Chapter 2
The Elements of Urban Form

Abstract This chapter focuses on the different elements of urban form. The presentation of these elements follows an order of increasing resolution of urban form. It starts with a description and explanation of the different urban tissues that we can find in our cities. It then increases the resolution and moves to the natural context and to the system of public spaces that constitutes each urban tissue, analysing both the spaces for circulation and permanence. The chapter moves then to plots which are, in our cities, the physical expression of individual property and, usually, distinct from the public or collective space. Once again increasing the level of resolution, the chapter moves to buildings, including both singular and common buildings.

Keywords Elements of urban form · Urban tissue · Streets · Street blocks · Plots · Buildings

The different elements that constitute the physical form to our cities is the theme of this chapter. Each of the main elements of urban form is isolated from its context, enabling a more effective analysis and understanding. This analytical exercise is not 'neutral' and it somehow implies the previous existence of reading instruments to organize and structure these elements. Yet, we have tried to minimize the role of the 'researcher' and to focus on the 'object', the city. The role of the 'researcher', and of its instruments for description, explanation and even for prescription, will be discussed in Chaps. 6 and 7, which will consider the different ways that distinct researchers use to deal with the same object, the city.

2.1 The Concept of Urban Tissue

Cities are, in morphological terms, extremely complex objects. In other words, cities are objects composed of different objects or distinct parts. It is possible to identify several relationships between these objects 'from the part to the whole' and to recognize a hierarchy in these relations. To deal with the complexity of cities, urban morphology uses this hierarchical view of the city, structured according to a set of fundamental physical elements.

V. M. Araújo de Oliveira, *Urban Morphology*, The Urban Book Series,
https://doi.org/10.1007/978-3-030-92454-6_2

At a general level, the city is composed of urban tissues. Karl Kropf, in his paper 'Urban tissue and the character of towns', strongly influenced by the Italian tradition, defines urban tissue as an organic whole that can be seen according to different levels of resolution. These distinct levels correspond to different elements of urban form. The higher the level of resolution, the greater the detail of what is shown and the specificity of morphological description (see also Fig. 7.4 in Chap. 7). At a very low level, the urban tissue includes only streets and street blocks. At a high level of resolution, the tissue might include several details, such as construction materials of an open space or building (Kropf 1996).

In general, all cities and their tissues are constituted by a set of elements of urban form—streets (in a broad sense, including open spaces for circulation and permanence), street blocks, plots, and buildings. Yet, in each city these streets, street blocks, plots, and buildings are combined in a specific way, originating different types of tissues. Some of these tissues are clearly identifiable, offering their cities a unique character. Each of these urban phenomena is deepened by the 'time' factor, as many of our cities are the result of long processes of construction, developed over centuries, and where different layers are continuously overlapping without erasing the previous layer. The notion of 'palimpsest' is often used in urban morphology to explain this continuous construction over time (we will get back to the notion of palimpsest in Chap. 6 when presenting the work of Gustavo Giovannoni).

Figure 2.1 presents, approximately at the same scale, eight cities in four different continents, with some urban tissues that are clearly recognizable: Brasilia, with a relation between (or a percentage of) open space and built form clearly favorable to the former; Djenné, in Mali, with a central and very compact urban occupation in clear contrast with the periphery; Venice, with its exceptional geographical context marked by the strong presence of water and with an extremely compact urban fabric; New York, with an extremely regular pattern of streets and buildings alignment, and a wide range of buildings height (New York will be analysed in detail in Chap. 5); Barcelona, with its rigorous grid—forming octagonal open spaces in the street crossings—only broken by the large Diagonal, and with its homogeneous alignment of buildings; Paris, with the large radial streets conformed by built forms with uniform alignment and height; Rome, with a very dense layout of small street blocks interrupted by a number of monuments and squares that offer the city a high level of intelligibility; and finally, Sana'a, in Yemen, in clear contrast with the first urban tissue (Brasilia), with a relation between open space and building fabric that is clearly favourable to the latter.

The same way we can find different urban tissues in distinct cities, in different continents, we can also find distinct urban tissues within the same city. Figure 2.2 shows—once again, at the same scale—four different tissues within the apparently homogeneous fabric of New York. Indeed, these tissues are included in only one of the five boroughs of the city—Manhattan.

The first tissue is in the Downtown area around Wall Street. Wall Street takes its name from the seventeenth-century wall located in this street. Its current importance is due to its central role in the global financial markets. The surrounding area, with a very rich urban history, is characterized by a pattern of narrow streets, forming

Fig. 2.1 Urban tissues of eight different cities, approximately at the same scale: Brasilia, Djenné, Venice, New York, Barcelona, Paris, Rome, and Sana'a. *Source* Google Earth

street blocks of irregular shape and small size, including a few plots and buildings. These buildings correspond to very large volumes given by their large block-plans (footprints) and heights.

The second urban tissue is the Soho area around one of its most notable streets, Greene Street. This area is made of more regular street blocks, with larger areas than in the previous tissue, with a reasonable number of plots and buildings. The buildings

Fig. 2.2 Different urban tissues in New York city, approximately at the same scale: Downtown, Soho, Harlem, and Stuyvesant Town. *Source* Google Earth

height is similar to the streets width. A fundamental factor for the high quality of this built environment is the excellence of its iron buildings, erected between 1869 and 1895. Another factor that should be noted is the great mixture of uses, which contributes, in an undeniable way, to the urbanity of this area.

The third urban tissue is the famous black neighbourhood of Harlem, in particular the area around the 125th Street (Martin Luther King Boulevard). Unlike Soho, this part of New York is clearly marked by the residential use, except for the 125th Street which is a truly commercial street. The street blocks of Harlem are larger than those of Soho, and include a higher number of plots and buildings. Yet, there is a significant number of vacant plots which, somehow, contributes to a decrease in the urban quality of this neighborhood.

Finally, the fourth urban tissue is Stuyvesant Town, a private residential development located east of Gramercy Park. Contrary to the previous tissues, in 'Stuy Town' the open space prevails over the built fabric (although this dominance is not as expressive as in Brasilia), and the area does not have a plot structure. The number of street blocks and buildings is very low when compared with the previous tissues. It has large dimensions, comprised between the 14 and 20th streets, and a strong formal homogeneity.

