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ROAD NETWORKS IN TERRITORIAL LAND USE ORGANIZATION, EVOLUTION OF THEIR REPRESENTATION AND GRAPHIC FEATURES.

Gomis Sánchez, Jordi (1); Ripoll Masferrer, Ramón (2); Turón Rodríguez, Carlos (1); Chamorro Trenado, Miquel Ángel (2)

(1) Universitat Rovira i Virgili, (2) Universitat de Girona

Public space is the property and domain of the public administration. Physically, it can be considered as the urban "emptiness" shaped by the edified space. They are places through which road, transport and utilities networks pass and are developed, thus ensuring habitability and communication. The street is both useful for services and for social activities. It must therefore be designed to be pleasant for spending time and for taking a stroll there. Together with the walls of buildings, urban spaces ultimately provide the city with not just its physical configuration and urban structure, but also its social, cultural, historical, political, economic and technological status. These urban areas are in most cases configured by road networks, the town/city's communication and structuring element. But, how have these road networks been represented in urban planning throughout its evolution and progress? We will see how changes over time of the conceptual and instrumental conditions have "sketched" a graphic itinerary in their "representation" or "non-representation".

Keywords: Road networks; Planning; Cartography; Technical drawing.

LAS REDES VIALES EN LA ORGANIZACIÓN DEL USO DEL TERRITORIO, EVOLUCIÓN DE SU REPRESENTACIÓN Y CARACTERÍSTICAS GRÁFICAS.

El espacio público es propiedad y dominio de la administración pública. Físicamente, se puede considerar como el "vacío" urbano modelado por el espacio edificado. Son lugares por los que pasan y se desarrollan las redes de carreteras, transporte y servicios públicos, garantizando así la habitabilidad y la comunicación. La calle es útil tanto para servicios como para actividades sociales. Por lo tanto, debe estar diseñada para que sea agradable para pasar el tiempo y/o pasear. Junto con las paredes de los edificios, los espacios urbanos proporcionan a la ciudad no solo su configuración física y estructura urbana, sino también su estatus social, cultural, histórico, político, económico y tecnológico. Estas áreas urbanas están configuradas en la mayoría de los casos por las redes de carreteras/calles, el elemento de comunicación y estructuración del pueblo o la ciudad. Pero, ¿cómo se han representado estas redes viarias en el urbanismo a lo largo de su evolución y avance? Veremos cómo los cambios en el tiempo de las condiciones conceptuales e instrumentales han "esbozado" un itinerario gráfico en su "representación" o "no representación".

Palabras clave: Red vial; Planeamiento Urbano; Cartografía; Dibujo.

Correspondencia: jordi.gomis@urv.cat

1. Introduction

The road network is the component of urban space that simultaneously facilitates parcellation, provides access and services to each of the parcels, allows movement from one point of the town/city to another and spontaneous communication between citizens and the perception of the town/city. The road network consists, mainly, of public spaces, because they are the property and responsibility of the community, and that means at the same time, that they are free for all to use, within the limitations the population itself may wish to establish.

Road networks establish a relationship of direct communication between the urban space and the surrounding territory (Benevolo, 1978). It could be said that rural space, formed by its tracks and roads, penetrates into the city becoming streets. At the same time, road networks form the interurban communication channels between the different parts of the city.

Along the road networks, all of the city's traffic movements -by pedestrians, or vehicles, be they public or private- take place. And finally, it is the permanent reference of parcellation, since it is the space that provides access and services to the individual piece of land that constitutes each parcel (Panerai, Caster & Depaule, 2004).

