-mentioned).

For example [16] recommends that the width of the corridors to be set depending on the *number of traffic flows* and taking into account the *two opposite ways of traffic* on the corridor.

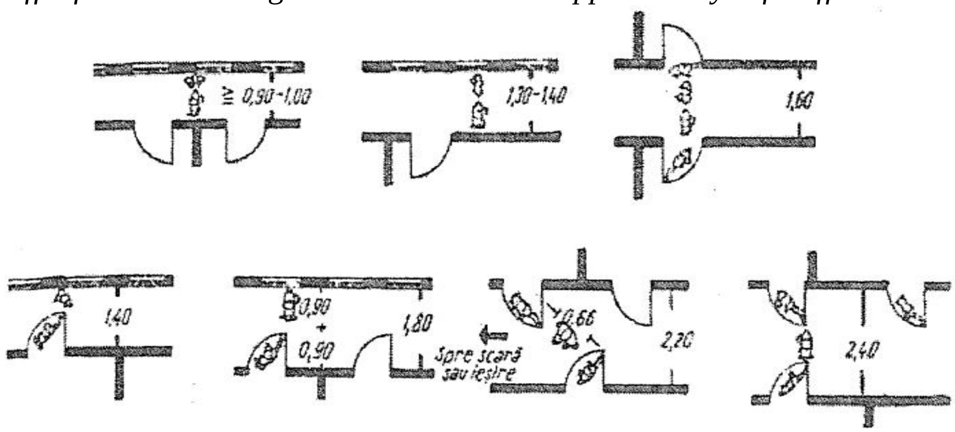


Figure 3.15 Width of corridors in buildings

Considering that a flux of traffic on horizontal may comprise between 50 and 90 persons per minute, the minimum width (**l_{min}**) recommended by [16] for corridors can be:

- for 1 stream - **l_{min}** = 0.90 m;
- for 2 streams - **l_{min}** = 1,10 m;
- for 3 streams - **l_{min}** = 1,60 m;
- for 4 streams - **l_{min}** = 2,10 m;
- for 5 streams - **l_{min}** = 2,50 m.

These widths represent minimum sizes at the corridors and they should be increased in some cases depending on various factors including: - the way of opening the doors (opening towards the corridor), of the existence of doors on both sides of the corridor, or on other special circumstances.

For example, sometimes corridors may have additional functions to circulation - may serve as the play spaces or relaxation for children in kindergartens and schools, as space for movement with carriers - in commercial buildings, hospitals, deposits, etc.

Very long corridors should have from place to place enlarged spaces (intermediate corridors) which can be provided with furniture for rest, or with utilities and food preparation facilities (in case of "offices" of hostels).

Corridors can be lit *naturally* on side or at the ends (when they aren't very long), *artificially*, or *combined*.

3.3.2 Elements of vertical circulation

STAIRS - are elements of construction, consisting of a series of steps, which link two successive levels of a building and may be (in terms of how they ensure vertical access in multi-storey buildings) of two types:

- *fix stairways (regular)*- part of the elements of construction;
- *mobile stairways* (electromechanical) called also *moving stairs* (escalators), part of the technical equipment or facilities of the constructions.

This work doesn't address to this second type of stairs (for reasons of topographic space) dealing only with the usual stairs, fixed, used in principle in all multi-storey buildings.

The make up of the stairways may be simpler or more complex depending on their type, number of steps at the floor's height, the structure of resistance of the stair and the way in which it leans on the building's structure.

Generally, the composition of stairs comprises (see fig.3.16):

- *ramp s*- inclined planes with steps;
- *stair landings* - horizontal planes;
- *ladder beams* - linear elements;
- *girder beams* - linear elements;

Ramps are connected through *landings* and are supported on *ladder beams* or on *landings* and the elements of structure of the building (bearing walls or frames).

In certain conditions of loading and dimensions intermediate beams and landings (between levels) may be missing.

Ramps have at least three steps and may have different forms in the plane and various sizes, according to the existing space and the flux of movement (number of people using them at a moment).

Landings are horizontal elements and are designed to allow the changing of the direction of walk, turning to climb or descent and to let the man "rest" while climbing (by proceeding some steps horizontally).

Landings may be "*of level"* (floor level) or *"intermediate"* (between floors - called "landings for rest").

Landing beams (girder beams) are beams placed along the landing resistance (in it's meeting with the ramps and perpendicular to them) and leans on the side walls of the staircase.

Ladder beams are arranged along ramps (perpendicular to the beams of landing- standing on these or on the frontal walls) and may be *central ladder beams* (the ramp middle) or *marginal* (on ramp edges).

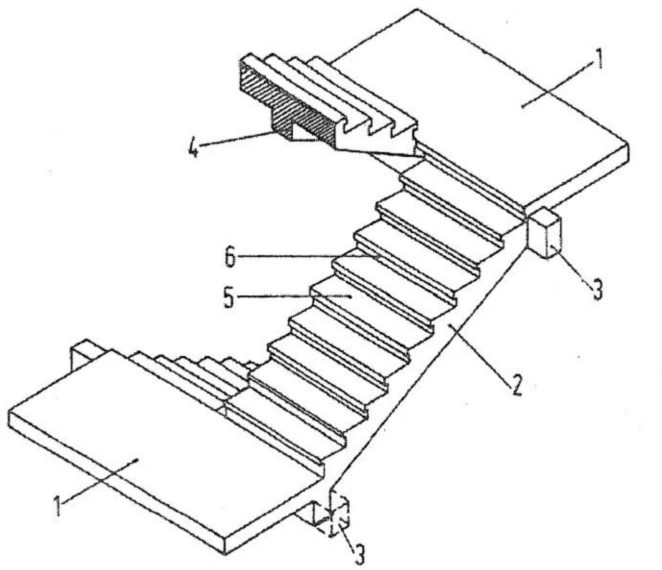


Figure 3.16. - Composition of stairs with parallel ramps
1- landing; 2 - ramp; 3 - landing beam; 4 - ladder beam (central); 5 - step; 6 - riser

The steps have different forms and compositions (Fig 3.16 and 3.17) and have two plane elements (faces):

- the *step* itself, with flat horizontal surface (that we walk on);
- *riser*, with flat vertical surface (fig. 3.17.a) inclined (fig. 3.17.b) or profiled (fig. 3.17c). Sometimes the landing beam may be missing - independent stairways.

To protect the movement (of the people) stairways are provided with *parapets* or *handrails* (made of concrete, masonry, metal, wood, etc.) mounted on the edge of ramps and landings with a height of 80-120 cm and having at the top a “current hand” (for direct support by hand).

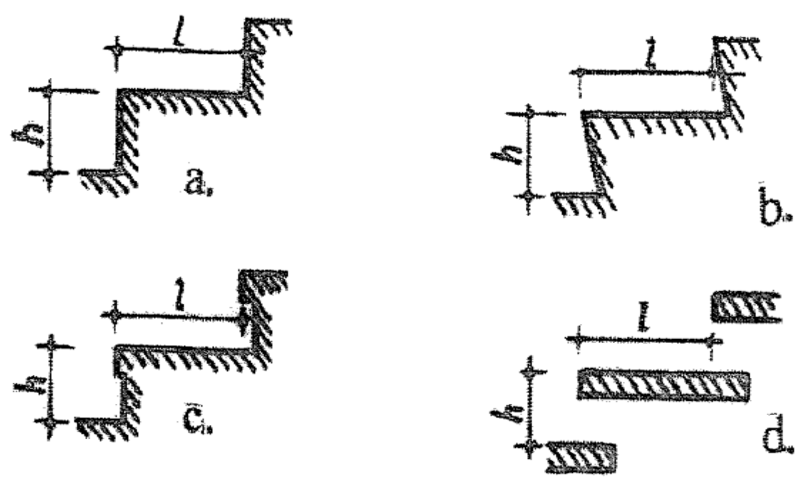


Fig. 3.17. Types of stair steps

Stairways may be classified according to many different criteria, the principal ones being:

a – According to their *position*:

- *interior* stairs – are located within a closed space of a building with natural or artificial lightning (fig. 3.18.a). This space is known as the *stairwell.*

- *exterior* stairs – are located outside of a building (on its facades) and provide access from the exterior into the interior (fig. 3.18.b).

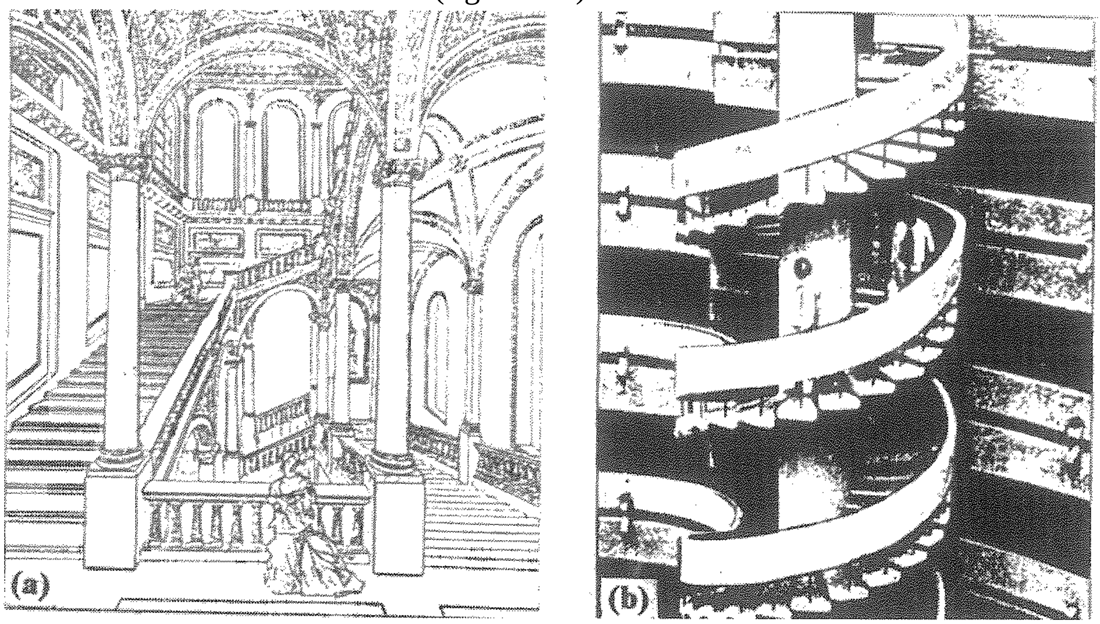


Fig.3.18 – Interior stairs **(a)** and exterior stairs **(b)**

b – According to their *function*:

- *monumental* stairs (or stairs "of honor") - are stairs with an impressive architectural look, a special plastic realization (by use of high quality materials and rich decoration) and are executed on one or maximum two levels (normally from the ground floor up to the first or second floor). They are placed in the principal halls of some public buildings (museums, hotels, theatres, opera houses, palaces, administrative buildings, etc.). In figure fig.3.19 is represented an example of a monumantal staircase according to [56].

- *principal* stairs – are the most frequently used, providing both the current circulation and evacuation in case of emergency; they are extending between floors above the basement and below the attic floor.

- *service* stairs – are leading to some certain levels (porch, basement, attic, etc.). They are also supplementary stairways for rapid evacuation.

- *emergency* stairs – they are used for evacuation in case of emergency. Normally they are made of metal and mounted externally on the buildings (on a secondary facade).

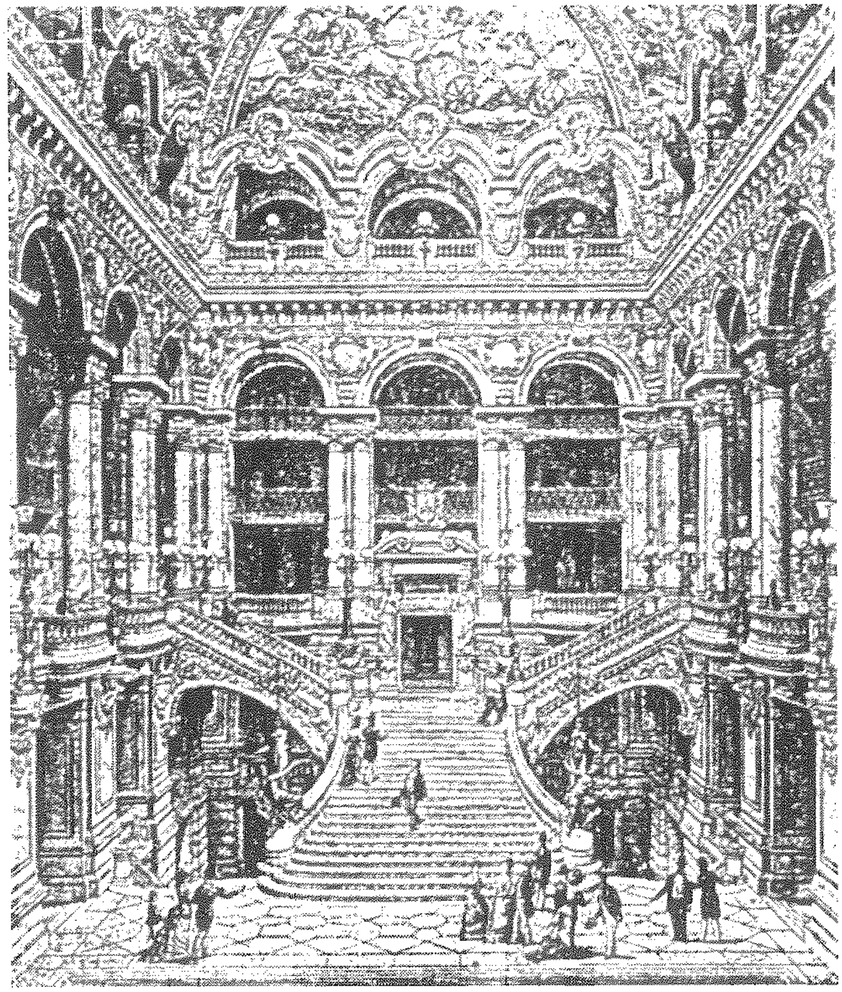


Fig.3.19 – Example of monumental staircase (according to [56])

c – According to the *material* that they are made of:
- stairs of *reinforced concrete* (monolithic or prefabricated);
- stairs of *metal* (mostly in industrial buildings);
- stairs of *timber* (at the entrance or in old buildings);
- stairs of *natural stone* (at the entrance of the old buildings);
- stairs of *modern materials* (interior staircases in dwellings);

d – According to the *slope of the pitch line* (or in function of the rise height of the steps - $\boldsymbol{h_{st}}$)
- stairways with low steps ($\boldsymbol{h_{st}} \leq 16.5$ cm)
- stairways with medium steps ($16.5 < \boldsymbol{h_{st}} \leq 17.5$)
- stairways with high steps ($17.5 < \boldsymbol{h_{st}} \leq 22.5$)
- stairways with abrupt steps ($22.5 < \boldsymbol{h_{st}} \leq 30$)

The rise of the stairs (the slope of the pitch line) is chosen in accordance with the destination of the building, respectively the destination of the stairs as follows:

- stairways with *low* steps are used in buildings where the principal users have a lower medium pace (buildings for children, old people, sick persons, etc.) or for monumental staircases;

- stairways with *medium* steps are the most usual, with daily utilization in most of storey houses;

- *high* or *abrupt* steps are usually used for secondary staircases (with reduced, occasional usage)

e – According to the *stair's shape in the plane* and the *form of arrangement of the steps*:

- stairs *with one or more straight runs*, that may be either continuous or with intermediate platforms (landings) (fig3.20.a,b,c,d);

- stairs *with winders* (at the turn of the runs); such a stairs have trapezoidal form in the plane;

- *curved* or *circular* (spiral) *runs*, that are continuous or with landings (fig.3.20.f,g), having a trapezoidal form in the plane;

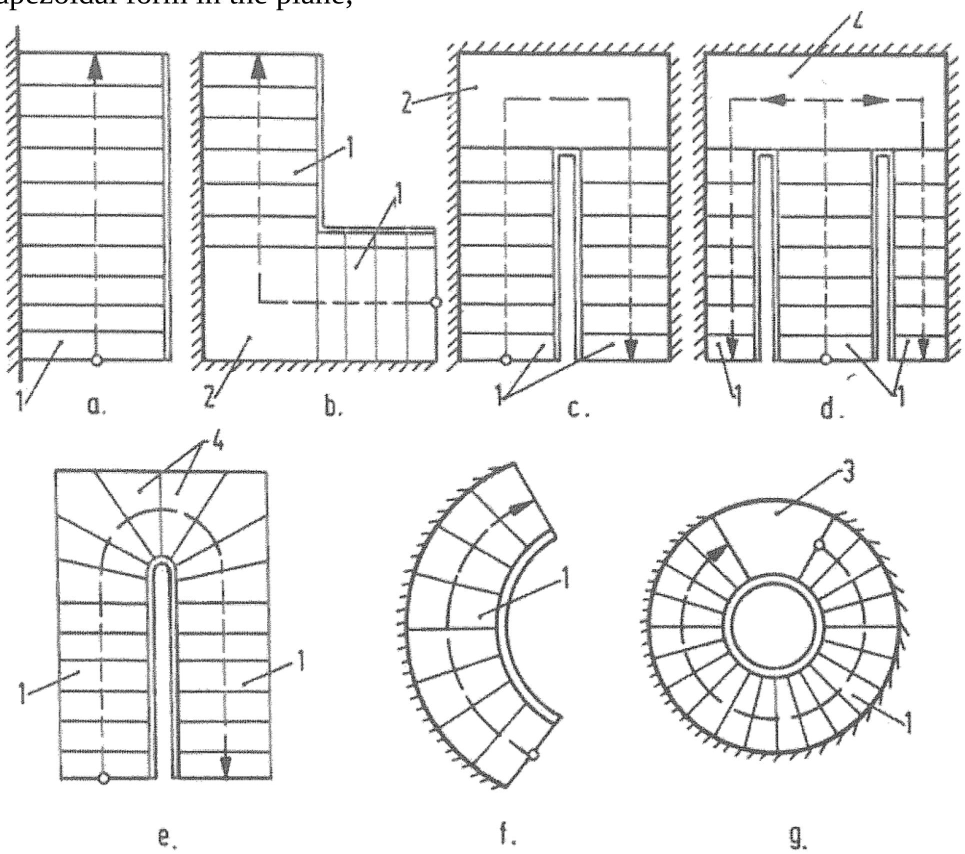


Fig.3.20 – The plane form of the stairs

a-with a straight run; **b**-with 2 runs at 90° with landing; **c**-with 2 parallel runs and landing; **d**-with 3 parallel flights and landing; **e**-with winders; **f**-with curved run; **g**-with circular (spiral) run; 1-run; 2-intermediate landing; 3-stairs landing; 4-winding stairs;

In figure 3.21 there are (according to [56]) two examples of spiral stairways (monumental ones) from the Barberini Palace of Rome and from a palace in Mergentheim (constructed in 1524) their monumentality being emphasized by the form and the dimensions of the staircase, as well as by the architectural elements and the decorations.

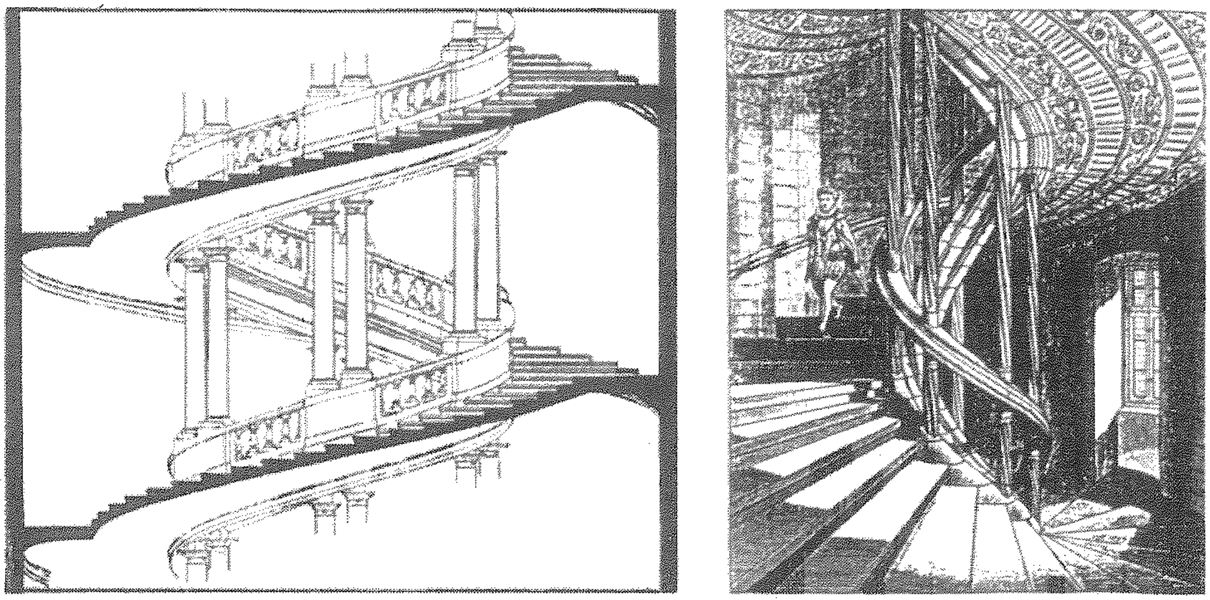


Fig.3.21. – Examples of monumental spiral staircases

The staircases' dimensions are in function of many factors, the principals being the following ones: - the *destination of the building*; the *structure of resistance of the building*; the *number of persons circulating* on the stairs; the *dimensions of the stairwell*; the *height of the floors*, etc.
The principal dimensional parameters of a staircase are (see fig.3.22. an example of a staircase with 2 parallel runs and an intermediate platform):

- The rise ($\mathbf{h_{tr}}$) and the tread of a step ($\mathbf{b_{tr}}$);
- The breadth of the flight – or the length of the step ($\mathbf{l_r}$);
- The breadth of the platform ($\mathbf{l_p}$);
- The distance between the flights (**d**);
- The total run ($\mathbf{L_r}$);
- The height of the balustrade ($\mathbf{h_b}$);
- The total rise ($\mathbf{H_{etaj}}$, $\mathbf{H_{liber}}$);

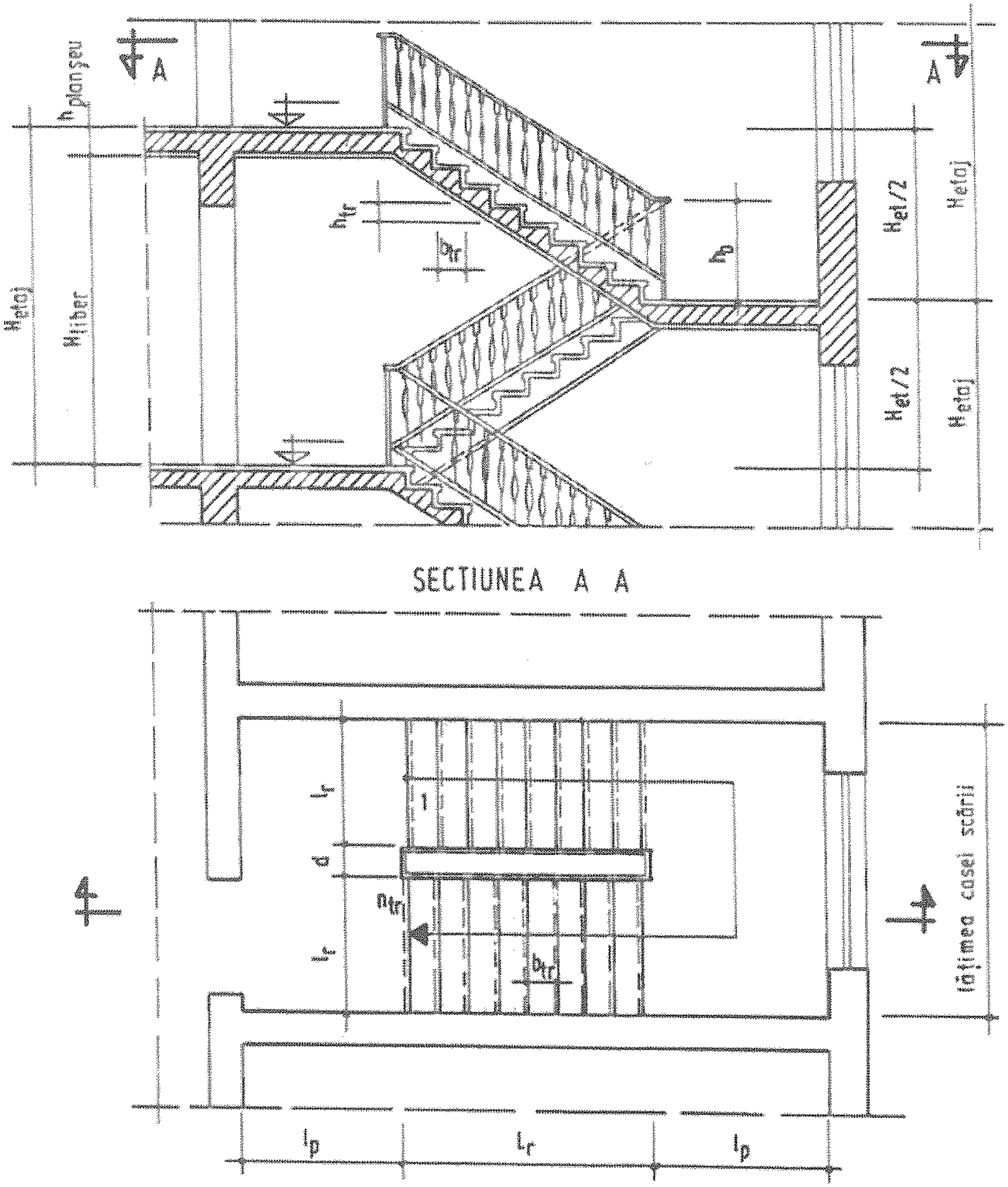


Fig. 3.22 – The dimensional characteristics of the staircases

(htr=hst; btr=bst; lr=lp)

The *platform declivity* is calculated through the ratio hst/bst which depends on *the average length of the step of the persons for whom the building is intended, while circulating on an inclined plane* (the length is *62...64 cm* in the case of residential or public buildings and *58....60 cm* in the case of buildings designed for children and for old or ill people).

The height of the stairs (hst- image 3.23.a) is chosen by the designer depending on the purpose of the building (from the values presented above), so that the ratio between the height of the storey and the height of the stair is *a round number* of stairs, which are distributed on one or more platforms on specific levels. *It is recommended* that, when the stairs are on two platforms, the platforms should have the same number of stairs (the total number should be *even*).

The width of the stairs (bst- image 3.23.a) is chosen by starting with the average step (mentioned above) using the following formulas:

$$bst+2hst= (62...64)\ cm \qquad (3.1)$$

and

$$bst+hst=(58...60)\ cm \qquad (3.2)$$

The width of the platform (l_r) is equal to the length of the stairs and is chosen under requirements of functionality and fast discharge capacity in case of danger:

- the number of *movement flows* (F) is to be calculated for the discharge of a certain number of people:

$$F=N/C \qquad (3.3)$$

Where:

N - is the number of people that have to be evacuated from the most crowded level at a certain point;

C - is the discharge capacity for a flow (the number of people who are discharged through that flow during the discharge operations);

- from the flow number (F) ratio resulting from (3.3), the height of the platform (lp) can be determined:

- For 1 flow -lp=0.90...1.00 m
- For 2 flows -lp=1.10...1.20 m
- For 3 flows -lp=1.60...1.70 m
- For 4 flows -lp=2.30...2.40 m
- For 5 flows -lp=2.60...2.70 m

Specialized standards indicate the minimum for the widths of the platforms for the main and secondary stairs, depending on the purpose of the building. This can be seen in the table below (table 3.1) where the regulations from STAS 2965- 79 [66] are shown:

Running Number- Purpose of the construction (building)- minimum free width for stair platforms, in meters- main/secondary;

Tabelul 3. 1

Nr. crt.	Destinaţia construcţiei (clădirii)		Lăţimea liberă minimă a rampelor şi podestelor, în m, pentru scări: principale	secundare
1	Construcţii pentru producţie sau depozitare şi clădiri civile auxiliare industrial		1,10	1,00
2	Clădiri înalte		1,25	1,00
3	Clădiri cu persoane ce nu se pot evacua singure: creşe şi grădiniţe de copii, staţionare medicale, ospicii pentru alienaţi, cămine pentru bătrîni şi infirmi cu scări destinate pentru:	transportul cu targa al persoanelor imobilizate	1,40	1,40
		transportul în braţe al copiilor preşcolari	1,15	1,15
		celelalte căi de evacuare	1,15	1,00
4	Clădiri pentru învăţămînt de toate gradele, avînd în total:	max. 300 locuri	1,15	0,90
		peste 500 locuri	1,35	
5	Clădiri publice şi administrative avînd la nivelul cel mai populat:	max. 200 persoane	1,15	0,90
		peste 200 persoane	1,35	
6	Clădiri de locuit cu:	max. 2 niveluri	0,95	0,90*)
		3...5 niveluri	1,05	
		6...8 niveluri	1,20	
		9 sau mai multe niveluri	1,25	
7	Clădiri cu săli aglomerate cu scări destinate pentru:	evacuarea publicului	1,40	1,40
		încăperi administrative	1,15	0,90
		cabine de proiecţie pentru filme de nitroceluloză	0,90	0,70
		locuri pentru orchestră	Lăţimea căilor de evacuare ale anexelor scenei (cu care se suprapun), dar nu mai mică decît cea a uşilor foaiei	
		scena şi anexele ei, la o arie a scenei (fără buzunare şi avanscenă), în m², de: 350 350...500 500	1,00 1,50 1,50	1,00 1,00 1,50

1. constructions for production or storage and auxiliary residential buildings for industrial purposes-1.10-1.00
2. tall buildings- 1.25- 1.00
3. buildings for people who cannot evacuate the construction by themselves, such as nurseries and kindergartens, medical buildings, mental institutions, nursing homes for the elderly and the disabled with stairs designed for: - transporting people who cannot move on a stretcher (1.40-1.40)/ transporting small children by carrying them (1.15-1.15)/ other means of evacuation(1.15-1.00)
4. Buildings used in any kind of educational activity, for a total place number of- max. 300 (1.15-0.90)/ max. 500 (1.35-0.90)
5. public and administration buildings that have a maximum of- 200 people (1.15-0.00)/ 200 people (1.35-0.90)
6. residential buildings with- max. 2 floors (0.95-0.90)/ 3...5 floors (1.05-0.90)/ 6...8 floors (1.20-0.90)/ 9 or more floors (1.25-0.90)
7. buildings with crowded rooms with stairs designed for: evacuating people (1.40-1.40)/ administration rooms (1.15-0.90)/ projection compartments for nitrate cellulose films (0.90-0.70); places for orchestras (the length of the evacuation spaces for the stage extensions (they overlap) but not smaller than the length of the doors);
8. the stage and its extensions, at an area of the stage without pockets, calculated in square meters, of: 350-1.00-1.00/ 350...500- 1.50- 1.00/ 500- 1.50- 1.50

The width of the landing (w_l) is calculated so as to be at least the same width as the platform (w_p), and in front of elevators the width of the landing should be of at least 1.60 m.

The free width between the platforms (*d*) is calculated depending on the size of the staircase, but it has to be of at least 18 cm so as to allow a mobile fire-hose to be introduced vertically, between the platforms, to put out any fire.

The length of the platform (L_p) it depends on the number of stairs on a platform and on their width, so that:

- when all the stairs on one level are on the same platform:

$$L_p = (n_{st}-1)b_{st} \qquad (3.4)$$

- when the stairs on one level are on two platforms:

$$L_p = (n_{st}/2-1)b_{st} \qquad (3.5)$$

The height of the handrail (h_h) should be between 80 and 100 cm, measured from the superior face of the stair (image 3.23.a)

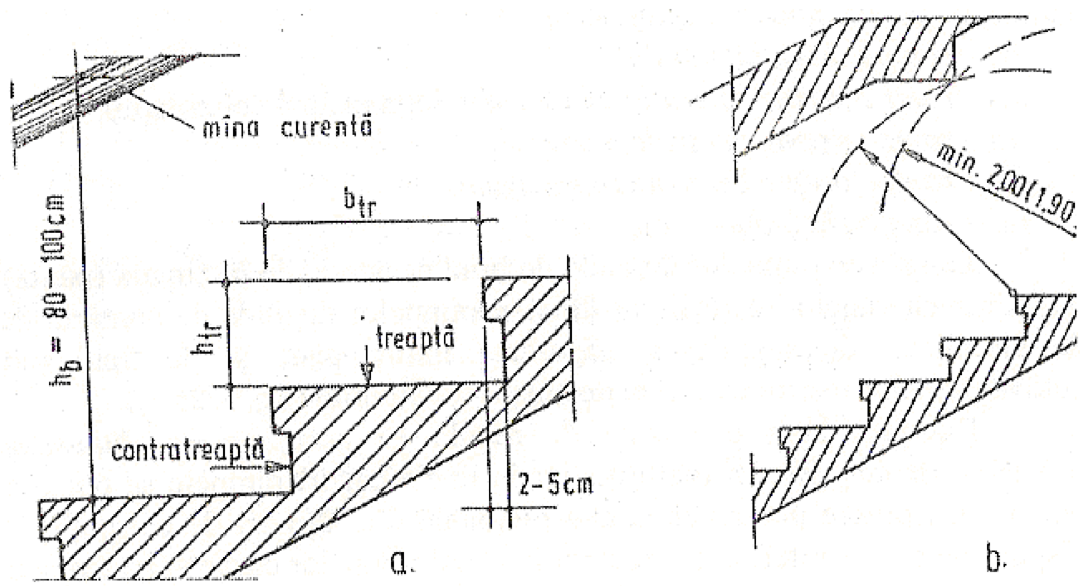


Fig. 3.23 - Dimensions of the stairs and the minimum vertical gauge
a. : Handrail; stair; riser; h_{st}; b_{st}.

The number of stairs (n_{st}) of the staircase on one level is determined by calculating the ration between the height of the storey and the height of a stair.

$$n_{st} = H_{storey}/h_{st} \qquad (3.6)$$

where (image 3.22):

H_{storey} is the height of the storey and:

$$H_{storey} = H_{free} + h_{platform} \qquad (3.7)$$

where:

H_{free} - is the free height (headroom) of the of the level

$H_{platform}$ - is the height of the platform, equal with:

$$h_{platform} = h_{board} + h_{paving} \qquad (3.8)$$

The minimum vertical gauge (thread) of the staircase, measured as shown in image 3.23.b, has to be of 2.00 m for main staircases and 1.90 m for secondary staircases.

When designing staircases, the designer must take into account certain general requirements (main):

- The height and width of the stair have to be chosen to assure easy traffic on the staircase;
- The width of the platform and of the landing must not hinder movement (and must correspond to the number of movement flows);
- The platforms and landings must be protected by handrails;
- The structural frame and building material of the staircase must correspond to the requirements of the purpose of the building;
- The number of stairs on a flight must allow people to climb the stairs with ease, and the vertical gauge must be built accordingly;
- The staircases should be properly illuminated (either naturally or artificially);
- The characteristics of the stairs must respect safety regulations for usage and in case of a fire.

THE PLATFORMS or *inclined planes* are plane construction elements, without stairs, that ensure vertical access in buildings with more than one storey due to their inclined position from the horizontal one.

The platforms are used for pedestrian circulation (to some extent), for transporting merchandise carts or wheelchairs and especially for motor vehicles in multi-storey buildings (subterranean or aboveground)- *parking lots, garages, maintenance and repair stations* etc.

According to their locations, platforms can be:

- *interior* platforms (inside the building);
- *external* platforms (outside the building);

and according to their shape on a plane, they can be *straight* or *curved*.

Platforms for the access of motor vehicles (the most common- image 3.24) can have one or two lanes, and the longitudinal declivity (p) should be [21]:

- $p \leq 14\%$: - for semi-platforms (half the height of the level);
- $p = 7...10\%$: - for straight and spiral platforms;
- $p = 3...5\%$: - for platforms “with no losses” (general inclined platforms on which both the access and the parking of motor vehicles is done)

Curved platforms (or the curved portions of straight platforms) must also have a *cross-cut platform* with a minimum of 3%, lowering towards the rotation center of the curve (they should be higher at the exterior of the curve) so as to partially absorb the centrifugal force that appears in the curves.

From the point of view of how vertical access is done and of the location of the platforms, there are many types of platforms in multi-storey buildings, such as (see fig. 3.24):

a. - *“total” straight platform;*

b. - *lateral straight platforms (with one or two lanes);*
c. - *parallel central straight platforms;*
d. - *criss-cross central straight platforms;*
e. - *spiral platforms; etc.*

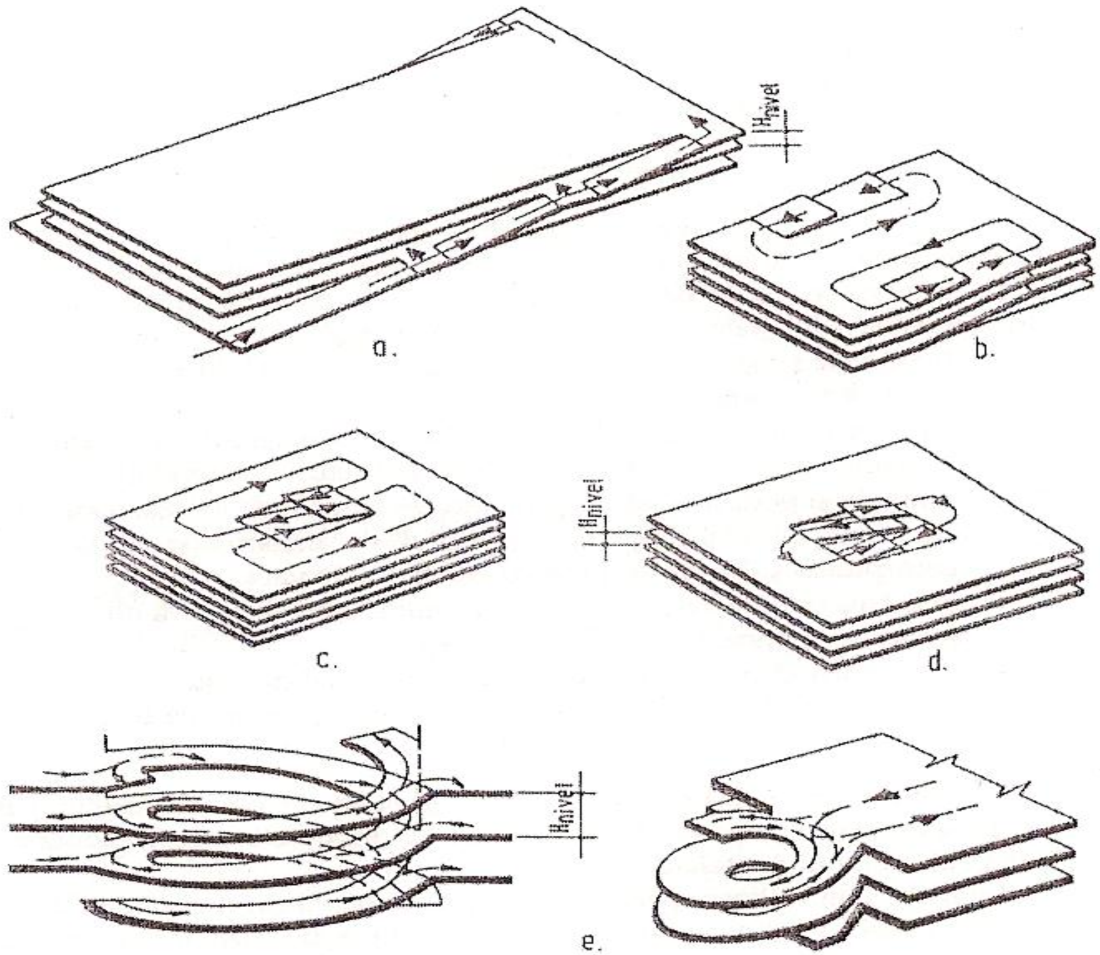
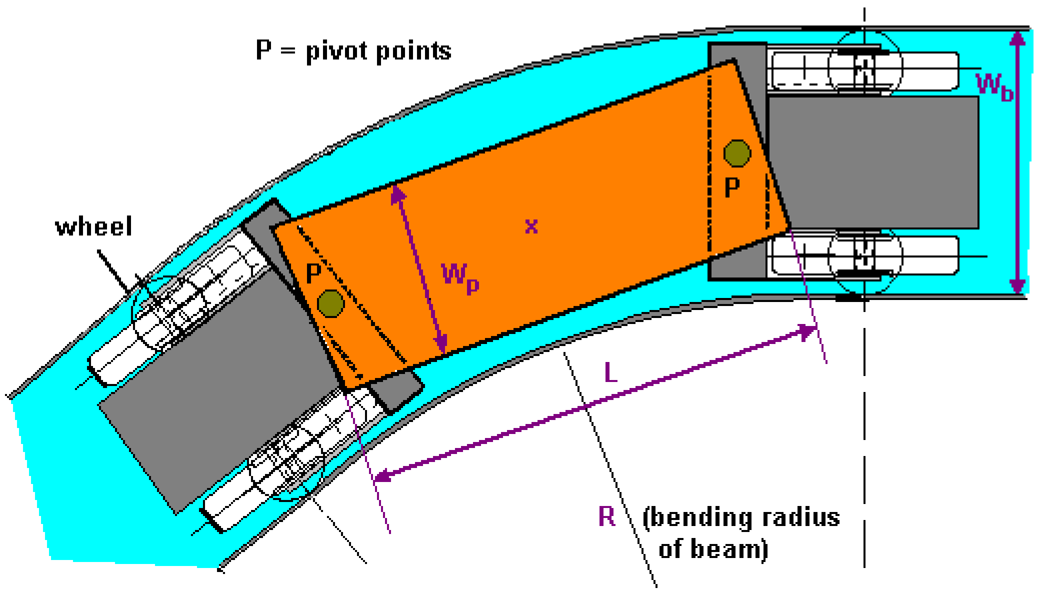


Fig. 3.24 - Platforms for the access of motor vehicles in multi-storey buildings

a. “total” straight platform;
b. lateral straight platforms;
c. parallel central straight platforms;
d. criss-cross central straight platforms;
e. spiral platforms

The length of the platforms depends on the type of platform, on their declivity and of the height of the building’s stories, whereas the *width* of the platforms depends on the number of lanes, on the safety areas between the lanes and on the type (width) of the motor vehicles that are to use the platform (fig. 3.25.a).



