The paper aims at analysing the building process carried on a housing estate, Alvalade, in Lisbon during the 1940's. Particular concern was given to the construction system and to the appliance of new building technologies. It comprises 302 buildings performing the first generation of reinforced concrete building type: dual structures with masonry resistant walls, wooden pavements and reinforced concrete slabs on wet areas (kitchen and W. C.), heavily infilled with brick walls. Pre fabricated components were also introduced as part of the innovative experience (e.g. doorsteps, window frames, wall cover). The operation began with an experiment contract work involving 3 buildings to test the building procedures and to ensure its success.

The estate is part of a planned intervention — decided, conducted and financed by the Central Government, aiming at offering affordable living space within a short time for public renting. It has a consistency in character, which stems from policies, building regulations and cost limitations formulated in the master plan. It is characterised by a disciplined urban and architectural design approach. The urban layout is arranged according to clusters, based on the primary school in the heart. Built-up fabric is geometric in character and building typologies, materials and forms are strictly limited. The plain architecture —self-contained 4-storey flats, placed in blocks of regular shape— with its studied detailed is a cultural declaration to simplicity. Dwelling spatial layouts define functional sectors according to a rational use of domestic space and family needs.

Nowadays the area is under a gentrification process. Buildings show performance problems due to functional and constructive anomalies as well as to unsuited renewal works made by the householders without appropriate knowledge of the construction system.

The paper considers three parts. The first one introduces the case study. It is focused on the social, political and urban context that worked as background to the conception of this area. The second part describes in detail the built up fabric and the building process. It refers to the spatial, physical and functional features and to construction system. The third part considers the present situation. Functional obsolescence indicators and constructive anomalies are identified and renewal interventions are analysed.

**INTRODUCTION**

Alvalade corresponds to the first significant urban operation planned to expand Lisbon urban fabric by public initiative during the second quarter of the XX century.

This new area was destined to the construction of infra structures, housing and public facilities. It was programmed to integrate social housing as well as low rental housing, supported in equipments —school, market, civic centre— and in small industry.
The integration of small scale building typologies (4 storey; 2 flats per floor) and innovative ways of housing promotion made the venture financially viable, diversifying housing supply in such a way as to include market values and allowed for the construction of a diversified and multi functional social fabric. The use of then innovative processes both at the level of conception—a project type with twelve variants—as well as at the level of construction and management—experimental construction—permitted the success of this operation.

THE MASTER PLAN

Alvalade Master Plan was planned at the start of the 40's. Framed within the structural scheme of Lisbon, proposed in the City master plan, elaborated by Etienne de Gröer (1938–1948), promotes the northward expansion of the city, and largely gives response to the elimination of the housing deficit that affected the city.

Alvalade occupies an area of about 230 acres. It is formed by a rectangular hierarchical grid, divided by a net of main axes defining eight cells, thus creating «neighbourhood units». The implementation of the plan created 12,000 houses for a population of 45,000. The first set of 84 buildings was inaugurated in 1947 (CML 1948).

In its organization the plan mirrors concepts and influences that characterized the first decades of the twentieth century. It applies concepts of modern urbanism such as neighbourhood units, the distributive allocation of functions and equipments, the hierarchy of the of the road system through avenue, streets, pedestrian paths, the de-privatisation of the ground and the freeing the inner part of the blocks for collective use.

The cells, «housing units», are structured from a central element, the primary school, around which the housing is distributed. Its average dimension was calculated in such a way as not to exceed a distance of 500 meters from school to house. The connection between these two points is facilitated by the creation of pedestrian paths that cross the inner space of the housing blocks.

These are designed as large common exteriors, to be used by the dwellers (CML 1948). The equipments and the large recreational spaces are distributed in such a way as to be accessible by the dwellers of each cell through comfortable and short paths, which occasionally cross the main arteries, where there is rapid transit. Within each cell the streets are the local access to buildings.

LOW RENTAL HOUSING

Characteristics of Low Rental Housing

Alvalade started with the construction of the programme of low rental housing located in cells I
The first generation of reinforced concrete building type

and II of the master plan. It considered the construction of 2,066 flats in 302 buildings of three and four floors without elevator.

The study of low rental housing under the guidance of Architect Jacobetty Rosa, considered the development of 9 types of housing grouped in three series of three types each, corresponding to the families' different social levels and the number of persons per house.

