# **RENOVATION OF MODERN SECONDARY SCHOOL BUILDINGS: TWO CASE STUDIES IN PORTUGAL**

Ana Fernandes, Maria Bacharel, Patrícia Lourenco, Alexandra Alegre (Portugal)

# ABSTRACT

This paper aims at analysing the conceptual strategies and design principles adopted in the renovation process of two school buildings located in the cities of Lisbon and Beja, which are part of the modern heritage of Portugal. It addresses the adaptation of the original buildings to current functional, environmental, safety and construction requirements. It is now possible to make a reflexion and critical review of the process, after the renovation and a period of users' adaptation to the renewed schools, in order to identify best practices and improvement areas for future interventions.

The main research question focuses on the adaptive capacity of modern school buildings to assimilate the current requirements in different domains while keeping the values of their modern identity. It is assessed how the renovation processes of two case studies suited contemporary educational challenges, the programmatic requirements, current safety directives, environmental requisites, and how these affect atmospheres, interior and identity of the building. This study was based on documentation analysis, site visits, interviews, and a post-occupancy evaluation.

The analysis of these two cases is therefore an opportunity to discuss the process of renovation of modern school buildings, stressing good practices and failures in these processes.

#### **1. INTRODUCTION**

The preservation of the modern heritage is a pressing concern for its specialists all over the world. In the specific case of public school buildings, the need to cope heritage values with functional requirements, current legal standards, and community demands enables room for improvement.

The refurbishment of two modern school buildings provides a unique insight into the adaptive capacity of modern schools to assimilate the current requirements in different domains while keeping their modern identity. It is also an opportunity to understand different issues raised by the preservation of modern schools still in use, the methodological approach re-

garding the refurbishment planning, and to identify the cultural significance of school values<sup>1</sup>.

The two case studies date from different times of the modern period in Portugal: Liceu Diogo de Gouveia (1930-36), designed by Cristino da Silva, followed the Modern Movement principles in the 1930's; Liceu Padre António Vieira (1958-1965), designed by Ruy d'Athouguia, expressed the late modern period in the 1960's.

This paper discusses the refurbishment process that occurred in each school regarding functional, environmental and construction efficiency, as well as post-occupancy evaluation. A critical review of the process is made, relating design planning methodological approach, the response to current functional and technical demands, and the daily use of school space. For a better understanding of the process and its transformations, a series of visits took place to both schools. Interviews were led to school directors, operational staff and to the designer teams responsible for the refurbishment project. The guidelines for each intervention scoped: space-use, organization, management, energy consumption, and the school awareness and involvement in the process.

#### 2. TWO MODERN SCHOOLS IN PORTUGAL

These two modern Portuguese secondary schools are wellknown and considered an expression of the modern architecture purpose: to serve a social and educational programme, aiming at providing a better society.

Liceu<sup>2</sup> Diogo de Gouveia (1930-36) designed by Cristino da Silva, followed an architectural language marked by the adhesion to the principles disclosed by the Modern Movement in the 1930's, the reinforced concrete enabled the exploration of a modernist vocabulary of form and rigorous geometry, based on pure, articulated volumes with smooth surfaces and flat roofs. It was the beginning of the modern period and its design was an opportunity to define the programmatic, pedagogical and hygienic requirements for the secondary education buildings.



Fig 1. Cristino da Silva, DGSS, Beja, Portugal. Classroom-block. @Estudio Mário Novais Collection, Fundação Calouste Gulbenkian BA-CFT003.100308.

Different functional and autonomous volumes, hierarchically and rationally organized, along with the inclusion of new sports facilities, and the distribution of the classrooms throughout extensive corridors (classroom blocks) had a great impact on school building design. The new approach aimed at improving the physical conditions and hygienic requirements. Due to the use of reinforced concrete, it was possible to design ample interior spaces with large windows, thus optimizing lightning and ventilation conditions. This new material allowed the exploration of a modernist formal vocabulary without decorative elements. Furthermore, the integration of new materials in the construction allowed the hygienization of the internal spaces: the use of marble stone, chromium plating components, and tiles in the circulation and learning spaces.