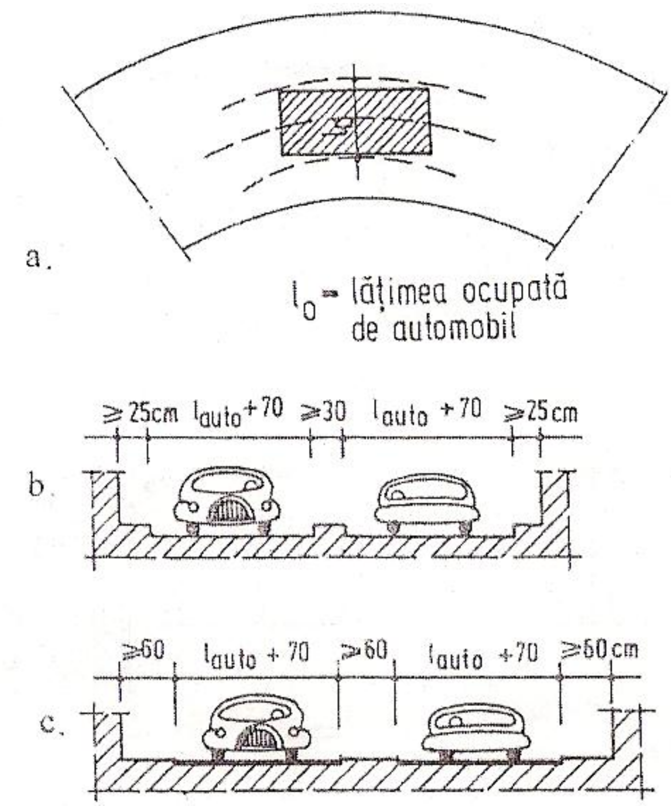


Figure 3.25- minimum width of a platform for motor vehicles

a. the width occupied by a motor vehicle on the curved portion
b. platforms with separation curbs and side-curbs;
c. platforms with separation strips

l_0= the width of the motor vehicle

Platforms are usually equipped with *battlements* and *rails* of approximately 90 cm in height, and in some cases they have sidewalks for pedestrians (with a width of at least 75 cm) on the inner edge for curved platforms and on both edges on straight platforms.

The curbs that separate lanes (fig. 3.25.b) are about 25...30 cm wide and 15...20 cm high and can sometimes be replaced by *separation strips* of at least 60 cm in width (fig. 3.25.c), represented by markings in the shape of a continuous white line.

The regulations in the field of road, bridge, viaduct etc. designing and the technical literature present the minimum values for the geometric characteristics of the platforms.

To avoid the possibility of slipping, the surface of the platforms is realized of coarse materials, and in case of high inclinations the exterior platforms are sheltered from precipitations by roofs.

ELEVATORS *(lifts)* are electromechanically "powered" installations used to transport people, merchandise or materials vertically in multi-storey buildings. Elevators can have various capacities, sizes and shapes, and they are sometimes located outside buildings- on the front (common in modern architecture).

Elevators are usually located on the central area of the horizontal plane of a building, very close to the staircase (with access from the staircase) and the vertical space through which the elevator moves is called "*the elevator shaft".*

Elevators can be categorized according to several criteria (purpose, placement, speed, number of cabins, placement of the power installation, command system, etc.); the recommended sizes for the elevator shaft can be found in the specific regulations [66] and they depend on the criteria stated above.

3.4. Empty spaces in construction elements

As shown in chapter 2.3, the architectural space is made out of volumes whose limits or ends are set by plane or curved surface construction elements (walls, platforms, arches, etc.).

The horizontal (and vertical) connection between these enclosed spaces, as well as their natural illumination and ventilation, can only be done by creating some *gaps* in the limiting and enclosing construction elements.

These gaps usually have two main purposes:

- *gaps for doors*- placed in the inner walls (inner doors) and in the outer walls (outer doors);
- *gaps for windows*- placed in the outer walls (and rarely in the inner walls, for indirect natural illumination).

The sizes of these gaps for doors and windows are built in *modulated*, and there are usually standard, [66], but unusual shapes and sizes for window or door gaps can also be designed.

3.4.1. Gaps for doors

The gaps built for doors are gaps whose size and position within the building depend on the type and on the importance of the door (on the purpose of the rooms they open to), and on the movement flow structure or on the *"intercommunication scheme"* between the rooms in the building (see chapter 2.3.1).

Doors can be classified according to the many criterions:

a - by the *location* and by the access they ensure:
- *interior* doors (for room-to-room access);
- *exterior* doors (for access to/from the exterior);

b - after the *material* they are made of:
- *wooden* doors (or wood base materials);
- *metallic* doors (totally or partially);
- *plastic material* doors (PVC);
- *glass* doors (totally or partially);
- *composite materials* doors.

c - after the *opening mode* (fig 3.26), the doors can be:
- doors *with pivot opening* (conventional), with one or two wings, simple or double (with one or two parallel sheets);
- *swinging* doors, with one or two wings;
- *sliding* doors (with lateral or vertical opening ,by sliding);
- *folding* doors (with lateral opening by folding);
- *rotating* doors (with rotating opening, the rotation is around a central vertical axis)

The most used types of doors are the pivot opening doors, which opening is chosen according to the sense of the flow movement. In this way, the doors (and their sense of opening) are called *“right hand side”* or *“left hand side”,* as when you push the door to open it (when you enter or exit the room) the hinges stay on the right or left of the person:

d – after the *number of wings* – the door may have *one, two* or *many wings*;

e – after the *assembly method* in the building structure – *frame doors, liner doors* or *frame and liner doors*.

In figure 3.26 you can see the vertical and horizontal representation of the doors in a plane, in function of the opening type.

Of course, the doors have to be sized in function of the flow of people who have to pass through the door, having any shape and size, but generally the shape of a door is of a rectangle in vertical plane and their size is designed at human scale (with the exception of large doors – *gates,* dedicated to the passing through of machinery).

For example (without representing the provisions of the norms in this sense [66]) we can give the size of the hole for the doors with one wing:

-*width* between 0.70 and 1.10 m (multiple of 10 cm);
-*height* between 1.90 and 2.50 m (multiple of 10 cm);

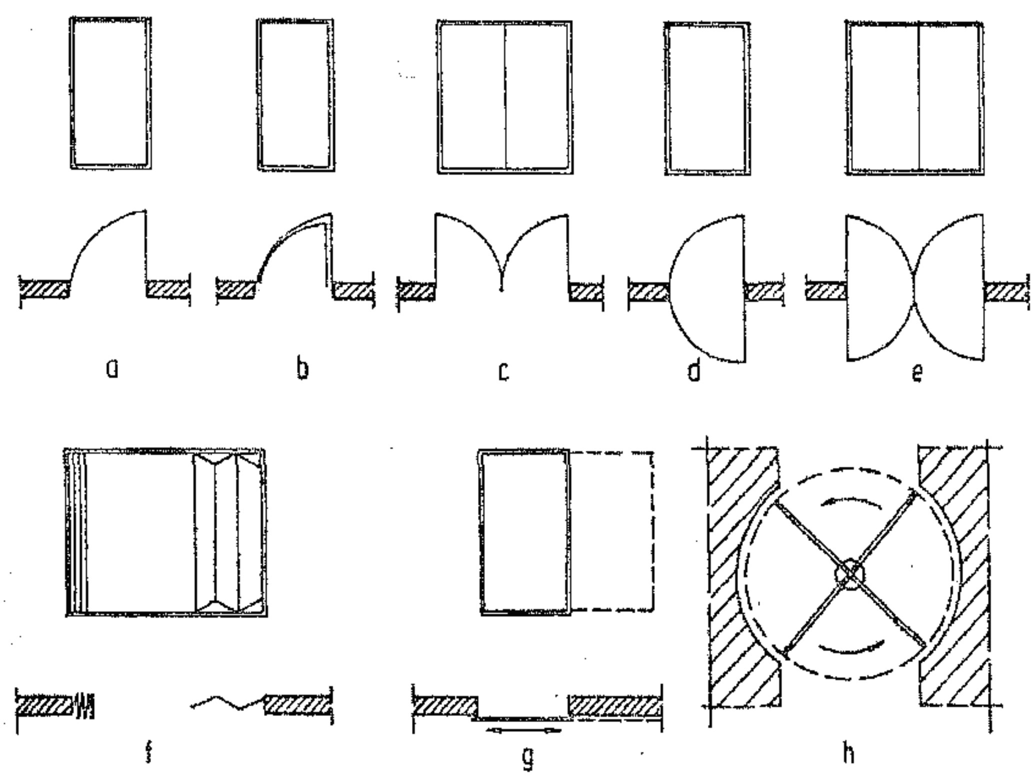


Fig. 3.26 – The opening method of doors in buildings
a – simple hinged door; **b** – double hinged door; **c** – hinged door with two wings;
d – swinging door with one wing; **e** – swinging door with two wings;
f – folding door; **g** – sliding door; **f** – revolving door;

having the opening handle at 1 m height from the room's floor.

These dimensions are modulated and can be modified (in particular its width) depending on need, by increasing the number of wings.

At exterior doors for example (sometimes at interior doors too) their hole may be bordered, decorated with frames or ornamental profiles, which give the impression of a bigger hole or they give an aesthetic value to it (generally used at monumental buildings).

3.4.2 Holes for windows

Holes for windows are holes placed on the exterior walls of a building, so natural light and fresh air can get in the rooms.

The location of the windows, the proportions and the size are chosen for aesthetic and comfort reasons, taking into consideration the purpose of the rooms and their position according to the cardinal directions (see chapter 2.3.2).

Just like in the case of door holes, the window holes are modulated and u can find the usual sizes in the speciality norms, [66].

The windows usually have a rectangular shape in vertical plane, but they may have any shape (square, rhombic, oval, round, hexagonal, etc.) depending on the architect's imagination and the solicitations of the investor.

The windows are usually placed at a height of 80-100 cm from the room's floor, height which can be bigger when the windows are smaller (having the main purpose of ensuring the room's ventilation not that of lighting it), or it can be smaller or it can be missing (window – doors) when the rooms' function requires that (for better natural lighting) or when the architect decides it for aesthetic reasons.

The windows are usually made of two main parts: - a fixed part in the walls hole, named the windows *frame* and a mobile part with one or two mobile frames with glass.

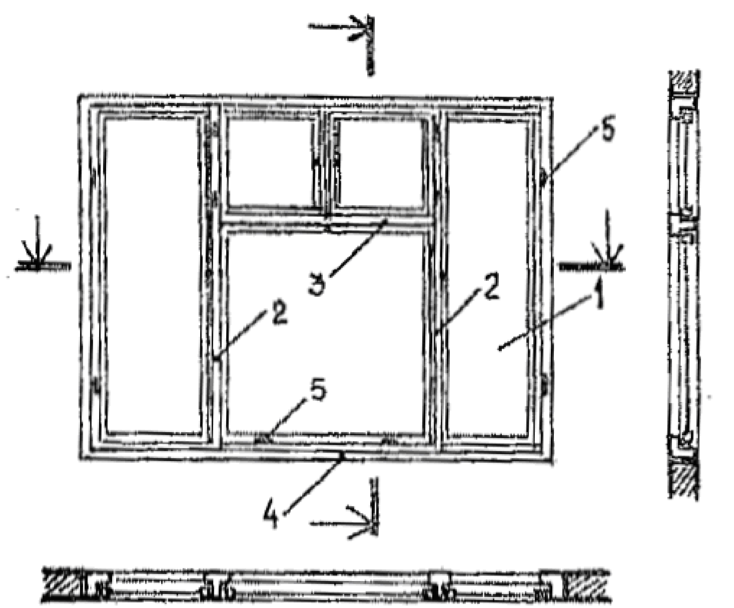


Fig. 3. 27 – the structure of windows
1- window panel; 2 – muntin; 3 – grid; 4 – window casing; 5 – hinges;

The closing and opening of the windows is made with the help of special metallic parts (hinges, casement fasteners, bolts, hooks, etc.) the division of windows in vertical and horizontal wings (in many window panels) is made with fixed elements – *muntins,* or mobile - *mullions* (see fig 3.27).

The windows classification is made after:

a- the material they are made of : -*wooden*, *metallic* (steel or aluminium), made of *plastic materials*, *reinforced concrete* (rarely), mixed;

b- after the *opening method* – with *mobile frames*, with *fix* and *mixed panes* (when just some of the panes can be opened);

c- after *the number of glass sheets* (in the same pane): - *simple*, *double*, *triple pane windows* (when it is necessary for isolation).

The double (or triple) windows may be of two different kinds:

- *attached* windows (for which the frames open together, being attached to each other with metallic pieces);
- *separate* windows (with the frames placed to a distance of 8-18 cm, one at the interior and one at the exterior side of the casing, opening to the same or to different directions).

d- after the *method of opening* of the window assembly they may be (see fig. 3. 28):

a. with *side hung casement,* opening inward or outward, called *casement* windows (with vertical hinges – fig. 3. 28. a, b);
b. with *projecting side hung casement*, turning around a central vertical axis (fig. 3. 28. c);
c. *pivot hung* windows, called *pivot* windows, that are turning around a horizontal central or a lateral axis, the latter also called *hopper* window (fig. 3.28. d, e);
d. *sliding* windows – sliding vertically or horizontally (fig. 3. 28. f, g);
e. windows that open by *folding* (fig. 3. 28h).

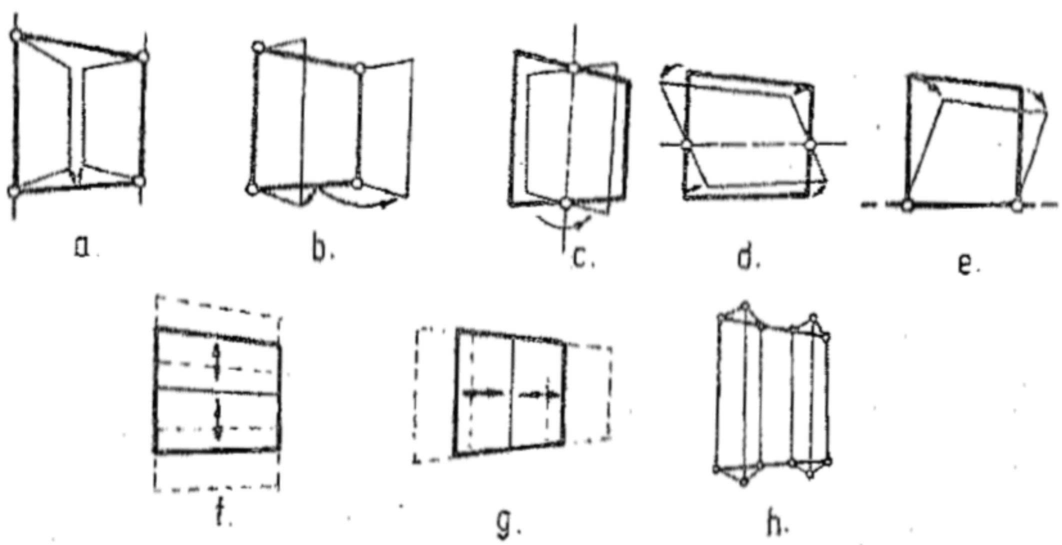


Fig. 3. 28 – Opening systems for windows
a- swinging inside, **b-** swinging outward, **c-** turning around a central vertical axis,
d- pivoting around a central horizontal axis, **e-** pivoting with a horizontal axis at the bottom
f- sliding vertically, **g-** sliding horizontally, **h-** folding

3.4.3 The representation of holes in architecture

In technical drawing for architecture or constructions the holes for closing elements or dividing elements (walls) are simplified, the height and position on vertical and horizontal is mentioned with the help of scales (see fig. 3. 29).

The holes for doors for instance (fig 3.29 a) are represented wit the sense of opening, and the width (above the reference line) and height (under the same reference line) are specified too.

The holes for windows are represented in a similar manner (see fig 3.29 b) with the height (under the line of reference) and width (above the line of reference) mentioned too.

The window's sense of opening is not regularly shown in architectural drawing (being mentioned in the written documentation of the project).

In all of the building plans (the plans for of the storeys) the height of the hole is specified with respect to the floor of that level, so *the height of the window parapet* (h_p or P), height which is written next to the certain hole, inside the room (at all of the windows if on that level we have windows at different heights, or only at some of the windows when they are at the same level with respect to floor).

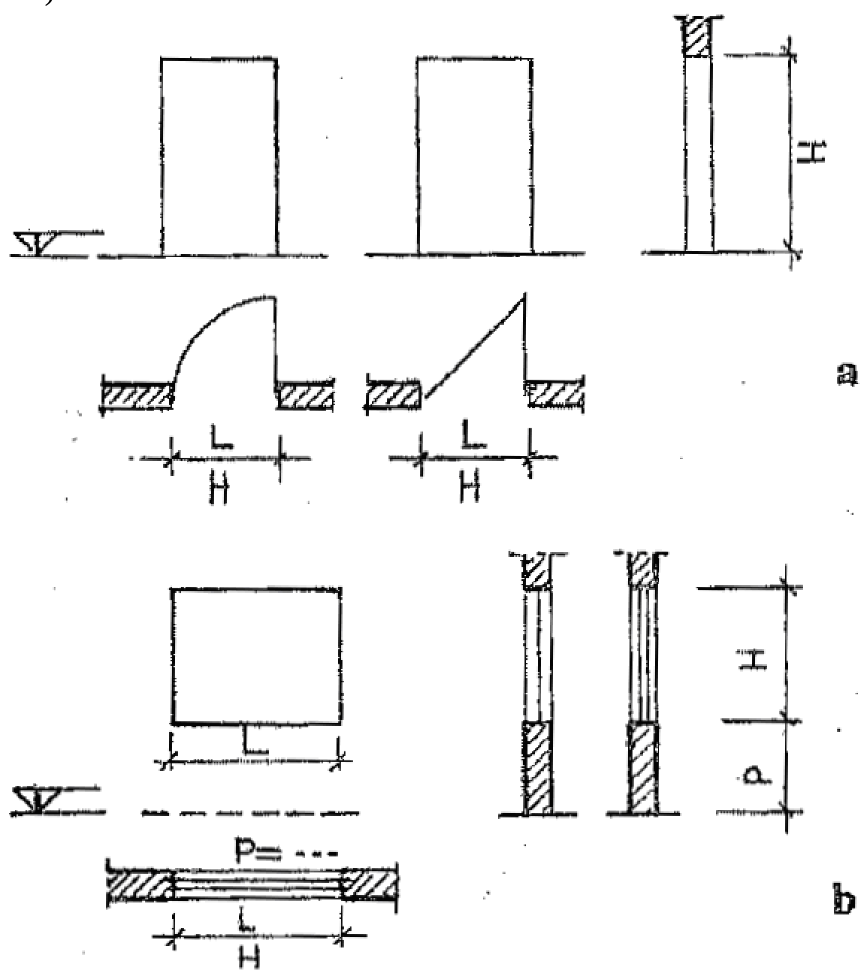


Fig. 3. 29 – Representation of the holes of doors (**a**) and windows (**b**)

3.5 Bathrooms in buildings

In a building were people work and live, the need for bathrooms is natural (washers, showers, toilets), their size and complexity depending on the destination of the building, on the number of persons which uses them and the way of arrangement of the architectural space (on the imagination of the architect).

Because the rooms destined to be bathrooms in any building have a water supply installation (with hot and cold water) and need to be connected to the plumbing system (for the disposal of used water), the placement of these rooms must be done in such a way, that the spaces being grouped horizontally and superposed vertically, we should get the least number of sanitary "columns" (plumbing installations).

So, the bathrooms can function as: *washrooms*, *showers*, *lavatories*, *bathrooms* or they may have *combined functions*.

Washrooms can be made as *separate* rooms, being used only for washing (the case of washrooms from dorms, kindergartens, chalets, sports camps, enterprises, etc.), or they may be rooms that you are passing through when going to showers or to the loo.

Shower rooms may be designed as *collective* rooms (in schools, enterprises, sport camps, etc.) in which you can find many shower cabins, after which you can find a locker room (fig. 3. 30. a) or the showers may be *isolated* with individual cabins (fig 3.30. b).

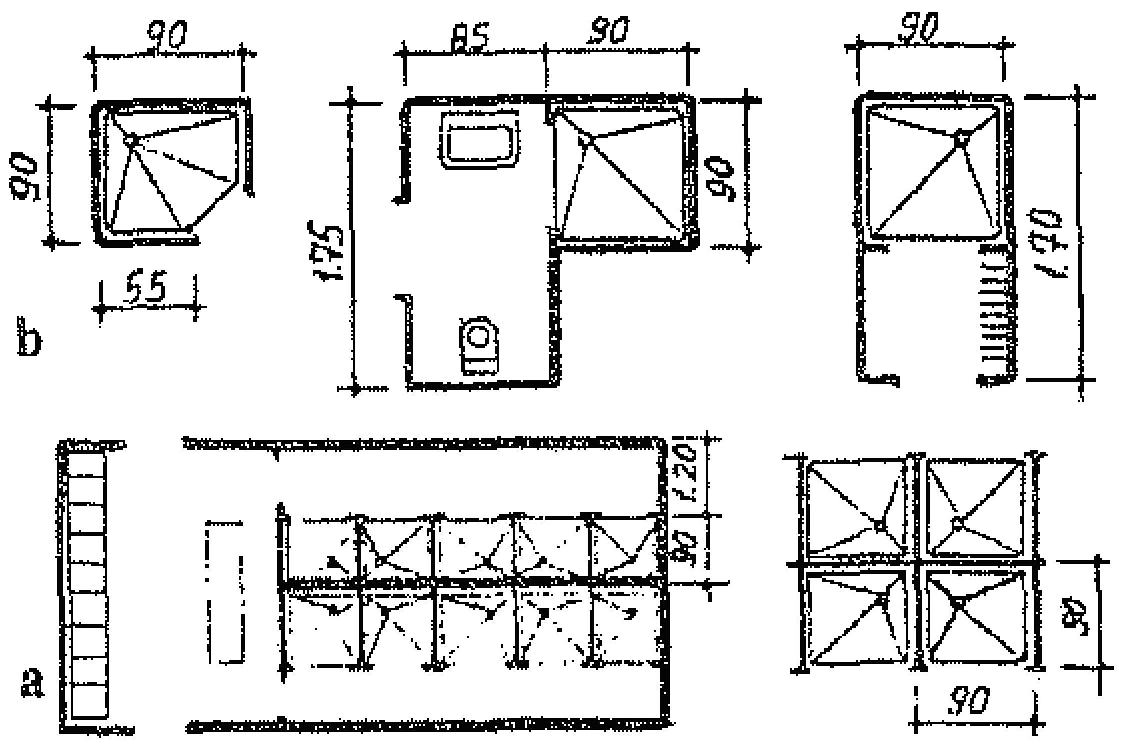


Fig. 3. 30. – Types of rooms for showers
a – collective; **b** - individual

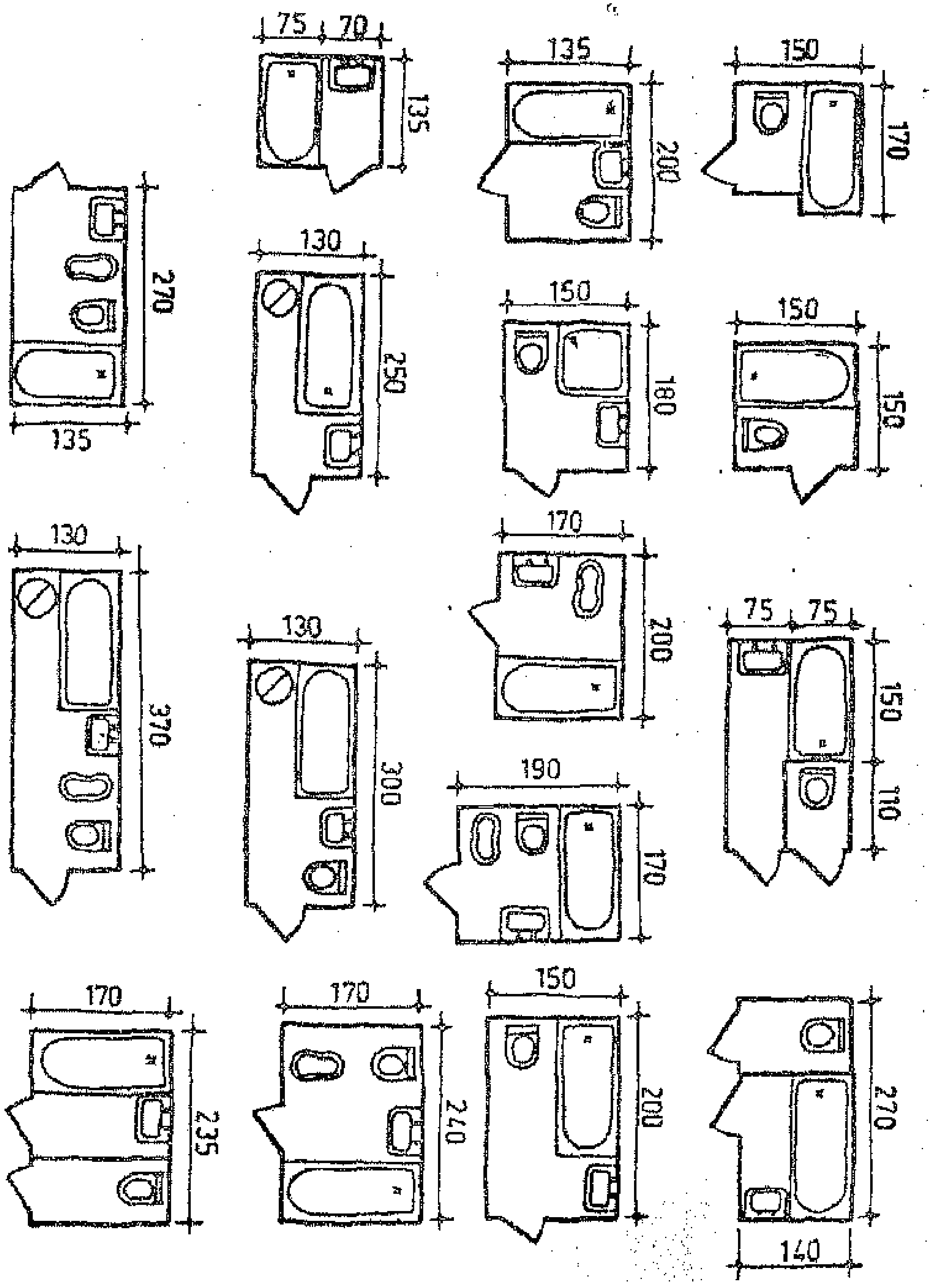


Fig. 3. 31 – Bathrooms' lay-out (horizontal plans)

Bathrooms are rooms generally used in homes (houses, apartments, etc.), or in hotels having different sanitary objects: *bath tubs*, *washbasins* (sinks), *bidet*, *toilet bowl*, etc. and sometimes (when there is enough space) even a *shower cabin*.

In the bathrooms (especially in case of homes) you can find a place for the washing machine too.

The placing of bathrooms in buildings is made usually near the bedrooms (sometimes with direct access to them).

In fig 3.31 you can see (after [34]) different possibilities of placing the sanitary objects in bathrooms and the minimum dimensions of the bathrooms, depending on the number of objects and their position in the room.

Loos can be collective rooms with many cabins (separated groups for men and women in public buildings) proceeded by rooms in which you can find washing machines (fig.3.32.a), or individual lavatories (in homes), equipped with a closet and eventually a washstand for washing hands (fig 3.32 b).

Such individual toilets are made usually in homes (in flats with two or more rooms there is recommended to place a second, supplementary closet usually named service closet) but in some public, social-administrative, cultural, commercial buildings too (public, administrative, commercial buildings, offices, etc.).

The rooms destined to be bathrooms always need good natural or mechanical ventilation (for the elimination of the smell and water vapours) and also a good lighting (when the room has at least one exterior wall to cut a window into).

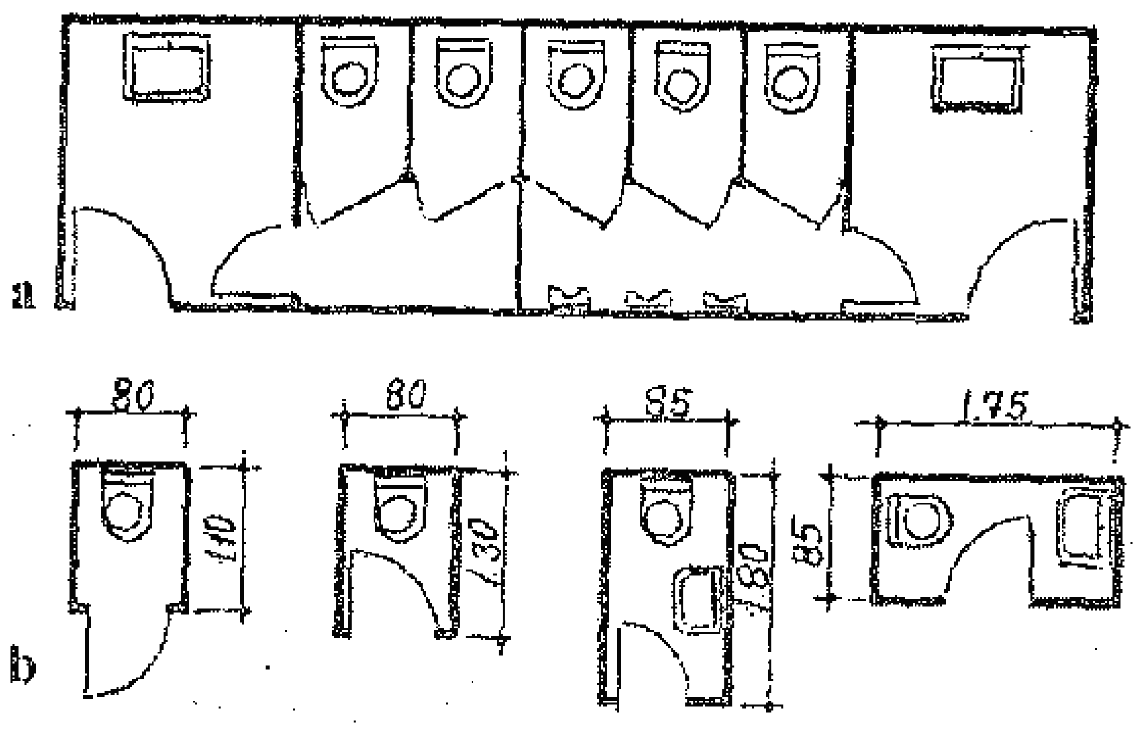


Fig. 3. 32 – Examples of bathroom lay-out
a - collective; **b** - individual

If the room doesn't allow the airing through a window (because of the absence of the exterior walls), the ventilation of the sanitary group must be realized with the help of airing conduits, which must have correspondence on the roof (in the loft or terrace of the building).

The sanitary groups must have special places for the columns of the water plumbing and piping ("alcoves", "masks", "ghena"), so that the pipes to be "masked" and phonic insulated.

3.6 The Modular Coordination and allowances in architectural designing

The system of designing based on "modules" is frequently applied in worldwide architectural design, because of the rhythm of building which presumes an industrialization and typification of the construction elements, as well as because of the quality and price necessities of the construction elements, which can be optimally satisfied only through an industrialized execution (through prefabricates).

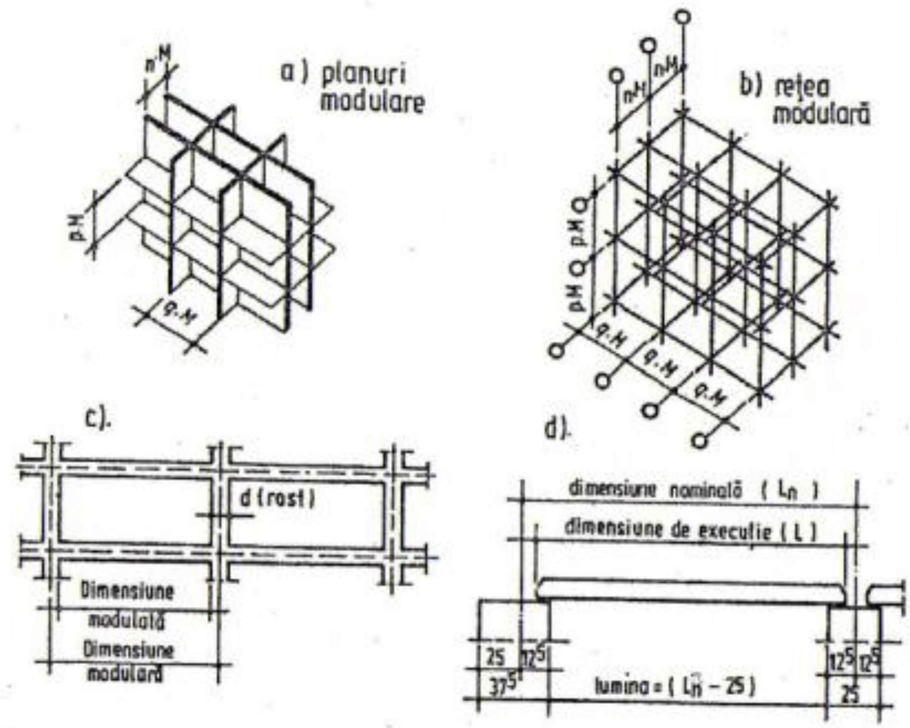


Fig. 3.33 – The modulating elements of constructions

Through ***modular coordination*** we understand the dimensional coordination after some rules, based on a primary dimension called ***"module***".

The *primary module* in the structural and architectural designing of constructions (the bench mark starting from which the mutual dimensions and positions of the construction elements and subassemblies are established) is conventionally established at the value:

M = 100 mm = 10 cm (after the *decimetric* modular system)

The primary module has a sum of derived modules, called:

- “*multimodules*” (multiples of the primary module, denoted with *“n M*”);
- “*submodules*” (submultiples of the primary module, denoted with “*M/n*”).

The primary module (M) represents the dimensional base for the *standardization* of constructions and for the *typification* of their component elements (structural or non-structural).

Typification represents the adoption of some dimensions of constructions collectively, of the component elements and of the distances between them that allows their *usage without adjustments and interchange without modifications.*

The spatial reference system of a construction (of building type) is made from a series of rectangular, three-directional planes (usually equidistant on each direction) called *modular planes* (fig.3.33.a). The intersection lines of the *modular planes* are called *modular lines* and they make the reference spatial system called *spatial modular lattice* (fig.3.33.b).

In modular design, different types of dimensions are used:

-*modular dimension*, which is the dimension (integer multiple of the primary module) measured between the axes (reference lines) of a modular lattice (fig.3.33.c);

-*modulate dimension*, which is the dimension of some construction elements (or materials), assembling with other construction elements (materials), so that through their joining in some way and taking into account the voids between them to result a modular dimension (fig.3.33.c);

-*nominal dimension* is a modular dimension, which refers to the principal characteristic dimension of the construction elements. It represents a theoretical dimension from the technical design of the construction element (fig.3.33.d);

-*execution dimension* is a modular dimension and it represents the real (fabrication) dimension of the construction elements (fig.3.33.d).

The modular coordination of the constructions can be made *in plane* (horizontally) and also on *the vertical*.

Coordination of the dimensions in *horizontal plane* is usually used at the establishment of the distances between the resistance elements (between the supporting walls, between the structure’s frames, between piles of the bridges, etc.) but also at establishing the spans of the holes in the construction elements (holes for doors and windows) or for the sections of the structural elements (piles’, beams’, walls’, etc. sections).

In the table below (tab.3.2) there are presented the horizontal *multimodule*s recommended by the Romanian norms [66], for establishing the distances between the axes of a modular lattice (of the “*openings”* and “*bays*” of a structure).

Table 3.2

Horizontal multimodules		Limits of dimension series [m]	
Symbol	Value [mm]	Minimum value	Maximum value
3M	300	0.30	7.50
6M	600	0.60	12.00
12M	1200	1.20	18.00
15M	1500	1.50	18.00
30M	3000	3.00	30.00
60M	6000	6.00	unlimited

The modular dimensions for the *vertical* coordination can be:

-the distance between the finite sides of two successive floors of a multi-storey building - ***the height of the floor*** (fig.3.22);

-the distance between the finite sides of the ceiling and flooring of a room or of a floor-the free *height of the room* (fig.3.22);

-the dimensions of some structural components which are conditioned by one another at the vertical assemblage (prefabricated elements);

-the dimensions of some hollows in the construction elements (door hollows, window hollows, etc.);

For example, in the table below (tab 3.3) there are presented the values of the coordination dimensions for the floor height or the room height for the construction of residential buildings (the recommended values of Romanian norms).

Table 3.3

	Floors' height	Rooms' height
Multimodal's[symbol]	26M 27M 28M 30M	20M 21M 22M 23M 24M 25M 26M 27M 28M
Value[m]	2.60 2.70 2.80 2.90	2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80

The tolerance is the maximum allowed difference between the *limit values* of the *real* magnitudes of the geometrical characteristics of the construction elements.

So the tolerance represents *an allowed variation interval for a certain magnitude or characteristic dimension of an element and it expresses the imposed precision degree for its execution.*

The limit-dimensions are *allowable extreme* dimensions, representing the interval in which we must find the actual (practically executed) dimensions of the elements.

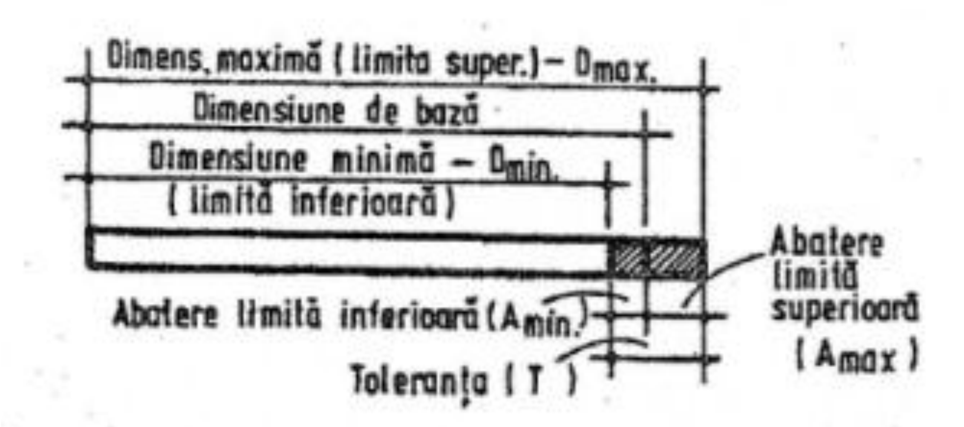


Fig. 3. 34 – Tolerance in construction

These limit-dimensions can be:

-*maximum* (the superior limit, denoted with *Dmax* in fig 3.34);

-*minimum* (the inferior limit, denoted with *Dmin* in fig 3.34).

The algebraic difference between a limit-dimension and the corresponding basic dimension is called limit-deviation and it can be:

-*superio*r limit-deviation - *Amax*;

-*inferio*r limit-deviation – *Amin.*

Regarding the previous aspects and the notations in the figure 3.34, the *tolerance* can be expressed function of the limit-dimensions (minimum or maximum) or function of the limit-deviations (superior or inferior), so that:

-function of the *limit-dimensions* (maximum or minimum), the tolerance can be computed as:

$$T = D_{max} - D_{min} \tag{3.9}$$

-function of the *limit-deviation* (superior and inferior), the tolerance can be computed:

$$T = A_{max} + A_{min} \tag{3.10}$$

The tolerance in construction refers not only to the dimensions of the elements, but to their shapes and aspects. These can be found in STAS and normative, for the component elements or parts of construction and even for the entire construction.

In some technical domains, like fine mechanics, robotics, electronics, the values of the tolerances allowed at the execution of the component parts of some mechanisms or assemblies are sometimes expressed in “hundredths” or even in “thousandths” of millimeters (microns).

The magnitudes of tolerances used in designing and execution of constructions, are obviously very diverse, function of the category of the construction elements to which they refer to, but they are definitely smaller then the magnitudes of the tolerances used in other technical domains.

So, the magnitudes of the tolerances allowed (maximum) at the execution of some of the usual construction elements fit approximately in some of the following intervals of vales:

- 5…10 mm - at the execution of metallic structural elements of big dimensions (civil or industrial constructions);
- 10…30 mm - at the execution of prefabricated structural elements of reinforced concrete, of big dimensions (civil or industrial constructions);
- 1…5 mm - at the execution of nonstructural elements of small dimensions;
- 0.5…1 mm - at the execution of element of installations (thermal, sanitary, electric, ventilation, etc.) of small dimensions;
- 5…10 mm - at the execution of the architectural details on the “facade” (at finishing elements like frames, risalits, motifs, etc.)
- 10…20 mm - at the execution of joints between structural elements of big dimensions (beams, piles, big panels, prefabricates), joints that are “monolized” after setting.

We can find bigger magnitudes of the tolerances allowed in designing and execution of construction at establishing the distances between the structural elements of the buildings (openings, heights, etc.) and mostly at establishing the distances between buildings, or between these and the environmental elements (the distance from the building to the neighboring buildings, to the main road, to the electrical lines of high tension, etc.).

Usually, the allowable values for the maximum tolerances in constructions are not indicated in the designing documentation of a building (on blueprints the elements' dimensions being specified without the allowable tolerances) but the constructor is obliged (through specific laws) to execute the elements at the dimensions specified in the project (or as close to these vales, as possible), so that it stays within the limit values of the allowable tolerances from the normative.

