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Innovation, green infrastructures and urban form

Towards regenerative city models

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Contents

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Green and revitalised cities through universities: Sarzano and Ferrol campus

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Abstract
Education is a topic of global interest in all areas, including the spaces where it takes place. However, although there is talk about a change in education and new active methodologies, the space necessary for these new methodologies is not being taken into account.
In this context where there is a need to update learning scenarios, we must take advantage of the opportunity to change university spaces in order to innovate, not only in educational spaces, but in the whole city, as educational centres are an important part of the urban fabric.
In this article we will analyse the importance of green infrastructures, investigate how to carry out the regeneration through the recycling of buildings and the reactivation of the city through the university. All this through two case studies that constitute examples of good practices, the case of the Sarzano campus of the University of Genoa, in Italy, and the Ferrol campus of the University of A Coruña, in Spain, which serve as a reference of innovative experiences that have achieved a good integration between universities, green areas, and the territory, achieving an increase in local environmental, social and economic welfare.

Keywords
University; Campus; Green infrastructures; Recycling of buildings; Reactivation of the city

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1. Introduction

Education is a topic of global interest in all areas, including the spaces where it takes place. However, although there is talk about a change in education and new active methodologies, the space necessary for these new methodologies is not being considered. And the space in which learning takes place has not changed in the last century, or not substantially (Prado-Acebo, 2024). In this context where there is a need to update learning scenarios, we must take advantage of the opportunity to change these university spaces to innovate, not only in educational spaces, but in the whole city, as educational centres are an important part of the urban fabric. Thus, the need to change educational spatial systems must be approached in an innovative way, taking into account relevant issues such as green infrastructures, as "university-community partnerships can play an important role in this green infrastructure maintenance issue" (Gerlak et al., 2022, p. 393-394), or how universities can reactivate cities and shape urban form, constituting models of regenerative cities; thus creating places capable of constantly renewing their resources, boosting the prosperity of citizens, protecting the environment, developing the local economy, and enhancing both the social and cultural life of their inhabitants. The form of a city can affect its sustainability, as there exists a relationship between the shape, size, density and uses of a city and its sustainability (Burton et al., 2013, p. 1), and the university plays a key role as developer of the city (Perry & Wiewel, 2015, p. 3), so the design of green infrastructure and urban greenery have become a central tool for enhancing not only environmental and ecological value, but also psychological well-being, social aggregation, services and quality of life within cities (Tucci, 2023, p. 91). "Innovation represents a critical factor in the process of transition towards greater environmental sustainability, the driving force for a new development paradigm and a new mechanism of evolution based on experimentation in design processes" (Tucci & Ratti, 2022, p. 191; Lombardini et al., 2023, p.213). Therefore, planners and designers, who have always played a central role in the creation and development of vital and liveable cities (Diepen, 2002, p. 93), must should plan the urban fabric by addressing these issues. In this article we will analyse the importance of green infrastructures, openness and contact with nature within the spatial structures of universities, producing a symbiosis with the environment, preserving natural resources, and making them available to the entire community, as these are not only public universities, but also spaces open to the entire population. We will also investigate how to carry out regeneration through the recycling of buildings and the reactivation of the city through the university, with a spatial arrangement of the universities integrated into the city, with their corresponding green areas at the service of the community, in order to achieve the multifunctionality of these spaces, which should be not only educational, but also for recreation and for the enjoyment of the entire urban environment. Likewise we will study a couple of examples of good practices, showing the history and design of two international case studies between which parallelisms could be drawn, such as the Sarzano campus of the University of Genoa, in Italy, and the Ferrol campus of the University of A Coruña, in Spain, which serve as a reference of innovative experiences that have achieved a good integration between universities, green areas, and the territory, achieving an increase in local environmental, social and economic welfare.

2. Two case studies as examples of good practices: Sarzano's Campus, UNIGE (IT) and the Ferrol's Campus, UDC (ES).

The study of the importance of green infrastructures in universities and cities, the recycling of buildings as a tool for the regeneration of cities and the reactivation of cities through universities, will be carried out through the thread of two case studies, which serve as examples of good practices, Sarzano's Campus of the University of Genoa in Italy and the Ferrol's Campus of the University of A Coruña in Spain. The Università degli Studi di Genova (University of Genoa, UNIGE), founded in 1481, is scattered throughout the city, still growing through the city today. However, it is possible to point out three main and clearly differentiated poles, which are the