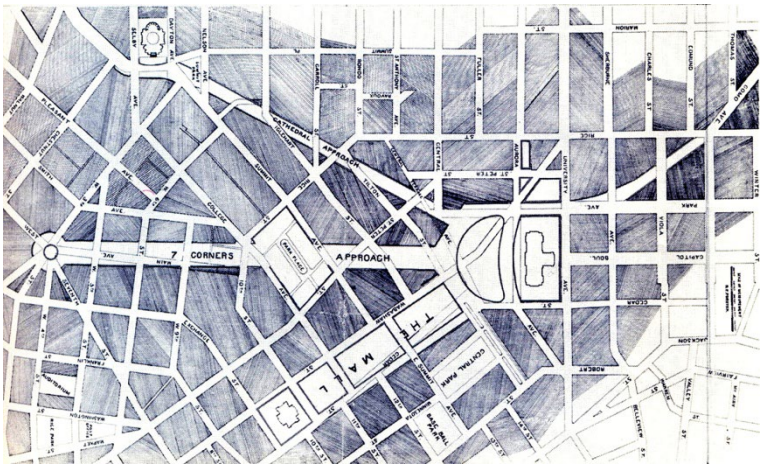
Road networks usually include all areas of the vehicle mobility system, but also a substantial part of civic spaces -pavements, squares, etc-. Mobility was the original reason behind the road network, which also acquired civic and later environmental values. When the urban area gains importance and mobility flows intensify, part of the network of open spaces is segregated and a system of specific areas of mobility is shaped: road networks.

In this paper, when we analyse the representation of the road network, we will be referring to the system of communication between urban elements and not to the capacity of the infrastructure that a city may contain, since the latter, rather than systems for movement and communication, end up being other urban elements (Boyer, 1986) that have little to do with the actual fabric that shapes the particular relationships within the city, that which forms the more local or community connection systems. We therefore refer mainly to the streets that are characteristic of the city, which often give it its image, but also those that will form the base of its urban diagram, capable of establishing the "chessboard" of the city and of establishing its relational rules.

2. The void of the city. The representation of road networks until the 19th century.

In the early twentieth century, road network needs had hardly changed compared to the nineteenth century or earlier (Bosma & Hellinga, 1997). In fact, streets were still used by pedestrians and carriages, with or without horses. It was not until in the late 1910s and the early 1920s that urban planners realized the qualitative change brought about by the massive eruption of the automobile, and its subsequent consequences on society all levels. With regard to their graphic representation, it could be said that road networks were what was left blank on the paper after representing private and green spaces. Indeed, it could be said that it was this lack of application of any graphic resource that characterized road networks in the urban plans of the late nineteenth and early twentieth centuries (Fig. 1).

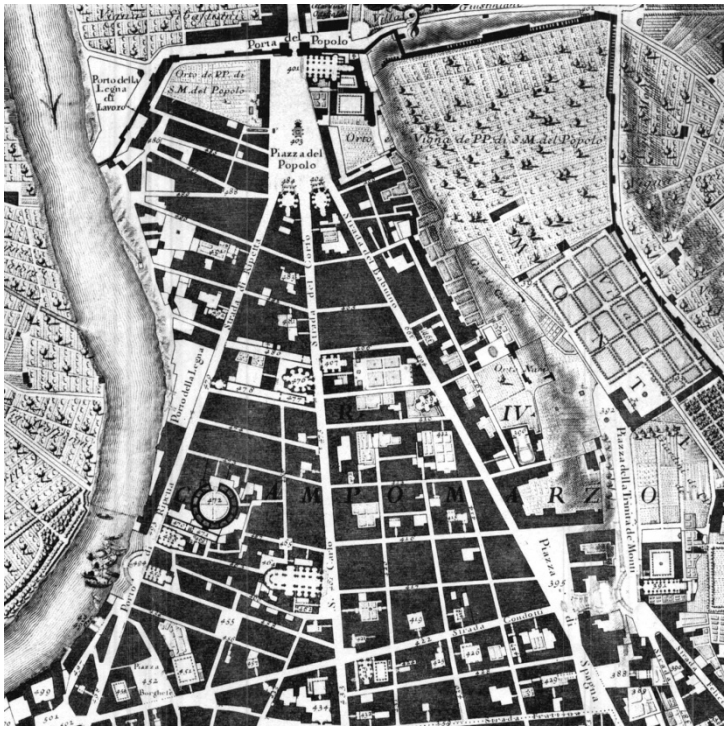
Figure 1: Urban development plan for the creation of the three main axes or avenues in the approach to "St. Paul, state capitol" of the state of Minnesota, United States.