The construction domain in which the tolerances are framed in the designing and executing documentations is that of executing the *typified prefabricated elements*, elements that must allowed *their utilization without adjustment on the construction site and to allow the interchange between elements of the same type (with the same dimensional and mechanical characteristics) without modifications.*

PART II
ELEMENTS OF ARCHITECTURE HISTORY

CHAPTER 4-
CURRENTS AND STYLES IN ARCHITECTURE

4.1. General characteristics of architectural currents

Despite the fact that the first constructions executed by the humanity don't touch a high level of complexity in space utilization, which to allow their considering as architectural artwork, much of these achieved besides the historic value given by the age (and the utilitarian one for knowledge) an artistic value.

If the rising in *Neolithic* of the *megalithic* monuments in Europe, in North Africa and in South-Eastern India (having probably mystic or religious function) can be considered a manifestation with "architectural essence", then we can appreciate the architectural phenomena aging as beginning in the prehistory ,with about 8000 years ago(about 6000 B.C.).

In his lecture, Leland M. Roth presents a comparative painting of the architectural culture in Occidental Europe, in which there are approximately limited the periods of time of the principal architectural currents. From this painting, we observe the fact that each architectural current had during its evolution a period of maximum development, preceded by a period of "looking after" (of growth and maturation) and followed by a period of declining.

As a general characteristic of the architectural currents evolution in time, we can remark the fact that *as the architectural currents approached to the present, they had a shorter and shorter manifestation period* (proved through objective whose existence was proved in a way or another), reaching from the periods of thousands of years (Mesopotamia, Antic Egypt, Antic Greece architecture) to the periods of tens of years (modern architectural currents).

Roth thinks that the architecture from the 18^{th},19^{th} ,20^{th} centuries contains elements of classic and modern architecture and it developed strictly to that respective century (the number of the century giving the name of the respective current in the chronologic table) and the accelerated evolution of this currents happened mainly because
Roth considers that the architecture of the 18^{th}, 19th, and 20^{th} centuries presents elements of classical and modern architecture and belongs strictly to that century (the number of the century also giving the name of the so called century in the chronological table that is presented next) and the evolution of these trends is mainly due to the scientific and technological discoveries in the field of construction engineering.

Actually, considering architecture as *a symbol and form of communication* or as "*a physical representation of man's thoughts and aspirations*" [44], we can say that the architecture of different time periods reflects through its characteristic elements *the level of cultural,* *technological and scientific development* of each period of the evolution of the human civilization.

Fig 4.1-Cronological table of the time development of the architectural trends

The first "architect", recorded in written documents, is considered by Roth [44] to be *Imhotep of Egypt* between 2635-2595 B.C .He is considered as the father of massive rock constructions from Egypt and "the inventor" of the Egyptian pyramids.

The first "official" descriptions of the component parts of the buildings, of the basic architectural details and elements, are due to *Vitruvius*, architect of the Antique Rome in the first century B.C., his manuscript "*De architettura*"(written between 27-23 B.C.), being the only work of such amplitude of this kind from antiquity that remained (even though the antique Greek school of architecture elaborated numerous works in this domain [60]).

Vitruvius highlights that architecture demands vast practical and theoretical knowledge from the one who practices it, among these being: Mathematics, History, Technical, Drawing, Philosophy, Music, Legislation, the Art of Writing and Imagination.

One of the greatest antique architects, disciple of Vitruvius' principles, was *Anthemion of Trellis* (5-6th century A.C.), which designed the famous *Haggis Sofia* from Constantinople (work finished, however, by the architect *Isidor of Millet*).

Significant changes in the architectural conception were introduced beginning with the Middle Ages, by the revolutionary progressive trend of *Renaissance* through famous designer architects: *Filippo Brunelleschi, Leon Batista Alberti, Michelangelo Buonarroti, Sebastiano Serlio, Giulio Romano, Donato Bramante* (the initiator of the project of the famous "San Pietro" Cathedral of Rome).

Together with the introduction of the Classical Humanism, the place of the *crafts-man-architect* is taken by *the humanist-artist*, scholar of "all" arts (Michelangelo, Leonardo da Vinci, etc.) and taught through systematic study.

It is the period in which the interest for the ruins of the Antique Rome, for the accomplishments of antiquity appears and in the same time it also appears the tendency to overpass these, but unfortunately, even though these antique accomplishments are studied a lot, many of them are destroyed, because there was no interest of protecting and preserving them.

It is also the period in which a lot of documents and treaties about architecture (and of arts in general) are written, among which the work of *Andrea Palladio-"I quattro libri dell'architettura"* published in Venice in the year 1570, presents plans of restoration of the ruins of the ancient Rome, and the works of *Sebastiano Serlio and Giacomo da Vignola* deal with the *classical orders* of architecture (introduced in the architecture of ancient Greece and in the one of ancient Rome).

The progress of arts, stimulated in general by the progress of the society, leads to the apparition of schools of architecture like the *Academy of Architecture* from France of the year 1671, reorganised as ***"The School of Fine Arts"*** in time of the French revolution and which contributes to the elaboration of some principles and architectural norms also used in the following centuries.

At the end of the 19th century the principles of "*modern architecture*" are established and at the same time the social responsibility of the architect towards society and the environment are underlined.

Therefore, architecture is considered, without a doubt, as a part of the surrounding environment, because the built environment must fit naturally in the natural surroundings and to assure man the necessary comfort of a normal life (functionality, solidity, protection to weather agents, aesthetics, etc.-see chapter 1.3 and 1.4).

Although the characteristic elements of the architectural phenomenon have not been defined by the ancient architects-constructors under the same form and scientific expression as they are today, they have been guessed and reflected upon in their writings even from old times.

The architecture of an era reflects the specific lifestyle, the relations between the social classes and the economic development of a geographic area or of a civilization, so that we can consider architecture as “*the synthetic expression of social life* “[29], from these areas or periods of evolution of society.

The limits of this work does not allow the presentation in detail of the characteristic traits of all trends, styles and tendencies that have appeared in the architectural phenomenon along time and it also does not allow references to the “architecture” of the prehistoric times; therefore, in the following, only the most important architectural trends will be analyzed by principle, which have put its mark on the built surroundings in the world in general and in Europe or the surrounding area in particular. For this reason, there will be no reference to the architecture of Farther Asia, of Latin America, of India, of China, of Japan, etc, architectures that have left the world with a series of built “proof” of the creating genius of man and of the level of culture touched by the ancient civilizations.

The architectural trends that will benefit of our attention (briefly) in this work are:

-the architecture of *Mesopotamia* and *Ancient Persia*;
-the architecture of *Ancient Egypt*;
-the architecture of *Ancient Greece*;
-the architecture of *Ancient Rome*;
-the *Byzantine* architecture;
-the *Romanic* architecture;
-the *Gothic* architecture;
-the Renaissance architecture;
-the *Baroque* architecture;
-the architecture of *Classicism*;
-the architecture of *Romanticism*;
-*Modern* architecture;

The characterization and comparison of architectural trends can be made by the emphasis and comparison of some representative *characteristic elements,* which can define the essence of the respective architectural phenomenon.

Therefore, in accordance with the work [29], the principal elements that can characterize an architectural trend are:

-*the urbanism* of that era and the respective area;
-the principal *functional* ***programs***;
-*the architectural plastics* or *the specific architectural forms*;

Urbanism-reflects the method of building, organization and aesthetics of cities (urban conglomerates) in a specific era or geographic area and is the result of a science and art of building and organizing cities*:-town-planning.*

The functional programs-define the utilization (function) of the principal constructions from an architectural trend, expressed in the placing and the orientation of rooms in function of its utility.

Architectural plastics-presents *specific architectural forms* of the respective trend and it characterize the conception of forms and volumes of the elements and details of architecture, and also the technique of harmonizing these.

In consequence, in the following we will approach each of the three characteristic elements of every architectural trend that we have mentioned in the above.

4.2 The Architecture of Mesopotamia and Ancient Persia

The architecture of Mesopotamia and that of Persia are presented together, due to the neighbouring of the two areas in time and geographical zone and due to the similarities in the way of living of the inhabitants, though they seldom present common characteristics and they can slightly be categorized in the same architectural trend.

4.2.1 The Architecture of Mesopotamia

Mesopotamia-"country between rivers", situated between Tiger and Euphrates, occupying the territory of Iraq of our days, has known one of the most ancient civilizations from the history of mankind, with a culture developed even from the Neolithic period.

This culture is represented also by the building of *fortress-cities*, of which development was tied the power of the empires which existed in these parts.

Fig.4.2-The Gate of Goddess Istar

(reconstruction)

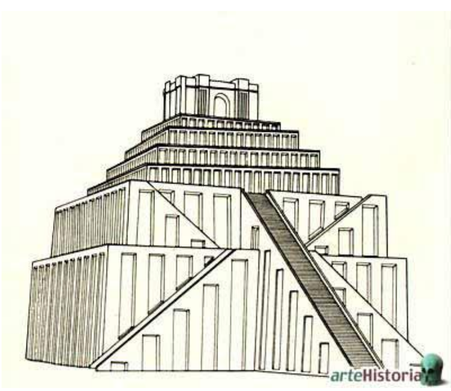
The architecture of Mesopotamia can be classified (by the work [29]) in four great historical periods (with time development smaller and smaller by period):

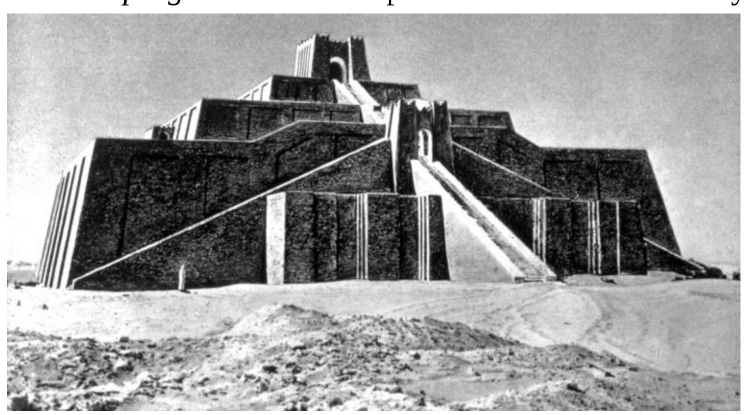
- *The architecture of primitive times* (in the period 6000-1850BC) characterized by the building of the first great urban agglomerations, centres of Mesopotamian civilization: Ur, Uruc, Kis, Nippur, etc.
- *the architecture of the ancient Babylonian kingdom*(1850-1030BC) in which period the legendary Babylon city is built(of which we have very little proof and witnesses today);
- *the architecture of the Assyrian kingdom* (1030-600BC) represented by some assemblies of constructions of great dimensions, with strong defence systems (the fortress-cities Assure and Nineveh);
- *The architecture of the new Babylonian kingdom* (606-538BC) characterized by monumental constructions (royal palaces, "the suspended gardens of Semiramida", "the tower", etc.).In this period, the famous "Gate of Goddess Istar" from the entrance of the ancient Babylon city is also built.

a - *The urbanism* of Mesopotamia is characterized by the construction of state-cities, strongly fortified by rounding them with massive high stone walls, enabled with defence towers and with massive well-defended gates.

The cities had in general geometrical forms organized in plane and were constructed by the principle of concentrically insides (in order to be easily defendable) having in the centre the royal palace and the stairway temple-**the ziggurat** (fig.4.3).

b – *The principal functional programs* in Mesopotamia were numerically



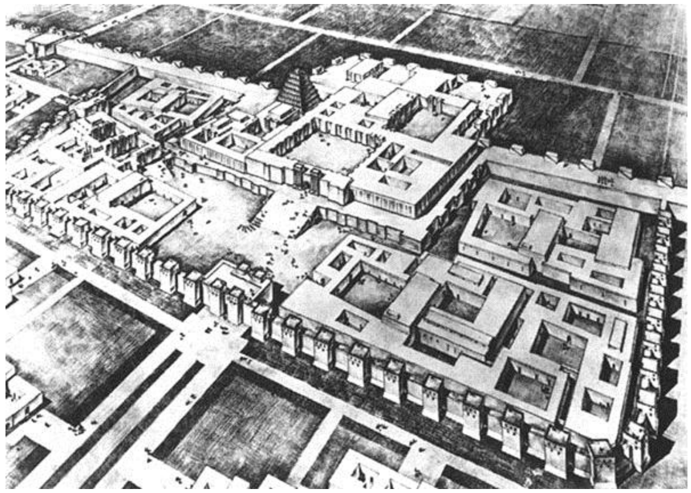


reduced*: the temples, the royal palace, and the habitats.*

Fig 4.3- Nannar's ziggurat from Ur

Figure 4.2

The temples were massive constructions which were part of greater religious buildings, together with the priest's chambers. The dominant silhouette of the religious assembly was the ziggurat (fig. 4.3), a massive construction made out of natural stone, composed out of prismatic volumes(chambers put on over another) with smaller and smaller sections, connected to each other by stairs and monumental ramps and also having a praying chapel on its superior level.



The royal palace - massive construction, situated in the centre of the city, strongly defended by thick and high walls made out of natural stone masonry, having few and rather small gaps. For functional purposes, the chambers of the palace were grouped around an inside courtyard to which the gaps corresponded, thus giving circulation and natural illumination.

Homes – built (regardless their size and wealth) following the same principle: chambers grouped round courtyards and having gapless walls surrounding them on the exterior as to be easier to defend.

The most common building materials used were: ***clay*** (under the form of blocks dried out by the sun), *burnt and polished brick and rock*. For the covering of the chambers *wood* and small arcs (from brick) were used and for protection against heat or cold, the chambers were covered with piles of threshed earth soil.

c – *The architectural plastics* in Mesopotamian architecture is characterized by using the following specific architectural forms:

- delimitated spaces in a succession of closed, rigid interior courtyards, displaced after organized plans, with symmetry axes;
- massive volumes developed horizontally and dominated by robust silhouettes (towers, ziggurats);
- simple massive walls with vertical stripes, or (in the case of rich homes and palaces) decorated with colourful mosaics, with bas-reliefs and sculptures;
- walls (in the palace halls) decorated with *frizzes* of large dimensions representing hunting scenes or scenes of battle;
- decorative motives representing stylized plants and fantastic animals (lions or winged bulls with human heads).

4.2.2 The Architecture of Ancient Persia

Unlike Mesopotamia, Ancient Persia was situated in a mountainous area, on the territory of Iran today, where natural conditions did not favour the development of great urban centres and on the other hand, the tribal way of living of the population and its tendency to conquer new territories led to the fact that Persian people mostly lived in their tents, around green oasis.

a – *The urbanism* of Ancient Persia is emphasized in its period of great expansion (till 330BC when it was conquered by Alexander Macedon) in which some important urban establishments were built-the cities *Ecbatana* and *Susa* (known only from the writings from antiquity).

As general characteristics, the cities were organized as military camps and were strongly fortified.

b – ***The functional programs*** were relatively fewer as types and with a general style sensibly different than the Mesopotamian ones.

The palaces-were grand constructions, having as principal functional element the large receptions halls, with the roof placed on columns, while the other chambers were grouped by their utility.

One of the most representative constructions of this type is the *royal palace from Persepolis*, constructed by steps in the period 521-425BC, under the form of balconies connected through stairs and ramps, containing vast halls ("The hall of 100 columns" with the dimensions 75x75m) with the roof placed on columns made out of rock, having highly decorated capitols and very great height (about 18m).

The homes-modest constructions made out of clay or rock, with narrow rooms covered with soil for protection against heat.

Religious constructions – taking the form of *altars* or *aedicule* of reduced dimensions, used in general for the cult of fire.

Tombs – funerary constructions, taking the form of stone towers with dense decorations, or dogged directly in the rock of the mountain.

Main building materials for the Persian people were: *stone* for columns and walls, *dried clay* for walls, *wood* for roofs and *polished ceramics* for covering.

c – *Architectural plastics* in Ancient Persia were characterized by:

- the monumentality of the reception halls, of the stairs and gates of the palace;
- the usage of simple prismatic volumes for rooms;
- the dividing of large spaces by using linear vertical elements: columns, richly decorated with capitols having volutes, tores, and animal representations (twin bulls);
- the rich decoration of halls with *frizzes* of great proportions and with *bas-reliefs* representing processions of characters and fantastic animals.

The conception of forms and volumes, the quality and richness of decorations and the amplitude of the architectural composition make the architectonic assembly from Persepolis one of the most valuable building and architectonic achievements of the antique world.

4.3 The Architecture of Ancient Egypt

Ancient Egypt, situated in northern Africa, along the valley of the river Niles, has adapted its whole existence and culture, even from ancient times (beginning from the 4th Millennium BC), to the conditions that the climate and natural local resources have given

Even though it encountered many wars, invasions and internal battleships, the society of Ancient Egypt has had along its entire existence the same characteristics: a state of slavery type, ruled by a pharaoh, military leaderships and the great priests of the temples.

This social composition has had a great influence over the whole culture and civilization of the Ancient Egypt and of course over its architecture. So, the power the pharaoh and the religion had, made that all the important constructions to be dedicated to them: the palaces, the tombs (pyramids), the temples.

a- The urbanism of Ancient Egypt is not very well known, because the time has erased all the proofs of the urban agglomerations, but proofs of important settlements have been kept: El Kahum ," the town of the pyramids builders"(1897-1878 B.C.) and Tell-el -Amarna(founded in 1370 B.C.) the residence of the pharaoh Amenhotep the 4th.

b- The functional programs are dominated by the constructions with a funeral character, because of the creed in the after life, which was very well developed in the Ancient Egyptians.

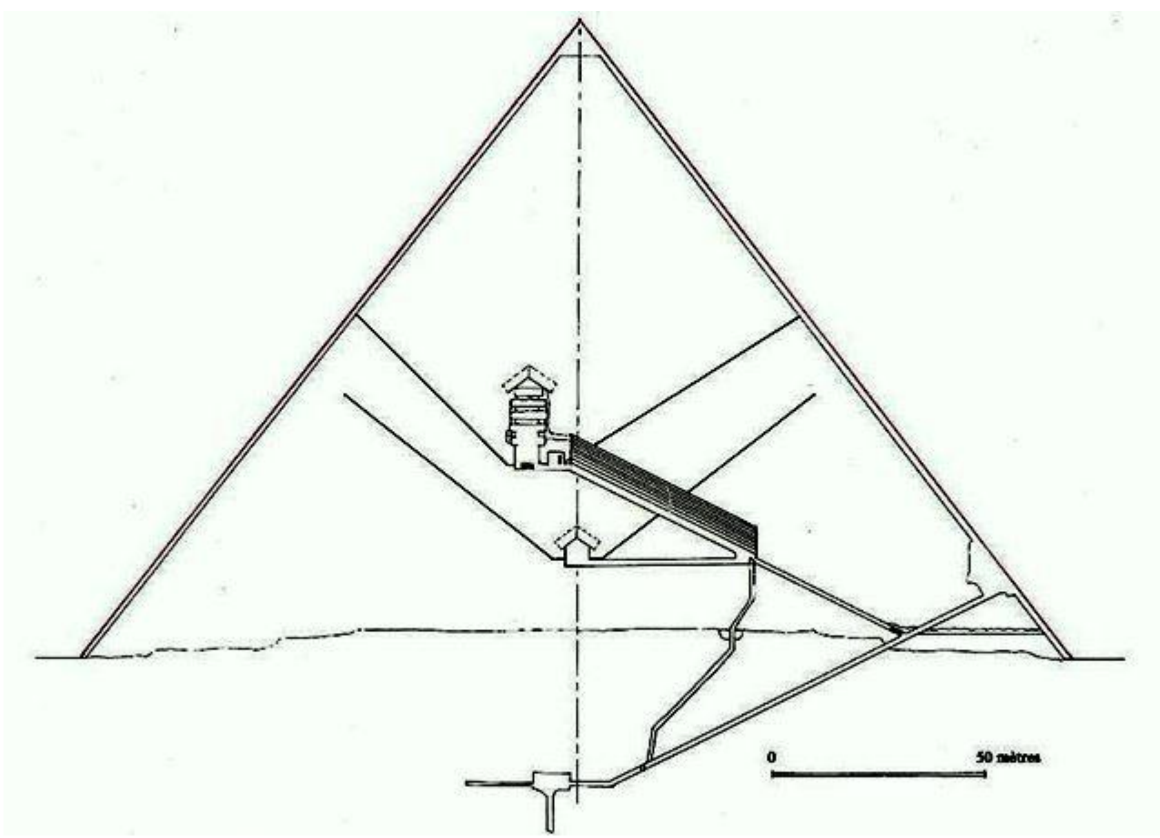


Fig.4.5-Keops's pyramid (cross-section)

The funeral constructions-having the destination of "the home for the after life" were having different forms and dimensions, according to the social importance of the owner and they were built while their owners were still alive with the help of the slaves. These constructions were various:

-*the pyramid* – a construction which was a grave of the pharaohs or the great priests, sheltering not only their mummy but also a lot of material goods which they could use in the after life.

Having simple forms and monumental dimensions, the pyramids were built with secret chambers (fig.4.5) and with protective measures (traps) to protect the mummy and the richness's from the inside against being desecrated.

The most important and well known Egyptian pyramids are those from Giseh (fig.1.4.) from the " Valley of the Kings", built for the pharaohs Keops (Khufu), Kefren (Khafre), and Mykerinos (Menkare) in the third millennium B.C.(between 2680-2560 B.C.).

Between the pyramids of the three pharaohs(grand father, father and grandson) that of Keops is the most impressive.(fig.4.5.) not only through its dimensions and its mass(over 2.300.000 blocks of stone , each of them having more than 2,5 tones) but also through the connection between the dimension and its position with elements from mathematics and astronomy. These connections allow some hypothesis that the Ancient Egyptians had a lot of knowledge about mathematics, the shape and dimensions of the Earth , the coordinates of the solar system ," the pyramid effect".

-*the mastaba* - a funeral construction made by stone, as a pyramid trunk above the subterranean funeral room and connected to this by a gallery.

-*the cave tomb*- dug into a rock and protected by it.

The temples were religious constructions having as a destination the " house of Gods" and the " praying place" for its followers and were made by a succession of yards and closed rooms, disposed on a longitudinal axis, having a monumental entrance and on the other side the sanctuary(accessible only to the priests).

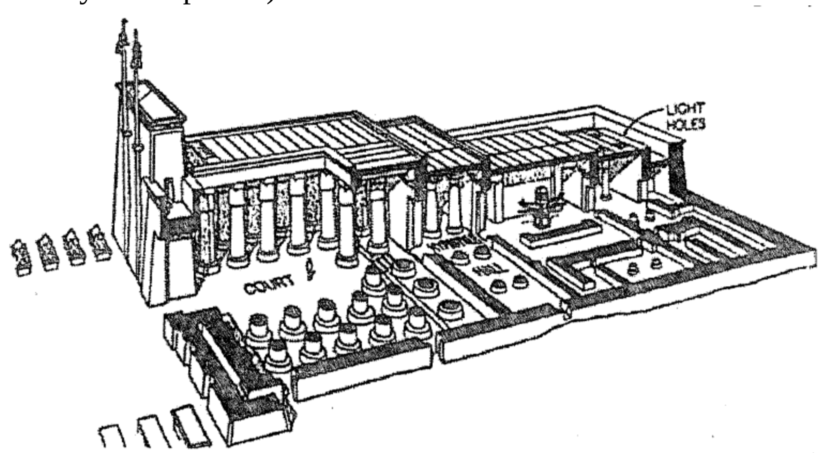


Fig.4.7-The temple of Khonsu-Karnak, Egypt

Most of the times the temples were dug partially in the mountain and the monumental entrance were solved with the help of some support columns for the roof of the temple, richly decorated.

In 4.7 is presented in perspective the temple of Khonsu from Karnak, built around 1170 B.C.

The funeral temples were constructions composed as a rule by a monumental building which was an entrance hall, an alley flanked by sphinxes (“dromos”) and then the ritual rooms.

Among the most important constructions built as funeral temples we have those of queen Hatsepsut from Deir-el-Bahari(fig.4.8) and the pharaoh Ramses the second from Abu-Simbel(dug in the rock of the mountain).

The palaces –homes of the pharaohs, great military leaders and priests were constructions of impressive dimensions from stone having vast rooms with the roof leaned on columns and beams from stone or wood. The most impressive palaces were those of pharaoh Ramses the second and Ramses the third. (Centuries 13 and 12 B.C.)

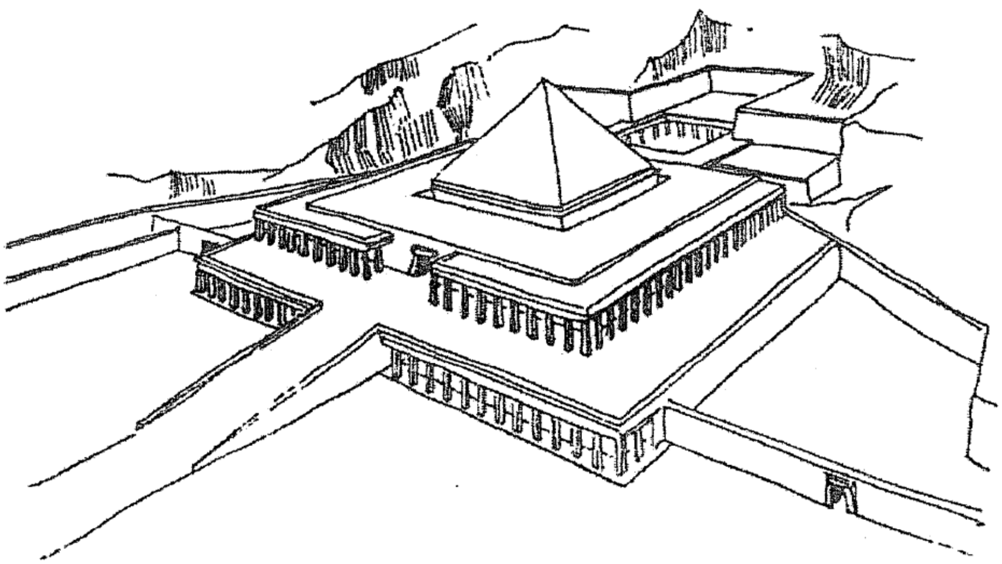


Fig.4.8.-The funeral temple of Mentuhotep from Deir-el-Bahari

The most frequently used construction materials were – *the clay, the stone, the wood, the bricks* but from all of these the stone was the most important because of the huge quantities the Ancient Egypt had, the easy transport on the Nile and the knowledge the Egyptians had on how to cut and place the stone.

c- *The architectural plasticity* in the Ancient Egypt is characterized by some specific elements such as:

-the use of closed rectangular spaces, well delimited;
-the use of some regular simple geometrical shapes (the pyramid, the prism, the pyramid trunk);
-the creation of some constructions of impressive proportions, monumental and overwhelming for the human stature (through the size and the decoration of the constructions the pharaohs showed their power and wealth and the religion servants tried to impress their people to be able to control them);
-the use of some balanced compositions, symmetrical (example-the creation of the temples in a *telescopically* system-spaces disposed successively throughout a symmetrical axis and having smaller and smaller dimensions);
-the use of some rich decorations (sculptures, paintings, bas-reliefs) and some columns with caps having vegetal or anthropomorphically motifs (a very specific element of the Egyptian

architecture is the frequent use of a statue of a supernatural being*" The Sphinx*", an animal having a human head and a lion body-fig.4.9).

Fig.4.9.-The Sphinx (Gizeh-Egypt)

According to the paper [29] the Egyptian architecture can be divided into four main periods:
-*the architecture of the old empire*- between 3200-2052 B.C. and characterized by the building of the great piles of the funeral cult (pyramids, temples);
-*the architecture of the medium empire*-between 2052-1657 B.C. when smaller constructions are built (funeral temples, mastabas);
-*the architecture of the new empire* –between 1657-1085 B.C. when great piles of houses, palaces, temples are built;
-*the architecture of the late and Hellenistic period* –between 1085-30 B.C. when the architectural spaces became more open and closer to the human scale, beginning to resemble the Greek architecture(especially the religious constructions-the temples).

A main characteristic of the Egyptian architecture is its prolonged reluctance to change, its unwillingness to using simple geometrical volumes(the pyramid for example) for about 2700 years, which made the Egyptian architecture to be considered an architecture of *massive geometrical volumes, with sharp edges* and the technology, the solidity of the materials and the proportions of the Egyptian constructions gave them durability and the guarantee of a certainty and of a indestructibility almost unlimited.

4.4 The Pre-Hellenic and Ancient Greek Architecture

The Ancient Greeks have been very proud of their civilization and their sacred architecture, says Roth M.L. and whoever visits Greece or studies about the ancient civilizations will admit that easily.

The ancient Greek architecture, one of the main springs of the world wide architecture, represents only a part of the ancient Greek culture, a very developed culture in many fields and spread across a vast geographical territory, which includes the actual Greece, the Aegean Sea islands, and also vast zones where the ancient Greeks spread their influence and leadership such as Upper Italy, Sicily, The Asia Minor shores, the Black Sea seaside.

The Greek people formed around 1100 B.C., between the fusion of the Pre-Hellenic population (with a long history of about 2400 years-between 3500 and 1100 B.C.) with the migratory nations that is why the architecture of Ancient Greece has its origins in the architecture of the Pre-Hellenic civilizations.

4.4.1 The Pre-Hellenic architecture

a-*The urbanism* did not know a very large development in the islands of the Aegean Sea and consequently huge urban agglomerations had not been built, the constructions being set inside some citadel settlements pretty modest as lay out.
The explanation is due to the main activities of the inhabitants:-agriculture, crafts, trade, navigation, but also to the geographical conditions: very close islands with small surfaces.

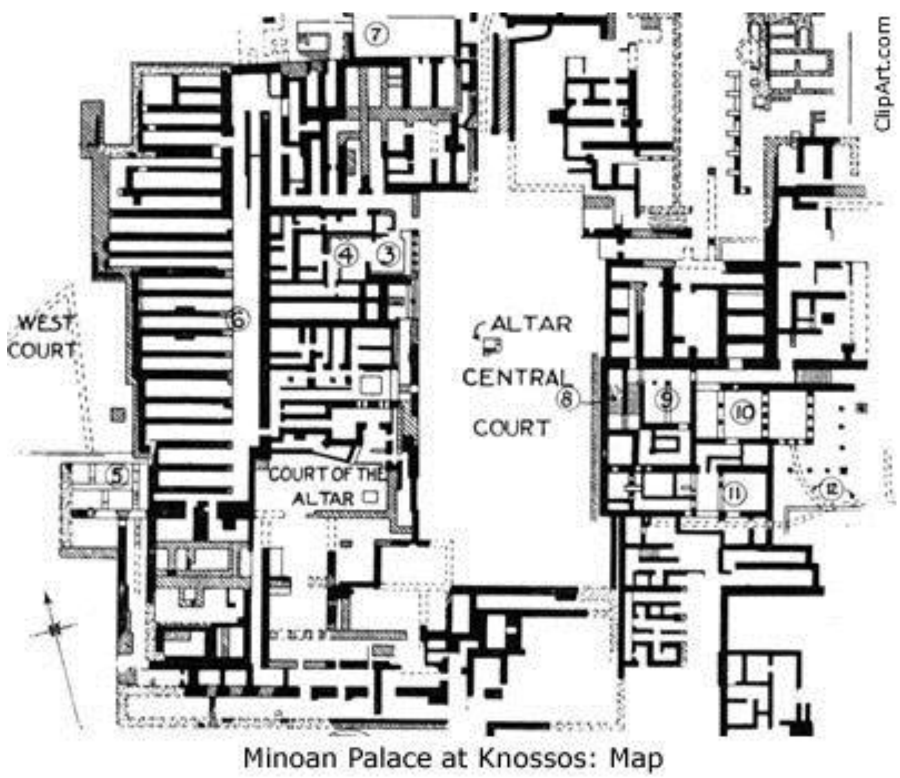


Fig.4.10-The royal palace from Knossos-Crete

b-The functional programs-contains few types of constructions:

The homes-modest constructions of collective or one family cabins type had a rectangular or ovoid form. A more evolved type of homes was the megaton composed by a room, a hall and an ante-hall with one side open to the outside. This type of home coming from Asia Minor (Troy) set up the pattern for the Greek temples.

The palaces – were constructions of monumental sizes (fig.4.10), included inside some citadels sometimes, but most of the times they were unfortified. They had rooms grouped on their functions, displayed around an interior yard and having special arrangements (water supply and sewerage) which offered them a great comfort for those times.

The constructions for the shows were destined to sport exercises or bull fights and were composed by stone steps set around a rectangular arena.

The defence constructions were citadels surrounded by strong walls with fortified doors (characteristic for the Mycenaean civilization).

The funeral constructions were having circular shapes, covered with arches and soil and having an access hall called “dromos”.

The construction materials used in the Pre-Hellenic architecture were the stone, in shape of polygonal blocks not used with mortar, the wood for the beams of the concrete floor, the bronze and semi-precious materials (alabaster) for the inside arrangements.

c-***The architectural plasticity*** was characterized through:

-the respecting of the human scale when building the constructions;

-grouping the rooms according to their function;

-the accomplishment of some continuities between the interior of the construction and the exterior, by using some specific architectural elements (columns porticos, interior yards, stairs, large openings);

-the refined interior decoration of the construction with frescos and alabaster or bronze ornaments, representing characters, plants, animals.

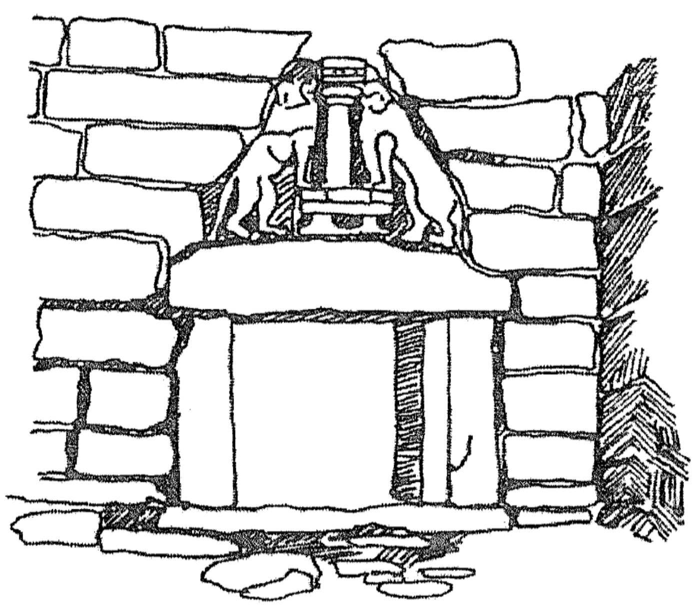


Fig.4.11.-The Lions Gate from Mycenae

The main stages of the Pre-Hellenic architecture are:

-*the Cycladic period* –between 3500-2100 B.C. when the megaron construction appears(in the Cyclades islands);

-*the Cretan period* –between 2100-1400 B.C. developed in the Crete island where the Pre-Hellenic architecture grew up and progressed through vast constructions (the Cretan palaces);

-*the Mycenaean period* – between 1400-1100 B.C. set in Peloponnese, the continental Greece , where monumental palaces were built(inside the citadels Mycenae and Tirint) strongly fortified.

During the Mycenaean period the trilic system is used for the first time to build the access doors: two blocks of vertical prismatic stones above which a horizontal block is set. In figure 4.11, the "Lions Gate" is presented, discovered in Mycenae's palace, built using the trilic system.

4.4.2-The Ancient Greece Architecture

Taking some elements from the Pre-Hellenic architecture, the Greek architecture begins to exist from the 7th century B.C., when the first independent citadel-towns appeared, called *polises*.

The progress of the entire Greek society beginning with this period determines the continuous improvement of the construction techniques and the ornamental sculptural elements leading in the same time to the huge growth of the number of temples built in the beginning in the *Ionic* and *Doric* style and later on in the *Corinthian* style.

During Pericles's leadership (450-429 B.C.), Athens, the capital city of Attica, became the centre of cultural and artistic movements and the testimonies of the perfection reached in the architecture of this period are the marble monuments built on the Acropolis of Athens under the surveillance of the great artist, sculptor and architect Phidias.

a-*The urbanism* of Ancient Greece presents few characteristic elements.

The citadel-towns (polises) developed around a natural fortified height (a hill, a mountain or a bigger cliff) and they were called acropolis (fig.4.12). On this natural height was the citadel and around it were grouped (randomly sometimes) the homes districts, while the rich and powerful towns were totally surrounded by fortified walls (Athens).

Around the year 500 B.C. some urban elements appeared, of arranging the streets in a rectangular network (in Piraeus, Alexandria, Millet, Priene) and also of placing the public constructions around a central commercial square ("multifunctional") called "agora" (the square which has become in time the place for the public gatherings)

b-*The functional programs* have been diversified especially in the maturity period of the Ancient Greece period (the "classical" period-between 450-306 B.C.) in comparison with those from prior architectural trends, due to, first of all, the development of culture and civilization in its whole.

Temples were the most spread and important constructions of Ancient Greece having the role of the "house of the god" to which they were dedicated.

Usually, the temple was built on high natural land formation (acropolis) within the boundaries of a fortified town or a big sacred ensemble located outside the city limits (Ex: The temple of Delphi).

Mainly, from functional point of view, the temple was composed of three main chambers:

- The nave (main chamber);
- The vestibule (narthex) opened to the outside (at the entrance);
- The hoard (sanctuary chamber destined only for those that were initiated)

Depending on the number and arrangement of the columns situated in the facade of the temple and the columns surrounding the central nucleus formed by walls, the Greek temples had different names [29]: -“in antis”,”prostil”,”amfiprostil”,”peripter” (Parthenon – fig. 4.13), “ pseudoperipter” , “dipter” , “pseudodipter” , but the cardinal rule that the number of columns on the long side of the temple was **2n+1** (*n*-the number of columns on the short side of the temple) was respected.

The majority of temples in Ancient Greece had a rectangular general shape (or were composed of rectangular surfaces), but temples that had a circular section called “*tools”* were also built.

We can see in figure 2.14 an actual image of the famous Parthenon from the Acropolis in Athens and also a drawing in which the temple is reconstructed by G.P. Stevens [44].

Most of the time, the temples were positioned together with other public constructions (altars, theatres, monuments, etc.) in monumental architectonic ensembles called *“sanctuaries”*.

Public constructions destined to the assembly of the Senate (*Tersilion*) or of other dignitaries (bouletherion- fig. 4.15, eclesiasterion, etc.) were grouped around the *agora*, which became the political life centre of the city.

Entertainment constructions had a remarkable role in the ancient Greek architecture being used sometimes for public or religious gatherings. Examples of such constructions:

- *the theatre* – an open air construction, made from natural stone, having a semicircular shape in plane and being compose of stone steps constructed on a natural slope of the landscape (this being the *theatre*) and a place for the choir (*orchestra*) under the form of a circular platform made from stone slabs, having the functionality of our modern-day stage.

- *The Odeon* – covered construction composed functionally same as the theatre used for musical spectacles.

The constructions used for physical exercising also had an important role in ancient Greece due to the attraction that ancient Greeks had for exercising and its benefits on the human body.

The development of these “special” constructions used for physical exercise and competitions was done according to different functionalities (depending on the type of competition it was destined to). Such constructions were:

- *The stadium* - construction destined for athletic competition;
- *The racetrack*- construction used for horse races;
- *The palestra* – construction used for gymnastics;
- *The gymnasium* – complex construction used for a combination of physical exercises and education;

The homes, rich or poor, were built with a common principle: rooms grouped around an interior yard with columns (peristyle) and closed at the exterior side.

An important functional characteristic of these constructions was the separate chambers destined for men and for women.

An important functional characteristic of these constructions was the separate chambers destined for men and for women.

In the architecture of homes, the ancient Greeks used brick masonry (sun dried bricks) laid on a stone footing according to plans in the shape of a quadrilateral (usually) with the walls laid rectangular, and due to the high density of houses in big cities, neighbouring houses were joined or had common exterior walls.

Town constructions are buildings that show the existence of a constant preoccupation for the rise of comfort, from the ancient Greeks.

Consequently, *water reservoirs* were built (Megara sec VII î.e.n., Athens), *aqueducts* (Samos*), wells, sanitary sewer*, etc.

The main construction materials, in ancient Greece, were: *rock, wood, brick, ceramic tiles*. The construction system used was that of the *trilit [29]* simply defined by a system of two vertical columns sustaining a horizontal element (beam).

Important constructions were covered by ceramic tiles or rock tiles sustained by wooden beams (or rock), the shape of the roof was in general with two slopes with gables at the ends (fig.4. 18).

c*-The architectural plastic* art of ancient Greece has highlighted a big variety of specific architectural shapes, mainly because of the creative capacities and talent of the Greek architects – constructors. Among these, the most important architectural plastic art characteristics have been:

- The creation of monumental volumes and remarkable sculptures;
- The realization of refined architectural compositions, through the use of studied asymmetry;
- The fine blending of the connections between different buildings which form an architectonic ensemble;
- The usage of "human scale" for building and obtaining grandeur through simplicity and through the arrangement of the elements composing the constructions;
- The repeated usage of *column rows* interconnected with horizontal beams – fig. 4.19. which by their alternation of gaps and filled space accomplished impressive light and shadow effects;

A special achievement of architectural plastic art in the evolution and development of ancient Greece architecture represented the usage of so called architectonic orders: - Doric, Ionic and Corinthian.

The ***architectonic order*** is (according to a definition given by Bordenache and Stern [3]), "the most limited organization of construction and decorative elements which form a Column Order, as a unit and a fundamental expressive way".

ORDER (according to the same authors) is "the effect of systematic and conscious coordination of the ensemble of parts and architectonic elements of an edifice, coordination and systematization realized with the observation of proportions, constant reports and analogies, in the purpose of obtaining a harmonious ensemble of the built masses, empty space and the whole constructive and decorative constituents which form it".

The structure of an architectural order is resulted from the vertical superposition in an ascendant direction of some supporting elements (*column* or *pillar*) with or without trestle (base) and of some “carried” elements which form the *entablature.*

The architectural order is composed (generally) from constant elements in shape and size, having *modular* dimensions that mutually interact, determining characteristic ratio specific to every basic *stile* of classic architecture.

The basic unit measure for the proportioning of different components of the order is the module, equal with the shaft section radius at the inferior part (the base of the shaft).

In figure 4.20 the component parts of two of the classic Greek orders (Doric and Ionic) are presented in detail (for comparing).