2.2 The Natural Context

The natural context is the first condition for the establishment and organization of the different elements of urban form. The land relief, the quality and suitability of soil and subsoil, the climate, the solar and wind exposure, the type of natural landscape—all these factors influence how a settlement is established, from its foundation, from the first paths and streets (and, subsequently, from all the infrastructures that would be built in these streets) to the way land is sub-divided into a number of different parts, to the various buildings that are built in these plots, and even to the materials that, at least until recently, would give expression and surface to all these forms.

In each initial intention of human settlement, in different historical periods, topography has its own configuration and geometry influencing its location and form. Rosália Guerreiro's master and doctoral theses, 'O território e a edificação' and 'Urbanismo orgânico e a ordem implícita', synthesize a number of key elements on this influence of land relief in human settlements. These are summarized, very briefly, in the two following paragraphs (Guerreiro 2001, 2011).

Generally, the land relief can be divided into two categories. In addition to the basic forms of land relief or micro-relief (a hill, a promontory…) there is a number of composite forms, the macro-relief or the structural relief. The formation of these forms is associated with endogenous forces that originated the process of geomorphologic formation of the continents. The structuring lines of the territory are as follows: the ridge lines corresponding to imaginary lines connecting the maximum elevation points and dividing the flow of water in opposite slops; and the lines of thalweg, linking the lowest elevation points, promoting the natural drainage of water to downstream. Both ridge and thalweg lines are associated in branched hierarchical systems forming the orographic and hydrographic systems. The points where ridge lines and thalweg lines are ramified are the singular points of the territory, usually referred to as distribution centres and encounter centres. There is also a third system of territory lines—the contour curves, cutting perpendicularly the ridge and thalweg establishing the relationships between them.

In different human settlements, the definition of the first paths follows this natural structure of territory, strengthening its own configuration and geometry. Indeed, ridge, thalweg, and contour curves represent the lines where the effort to overcome the slope is smaller. As such, for centuries, these were the lines of movement. The place where these lines of movement get together—the notable points of the territory—became the central places (Fig. 2.3).

Figures 2.4 and 2.5 illustrate the importance of land relief to human settlements. It is impossible to imagine the urban forms of Machu Picchu (Peru), Masada (Israel), Saint-Michel (France) or Lhasa (Tibet) without considering the land relief. The city of Machu Picchu, built in the fifteenth century (and abandoned in the following century after the Spanish conquest) by the Inca civilization in the Andes, at almost 2,500 m above sea level, is one of the most remarkable examples of integration between human settlement and natural support. The city was structured in a set of terraces, ramps and stairs, around a central 'square' and included about 200 buildings distributed

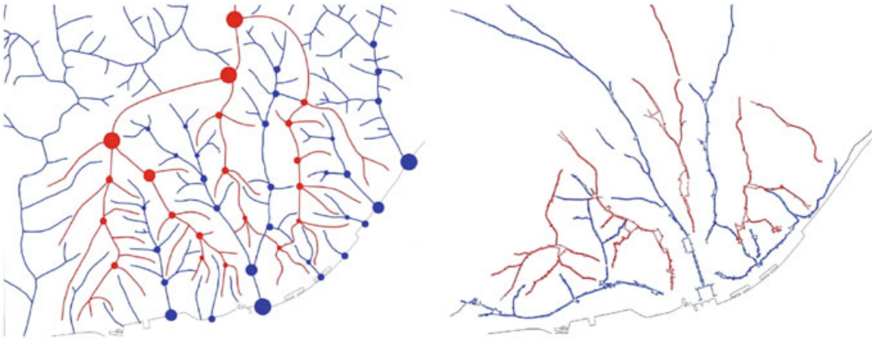

Fig. 2.3 Physiography of the physical support (ridges in red, thalwegs in blue; distribution centers in red and encounter centers in blue) and of the street system (ridge streets in red, thalweg streets in blue) of Lisbon. *Source* Guerreiro 2011

by religious, agricultural, industrial and residential areas. The second example is Masada, a fortified settlement built by the Jews in the Judean Desert near the Dead Sea at about 400 m altitude. Similar to Machu Picchu, Masada had a short period of occupation, being conquered by the Romans in the first century. A key element in the life of this settlement was a sophisticated water supply system.

The building complex made of the *Potala* Palace, *Jokhang* Temple, and *Norbulingka,* built by the Tibetan monks from the seventh century onwards on the Red Mountain at 3,700 m of altitude, is another notable example of the relationship between man and nature. Finally, the last example, linking Figs. 2.4 and 2.5, is Saint-Michael. Saint-Michael is a small settlement in Normandy, France, developed around a Benedictine abbey, built between the eleventh and sixteenth centuries. The uniqueness of this settlement is due not only to the dialogue with the land relief, as in the three previous cases, but also with water—when the water rises the settlement site becomes an island.

As in the previous cases, we cannot imagine Varanasi or Venice without their relation to water (Fig. 2.5). Indeed, the Italian city, founded in the fifth century, constituted by 120 small islands and a wide set of channels, is a singular case of relationship between human occupation and the lagoon where it is settled. The relationship between Varanasi and the Ganges River is also very intense. While the urban forms of this Indian city seem to touch the river, the life of its inhabitants is inseparable from the Ganges, using it in numerous actions including bath, laundry, and funeral services.

Depending on the concept of city (bounded, in a very simplistic way, between an organic model and a rational model), the influence of the natural context can have different degrees. This influence can also vary between different parts of the same city. Let us return to the example of Manhattan in New York. The establishment of a settlement on an island clearly influenced the way how, in the oldest part of city, faced with shortage of land, buildings height started to increase. However, if we move to another part of the island, for instance, a northern area where in the early nineteenth

Fig. 2.4 Relationships between urban forms and natural context—land relief: Machu Picchu, Masada, Lhasa and Saint-Michel. *Source* Photographs by Filipa Neiva (**a**), Urszula Zdzieborska (**b**), Jan Reurink (**c**), and Cláudia Lira (**d**)

Fig. 2.5 Relationships between urban forms and natural context–water: Venice and Varanasi. *Source* Photographs by Sara Guedes (**a**) and Jorge Correia (**b**)

century the regular grid started to be implemented, we can see that the rugged relief was not an obstacle for the construction of that grid. Furthermore, if we continue to move north, we arrive at the magnificent Central Park, where the 'apparently natural' physical support was, in fact, built by man.

2.3 The Streets System

It is through the streets system (in the generic sense, including avenues, boulevards …) that we travel, and start to know, a city. Streets define the different street blocks, distinguishing what is 'public', and is therefore accessible to all citizens, from what is private or semi-public. Streets are, in broad terms, the public and democratic space of the city, the place where we all met, with all our differences, and where we all interact in social terms.