historical pole in Balbi, the medical, scientific and technical pole in San Martino, and the new pole in the historical centre in Sarzano, which is the one we are going to pay more attention to, as this is where the Department of Architecture and Design is located, and where we can observe both green infrastructures, such as the recycling of construction, and the integration and reactivation of the area. The Department of Architecture and Design (DAD) stands on Castello Hill, in the oldest part of the historic centre of Genoa, the site of the ancient convent of San Silvestro. Despite a previous project, the DAD was not moved to Sarzano until the San Martino pole became too small (Decri & Russo, 2021m). The decision to relocate to the old town met with opposition but proved to be a success and one of the most interesting cases of revitalisation of an old quarter in a European city (Ricci & Schroeder, 2010, p. 55). In contrast to this Italian case, there is the Spanish case of the Ferrol campus of the Universidade da Coruña (University of A Coruña, UDC), where, among other schools, the EUDI (Escuela Universitaria de Diseño Industrial, University School of Industrial Design) is based. The Ferrol industrial campus, located in the Esteiro neighbourhood, is an example of green infrastructure, as well as of recycled construction integrated into the urban area, reactivating it. It was originally a hospital, which after suffering a fire was rebuilt using the Tollet system, creating the pavilions hospital of Esteiro. It consisted of 4 main pavilions (General Services, Medicine, Surgery and Venereal), 2 medium ones (Contagious and Prisoners), 5 smaller ones (Washing rooms, Operating theatres, Insane, Cadaver Deposit and the Apothecary), and a series of complementary spaces (Soraluce Blond, 1996, p. 116-118). Of all these, only the four main pavilions and one medium-sized one (the prisoners' pavilion) remain, the other pavilions having been demolished or replaced by more modern buildings. It is in one of the main pavilions that the EUDI is now located.

3. The importance of green infrastructures in the universities

To begin with the importance of green infrastructures in universities, we must take into account the openness of learning scenarios (both from the perspective of the audience admitted with the corresponding openness to the community and from the perspective of the physical boundary), as well as their contact with nature, for the correct development of the teaching-learning process. "Come, always come! The walls of a school should be made of glass, it has been said, and quite rightly so; they should be made of glass so that everyone can see what is going on inside: the parents because inside are their children and the people and the state, because those children will be citizens tomorrow" (Pizzurno, 1890, p. 600, as cited in Toranzo, 2020, p. 34). Using the fact that everyone sees everything as a mechanism of social transparency (Pozo Bernal, 2017, p. 234). These words could serve as a manifesto, as they clearly express the idea pursued through the opening of classrooms and educational centres. Thus it will be necessary to consider issues such as the dissolution of the boundary, transparency, visual continuity, spatial continuity, flexibility, openness and nature. Indeed, nature and interaction with the environment are a key factor in human development. Connecting people, living in cities, with urban nature is necessary, as people are biophilic and contact with nature has physical and emotional benefits (Beatley, 2016, p. 79). Green infrastructures in urban areas bring public health benefits (Sommariva et al., 2022, p. 155-156), green spaces provide a context to facilitate social interaction on campus, building a sense of place and community, bolstering student health and resilience (Walshe & Law, 2022, p. 979-980), and them could even be considered a therapeutic green (Tucci, 2023, p. 92). The opportunity to connect with nature is ubiquitous and it must be taken (Beatley, 2016, p. 79-80), and not only projecting green belts, but also ensuring the access to green space (Burton et al., 2013, p. 25, p. 35), so its necessary a re-appropriation of urban spaces by nature, and the integration of greenery in the urban environment has become one of the main objectives of development strategies in European community programmes (Tucci, 2023, p. 92). Gardens and parks are excellent learning spaces (Hertzberger, 2008, p. 245), since Rousseau already indicated that the best school is the shade of a tree, implying that the best school was in the open air, in nature, and not within the walls of a building. But, as Viñao points out, once the need for the architectural

work was accepted, the schoolyard or school field signified the presence of nature within the educational centre. And it is not only necessary to go out into it, outside, but also to incorporate it (Viñao, 1993-1994, p. 34), associating these green spaces with the active methodologies that are intended to be encouraged in today's learning scenarios. The open-air classrooms took as their starting point one of the needs of the educational centres, the extension of the limits of the classroom and access to the outside, in order to develop the teaching-learning process and its activities in the open air. Although they did not last for long and this model did not become established, it is worth highlighting the capacity of outdoor schools to experiment, breaking with existing models and proposing new alternatives. There are numerous actions in which attempts have been made to open the doors and even demolish the walls of the classrooms, and history repeats itself, "although the old master Wright had already led the research on the opening of the box, we went back to it" (Asensio-Wandosell et al., 2014, p. 21), it seems that not only history, but also architecture, are cyclical. In the cases taken as a reference, the importance attributed to green areas stands out. At this point, we must emphasise the original Latin or Mediterranean meaning of the word school, thus, going back to its etymological origin, we observe that school comes from the Latin schola, and this from the Greek σχολη scholé, which means leisure or free time (RAE, 2022), for which recreation and gardens played a primordial role. And if there is a single term that seems to capture the essence of green university infrastructures, it was and remains the term campus, the Latin word for field (Perry & Wiewel, 2015, p. 7). However, in contrast to the American campus, the selected case studies do not imply a university community separated from the city, but rather integrated with it. On the Sarzano campus, its spaces and classrooms are mainly enclosed, however, the inner courtyard and its gardens create that openness and contact with nature. The hanging garden of the nuns of San Silvestre, also known as the roof garden, is part of the monastery and it took many years, several projects and several attempts to create it (Decri & Russo, 2021i). The Ferrol campus also has mostly enclosed spaces, although in some of its centres, such as the EUDI, the intermediate spaces have an open and wide character, which allows them to be used as meeting areas, and has some flexible classrooms with a transparent boundary; and it is located in a privileged space, since connecting all the buildings of the campus, we can observe a garden, which is in addition a botanical garden, and which also creates this openness and contact with nature. Among the abundant open spaces on the Ferrol campus, the central green area is particularly noteworthy, which serves as an agora and a pedestrian meeting place. This open space can be interpreted as the result of the opening of the different educational centres towards a common place, caused by the action of the configuration and layout of the campus (Universidade da Coruña, 2009, p. 148), which encourages interaction and connection between them. In the same way, the gardens of the Ferrol campus make it a campus with a strong presence of nature, recovering that original meaning, which allows us to enjoy the gardens and the privileged environment of the schools and colleges that make up the campus. We can even speak of the garden or nature, in a double dimension, firstly, because it is incorporated within the campus and buildings themselves, and secondly, because the university expands and extends outwards, colonising all the spaces that surround it.