The principal characteristics that define the classic Greek orders can be presented by the description of the representative element - *the order column* [29].

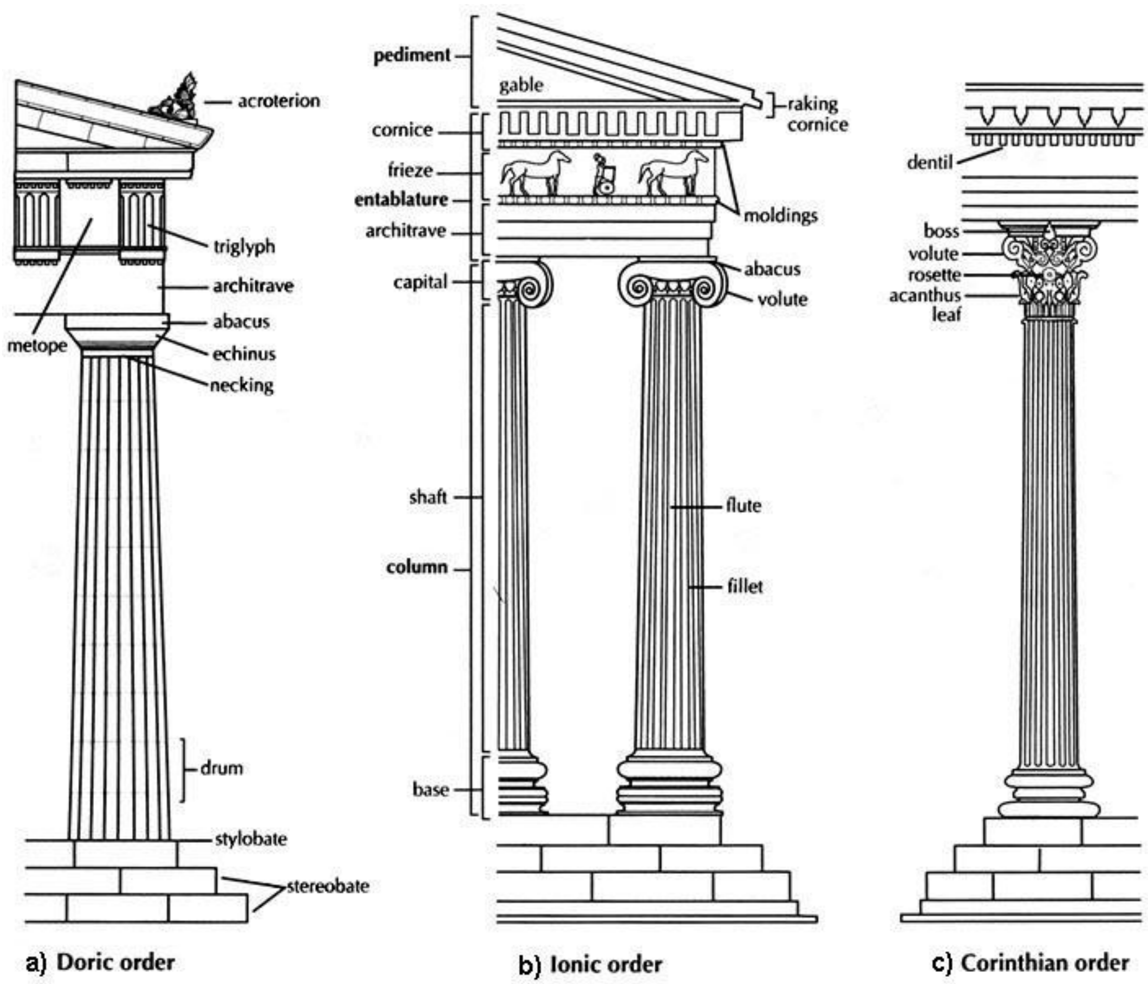


Fig. 4.21 – Classical Greek Orders

The Doric order- used especially in continental Greece, it derives from the popular architecture of the Peloponnesian zone (from the Doric structure of wood), and the simple and austere forms of the Doric order elements, give the impression of solidity and force (fig 4.21. a).

The principle elements that characterize the *Doric* order are:

-absence of the column *base* (the column resting directly on the stylobate);

-the capital has two parts:

-*the echinus*, with a round shape;

-*the abacus*, with a prismatic shape;

-*the shaft* (easily having the shape of a truncated cone) with exterior flutes what have sharp edges;

-*the frieze* decorated with sculptures (metopes - sculpted plates and triglyphs- wood beams end forms imitated in stone).

Among the most representative constructions for the Greek Doric order is situated the Parthenon from Athens (see fig. 4. 14) built in 437 B.C.

Figure - The Doric order of the Parthenon

The Ionic order – derives from the popular architecture of Ionia (situated towards the Asia Minor zone) and reproduces a structure of woodwork with reduced sections in comparison with the Doric order ones, transposed into stone. The oriental influence is felt by the more generous decoration, by the gracefulness and elegance of the elements.

The principal characteristics of the Ionic order (fig 4.21. b) are:

-the existence of a base of the columns on which they rest on the stylobates;

-the shaft (easily having the shape of a truncated cone) with exterior flutes what have soften edges.

-the capital is sculptured in the form of a volute (alike the form of “a buck’s horns”)

-the frieze is decorated with bas-reliefs “in a continuous row” (at the “Attic” Ionic) or is not present at all (at the “Asiatic” Ionic).

Within the most important buildings built by the Greek Ionic order are the Erechtheum from Athens (fig.4.22.), the temple of Athena Nike (fig.1.4), etc.

Fig.4.22 – Erechtheum from Athens

The Corinthian order – was less used in the Greek architecture; it has alike characteristics with the Ionic order, but the manner of execution and decoration of the capitals differ (fig.4.21.c).

The principle characteristics of the Corinthian order are:

-the columns have *base* columns on which they rest on the stylobate;

-the shaft (easily having the shape of a truncated cone) with exterior flutes what have soften edges;

-the capital of the Corinthian column is decorated with vegetal themes in the form of an acanthus leaf bouquet, disposed on one or more ranges (rows);

-the frieze is decorated with bas-reliefs “in a continuous row”

Within the building (temples) more known built in the Greek Corinthian order, we can name the Epikourios Apollon Temple from Bassai, the Olympieion from Athena (fig.4.23), etc.

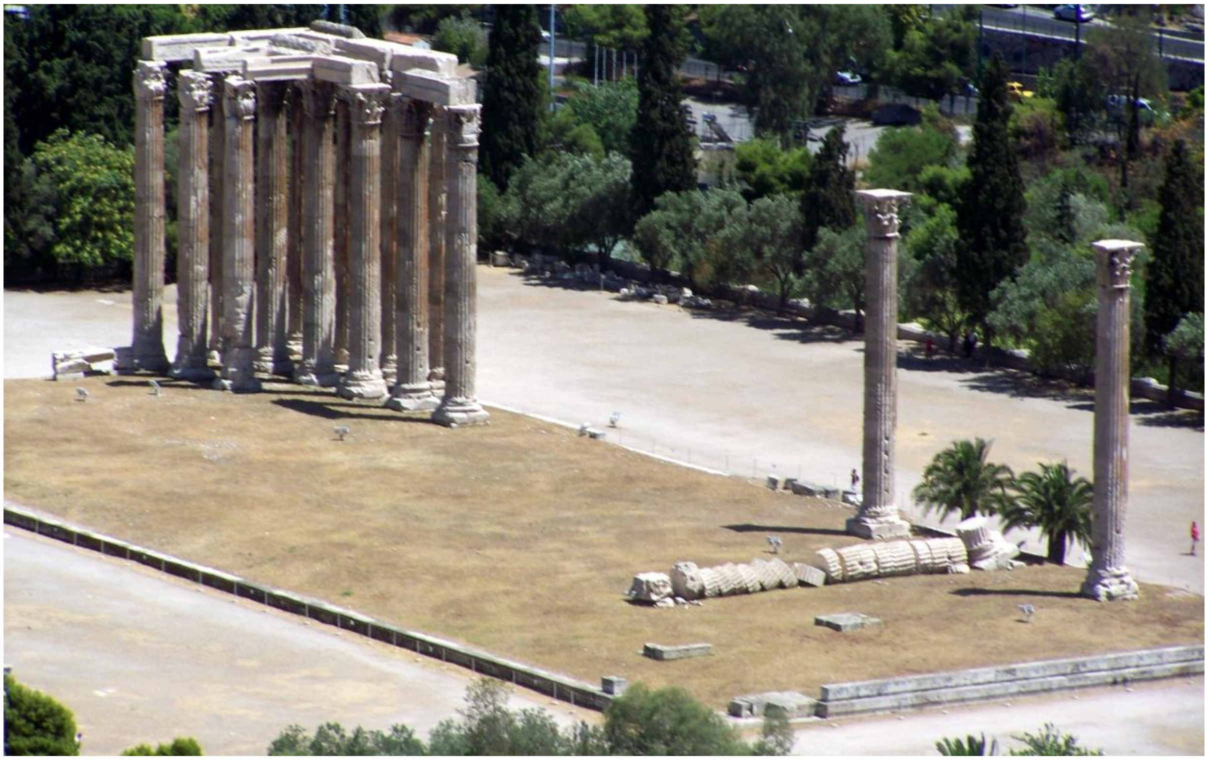


Fig.4.23 - the Olympieion from Athens

In the old Greek architecture, the decorative elements have established a principal mean of accentuating of architectural forms and of attaining artistic compositions of great refinement, thus also a decorative, aesthetic role is often attributed to structural elements, apart from the carrying role.

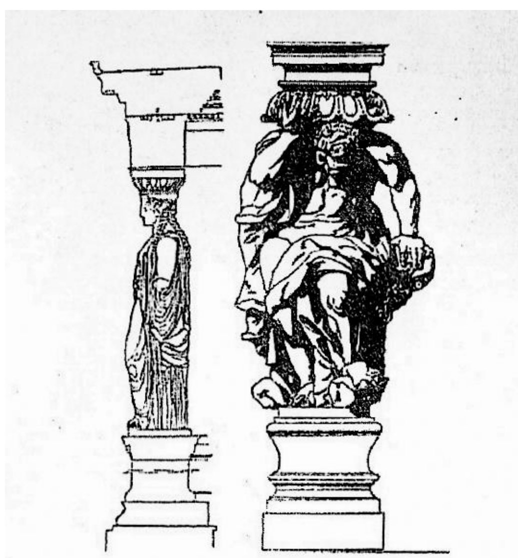


Fig.4.24 – Caryatid and Atlantis

For example, the columns in Greek architecture are sometimes replaced with sculptural carrying elements representing the human body:

-Caryatids –figuring women's body

-Atlantes – figuring men's body

In fig.4.24 there are two examples of carrying-decorative "columns" (one caryatid and one atlas), and fig.4.25 displays a part from a famous temple at which it has been used this carrying system of the roof, namely "The Porch of Maidens" from the Erechtheum of the Acropolis of Athens.

Also, for obtaining artistic compositions of great refinement and supplementary aesthetic effects in Greek architecture it has been used lively colour painting (for laying stress on architectural elements)

Fig.4.25 - The Porch of Maidens " - the Erechtheum (Athens).

In its historic evolution, Greek architecture has got through the next principal periods, [29]:

- *Archaic period* – between 1100 – 450 B.C. characterised by successive qualitative accumulation and a continuous perfection of forms and architectural proportions, in a word by progress
- *Classical period* – between 450 – 306 B.C. in which the architecture reaches maturity. Pericle's époque ("the golden age" of Ancient Greece) has stimulated the construction of big public architectonic complexes, in which also "the pearl" of Greek

architecture: the Acropolis of Athens. Built between 447 – 439 B.C. of the architects Ictinos and Callicrates and artistically decorated by Pheidias (Fidias), the Acropolis of Athens is still one of the grand realisation of the universal architecture.

- *Hellenistic period* – between 306 – 30 B.C. coincide with the spreading in the entire Hellene world (the Macedonian empire) of Greek architectural experience. In this way, through combining Greek classic with local provincial elements, a perfectionism of architecture has been reached, characterised through: - architectural plastic enrichment , "activation" of volume plastics, the encouragement of the taste for luxury, increase of architectural composition complexity. In the same time urbane workmanship and improvement, building orientation and there lay-out in the terrain, etc. are made after more and more rational principles anticipating the true ulterior urbanization regulations.

Old Greek architecture had a powerful influence also on buildings in Romanian territory. Thus big Greek colonial citadels (Tomis, Callatis, Histria) have been built even in the VII century B.C. after urban and architectonic principles of Ancient Greece.

4.5. Etruscan and Ancient Rome's Architecture

Ancient Greece's architecture along with ancient Rome's architecture constitute the main source of global classic architecture and they have had an overwhelming influence over the further development of architecture in a very big part of the world.

Very developed for its times, Ancient Rome's civilization has spread due the powerful expansion of the Roman Empire, not only in almost all Europe, but (in I-II A.C.) also in northern Africa and in an important part of Asia Minor and in the entire Balkan peninsula, practically containing the entire Mediterranean basin.

The immense economic and military power that Ancient Rome represented reverberated once with the advanced and flourishing civilisation on the culture and civilisation of the concurred nations, and from the mixing of their characteristics an evident progress of the whole culture resulted specific elements of that time's architecture in the roman's influence zone taking shape.

A study of Ancient Rome's architecture can not be made without taking into account the *Etruscan architecture* (Etruria being an important part of ancient Roman Empire) which stood at the base of the development of Ancient Rome.

4.5.1 Etruscan architecture

Etruria was situated in the North-West zone of nowadays Italy, containing the actual Tuscany province, populated by the Etruscans even at the beginning of the I millennium B.C. Between 800 – 500 B.C. takes place the development of the Etruscan civilisation, especially in Tuscan cities Perugia, Volterra, Tarquinia, Populonia, Capua, Felsina (Bologna), etc., and along with it the bases of an architecture and of an specific mode of building are set, but influenced by the Greek city-states.

a- *Etruscan Urbanism* is characterised through:

-a high level of civilisation, justified by important urbane workmanship and improvement (culverts, underground canals, drainages, etc.);

-regular geometric forms of the cities plans and their delimitation into four districts separated by two principles arterial highways perpendicular to each other (situated on the directions N-S and E-W);

-grouping of the housing into rectangular parcels, delimitated by a web of orthogonal streets paved with stone;

-a pronounced character of defence gave by the strong fortification of cities with massive and tall stone walls, having defence towers, loopholes and double monumental and massive gates.

b- *Functional programs* were relatively few in the Etruscan period:

Housing, built after simple plans, generally of rectangle shape in plain, with rooms disposed around an interior court (a partial uncovered space named *atrium*).

Funeral constructions – representative for an Etruscan civilisation, generally were realised grouped in assemblage – *necropolises* and they had diverse forms, being dug in rock, in the form of *niches* on the terrain surface, or *tumulus* (of circular sections, covered with earth).

Temples – initially uncovered sacred precincts, they later become “houses of good” with a square section elevated on a high podium.

Functionally, the temple (fig. 4.26) had in the anterior side an open vestibule (the porch) and in the posterior side three rooms – forming the cellar destined to the Etruscan divine triad (Tina, Cupra, Minerva). The roof was solved with a cover in two slopes.

The used *building materials* were: *stone* (in the form of big polygonal blocks or prismatic slabs), *wood* (for roofs, floors, pillars) and *ceramics* (for coverings and decorative elements)

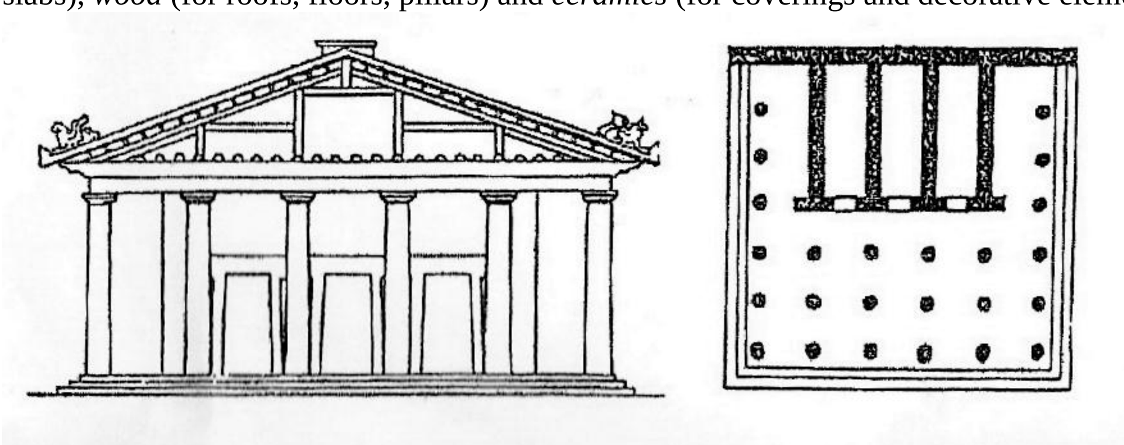


Fig.4.26 – Etruscan Temple

c- *Architectural plastic* was characterized through:

-relatively simple forms;

-reduced dimensions of the rooms;

-the utilisation of *porches* (at temples) corresponding to the *Tuscan order* (based on the Greek Doric order)

-decoration of construction with lively coloured elements of terracotta at exterior and at the interior *fresco* and sculptures.

4.5.2 Ancient Rome's Architecture

Ancient Rome, whose foundation took place at the middle of the VIII century B.C. [3], has a fairly reduced evolution for 2-3 centuries, then to become a great military power in the region (centuries VI-V B.C.), power which extended in the entire Mediterranean basin in the *aristocratic slave republic* period (509-31 B.C.) .

Capital of a giant empire, Rome gradually enriches with architectural complexes, built with financial contribution and concurred nations workers. In this way, forts, temples, basilicas, public and commercial buildings, porticos and triumphal arches, buildings for entertainment and sport battles, culture buildings, etc. have been built, some of them lasting up to nowadays, as a witness to the genius and technology of Ancient Rome's builders.

a- Ancient Rome's *Urbanism* is characterised through:

- a rational biding between ordered structure of the street network and advanced planning system (sewage, running water, garbage evacuation, etc.);
- -a pronounced defending character of the city, given by the strong walls and the fortified monumental gates (orientated after the cardinal point direction);
- -a ordered systematization of the city, through dividing it into 4 principal districts delimitated by two important pedestrian circulation arteries perpendicular one to the other (similar to the Etruscan urbanism);
- -the rich endowment of the city with monumental architectonic ensembles generally grouped around some squares named *for* (or *forum*) having public, commercial, administrative buildings, etc.
- attentive solving of the circulation and transport problem through the accomplishment of strategic roads, of large paved highways and numerous bridges over rivers.

b- *Functional programs* – existent in very big number:

Accommodations – were conceived very differentially according to the social and economic position of the homeowner. Therefore in Ancient Rome there were:

- i*ndividual* accommodations (familial)
- *collective* accommodations (for the mass of the citizens - Romans)

Familial accommodations were on their turn differentiated (generally after the same social-economical criteria) into two large groups:

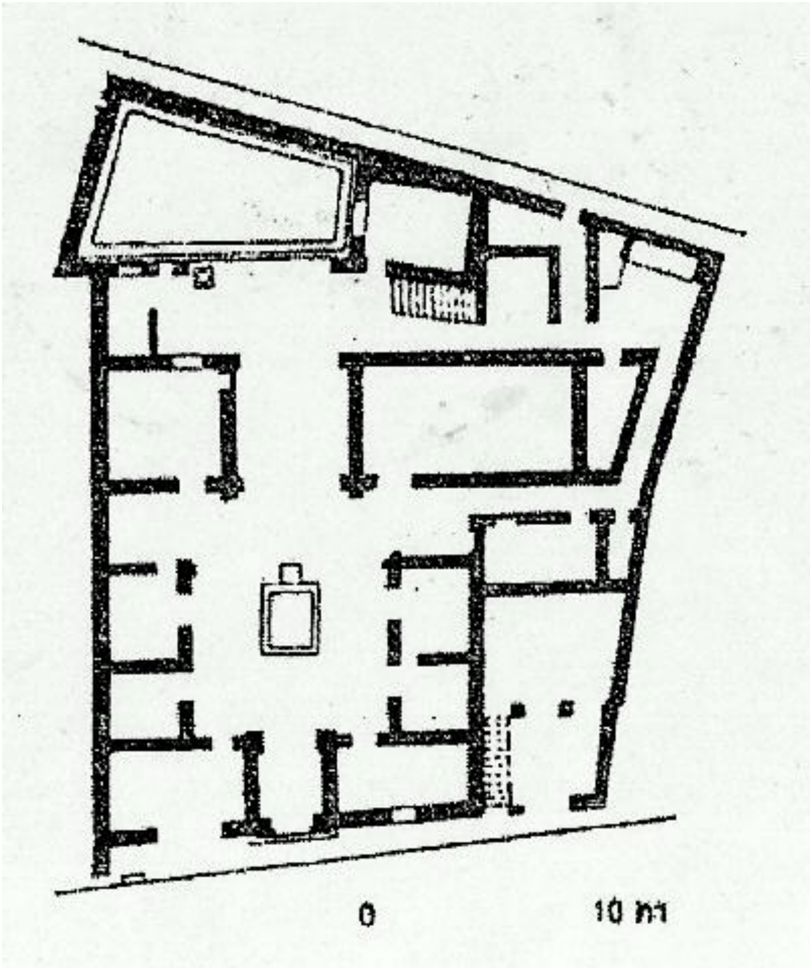


Fig.4.27 – Roman house of “domus” type

Modest housings – built by the Etruscan model, with rooms arranged around a central atrium and everyone having a “reception” room (tablinium) and one or more bedrooms (cubiculum). Sometimes the housing had towards the exterior little commercial spaces – shops (tabernae), and if the owner was richer, it also had at the back of the house a little courtyard with gates (peristilium) sometimes even a little garden (with a well). In the same area were disposed the household rooms and annexes, the dining room (triclinium), etc.

As a development of the atrium house, the domus type of housing had similar characteristics and was developed around the atrium, but the roofing was made with four slopes inclined towards the interior, leaving a central area open for light and for collecting the rain water in basins and reservoirs of stone.

Rich housings (*palaces and villas*) – were made by the same functional principle, but they constructed complex architectural compositions, with monumental spaces, having large and luxurious reception rooms (fig.4. 28)

Roman villa (Casa di pansa – Pompeii – 1st century B.C.)

Fig.4. 28 –Palaces and villas

Palaces and villas – housings of the roman leaders and rich statesmen, had gardens – parks with large areas, having basins with water and ornamental fountains which were generously ornamented with column gates, statues of marble, frescoes and mosaics on the walls of rooms.

The forum – represented an assembly of constructions grouped in a central area of the city (having the significance, functions and attributions of the Greek *agora*) and with time became a public place of political and religious meetings, in short terms the primary architectural and urban space in which the public life of the ancient roman city took place.

In the forum were placed buildings and constructions with commercial, social, administrative, political, commemorative purposes (basilicas, theatres, thermae, temples, arcs of triumph, gates, shops, etc) and the whole forum was paved with stone and mosaics,

Fig.4.29-Roman forum

decorated with states and groups of statues and had circulation spaces (streets, alleys) luxurious and well kept.

Vestiges of roman forums remaining after thousands of years (The Forum in Rome, The Forum in Pompeii, etc) attest to the importance of this architectural space in the cities of the Ancient Rome.

The temple – represented one of the most spread functional programs in the Roman Empire and resulted from the combination of the construction principles of the Etruscan temple and the Greek Hellenistic one.

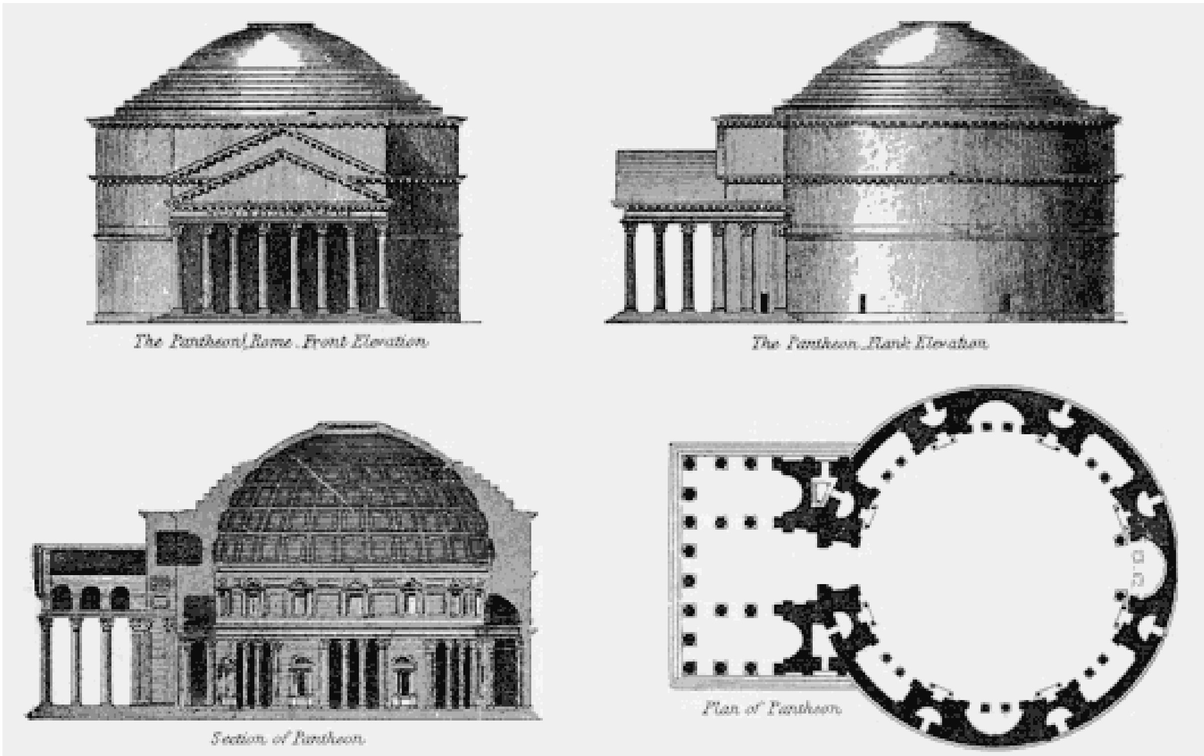
The temple was built on a high podium, with a large gate at the entrance and had a circular or rectangular shape.

Fig 4.30 Roman temples: a - temple of Vestales ; b - Fortuna Virilis temple - Rome

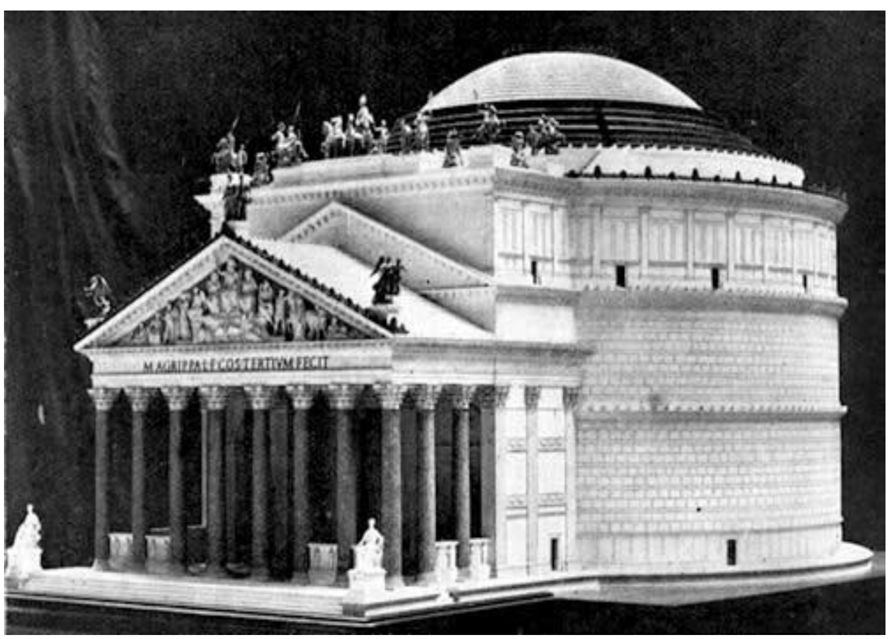
One of the most imposing and representative temple of the Ancient Rome's architecture is the *Pantheon* from Rome, called "the temple of all gods", built and rebuilt between 23-125AD (finished by the famous Apollodor of Damascus).

Made of a vast rotunda with an inner diameter of 43.20m, covered with a dome of the same size and having a central circular opening of a 9m diameter and an original constructive system (square boxes withdrawn successively in the thickness of the vault), the temple was made to shelter the statues of the main roman deities.

Having in time various destinations (temple, medieval fortress, military garrison, prison, etc) the Pantheon becomes starting the 15th century monumental mausoleum, sheltering graves and busts of the celebrities of the Renaissance and modern era, and today is one of the greatest mausoleum museums of Rome.



Pantheon in Rome - different cross sections



Model of the Pantheon

The Pantheon - Inside View

In front of the rotunda, richly decorated with tiles of polychrome marble, an ample vestibule opens (narthex) made of 16 Corinthian columns, which share the narthex in three ships (one central and two sideways).

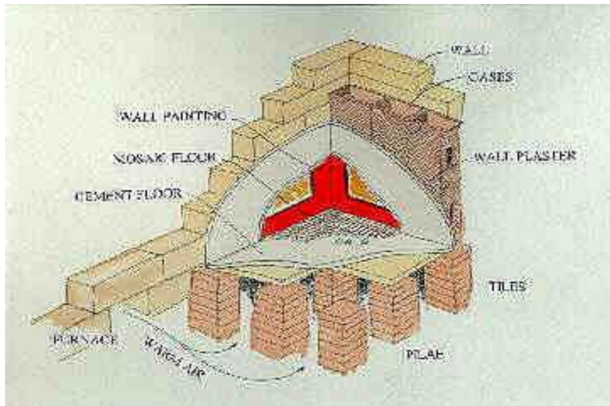
Thermae – public buildings having the initial function of public baths achieved more complex functions later: - public baths, meetings and business places, sports, lecture, recreation, etc.

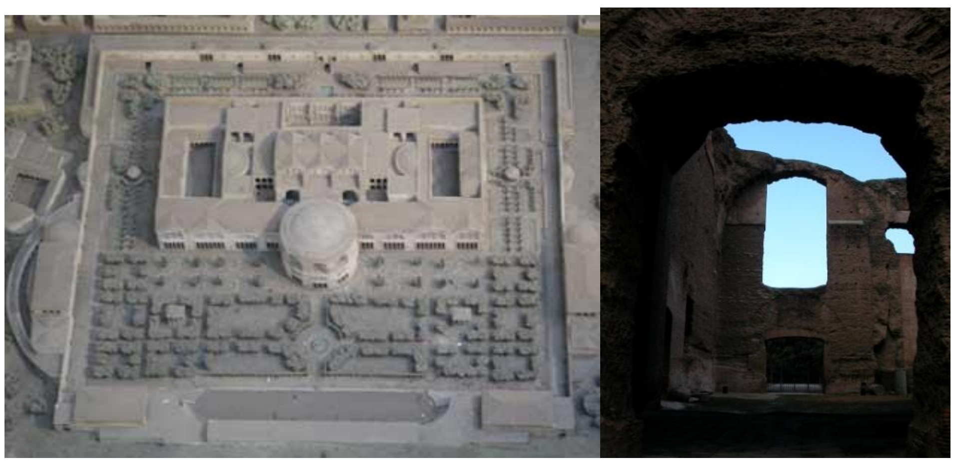
Roman thermal heating system

Testimony of the roman civilization and his concern for comfort, the "termae" were groups of constructions present in all roman cities. The most important ones (in general for the influent peoples in the life of the Ancient Rome) offered a high level of comfort by equipping with aqueducts, with systems of steam or hot water, sewage pipes, evolved heating solutions (hot air systems – *hypocaustum*) and had a high degree of finishing and decoration, with expensive materials, frescoes, mosaics, statues, monumental fountains, etc.

Some of the ancient roman thermae were true architectural works because of their grandiose scale, of the way they were decorated, of the richness of the endowments and of the complexity of functions.

For example *Caracalla's thermae,* of the emperors, and senators (Diocletian, Augustus, Titus, Traianus, etc.) were architectural groups which had a great number of rooms and spaces for bathroom halls (with marble basins, with water of different temperatures), steam baths, reception halls, massage halls, lockers, rest rooms, libraries, sports ground, gardens, gyms, etc.





Caracalla's thermae - Rome

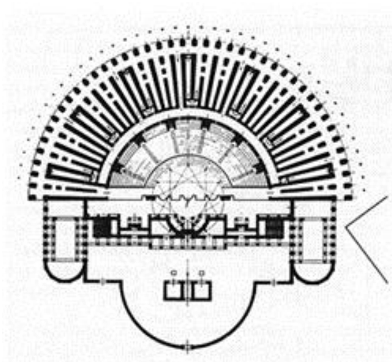
Constructions for spectacles – were important buildings for the roman people and are representative for the ancient roman architecture

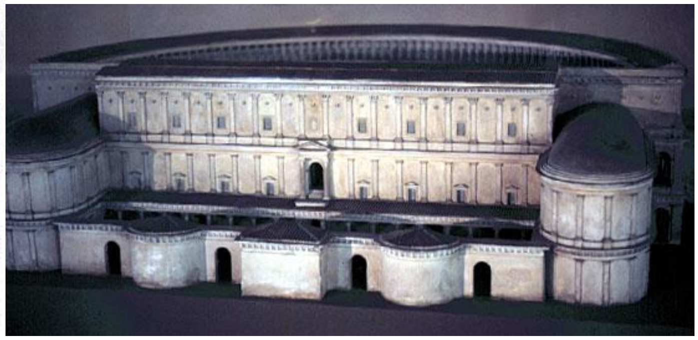
T*heatre* – building for spectacles, having as base the principle of the Greek theatre, but unlike this one (which had the steps placed on the natural slope of the terrain), the roman one had the steps above the terrain, sustained by a system of bolted galleries on multiple levels (from stone masonry or brick) which assured the resistance and functionality of the construction, solving also the entrance or exit of the spectators.

The shape of the roman theatres was usually semicircular, with the step disposed on multiple semicircular levels, on radial sectors separated by access stairs.

One of the most representative theatres of this type is the one of Marcellus in Rome built between 13-11B.C.

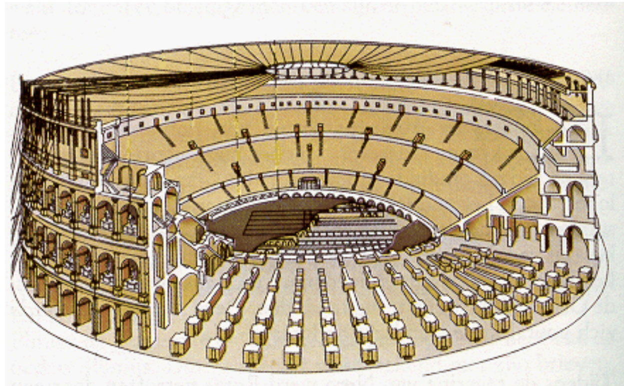
With a capacity of about 13500 spectators, built on three levels stone, the Marcellus' theatre fixes by his architecture and his structure the type of the roman theatre for a long time.





By coupling two theatres front to front it was obtained another construction for spectacles – the amphitheatre, having an elliptic for in plane and being used for the great spectacles (such as sports, gladiator fights, important public manifestations, etc)

One of the most imposing creations of the classic roman architecture and one of the most known buildings of the Ancient Rome is exactly such a construction, the COLISEUM or the *Flavian Amphitheatre* from Rome built between 69-96A.D.



Roman Coliseum

Having impressive dimensions: - the axes of the ellipse of about 188 m, respectively 156 m and the height of 48,50 m, the amphitheatre could support about 45.000 spectators on the five rows of steps, on radial display around the elliptical arena.

The steps were sustained by a complicated structural system, composed from arched galleries on four levels, which have in front four levels of order, one on top of each other like so: - archways framed by columns, *Doric* (first level), *Ionic* and *Corinthian* (second and third levels), and at the fourth level a compact wall, with rectangular openings and decorated with pilasters of composite order.

The amphitheatre arena had a network of galleries and underground rooms for shelter and the circulation of wild animals, slaves or gladiators entering the arena.

Made from masonry of natural rock (volcanic rock, travertine, etc.) and from brick, plated with marble and travertine, decorated with sculptures and statues, The Coliseum, an architectonic work of universal value, is evidence, for more than two thousand years, of the technique and art of the constructors and architects of Ancient Rome.

Along theatres and amphitheatres were other buildings for performances, like:

- *the Odeon* - designed for musical auditions;
- *the Stadium* - designed for sports competitions;
- *the Racecourse* - designed for horse races;
- *the Circus* - designed for trainings and acrobatics;

All of these reveal the cosmopolitan image of Ancient Rome and acknowledge the roman taste for fun and recreation.

Religious constructions – characteristic to the breaking-up period of the Roman Empire, have evolved very little due to the persecution of Christianity until the beginning of the IV century, but in the IV and V century appears prosperity in Christian constructions of modest dimensions like *basilicas*, *baptisteries* etc.

Military constructions – designed for defending the roman cities (or those from the surrounding areas) having a strategic role in assurance of fast displacement of the roman army: - military *castra*, *bridges*, *aqueducts*, *strategic roads* etc.

Funeral constructions – in the form of: *funeral monuments, community cinerarium* and other circular constructions of Etruscan origin.

Memorial constructions –built for the glorification of the roman army successes (mausoleums, columns – column of Traian from Rome, *arches of triumph*).

In the figure 4.37 there is an example of Septimius Severus's Arch in Rome, built between 193 – 211 A.C

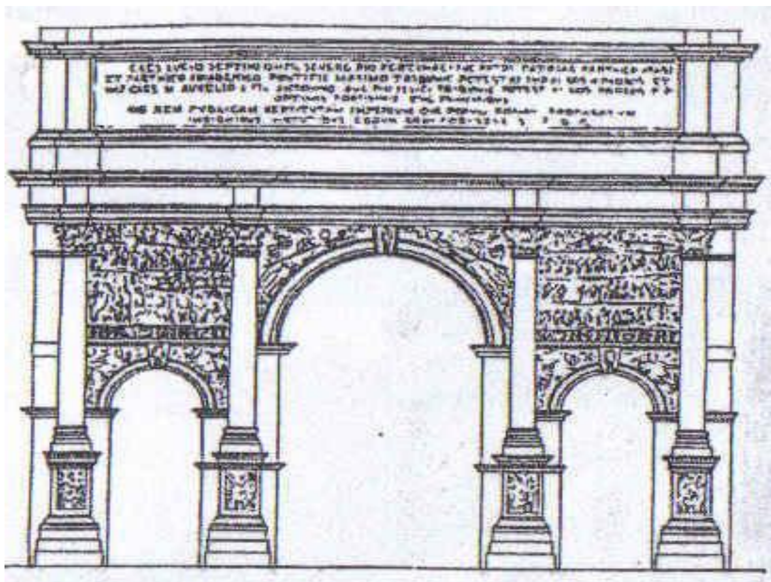


Fig 4.37 – Arch of Septimius Severus – Rome

Built from marble and travertine, it has 21 m in length and a height of 19 m, the arch is crossed by three arched openings, framed by four composite columns on each frontage. Highly decorated with bas-reliefs displaying battle scenes, the arch of triumph mentioned is representative for roman commemorative architectonic monuments.

The construction materials mostly used in Roman Empire architecture were: - *wood, masonry* from *rock* and *brick* with mortars based on lime of high resistance, *marble, ceramic, bronze, iron, led* and later "*concrete*", made with the famous "*roman cement*".

c – *The architectural craftsmanship* of the constructions of Ancient Rome and the architectural shapes specific to that time are the result of the combination of Etruscan, oriental and Greco-Hellenistic architecture.

The main characteristics of this architecture are:

- great capacity to create monumental edifices;
- the organization of big sets of buildings – forums in axial arrangement with a sequence of openings delimited by walls or porch;
- the high use of curved or rectangular porch as connection elements to the inside of the buildings to the exterior;

- main utilization of the covering system by arched roofs or domes, for defining the greatness of the space;
- the sumptuous exterior and interior decoration of buildings by the use of sculpture (friezes, bas-reliefs, decorative panels, inscriptions, etc.) or paintings (monumental wall-paintings);
- the utilization of a special column (fig 4.38) for the realization of the archways in important constructions (The Coliseum, Marcellus's theatre, etc), in which the column (semi-column) has not only a prop purpose, but also is for adornment of the archway's sustaining pilaster.
- the utilization of some expensive materials for decorating the buildings: rare marble, mosaics, etc.

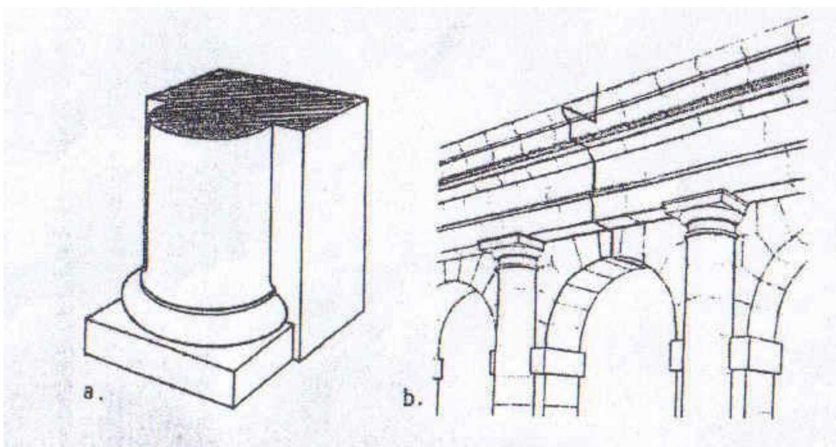


Fig 4.38 – Special column

a. - detail; **b.** - the backing perspective of the entablature the special column

The architectural orders used in Ancient Rome architecture, have resulted from taking Greco-Hellenistic orders and processing them in a new way with the introduction of some own characteristic elements.