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In the late modern period, the conceptual design principles were based on a different approach. Liceu<sup>3</sup> Padre António Vieira (1958-1965), designed by Ruy d'Athouguia, proposed a modern approach to the site, a clear individuality of functional volumes supported by *pilotis*, and an explorative expression of different materials.

The placement and the building's location were carefully studied attending to the best solar orientation and their surroundings' interconnection. The impressive block of the classrooms with three floors contrasts with the rest of the school, which assumes a grounded one-floor layout. Ruy d'Athouguia took advantage of the scale and proportion of the buildings playing with "the contrast of the volumes, the emptiness and fullness of spaces, the light and shadow, and materials"<sup>4</sup>.

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Clear and rigorous, the design of the school was determined by the rhythm of the structure and the modulation of the classrooms, revealing the pure elements and materials in each detail. The core circulation was materialized in a wide concrete block that houses a ramp linking the entrance with the classrooms building, aiming at the democratization and simplification of circulation throughout the school. The classroom block, located on the slope, is slightly elevated from the ground, creating a covered area under the building used as a playground.

Exposed concrete and brick, coloured window frames, and wood replaced the hygienic smooth surfaces from the previous modern period.

### 3. SECONDARY SCHOOL MODERNIZATION PROGRAMME

In 2007, the Portuguese government launched the Secondary School Modernization Programme aiming at the renovation of secondary education school facilities. This programme promoted a customized school building model adapted to the educational project pursued by each school, its needs, objectives and characteristics, ensuring school buildings' durability and sustainability while taking into account the adaptability and continued need to restructure space in light of changes in educational strategies.

The conceptual model that guided the renovation process relied on three basic principles: integration between the various functional areas, guaranteed conditions for integrated use of the space, and the possibility of opening up some areas to wider community use.

The interventions focused on the correction of construction problems and the improvement of use conditions, considering the new pedagogical needs and learning modes, environmental comfort, safety and accessibility. Beside the classroom, other school spaces were given a growing importance in the learning process. Meeting, social, and circulation spaces were designed as informal learning spaces, where collective or individual work could take place, promoting active interaction among its users.

#### **4. THE REFURBISHMENT PROCESS**

Despite the particularities of each school, both projects adopted a similar approach in the refurbishment strategy: to preserve the original character of the pre-existing school in its spatial, formal and construction features, to respect the original functional layout and typology, and to build new blocks to house specific learning spaces such as the library, ICT rooms, multipurpose laboratory and covered games fields. The new buildings were placed and dimensioned in a way to avoid overpowering the existing ones and to respect the orig-

Fig 2. Ruy d'Athouguia, PAVSS, Lisbon, Portugal. Entrance and classroom-block. @Archive of Secretaria-Geral do Ministério da Educação, 1965/6.



inal typology and geometry. The articulation with the existing buildings enabled the functional and safety conditions for opening the school to the community in post-curricular periods. Large scale technical equipment was placed in the new blocks, avoiding overloading the original structures. Also, the improvement of accessibility conditions for people with disabilities was accomplished by placing ramps and elevators in the new buildings.

During the design process, a meticulous historical analysis was undertaken, based on archive research and physical evidence to identify building's values and significance. A participatory process included meetings between the design teams and the schools' directors.

# 4.1 Diogo Gouveia Secondary School (DGSS)<sup>5</sup>

The original school building is classified as Building of Public Interest. The design strategy focused on assuring the authenticity and integrity of the building and its components and materials. A set of photographs taken by Mário Novais<sup>6</sup> (1899-1967) was a valuable resource to apprehend the original atmosphere of the buildings (space, light and shadow). The designers mentioned that complying with fire safety and energy performance regulations while keeping the buildings integrity was a major challenge. Fire safety compliance implied the subdivision of the existing classroom block - with almost 100 meters in length - into isolated units, which would destroy its main spatial character. The adopted strategy

Fig. 3. Pedro Botelho and Rosário Beija, Refurbishment of Diogo Gouveia Secondary School, Beja. Classroom-block. General plan with new buildings in yellow. ©Alexandra Alegre and Pedro Botelho



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was to use a smoke and fireproof curtain that can be lowered to isolate areas from each other in case of fire.

