School Architecture in Portugal: Education, Heritage and Challenges

Alexandra Alegre
Teresa Heitor
(Edited by)

FCT Fundação para a Ciência e a Tecnologia

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ATLAS OF SCHOOL ARCHITECTURE IN PORTUGAL ASAP
FCT Fundação para a Ciência e a Tecnologia
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Education, Heritage and Challenges

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Part I

Atlas of School Architecture in Portugal

Education, Heritage and Challenges

Contextualisation

Legend
Figure A: Escola Técnica Elementar da Marquesa de Alorna

"Atlas of School Architecture in Portugal – Education, Heritage and Challenges": Presentation of the Research Project

Alexandra Alegre and Teresa Heitor

Presentation

Atlas of School Architecture in Portugal – Education, Heritage and Challenges (ASAP_EHC) is a research project financed by the Fundação para a Ciência e Tecnologia (FCT – Foundation for Science and Technology) and developed between June 2016 and November 2019 by a team of researchers from different Portuguese research centres and distinct disciplinary areas[1]. Its aim is to contribute to the study of school architecture in Portugal, with the research being centred on buildings designed to be used for secondary education (lyceums and technical schools) and middle (or high-school) education[2], sponsored by the State and built between the end of the nineteenth century and the early 1970s, after which date there was a distinct shift in education policy in Portugal.

1 Research team members and their research centres: Alexandra Alegre (principal researcher), Teresa Heitor, Ana Tostões, Francisco Teixeira Bastos, Patrícia Lourenço and António Gago (CITUA/CERIS, Centre for Innovation in Territory, Urbanism and Architecture/Civil Engineering Research and Innovation for Sustainability, Instituto Superior Técnico, University of Lisbon); Áurea Adão (Institute of Education, University of Lisbon); João Paulo Martins (Centre of Research in Architecture, Urbanism and Design, Faculty of Architecture, University of Lisbon); Gonçalo Canto Moniz, Carolina Ferreira (Centre for Social Studies, University of Coimbra). Scholarship holders: Maria Bacharel (PhD), Ana Fernandes (Master's Degree) and Pedro Borges (Graduate). Consultants: Justino Magalhães (Institute of Education, University of Lisbon); Catherine Burke (University of Cambridge) and Mark Dudek (Mark Dudek Associates, Architecture, Building and Research).

2 In Portugal, "middle education" (*ensino médio*) corresponded to a higher level of technical vocational education. It was divided into industrial, commercial and agricultural middle education, as well as nursing schools and teacher training colleges. It was definitively abolished in 1986 when the Basic Law of the Educational System came into force. Law No. 46/86, of 14 October.

The research was undertaken with the support of the *Núcleo de Arquivo Técnico de Construções Escolares da Secretaria-Geral da Educação e Ciência* (NATCE–SGEC, Technical Archive for School Buildings of the General Secretariat of Education and Science), the partner institution in this project, where important documentation is kept relating to the production (design and construction) of school buildings in Portugal.

One of the basic premises of this research was the adoption of a multidisciplinary approach. With its main focus being on the disciplinary area of architecture, this research project had various objectives, each with quite different dimensions and meanings. The prime aim was to recognise the identity of school architecture in Portugal, looking at questions of a programmatic, aesthetic and technical nature and seeking to understand its specificities, evolution, influences and innovative aspects, as well as to identify its promoters and authors, trends and key moments in its transformation, based on two distinct approaches: i) the study of the documentation and processes relating to the school buildings under study, which are available at NATCE–SGEC, complemented with other information and documentation gathered from archives, libraries, personal papers, etc.; ii) a comparative study undertaken within an international context and, in particular, comparing with the school architecture produced in Europe and North America, identifying influences, convergences and divergences, and making it possible to assess the degree of autonomy that was enjoyed in the production of school architecture in Portugal. These comparisons help to identify the specificities of this process, its architectural, urbanistic and constructive identity, the associated educational practices, and its influence on the design and production of school buildings in other geographical contexts.

Accordingly, an attempt was made to identify the relationship that existed between political ideals, state education policies, social and economic concerns and their impact on the production of school buildings, as well as to identify the main protagonists involved in this process. In parallel to this, the aim was to facilitate public access to the documentation existing at NATCE–SGEC (processed and digitised under the scope of the research) through an online platform that would make it possible to conduct future research projects according to different search criteria[3].

With these aims in mind, this research is designed to contribute to a greater awareness of the architectural legacy and heritage represented by the group of school buildings in Portugal through the recognition of their identity, values and cultural meanings, and the identification of their potential, constraints and fragilities, as well as the full extent of their resilience.

Finally, the research also seeks to fuel the debate about the contribution of school architecture to education in the twenty-first century, underlining the importance of comparing and incorporating knowledge from different disciplinary areas in the design of school buildings, as well as the value and meaning of architecture in responding to questions of an educational,

3 http://asap-ehc.tecnico.ulisboa.pt

urban, social, technical and technological nature and the challenges presented by safety, security, comfort, sustainability, accessibility and inclusion.