4. Recycle to regenerate

The urban recycling paradigm could be defined as a space of coexistence between new classrooms and architectural heritage. This scenario consists of a combination of past and future, in which identity and heritage are mixed with novelty, combining memory and innovation. There is a multitude of educational spaces that "have not been built with the purpose for which they were intended" (Sarmiento, 2020, p. 13), and the fact is that taking advantage of existing architecture is something that has been done since the beginnings of the university. This same recycling situation can be found on the Sarzano campus of the UNIGE, along with most of the faculties and schools of this Italian university, located in former monasteries and palaces. Another example could be the complex of the Esteiro campus of the UDC, which used to be a former hospital. Although

this practice is carried out in many countries and cities around the world, the Mediterranean area, and more specifically Italy, is an example that should be highlighted. The University of Genoa is scattered throughout the city of the same name, in ancient and majestic palaces, churches and various buildings with a strong historical component. The Faculty of Architecture and Design occupies a former convent, used between the 15th and 19th centuries by the Dominican nuns of Pisa (Decri & Russo, 2021e; Decri & Russo, 2021m). One of these Genoese streets, via Balbi, also stands out, where in the same block we can find four ancient palaces that today are the seat of different faculties of humanistic sciences, namely letters and philosophy in Balbi 2, 4 and 6, and jurisprudence in Balbi 5. Thus, while it is an opportunity to build a new building from scratch for teaching purposes, it is also an opportunity to recycle a building with a great historical character and great heritage value to convert it into a university building. Each has its advantages and disadvantages, which we are not going to mention here since, in any case, the recycling of buildings is a situation that usually occurs, and this circumstance should be taken advantage of, adapting its interior as far as possible, to make it a valuable setting for learning. The fact is that architecture has an impact on the way we learn, and in the case of these large inherited constructions, just the building itself has a formal impact. As the Department of Architecture and Design works within the concepts and formalisms, beauty and aesthetics are explored in part thanks to the invitation of the space where they are studying, which serves as an example. In addition to the direct advantages of learning in such a space, the recycling of space also provides economic advantages. Thus, according to the Ministry of Education, the knowledge-based economy presents an opportunity to revitalise obsolete heritage buildings. And especially in times of crisis, universities should consider as a priority the strategy of using old buildings rather than building new ones. It is clear that state-of-the-art laboratories are more difficult to integrate into old buildings due to security restrictions and very specific technical requirements. However, more flexible activities can easily be adapted to historical buildings of cultural and industrial heritage with specific local character and significance in the city. These symbolic buildings, which are found in many European university cities, can contribute to creating inspiring learning scenarios and strengthen the position of European universities in the global competition to attract the best students, professors and researchers. Thus, giving new life to old buildings may be the key to the campus of the future (Ministerio de Educación, 2011, p. 83). And in order to adapt the heritage to the necessary learning scenarios, "the university must act combining respect and progress, by recovering pre-existing structures in order to adapt them to the new use. By proceeding in this way, it will be able to benefit from a quality consubstantial to any monumental piece, which is its living character in time" (Campos Calvo-Sotelo, 2017, p. 327). Thus, monuments and the historic urban fabric act as containers for university uses, encouraging the culture of reuse in university buildings or urban recycling. In all these cases of urban recycling, it has been necessary to carry out various works to adapt these ancient architectural complexes to the different needs and programmes required by the evolution of university institutions. Broadly speaking, two main approaches have been followed. On the one hand, the aim has been to adapt historic buildings originally designed for specific university purposes so that they can meet the new missions and demands of these constantly evolving institutions. On the other hand, the recovery of buildings that had completely different functions has been carried out, transforming them for their use as university spaces for the teaching-learning process and for research (Clemente & Ibáñez, 1995, p. 192-193), with this second model corresponding to the two selected case studies, which reflect the historical and cultural diversity of the educational institutions, merging the architectural legacy with the contemporary needs of the university.