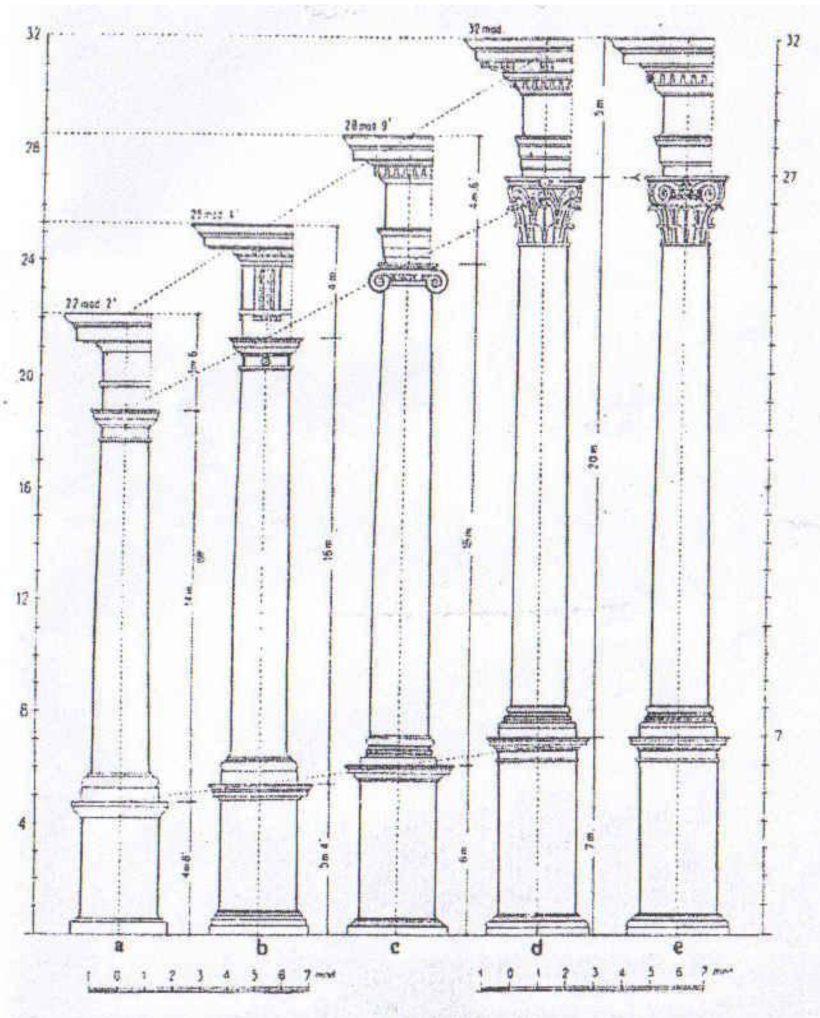


Fig 4.39 – comparative analysis of roman classic orders by Vignola
a– Tuscan; **b**– Doric; **c**– Ionic; **d**– Corinthian; **e**– Composite.

Thus, by undertaking some elements from the Greek *Corinthian* order and combining them with elements from *Ionic* order had been formed a new architectural order: *Composite order.*

The classic roman orders present two general common characteristics, regarding the neck of the columns:

- *the neck of the roman order column doesn't have grooves,* exception only for the composite column.
- *the neck of the roman order column has two levels*: - the base of the column is usually followed by a cylindrical part (the interior part of the neck) on about a third of its height, and after that another "base" is completing the neck (the superior part) slightly conic until the capital (fig 4.39).

The experts consider that the classic roman orders are only four: DORIC, IONIC, CORINTHIC and COMPOSITE, but the renaissance theorists have separated a derivation of the Doric order, used mainly by the Etruscans, and naming this order TOSCAN.

The Tuscan order is very similar to the Doric order, but more robust and more simply decorated, and with a side made from curved and straight planes which gives it massiveness and robustness.

If in the first roman orders the capital of the column is similar with those of classic Greek order (Ionic, Doric, Corinthian), in the *Composite* order the capital of the column is made from 1 or 2 registers with “bouquets” of “*acanthine leaves*” from the Corinthian order combined with a *volute* register from the Ionic order (fig 4.40).

The neck of the Composite column has (sometimes) semicircular grooves and flattened sides.

Remarkable differences between the roman classic orders and those of Greek origin appear in the structure of the *entablature* by changing its dimensions and decoration style.

An important characteristic of the classic roman orders is that the elements of the order (columns, entablatures) have often diminished their role in resistance (bearing capacity elements for roofs or superior structures) this being taken over by the solid wall and the arches leaned on “*pile*”, elements with decorative role.

Some architecture historians divide the development and evolution of roman architecture into two main periods (having the same approximately the same time span):

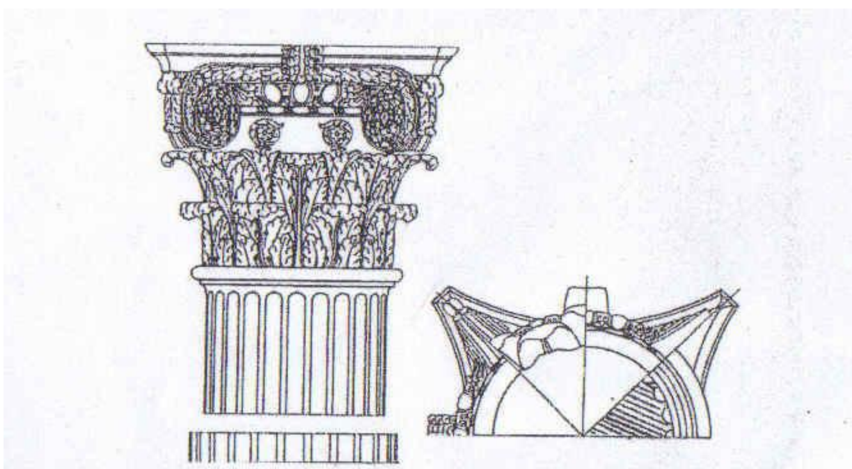


Fig 4.40 – roman composite capital

- *Republican Rome architecture* - between 509 and 31 B.C. when the fusion between elements from the Greek architecture and the local traditional elements occur (the shaping of the roman architectural orders);
- *Roman Empire architecture* – between 31 B.C. and 476 A.C., time in which we can distinguish the main features of the roman architecture, the main architectonic assembly of Ancient Rome is built, based on architectural compositions orientated towards the symmetry of spaces and rich in complex and evolved technological processes.

The architectural creation of the Roman Empire started to decline in the same time with the falling of the empire (476 A.C.) once with its conquest by the migratory nations and the Byzantine Empire.

Just like the ancient Greek architecture, the ancient roman architecture had a very strong influence on the buildings from the territory of Dacia, due to 165 years of roman domination a series of buildings are made by the Romans (generally constructions of military order, like “castre”, bridges – Turnu Severin) and there are built cities like *Apullum* (Alba Iulia), *Napoca* (Cluj), *Ulpia Traiana Sarmizegetusa* (at Haţeg), etc. These cities are the base constructions of some actual cities.

4.6 Byzantine Architecture

The Byzantine Empire appeared in the declining era of the Roman Empire (due to repeated attacks of the migratory nations, but mostly due to inside problems) about the year 330 A.C. and the most important urban concentration (Constantinople) becomes the new capital of the empire, which will stand for about 1100 years.

The peak of development of the Byzantine Empire is reached between the years 527 – 565 during the domination of Justinian, after that there follows a long period of weakening with the culmination of the conquest of the empire by the ottomans in 1453.

The geographic area of the Byzantine Empire included: the Balkan Peninsula, North Africa, Italy, Sicily, Small Asia, but as a consequence on the same area there have developed the Byzantine architectural principles.

The Byzantine society went through a long process from slavery to feudalism, and the administrative and military structures were coordinated by the two Byzantine powers: imperial and religious powers.

The Orthodox Church, a very important system of spiritual domination of the people has influenced not only the living way of the people but the construction environment in such a way the most important Byzantine constructions were of religious aspect.

a) *Urbanism* in the Byzantine Empire can be outlined by some main features:

- main urban concentrations (Constantinople, Salonik, Trapezunt) have developed without any exception around important religious centers.
- the structure of the cities was based on the “centralism” principle, according to which the streets were organized plan metrical in a radial displacement, converging to a main central attraction: the cathedral.
- the city paid a great deal of importance to the defense system, by fortifications with strong walls, defense towers etc.

b) *Functional programs* had the following components

Houses – constructions made in accordance with the Greco-oriental system, under the form of rooms with different functions, round an inside yard, putting up a closed assembly to the exterior. The differences between the luxuriant houses are only regarding dimensions, decorations and comfort.

Palaces – very luxuriant buildings, for the imperial family or for high ranked military or church statesmen, were a set of big buildings with vast spaces, lots of rooms grouped by functions, interior luxurious gardens decorated with expensive materials.

Monasteries – religious edifices build as fortified constructions which contained common buildings, cells, libraries, mess halls and other rooms, having in the center the monastery.

Churches – most representative Byzantine constructions made up (according to the Christian requirements) from:

- narthex (entry vestibule in the church);
- nave (area for believers);

- altar (the sacred room, for priests, having two lateral annexes).

Byzantine churches, also called **basilicas**, have gradually became more and more impressive by means of dimensions and shapes as well as by means of interior and exterior decoration, and the construction manner had permitted distinguished spatial aspects different from other constructions of this type.

Military constructions – were based on the Greco-roman technique of fortifications and were mad e like fortresses with strong walls from rock masonry and with fortified premises.

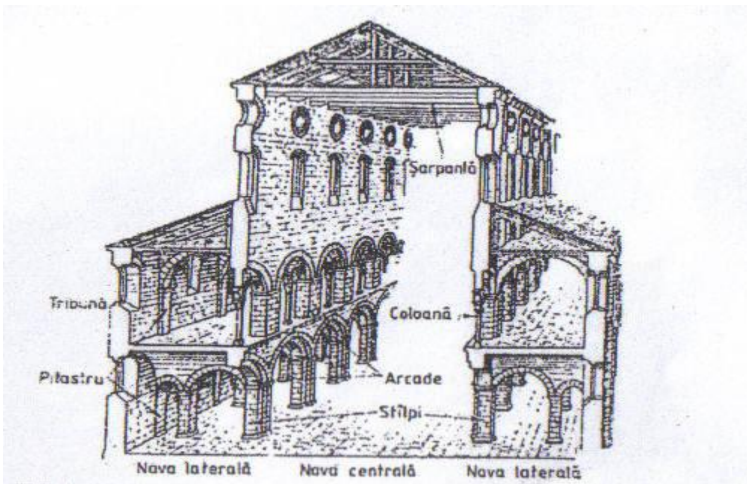


Fig 4.41 Byzantine Basilica

The main materials used in the Byzantine architecture were: brick and rock masonry for foundations, walls and arches, wood, tiles and led for roofs and coverings.

c) *The architectural craftsmanship* in Byzantine constructions can be illustrated better, starting from the principal Byzantine religious constructions: *churches.*

Byzantine constructors have reached a high technique in the realization of archways for covering large spans and have realized complex systems of archways (fig1.6) of the following types: on pendants, arches, trumps, domes, semi-caps destined for bearing large weights and transmitting them to the foundation terrain.

The volumetric compositions used for Byzantine churches:

- *Basilica* (fig 4.41), construction with three “naves” (a central one and two lateral) delimitated by columns with entablatures or with arches on piles. The central nave, higher than the lateral ones, received light from lateral windows above the lateral naves.
- *The domed basilica* – similar with the simple basilica, but with a dome above the central nave.

One of the most representative constructions of this kind is the famous basilica Santa Sofia from Constantinople, built between 532 and 537 by the architects Anthemonis from Tralles and Isidor from Milet, during the reign of the Byzantine emperor Justinian (fig 4.42).

Fig 4.42 Santa Sofia Basilica – Constantinople (recent view)

Basilica Saint Sofia is a monumental building of masonry, both by impressive proportions, but also by its remarkable interior space, which is covered by a dome with a diameter of about. 33 meters, situated at a height of 45 meters above the floor. The 4 svelte towers located over the general plan of the whole, were added afterwards, after transforming the Orthodox Church in a mosque.

The bright “ring”, consisting of 40 windows at the base of the dome (separated by reduced section embrasures), gives the viewer, from interior, a feeling of expansion of space and “floating” of the dome.

The expensive decoration (with gold mosaics and rare marble) of the walls, the corners, the semi-domes and the 107 stanchions emphasizes the grandness of the construction and strongly impresses the viewer.

The Central Constructions (central plan) – churches (basilicas) with an organized space around a vertical axes, corresponding with the centre of the vault or the dome centre. The canvas form of these constructions is orthogonal, or (in most cases) under the form of a *cross with open arms* (the San Marco church in Venice), or under the form of a *Greek cross* (the Saint Apostles church in Salonic).

These forms have resulted from the disposal method of the domes coverage and of the semi-cylindrical vaults in the general plan (square) in relation with the central dome.

As it can be noticed the cupola can be placed:

-in the *centre and in the axes* (arms) of the cross (San Marco church in Vienna)

-in the *centre and in the corners of the general plan* (the Saint Apostles church in Salonic)

The "three-cusped" constructions – achieved with the form of a central space, flanked with 3 apses, covered by the church tower or a dome.

In order to support vaults and arches the Byzantine architecture used columns with carved capitals decorated with oriental arabesques (intricate weaving in stone, with geometrical motives, representing plants or flowers)

Another characteristic of the Byzantine architectural construction is the tendency to use precious materials, mosaics and paintings, in order to obtain rich and gorgeous decorations of the buildings.

After [29], the Byzantine architecture over went 3 important periods:

- *early Byzantine architecture* (sec. V – VIII) characterized by “the search” for finding a style for their own local traditions.
- *intermediate Byzantine architecture* (sec. VIII – XIII) characterized by prosperity and growth of the construction principles and their means of expression.
- *late Byzantine architecture* (sec. XIII – XV) orientated mainly on the refined decoration of the exterior construction and characterized by a reduction in construction activity.

The Byzantine architecture had a great influence on the architecture of some neighboring countries and nations, because of the existence of the same type of religion in these regions – Orthodox.

Thus have appeared the real religious architectural “schools” of Byzantine type, in Greece, Serbia, Russia, Bulgaria, Armenia, Georgia and Romania, where they built many religious buildings, whose architecture combines, most of the time, the principles of Byzantine architecture with local traditional elements, conferring original architectural character to the buildings.

4.7. Romanic Architecture

Romanic architecture or EARLY MEDIEVAL architecture, [44], answered the needs of the Catholic religion and therefore appeared and extended in Western and Central Europe (France, England, Italy, Spain, Germany, Netherlands, Austria, Hungary, Poland and Transylvania), where the Catholic religion dominated between the sec. VI – XII.

Feudal relations occurred after the annulment of the Roman Empire and the important role of the Catholic Church in political and economic life, of those times, orientated the culture, arts handicrafts, and of course, architecture to a predominant purpose - to satisfy the requirements of the feudal masters and the Catholic church leaders.

But, inevitably the development of commerce and crafts has caused the emergence of some forms of education and of some cultural centers, thus leading to the formation of some great urban centers, which have established the future European cities of our times.

a. *Romanic urbanism* has been characterized by the formation of some urban centers (cities-strongholds), with powerful exterior fortifications, which were necessary for defense during the endless wars of conquest worn by the great feudal.

The need to group in small spaces in buildings has lead to the formation, in the enclosure of the fortress, of *unorganized street network*, with markets which have irregular form, surrounded by more important buildings, leading to cities without scheme rules. Buildings were located and targeted depending only on the available space and of the economic power of the owner.

b. *Roman functional programs* were determined by the component of social, political and religious life of the population.

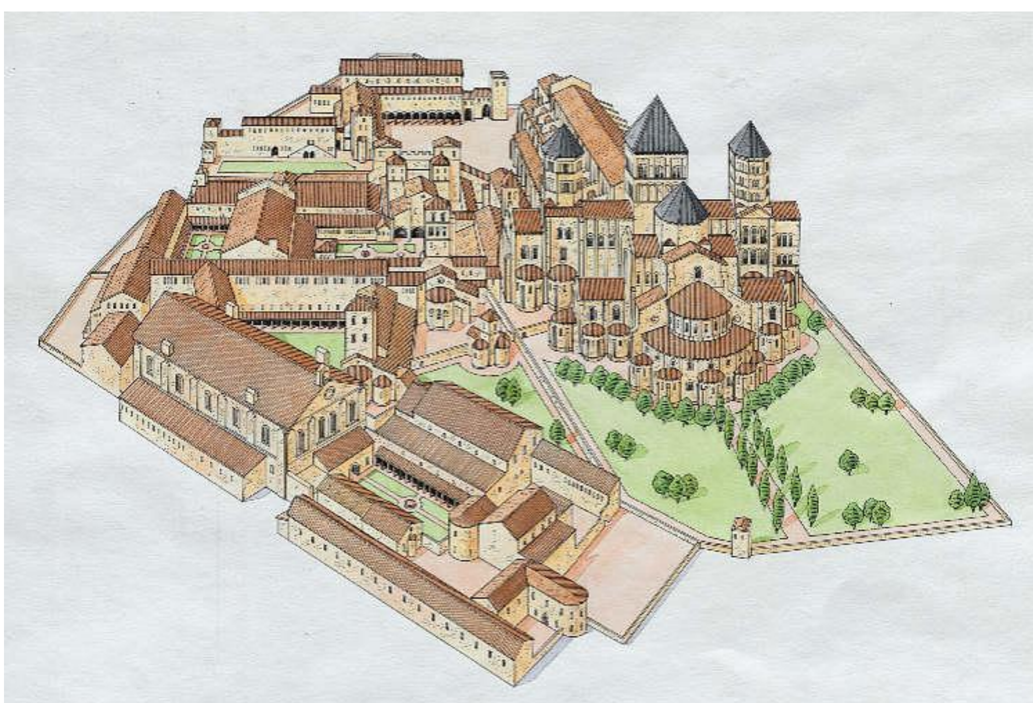
Housing – (relatively little known because of their disappearing), had overall conformation of town houses [29], with 2 or 3 levels, lined up along both sides of the streets, attached to one another and with shops at ground floor, handicraft workshops, household annexes and at the top floor the home owners.

The most commonly used constructive system was the wooden frame with masonry panels of stuffing.

Military constructions – have been one of the main principles during the roman period and consisted of strong *fortifications* around cities, consisting of massive walls of stone masonry, with high battlements and fortified gates, with swing bridges, defensive ditches filled with water, guard towers build with “mouths drawing” etc.

Fortifications – military constructions and also the residence of the local senior were constructed in the form of fortified enclosures, situated on the high parts of the relief to be easier to defend. In the center of the fortified enclosure, surrounded by annex buildings or dwellings of vassal, was situated the dwelling place of the senior, in a construction called *donjon or castle.*

The *donjon or castle* was a massive and powerful construction, fortified to be easier to defend, which also was the dwelling place of the noble and its servants and it was built on the highest part of the stronghold.



Monastery – religious constructions, housing different monk "orders", were also strongly fortified for defense and were sometimes made from large ensembles of buildings with different functions, organized around an interior courtyard : - the church, gathering rooms, library, dining room, household annexes etc.

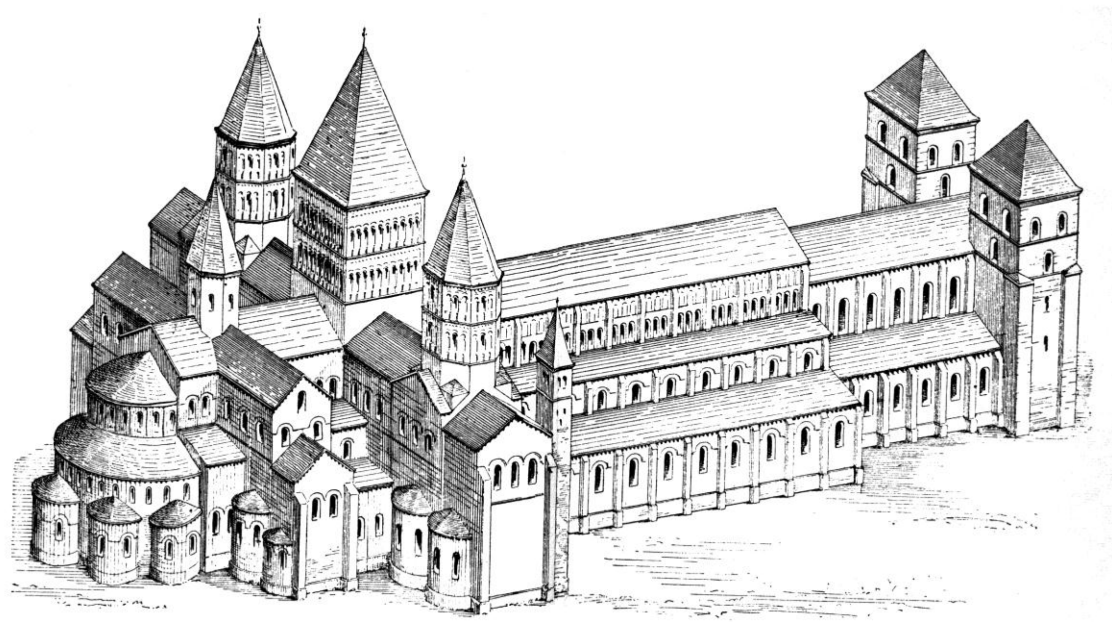
The Cluny Monastery (Burgundia, France) was founded in the year 910 at the initiative of senior Guillaume le Pieux and was strongly developed between the year 1024 – 1130.

It includes about 1039 buildings, the Cluny monastic complex along with the church monastery (Cluny III). It became one of the most important roman monuments of Western Europe and it played an important role in the formation of roman cult architecture.

Churches – built after the basilica type, the same as the independent buildings or part of large monastery ensembles were organized by functionally after the requirements of the religious Catholic ceremony.

Such a composition comprises the following Romanesque principle components (spaces):

- *Entry or narthex* (area in the church entrance) ;
- *Main body* made out of 3 (5 or 7) *nave* ;
- *The transept* (space before the altar) ;
- *The choir* (space for the church choir) ;
- *The altar* (sacred space, for church servants) ;



2. CLUNY (NO).

Around the altar were arranged small *chapels* with altars, to which access was through a side gallery called *perambulatory*, and under the main altar was a crypt containing relics and holy relic.

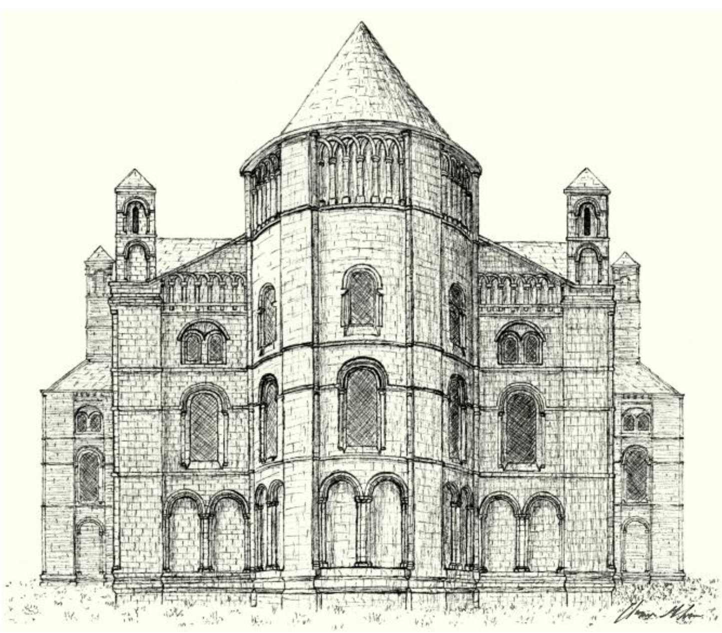
The plan of the principle church of the same monastery, an important construction, has a length of 187.5 meters, a maximum width of 36 meters, which has the main body divided by gates columns, into 5 spaces. Besides its impressive dimensions, the Cluny III church is the first western large church to be covered by a *cylindrical vault* over the main space and with *cross vaults* over the lateral spaces.

The chapels, where another type of religious constructions, small buildings, comprised of a core of circular or polygonal, covered by a dome on the walls or columns and surrounded by galleries.

The principal construction materials used for Romanic constructions were: *wood*, *stone* and *brick*, local materials which were procured more easily due to the relative isolation of feudal settlements.

c. *Architectural plastics* in Romanesque architecture is illustrated through a number of features, found mainly in religious architecture :

- use of constructive systems based on the use of walls, massive, heaviness, use of some covering systems of *wooden roof framing* type, strengthened with masonry arches, the type of longitudinal *semi-cylindrical arching* strengthened with arches, or the type of *sequence pendent domes*.
- separation of the lateral spaces from the central space (and between them) with rows of columns or pile of masonry.
- increased space lengthwise through continuous horizontal lines, ordered fluency through the archways into the altar, lighting by increasing dosage to the altar etc., everything destined to create a mystical and impressive atmosphere.
- using exterior *buttresses* to resist lateral movement which takes place when loads are transmitted to the ground from arches and vaults.
- boost volumes and their increase with impressive towers, high above the entrance or transept.
- severe and sober decoration of buildings with frescoes of religious character, with friezes and bay a*rching*, with groups of *biforium* and *triforium* windows and *carved portals* with a semicircular opening.
-



There are 2 Romanic architectural periods:

- *pre-Roman architectural period* (sec. VI – X) – characterized by a rudimentary technique, through a reduced constructive activity and slow evolution of architectural thought ;
- *Roman architectural period* (X- XII) – a period of prosperity, initiated in feudal France, where true *schools of roman architecture* appear in Burgundies, Province, Normandy.

Such centers or schools of architecture appear in Italy (Venice, Pisa, Florence, and Verona, Sicily), England (Durham, Lincoln), Germany, Poland etc. some influences of the roman architectural school were found in Transylvania.

Some of the most representative roman constructions, in addition to those listed above (*Dover Castle*, *The Durham Cathedral* in England, *The Cluny III* church and *Saint-Sernin* church in France) , may be considered the following :

- *Fontenay* monastery, *Carcassone* stronghold, St. Front – Perigueux, St. *Foy* – Conques, *St. Trinite – Caen, Saint Martin du Canigou monastery, St. Philibert – Tournous,* etc. (*France*)
- *San Vitale – Ravenna, San Zeno – Verona, San Miniato al Monte – Florence*, religious complex in Pisa, The *Monreale Dome* etc. (*Italy*).
- The chapel from *Aachen*, the cathedral from *Speyer*, the Saint Michael monestry a. s. (in *Germany*)
- The cathedral from *Lincoln*, *Harlech* castle – *Wales* a. o. (in England)
- The *Saint Gall* monastery (in *Switzerland*) a.o.

4.8. Gothic Architecture

The gothic architecture is considered to be a true *assembly of constructive methods and decorative means*, having at its base the elements of romantic architecture from France and it is a continuation at a superior level of the schools and principles of architectural creation that were found in the catholic religion service.

As a consequence, the spreading area of the gothic architectural style (current) was approximately the same as the one of the romantic architecture (Central Occidental European Countries).

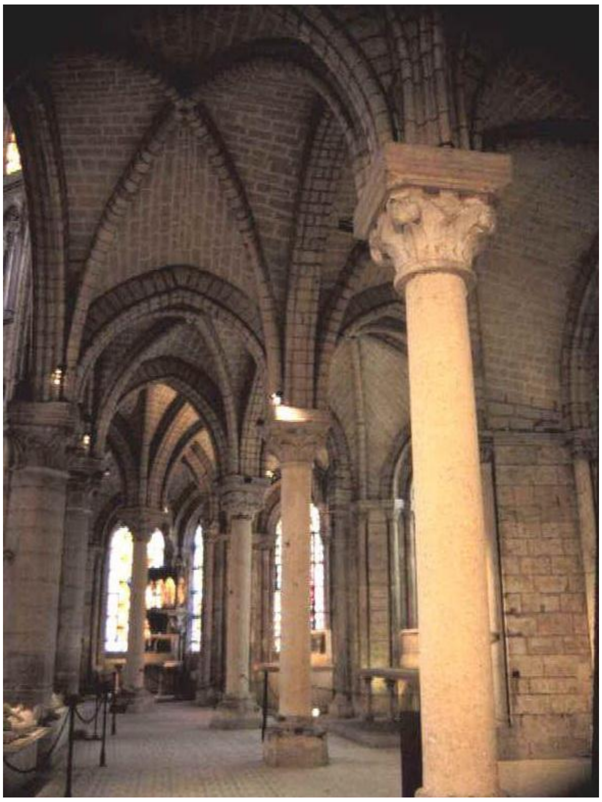


Fig 4.50 – Interior Saint – Denise church – France

L.M. Roth states that the gothic architecture was initiated by Sauger, the abbot of the Saint – Denis monastery (north of Paris), in the year 1141, when, to bring some improvements to the old romantic church, he included in the roofing of the buildings, "*sharp" arches* and *ribbed vaults*, basic elements of the future gothic style which illustrates with clarity something new in architecture and the penetration of the rational thinking in the construction techniques.

a. *Town planning* in the gothic architecture is characterized through the same elements of the late romantic urbanism, the cities being organized according to the same criteria, economical and functional, having the same strategic defense character and the same unordered street textures with irregular shaped squares.

b. *Functional programs*, they were just a few, having ion mind the orientation of the gothic style with predilection towards the religious constructions.

The houses – realized after principles similar with the ones of the romantic houses, developed on 2 or 3 floors, having at the first level shops or workshops, and at the second level the living space of the owner.

Because the buildings were built usually with common walls, the light entered in only through the façade, and through an interior courtyard, and the constructive system most used is the one with wooden skeleton, with filler masonry.

The rich houses had the aspect of small palaces, with thick walls, round towers and roofs with very steep slopes.

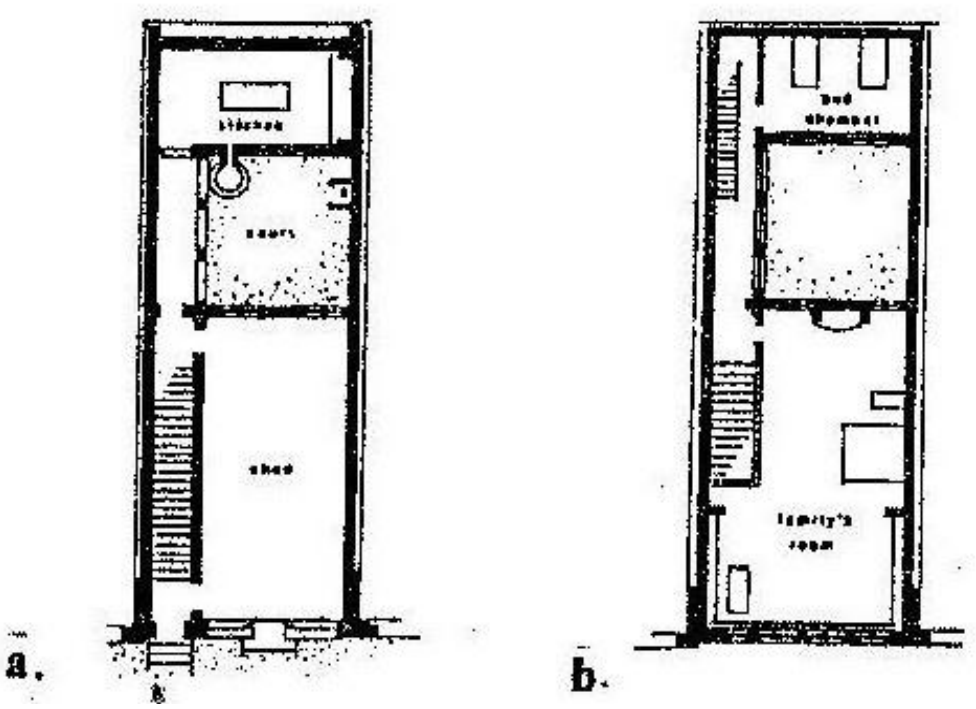


Fig. 4.51 – Example of gothic house
a – ground floor plan *b – second floor plan*

Military constructions – are represented by different systems of fortified constructions (castles and fortresses), realized on the same principles as the ones presented at the Romanic architecture. In the gothic architecture period an interest for the growth of comfort appears in the castles and fortresses but still keeping the strategic character of defense.

Religious constructions – convents and churches are representative buildings of the gothic architecture, but the basis of a new kind of church are put, greater and more imposing – the cathedral.

The cathedral has developed after a “basilica” system with 3, 5 or 7 ships, or branches, like in the romantic architecture, the big difference being in the style and the systems of covering of the interior space.

So, instead of the domes and cylindrical arches used in the Romanic architecture, at the gothic buildings heavy *crossed arches* appear, with panels and with arch ribs of the shape of the *broken arch*, that rest on *piles*.

From the functional point of view, the crypt disappears, and the transept is reduced, and the vestibule more robust sustains the towers which usually encloses the façade.

In fig 4.52 a principal façade is presented and a vertical section of the central body of the famous Notre – Dame de Paris cathedral, built between the years 1163 – 1345, in several stages.

The basilica construction has 5 ships and a capacity of about. 9000 persons, the building is impressive because of its dimensions (129 m length, 48 m wide, 69 m the height of the towers), but mostly because of its proportions harmony, the rich and elegant ornamentation and because of the purity of the architectonic line.

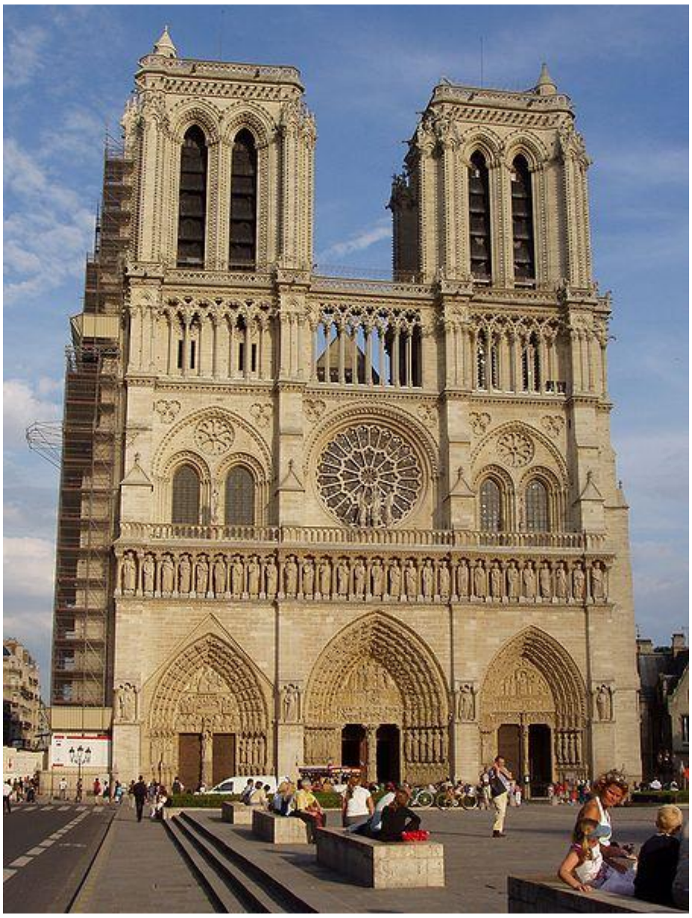
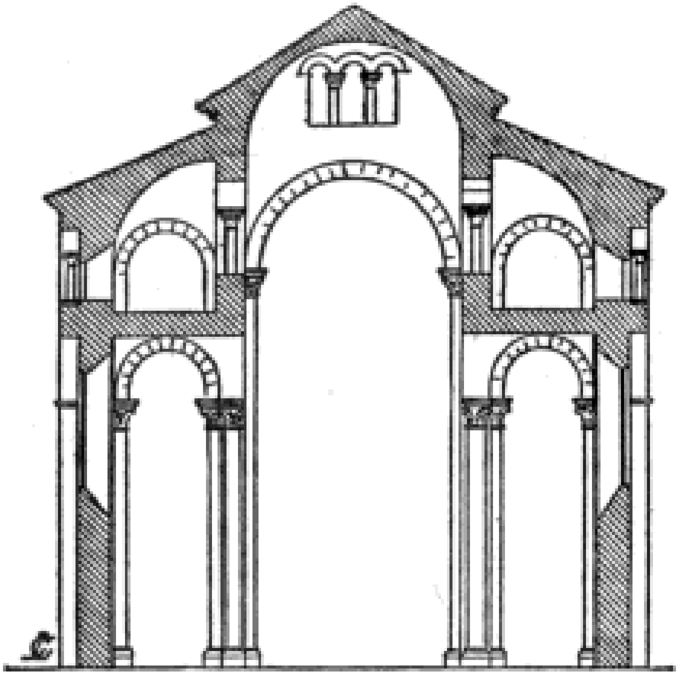


Fig 4.52 – Notre Dame de Paris cathedral



Notre Dame due Port cathedral section

Fig 4.53 – Notre Dame de Amiens cathedral

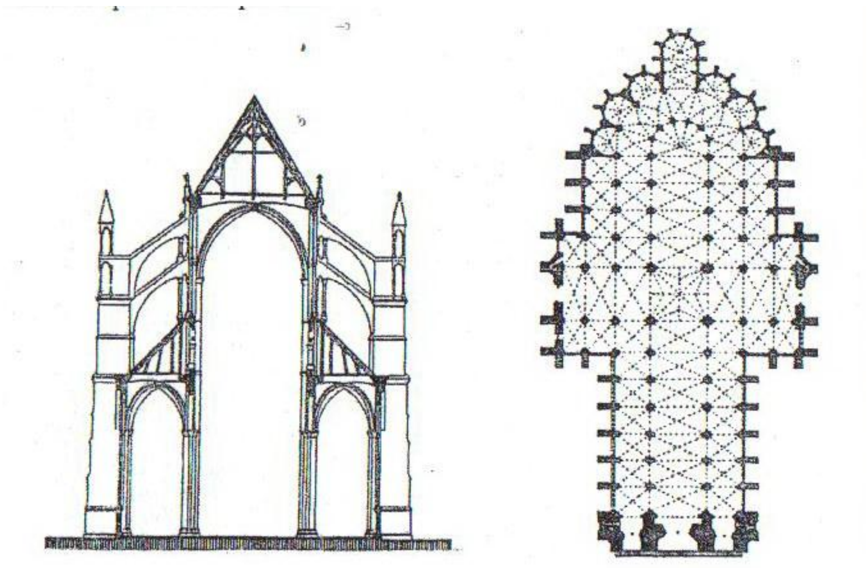


Fig 4.54 – Notre Dame de Amiens cathedral (section and plan)

Another beautiful representation of the gothic architecture in France is the *Notre – Dame de Amiens* cathedral, built between the years 1220 – 1269. With impressive dimensions (118 m length, 59 m wide, and 42 m height of the central ship) the cathedral presents a particularity through the fact that it is the first one at which for the covering of the central square of the central ship, the *star arch* was used.

Besides the Notre – Dame de Paris and the *Notre – Dame de Amiens* cathedrals, in France, where "schools" of gothic architecture appeared, some other impressive cathedrals were built, each one having the general gothic characteristics, but in the same time also some particular features.

In France the cathedrals from Sens, Charters, Reims, Poitiers, Beauvais and Rouen and others were built.

The gothic architecture is very well represented by the cathedrals or public buildings (city halls) in other countries. As follows:

- In *England* – where the gothic evolves passing through some stages (the "decorative" gothic, the "perpendicular" gothic – creator of the "Tudor style" influenced by the renascence architecture) a series of important gothic constructions are built: - the cathedrals from *York, Salisbury, Wells, Lincoln, Exeter, Gloucester, Canterbury*, a. o.
- In *Germany* – the cathedrals from *Colonia, Marburg, Ulm* a.o.
- In *The Lower Countries* – the cathedral from *Anvers (Belgium)*, the town halls from *Louvain* and *Bruges (Belgium)* a. o.
- In *Italy* – the cathedrals from *Milan* (the dome of Milan), *Sienna, Florence*, the abbey from *Fossanova* (near Rome) a. o.

Besides these impressive gothic buildings, most of them with a religious character, in many countries a series of administrative constructions were built, palaces, villas a. o. which use the shapes specific to the gothic architecture.

c. - *The architectural plastics* in the gothic architecture contains a sum of characteristic elements connected with the constructive system and also with the volumes and shapes plastics, and with the interior and exterior decoration style.

The most important elements of the architectural plastics which characterize the gothic construction architecture are:

- ❖ The utilization of the 'prevailing', through the prevailing of the whole town by the monumental silhouette of the gothic cathedral.
- ❖ The tendency of rising of the constructions through the shrinkage of the section of the sustaining elements (piles, columns), through the emphatic raising of the central ship compared with the lateral ones, and the emphasis of the verticality through the decorating style of the interior and the exterior of the buildings.
- ❖ The use of the *crossed arches,* with panels that rest on *ribs* of the shape of *broken arches called* in general *pointed arches.*

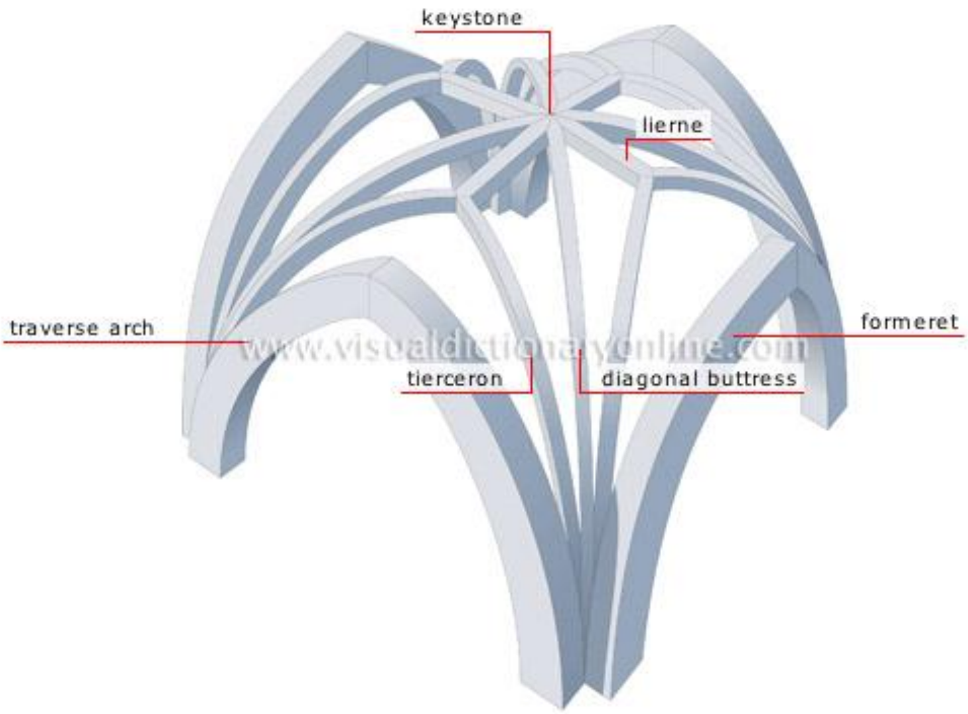


Fig 4.55 – Types of gothic arches

Remark:

The positioning of the pointed arches in many styles, led to the realization of some different types of gothic arches, their difference depends on the number and the position of the pointed ribs and in consequence of the panels of arches.

