The underground of European cities in planning documents: the case of A Coruña (Spain)

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Abstract

The knowledge of the underground is a key issue for cities in the beginning of the 21st century. So far, only very few European cities have included the underground in their planning documents and management. There is an evident gap between north and south of Europe, as it was clear in the COST SUBURBAN action, carried out by a consortium of 29 different European countries. In this action, several case studies from different parts of Europe were examined, including the successful cases of Rotterdam, Glasgow, Oslo, Hamburg, Odense and others, all of them in Northern Europe. Spain was represented by the case of A Coruña, a coastal city in the northwest of the Iberian Peninsula. This text focuses on the analysis of the level of development between urban planning and the knowledge of the underground. In particular, attention is paid to the treatment of the underground in the current planning and its importance in urbanism and local planning.

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1. Introduction

Underground is an important element of the physical environment of cities. We live on top of it: the buildings have to accommodate to the structure and properties of the ground, and occasionally confront the dangers it presents.
Cities not only expand outward and upward but also downward. Increasingly, the subsoil is used to attenuate the eternally crowded and congested urban area, especially for networks (meters, tunnels, cables, wastewater, sewage), storage (basements, warehouses, parking lots, thermal energy), and facilities of shelter and protection (bank vaults, nuclear bunkers, underground passages in cities with harsh climates). The more use of subsoil, the more surface space is released to the function which is not possible without natural light and fresh air: life.

Just as the rocks are generally a record of the conditions and events in the geological past, urban underground can be interpreted as a physical record of the history of cities. The buried cultural heritage needs our protection, either by preventing its degradation in situ or through a careful excavation before construction takes place. This heritage, and all the ground, also opposes the industrial legacies, such as contaminated soil or unstable mine shafts.

Therefore, the importance of knowing the existing ground beneath the cities seems clear, although the urban subsoil is still largely "out of sight, out of mind". There is not a daily concern for planners and city administrators, and when it is, usually because of problems. Thus, the action Sub-urban COST TU1206 has proposed to explore, promote and improve the use of urban underground.

Its aim is to help to identify options for cities in order to grow and develop more sustainably. To achieve this goal, this paper provides a theoretical framework that describes the interactions between urban domains and subsoil in general terms, with particular reference to data acquisition, interpretation into useful models and the transferability of these planning documents.

2. The COST SUBURBAN action and the state of the art in terms of urban planning and underground management

One of the most striking processes that have occurred in recent times is the intense growth of cities and urban spaces that extends around the globe. This growth consumes space, natural resources and enormous amounts of energy. Consequently, the concept of development has been linked to sustainability, as megacities and large metropolitan regions distributed across continents pose significant challenges environmental (pollution, waste management, traffic congestion, abnormal conditions weather, etc.), that urban planning should address [5,6].

Undoubtedly, plans and strategies to be adopted should also take into consideration the new term of resilience, or the ability of a city to deal with an external shock, a generally impact of natural or environmental nature [7,8]. Cities and metropolitan areas have to withstand the effects of floods and flash floods, adapt to the new conditions that climate change brings and keep under control an enormously complex ecosystem that generates constant threats and risks. For all these reasons, the theory and the disciplines that deal with the city, and urban planning must recover a strict physical, ecological and territorial dimension in the new models and documents given by them in the future [1].

In this regard, advance knowledge of all the dimensions that takes the city and urban space becomes a priority. Thus, although the city has been characterized designed and analyzed almost always thinking about the visible part of it, the systematic study of the underground spaces of the same charges a growing interest [9,11].

An interest therefore reinforced by the environmental dimension of urban alluded to, such as the possibilities offered by new mapping and analysis models to know precisely what is beneath the city and its importance for the overall development of the organism urban / metropolitan.

In addition, this pioneering approach is logical that has been made in Europe for several reasons: a) the existence of institutions and national geological surveys of great tradition and experience; b) disciplinary dialogue that had begun sometime between geologists, planners, architects, geographers and engineers, among others; c) the observation that some big mainland cities (Glasgow, Hamburg, Rotterdam, Oslo, Odense, etc.), had integrated data and comprehensive information of the subsoil both the planning documents and the daily tasks of urban management; d) the possibility provided by the European institutions to finance networks of experts from many different countries to address a new issue of collaborative research.