At a level of functional organization, in each series the types differ according to the introduction of a bedroom, and the variation series to series is achieved through the introduction of a den office and larger areas for complementary installations from series I to series II; and with the introduction of

Figure 3
Low Rental Housing in cells I and II of Alvalade

Figure 4
Type Records of series I (Type 3), series II (Type 6), and series III (Type 9) with plans, cross section and elevation
installations for a maid (room with sanitation) from series II to III.

The buildings fit in a bloc typology, with a rectangular plan. They were grouped in open blocks, allowing the existence of small gardens in the backyards. Formally, the buildings are characterized by sobriety and the small variation of the elements of architectonic composition; thus the housing estate presents an exterior image of great unity.

The plans of the different housings is an economic solution based on the rationalization of the spatial organization and from the adaptation of spaces to the designated functions: an increase of the liveable area of each house through the reduction of unused spaces (elimination of the corridor integrating its area in the living room) and the creation of simple and rational plans; further useful areas were obtained by inserting furniture in the construction.

The rationalization of the housing was based on the study and analysis of meaningful indexes that permitted to perfect the correlation conditions of the different housing functions, and so adopt distribution solutions of the different partitions that allow for greater comfort in domestic life. Above all, it is aimed at rationalizing the house in such a way as to «increase the value of the house reducing to the compatible minimum its area» (CML 1946).

The application of these innovative methodologies to the concern over creating housing with good habitability conditions —natural light in all the partitions, transversal ventilation of the apartments and hygiene— yields apartments with rectangular plans. So the inner yards were suppressed and the existence of dark and humid corners was avoided as the result of an innovation carried out by the municipality in the organization of the housing plans.

**Implementation of the Programme**

The implementation of the 302 buildings programme that make up the cells I and II was divided in four construction contract works, with a similar load of work, added to the construction of an experimental group made by 3 buildings of different types (Types 3, 6 and 8). This option allowed to test the solutions adopted in the projects, both from the point of view of the conception as well as the constructive technologies; thus providing useful lessons for the overall implementation of the programme. The cost of construction of this experimental group, while being superior to the expenses forecasted, became self-rewarding in as much as it allowed to introduce corrections in the construction of the following houses. In the first three construction phases stone and brick masonry was used, the fourth is different for the use concrete block masonry. The rationalization and simplification processes applied to the study of housing were also applied at a constructive level, thus applying solutions that seek to concentrate kitchen and sanitary plumbing, a rigorous choice of materials and construction processes, as well as a careful planning and management of the construction.

Figure 5
Low rental housing. Conclusion of the first group

Figure 6
Aerial view of cells I and II of the urbanization Plan of Alvalade: execution of the different construction groups
Together with the construction phases, supplies of materials and construction elements were organized throughout time periods according to the general plan of works, in such a way as to guarantee regularity in supply. Thus there were independent programmes for the supply of wood, fenestration and doors, aiming at an improvement of the quality of these elements; an action programme for the supply of plumbing, concrete tiles, sanitation equipment, bricks and roof-tiles.

The standardization and pre-fabrication of some elements used in the construction allowed for reduced costs and swifter construction: pre-fabricated elements such as doors, windows and cladding; standard concrete elements for steps and exterior windows lintels and sills of standard dimension, standard tubes for water supply, drainage and electricity.

At the planning and management level of the construction, municipality counted with the help of the «Federação de the Caixas da Previdência», that by the end of 1946, in a contract signed with the Lisbon municipality, made available the financing needed to start the Low rental construction programme. According to this contract it was up to the Caixas de Previdência to: pay expenses of the contractors and builders; expenses with suppliers and unexpected expenses, up to 5% of those expenses, and expenses relative to the supervision and control of the works, at a 1% of the total of remaining expenditure. On its turn, it was up to Lisbon City Hall to: elaborate the overall urbanization plan, including all the technical economical and social studies; elaborate the general plan of the works, including the definition of deadlines for execution and the programmes for the
different stages of construction; to organize the special actions to assure the supply of all the necessary construction materials; to assign according to a public auction, the production of pre-fabricated elements, as well as supervise and guide its production.