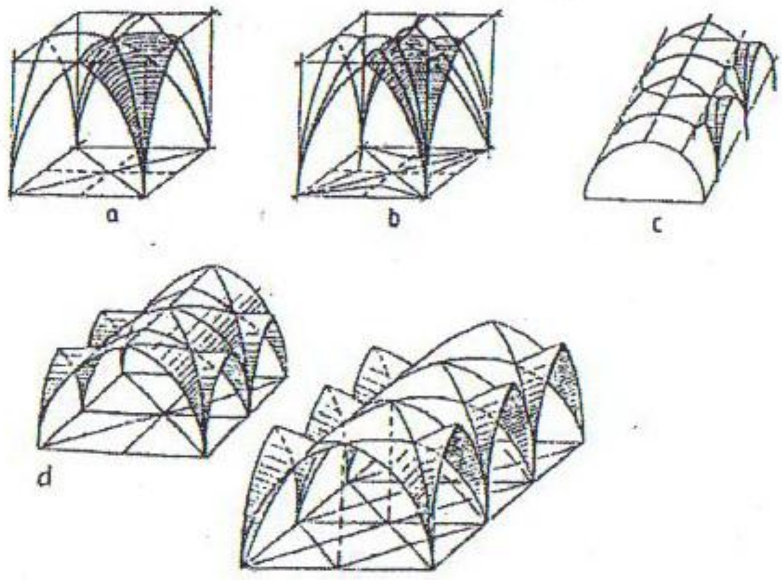


Fig. 4.56 – Types of gothic vaults
a – crossed
b – star-shaped
c – mesh type

d – with multiple penetrations

- The taking over of the lateral pushing forces given by the arches through the use of the flying buttress arch, which transmits these forces to the exterior buttress .
- The gradual reduction of the exterior walls in the favor of some large hollows (*strained-glass* window surfaces), closed with valuable multicolored *strained-glass* window (hollows with circular shapes – *rosettes*, or rectangular shapes with the lintel in a broken arch shape – *pointed arch*)
- The use of some rich exterior ornamentation of the buildings, with different height towers, with sculptures representing religious and laic figures or with representations of some bizarre fantastic beings, combinations of elements with human reasons, animalist and floral, anthropomorphous and zoomorphic.

Fig 4.57 Gothic vaults (interior sight)

The construction materials used mostly in gothic buildings were (like in the case of the romantic architecture): *stone* masonry or *brick* masonry, wood, *glass, ceramics, marble* a. o.

All this constructive and architectural elements presented before, offer to the gothic architecture the character of a *bold* architecture, *logic* and *highly expressive* and it places it in the architectural currents with one of the greatest influences in the universal architecture and with the greatest number of representative edifices kept in function (mainly religious).

The gothic architecture had an influence on the territory of Romania also, where a series of constructions (catholic cathedrals and churches), built after the gothic architectural system and containing a series of elements characteristic to the gothic architecture (*The Black Church* in Brasov, the *Saint Michael* church in Cluj a. o.)

Fig. 4.58 – Charters cathedral – detail

4.9. The Renascence architecture

'The Renascence' represented a true cultural and ideological phenomenon, which appeared in Italy in the XV-th century, and which got to such a great amplitude in the Occidental European countries in the XVI-th century that sometimes was interpreted as a true historical 'period' with special characteristics in all the social and economical life domains of the society.

The Renascence 'current', characterized in a word by *progress,* has manifested in all the societies components, in science and technology, in philosophy and culture, but mostly in art and its components.

Evident, the time architecture was strongly influenced by the 'renascent' thinking of laic orientation, contrary to the medieval theological principles, and the source of the renascence architecture is the roman antic architecture, which outlined some *characteristic principles* after which the renascence architecture developed:

-the proportions and the architectural volumes harmony;

-the use of architectural orders for creating the constructions' "personality";

-the purity and clarity of the architectural forms;

-a report to the human scale of the volumes and dimensions.

Fig. 4.59 – Rotonda Villa – Vicenza, Italy [29]

a – *The Urbanism* in the Renaissance age was strongly influenced by the urban elements from feudal times; - the random street network, big groups of buildings placed by functional and economical criteria, or around the church or city hall, etc.

The aspect of the Renaissance town doesn't undergo heavy changes, although some dominant "accents" occur due to the construction of impressive church arcs, but with the emerge of some architecture "schools" placed around European cities' prominent artistic personalities, the cities enrich themselves by a series of public or private monumental constructions, specific to the Renaissance age.

b – *The functional programs* in the Renaissance age are more diverse, and they are lead by the society's progress and necessities.

The villa, as the rich man's "country residence", had a large variety of forms, plans and architectural compositions in the Renaissance age, pending on the owner's economical possibilities and the architect's skill. Some famous Renaissance villas represent outstanding architectural achievements (examples: Rotonda Villa near Vicenza, Italy, work of the architect Palladio, fig. 4.59 [29]).

The palace and *the nobleman's castle*, one of the very diverse programs of the Renaissance by functionality and façade graphic and volume point of view, has some common characteristics though:

-the relatively simple general plan, polygonal shaped;

-the rooms placed along some inner grounds, along one or two symmetry axes;

-the inner ground surrounded by *porches* on columns;

-the facades made by rhythmical alternations of fills and blanks.

In the Renaissance architecture peek (especially France), the palaces have become monumental building ensembles, made of several parts, with broad "wings", several honor-yards and monumental gardens (example: *Medici Palace* – Florence, Italy – fig. 4.60, built by the architect Michelozzo di Bartolommeo).

Fig. 4.60 – Medici Palace – Florence, Italy

Within the bunch of famous Renaissance palaces the following may be included: -*Rucellai palace* of Florence (arh. Alberti), *Vendramin palace* of Venice, *Cancelleria*, *Massimo, Farnese, Senators, Conservatives palaces* of Rome, *Valmarana* and *Chiericati palaces* of Vicenza, *Chambord, Chenouceaux, Anet castles* and the impressive *Louver, Tuilleries* and *Versailles palaces* of France, etc.

The city halls – ensembles of public-administrative buildings, built after symmetry-axes-built plans, having the council chamber as composition center (examples: city halls of *Augsburg* and *Nurnberg* – Germany, *Seville* – Spain, *Anvers* - Flanders, *Leyda* – Holland).

Educational buildings – constructions of theological school type, they were ensembles of buildings built under the guidance of the churches and monasteries and administrated by them as well.

Charity establishments (hospitals and orphanages) – constructions made after plans with one or more inner grounds, necessary both for the natural illumination of the inner spaces and to offer resting and recreational spaces away from the city excitement.

Religious programs – remain the best represented functional programs in Renaissance architecture, due to both form diversity and volume, and architectural plastic elements, characteristic to the Renaissance conceptions.

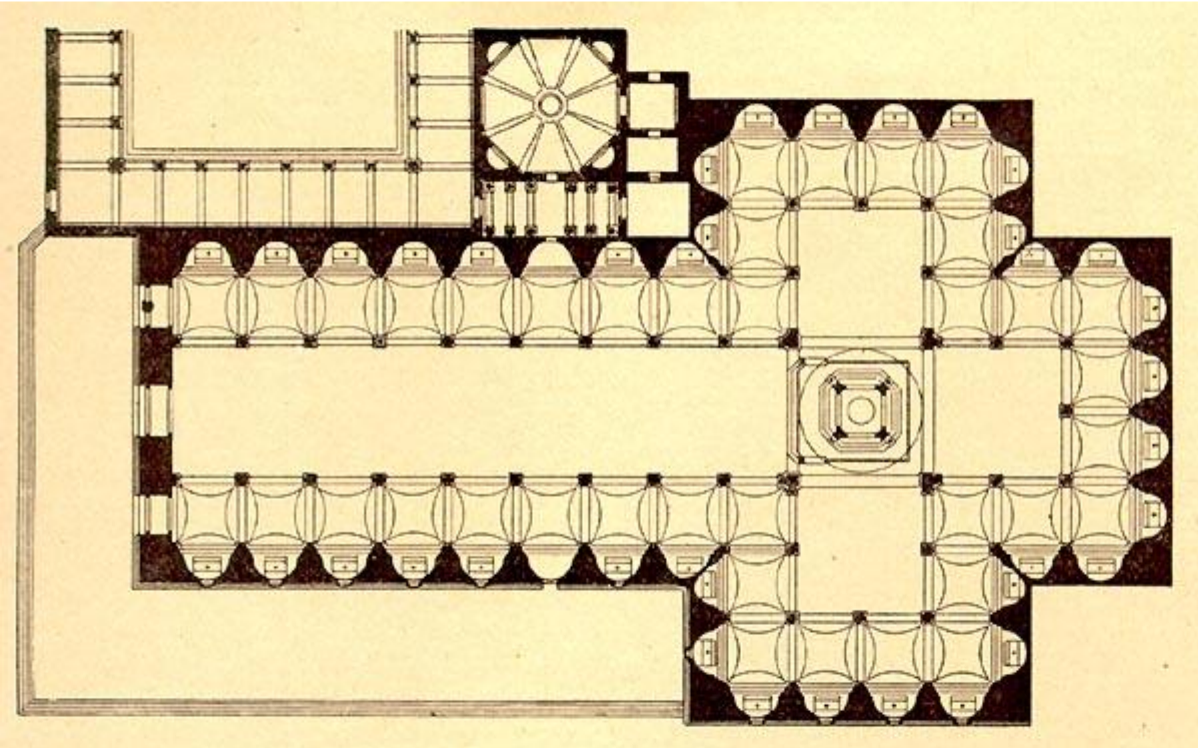


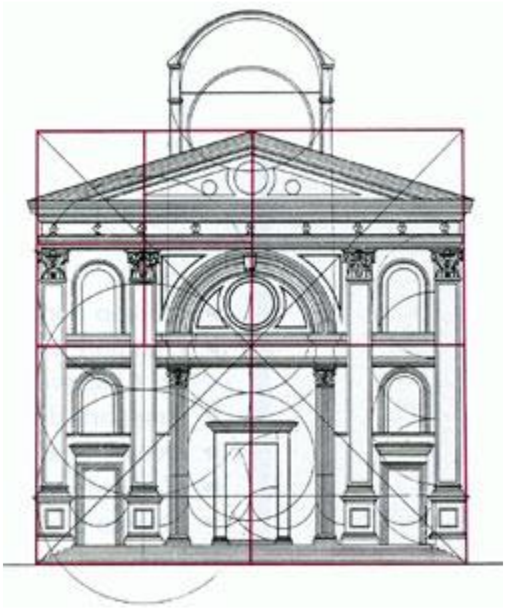
Fig. 4.61 – General plan of Renaissance churches

The Renaissance churches were generally built in 2 ways:

- *central plan churches*, having a general Greek cross (fig. 4.61. a) or polygonal (square, circle, polygon, etc.) plan form, and having a central dome;
- *Basilica churches*, Latin cross shaped, generally having three naves (one central and two laterals) and a dome at the intersection of the main nave and the transept, following the Christian church model.

To exemplify, from the wide variety of churches built in the Renaissance age, in fig. 4.62, the plan and a view of the main façade of the Saint Andrea of Mantua church – Italy – is presented (basilica church).

Fig. 4.62 – Saint Andrea of Mantua church – Italy
(Plan and façade)



Of all the central plan churches, one of the most impressive (maybe the most original and the most important catholic religious construction) is *Saint Peter Cathedral of Rome* (San Pietro – see fig. 4.63, 4.64, 4.65).

Started in 1506, after the project of the architect *Donato Bramante* (fig. 4.63.a), Saint Peter basilica is continued starting with 1547 after the project of the great *Michelangelo* (fig. 4.63.b) and it is finished in 1612 after the plans of Giacomo della Porta and Carlo Maderna.

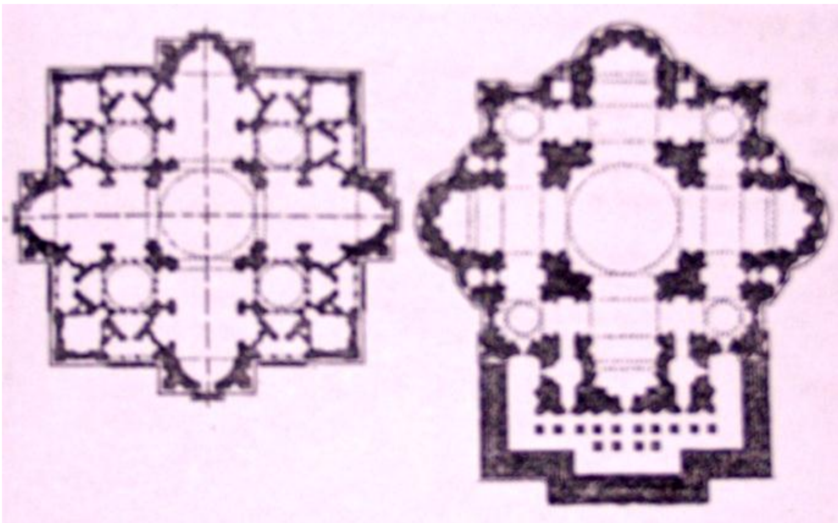


Fig. 4.63 – St. Peter Cathedral – Rome [51]
Bramante's (a) and Michelangelo's (b) blueprints

St. Peter cathedral in Rome is part of an architectural monument ensemble along with San Pietro square of Rome (fig. 4.64), ensemble which was executed in several stages (fig. 4.65), construction to which contributed several architects and construction workers, as architect Bernini, who designed the great elliptic colonnade (with four rows of porches) of San Pietro square.

The basilica cathedral San Pietro, with a built area of 15,160 square meter and a maximum height of 143 meters (having the dome height of 119 meters and the interior diameter of 41.47 meters), is a grand monument, a Renaissance architecture masterpiece and the largest church in the world, being one of the constructions that strongly influenced that time’s architecture and even next centuries’ architecture.

The basic *construction materials* used in the Renaissance architecture were *stone* and *brick* masonry for the bearing elements (walls, foundations, poles, counterweights, arcs, pins, etc.), *wood* (for floors, roofs, etc.), *ceramic tiles* and *metallic plates* (for coverings).

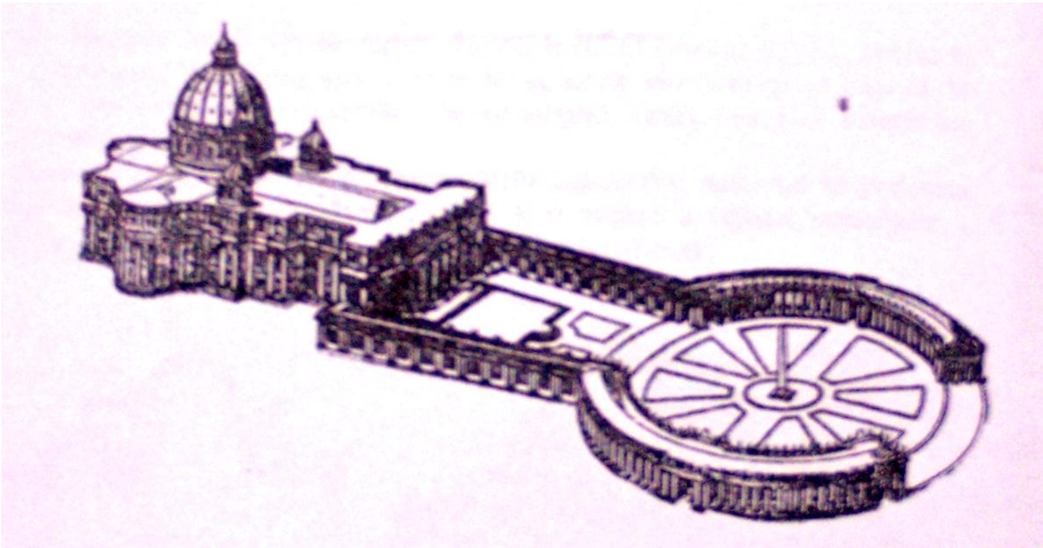


Fig. 4.64 – St. Peter Cathedral and Bernini’s Colonnades - Rome

c – *Architectural plastics* in the Renaissance age were strongly influenced by the European countries' local traditions, but present a few general common characteristic elements:
-the ensemble's form, clarity and construction detail and built space allowance in relation with human dimensions;
-the harmonization of the buildings' proportions and component elements between them and with the surrounding environment;
-the replacement of the gothic vertical elements with the horizontal line, the horizontally expanded plane;
-marking the city figure with dominant elements: - church domes (lighter elements with large openings);
-the increase of the architectural elements' "mobility" by light and shadow alternation and by volume styling;
-the increase of the building's interior comfort through enhanced functionality, by ensuring the equilibrium of space and human body proportions, by interior space modulation and "discipline", by the superior technique of building decoration;

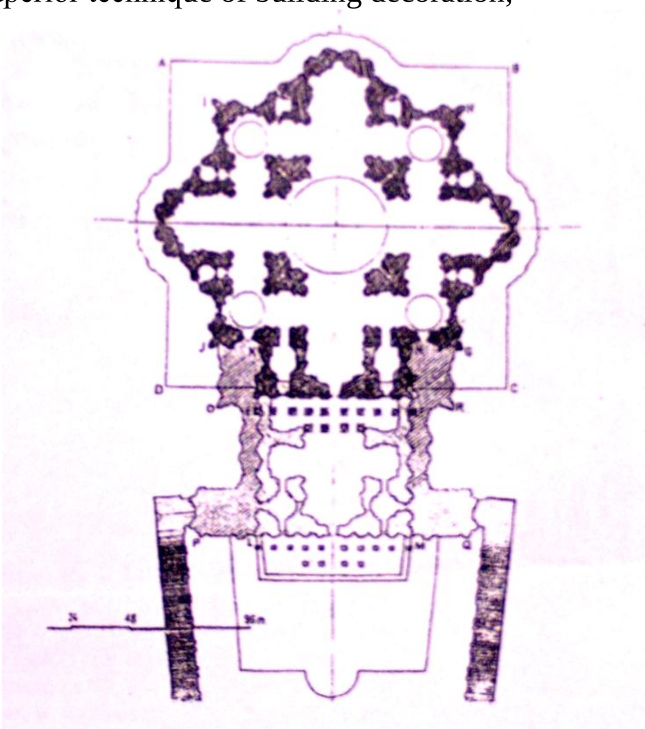


Fig. 4.65 – Evolution of the construction of St. Peter cathedral in Rome [51]
ABCD – Bramante's prject; EFGHIJ – Michelangelo's project; KLMN- Fontana's project; OPQR – Maderna's project

-introduction of *the classic order* (see chapter 4.4.2), and the architectural orders in construction decoration technique and adapting them to the specific architectural forms;

-the use of some various decorative elements: - stone and marble inlays with colored drawings, enameled ceramic elements (terracotta), figurative sculptural motifs, painted panels surrounded by moldings (announcing the baroque style),etc;

-relating the built space with the exterior by constructive elements such as *porches* (fig. 4.66) *galleries* or *loggias*, which allowed the "grading" of the interior-exterior passing and provided personality and privacy to the inner grounds, squares and gardens, adding an open and balanced character to the architecture;

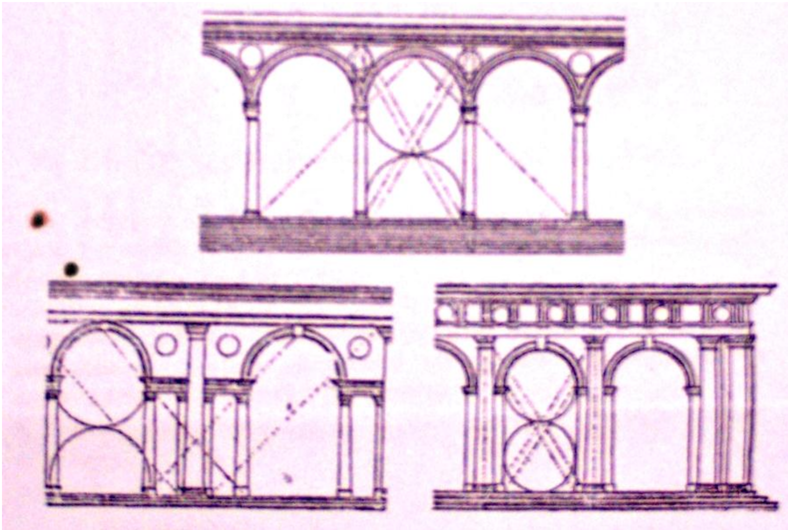


Fig. 4.66 – Renaissance architecture porches

All of these Renaissance architecture characteristics underline its ongoing general content, based on ration and desire of beauty.

Renaissance architecture has encountered specific development periods in different European countries (Italy, France, Spain etc.), where true Renaissance "*architecture schools*" appeared, where marking personalities established, which remained in the world's conscience by exceptional architectural creations.

In ***Italy*** for example, Renaissance architecture, during its evolution, has know 3 large periods of time [24]:

-*early Renaissance* (*QUATTROCENTO*) – between 1420 and 1500, developed in central and northern Italy, characterized by style "searches" and divided into three schools:

- *Tuscan school* (in Florence) – where some architects may be singled out: *Ghibert, Bruneleschi* (Santa Maria del Fiore Cathedral, The Florence Dome, Pazzi Chapel, Ospedale degli Innocenti), *Michelozzo di Bartolomeo* (Medici Palace – Riccardi), *Alberti* (Rucellai Palace), etc.;
- *Lombard school* (in Milan) – represented by *Donato Bramante*;
- *Venetian school* (Veneto region) – Mauro Caducci, Bartolomeo Buon, Pietro Lombardo (*Vendramin palace* – fig. 4.67.a), etc.
- -*The climax of Renaissance (CINQUECENTO)* – between years 1500-1550, when the center of architectural creation is Rome with its highly expressive structures.
- In this period Bramante begins the building of Vatican's ensemble of monumental squares and buildings (San Pietro basilica), and Michelangelo designs Saint Peter's Cathedral dome, Capitol's square, the Medici chapel and other outstanding architectural works in Rome.
- -*The late Renaissance (MANNERISM)* – between years 1550-1580, when Italy's architecture does not evolve artistically, the procedures of the predecessors are taken over and the first signs of baroque architecture show up. Giacomo de la Porta, Vignola, Giorgio Vasari and Andrea Palladio (which put an accent on architectural expressiveness by taking over the classical forms and giving up on the futile decorations in favor of increasing the compositional variety) count among the remarkable representatives of this period.

Fig.4.67 – Examples of palaces in Renaissance architecture

a) – Vendramin palace in Venice;

b – Louvre palace in Paris (partial view – drawn after [4])

One of the domains in which MANNERISM has excelled in Italy was that of designing and laying out the palace's and villa's *gardens* built in the Renaissance period, therefore that of the "landscape" architecture.

Renaissance gardens, inspired by the pioneer's description (Cicero, Scipio, Pliniu the Young) parceled out in geometrical sections with systematized alleys, exploiting the configuration of the terrain and decorated with ornamental fountains and basins, represent remarkable works of renaissance landscape architecture (ex.: -Villa Lante-Bagnania gardens, Villa d`Este-Tivoli gardens, etc.).

In ***France***, renaissance architecture also greatly evolves, at some time after the Italian renaissance period.

Starting with the Italian Renaissance principles, the French School of architecture takes the path to *classicism* and goes trough three distinctive periods [29]:

1. *Early Renaissance* (1500-1540) – the period in which the construction of the castles on Loire's Valley begins (Characteristic to this architectural period is the well known Chambord castle).
2. -*The French National School of Renaissance* (1540-1640) – represented by Pierre Lescot (who begins the construction of Louver – fig. 4.67.b), Jean Goujon, Philibert Delorme, Jacques Lemercier, etc.
3. -*The French Royal Classicism* (1640-1715) – characterized trough refined architectural elements and exceptional accomplishments in landscape architecture. Finalizing Luvre, the great Tuilleries and Versailles complexes (fig.4.68), the Victoria and Vendome squares in Paris, the Invalid's Dome, etc. represent only a part of the accomplishments of the architects of the French Renaissance period (Jules Mansart, Le Vau, Claude Perrault, Le Brun, etc.).

Fig. 4.68 – Versailles Castle and park

Renaissance also had a significant influence over the architecture in other European countries, starting from the XVI-th century, where taking over local elements, it generates a new type of architecture with traditional characteristics.

Therefore, among the most well-known creations, influenced by the renaissance architecture in the 16th – 18th century Europe there can be mentioned:

-in ***Spain*** – The Seville *Mayoralty*, The Salamanca *University Cathedral*, *Carol Quintus* and Palace in Granada, *The Escorial* in Madrid;

-in ***Holland*** – *The Justice Palace* in Burgess, The Anvers *Mayoralty*, The Leyda *Mayoralty*;

-in ***Germany*** – Augsburg *Mayoralty* in Nurnberg, the *castles* in Heidelberg and Aschaffenburg;

-in ***England*** – *Wallaton-Hall* in Nottingham, *Hatfield-House* in Herefordshire, *Whitehall* in London.

Certainly, Renaissance also influenced the architecture in other countries, further away from its place of origin, such as Russia, Poland, Romania (examples: *Haller House* in Sibiu, *Cris Castle, Fagaras Castle, "Magna Curia" Castle* in Deva, etc.).

Sometimes the influence of renaissance manifested in the general composition of a building ensemble, but mostly the elements that characterized this style were those of plastic decoration (portals, windows, doors, etc.).

Renaissance architecture is considered as an architecture "*of human ideals*", due to the fact that it is *rational*, makes use of shapes, plans and volumes organized according to human proportions and requests (human scale) and more importantly, using with clarity and ration the classical architectural elements (columns, entablatures, arches, etc.) it manages to respond to the human desire for beauty.

4.10 BAROQUE Architecture

Baroque, as a style or complex artistic tendency shows up at the end of the 16th century and it was founded by the prestige of the Catholic Church and its desire to impress trough the realization of great architectural ensembles.

Baroque architecture has been foreshadowed ever since the renaissance period, in some western European countries (Italy, Spain, Germany, France, etc.), but in contrast with renaissance architecture, which was characterized trough the clarity and uniformity of the detail elements , baroque is characterized trough *complexity, ambiguity, variety,* and *contrast.*

If in painting and sculpture baroque imposed itself trough impressive creations which had religious themes (miracles, apotheosis, and ecstasy), in architecture baroque means abundant decoration, rich plastic processing, and excessively making use of curved lines and lights and shadows effects.

a – *Urbanism* in this time was characterized by a few elements which can still be found in the conception of big urban congestions:

- optimum exploitation of the configuration of land;
- usage of lines and curves in the conception of ensembles built and laying out exterior spaces (gardens, markets, parks);
- usage of rich decorative elements in interior and exterior spaces (fountains, groups of statues, etc.).

In the 16th – 17th century Rome is (from the point of view of urban layout) a classic example of a city built and organized under the influence and after the town-planning principles characteristic to baroque.

b – *Functional programs* in this time resemble those of the Renaissance period and are extremely diverse: - social-administrative and cultural building ensembles, palaces and castles, churches and cathedrals (achieved after the same principles – churches on a central plan and basilicas with domes – just like Renaissance architecture).

c – *The architectural design* in baroque architecture has been influenced by the taste for complex shapes, which are not linked to the content, presenting a certain coefficient of irrationality.

←

Santi Vincenzo de Anastasio church (Rome);

→ San Carlo Church (Rome)

11. Oppolding, St. Johann Baptist, high altar by Matthias Fackler (1764). The marbling of the altar with its representations is the work of Georg Andrä and his son Franz Xaver Zellner.

Fig. 4.71 – Baroque interior (Priory-Church, Rohr, Germany)

The first architectural forms specific to baroque are characterized by:

- Rich processing of the façade design and the use of towers , parapets, attics decorated with pilasters) etc. all these generating an emotional impact over mankind (fig. 4.69);
- Putting accent on the verticality in an artificial manner, trough fake towers and parapets, or by building some elliptical or circular domes (fig. 4.70) in plan;
- Using a few elements of architectural design – curves and counter-curves, of alternation of materials and different colors that “mask” the structural system trough mobility and sometimes shocks the viewer and tires his eyesight;
- Excessive decoration of interior spaces and the realization of a strong expressive force of these spaces by using multicolored structures, golden bronze, marble, colored sculptures and frescos, all exploiting light effects and generating a festive and scenic setting (fig. 4.71)

Fig. 4.70 – Baroque dome (Santa Maria Della Salute church – Venice)

As in the case of Renaissance architecture, Baroque architecture has greatly evolved in some western European countries, in which valuable ensembles of baroque structures have been built.

In ***Italy***, for example, baroque architecture can be split into three main periods [29]:

- *Early baroque* – in the 1580s – 1630s, when Italy imposes itself with a new architectural style based mainly on the evolution of decorative design;

- *The climax of Baroque* – in the 1630s – 1700s, period in which architectural characteristics grow mature suggesting elegance, refinement and adopts a pompous style.

During this time Carlo Maderna and later on Giovanni Bernini finalize the building ensemble in San Pietro square in Rome (fig. 4.72) by extending the Cathedral's plan and respectively enclosing the square by use of a portal system (a colonnade made out of four rows of columns, linked trough a common entablature having an attic decorated with numerous statues (see fig. 4.64) which generates an effect of perspective to the ensemble.

-*The late Baroque* – in the 1700 – 1760s, when the character of architecture becomes more sober and conventional, prefiguring classicism.

Fig. 4.72 – San Pietro square ensemble - Rome

-In ***France***, baroque in architecture has been less outlined, having a better approach on classicism through the sobriety and rationalism of the ideas.

On the other hand, a new decorative stile is outlined – *ROCOCO (ROCAILE)*, which offers grace, elegance and fineness to the interior spaces, trough delicate ornaments, by intensively using curve shapes, mirrors, doors and windows with large openings, etc.

The direct connection between the interior (villas, palaces, hotels) and exterior (gardens and private parks) spaces by the use of numerous tall doors and windows (fig. 4. 73) and trough elegant terraces open to the exterior, give Rococo an open, bright, fresh character and a lot of elegance.

The Rococo stile marks the end of Baroque in France and spreads in some of the neighboring countries (Germany, Italy, Austria, etc.).

Baroque architecture also manifested in the other European Occidental countries, adopting some local characteristics.

Fig. 4.73 – Rococo interior

Therefore, it can be shortly emphasized the fact that:

-in ***Germany*** and ***Austria*** baroque manifested especially in religious functional programs but also in the construction of palaces;

-in ***England*** baroque had a romantic character;

-in ***Belgium*** and ***Holland*** baroque imposed itself in the construction of some public edifices (example: *Amsterdam Mayoralty*);

-in ***Spain*** baroque architecture presented two tendencies, one oriented to classical compositions (The Royal Palace in Madrid) and the other oriented to abundant decorations, with particularly Spanish elements (*Salamanca Town Hall*).

Baroque architecture is considered "*the architecture of invention and creation*" but it used a lot of elements of "artificial" plastic architecture (space and shape modeling, light effects, shiny coloring, decorative details that impress humans, etc.), elements which do not only give no importance to the building's structural system, but it dimes it most of the time, making it the second priority.

This character has sometimes imposed [44] the idea that baroque architecture is architecture of finishing and not of structure.

4.11 Classicist Architecture

"***Classicism***" was a current in the European art and culture of the XVII-th and XVIII-th centuries, characterized through the *discipline of the imagination and sensitivity* in the advantage of ration and of the interest for truth and natural.

In architecture**,** classicism manifested by having the tendency to accomplish harmonious ensembles, in which beauty and rational would coexist in a stable system, realized by strict rules based on order, clarity, balance and perfection of shapes.

Starting from taking some models from classic Greco-roman architecture and adapting them to the requests of a dynamic society in continuous change (conflicts between feudal and bourgeois society), classicist architecture prefigures from the second half of the XVI-th century in Italy, in some of the accomplishments of the late Renaissance artists and evolves in the western, central and eastern European countries once the "revolutionary" ideas penetrates the art and culture of these countries.

Classicist architecture has obviously been influenced by the philosophy of time, which militated in favor of replacing the old feudal society, with a new society, a rational one, based on spreading culture and "light" among the people (philosophical tendency of "*enlightenment"*).

a – *Urbanism* in this period actually represents the core of the modern urban principles and can be characterized trough some characteristic elements:

- Organizing some monumental squares of great amplitude, of some *esplanades* (large spaces with alleys and green spaces) as starting points for important circulation arteries, or for putting into value of some special architectonic ensembles;
- Utilization of the symmetry and order principle (mono or bidirectional) in arranging spaces of buildings.

In figure 4.74 some examples of monumental squares organized according to classicist principles are presented in two of the great European cities (Paris, Petersburg-Leningrad).

Paris- Vendome square

➞ St. Petersburg square

b – *Functional programs* in classicist architecture respect the basic principles of order and symmetry, of balanced shapes and volumes in architectural creation.

The bourgeois dwellings were a functional program with a rigid and conventional character from the constructive system and functional plan point of view (Among whom it existed equilibrium) but, if the exterior decoration of the buildings was level-headed, the interior one reached a high degree of refinement.

Even some *styles* in the interior decorations have been imposed (“Rococo” and “Empire” in France,” “Adam-Style” in England Biedermayer” in Germany), styles which manifested themselves also in the creation of furniture elements.

Versailles palace

Versailles square

Fig 4.76 – Royal Theatre from Berlin (Project of K.F.Schinkel, after [35])

Fig. 4.75 Pashkov palace from Moscow

From architectural conception point of view the aristocrat castles were realized after rational functional plans, which attest the seeking of functional comfort, and the main façades were emphasized by using of portico columns with gables, which remind of the temple from antiquity (fig. 4. 75).

Theatres, constituted an important functional program of classicism due to the influence of the "enlighten" current through culture on the people, manifested in Europe in the period of the centuries XVII and XVIII.

Thereby were constructed famous theatres after a common principle:
-the theatre's hall was surrounded by superimposed boxes, arranged in a horseshoe shape and make account of the lobby (through the space reserved for it, through the luxurious decoration and through the huge stairs).Some of these architectural performances are: the "*Scala" theatre from Milan, the regal theatre from Berlin* (see fig. 4.76), the *Bordeaux theatre, Besancon theatre* and so on.

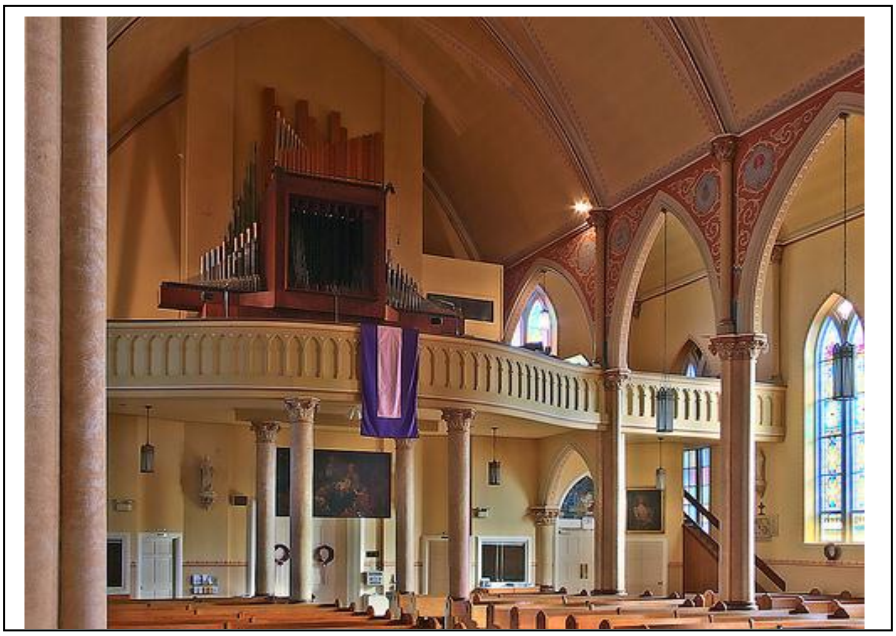
The interior of the Scala theatre

The religious buildings (churches) built in a reduced number during the period of classicism, had some common characteristics as:

- The preference for the Greek shaped cross(with equal wings)
- The monumental accentuation through a central ample dome
- The utilization of columns portico and of the gables with bas-reliefs

Fig. 4.77- Arches in classical style (study by K.F. Schinkel[35])

The covering of churches was realized with the help of domes and of arcs of contact supported on pendant arcs (fig. 4, 77 and 4.78), which at their turn bear on groups of columns with Greek classical architectural characters.



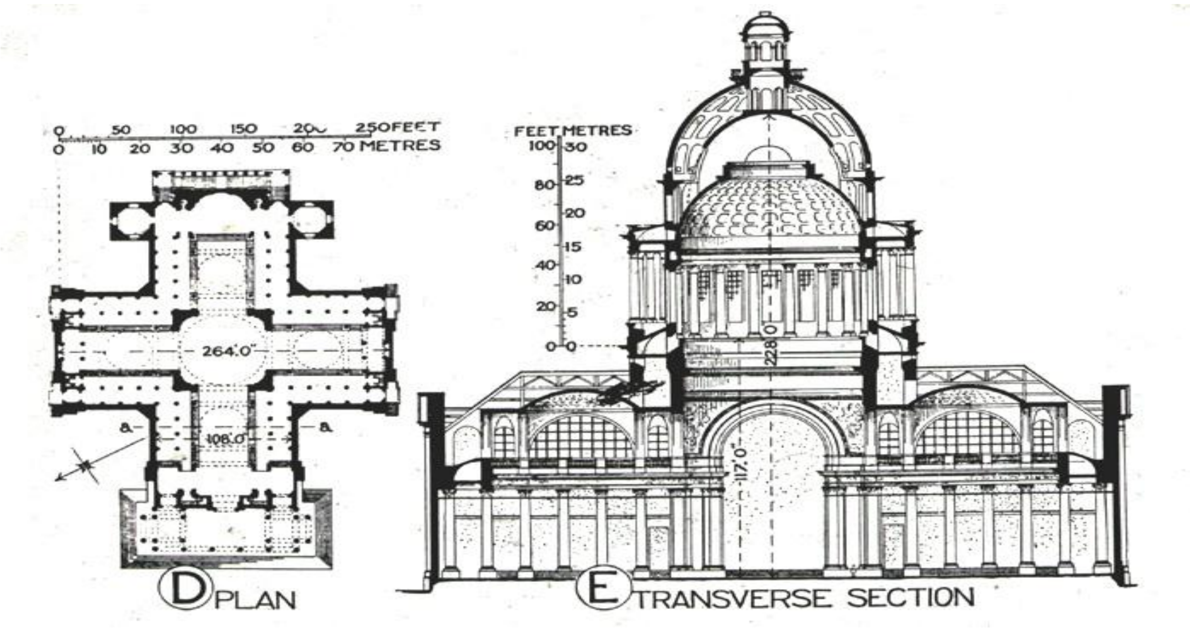


Fig. 4.78a) Saint- Genevieve (Pantheon) from Paris

A representative example for the classical churches is the church *Sainte-Genevieve (Pantheon)* from Paris (Fig. 4.78) which respects the form of geek crosses in the formation of the horizontal plane.

Fig. 4.78b) Saint- Genevieve (Pantheon) from Paris

The administrative buildings , constituted a very diversified functional program in classicism , including public buildings for headquarters of governments ,parliaments, justice, banks and stock-exchange, and so on, and they all present a common general feature:- they are monumental constructions being points of reference in the systematization and urban organization of cities.

The buildings for education, were realized with the same character of monumentality and after functional planes containing blocks of buildings (with symmetrical wings and interior courtyards), all of them pointing out the racial block of the assembly.

The commemorative monuments ,are constructions which have most of the time the general aspect of " ancient temples " or "triumphal arches" ,at which the proportion(report) between principal characteristics –*symbol* and *utility*- is huge (see the explanations from chapter 1.2 and the figure 1. 3) Which were raised for glorify some of the most big military victories or the heroes.

Fig. 4.79 Commemorative monuments:

a. Triumph Arch (Paris)

b.Valhalla (Regensburg)

Thus, among the most representative *commemorative monuments* we can remind:

-the *Triumph Arch* from Charles de Gaulle square, built at the order of the emperor Napoleon the first in the honor of French army (see the fig. 4.79.a), impressive and monumental construction which dominates the huge Parisian square through its dimensions(50 m height and 45m length) and through the severity of its silhouette .

-the church "*La Madeleine*" from Paris was realized under Napoleon I as a temple glorifying the heroes from the Great French Army;

-Valhalla, a monument having the shape of an ancient temple, near of Regensburg-Germany which commemorates the victory against Napoleon from Leipzig (1813) (Fig. 4.79.b)

Figure -University's Rotunda from State of Virginia

The above examples are some of the most representative constructions of this type, their number in the period of classicism being very large.

The *classicism's* current was widely spread in Europe but also in further away geographical areas from the entire world.