In fact, the joint work of professionals across Europe in the COST TU1206 formulated action aims to improve the overall performance of the urban underground, in order to improve its management and incorporate it into official documents planning level metropolis, city or neighbourhood. So, it is a bridge between the theoretical reflection, based on the progress that has been recorded in the geological and mapping subsurface investigation, and urban planning, embodied by the technical and public administrations [3]. The mission is to transfer knowledge to planning and urban management, always with the aim of improving the quality of life of city dwellers.
In this sense, historically geological research and information provided by it was used in engineering, planning and development projects. It appeared concentrated mostly in maps and reports. Certainly, institutes and national geological surveys across Europe have developed wide information and mapping, available for public use set. In recent times, it has achieved great significance transit from the representations of two-dimensional (2D) to three-dimensional (3D). This continuous updating process has resulted in the preparation of information loaded and processed at very different scales digital models. In particular, today you can display 2D data (GIS), 3D (deterministic attributes, frame and stochastic geological models, models voxelados clean) and 4D (series of predictive temporal patterns, for example, changes of flooding water), with a set of increasingly numerous representations [3].

However, only a small number of large European cities routinely use this information as a guide to everyday urban management (include Hamburg, Oslo, Rotterdam and St. Petersburg), and in most cases this knowledge is underutilized. Therefore, the use of these best practices as examples and expanding the group of cities generalize the use of information and mapping urban subsoil should be a goal to achieve. Another goal is also the integration of information systems employees underground in different parts of Europe, for joint improvement of certain issues and problems. In fact, these ideas of modeling and integration tried to develop some years in the LIFE06 project "Integrating Geological Information City Management to Prevent Environmental Risks [4].

Consequently, the reasons for the COST action TU1206 subsurface study of European urban areas stems from the realization that cities do very intensive use of it for infrastructure: subway, tunnels, sanitation and other services, parking and storage in addition to the use of existing water resources. All these activities generate significant environmental effects and inadequate control of local geological features can lead to many problems, such as pollution of groundwater [4].

Only in relatively recent times, governments have become aware of the coordinated implementation of measures to avoid the impacts identified. Thus, in the UK the "Urban Futures research project" (http://www.urban-futures.org) has developed a tool for urban relief to analyze the level of resilience of cities and provide sustainable solutions to them [3]. The Directive INSPIRE [2] about building environmental spatial information, including subsurface data with uniform criteria between public sector organizations and citizens with open access.

Despite these efforts, there is still a lack of accurate data on urban groundwater is presented as a major problem in many cities and metropolitan areas. For all this, it is vital to ensure their availability and use for different purposes, as both social and economic benefits of various kinds as appropriate evaluation criteria for governance and urban planning will be achieved. In addition, conflicts of subsoil use may be regulated and determined by specific safeguard instruments, expand the current understanding of the complex ecosystem of the cities, still very focused on its surface, visible spaces.

One of the first legal regulations with regard to the right to property is included in the Spanish Civil Code. The current Civil Code states that "The owner of a land owns its surface and what is below it, and it is allowed to make works, plantations and excavations (...)") This power to do what the owner wishes with the is limited by legal easements and by the urban legislation that limits the legal powers of disposition of the owner to what is established by laws and planning instruments, as well as by the protection of goods in the public domain.

On the other hand, and traditionally, in Spain the regulation of land uses has been limited to the sole purpose to order what happens on the surface. The elaboration of the planning instruments has taken into account the easements of protection established by the different sectoral regulations (coasts, roads, water, forests, heritage, etc.) but has not payed any attention to what happens in the subsoil, if this is not the object of protection itself.

The urbanism regulations, made up of planning and urban planning legislation, contain an extensive regulation of all aspects related to the urban development of new soils that are incorporated into the urban scene: maximum intensity of use, conditions of occupation (eg. conditions of exposition to the sun), characteristics of public spaces. But, in general, it does not regulate in the same way what happens in the subsoil.

The current subsurface regulation is given by two main aspects:

1. The underground is the traditional support of the infrastructures of services, which run through it. In this sense, the current regulation of the underground from planning, and in its absence the urban legislation, establishes that these infrastructures have to be run by lands of public ownership, in order to guarantee that the administration that owns the same has full capacity to operate and maintain such networks, and protect their property in the interest of citizenship.