Throughout the construction process, various tests of materials and execution processes that were at the time innovative in terms of construction management. Specifically one notes the tests of concrete without fine sand; the studies on the most adequate mortar of concrete for application in interior and exterior cladding and for the elaboration of masonry, particularly the concrete blocks; the studies elaborated by the National Laboratory of Civil Engineering, relating to plaster and woods. For the latter it was proposed a more adequate treatment for this material, one that permitted better quality in fenestration.

It was also aimed through the different construction phases, to improve the quality of the ironworks used creating more functional and economical types; the grés tubes, the sanitation equipment and the hydraulic tiles satisfied predefined requirements for quality and fabrication. Employing concrete-block masonry rather than stone and brick lead the municipality to acquire an installation for the manufacture of the blocks, thus trying to satisfy the technical and economic conditions to stabilize production.

Constructive characterization

The buildings of the cells I and II belong to an era of construction that characterized the first half of the twentieth century in Portugal — the transition to reinforced concrete. As mentioned above, its execution was divided in four groups of contracted works.

The first three are characterized by the use of stone masonry (hydraulic masonry) in the exterior walls and brick in the inner walls, belted on all floors by reinforced concrete beams at the height of the window lintels. The pavements in the kitchens and W. Cs were built with slabs of reinforced concrete, the rest were made with wood beams and Portuguese floorboard. The ladders were built with prefabricated concrete steps, supported by brick fronts.

The fourth is characterized by the use of hollow concrete blocks in the outer walls, by massive concrete blocks in the front walls and by stone or plaster in the partition walls. The pavements were executed with pitch blocks that made coffering unnecessary.

In all the building projects the roofs are made with a wood structure and tiling in Lusa roof tiles. The fenestrations are pine wood and the outer walls plastered with concrete mortar of and sand, and finished in the exterior with mass of sand, and in the interior plastered.

It is worth referring that the execution of the replacement of the wood pavements for reinforced concrete, in buildings that presented serious anomalies in the wood used in the execution of those elements. These works were carried during the fifties.

Conclusion

The exit of Alvalade experiment is reflected in the great advantages of an urbanization orderly planned, studied and executed by the municipality; that established rule both at the urban planning and design as well as the conception and construction of housing. This experience also permitted to demonstrate that construction costs can be controlled through the study of the technical conditions of execution: at the level of materials, use of standard and pre-fabricated elements and construction solutions that are economically viable.

However, after the conclusion of the urbanization some deficiencies were noted: a slight excess of population density and reduced distance between the facades in the secondary lanes, excessive distance between some housing and the commercial area of the neighbourhood, inconvenience of the inner patio spaces, individualized and walled, seldom used by residents.

Almost fifty years after the conclusion of the urbanization, this now appears as a consolidated area of Lisbon, with urban, constructive and architectonic characteristics that make it distinct from the rest of the city. Through out this period there are several post occupancy changes at various levels: At a physical level, in the buildings that constitute the neighbourhood; at a social level in the inhabitants; at a functional level, both in the built constructions as in the urban space.
At a physical level the buildings sustain a level of degradation resulting from the wearing and aging of materials, associated to the effects of pollution and weather combined with an absence of maintenance. There are some occasional actions of executed inside the buildings that may aggravate their maintenance condition. At a social level, Alvalade has witnessed a process of ‘gentrification’ involving new residents with new dwelling habits. The social position of the population is characterized by the new composition of families, with smaller numbers and greater purchasing power. This «new» residents are responsible for the alterations introduced to housing, adapting it to new functional requirements, with an impact in the spatial and constructive organization, resulting in interventions that, because of their depth and lack of knowledge of the built reality are responsible for negative consequences in the construction and structure of the buildings.

At the urban space level, one notes some environmental problems, namely: security, parking, public lightning, illegal and disorderly of the inner accessible spaces —spaces that were planned to be green and recreational for the benefit of residents.

Alvalade is the first experience of integral, defining norms and rules at an urban, architectonic and constructive level. The elaboration of a municipal regulation that established specific rules of action, guaranteeing the goals of an urban rehabilitation programme is imperative. This process must be supported in its totality by an knowledgeable, multi-disciplinary team in the area of rehabilitation, Thus, it is guaranteed the aesthetical and urban unity of the built ensemble, that not only occupies a noble area of the city of Lisbon, but is also representative of a well defined urban development phase, with its own and exceptional characteristics.

**Reference List**


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