So, "the classicism's architectural current" or the *neoclassicism* was taken over also in America, where are constructed numerous administrative buildings in the neoclassic style of roman influence (for example the *Capitol* and the *University's Rotunda* from State of Virginia have as a source of inspiration the roman Pantheon)

c. – *Architectural appearance* in classicism can be characterized through the following general elements:

- the taken over of architectural elements from the ancient period
- the utilization of composition rules based on order ,equilibrium and on the order of imagination
- to render evident the structure of buildings through rhythm and color, through the utilization of simple and clear bulks.
- the insistent utilization of a dominant compositional element :*the portico with gable of ancient inspiration*
- the development of buildings interior decoration ,starting from elements belonging to geek and roman architecture, until the creation of some styles of decoration emanating solemnity, delicacy, or luxury
- the enrichment of architectural appearance through the utilization of some new construction materials at adornments and structures(steel and cast iron)

The architecture of classicism , named in Europe ***neoclassic*** architecture , can be considered a *reasoning* architecture , thanks to giving up the excess of exterior ornaments and baroque and also thanks to imposing a discipline and a structural order laying at the basis of the architecture's principles .

The divination of the church and the diminution of its moral and political dominant force character, together with bourgeois class evolution determined the gradual disappearance of the old architectural models (religious and aristocratic) preparing the heave in sight of a new architecture, that of the XIX century, based first on the ideals of equalitarianism and on the society's industrialization tendency .

The architecture of classicism has the possibility to be engrossed in the *restoration and conservation of ancient monuments*, for the first time, Rome being the first gainer of this important act of civilization and culture.

4. 12 Architecture of the XIX century- ROMANTISM and ECLECTICISM

ROMANTISM appeared at the end of the XVIII century in England and Germany like an esthetic fundamental attitude, expanding then in almost all the countries of the world (firstly in occidental Europe) , like a reaction against classicism , characterized through its tendency of showing the world under its precise aspects.

Romantics permitted thus the affirmation of the emotional factor, of the imagination and sensibility, promoting the getaway in exotic, in the dream, in the glorious and bright past of the ancestors.

Like an artistically , literary and philosophical general movement, romanticism leaves its mark on the architecture of the time .Thus the *romantic architecture* resumes some medieval characteristics (especially gothic architecture) giving birth to a new style, called ***"neo-gothic"*** which inspires itself from various styles.

The buildings of so-called "*Victorian*"(among which the *Parliament Palace* from *London* – fig. 4. 80 , projected by Charles Barry is one of the most representative)uses classical compositions of the façade and plane , medieval towers and long galleries on columns , while at the decorations and vaults appear some clear gothic elements .

If in England the romanticism created various picturesque constructions (palaces, buntings, lordly houses, administrative buildings, and so on.) at which the functional element interweaves with the aesthetic of exotic inspiration (medieval or even oriental), in Germany the romanticism was level-headed and is represented in general through constructions with commemorative character.

Fig.4. 80 – the Palace of Parliament (London)

In France, the romantic architecture created a series of *castles* (especially in the Loire Valley-fig. 4. 81), and the tendency was to create a style unity, to use the new technique rationally and the new materials which the XIX century placed at the architect disposal .For example the *cast iron* starts to be utilized ,a new construction material , at the construction of buntings and domes ,of some glasshouses or even churches(the beams and arches belonging to the church St.Clotilde from Paris)

The ECLECTICISM ,one of the most contested architecture styles ,is the result of the mechanical joint tendency of *a new function with anterior architectural style* (any of the new ones) and in the meanwhile it is the consequence of the appearance and development of new construction technologies ,based on materials (*metal, glass, reinforced concrete* and so on).

The eclecticism's architecture, principal component of XIX century, "imposed" the using of certain styles for each of the functional plans which are more spread.

Fig. 4.81-Loire valley castles (France)

So, the eclecticism was recommending the adjustment of some churches to the *Byzantine* or *gothic,* of some lodges to *renascence* styles, of the administrative buildings to the *roman* or *medieval* style, all these concealing the real use of the buildings.

It is representative for the eclectic architecture, Robert Ventouri's project [48], referring to a lodge where the classical renascence's columns are adapted from functional point of view at a modern architecture (fig.4.82).

Fig. 4.83 – Buildings in eclectic style (after [35])

Another example of eclecticism may be the one from the fig. 4. 83 , (after[35]) where, for expressing the national traditions were realized (for the Universal Exhibition from Paris-1878) pavilions of different countries ,constructed in personal architectural styles (the XVI century's architecture in *South America, Nordic mannerism*' *s* architecture ,*Greek neoclassicism's* architecture).

The combination of these different architectural styles, with the obvious functionality as an exhibition pavilion determines their *eclectic* character (hidden or masked).

In England, the eclectic style of the *Victorian period* was characterized by austerity and by the utilization of the street fronts with apparent brick, or of the metallic structures rich decorated, and in France the eclectic architecture (sustained by the School of the Beautiful Arts from Paris) was based on the architecture of the preceding styles, readjusted to the new functions and giving this way birth to representative buildings, with imposing, great, rich decorated characteristics but equilibrated from functional point of view – example *The Opera from*

Paris, designed by the architect Charles Garnier and built between 1859 – 1874 in *neo-baroque* style (fig. 4.84 and 4.85).

The eclectic style, architecture of alternative, was a creative style, resulted from the combination of the plastic architecture and the details from the classic architecture styles with new functional requirements imposed by the buildings' destination

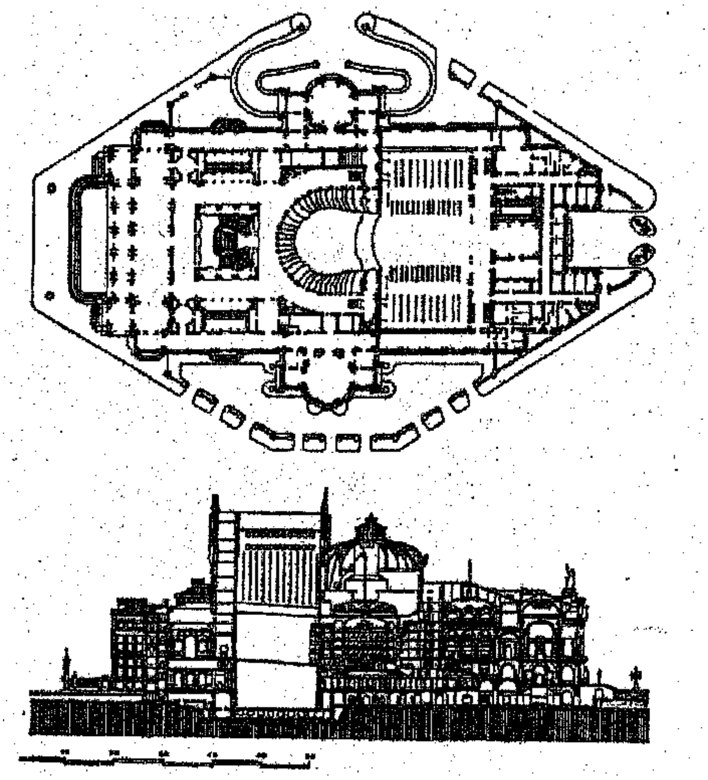


Fig. 4.84 – The Opera from Paris- plan and vertical section. [44]

The eclectic style knew a large expansion in the world, being represented by multiple monumental buildings in ones of the biggest European metropolis and over the ocean: Example – *The Palace of Justice* from Bruxelles (arch. J.Polaert), *Burgtheater* from Vienna (arch. J.Semper), *Capitol* from Washington (arch. T.V. Walter), the *Opera from Paris* (fig. 4.85), *The Monument of Vittorio Emanuelle II* from Rome (arch. G. Sacconi – fig. 4.86).

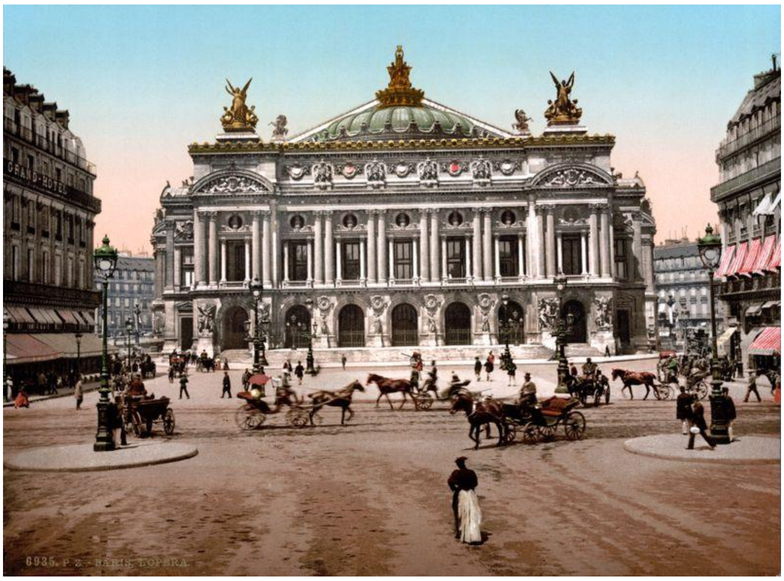


Fig. 4.85 – The Opera from Paris (the view) [37]

In the eclectic architecture the orientated artistic feel towards glamour and grandness was related to modern functions, materials and new technologies of construction, resulting an original architectural style with a powerful and expressive force, designed with generous decoration as well as with spectacular buildings.

Fig. 4.86 – The Monument of Vittorio Emanuelle II – Rome

4.13 The Modern Architecture – the architecture of XIX – XX centuries

In general it is considered that the *modern* architecture begins in the XIX century along with the quick development of techniques from the period of “industrial revolution”, development joined by the discovery of new materials of construction, with characteristics superior to the classic ones and by the appearance of new modern technology for the execution of the constructions.

In the same time begins to manifest more and more the wish of freedom from the classic architectural forms, considered by many architects to be not only overpass by the necessities and by the structural possibilities, but also needful of esthetic value and practical utility.

Further, the architects from the XIX century begin to confront with multiple problems which they had to respond to, related to the appearance of a great number of new functions of buildings, besides the known ones (buildings for living, religious, public, etc.) like : *big commercial complexes, railroad stations, institutions of charities, hospitals, asylums, hostels, headquarters for factories and enterprises, sport arenas of big sizes, pavilions of exhibition, cinemas, buildings for transports, museums* and *airports*, etc.

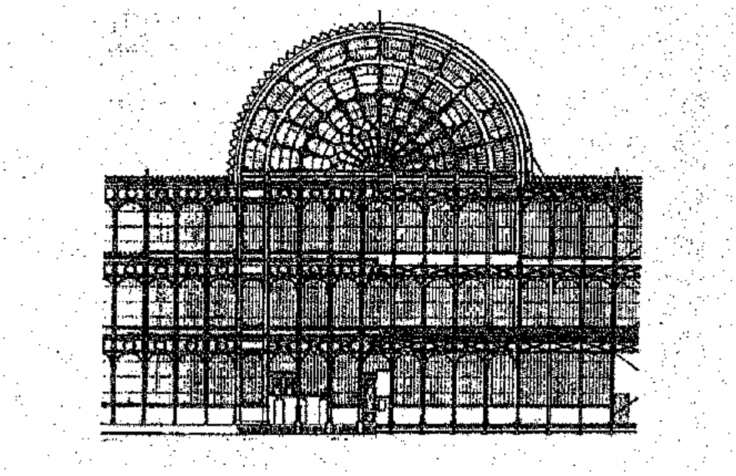
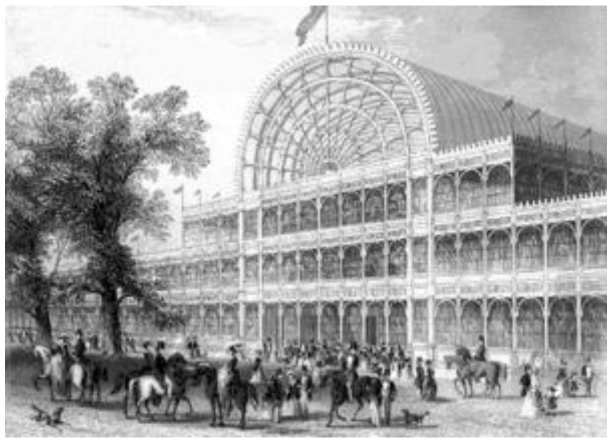



Fig. 4.87 – Crystal Palace – London

All these new elements which appeared with the accelerated urbanization of the society, determine radical changes in the concept of the constructors, in the thinking of the architects and of the engineers and these leads to the appearance of new *tendencies* and of new procedures in the architectural concept, some of them being well spread.

These tendencies were split in the following three categories:

a- *Rationalist* tendencies (the technical rationalism);

b- *Formalism* tendencies(the architectural formalism);

c- *Functional* tendencies

a - THE TECHNICAL RATIONALISM- progressive tendency of the architecture, being based on the concept that the *structure must determine the shape,* and the architectural expression must be adapted to the material of construction and to the structural scheme, renouncing to the excessive décor.

There existed a large number of adepts of the rationalist current between the greatest architects and engineers of the XIX century, who realized many representative constructions of these tendencies. We can remember the following : - *Viollet Le Duc*, *J. Paxton* (who realized the Palace Crystal from London, fig. 4.87), *T. Garnier, A. Perret* (the first who used reinforced concrete from the civil architecture), *P.L. Nervi* (the author of the Palace of Sports from Rome – fig. 4.88 and the headquarter of UNESCO from Paris), *E. Saarinem* (the author of the T.W.A Terminal from the J.F. Kennedy airport from New York – fig. 4.89).

Fig. 4.88 – The Palace of Sports – Rome

A particular place is occupied by the engineer *Gustave Eiffel* whose realizations are representative constructions for the technical rationalism, the form of these being well imposed on the metallic structure. The *Eiffel Tower* from Paris (with the height 324 m – fig. 4.90) constructed for the Universal Exhibition from 1889, was contested to be an architectural value by big part of the contemporaneous architectures, but it remains a symbol of Paris and a combination between a modern structural technique and an open architecture, inverse to the conservatory aesthetic of an old society.

Fig. 4.89 – Terminal T.W.A – New York

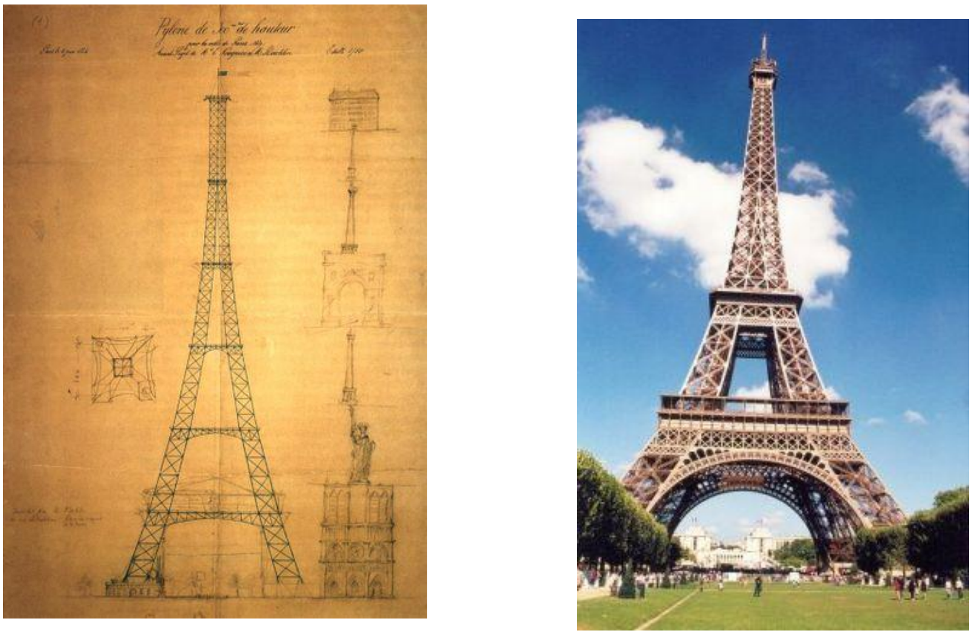


Fig. 4.90 – The Eiffel Tower – Paris (sketch and view)

In the same time the Eiffel Tower has a clear functionality, the one of turistic aim and tower for the radio and television transmition from Paris.

b – THE FORMALISM – modern aesthetic orientation, which accorded the necessery importance for the *shape* of the construction (considering it as a aim and not as a expresion of the content).

The formalism manifested in the architecture of the XIX century and it had the awesome tendency of prominence of the architectural form in the detriment of other construction components (structure and function). The formaly tendencies manifested as an *artistic movements* appeared in the geographic zones or in different period of times and they had a series of adepts between architects and constructors of that time.The principal tendencies of formalism were:

- **Art Nouveau** – an artistic movement in architecture, of formaly tendency, which had a *romantic* orientation, pleading for the replacing of the classic ornamentations with the curly ornamental forms, asymmetric, curves, of flower inspiration or geometric [29]. The expansion of these artistic movements in the countries of Europe converted many adepts : *Victor Horta, Henry van de Velde, J.M. Olbrich, H. Guimard, P. Hanker, O. Wagner*, who created a large number of works whose decoration was realised with fantasy and exuberance, utilising full contours of grace and elegance. The artistic current of type Art Nouveau met in fact multiple forms and names in different countries of Europe in 1900 :

  - *Style Guimard* or *Style Nouille* in France;
  - *Sezession* (secession) in Austria;
  - *Jugendstyle* in Germany;

- *Stile Floreale* and *Liberty Stile* in Italy;
- *Coupe de fouet* in Belgium ;
- *Moderne Style* and the *School from Glasgow* in England;
- *Modernismo* in Spain;

all having the same characteristics mentioned above.

The formalist current *Art Nouveau* entered also in Romania where (moderate by some local influences) where realised some representative constructions, between which : The *Casino* from Constanta, The *Athenee Palace Hotel* from Bucharest (arch. D. Renard), The *Culture Palace* from Tg. Mures, The *Black Eagle Complex* and The *Ullman Palace* from Oradea.

- ***The Expressionism*** – current of formalist tendency which appeared in Germany at the beginning of XX century, as a protest against the academic architecture, eclectic and functionalist and it's manifested through : insistent chromatic-scale, powerfull contrasts, pronounced symbolism of forms and an original language of the expressiveness of the space.

Between adepts of this current there were *: P. Behrens, H. Poelzig, Mies van der Rohe, E. Mendelsohn and Antonio Gaudi* (whose works were original, with weird forms, unordered and of organic inspiration).

In fig. 4.91 is prezented a well known construction of the architect A. Gaudi, the Church "Sagrada-Familia" from Barcelona.

Fig. 4.91 – The Church "Sagrada-Familia" – Barcelona (A. Gaudi)

In fig. 4.92 is presented another example of a building in expressionist style, The *Einstein Observatory* from Potsdam – Germany, a creation of the architect E. Mendelsohn.

Fig. 4.92- The observatory “Einstein”-Porsdam (E.Mendelsohn)

The Futurism –another formalist current appeared in Italy at the beginning of XX –th century, having as adepts: *A. de Sant’Elia* and *M.Chiattone*, pleaded for the agreement between the architecture and the new conquests of the technology and science, for dynamism and mobility.

The Constructivism- one of the architectural movements of formalist tendency appeared after 1920, pleaded for the expressivity of the constructions, to give up the classic decorations, putting the accent on the plastic effect created by the ratio between the constructed volume and the effective space.

Using modern materials of construction (glass, steel, plastic masses) the constructivism underlines the aesthetic and decorative function of structure, giving great attention to its expressivity.

The constructivist -movement manifested also in Soviet Russia, where architects as *V. Tatlin*, brothers *Vesnin, I. Leonidov*, built a series of administrative buildings of constructivist nature.

The Brutalism – movement of formalist orientation, appeared at the middle of our century, characterized by aggressive and rough forms, with the utilization of apparent, rough, raw materials.

The principle personality of this current, architect Louis I. Kahn made between the other important goals:- the buildings of *Pennsylvania University* of *"J. Salk" Institute* of Biological studies , from California (fig. 4.93), etc. buildings that are real monuments dedicated to the human reason.

Fig. 4.93- "J. Salk" Institute from California (arch. Louis I. Kahn)

- De Stijl (the style) – this motion appeared in Netherlands after the First World War, being based on the principles of "cubism" and advocating on the purity of geometrical shape and on the primary colors. *T. Doesburg, P. Mondrian*, etc have used with predilection geometrical forms: - the cube, the parallelepiped, the prism, the plane surfaces, the right angle, etc. to realize the idea of continuity of the built space.

- Neo-Classicism - formalist tendency in architecture emerged as a reaction against the functionalist trends, volumes and simple geometric forms. Advocating for the use of elements of classical architecture: - the arch, the vault, the dome, etc. and for the reintroduction of symmetry, of axial composition and of the ordinance in architectural ensembles, the neo-classicism occurs in parallel with modern architecture and has the following representative names: *L. Miles van der Rohe, Louis I. Kahn, etc.*

c - FUNCTIONALISM- was and remains a tendency (a principle) important in the modern architecture, which is based on the concept that *the form* is *the logical result of the function* and supports the direct correspondence between *the architectural expression* and *function of the building* (the main destination is: - the work, the study , the recreation, the rest etc.).

The need for a balance between the different functions of the buildings and of the correct relationship between the functionality of buildings and the real possibilities of materialization of the aesthetic conception, resulted in the second half of 20th century from the ideas of *Viollet-le-Duc* and was retrieved by *L. Sullivan*, whose expression *" the form follows the function "* characterizes the principles of functionalism in modern architecture.

The functionalist architecture is generally characterized by the use of new construction materials (concrete, steel, aluminum, glass, plastics, etc..) and the new technologies of execution, and the performances of functionalism are in mostly of modern constructions with multi-destinations (mainly buildings for offices, commerce, housing, industrial buildings, etc.).

The functionalist tendencies of modern architecture had representatives both in Europe and in the rest of the world. If the common feature of their thinking was considering functionalism as an absolute generator of the artistic expression and of the renunciation of decorative elements, there were, still, some conceptions that deviated somehow from the general principle, considering it monotonous and without personality.

There have outlined so real "schools" of functionalist architecture as the *"Bauhaus School"* and *"Chicago School".*

Bauhaus, school appeared in Germany in 1919 at the initiative of the architect *Walter Gropius*, represented in many areas of art an attitude which pleaded for the unity *technical-art* and for a synthesis of the arts, ranging from the furniture details to the level of urban organization.

Bauhaus school has initiated the introduction of the prefabricated elements of the buildings, defined the aesthetics of industrial product and militated for the industrialization of constructions, setting the function before the form and the architectural plastic. Modern buildings designed by the Bauhaus School of architecture are buildings with light structures, with stained glass facades, made of concrete, steel and glass, having volumes and simple forms, solved with clarity and thoroughness (fig. 4.94).

Among followers of the Bauhaus were: - Walter *Gropius, Paul Klee, Ludwing Mies van der Rohe, Marcel Breuer, Wassily Kandinsky, etc.*

Fig.4.94 - Bauhaus-style commercial building (arch. W. Gropius)

- Chicago's School, represented a group of architects of functionalist tendency, which was stated at the end of the last century and had as main representatives: *Luis H. Sullivan, Henry H. Richardson, Daniel H. Burnham, John W. Root, D. Adler, etc.*

The achievements are generally very high buildings, with structure of metal resistance (sometimes combined with concrete or masonry), at which the form corresponds to the clarity function and which aborts totally the forms and decorations of the classical architectural styles.

It was born with the Chicago School, a daring architectural language, innovative, based on modern techniques of construction and on the use of materials of high resistance.

There appears that such category of buildings named "Skyscraper", which quickly penetrates in the architect's creation of the large European cities.

In fig. 4.95 is presented one of the highest buildings in the world (creation of the Chicago School survivors): - the Sears Tower building from Chicago (arch. *Bruce Graham*). With 110 floors, 443 meters high and a steel structure composed of nine "tubes" whose height is different (the horizontal plane is reducing on the height of the building), the Sears Tower was until 1996 the highest type of construction building in the world (now is only the 4th construction of the world).

Fig. 4.95 – “Sears Tower” Building – Chicago, SUA

In 1998 the two "twin" Petronas towers have been completed throughout *(Petronas - Towers)* in Kuala Lumpur - Malaysia, designed by a team led by architect *César Pelli.*

Having "only" 88 floors and 452 meters in height (fig. 4.96) Petronas Towers were the highest buildings in the world until 2004, when in Taipei (capital of Taiwan) is given in the use *the highest building in the world for this moment*, "**Taipei 101**", designed by a team led by architect *C.Y. Lee*.

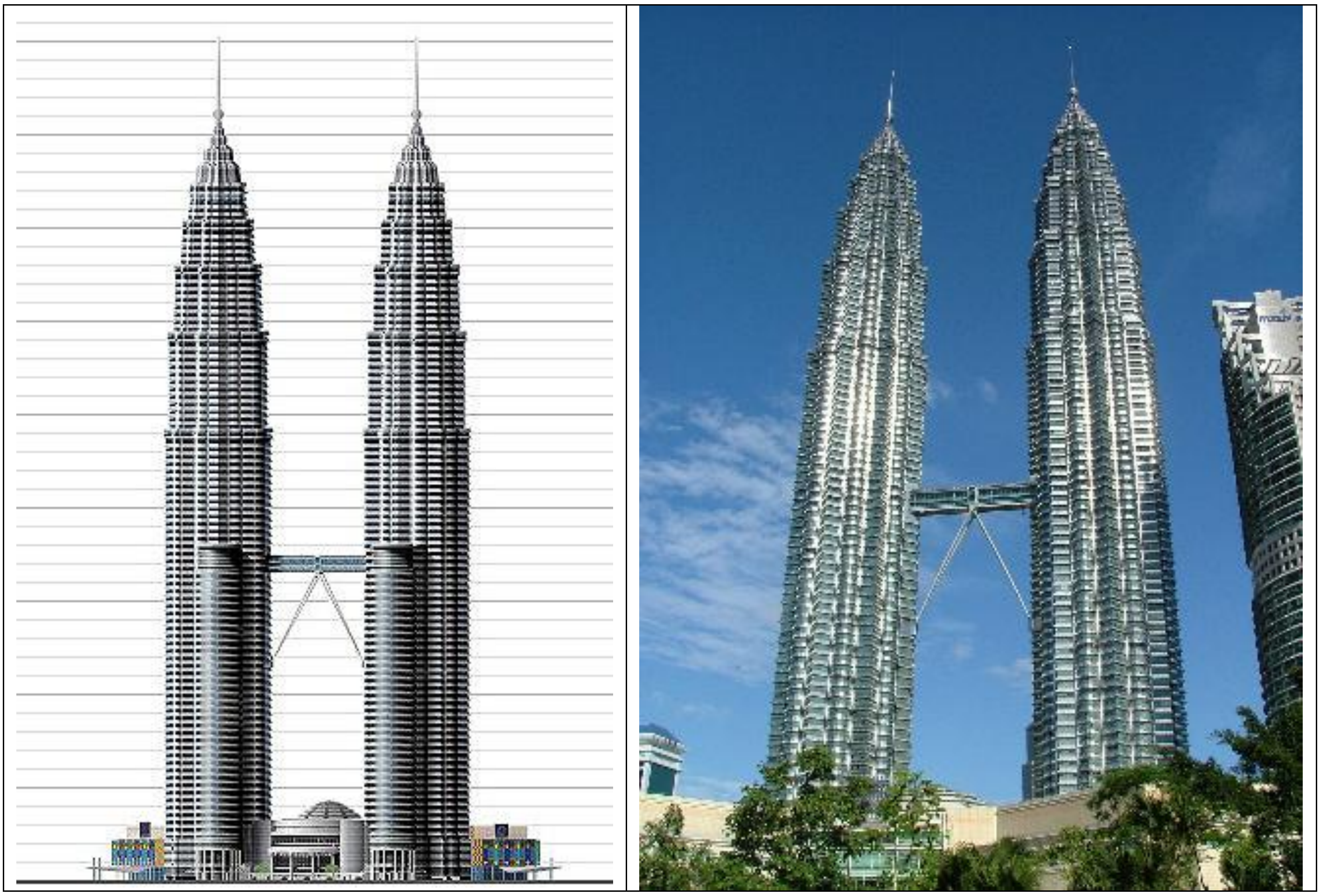


Fig. 4.96 – “Petronas – Towers” from Kuala Lumpur, Malaysia

"Taipei 101" building (fig. 4.97) is achieved with a structure of steel and reinforced concrete, has 101 levels and a height of 509 meters and the tower plane has a general square section. It is the *highest building*, but the highest *construction* in the world is Railways Tower of Toronto - Canada, which has a height of 550 meters (with the antenna)

Fig. 4.97 – “Taipei 101” Tower – Taipei, Taiwan

The modern technologies of execution of construction and high strength materials allows the designers to make projects more and more daring, so the supremacy of "Taipei 101" building is threatened by the new project of *"Burj Dubai"* building in the United Arab Emirates.

Scheduled to be put into service in 2008, the tower *"Burj Dubai"* will be *the highest building in the world*, with *160 levels* and its *705 m height* (in fig. 4.98 is presented a general view of the project coordinated by the architect *Adrian D. Smith*).

Fig. 4.98 – *"Burj Dubai"* Tower – Dubai, United Arab Emirates

Definitely the most "currents" and "trends" manifested in modern architecture appeared and were developed around famous architects, whose personality attracted followers and ordered to them a certain style of work and a certain orientation in architectural creation.

Among the creators of modern architecture (the rationalist orientation) is included the famous French architect of Swiss origin, Le *Corbusier* (with his real name Charles Edouard Jeanneret).

Besides his numerous writings about an architecture which should have a social responsibility and which should be subordinated to the structural necessities; Le Corbusier made an account of architectural works using simple volumes and original construction elements (terrace roof, pilots, windows "in band", walls of glass, etc.).

Simplicity and clarity of architectural forms, obtained at Villa Savoy near Paris, designed by Le Corbusier (fig. 4.99) characterizes architecture principles adopted and promoted by him.

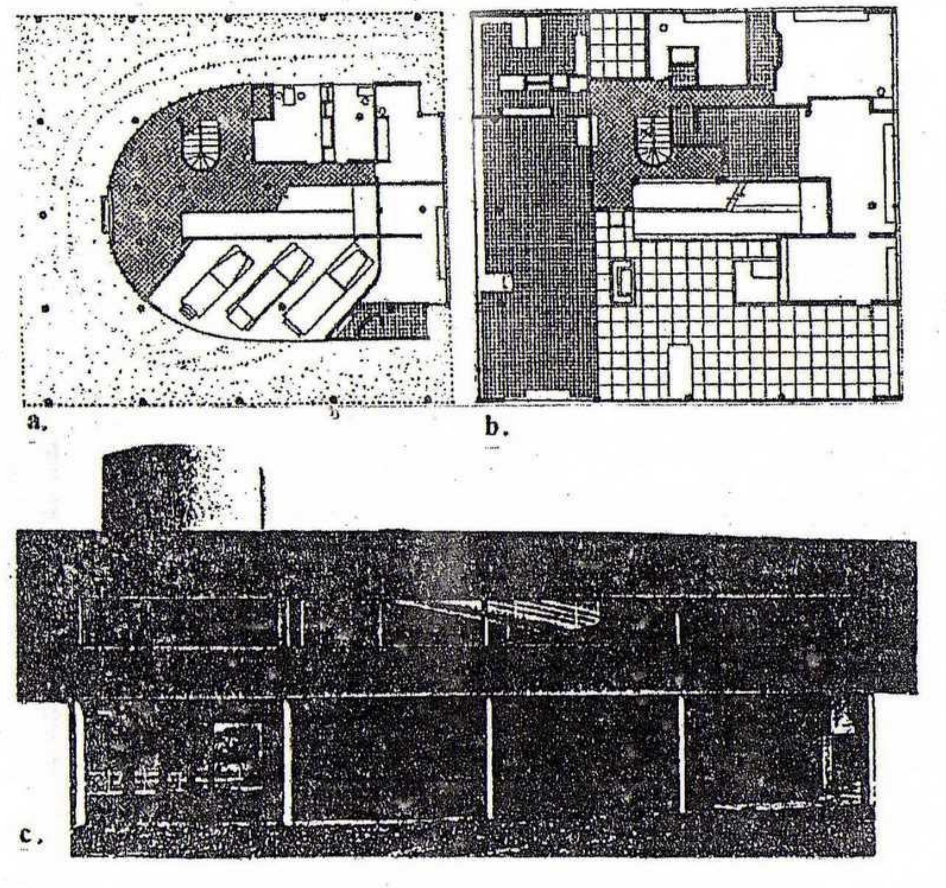


Fig. 4.99 – Vila Savoye – Paris (Le Corbusier)
a – floor plan; b – level plan; c – view (over [44])

Le Corbusier (who was also a great town planner) has designed among others the general plan of the city of Chandigarh from India and imagined a project for a city with three million inhabitants (fig. 4.100) since 1922.

In a way Le Corbusier is the "moral" author of the city Brasilia (Brazil's new capital), because the general plan of Brazil as the major public buildings from here were designed by his students and collaborators (also famous), architects *Lucio Costa and Oscar Niemeyer*.

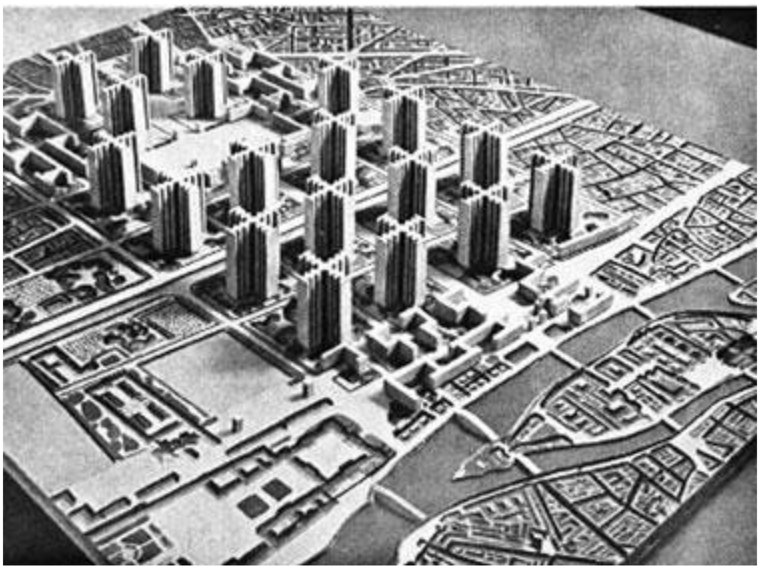


Fig. 4.100 – “City for three millions” – Le Corbusier [44]

Another huge personality of architecture was *Frank Lloyd Wright* who was considered one of the greatest architects of America and from the world.

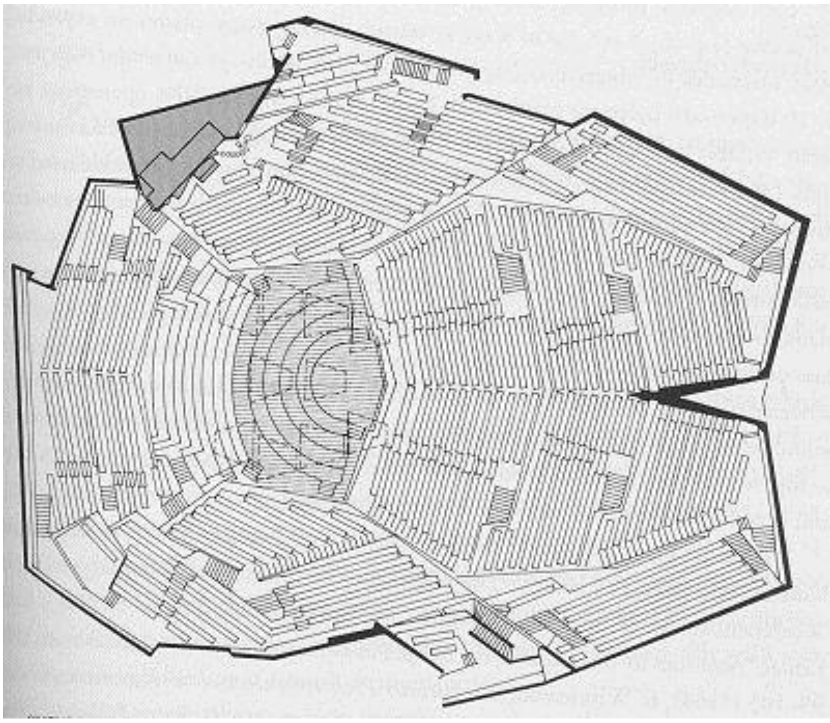
Creator of an architecture which militated for the "organic" unit between the location, structure and decoration of a building, for a harmony of the building with the environment (also natural bodies harmony, Frank Lloyd Wright has made numerous reference constructions in the modern architecture of the XX - century. Among these, the *Guggenheim Museum* building in New York (fig. 4.101)realized on a structure made of reinforced concrete, under the form of a continuous spatial ramp on all the floors to the glass dome of the roof (which closes a "yard of light") is one of the most important creations of *"organic architecture"* initiated by Wright.

"Late" architecture of the XX century - has witnessed several trends, characterized by Leland M. Roth [44] as: *neo expressionism, late modernism and post-modernism.*

- ***The neo-expressionism*** had among followers, in addition to *Frank Lloyd Wright* and *Miles van der Rohe*, and the Finnish *Aalto Alvarez* and *E. Saarinen* (designer of Dulles International Airport from Washington and TWA air station in New York – see fig. 4.89), the German *Hans Scharoun* (the designer of the Berlin Philharmonic-fig.4. 102), the *Danish Utzon J.* (the author of the project of Sydney Opera in Australia-fig.4. 103), the Japanese *Kenzo Tange* and *Kisho Kurokawa*).
- .

In this period (after 1950) some of the most important architects of the world (Louis Kahn, Robert Venturi, etc.) start to pled for the implementation of an architectural creation more human, fighting against monumental and heroics *(grandiloquence).*

- **The Late Modernism:** it appeared after 1965 and it had also important representatives.



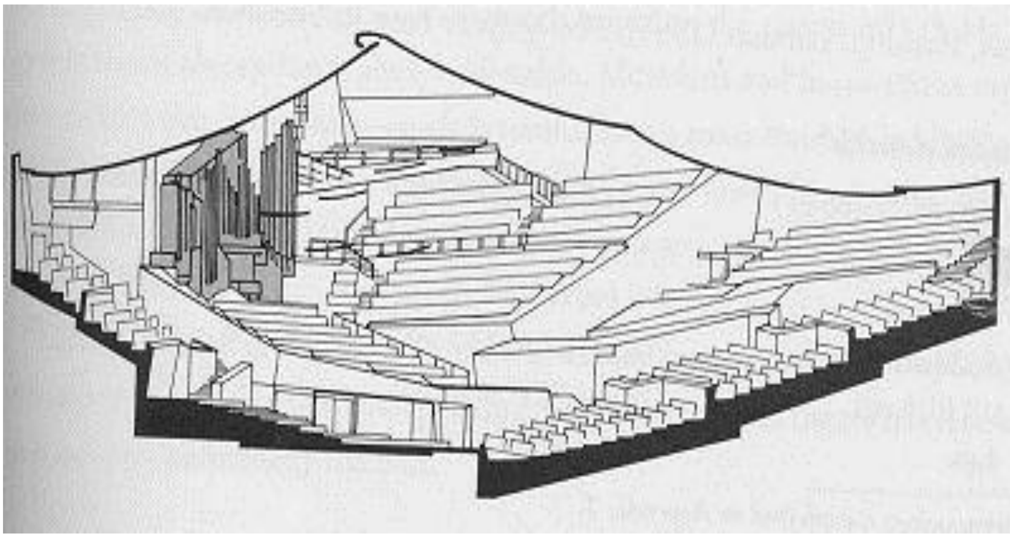


Fig. 4.102- Berlin Philharmonic (plan and section)

Between the contemporaneous architects, like: *Renzo Piano* and *Richard Rogers* (the authors of the Cultural Center “Georges Pompidou” from Paris), *Peter Eisenman*, *Richard Meier* (the author of the Art Museum from Atlanta,Georgia), etc.

Fig. 103.-The Sydney Opera (J.Utzo)

Post Modernism**:** is derived from the late modernism and it militated for a modern architecture, with the meaning related to function (unlike the late modernism, which pleaded for the expressivity of architecture).

The adepts of the post modernism where: *Philip Johnson* (coauthor with M. van der Rohe – the Seagram building in New York); *Robert A. M. Stern*, *Charles Moore*, *Allan Greenberg*, *Michael Graves*, etc. They realized modern constructions, using usually standard type elements like “curtain” glass walls, but under modern forms, which suggest the functionality of the buildings.

In the 9th decade of the XX century, it appeared a new ingenious tendency, at some of the contemporary architects (Indians *Charles Correa* and *Balkrishna Doshi*, the Swiss *Mario Botta*, etc.). This tendency was about making modern functional constructions, introducing architectural symbol forms suggesting cultural traditions and old religious models.

So, for example, Mario Botta creates buildings which forms recall ancestral memories (fig. 4.104), but which have geometric forms and are perfectly adapted to functionality.

Fig. 4.104 San Francisco Museum of Modern Art (architect Mario Botta

No matter the trends, the currents and the styles that the modern architecture has adopted, and with the huge diversity of plasticity and specific architectural forms, utilized by this, there can be outlined some general characteristic elements for *urbanism*, for *functionality programs* and for *plasticity of architectural forms* in modern architecture.

URBANISM**:** in modern architecture becomes a *science* (which takes care of the *systematization*, *projection*, and *concept of urban agglomeration*). This term of urbanism was introduced in 1910 and whose principles *Le Corbusier* has initiated.

The apparition of urbanism as a science is the consequence of the process of "urbanization" of the population and the characteristics of the modern urbanism are very different from the urbanism, which belongs to early periods, because of the new functions of the city and because of the factors, which influence its development.

Mostly the modern urbanism may be characterized by the following *requirements* (which in very few cases are fully respected):

- There must be a clear composition of the city, which needs to satisfy the basics functions of it (space for work, for living, for relaxation, for rest).
- There must be a zonal assessment of the space, optimum to serve the basics functions of the city.
- The priority problems of a city agglomeration must be resolved: circulation, evacuation of waste products, alimentation with water, the supply with electricity, alimentation, and power fuels.
- The later development and expansion of the city must be assured without respecting the upper principles.

The chaotic development of the cities in our century, like a consequence of the fast growth of their numbers and dimensions, has made that in most of the cases the upper requirements not to be fulfilled, because in the most situations the development of the cities has not been planed from economical point of view and without taking into account the further expansion of the city. The exception is made by some new modern cities, projected taking into account the upper requirements, for example: *Brasilia* (Lucio Costa and Oscar Niemeyer), *Chandigarh* in India (Le Corbusier) etc.