All these possibilities of interaction are restricted when we move from the streets to the interior of buildings. Bill Hillier, the founder of Space Syntax, wrote, in a paper submitted to the International Space Syntax Symposium (ISSS), that social differences have no expression on streets. This British author argues that streets 'do not reflect the society' (or the most negative aspects of society), and that, on the contrary, streets can gather in space what society insists in dividing. In addition, Hillier argues that the livability of streets is probably the most relevant indicator of the presence of a strong civil society (Hillier 2009).

In morphological terms, and in a temporal perspective, streets are the most stable element of urban form. While the physical process of city building is something that 'takes time', involving permanent transformation, the streets system of a city is the one that offers greater resistance to this process of urban transformation, attaining a great temporal stability. The plots system has a lesser durability than the streets system, and the buildings system has a lower stability than these two.

There is a wide variety of streets, with different shapes and sizes, distinct ways of relation with surrounding streets, and different functions. The analysis of each of the main elements of urban form that we are developing in this chapter does not ignore that, for instance, the character of a street is influenced by other elements of urban form shaping it. This character is actually influenced by plots on one or both sides of the street; by buildings (by their height, and the relation between their height and the width of the street); by the way buildings are located on plots, sometimes near to the plot frontage, offering the street a higher sense of enclosure, sometimes far from the plot frontage, offering greater openness to the street; or by the ground-floor and the 'doors' these buildings open to the street. Another important issue when analysing the streets system, that will be developed in later chapters, is how in each street the space for pedestrians and vehicles (public or private, motorized, or non-motorized) is divided. 'Great streets', by Allan Jacobs, is an example of a notable book on the streets of our cities (Jacobs 1993).

Figure 2.6 presents a diverse set of streets in four different cities. The first photographs address the intersection of two of the most important streets of New York: the Broadway, which crosses the whole Manhattan island in the north–south direction, being the only street with an irregular pattern on the orthogonal grid of the city; and the 5th Avenue (with 10 km long and 30 m wide), which is perhaps the most famous of the eleven avenues of New York.

The two following photographs refer to the *Avenue des Champs Elysées* in Paris, one of the most important symbols of Baron Haussmann' s intervention in the French

Fig. 2.6 Different streets in different cities, approximately at the same scale: Broadway, intersection with the 5th Avenue, in New York; the Champs Elysées in Paris; the Via *Rinaldini* in Siena and the *Reguliersgracht* in Amsterdam. *Source* aerial views—Google Earth; photographs by the author

capital in the second half of the nineteenth century (see Chap. 3). This is an axis of 2 km long and 70 m wide (in its western part which is clearly more urban), conformed by a homogeneous set of buildings. Building height is clearly inferior to the street width, which gives *Champs Elysées* a strong sense of openness. It has a strong presence of trees, and very different uses including shops, cafes, and cinemas. This avenue is part of a longer axis with a fundamental importance in the city, linking *La Defense* and the *Louvre* Museum.

The third set of images refers to a small mediaeval street in Siena, Via *Rinaldini*. This street is directly linked with the famous square of the city, *Piazza del Campo*(that will be analysed in the following paragraphs). Via *Rinaldini* is less than 50 m length and 5 m width. Despite the clear differences in relation to the two previous streets, we should highlight that the cross-section of this street is somehow close to the cross-section of the 5th Avenue, where the building height is clearly higher than the street width.

Finally, the fourth set of photographs addresses the *Reguliersgracht*, one of the streets of Amsterdam, within the so-called 'ring of canals', an area that started to be built in the early seventeenth century. The built environment of Amsterdam—as well as of other Dutch cities—is marked by a sound presence of water. As such, the cross-section of the street (the street is about 30 m wide and 600 m long) is clearly different from the previous examples. Indeed, it includes the canal and on each of its sides a street with three different spaces: for pedestrians, vehicular traffic (distinguishing it from the urban environment in Venice where there is no vehicular traffic in the historical city), and car parking.

The public spaces system of a city includes not only the open spaces for movement, which we designate in a simplified way as streets, but also the open spaces for permanence, which we designate as squares and gardens. All this diversity of streets, described in the previous paragraphs, can also be found in squares.

Figure 2.7 presents four squares in three different continents. The first is Times Square, New York, located at the intersection of Broadway and 7th Avenue. While, in morphological terms, this square is no more than the intersection of the two streets, with no particular conditions inviting for a staying (somehow similar to Picadilly Circus, London), Times Square is full of people at any time of day or night. In terms of uses, the square is in the heart of the theater district and includes cultural and commercial activities contributing, not only to the dynamics of this space but also, to the consolidation of the image of the square through a significant number of attractive neon lights. Our collective imaginary is undoubtedly informed by the traditional party in the New Year's Eve, when a crystal ball falls from the top of the number 1 of Times Square.

The second square included in Fig. 2.7 is the *Place Georges Pompidou*, Paris, near the former market of *Les Halles*. This square is clearly different from the previous, both in morphological and functional terms. It has a clearly defined shape, a rectangle of about 175 m long and 70 m wide, and a slope upwards from the entrance in the *Centre Georges Pompidou*, that establishes its eastern limit, up to the buildings of the *Rue Saint-Martin,* that constitute its western boundary. This immense sloping surface is one of the fundamental characteristics of the square and it is a key element