Note: The plan, dating from 1903, is the work of the architect and urban planner Cass Gilbert, who was also the architect of the building of “St. Paul” - the legislative chamber of the state of Minnesota- (Peterson, 2003).

Now, this was in no way unique. Since the first representations of the fifteenth and sixteenth centuries, and especially in the drawings of Leonardo i Nolli (Fig. 2), that can be considered "model-plans", road networks are characterized by a lack of specific illustration and the observer can interpret them due to the "positive-negative" contrast. The drawing of the edified areas or, put another way, private spaces, explicitly involves the representation, by omission, of the road networks serving them.

Figure 2: Part of the Plan of Rome in 1748, by Giambattista Nolli (1701-1756).



Note: The part of the plan shows the connection of the "Piazza del Popolo" with "Piazza di Spagna" (bottom right) via the "Via Babuino"; note the Tiber on the left and what is now the "Villa Borghese" park, on the right.

As we have said, the road networks and streets facilitate parcellation, provide access and services to each of the parcels, allow movement from one point of the town/city to another and spontaneous communication between citizens and the perception of the town/city. But, regarding the mechanisms of representation, we see that road networks are basically defined

on the basis of the perception of parcellation suffered by urban land (Yee, 2009). Road networks are interpreted by the observer of the plan as the contrast to the private, parcelled, delimited, clearly represented private spaces. This reading, conceptualization and understanding of the road network by the interpretation made of the inter-space between the blocks of housing, lines of façades or pavements, or other delimiting lines, is practically constant in all urban plans up until the start of the twentieth century.

The analogy between the emptiness of the street and the "emptiness" -lack of specific graphic representation- of the drawn street, or, seen from the opposite standpoint, the analogy between existing buildings and the "solid" -application of colour or textures- of the illustrated blocks, is something that any reader of the plan assumes without thinking, whether a specialist or not. The graphic representation of streets is mainly rendered by drawing property boundaries, generally thicker (and directly related to the graphic representation of the edified blocks or the boundaries of private plots), and the usually thinner lines that depict street pavements (École Nationale des Sciences Géographiques, 1999).

These graphic mechanisms are not present in the plans of the nineteenth and early twentieth centuries, because at that time road traffic had not reached the significance it acquired throughout the Western world as of the 1920s. So, until then, the functional compartmentalization of the street, between pedestrians and vehicles established by pavements, was not as important or significant in urban planning terms, although we can see how historically, such distinction of uses in the same space of the street, has existed since ancient times (Fig. 3).

Figure 3: Photograph of a street in the Roman city of Pompeii.

Note: Pompeii was destroyed by the eruption of Mount Vesuvius in the year 79 BC. It depicts the pavements intended for pedestrians and the road network intended for the passage of carriages and horses. The stones placed in the middle of the street were designed to help pedestrians cross when the street was filled with rainwater.