The original structural walls in stone and ceramic brick masonry, supporting reinforced-concrete slabs and reinforced concrete beams, were in good conditions, requiring only minor repairs. The exceptions were the water tank, which was demolished because of the degradation of the reinforced concrete due to reinforcement corrosion, and the terraces that reflected practices used in the early days of reinforced-concrete construction structures in Portugal. The 8 cm slabs had a rainwater damage and had been unsuccessfully repaired over the time. This refurbishment was an opportunity to rebuild the terraces as they were designed in the 1930's while correcting the drainage problems.

Non-intrusive methods were used for HVAC and networks, by adopting suspended cable trays and ceilings, avoiding the destruction of the existing walls and floors.

One of the main important aspects in the refurbishment of modern buildings is the preservation of the original window frames due to their aesthetical value. However, original wooden or metallic frames with single glass do not fulfil the current comfort and energy performance criteria, raising issues related to their replacement by new ones. It is already known that the original character of these buildings often depends on the design of the original window frames. In this case, the original wooden window frames had already been replaced by aluminium frames, so the option was the redesign of the win-

dows according to their original design and material (wood) but supporting a double-glazed system.

#### 4.2 Padre António Vieira Secondary School (PAVSS)<sup>7</sup>

The main objective was to preserve the modern character of the existing buildings and its spatial and construction characteristics, since they were compromised by different additions through time. This purpose had to be balanced by solutions that ensured the resolution of seismic resistance and construction problems, as well as the proper integration of the new HVAC network, and lighting infrastructures.

The structure reinforcement solution followed the premises expressed in the Principles for the Analysis Conservation and Structural Restoration of Architectural Heritage (2003) implying that "each intervention should respect, as far as possible, the concept, techniques and historical value of the original or earlier states of the structure and leaves evidence that can be recognized in the future". A new metallic structure was introduced, cross bracing the original concrete structure while strengthening the system as a whole. In the entrance and gymnasium blocks, the seismic reinforcement was executed in both directions and fitted inside partition walls, thus minimizing its impact. In the classroom block, only one brace frame was introduced in each structural module across all the floors, positioned longitudinally in the wall between the classrooms and the corridor<sup>8</sup>. These new elements painted in white for better integration, are clearly assumed as new additions. The construction elements that presented signs of decay were replaced according to its original design.

The integration of the infrastructures was thought to simplify and lighten the need of heavy machinery. A Computerized Building Management System (BMS) was installed to optimize the facilities management. Despite the increase of technical infrastructures, the classrooms preserved the original identity by concealing them in the suspended ceilings and in technical cabinets. The new ceiling incorporating lighting and acoustic isolation defines a margin in the classrooms' perimeter, thus preserving the original height of the windows. The cabinets hide independent HVAC and electrical switchboards in each classroom, to avoid large equipment and ducts. Along the corridors a suspended cable tray was installed, concealing electrical, telecommunications, water and fire safety systems with lighting fixtures integrated below, thus avoiding the destruction of the existing walls and floors.

Given the importance of the window frames for the image and aesthetical value of the original building, a new window frame system was designed in aluminium. Despite of adopting a new material (originally in iron), the same frame thickness was maintained, meeting current energy efficiency and comfort requirements. The passive ventilation system was preserved in the corridors allowing the upper windows to open when necessary.

Two new buildings were designed in alignment with the

Fig. 4. Teresa Nunes da Ponte, Refurbishment of Padre António Vieira Secondary School, Lisbon. Entrance and classroom-block. General plan with new buildings in yellow. ©Maria Bacharel and Teresa Nunes da Ponte, arquitectura.



pre-existing. The smaller for the cloakrooms near the gymnasiums and the larger connected to the classroom block with an independent entrance that ensured continuity to the urban area. This new building accommodates new laboratories, arts studios and teachers' room along with the kitchens, canteen and cafeteria, which needed to expand to meet current legal standards. It also includes new facilities, such as the multi-purpose space and the centre for adult education.