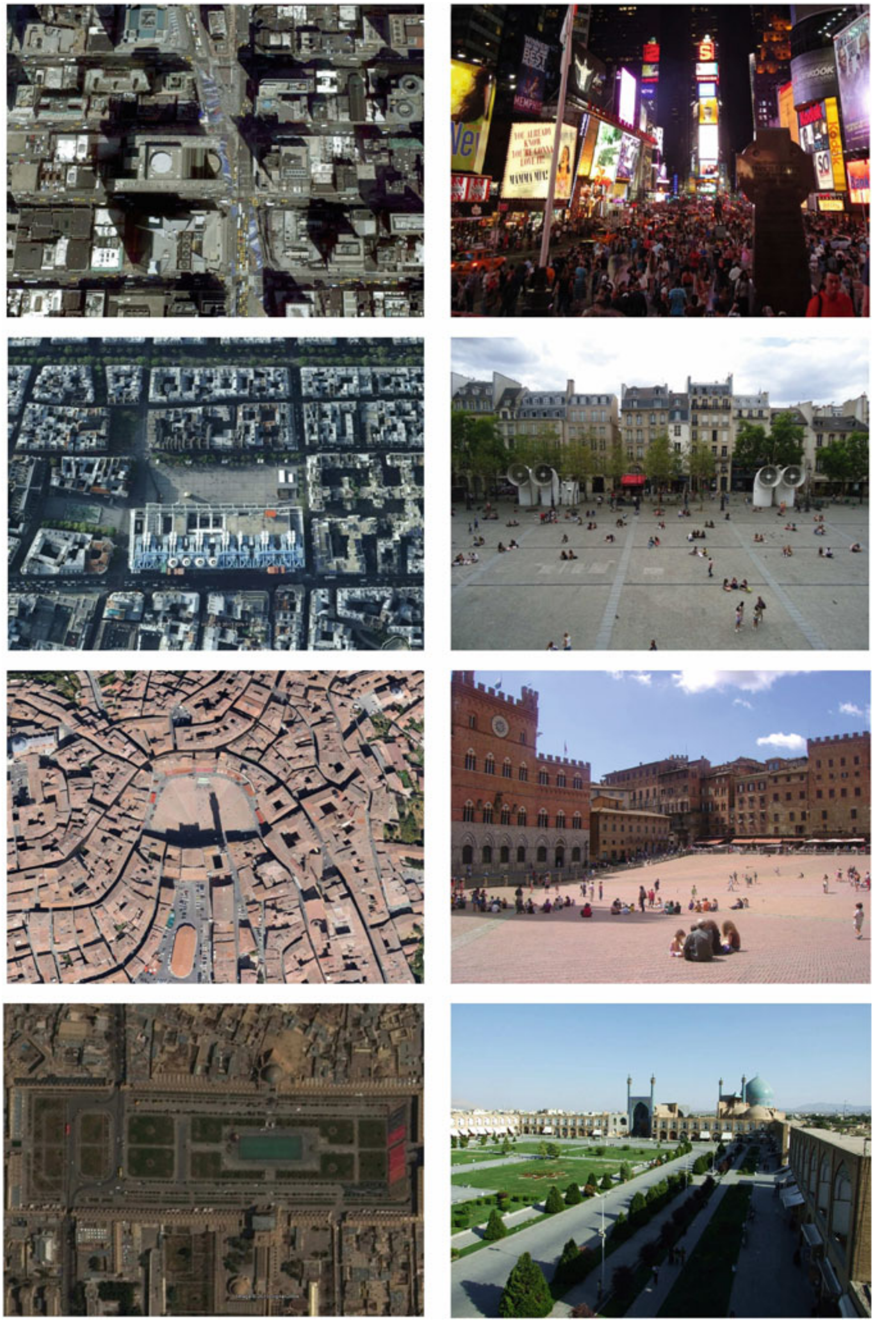

Fig. 2.7 Different squares in different cities, approximately at the same scale: Times Square in New York, *Place Georges Pompidou* in Paris, *Piazza del Campo* in Siena and *Meidan Emam* in Isfahan. *Source* aerial views—Google Earth; photographs b, d and f by the author, photograph h by Jorge Correia

inviting people for different activities, from the simple lay down to various artistic performances. In terms of function, this square is clearly distinguishable from the first because it has a strong artistic dimension, due to the presence of the remarkable *Centre Georges Pompidou*, built in the late 1970s. As a complement, the *Place Igor Stravinsky* (south of *George Pompidou*, in Fig. 2.7) including a set of modern sculptures and the Stravinsky Fountain, should also be referred.

One of the most famous squares in the world, particularly among those studying the physical form of cities, is the *Piazza del Campo* in Siena. This Italian square, dating from the twelfth century, has a shell shape and it is delimitated by several notable buildings (*palazzi*) with different height (five to seven stories). Similar to the *Place Georges Pompidou*, this square has a wide sloping surface—following the city topography—with the lowest point in the northern part, in the entrance to the town hall, the *Palazzo Pubblico*. One of the most famous events taking place in the square is the *Palio*, a horse race which dates to Roman military exercises.

The last example included in Fig. 2.7 is the *Meidan Emam* in Isfahan, Iran. This large square, 520 m long and 160 m wide, has a rectangular shape (similar to *Place Georges Pompidou*) and it is delimitated by a continuous building complex, two stories, with a double colonnade. A few exceptional buildings stand out in this set—two notable mosques, classified by the United Nations Educational, Scientific and Cultural Organization (UNESCO), and a palace. The northern part of the square leads to the *Bazaar*. In addition to accommodating some exceptional functions, the square is intensively lived by local people for many different activities. Contrary to the three previous cases, there is not a strong presence of foreign tourists in Isfahan (mainly due to the international isolation of Iran).

As we can find substantially different urban tissues or streets in the same city (as we have seen in the example of New York), we can also find different squares with clearly distinct forms and functions in different parts of the same city. The following paragraphs, and Fig. 2.8, illustrate this phenomenon in Paris.

The first example included in Fig. 2.8 is the *Place Vendome*, in the *Tuileries* area. This square was built in the early eighteenth century (it is the latest example of this set). It has a rectangular shape (octagonal cut in the corners), 140 m long and 120 m wide; it is crossed by one street only—the *Rue de la Paix*, and it is made of a group of homogeneous buildings (architectural style and height). *Place Vendome* is the home of several fashionable shops.

The *Place des Vosges*, built in the early seventeenth century in the *Marais* area, is the second example. Slightly larger than *Place Vendome*, *Place des Vosges* is a 140 m square, configured by an extremely homogenous group of buildings comprising 36 houses (nine in each of the four sides) containing an arcade around the whole perimeter of the square. The centre of *Place des Vosges* is a green. The access to the square from the *Rue de Birague* is made through the arcade. As such, the square is delimitated by one important street only, the *Rue du Pas de la Mule*, at north.

The third example is the *Place des Victoires*, in the *Tuileries* area, nearby *Place Vendome*. This square, of circular shape, is smaller than the previous two—approximately 75 m diameter. As these two, it is defined by an homogeneous set of buildings, four and five storey. The square was built in the seventeenth century to frame the

Fig. 2.8 Different squares in Paris, approximately at the same scale: *Place Vendome*, *Place des Vosges*, *Place des Victoires,* and *Place Dauphine*. *Source* aerial views—Google Earth; photographs by the author

statue of Louis XIV. Although it is a very interesting example in terms of urban form, hosting important fashion shops, the square is not much more than a roundabout.