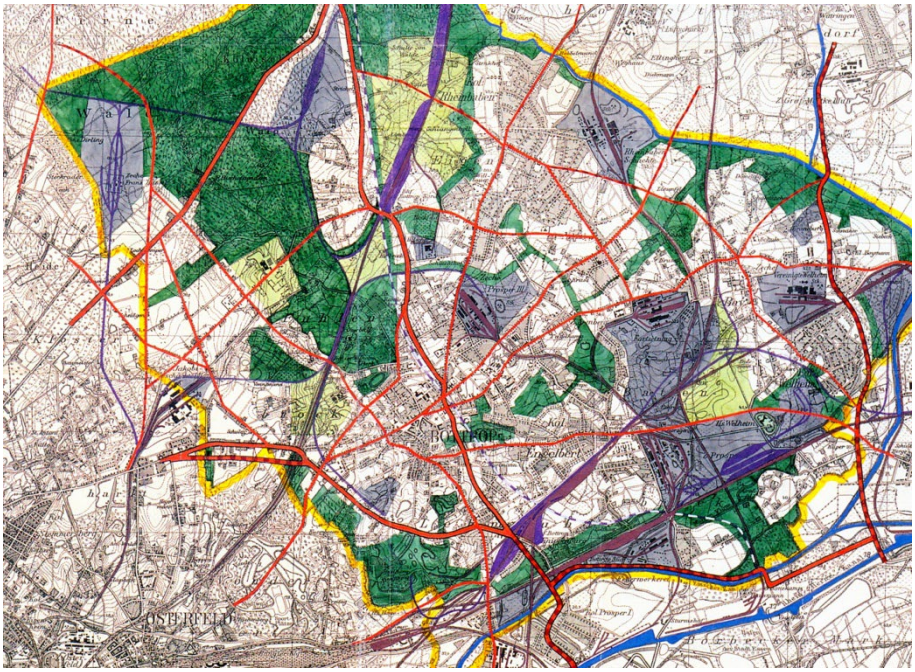
However, one may think that the graphic representation of pavements is not only correlated with a problem of the partitioning of the public communication space, but simply responds to a problem of scale of representation. Indeed, this consideration is partly true, but it manifests itself more clearly in the plans of planning carried out in the 1920s and 30s, and, in contrast, is far more difficult to find in earlier plans. In fact, this functional separation of the public space of the city was often achieved through more subtle mechanisms of appropriation of space than the simple differentiation of pavements and their boundaries (Bosselmann, 1997).

3. Road networks and modern urban planning.

The In spite of everything, modern urban planning requires developing far more complex documents than a simple floor plan, often accompanied by the appropriate classification and qualification of its zoning and the road network that structures it, whether a plan of the whole town or one of parts of it. Urban planning drawings developed during the first half of the twentieth century no longer contain only the typical floor plans with the layout of streets, zoning and design of the plots, private property and public spaces. Planning drawings rendered by modern urban planning begin to require a whole set of thematic plans that consider far more complex and extensive urban and regional studies.

Hence, the first spatial plans appeared that involve an analysis of the regional infrastructures and the relationship and conditioning factors they have with the wider geographical area. As a connecting line, the road network greatly affects the efficiency and effectiveness of regional functions (Wardhani & Bahri, 2020). In this case, rotund graphic representation, often in colours, of the communication networks, of all kinds, becomes a necessary tool for the understanding of the proposed territorial organization (Fig. 4).

Figure 4: Plan of the German city of Bottrop and surroundings, in the Ruhr basin, 1926.



Note: After the First World War, urgent rehabilitation of the German mining industry was needed. Dr. Robert Schmidt (1870-1934), an urban planner, was appointed director of the first body with the legal power of decision in the area of regional planning and the "Gesetz Betreffend Verbandsordnung für den Siedlungsverband Ruhrkohlenbezirk" in 1920. The plan displays the main communication routes of the area (roads in red and railways in purple) and industrial areas (dark grey), natural spaces (green), rivers and waterways (light blue), and residential areas (light grey) (Bosma & Hellinga, 1997).

Referring to the plans examined in this paper corresponding to a sample of what we call "modern urban planning", the preference of representing road networks based on the drawing of blocks of housing or plots and pavements remains. The same progressive variation can be seen in both the evolution of fonts and their thickness, as had previously been detected in other respects analysed in studies on the graphic representation of urban planning submitted to Geographia Technica (Gomis, Turón, &. Ripoll, 2014/2015).

Generally, there is a tendency not to apply any graphic resource when drawing streets, barring the strict boundaries of properties and pavements with its usual grading of thickness -fine for pavements and thicker for property boundaries-. However, during the 1960s, 70s and 80s, it appears, a rather unexpected feature emerged. It was the variable corresponding to the