5. The reactivation of the city through the university

And not only do we find these new recycled spaces, but we must also highlight the reactivation of the city through the integration of the university in the environment, blurring the boundaries between both, creating a link within them, and thus moving from the university to the city, achieving openness to the community.

The different schools and departments of UNIGE are housed in recycled buildings and are integrated into the city with the aim of reactivating the city. It may seem curious, for example, that the universities do not have basic services such as a cafeteria or reprography, however, this is a strategy to stimulate the city, using all the establishments, restaurants and shops that are in the vicinity of the schools and surrounding them, so that university life is not limited to the university campus, but expands throughout the city, since the various schools are scattered throughout the city and we are therefore talking about a campus city. The enormous potential of the universities for city revitalization must be considered, not only through their influence as institutions but also via the purchasing power of students and the broader academic community, which generates demand for goods and services. In recent years, many universities have chosen to live together with their community rather than live apart from it. This approach aligns with Dewey's philosophy that education and society are intrinsically connected, positioning universities as catalysts for positive transformation within their local environments (Cisneros, 1995, p. 11-24). According to Magnani, the aim is for the city to be reflected in the university, and to achieve this concept, UNIGE manages an important part of the city's great real estate heritage, so that there is a close link between the historic university buildings and the urban dimension of Genoa. In this way, the aim is not only to reflect the urban dimension of Genoa in the historic university buildings, proposing an itinerary through the interesting material testimonies of a cultural heritage that extends over the centuries, but also to offer a wide panorama of the knowledge and know-how of the city. The aim is therefore to open up the university buildings to the city, with all their problems, but also with their potential as elements fully integrated into Genoa's history and current affairs (Magnani, 2015). The city of Genoa has at its core the university division of functions into clusters, which thereby relate to the city. The humanities universities located on Via Balbi are housed in prestigious buildings within the historic fabric of the city, and the relocation of the Department of Architecture to Sarzano Hill has helped to recover this territory. In this way, it is possible that the relocation of the School of Engineering to Erzelli will allow the formation of a strong and viable cluster, however, it is necessary that the connections and the surrounding fabric are able to absorb the energy of a new pole. At this point it is interesting to appreciate the constant relationship that could be established between the city and the universities in the planning of their growth, since synchronising and moving from the university to the city creates multiple benefits for the citizens (Ricci, and Schroeder, 2010, p. 47). Thus, in the metropolitan area of Genoa a linear university settlement system is emerging within the urbanised territory, as the progressive creation of new scientific clusters is creating new central areas in the city, in which around them the urban functions change and increase, raising their rank (Ricci, and Schroeder, 2010, p. 35). Furthermore, this system is centred around a possible long public transport line, although it is currently uninterrupted, which would connect the four urban nodes that can be considered urban regeneration poles. The first pole is the Erzelli area, where it is proposed to locate the Politecnico, a centre for technological and engineering education, next to Genoa's international airport, the Cornigliano train station and the coastal motorway node. The second pole is via Balbi, which contains the main area of the University. The third pole refers to the complex of the Department of Architecture in the historic centre district, in Sarzano. And the fourth pole refers to the Schools of Medicine and Science in San Martino (Ricci & Schroeder, 2010, p. 36). Thus, the city as university is a European model, according to Ricci and Schroeder, it should also be addressed in the ongoing debates. The current shapes and images of dispersed or diffuse urban landscapes, through the urban occupation of almost all parts of the territory, are obstructing a truly urban conception of the university, transcending the intra-urban or peri-urban models of the past. And the university's potential as a catalyst for the development of surrounding areas or as a connecting element, through the creation of new spatial and mobility networks, within dispersed territories is systematically underestimated. The knowledge society clearly encourages the university to be considered as important as industrial or transport issues in urban development. The constraints and spatial density of the Genoa case study, coupled with the scale of the Ligurian coast as an urban landscape and the size of its university, suggest a conception of a different

type of university. Thus, the opening of campuses and the creation of new interrelationships combine the economic advantages of integrating the university into urban development with the improvement of neighbourhoods, post-industrial sites and the overall quality of the environment (Ricci & Schroeder, 2010, p. 24-25). In short, within the opening up of learning scenarios, we have already seen that it is not only a matter of creating open spaces and favouring transparency between learning scenarios, but also of opening up to the community, through spaces accessible to all people, creating links between the university and its surroundings, moving from the closed enclosure of the university to the city (Prado-Acebo, 2024).