The *Place Dauphine* is in the oldest part of the French capital, the *Ile de la Cité*. This last example is clearly different from the previous three cases: the square has a triangular shape (with an area that is larger than the Place des Victoires and smaller than the other two cases), and its buildings are more diverse than the previous ones, both in terms of height and architectural style, revealing the action of different agents.

The following paragraphs, and Fig. 2.9, illustrate the same phenomenon in Rome. As mentioned above, Rome is a city of a very dense layout made of small street blocks interrupted by several notable squares. Let us focus on four of these squares, *S. Pietro, Campidoglio, Navona,* and *Rotonda*. The *Piazza S. Pietro*, with a dominat religious nature, is located east of the *Tevere* River, within the Vatican territory. The square, the *basilica* and the colonnade (four columns deep) shaping it, were built in the sixteenth and seventeenth centuries. The square has a complex shape, composed of an ellipse (200 m long and 150 m wide) and a trapezoid (where the parallel sides have approximately 100 m and 115 m long and are distanced 100 m). The square is part of a wider composition, being the western limit of a strong axis defined by the Via *della Conciliazione*, which is bounded at east by the *Castel Sant'Angelo*. While the exact centre of the square is marked by an obelisk, two different fountains appear to be the two centres of the ellipse.

The second example included in Fig. 2.9 has a rather different nature, shape, and size. The *Piazza del Campidoglio* is in the historical kernel of Rome. The square and the three surrounding *palazzo* were built or restored in the sixteenth century, as a new civic centre for the city. It now gathers civic and museologic functions. The *Piazza del Campidoglio* has a trapezoidal shape. The bases of the trapezoid have approximately 55 m and 40 m and are distanced about 75 m (it is substantially smaller than *Piazza S. Pietro*). The square has a notable pavement with an oval geometric layout and, in the centre, an equestrian statue. Limited at east by the *Pallazo Senatorio*, the axial composition of this set includes, at west, a wide-ramped stair (the *cordonata*) connecting the square to the Via *del Teatro di Marcello*.

Contrary to the four Parisian squares presented above, the four Roman examples have a strong touristic dimension. That is the case of *Piazza Navona*, located north of *Corso Vittorio Emanuelle II,* which has an intense social life. The square as we know it was established in the seventeenth century. Its peculiar shape, a long rectangle of about 250 $\times$ 50 m with round ends (a proportion of about 5:1, where the largest dimension is higher than the largest dimension of *S. Pietro*), draws on the ruins of a stadium erected in the first century. Three notable fountains (*Nettuno*, *Quatro Fiumi,* and *Moro*, from north to south) have a central role in this remarkable baroque set. In addition to the numerous cafes, restaurants, and shops, *Navona* includes the church of *Sant'Agnese in Agone*.

The last example is *Piazza della Rotonda*, located 250 m east of *Navona*. The square was defined in the fifteenth century. Yet, the surrounding building fabric dates from earlier periods. That is the case of its main building, the Pantheon (the church of *Santa Maria Rotonda*, giving the name to the square), dating from the first century. As we can see in Fig. 2.9, the square is considerably smaller than the

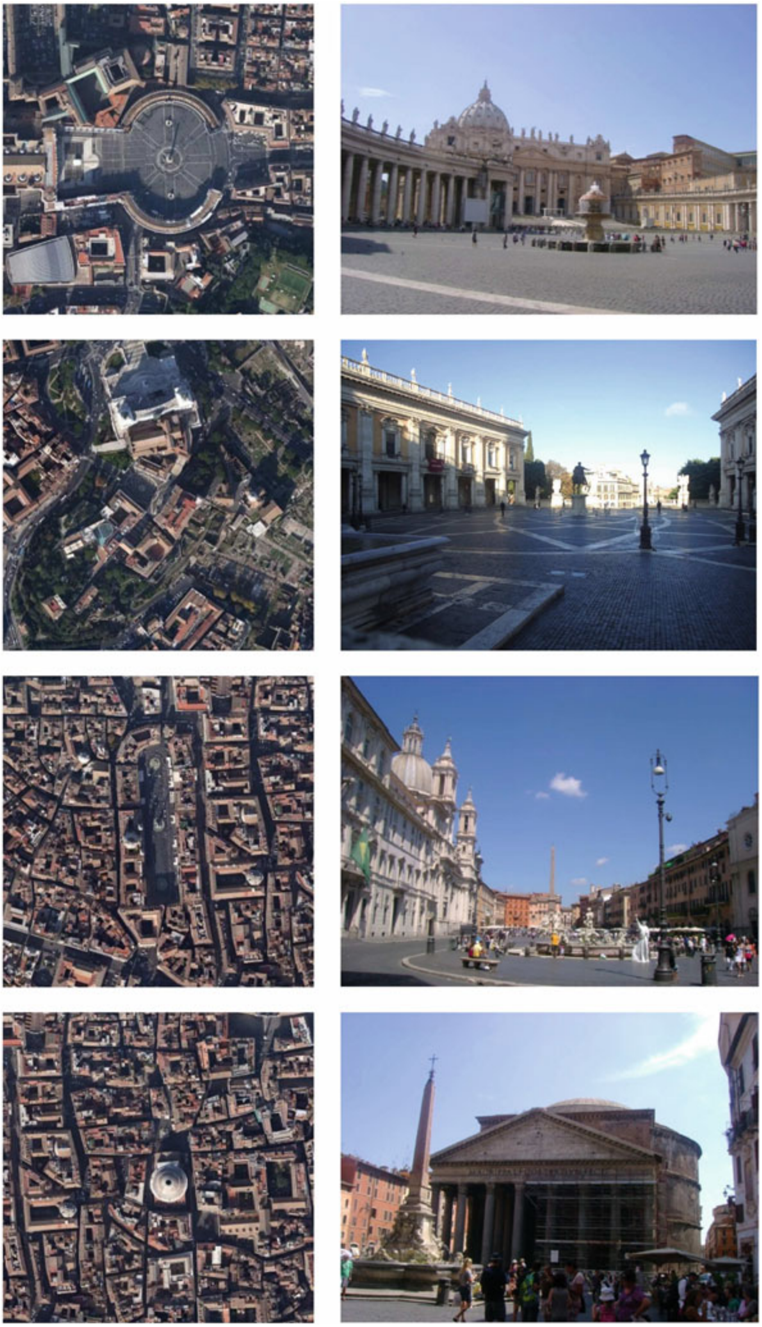

Fig. 2.9 Different squares in Rome, approximately at the same scale: *Piazza S. Pietro, Piazza del Campidoglio, Piazza Navona,* and *Piazza della Rotonda. Source* aerial views—Google Earth; photographs by the author

other three examples. It has an irregular shape near to a trapezoid. The bases of the trapezoid have approximately 45 m and 35 m and are distanced about 60 m. The square has a fountain with an obelisk in the centre. The square has many cafes and restaurants.