### 5. RETHINKING MODERN SCHOOL BUILDINGS

The refurbishment of both schools provides an opportunity to discuss the adaptive capacity of modern schools to meet current functional, aesthetical, constructive and environmental demands, while preserving their modern identity. This discussion raises a number of questions related to the design/ planning phase, the response to current educational, functional, and technical demands, and to day-to-day use of school building.

The initial planning stage provided a basis to recognize modern values to be maintained in the schools, which give them a cultural significance, through methodological procedures such as documentation analysis, historical research, together with an effective on-site survey (physical analysis, construction and structural condition, uses and functions). In a second stage, these values should be assessed identifying the constraints and vulnerabilities of their preservation, in face of current educational, functional, technical requirements and regulations. This procedure is often forgotten regarding modern heritage<sup>9</sup>.

Both case studies recognized importance of preserving spatial<sup>10</sup>, formal, material, and construction characteristics of the original building, as well as the respect for original typology, as values to preserve.

The refurbishment of both schools proposed a compromise between the preservation of the existing building, and the resolution of new functional and educational demands. Rather than provide new pedagogical methodologies, some interventions allowed small improvements in the learning process: proposing multifunctional common spaces, redesigning outdoor spaces, fitting labs with new equipment, access to information technology equipment in the school spaces, and opening facilities to community use.

Updating of the technical infrastructure and legal compliance are major challenges. Maintenance needs and such equipment's short life cycle should be taken into account in the design and planning strategies.

A post-occupancy evaluation shows evidence of best practices

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as well as situations to be improved. Some problems were observed after few years of interventions regarding windows usability, shading systems, floor covering, sanitary equipment, difficulties in managing the new HVAC and electrical system, the lighting system and the BMS.

School space is exposed to an intensive and demanding use by a community (with different kind of people), which was not taken in consideration in the planning stage. This demands robust and cost-effective, low maintenance solutions, which may be incompatible with modern solutions and materials.

The consumption of energy and obtained thermal comfort were also a matter of analysis. In both schools, the energy consumption increased due to its expansion and more intensive use of equipment. When compared to other secondary schools, also refurbished under the same modernization process, DGSS has similar energy consumption levels<sup>11</sup>, but PAVSS has significantly lower values. In this school, the HVAC system is not being used. The users do not feel able to use both the HVAC and the BMS system in an efficient way, undervaluing its potential, due to lack of instruction on its use and management.

In this school, thermal comfort conditions were measured in three classrooms during one week in the winter season. The original classroom building in PAVSS, facing south, presented temperature values within the adaptive comfort interval<sup>12</sup> during the operational period (17°C-24°C), even though the HVAC systems was not operating. As for the new building, classrooms facing north presented values below the comfort interval during part of the operational period. Nevertheless all measurements revealed relatively constant interior temperatures, revealing good thermal inertia. Although no measurements were performed in the summer period, during the interviews users expressed to be satisfied with the thermal conditions in the original classroom block during the all school year, revealing the efficiency of the innovative solutions of the modern design. The constructive features developed were comprehensive and dynamic, assuring an effective environmental passive performance. Understanding the environmental and comfort performance of modern buildings is also crucial to grasp the complex building system of the Modern Movement as a unit.

The school community is not always aware of the heritage value of the building that they use daily. Actions of awareness are essential in parallel with the recognition of user's behaviour and efficient management strategies. This is essential in a school: a place for education.