6. Analysis and comparison of the two case studies

Focusing on our two case studies, Sarzano's Campus of the University of Genoa in Italy and the Ferrol's Campus of the University of A Coruña in Spain, it is possible to observe how both cases respond to the urban recycling paradigm, conserving the exteriors and reconditioning or rehabilitating the interior, also producing the transition from the university to the city, as the university is dispersed throughout the urban area, integrating and re-activating the city. In both case studies, the classrooms are still very traditional, and the spaces are fundamentally enclosed. However, in the DAD, the interior courtyard and its gardens stand out, creating an openness and contact with nature. In the EUDI, the privileged space in which it is located, the campus, because connecting all the buildings there is also a garden. The diversity of spaces in both universities could be improved, as they are mainly traditional classrooms, although they are located in privileged places. It is fascinating to observe the historical component of the UNIGE, as well as to admire the art that invades walls, ceilings and, in short, surrounds all the rooms, or the historical value of the Ferrol campus and enjoy its gardens. In the case of the DAD, the classrooms are located in a former convent, like many other UNIGE locations that use old palaces, monasteries, churches and various historical constructions, recycling buildings, where in some of them the building and its exterior facades are preserved, having been rehabilitated inside, while in many others both the exterior and the interior of the original work are preserved, thus finding classrooms with frescoes on the ceilings and walls full of works of art. However, both in the EUDI and in most of the buildings on the Ferrol campus, only the exterior of the pavilions of the old hospital have been preserved, which have been refurbished to house the classrooms and halls in which the university is located, accompanied by new constructions on the same site. The Sarzano campus is notable for its inner courtyard and gardens, which create an openness and contact with nature. As well as the botanical garden that connects all the centres on the Ferrol campus, a large green space that encourages interaction and connection. Moreover, in this way, the learning scenarios are expanded throughout the Ferrol campus, open to the city, encouraging interaction with it. In the same manner as happens in the DAD, which benefits from the services that surround it, reactivating the city through its educational centres scattered throughout the city. Thus, thanks to the fact of sharing resources and infrastructures, it is possible to avoid unnecessary, absurd and costly duplication in certain facilities that both the university and the city can use in a coordinated manner. This allows for a more efficient return on investment, especially in sports facilities, auditoriums and other spaces that can benefit both communities (Universidade da Coruña, 2009, p. 58). Furthermore, this collaboration contributes to strengthening the links between the university and the city, creating a closer and more mutually beneficial relationship. However, while in UNIGE the university is dispersed throughout the city of Genoa, the UDC has the peculiarity of being dispersed not only throughout the city but also throughout the territory of A Coruña, with its various campuses in Coruña and the centre located in Ferrol, on which we are focusing. Taking all these issues into account, it could be said that both universities are located in privileged places, so it is fascinating to observe the historical component that is breathed in the Sarzano campus, as well as to admire the art that invades walls, ceilings and, in short, surrounds all the rooms, or the historical value of the Ferrol campus and enjoy its gardens. In conclusion, it is possible to observe the parallelisms between both case studies, reinforcing the established paradigms, especially regarding the importance of the garden, green areas

and contact with nature, urban recycling as a tool for the regeneration of cities, and the reactivation of cities through the strategic location of universities, blurring the boundaries between the two of them to transform the learning scenarios from the university to the city.

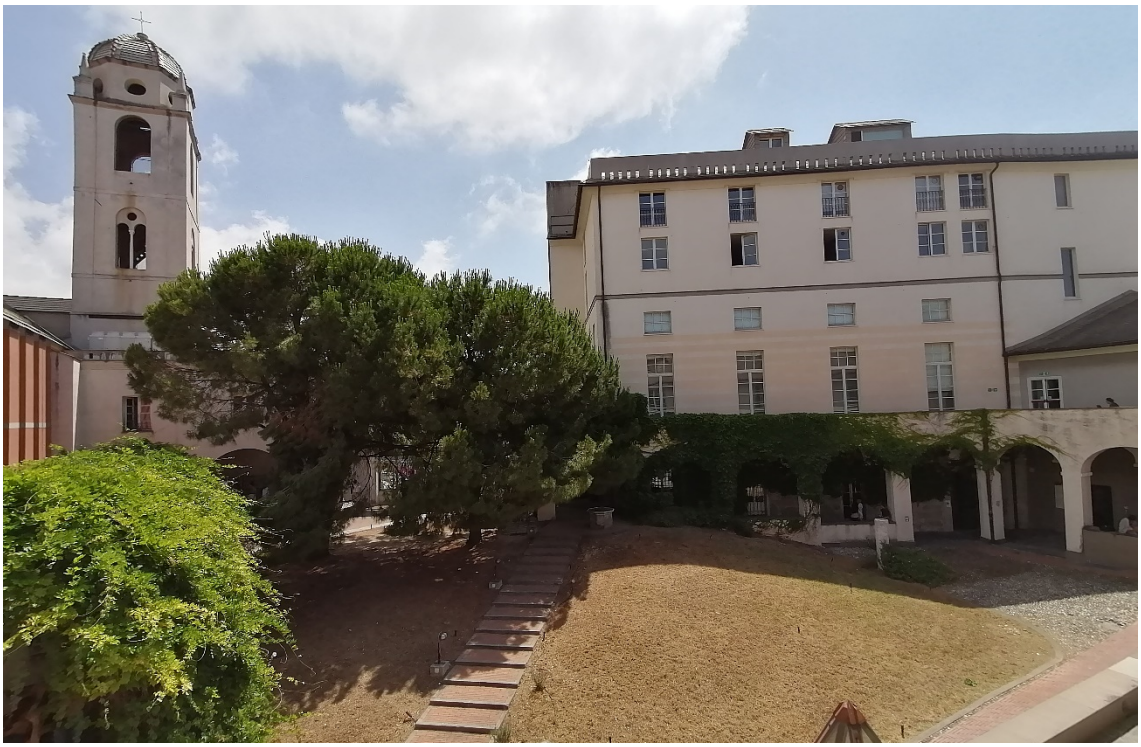

Fig.1 DAD (Deparment of Architecture and Design), Sarzano Campus, University of Genoa, Italy