2.4 The Plots System

As mentioned above, the plots system of a city is one of the most important elements of urban form, separating the public and private domains (or the different private domains). Nevertheless, the role of this fundamental system is often neglected by the main agents and stakeholders in the process of city building, largely because of the, apparently, reduced urban visibility of plots.

The definition of the plots system in a territory is an essential element of its urbanization process and has considerable stability over time. The decision on what would be the new structure of private ownership in a particular territory might involve the subdivision of a set of large plots—for instance, plots of former rural use—or the proposal of a new land division. The subsequent stage of this urbanization process usually involves the precise definition of the different plots: (i) how is each plot related with the street? (what is the size of plot frontage? what is the orientation of the plot in relation to the orientation of the street?); (ii) what is the position of each plot within the plots system? (is it in the middle or in the edge of the street block? is it located in a long side or in a short side of the street block?); and (iii) what is the shape of the plot, and what are its dimensions and proportions? It is essential that we acknowledge that these definitions, taken when each plot is laid down, will condition the future options in terms of building types and, as such, have a significant impact on the urban landscape.

Although there are considerable differences between each specific context, in many cities the processes of plot subdivision and plot amalgamation are not very common. This means that the choices that we make, as agents, in very early stages of the urbanization process will condition, for long periods of time, the urban forms that in the future will be built in the city. It is also important to refer that, although the city suffers many kinds of disturbances over its 'life'—such as wars, fires, earthquakes, tsunamis, to name just a few—that could be used as a pretext to erase the pre-existing plots system (or parts of the plots system) and to create a new plot structure. Yet, in most of the cases, this does not happen, and the pre-existing plots system is maintained.

An important element in the description and explanation of the physical form of the city is the dimension of its street blocks and, within these, of its plots. In general, the dimension of street blocks and plots increases as we move from the historical centre to the peripheral parts of the city. Yet, there are some exceptions. These exceptions are not negligible, and they contribute to the identity of each city—in this regard, the concept of fringe belt will be presented later in Chap. 6. Another important element is the number of plots per street block, as it somehow expresses the greater or lesser diversity of agents and stakeholders—and of urban strategies—that are present in the street block. Contrary to the size of street blocks, in general, the number of plots per street block decreases as we move from the historical centre to the peripheral parts of the city.

Figure 2.10 illustrates the plots system of central Pingyao. This plan is included in the paper 'Extending the compass of plan analysis: a Chinese exploration' by Jeremy Whitehand and Kai Gu (2007). Located nearly 500 km south-west of Beijing, Pingyao is a city that is notable for the survival of its traditional form. It is roughly a square-shaped walled city, with a significant number of planned streets and plots. Figure 2.10 presents the complex plots system of the city. Plots can be distinguished according to the extent to which they depart from a regular rectilinear form, as the result of modifications to the boundaries of plots since they were originally laid out. Figure 2.11 focuses on three different parts of the walled city, with different degrees of change. In the first part, characteristic of the central and southern areas of walled

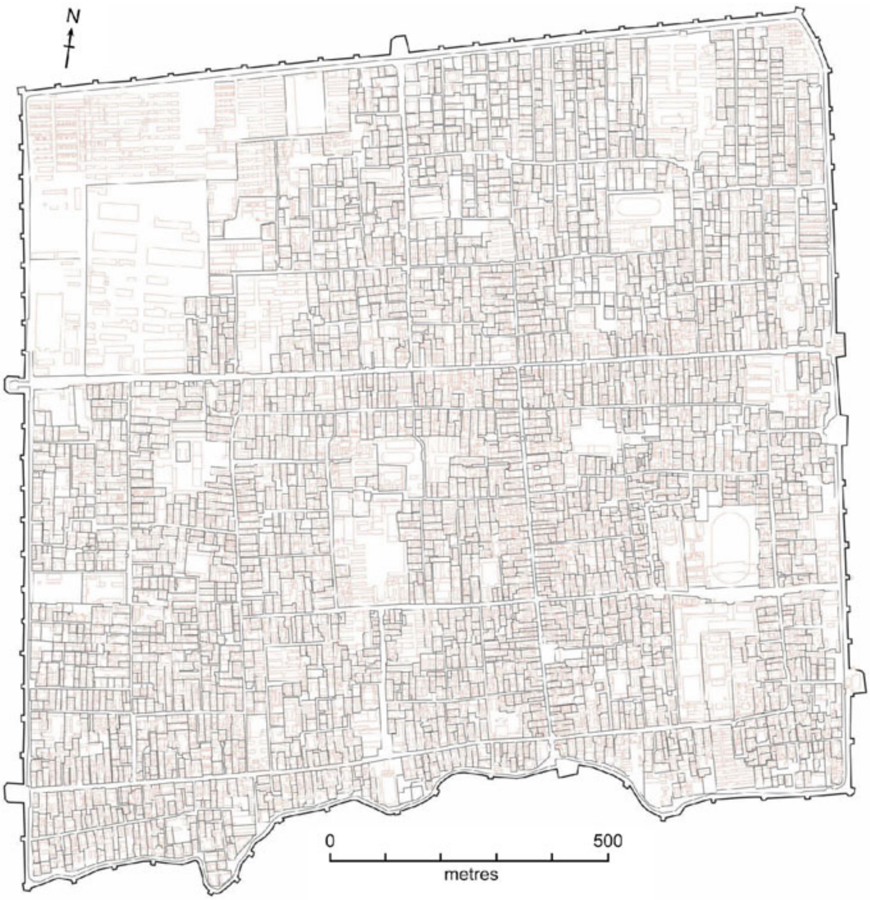

Fig. 2.10 Plot boundaries in central Pingyao, in 2000 (Whitehand and Gu, 2007)

Fig. 2.11 Plot boundaries in central Pingyao—three different parts (Whitehand and Gu 2007)

Pingyao, the irregular shapes of plots reflect the very long time span over which they have been exposed to forces for change. In the second, characteristic of the former western and northern city limits (former city wall), the shapes of plots reflect the strong influence of more recent planned plot series. Finally, in the third part, characteristic of the current northern and western areas of walled Pingyao, there is a greater regularity of plots and street system.