   It is in this aspect in which the greatest progress has been made with regard to land regulation, since the limitations imposed for the use of the underground are given by the need to ensure that the use of the underground by individuals does not hinder the protection of public domain, as regulated in the state land law.

2. The land as a space in which archaeological remains, or vestiges of them are found, that is necessary to excavate, is protected, and a restriction on the ability of the owner to dispose of his property, limiting its capacity to use.

   The maintenance and management of this information may involve several authorities or stakeholders. The city Public Company, EMALCSA (see fig. 2).

3. The use of the subsoil is mainly oriented to support the different supply networks, and is defined by the presence of high and medium power lines. To be managed, it is vital the acquisition and treatment of the information related to those pipelines.

Fig. 1. View of the city of A Coruña
2. The land as a space in which archaeological remains, or vestiges of them are found, that is necessary to excavate, document and maintain. This implies the need to establish perimeters for the protection of cultural heritage elements that are protected, and a restriction on the ability of the owner to dispose of his property, limiting its capacity to use.

However, the study of the underground in relation to its intrinsic characteristics, and not as a support of service networks, or as a means in which archaeological remains are found, is not integrated into the urban development process. The planning or management of land attends to reasons external to the characteristics of the land, and when some type of protection related to the subsoil is established (due to the existence of archaeological remains, groundwater) the distances and conditions of protection imposed are usually generic.

3. Planning and management of the underground: the case of A Coruña (Spain)

A Coruña, with a population of 250,000 inhabitants, is the main metropolitan in the northern of Galicia. The municipality covers a surface area of 36,8 sq km, with a peninsula, where the historical centre is located, and an isthmus with the original fishermen neighbourhood. The space and geographic configuration grants it certain uniqueness, as we can see in figure 1.

![Fig. 1. View of the city of A Coruña](image)

The location of A Coruña on a peninsula and an isthmus makes it easy to orientate in it, as always has the sea as a reference. First, we must distinguish the historical centre, made up of the districts of the old town (Ciudad Vieja) and the Pescadería. The first of them, the old town is characterized by narrow and winding streets that were restricted its development by defensive walls existing at the time, whose remains can still be found. The Pescadería was a neighbourhood of fishermen, and remained walled until the 19th century. Today it is a centre of business and commerce.

If we go to the peninsula, we find the Monte Alto neighbourhood. This neighbourhood was occupied in the decade of the 1960s, with buildings that not saved any aesthetic, and generate overcrowded areas, where shortage of green areas and free zones is the general trend. At the edges of the maritime promenade, we find the neighbourhoods of Adormideras and As Lagoas, characterized by its curved buildings. Remarkable is the spatial and geographical uniqueness of the municipal area, at the end of a natural peninsula, which multiplies the perimeter of the coastline, in spite of his small area, and gives it a great landscape singularity.

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Under the subsurface, you can find supply networks with different scales and impact. The main ones are those included in the general supply system: the water supply and sewages big pipes, the oil and gas pipelines, and electrical high and medium power lines. To be managed, it is vital the acquisition and treatment of the information related to those pipelines.

The maintenance and management of this information may involve several authorities or stakeholders. The city council manages the sewerage and public lighting networks, while the water supply network is managed through a public Company, EMALCSA (see fig. 2).
Regarding the oil pipeline, the surface’s uses are largely conditioned or directly restricted by its trace. The city council is developing the implementation of a Geographic Information System, to achieve a better knowledge of the state, conditions and other aspects of the urban networks. The GIS Project is mainly based in obtaining the information, developing the technology to collect data, and processing and organizing the data. The entire Project is oriented to develop and to set up an infrastructure that provide an easier way to produce, update, use, and spread data.

All this is also intimately related to the concept and program called Smart City Coruña. This project aims to achieve optimal management of services, and a sustainable and efficient consumption of the city’s own resources. The basis of the program is the collection and the treatment of the data in a centralized computer platform, and its management and interpretation so that, depending on the different possible scenarios, optimize the resources could be optimized for the proper functioning of each service, from the water supply to the public transport network. The data refer to many aspects such as air and water quality, traffic density, noise levels, etc.