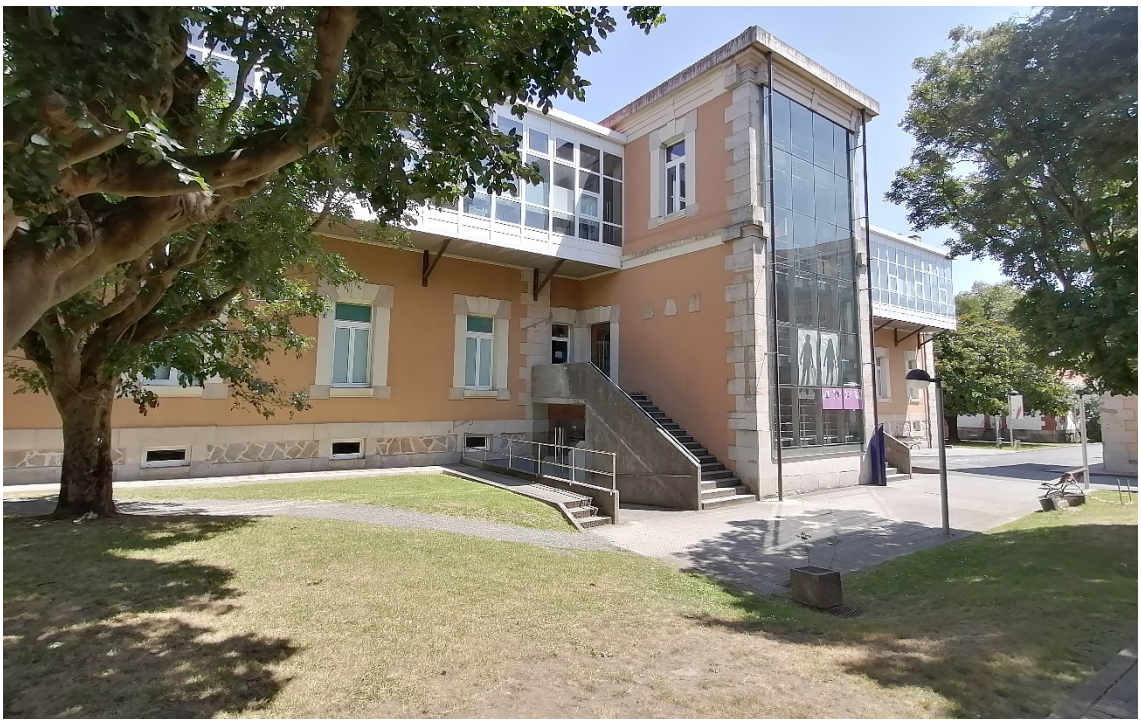

Fig.2 EUDI (University School of Industrial Design), Ferrol Campus, University of A Coruña, Spain