THE FUNCTIONAL PROGRAMS **in** the modern architecture are characterized first of all by and extraordinary diversity, like a consequence of diversification and development of the component elements of social life, of occupation and of the life conditions.
The principal functional program remains the *home*, but because of the accelerated process of urbanization, soon the function of the "home" is taken by the "*collective homes*", meaning *apartment blocks*.

Then a big importance is given to the *production* programs, the *logistics* programs, to *educational* programs, to *cultural* programs, to *sport* programs, to *tourism*, to *commerce* etc. Concomitantly the types of *administrative* buildings and *public* constructions (the ones for *social* and *political* activities, the ones for *exhibitions* and *markets*, the ones for *international institutions*) start to diversify.

New programs appear, they impose new "unique" objectives once with the apparition of new preoccupations and new professions. The interest for *multifunctional* ensemble constructions is growing (poly-functional halls of big capacity, business and international terms centers etc.).

THE CONSTRUCTIVE CHARACTERISTICS of the modern buildings are also much diversified, but we can keep in mind some *general* characteristics, which are met at most of the constructions from the modern architectural époque:

- The utilization of *new construction materials* with superior physic characteristics (steel, glass, plastic material, aluminum, Ferro-concrete, etc.).
- The apparition of some *modern structural systems* that permit functional diverse solutions and adequate structural answers to the various actions (loads) at which the constructions are subjected to. Between the structural solutions we can remind the following structural systems: - with *structural walls* (diaphragms), with *structural frames*, with *mixed structure or combined*, with *central or marginal core* (fig. 4.105), structures from *pre-made elements*, *pendent structure* (fig 4.106), structures with "*thin curved cloth*" from Ferro-concrete, *pneumatic structures* etc.
- The utilization of some *advanced techniques and technologies* of building, like: -the execution of multileveled constructions made from concrete by *lifting*, by *sliding* or by *integral prefabrication* elements.

Fig.4.105 - The tallest building between Toronto and Calgary, Canwest. Constructed in 1990, the main tower structure is supported by a reinforced concrete core surrounded by perimeter steel framing and poured-in-place concrete decks.

Between these technologies, for example the *integral or partial pre-made elements*, (fig.4. 105) represent a solution with many advantages in typification like: - *growing productivity* and *shortening of the execution time* of constructions, the possibility of realization of construction elements *in an industrialized way* (which leads to a higher precision and quality and reduction of tolerance at the fabrication of construction elements).

The utilization of modern execution technologies has lead to the *reduction of the constructions' self weight* (see cap. 1 and fig.1 8) and once with the tendency to *build taller and taller* buildings, by using structures made from light materials and with high resistance, by accommodation of some structural statistic schemes which allowed the reduction of the resistance elements' section, or by accommodation of some light unstructured elements (insulations, closing walls or separation walls etc.)

The utilization of high performance materials and light structures has allowed a *considerable rise in the construction aperture* (at exhibition and meetings halls, show halls and for sport events, commercial buildings, etc.)

Fig.4.106 – The Olympic Stadium in Montreal Canada

Fig. 4.107 – Prefab House

THE PLASTICS OF ARCHITECTURAL SHAPES (the shapes of the specific architecture) in the actual modern architecture also shows a huge variety of specific elements, but one can try to present some of the most important *general features* of the plastics of modern architecture, such as:

- There is much more emphasis on the relationship between the *inner space and the outer space* of the building, and the sharp separation between them is canceled, by using some elements of connection or by removing the outer walls (which are massive and opaque) and replacing them with light walls, the so-called curtain-walls (fig. 4. 108) that conceal the structure, allow the optimization of the natural lighting by using industrial glass and giving a modern look to the buildings. This way the differentiation between principal and secondary facade disappears, and the building is integrated organically within the environment.
- The general trend is to *quit using traditional decorative elements*, and this sometimes gives some monotonous and tern look to the modern buildings.
- There is also a more emphasis on the *decorative qualities of the building materials* (stone, concrete, steel, wood, brick, glass, aluminum, plastic etc.) whose raw aspect is sometimes prefer instead of the finished one.
- The *effects of shadow-and-light* are also exploited, as well as the effects of *color and shape*, so that they increase the aesthetic comfort of the building.
- There is an increased preference towards the use of straight line and angle, towards *simple shapes* and *geometrical volumes*: cube, sphere, cylinder, pyramid, cone, prism etc.

Among those special buildings with simple geometrical shapes, one of the most impressive in the modern architecture is "*Le Grande Arche*" from *La Defense* district in Paris, (fig.4. 109) also known as "*the great cube*".

Designed by Danish architect *Johan-Otto von Spreckelsen* between years 1983-1985 and built under the coordination of engineer Paul Andreu, La Grande Arche was finished in August 1989.

Fig. 4.108 – Building with curtain walls

The building itself, an empty “cube” – (108 m by 110 m and 112 m deep), is a pure and simple volume, grandiose and monumental, built on a reinforced concrete frame.

Defined as a *“window open towards the world*” by its designer Le Grande Arche, functioning as an international communications center as well as an office building (42000 m2) and including expo, art and culture halls is a modern “*triumphal arch*” dedicated to the human genius and spirit.

Another significant example would be the *Phoenix Insurance Company* building in Hartford, Connecticut – USA, designed by *Harrison and Abramovitz*. The edifice, shaped as a tower with a horizontal section of a sharp-angled ellipsis (fig. 4.110), and built on a square frame, with curtain-walls is a special architectural achievement due to its aerodynamic shape, but also an engineering feat of exception because this shape gives it a very good behavior against the horizontal stress caused by wind.

The sphere is considered to be the ideal shape in nature and found some applications in constructions also especially in the construction of modern public constructions.

The spherical shape was and it is the most frequent shape used in construction industry, for the realization of special constructions, having the reservoir function (of gases, of water, of fuel, etc.).

In the “civil” constructions domain the spherical shape was used for public constructions of large dimensions, the most times the spherical shape was that of a *semi-sphere* or a *spherical calotte*, with a light metallic structure having the shape of a geodesic network, and the light cover (made from glass or plastic materials) was suspended or sited back on the resistance structure.

Hereinafter are presented for example a few modern constructions whose volumetric conception has at its basis the sphere or segments of the sphere.

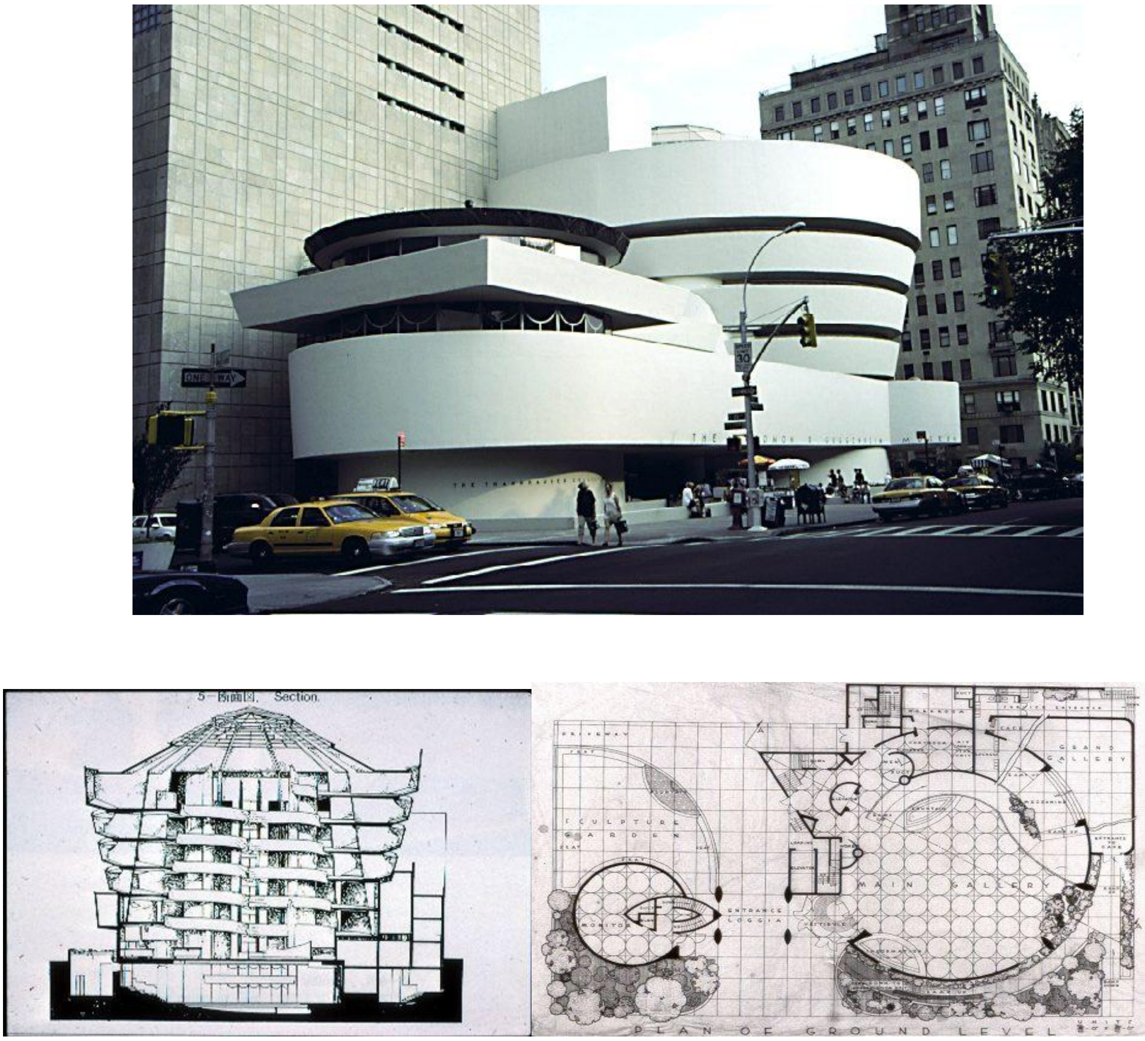


Fig. 4.101- Guggenheim Museum, New York (F.L. Wright)
(exterior view, section and plan).

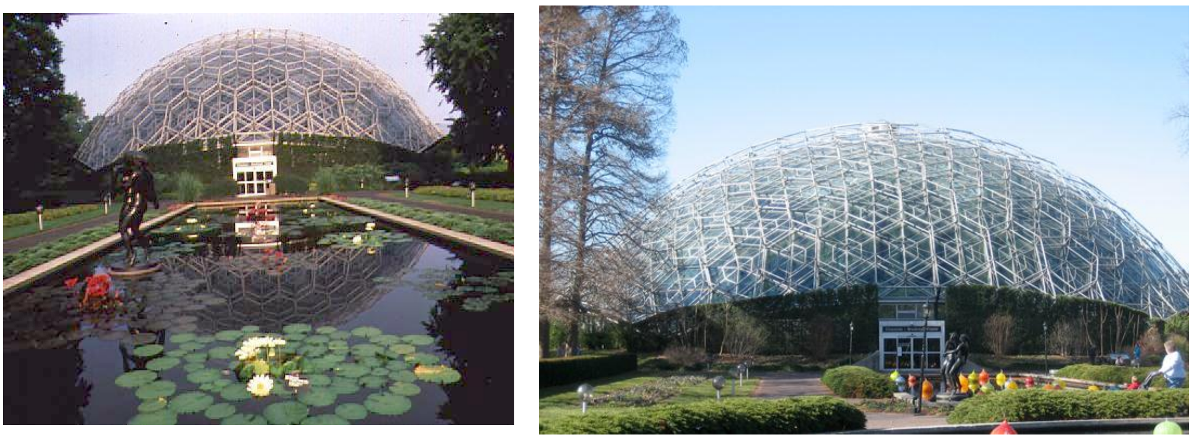


Fig. 4.111 the Geodesic Dome from the botanic garden in St. Luis

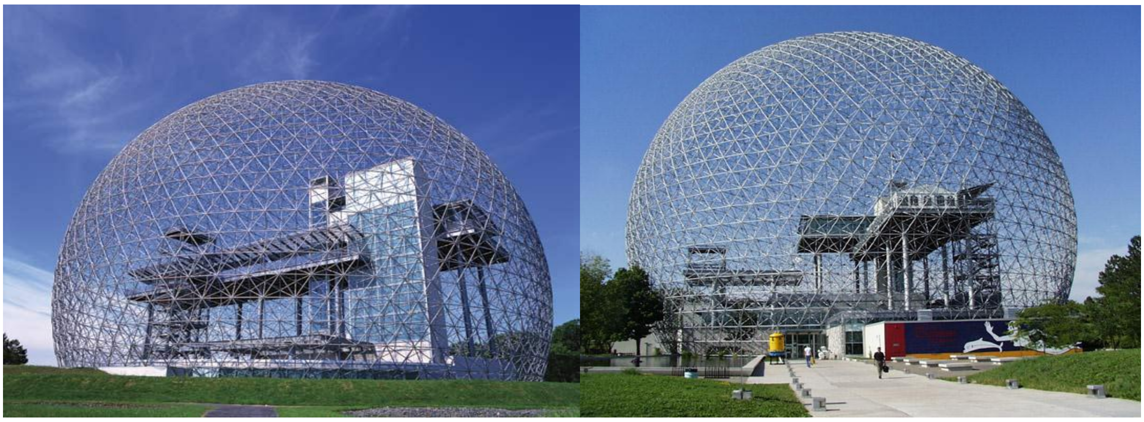


Fig.4.112 “The Biosphere” from Montreal, Canada

Fig. 4.113 The cinema in Valencia

Figure 4. 111. presents (after[54]) *The Geodesic Dome* from the botanic garden in St. Luis, SUA, in the fig.4 112 it is presented “*The Biosphere*” from Montreal- Canada, and in the fig.4.113 it is presented a building projected by the architect *Santiago Calatrava Valls* (Valencia-Spain) functioning as a *cinema*.

The prism was also o used shape for the general conception of modern buildings. Being a simple geometrical shape, with a high stability, the prism it was often used for the building of religious constructions (churches, temples, etc.).

Fig.4.114 The chapel of the American air force

“The Chapel of the American air force” (fig.4.114) from Colorado Springs, realized on a steel structure, it is an example it this sense [54].

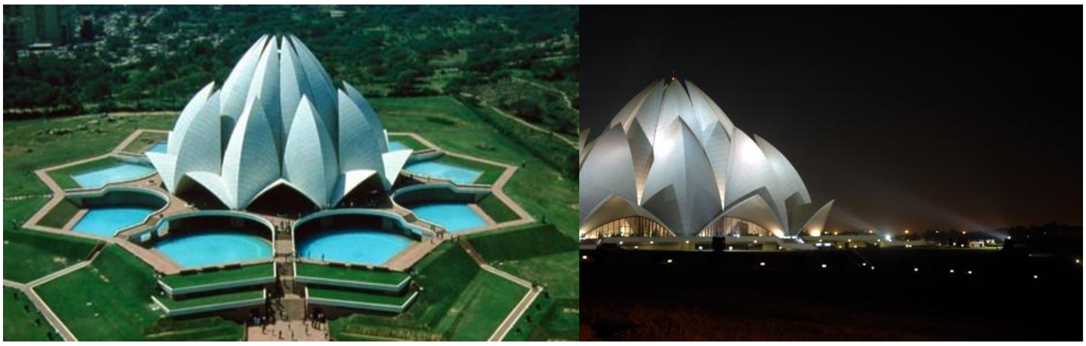


Fig. 4.116 The Bahai “Lotus”,India

Anyway, when the architect’s imagination or the functional and cosmetic necessity asked it, the modern architecture created composed and complex shapes, starting often from shapes created by the nature, like those presented in the fig.4.115(The Church of the Benedict Monastery from St. Louis, Missouri-USA) and the fig.4.116(The Bahai”Lotus” temple from New Delhi- India), in which the self-supported undulated elements who make the roof of the building represents in the same time the structure of resistance of the building, the closings to exterior being actually simple windows for natural light.

This type of buildings, whose simple form, line and the straight rigid angle are replaced of expressive forms which bring out the plastic value of architecture(shapes inspirited from the nature), represents a replica which some “schools”,” trends” and “tendencies” from our days architecture gives it to the functional architecture and its adepts.

According to some authors, [29], the evolution in time of the modern architecture can be spread in three big steeps:

-*The sapper* - it is characterized through the finding and the consolidation of some modern principles in the architecture and a new architectural language, corresponding to the fast evolution of the technique and society;

-*The international style*- in which some architectural tendencies and trends (rationalism, form, function) get a universal character and have a large spread and applicability not only in Europe, but also in SUA, Japan and Latin America, etc. ;

-*The maturity*- the period started at the middle of the XX century, when the modern architecture spread practically in the hole world, but they are starting to configure and to assert to the school some national and local tendencies and trends in the architecture (some of them repelling the other), which respond in principle to the functionalist requirements and also to the ones connected to architectural expression and plastic.

The modern architecture it is a very complex phenomenon and has a large variety of forms of expression, which can hardly be analyzed through some common characteristics.

The only one affirmation which can be considered *a certitude* it is that the contemporary architecture it is in a continuously search of new forms of expression, which have to reflect the fast transformation of the society and also the always growing needs of beauty of the mankind.

CHAPTER 5

THE ARCHITECTURE IN ROMANIA

5.1. Generalities

Analyzing the evolution in time of the culture and civilization of any geographic zone you are tempted sometimes to discover some elements characteristic usual to that zone, which can admit a framing of the zone in the world wide culture, or which can allow at least a classification of the principal cultural components of the that society, and the architectural creation represents an important component of the culture and civilization of a society.

From this point of view it is very hard to put the Romanian architecture in a certain "type" valid on the whole Romanian territory, because in time Romania took the influence of more cultures and civilizations closer or distanced, influence that developed in all domains of the life and also in the architectural creation.

The explication of the diversity of cultural influences from Romania results from the geographic position of our country, in the "border" with great empires and in the intersection of important "roads" which bends the occidental civilization with the oriental civilization, also from the attraction which this territory rich in natural resources had on the great powers of all times.

The principal civilizations and empires which influenced the architecture on the Romanian territory was the *Antic Greek* and *Antic Rome* civilization, and those of the *Byzantine, Ottoman, Russian* and *Austro-Hungary* empires, but always the characteristic elements of these architectures were worked or completed with local elements, taking to the affirmation of some own characteristics.

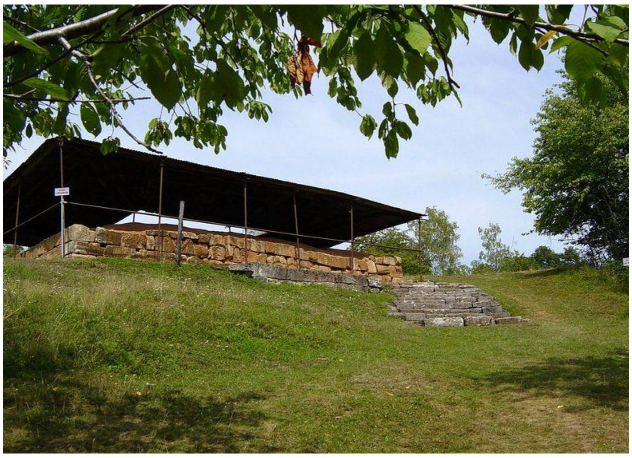
The evolution of the architecture and of the technique in construction on the Romanian territory was described in many ways by different authors ([9], [17], [28], [32], [42]) and the final conclusion of those authors is that from the oldest times till the modern time, the Romanian people proved technique and artistic intelligence in the construction domain, leading to a valuable characteristic architecture.

Surprisingly(considering the multiple influences that has suffered) the Romanian architecture kept in time a continuity character and it can by characterized through a few general distinguishing features:

-the using of the local material of building;
-the adaptation of the building function at life's general requirement;
-the keeping o the human scale in the buildings dimensioning;
-the existence of a high grade of construction creativity;
-the existence of the proportion sense in the relation between the elements;
-mastery in plastic expression;
-adaptation and capacity of assimilation of new elements in architecture;

5.2. The evolution of the architecture in Romania

Analyzing the buildings and architecture evolution in Romania after the model from the chapter 1.2(classification of constructions by "generations" according to work[7]), becomes evident the existence of a constructive original technique on this territory, starting with the *first generation* buildings, which can be the old *dacian fortresses*.



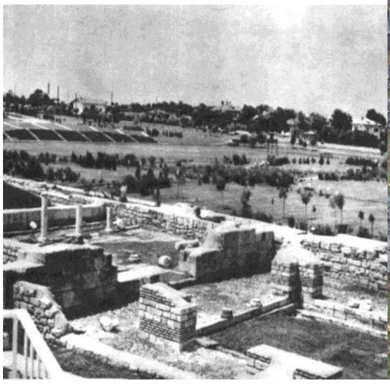
In the first picture we can se Blidaru castle, in the second picture we can se Cetatuia Castle and in the third picture we can se a living tower from Cetatuia.

Paved road at Sarmizegetusa

Massive defense walls

The distinct execution of the massive defense walls of the castles, the material and the massive elements used, made that the most important castles to remain till our days: the fortified complex from Orastie mountains (from *Sarmizegetusa-Regia*) which had on its territory the castles *Costesti*, *Blidaru*, *Piatra Rosie*, *Gradistea* and many others castles spread on a large zone: *Deva* (Hunedoara), *Pecica*(Arad), *Periam* (Timis), *Tilisca* (Sibiu) *Capalna*(Alba), *Polovragi(*Gorj), *Zimnicea* (Teleorman).

In this first generation buildings can be included *old* "*Greek" settlements* situated in Dobrogea zone in the Byzantine empire time (*Tomis*, *Histria*,*Tropaeum Traiani*), at this buildings the elements of Greek, roman and Byzantine architecture are braided with the local elements.



Callatis Tomis Histria

The most "fertile" period from architectural point of view on the Romanian territory was the medieval period in which the Romanian architecture developed in other directions: the **folk, religious** and **civil** architecture.

5.2.1 The folk architecture

The folk architecture developed in the rural surroundings, in a small number of functional programs (houses, farm annex, and churches) and the massive development of the folk architecture can be found in the house building domain and has a vast variety of expressive elements specific to diverse zones of the country.

The utilization of the local building materials (wood, stone, brick, and clay) permitted the building of rich architectural elements, based on the utilization of the folk decorative motive.

The wood for example it was the most used material in the folk architecture, for the realization of some structural elements but also for the realization of some decorative elements, thanks to the rich wood resources in Romania, the easily workability and the cosmetic and physics-mechanics characteristics of the wood.

Wood objects Wood gate Wood Church



Wood gate in Maramures

Wood sculpture

Tooled with chippings and nick's locally specific (fig.5.1), wood was considered as the base element in rural constructions decoration, and this original decoration contributed to the outlining of some specific characteristics in folk Romanian architecture for each geographic zone.

With all the differences locally specific, the Romanian peasant house presents some commune general features:

- vertical development on one or two levels ;
- the existence of a number of two or three main rooms (sometimes more) , and the existence of some secondary (addition to structure) rooms ;
- the existence , in most cases , of an area which connects to the exterior ("transitive" area – see chap. 2.3.1) shaped like an open gallery on columns , on the entire length of the building – *porch* (fig. 5.2.a) or of a *turret* (fig. 5.2.b) ;
- top course with roof of wood , of "framework" type, with covering in tile , having the slope reduced in the hot regions of the country , and more bent in the cold regions (hill and mountain regions) .

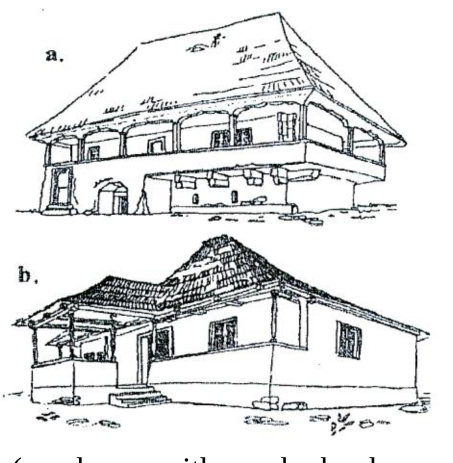


Fig. 5.2 –peasant house (a – house with porch , b – house with turret)

5.2.2. Religious architecture

Religious architecture had an extraordinary development in Romania and the creations of this architecture – *churches*, are the result of the connection of local and foreign architecture influences.

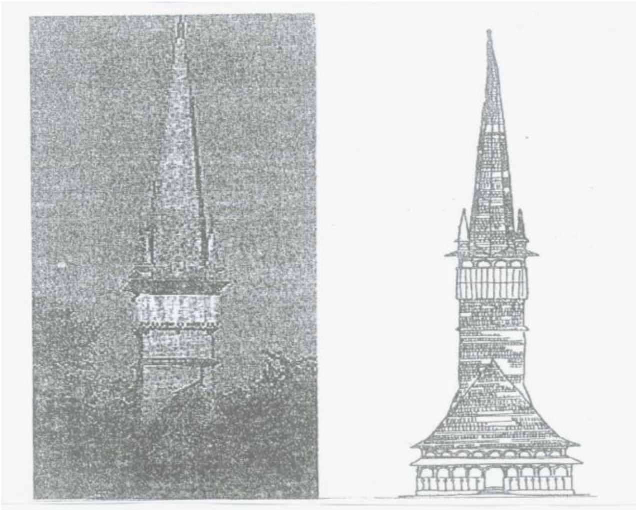


Fig. 5.3 – Church from Maramures made of wood (Surdesti) – foto and drawing [29] .

Rural churches have reduced dimensions and simple shapes, which express sincerity and are made of wood or rubble masonry or brick masonry, and their originally and picturesque are turred particularly in the case of churches from Maramures , made of wood (fig. 5.3) whereat the shapes are simple and hoist , illustrates the simplicity and purity of the judgment of the Romanian peasant .

The foreign influences on the Romanian religious architecture has manifested differently on the country's territory.

In *Tara Romaneasca* the Byzantine architecture influenced the shape in pan of churches, imposing a shape of " *circumscribed Greek cross* " (princely church *Sf. Nicolae din Curtea de Arges* fig. 5.4.a) as well as the church with " *three naves – cusped* " (churches of the monasteries *Cozia,Dealu,Tismana*)

The Church of *Argesului Monastery*, whose dynamic silhouette with 4 towers is covered with a rich decoration of oriental influence:

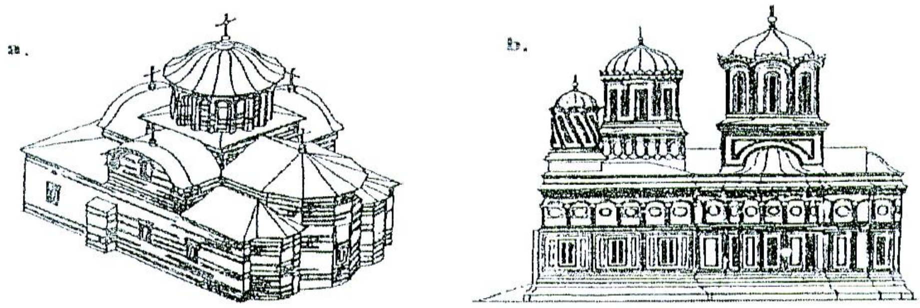


Fig. 5.4 Church Sf. Nicolae from Curtea de Arges and Church of the Monastery Argesului (after [29] and [7]).

Is to be remarked the apparition of an original style " *Brancovenesc* " in Tara Romaneasca , like a design of connecting shapes and local volumes with Byzantine elements , of late renaissance (see chap. 4.9) and of baroque (see chap 4.10) .

The architectural style " *brancovenesc* " is recognized by utilization of opened spaces unto exterior (porch , turret , loggia) , of balustrades and of short columns on which " trilobite “ arcade stays , of frames sculpted in stone at door and windows and it was used in religious buildings and civil buildings of palace type or of landowner mansions .

In fig. 5.5 is presented a laic building done in brancovenesc style (volumetric equilibrated and well – proportioned) namely Palatul Brancovenesc from Mogosoaia , near Bucharest (built in 1702) it can be remarked specific features of the style (turret , columns with trilobite arcade , etc) .

Fig. 5.5 – Palace Brancovenesc from Mogosoaia , near Bucharest [24] .

In Moldova , religious architecture suffered in principal two important influences : gothic and Byzantine , giving birth to an original architecture – “ ***Moldavian*** “ , which imposed between many more original elements and the so called “ ***Moldavian vault*** “ at which the successive decrease of the covering space is obtained by utilization of a successive pendants , diagonal arcs and barrel rings , which make the passing from square plan of large arcs to circular plan of the turret . In fig.5.6 are represented two examples of Moldavian arches utilized frequently to cover the space of the churches from Moldova.

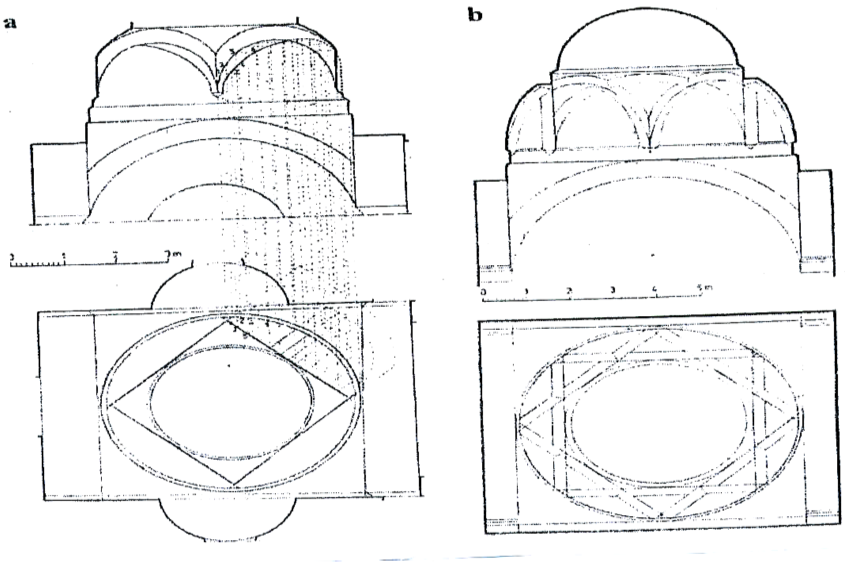


Fig 5.6 – Moldavian arch, [24]

On the other hand, religious Moldavian architecture from the XVI century is characterized by the presence of an open hallway (exonarthex) and by utilization of external pictures on the entire façade of the churches under the form of overlapping registers of frescoes representing religious scenes(for example: the churches of the monasterieries: *Humor,Moldovita,Arbore,Voronet*-fig.5.7 and others)

By plan point of view, Moldavian churches have simple rectangular plans, or "trilobite "plans, having the covering system with cylindrical vault without turret or with Moldavian cylindrical arches with turrets above the nave.

In most cases, churches are made with the help of exterior buttresses for taking – over the arch loads.

Some religious settlements from Moldavia have a character of fortified assemblies they are a group of buildings settled around a precinct having in the middle the monastery church (Putna , Moldovita , etc) .

At the beginning of the XVII century , in Moldavian architecture appear features from the architecture of Tara Romaneasca , with oriental influences , mostly in what concerns the decoration of the facades (floral motives , vertical panels separated by central pipes tied with arcs in accolade , profiles and ribs , etc) .

Fig 5.7 Monastery Church Voronet [25]

Among these churches representative for this style we remark the Monastery Churches *Galata , Bragamina , Solvca , Galia , Trei Ierarhi* from *Iasi* , etc .

In *Transylvania* , religious architecture has developed on the basic principles taken from *Romanic* architecture (see chap. 4.7) and *gothic* (see chap. 4.8) , at which the contribution of local masters (based on nature and economic conditions) have added some particular features , which are : reducing the height of the buildings , reducing the interior and exterior decorations , the absence of swinging arcs , reducing the area of windows , increasing the thickness of the walls , etc , the structural system used is in general the " ***basilica*** " system , with one or 3 naves , covered with gothic arches sustained by broken arcs .

Among the religious constructions representative for Transylvanian architecture are: *Church St. Mihail* from Cluj – Napoca (with 3 naves covered with star like gothic arches, with the renaissance vestry portal and with the baroque pulpit).

The Evangelic Church from Sibiu , Cathedral *Romano – Catholic* from Alba – Iulia (an imposing basilica with 3 naves and transept – fig. 5.8 , realized after late Romanic architecture principles and with sample elements of gothic style) , etc .

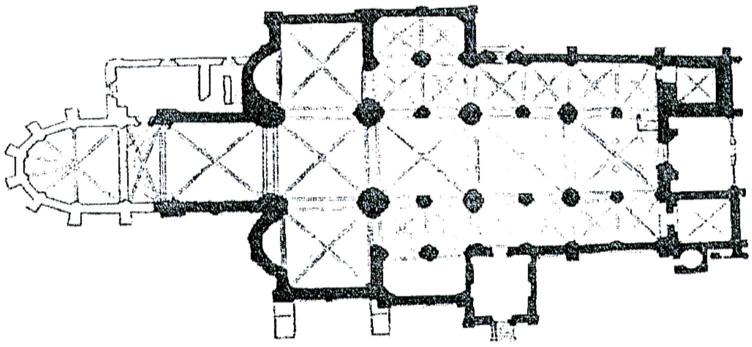


Fig. 5.8 – the plan of Cathedral Romanic – Catholic from Alba – Iulia [24]

Other religious constructions, such as Church of *Iezuitilor Monastery* from Cluj – Napoca , *Catholic Dome* from Timisoara (fig. 5.9 – built between the years 1736 – 1754 after the architectural plans of I.E. Fischer von Erlach) , *Catholic Cathedral* from Oradea , etc. , are representative for the style "*baroque-Transylvanian*" of Austrian influence, in the second half of the XVIII century .

In Transylvania were built a large number of religious edifices with an architecture with renaissance influence or baroque , mixed with local original elements , (cathedrals from *Blaj* and and from *Lugoj* , *Church St. Nicolae* from Scheii Brasovului , etc.) which even though they are constructed with modest dimensions and with " poor " decorations , are representative and priceless for Romanian architecture of XVII century .

Fig. 5.9 – Catholic Dome of Timisoara

Fig. 5.10 – Orthodox Cathedral of Timisoara

Romanian architecture has multiple achievements , very valuable and in orthodox religious edifice domain , churches raised in a lot of regions of the country in the 1st half of the XX century , being creations at which we can meet elements of old Romanian Byzantine architecture . Among the most valuable edifices of this type we can remember Orthodox Cathedral of *Cluj-Napoca* and Orthodox Cathedral of *Timisoara* – fig. 5.10 (arch. I.D. Traianescu).

5. 2. 3 Civil architecture

Civil architecture of XV and XVI centuries is less represented in our country by existing objectives, exceptions being some fortified constructions with an important military character of Moldavia region, leaving marks which can be seen even in our days (castles *Neamt*, *Suceava*, *Roman*, etc.) and which had, among a defensive strategic role, home for the lords of that time and their subjects.

The same character of “fortress “some of the feudal constructions from Transylvania Had, where some cities kept until today their character of feudal fortified city (ex. – Sighisoara, Medias, etc.).

Among the most valuable pieces of midevil civil architecture kept in our country are as specially *Castle Corvinilor* from Hunedoara(fig.5.11) , *Castle Bran* and *Fortress Prejmer*(Brasov).

Fig.5.11 – Castle Corvinilor from Hunedoara

A great development of civil architecture took place in XVII , XVIII , XIX centuries, when on the entire territory of Romania there were built numerous laic edifices, most of them with the role of “ residence “ (mansions , manors , palaces , inns , lordly houses , etc.) , some are representative for architecture in that time and geographical region in which they are placed.

Therefore, in the *Tara Romaneasca* we can speak of : The *Mogosoaia Palace* (in “Brancovenesc” style, see fig. 5.5),The Mansion from *Bajest*i (Muscel area),The *Cantacuzin’s*

House from Magureni(Prahova county),The Palace from *Potlogi* (*Dambovita* county),**The** *Kretulescu* House from Bucharest(beginning of the XIX century) etc.

Also we can observe a lots of civil architecture sets in *Transylvania*, for example: The *Haller* from Sibiu, The Castles from *Cris* and *Fagaras*,The Inn from *Medias* and The "*Magna Curia*" Castle from Deva**,**The Episcopal Palace from *Oradea*, the "*Brukenthal*" Palace from Sibiu (with the face wall build on "pre-classic" style and with some baroque elements on the interior flanks and at the passage portal towards the secondary yard)etc.

We can't find too many civil architecture sets in Moldova in the period of XVII – XVII centuries, because the development of rural life was slower due to the overlong ottoman domination which kept hold of the "semi rural" character of the urban settlement from the area, excepting some *manorial houses*, for example: The *House With Arcades* from Iasi, the *Cantacuzino-Pascanu House* from Pascani, the *Lord's Houses* from "Cetatuia" near Iasi.

In generally in the laic edifices architecture we can observe the interlacing of compositional elements of foreign origin (Byzantine, Gothic, Oriental, Baroque, and Renascent) with traditional and local elements, the result being most of the times original and valuable architectonic compositions.

5.2.4. Modern architecture

We have to make a particular mention about the modern architecture era on the Romanian territory, considered by some authors that started on the second half of the XIX century, along with the formation of the unitary Romanian state and with the creating of the necessary conditions for economic and administrative development of the country.

The modern architecture from Romania was influenced by some foreign architectural styles and currents, but the deepest mark was left by the *classicism*, the *romanticism* and the occidental *eclectic's* percepts.

The influence of the architectural current of the *classicism* in Romania is found in the accomplishment of numerous religious and civil sets on the entire country territory, but the territorial evolution of this current was different, because while in Transylvania and Banat already existed a major influence of *Renascent* and *Baroque* architectural percepts, in the Romanian Country and in Moldova the *Classicism* architecture came in on an unready field from this point of view.

Stirbey Palace

Peles Castle

From the constructions built in Romania by the classicism percept we can remember : "*St. George*" Church from Neamt Monastery, the *Ruset Church* from Botosani, *The Frumoasa* Monastery's Church from Iasi, the *Cretulescu House* from Bucharest the *Stirbey Palace* from Bucharest the *Ghica Palace* from Bucharest the *University Palace* from Bucharest the *Korda Palace* from Cluj-Napoca etc.

The *Romanticism* influence in Romania developed to buildings with different functions(palaces, hospitals, houses, churches etc) and consisted in catching up some constructive and decorative elements from the Gothic architecture(portals and broken lancets ,loopholes, towers etc.),examples in this way being : The *Peles Castle* from Sinaia,The Culture Palace from Iasi,   The *Cuza Palace* from Ruginoasa(Iasi county),The *Librecht and Filipescu House* from Bucharest.

The *Eclecticism* influence in Romania is recaptured especially in the execution of some buildings from the country's capital, Bucharest, but also in other big cities from the country (Iasi, Oradea, Arad, Constanta etc.) according to the Academicism percepts of French origin. Among the most significant edifices of this kind we can remember: The National Bank, The Romanian Atheneum,The CEC Palace from Bucharest,The History Museum from Bucharest,The Casino from Constanta and from Sinaia.

In the last decade of the XIX century and the beginning of the XX century, in Romania starts the release from the French influences and following more a national characteristic generally in arts (also in architecture especially),like a reaction against the currents based on the Eclecticism taking-up of the Classic architecture percepts.

Therefore, in the first half of the XX century came into one's own a band of Romanian architects(*Ion Mincu*,*Petre Antonescu*,*Nicolae Ghica*,*Duiliu Marcu*,*Octav Doicescu* etc.),the initiators of some kind of *national characteristic* in architecture ,which realized in the period during the two world wars, some representative architectonic objectives(houses, culture and art and commercial buildings,banks,society headquarters, mansions, hospitals, hotels etc.) ,which combine the modern style of the European architecture with the Romanian national characteristic.

Like we saw in the 4.13 chapter, the modern architectural creation started in Europe in the XIX century in the "industrial revolution" period, and her development was asserted by the discovery of some new characteristics, superior to the classic ones and by the appearance of new modern technology, for the constructions executions.

In Romania, starting with the XX century(after the second world war) took place a powerful diversification of the functional programs in architecture, being achieved on the whole country's territory an impressive number of buildings(especially laic civil buildings),all having as model the modern architecture percepts and using construction materials with superior characteristics and new and efficient work technologies.

These achievements are the creations of one real *Romanian Architecture School*, whose great representative are the following : *C. Lazarescu, N.Badescu, N.Porumbescu,I. Grigore,R. Bordenache* etc. , which together with a big number of the Romanian Architecture School's partisans manifested their disengagement desire of the formal classic architecture, sometimes considered as being not only overreached by the need and the structural possibilities, but also deprived of aesthetical value and practical usability.

In this period, the Romanian architects are starting to confront with issues attached to the appearance of numerous building functions : *society headquarters, factories and enterprises, big scale sporting constructions, big commercial complex, railway stations, charity institutions, hospitals schools, proletarian hostels, exhibitions pavilions, cinemas, transportation buildings, public buildings, museums, airports* etc.

It is very difficult to pick the significant modern construction examples achieved in Romania, but for edification we present two examples without the demand of saying that those are the valuable of all.

Therefore, in the pictures are represented two modern buildings relative recently realized, with the resistance structure made from reinforced concrete.

The Intercontinental Hotel Building from Bucharest, realized in 1970, with 25 levels and about 80 meters height.

The BRD Bank Building from Cluj-Napoca, realized in 1997, with 12 levels and about 50 meters height.

Analyzing concisely the modern architectural creation from Romania we can distinguish some general conclusions referring to his evolution:

® The modern architecture from Romania was determinate by the fast urbanization of the XX century society and mostly by the spectacular evaluation of the construction materials, of the technologies and of the construction executions techniques.

® Romanian modern architecture constructions were divided on three general architectural courses(*Rationalism, Formalism and* Functionalism)without the existence of "Architectural Schools" with unilateral orientations, but only architects with own creation styles.

® contemporaneous Romanian architecture got through in an normal way the "accumulation" and "searching" period, reaching a maturation and affirmation level which allows her to rival with the architectonical achievements from anywhere.

International examples of modern architecture