The horizontal platform, called brain of the city, receives data, or real-time information about what happens in our city, from sensors and measuring devices, and processes them to make the available to different applications and services. In addition, all this information can be viewed in real time in the advanced visual representation system, eVidens, a visualizer that integrates the data to offer them on an interactive system, based on a territorial representation of the city.

The second phase is to provide this brain with integrated data from a set of pilot projects, with different objectives, ranging from urban infrastructure management, environmental monitoring and care, the support to the commerce and the tourism, to the own municipal administration management through the development of the Electronic Administration.

The Smart City program also includes initiatives to make the city more accessible, such as the implementation of electronic administration or the publication of information.

3.1. Archeological remains.

The second condition is the great number of archaeological remains, due to the existence, among others, of a pre-roman settlement in the area of Elviña, of defensive fortifications in the Pescadería (late 15th century), and of remains of medieval walls (13rd century).

Any intervention in the existing archaeological remains, or in the areas susceptible of containing them, must be authorized, or at least informed, by the competent body on cultural heritage. This implies that during the administrative procedure of any planning document must obtain the favorable report of the Department of Culture of Xunta de Galicia (regional government), that has the competences in the matter of protection of cultural heritage.

This report, or authorization where appropriate, may impose restrictions on the removal of soils and subsoils, preventing building in the subsoil, if they understand that the preservation of archaeological remains may be affected. It may also impose restrictions on use of the grounds or on the constructions above ground level. Many of the existing restrictions are already included in the cultural heritage protection legislation itself.

The existence of archaeological heritage in the subsoil requires being especially cautious with the removal of soil in certain areas. In this case, before starting the works, a survey should be carried out to verify the existence of possible archaeological remains, and depending on the results, an excavation of the area must be needed. The proceedings must be directed by an archaeologist, and the competent body on cultural heritage must inform the excavation projects. The appearance of remains can even force to modify the project of the works to make them accessible.

3.2. Other uses of the subsoil.

Finally, we have the actions to free up space on the surface to accommodate the provision of car parks that the high density of occupation of the center demands, and the buried road connections. In this way, we have underground car parks in the city that can be associated with underground roadways that allow the traffic to be removed from the surface, and recover space for pedestrians and bicycles.

The communication routes and streets of the municipal area constitute the communications system, and may be general or local. They are of general character those ways that serve the municipality, and local ones that serve the neighbourhood. Whatever its class, as a public domain property, the city council may dispose of the soil for this...
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specific purpose including the subsoil and the flight, and use them for different purposes, such as burying a road or allocating the soil for open spaces.

Galicia’s urban planning law admits the possibility of occupying the subsoil of road systems and free spaces to dispose of public car parks, which allows free space on the surface, disrupting traffic by types or providing for the necessary parking reservations.

For this, the urban plan must anticipate this possibility, assigning a double urbanistic qualification to these soils. This system optimizes the use of land, allowing the coexistence of two uses in the same plot.

These actions correspond to the municipal administration, which can choose several methods to carry them out. The most common is the adjudication of the execution of the works linked to the management of the parking once finished, for a certain period, and may or may not entail the payment of a fee. Within the municipality of A Coruña there are several actions of this type, with car parks operated by private companies during the term of the concession as consideration for the completion of the works. The construction of a public car park may even entail the obligation for the successful tenderer to execute a stretch of road for the public use and not exclusive to the car park.

4. Conclusion

The subsoil becomes a key factor when planning urban development, since there are several factors that must be taken into account when drafting a planning document: the existence of networks of services, archaeological remains, or the need to remove certain uses of the surface, in order to obtain a quality urban space.

To sum up, in a city whose surface is small if we take into account its density of occupation, the use of the subsoil is increasingly necessary, and proper planning of it is a question of great importance to plan rationally, having in mind both the future developments foreseen by the urban planning and the regeneration of the consolidated urban plot in those areas where it is deficient of public facilities and free spaces.

In Europe, there are important differences between the countries of the north and the south, in relation to the incorporation of the underground to the planning of the cities. The analyzed case of A Coruña shows the gap between north and south of Europe, and the need to follow the good practices of cities of the north of Europe that have participated in the action COST SUBURBAN.

References