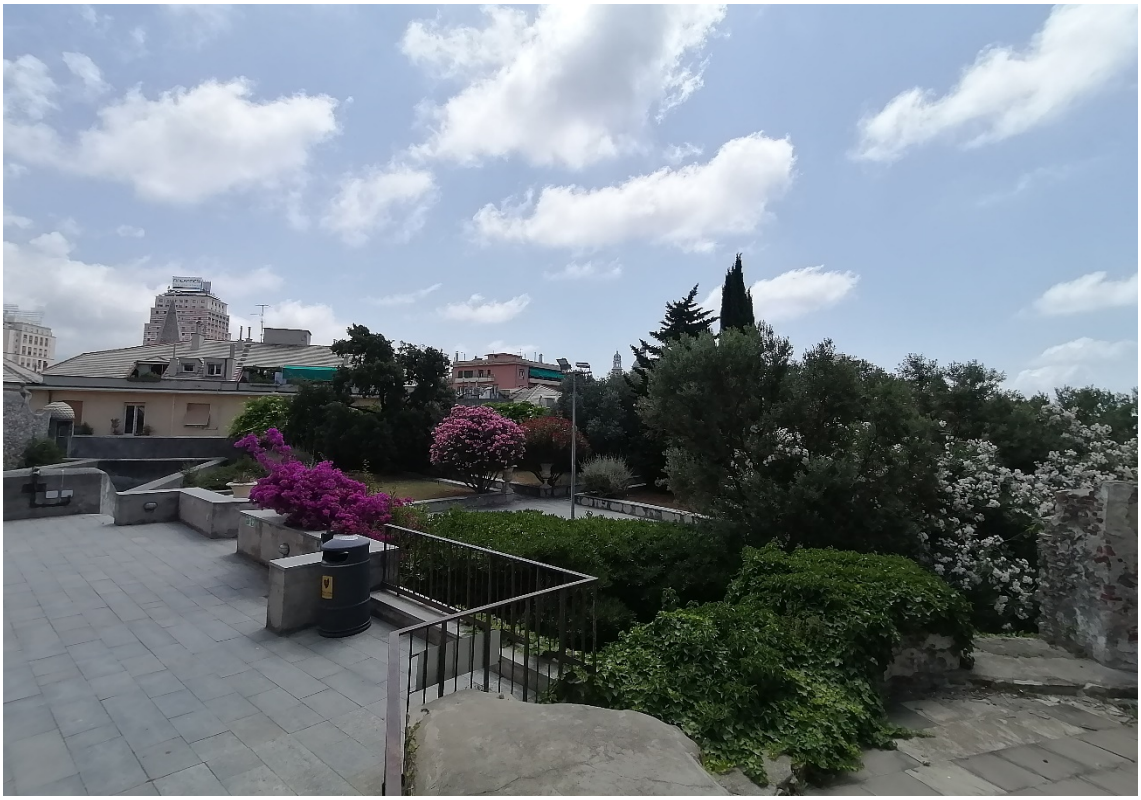

Fig.3 Sarzano Campus Garden, University of Genoa, Italy

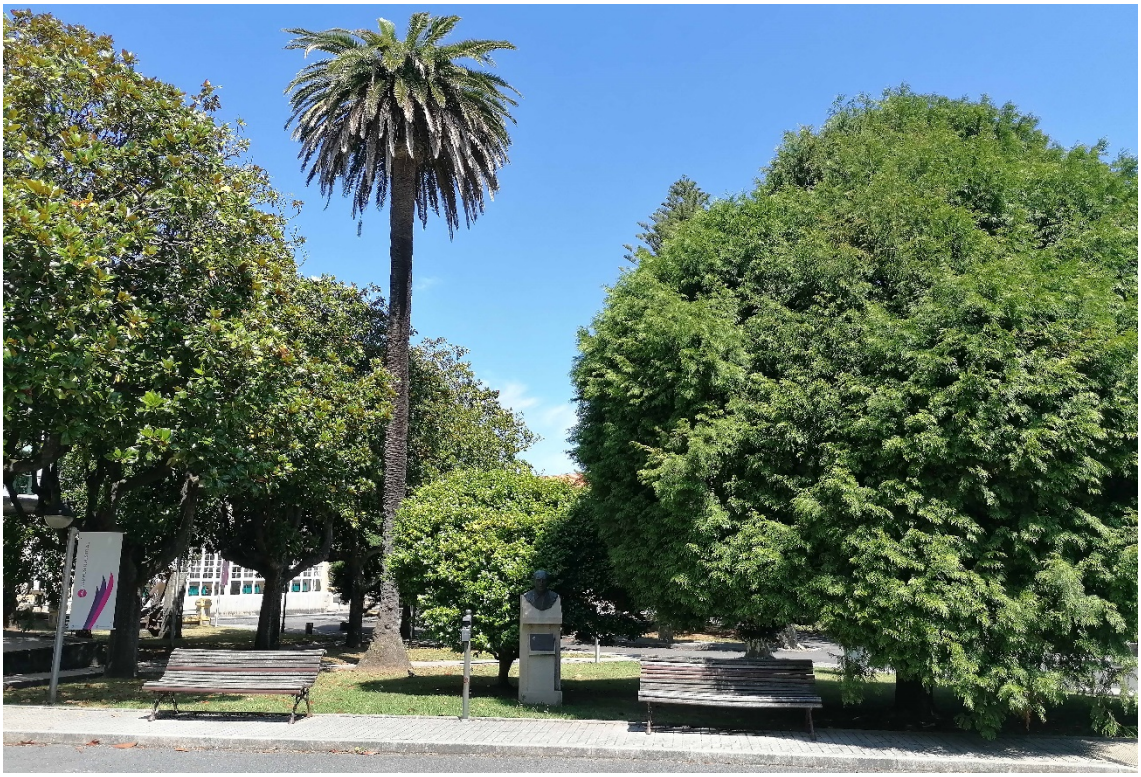

Fig.4 Ferrol Campus Garden, University of A Coruña, Spain

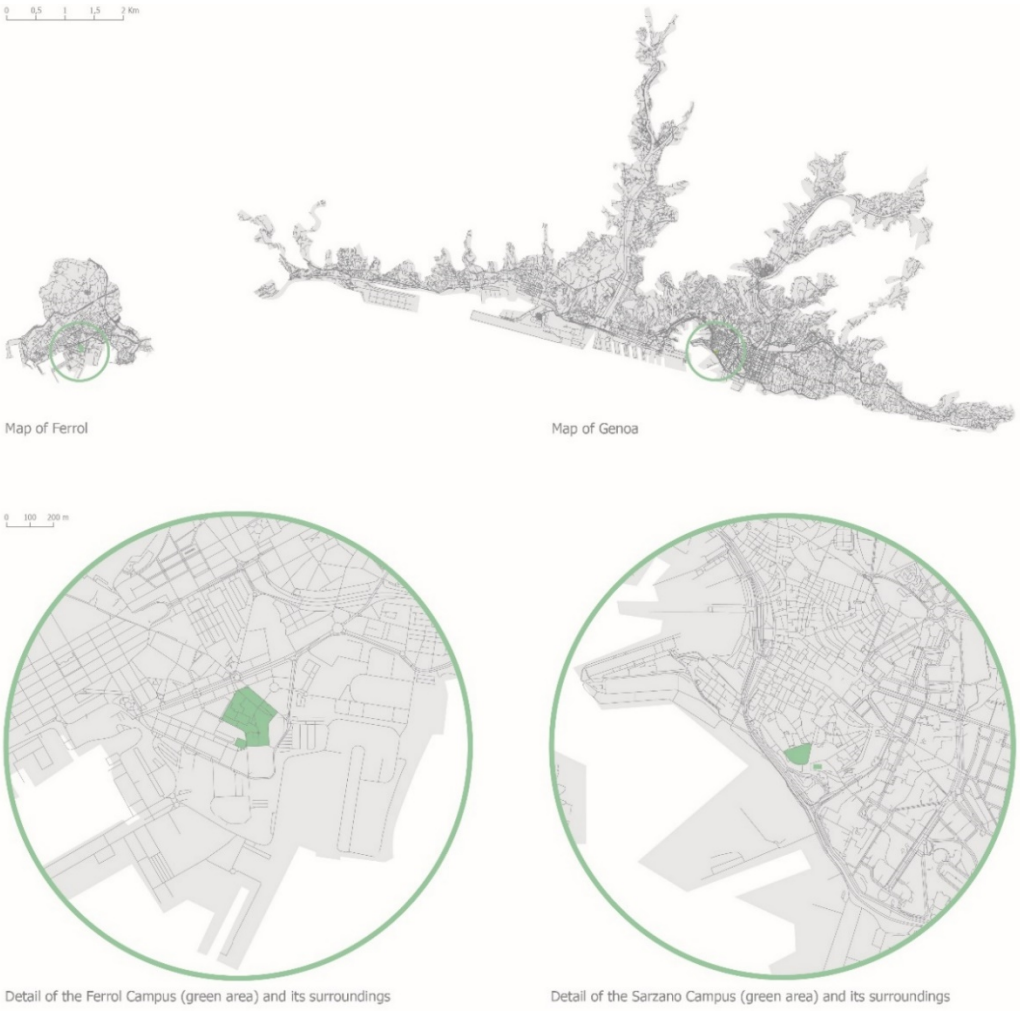

Fig.5 Sarzano and Ferrol campus as a green infrastructure in relation to the cities of Genoa and Ferrol

7. Conclusions

This research is based on education as a topic of global interest, and specifically on one of the spaces where it is developed, the universities. These learning scenarios need to be updated, and the opportunity to change these university spaces must be taken in order to innovate, not only in educational spaces, but also in the whole city, as educational centres constitute an important part of the urban fabric and allow the development of integrated strategies that innovatively address green infrastructures, the reactivation of cities and the configuration of urban form, constituting models of regenerative cities.

This document aims to highlight the importance and potential of universities as a mechanism through which to achieve innovation, the inclusion of green infrastructures and the regeneration of cities, as educational centres are a fundamental element for the progress of society and are a basic design resource for shaping urban form. Two examples of good practices have been presented, such as the Sarzano campus of the University of Genoa, in Italy, and the Ferrol campus of the University of A Coruña, in Spain. These case studies allow us to observe the role of the university in incorporating green infrastructures on campus, which are crucial for the development of students, and whose benefit and enjoyment extends to the whole community; as well as recycling buildings to regenerate value by giving new life to historical heritage, with the multiple advantages that this entails; and reactivating or revitalising the city through the university and the consequent university life. Universities represent a rather critical challenge at the urban level, however, they can constitute an interesting case study for developing integrated strategies to address these issues (Costa & Delponte, 2024, p. 33), and serve, like the cases presented, as a reference of innovative experiences that have achieved a

good integration between universities, green areas, and the territory, achieving an increase in local environmental, social and economic well-being. Universities, which are often conceptualised as small cities, and which play a role in environmental sustainability, have a responsibility to lead society towards a sustainable future. Moreover, nowadays, universities all over the world want to set an example with their environmentalist approaches, sustainable activities, academic achievements (Altun & Zencirkıran, 2023, p. 425-426), green infrastructures and learning scenarios that bring added value to the city. Ultimately, university planning and all the services associated with it, as well as the opportunities for urban innovation it presents, must be taken into account when drawing up urban strategies.

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