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#### NOTES

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1 See Macdonal, "Preserving the Ephemeral", 305-311. 2 After the unification of the educational system, these schools shifted the designation of 'Liceu' to 'Secondary School'. 3 See note 2, above. 4 D'Athouguia, "Memória Descritiva". 5 The refurbishment of the school was carried out by the architects Pedro Botelho and Rosário Beija, between 2008 and 2011. 6 Mário Novais was a famous Portuguese photographer from Lisbon, specialized in photography of art-works and architecture. 7 The refurbishment of the school was carried out by Atelier Teresa Nunes da Ponte between 2008 and 2011. 8 Menses, Seismic Strengthening of School Building. 9 See note 1 above. 10 High ceilings, lighting conditions, original material, window frames and relationship with the outdoor space. 11 Lourenço, "From indicators to strategies" 12 Matias, "Adaptive Thermal Comfort"

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# VANCOUVER EXPERIMENT:

# **REINVENTING A MODERN UNIVERSITY CAMPUS**

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#### ABSTRACT

This paper addresses questions of heritage and change as considered through the paradigm of modern architecture as 'experiment'. It argues for alternate ways of preserving modernist ideals associated with educational structures and landscapes, through a renewal of 'the experiment'. The post-war university campus was a key place of research and development for architecture, landscape and urban design in Canada. Known for promoting modernism since the 1950s, the University of British Columbia's design schools and campus structures are also known for teaching and demonstrating sustainable design. UBC upholds itself as a 'living laboratory' that seeks a deep integration of operational and academic efforts in sustainability challenges. More fundamentally, increased participation of the ancestral Indigenous keepers of the land, the Musqueam people, is reflected in educational programming and a metamorphosis of the public realm. Through consideration of selected projects, this paper illustrates how maintenance, renewal and transformation objectives are interwoven to create distinct outcomes for heritage conservation, resource re-use, and, renewal of the relationships to BC's First Nations people.

#### 1. RENEWING A MODERNIST UNIVERSITY **EXPERIMENT**

Built heritage is often portrayed as a 'non-renewable resource', tion's expression of the ongoing possibilities for metamorthat is, a resource that does not renew itself in a time frame meaningful to human measures. Resource renewal replicates phosis.<sup>3</sup> the biological function of a living organism, in which naturally occurring processes are the basis of renewal. However, there 1.1 UBC settlement, planning and modernization can be many good reasons to challenge this metaphor, per-The UBC campus is located on Point Grey, a formerly-woodhaps none better than when the legacy of the 20<sup>th</sup> century ed coastal plain southwest of downtown Vancouver. The reflects the troubled politics of resource exploitation and colnorthern perimeter is bordered by cliffs overlooking the Strait onization. This is the case on the West Coast of Canada, of Georgia and magnificent views of the Coast Range's North where Vancouver, British Columbia, as the site of a number Shore mountains. For thousands of years before the universiof corporate headquarters of expanding resource industries, ty existed, the Musqueam people inhabited and cared for this land. After the site was taken over by the university in 1910, intersected with leading experiments in modernist design.

This is part of the legacy of the University of British Columbia (UBC), where its vital connection to engineering and science research and development goals of the era facilitated the education and training required for professionals and industry leaders. Even as it has expanded this post-war legacy, UBC has also been reinventing itself, offering many instructive examples of the renewal of its modern heritage. As places for experimentation in laboratories, in planning models, and in social structures, the university context has offered a unique place for reflection on this evolving and diverse legacy.<sup>1</sup> By addressing questions of heritage and change, and connecting them to the paradigm of modern architecture as experiment, this paper argues for alternate ways of preserving the associated modernist ideals, advocating processes of reinvention that consider expanded perspectives and new ideals.

The achievements of post-war Canadian university research and development in architecture, landscape and urban design critically reflected rethinking the models of the institutions themselves. Muthesius has identified two distinct contexts for these idealist efforts, the 'concentrated college' and the 'spreading campus'.<sup>2</sup> Canadian universities, like Lethbridge University in Alberta, designed as a single structure campus by Arthur Erickson, are celebrated for their unique contributions to this international post-war experiment with 'the academic utopia'. But expansive older campuses like UBC's are no less interesting for what they can tell us about moderniza-