Let´s now take a small part of a city. *Rua do Almada* is a fundamental street in the urban history of my city, Porto (Fig. 2.12). The construction of this street in the second half of the eighteenth century was promoted by the so-called *Junta das Obras Públicas*, a public agency responsible for urban planning and management. *Rua do Almada* is 800 m long and 10 m wide. It links two different squares, *Largo dos Loios*, at south (smaller), and *Praça da República*, at north (larger). As shown in Fig. 2.12, the street consists of ten street blocks and 214 plots. The largest street block of this set is located south of the *Praça da República*, including 58 plots. In a significant part of these 58 plots, frontage is about 5 m and depth ranges between 20 and 90 m. Over more than two centuries in the 'life' of these plots, buildings were conserved recurring to small maintenance works. Yet, eight buildings erected in the last decades of the twentieth century can be found in these 58 plots. However, even in this set of eight buildings, seven were built in the original plots of the eighteenth century, and only one building was erected on a plot resulting from plot amalgamation (of two different plots). In *Rua do Almada* the establishment of a particular type of plot, long and narrow, led to the emergence of a particular type of building. Due to the reduced dimension of the plot frontage, the building type had to adopt an in-depth organization, usually with more than 15 m depth. This in-depth organization of the building has led to the location, in each storey, of one (or two) room (s) near the two facades and of a staircase, and of one (or more) rooms in the interior of the building.

The German geographer MRG Conzen, whose work will be analysed in detail in Chap. 6, was one of the main promoters of the study of the plot to describe and explain the physical form of a city. One of the concepts proposed by Conzen is the burgage cycle. The burgage cycle is the progressive built occupation of the back of the plot culminating in a significant reduction of the open space, resulting in the need to release this space and in a period of urban fallow, preceding a new development cycle. The proposal of this concept was based on the study of Alnwick, in particular on the analysis of the plot belonging to Mr. Teasdale in six different periods of time between 1774 and 1956. Although this phenomenon was recognized in Alnwick, it occurs in many different contexts, including the plots of Porto. In the city of Porto, the burgage cycle conceptualizes a process of plot occupation and construction of working-class housing in the back of the *bourgeois* building facing the street, without changing the plot structure—the so-called *ilhas*, built in the nineteenth and twentieth centuries.

Fig. 2.12 Plots in *Rua do Almada*, Porto. *Source* Google Earth

2.5 The Buildings System

Although buildings do not have the stability in time that streets and plots have, they are one of the most important elements of urban form and the most visible of these elements. In general, the city is made of two different types of buildings, ordinary or common buildings and singular or exceptional buildings. The main characteristics that distinguish these two types are related to the building form and utilization. The former includes most buildings making the city. The similarities between buildings, within this type, are stronger than the differences between them. This type includes mostly buildings of residential utilization, but also commerce and services buildings. The second type includes only a few buildings of the city, those buildings that because of their shape and utilization are clearly distinguishable in the urban landscape. Within this second type there is a smaller set, a very special set of exceptional buildings whose form has become indistinguishable from the form of the city they are part of. This is the case, for instance, of the Opera House in Sydney.

The position of each building within its plot is of fundamental importance for the character of the urban landscape. In most cities, until the end of the nineteenth century, the continuous alignment of different buildings defined, in a very clear way, the street form. Yet, a number of city theories, developed over the twentieth century, have questioned this traditional alignment of buildings and led to the introduction of an increasing variation in the position of buildings within plots, questioning the traditional definition of 'street' and 'street block'.

Another important characteristic of buildings is their height, and particularly the relationship between their height and the width of street where they are located (Fig. 2.13). The variation of these two measures can introduce significant changes in the urban landscape. If the height of buildings is much less than the street width, we will have little sense of enclosure. Yet, if the height of buildings is greater than the street width, the sense of enclosure will increase. Other important characteristics of

Fig. 2.13 Relationship between buildings height and street width, New York. *Source* photographs by the author

buildings are the organization of the ground floor and the physical relation between exterior and interior, the façade design (important for the urban landscape) and, in the interior, the position of the staircase and the organization of dwellings.

Although in last decades there has been a powerful trend towards an increasing uniformity of buildings at the global scale, we can still find a great diversity of buildings across different countries and different continents. Figure 2.14 includes five photographs of different buildings in different cities and villages, in five different continents. The first is a photograph of Chicago taken from the Lake Michigan. This part of the city, around Lake Shore Drive, has a regular street system with a great diversity of buildings with very different heights. In the middle of the photograph, some skyscrapers seem to emerge within the set of tall buildings. Although there is also a great diversity in terms of building materials, the urban landscape is marked by the presence of steel and glass. The second photograph is in a rather different geographic and cultural context: Djenné, one of the oldest towns of sub-Saharan Africa, inhabited since 250 B.C. This area includes almost 2,000 traditional buildings that were built using earth as the main material. The architecture of Djenné, of its ordinary and exceptional buildings (such as the Mosque, in the photograph) is characterized by its homogeneity of materials and colors and by a strong sense of verticality. The third photograph shows a traditional building of the *Batak Toba* people, located in *Samosir* in the middle of Lake *Toba*, in Sumatra (Indonesia). This house, very different from the buildings in the upper photographs, has a boat shape and it is elevated from the ground. It is mainly built of wood, and it has intricately carved gables and upsweeping roof ridges. The fourth photograph presents a set of buildings in the *Stortorget*, a small public square in the *Gamla Stan*, the historical centre of Stockholm. Despite the similar height and alignment of buildings, there are some subtle differences between them like the different colors and the design of the upper stories and roofs. Finally, a traditional building of the Māori people located in Taumaranui, New Zealand, is included in the last photograph of Fig. 2.14. The design of the roof and the central column in the main façade (usually two other columns are in the interior of these buildings), and the sound presence of sculpture distinguishes this building from those in the previous photographs, contributing for the identity of the Māori architecture.

As we have seen when analysing other elements of urban form, we can also find very different buildings within the same city. In addition, it is possible to identify a kind of evolutionary path or a typological process, corresponding to a succession of building types in the same cultural area. Focusing on a particular part of my city, the *Rua de Costa Cabral*, Fig. 2.15 identifies the main residential types of the area and offers a reading of how these building types have evolved over time. The first column of photographs displays the transformation of single-family houses: from the terraced houses built in narrow frontage plots (a), in medium frontage plots (b) and in large frontage plots (d) to the semi-detached houses (f) and the detached houses (h). The second column of photographs presents the transformation of multi-family buildings: from terraced buildings erected on narrow and large plots (c and e) to semi-detached buildings (g) and detached buildings (i)—this will be developed in the last section of Chap. 6.