patterns and textures which, while on the plans of the early and mid-twentieth century and also the end and the early twenty-first century, are used only sporadically to graphically reinforce the visual image of the represented road networks, in the plans of the 1960s, 70s and 80s they were the norm. Indeed, it can be seen how the application of patterns and textures, in this case adhesives and generally of uniform shape and aspect, is used mainly graphically to highlight the streets for representation in planning drawings. It should be said that if we consider all of the urban plans studied, the non-application of concrete graphic resources, except the representation of the lines used to draw facades and pavements, is by far the common denominator that characterizes the representation of road networks. The drawing of streets by incorporating patterns is most uncommon -and in the case in hand, curiously concentrated around the aforementioned period-. To some degree, it is especially surprising how this clear tendency not to apply specific graphic resources, both in the plans of the first half of the twentieth century and in the late twentieth and early twenty-first centuries, is unexpectedly altered when we look at drawings planning representations subsequent to 2010. In this case, updates to and enhancements of CAD programs have facilitated the possibility of incorporating limitless colours and patterns into planning drawings. From now we will see how, generally speaking and in a great many drawings, colour covers the entire surface of the represented area, -even road networks-, often regardless of their size (Fig. 5 and 6).

Figure 5: Drawing of the improvement and expansion plans for the town of "Lopik", Netherlands, 2010.

Note: Work by "KuiperComapagnons" –planning consultants-. All of the land to subjected to the plan is represented in different colours. The coloured surfaces not only indicate residential areas and green spaces but also the streets and road networks (in grey, this case) (Kuiper, 2010).

The use of powerful graphic representation is especially suited for larger scales where land use is conditioned, too, by the network of roads that structure it. It is in this kind of drawings that draughtsmen reinforce the representation of road networks, clearly demonstrating how their courses affect the planned layout. In this case, the indication of the classification of the urban land comes in second place and thus colour is often absent.

Figure 6: Zoning plan for the town of "Lieren" belonging to the municipality of the Dutch city of "Apledoorn".

Note: The plan, dating from 2009, provides for the expansion of urban land in order to build a further 200 dwellings in the period 2010-2015. Major and secondary road networks are rendered in dark grey and brown (Rinjboutt -Projectes-, 2009).

The latest features that technology has enabled incorporating into graphic planning documents are photoplans, that include the drawing of the proposed arrangements. While a photo plan may be related to other planning maps, it appears to be more specific and specialized in communicating a message to map users (Bettinger, Merry & Boston, 2020).

These photoplans, for which the base photograph can be in colour or in black and white, are normally corrected by superimposing contours -orthophotoscopic maps-. In the example in Figure 7, we see how the corrected photoplan shows an urban land expansion drawing on top of an aerial photograph. In this case, the representation of the road network has been preserved, recovering the practice of drawing of the majority of the urban plans of the last century, represented by property boundary lines and lines indicative of pavements, leaving their entire surface free from the addition of colour.

Figure 7: Urban development plan for the eastern area of Santa Paula -California, United States- 2008.

Note: Work by urban planner David Sargent and his team. The drawing organizes the area into three subzones dedicated to multifamily housing of different densities, mixed-use buildings in the centre of the neighbourhood, and a strip of industrial buildings along the railway to the south. It also preserves as natural spaces the hills that border the northern perimeter of the planning area. Note the graphic representation of the plan rendered on the orthophotoscopic plan that serves as the basis for the drawing of the zoning planning (Sargent, 2008).

3. Conclusion.

When observing the study of the evolutionary process of the representation of the city and its planning, it is not "a priori" apparent that the model of management has particularly influenced its graphic representation. It is quite clear that, regardless of the projected model of city, the graphic items and resources used to represent it are completely conditioned by instrumental techniques and the concept of representing of the time, thus also affecting the representation of the road networks. It is thus clear that, in a timely manner, the model of city and its road networks represented stimulates the use of series of specific graphic resources, but the resources and how they are used are not always the same. Graphic representation may vary slightly if one is drawing a city structure formed by closed blocks or if drawing an arrangement formed by isolated blocks or a garden city. It can also be said that, depending on the scale used, the criteria for the application and use of the various graphic resources differ and vary in the representation of the road networks. However, these nuances are not always constant

and, in any case, can be considered almost irrelevant, especially if these graphic documents are seen from a certain global perspective. In general, the graphic model of representation of the urban road network remains constant for long periods in the history of urban planning, being especially influenced by the instrumental techniques applicable to each of them. Only such personalized considerations as "the graphic style" or other such trivial ones as the available means, significantly alter the representation of some aspects of the road networks represented.

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