Fig. 2.14 Different buildings in different cities and villages, in five continents: Chicago, Djenné, Samosir, Stockholm and Taumaranui. *Source* photographs by the author (**a** and **d**), Elisa Dainese (**b**), Janto Marzuki (**c**) and Bryan Woodhead (**e**)

Fig. 2.15 Succession of building types in the same cultural area, Porto (Oliveira et al., 2015)

Exercises

A. **Testing Your Knowledge**

2.1 **What are the main similarities and differences between the most representative tissues of Barcelona and New York?**

i. They are similar in terms of streets, street blocks, plots and buildings; one major distintion between the two cities is the number of buildings erected after the mid-tweentieth century.
ii. Both cities have a regular pattern of streets and buildings (alignment and height); Barcelona is made of squared street blocks and New York is made of rectangular street blocks.
iii. Both cities have a regular pattern of streets and buildings alignment; the form of street blocks and plots, and particularly the height of buildings are different in Barcelona and New York.

2.2 **What are the fundamental structuring lines of the territory, in terms of macro-relief?**

i. Ridge lines (highest elevation), converging into distribution centres.
ii. Ridge lines, thalweg lines (lowest elevation) and contour curves (perpendicular to ridge and thalweg).
iii. Thalweg lines, linking the encounter centres and promoting the natural drainage of water.

2.3 **What are the most persistent elements of urban form?**

i. Buildings; and in particular, singular exceptional buildings.
ii. Streets, plots, buildings, and land uses.
iii. Streets, and the system of public open spaces.

2.4 **Why is the frontage width a main characteristic of plots?**

i. It allows the construction of buildings with larger frontages.
ii. It enables a higher control on the design of building facades.
iii. It enables increasing, or decreasing, the number of agents and urban strategies present in the street.

2.5 **What has been the main change in buildings, taking place over the twentieth century?**

i. The change in the position of buildings within plots.
ii. The increasing range of construction materials.
iii. The increasing range of architectural styles.

Solutions

2.1. iii
2.2. ii
2.3. iii
2.4. iii
2.5. i

Interactive Exercices

Exercise 2.1—The Game of Cities

'The game of cities' is an exercise that brings out the importance of both collective action and streets in the process of city-making (Oliveira and Perdicoulis 2014). 'The game of cities' is played in a computer aided design (CAD) environment, projected on the wall, with the players being coordinated by a moderator. The game is in two parts. There is a common process, but these parts are made of different contents. The first part of the game presents a site merely as a topographic relief—preferably of a real city, the city where the game is taking place (Fig. 2.16, left). The first player is called to play, while all the others watch, and is asked to draw one urban form element: streets (and also squares and green areas), street blocks, plots, and buildings (including common and singular buildings). If one player decides to design streets, street blocks or plots, the width and length of each of these elements is enough. If a player designs one or more buildings, then must also provide the height and the use (residence, commerce/services/offices, public equipment, industry). When the design of the first player is concluded, the second player is called to play. Contrary to the first player of the game, who finds a totally vacant terrain, the second player has to considerer not only topography, but also the elements of urban form designed

Fig. 2.16 Exercise 2.1—topography of the site (left), and topography and street system (3 km x 3 km, Boavista, Porto)

by the first player. One by one, all players are called to play. If the number of players is high (e.g. 15 or more), then each player should play only once. If the number of players is low, it would be interesting to go through a second round. The result of the game will be a small (part of a) city with different inputs from different agents, simulating what happens in real life.

The second part of the game goes one step further: the diagram of the site reveals not only topography, but also the existing street system (Fig. 2.16, right). The street patterns may turn the site familiar, and some players are likely to recognise it. The dynamics of the game in the second part are very similar to the first, yet the actions of each player are considerably conditioned by the street system. The players are expected to gradually understand the fact and the way that a street system will contribute to the organization of the urban form elements of the city.

The contribution of 'The game of cities' is towards the conscience that city-making is a collective work, achieved in successive steps of development by many agents, and a change of focus from buildings to streets.

Exercise 2.2—Your Urban Landscape

'Your Urban Landscape' is an exercise that explores the capacity of each student to describe a familiar urban landscape using a new language learned in this chapter, based on the main characteristics of the fundamental elements of urban form.

The starting point for the development of this exercise should be the house of the student. Starting from there, the student is asked to describe and explain, in morphological terms: i. the street where he lives, and the streets defining his street block; ii. the nearest square, iii. the plots of the street block; and, finally, iv. the buildings of the street block where he lives. Based on this homework request, each student should prepare a brief PowerPoint (5–10 min, 10 slides maximum) to be presented in classes. The student should use text and images (drawings and photographs), or any means that he thinks it is adequate. The realization of the exercise should involve one or more visits to the site under analysis.

The exercise highlights the benefits of fieldwork, notably of walking, of direct observation, of immersive experiences, and engagement in real-world urban landscapes (including the possibility of measurement of some physical characteristics).

Exercise 2.3—A Collection of Urban Tissues

The exercise 'A Collection of Urban Tissues' explores the idea that, despite the differences, all urban landscapes are structured by the same elements of urban form. What changes, from place to place, is the way these elements are combined in each specific setting. For instance, the combination of irregular streets, small street blocks, many plots per street block, small plots of irregular form, coincidence between plot and building frontages, and high building coverage, are characteristics of mediaeval urban landscapes. Yet, the basis for this morphological description of mediaeval landscapes are streets, plots and buildings – the main elements of all urban landscapes.

For this exercise, each student should select one city in his country. Different students should select different cities. Using a software for the interactive visualization of maps and satellite images (like Google Earth, Bing Maps or Baidu Maps), and focusing on the two-dimensional view of the selected city, the student should try to identify different urban tissues. Each identified tissue should be formed by a particular combination of streets, plots, and buildings. Based on these results, each student should prepare a brief PowerPoint (5–10 min) to be presented in classes. The PowerPoint should contain three main slides for the whole urban tissues: i. one slide with plans of the tissues, approximately at the same scale (see also Fig. 2.2); ii. one slide with photographs of the tissues (street-views obtained from the referred software); and, finally, iii. one slide gathering the major characteristics of each tissue, in terms of streets, plots and buildings.

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