School architecture has been a subject of international debate since the nineteenth century, coinciding with the recognition of the autonomy of the school as a public building, a natural consequence of the imposition of compulsory free education, in different historical periods and geographical regions, or, as Barroso (2001, 63) puts it, with «the creation, structuring and regulation of national systems of public education under the impulse or auspices of the State». It was also in that century that the first experiments were made with the design and construction of school buildings, continuing thereafter throughout the twentieth century (Adão 1982). As a subject of much debate, driven by architects, teachers and doctors in relation to the fields of architecture, education and the hygienic and sanitary concerns of that time, school architecture became established as an area of autonomous research, recognising its contribution to the configuration of spaces and places, and to the definition of a school culture (Viñao Frago 1993-94).

Portugal joined in the international debate in the late nineteenth and early twentieth century, underlining the urgency for constructing secondary school buildings, centring the discussion at a political level and focusing on the question of the hygienic and sanitary conditions of the school space. However, publications in the field of school architecture in Portugal have been rare and mostly correspond to articles published in journals and catalogues, or in the form of technical documentation. At the turn of the twenty-first century, the first studies began to appear in the field of the history of education (Marques 1999, Silva 2002, Nóvoa 2003) and architecture (Moniz 2007, Alegre 2012), contributing towards the systematisation of our knowledge about the development, evolution and transformation of secondary school architecture in Portugal.

Two research projects were financed by FCT: "*Espaços de Aprendizagem em Portugal. Edifícios escolares destinados ao 2º e 3º ciclo do ensino básico e ensino secundário*" (Learning Environments in Portugal. 2nd and 3rd grade Elementary and Secondary School Buildings), between 2007 and 2009, and "*In Learning. Projectar Ambientes de Aprendizagem Activos*" (In Learning. Designing Active Learning Environments), between 2010 and 2013. Both of these projects were coordinated by Teresa Heitor and initiated the practice of research into school architecture within the disciplinary field of architecture in Portugal. We can also add to these the following research projects conducted in the area of architecture: "*EWV Visões Cruzadas dos Mundos: Arquitectura Moderna na África Lusófona (1943-74)*", (EWV: Exchanging worlds visions: modern architecture in Lusophone Africa (1943-74), coordinated by Ana Tostões, and "*África: Visões do Gabinete de Urbanização Colonial 1944-1974*" (The Colonial Urbanization Offices: Architectural Culture and Practice 1944-1974), coordinated by Ana Vaz Milheiro, which helped to increase our knowledge of the influence of the architecture produced in Portuguese territory in Africa (Angola and Mozambique) by providing further information relating to school architecture; and "*Móveis Modernos. A actividade da Comissão para Aquisição de Mobiliário no âmbito da Direcção-Geral dos Edifícios e Monumentos Nacionais.*

1940-1980" (Modern furnishing. The work of the Furniture Acquisition Commission in the scope of the Directorate-General of Buildings and National Monuments. 1940-1980), coordinated by João Paulo Martins, which establishes the framework that existed for the design and construction of school furniture within the broader context of the furniture produced for public buildings in Portugal. In the field of education, mention should also be made of the project "*Atlas – Repertório dos Municípios na Educação* e *na Cultura em Portugal (1820-1986)*" (Atlas-Index of Municipalities regarding Education and Culture in Portugal (1820-1986)), coordinated by Justino Magalhães, which created an important directory designed to inventory and reconstruct the educational and cultural supply offered at a municipal level (Adão and Justino 2013). The *Programa de Modernização das Escolas Secundárias* (Secondary School Modernisation Programme), which was begun in 2007, also opened up the discussion to a wider audience, including architects and academics, and stimulated the publication of works geared towards the rehabilitation of the school space (Heitor 2010, 2011; Blyth et al. 2012).

Despite these contributions, detailed multidisciplinary studies undertaken in a continuous fashion and in close collaboration with the bodies responsible for the process of producing school buildings are still very rare in Portugal, when compared with the amount of research that has been produced at an international level, as well as with the growing number of researchers and architects dedicating their attention to this theme. In parallel to this, there is also very limited public access online to archive information relating to these processes.

The documents housed at NATCE–SGEC, consisting of design and construction processes, photographs, varied documentation, reports, personal papers and publications, constitute an important resource for our knowledge about, and the systematisation of, school architecture in Portugal, in different areas of knowledge and, at a broader level, for the history of education in Portugal. Recognising its value and significance and, at the same time, seeking to guarantee the necessary safeguarding of this heritage and the expansion of its public visibility, this research project has made use of this documentation, by identifying, processing and systematising the existing information.

The first phase of research was centred on the study of the documentation existing in the archive and on the design of an online public access platform for the dissemination of the material analysed. This involved the identification, study, classification and digitisation of the archive material existing at NATCE-SGEC that was considered relevant for the aims of the project. In parallel to this, the school buildings under study were mapped and georeferenced.

The need to complement this information called for additional research at a national level in other archives, libraries and personal papers[4], interviews conducted with different actors who took part in the production of school buildings and fieldwork in a group of schools.

4 In particular, these included the Library and Historical Archive of the Ministry of Public Works (which forms part of the Department of Documentation Services, Communication and Public Relations of the General Secretariat for the Economy), the Forte de Sacavém Archive of the Directorate-General for National Monuments, the National Archive of Torre do Tombo, the Photographic Archive of Lisbon Municipal Council, the Portuguese National Library, the Calouste Gulbenkian Foundation Art Library, the Library and Documentation Centre of the Faculty of Architecture of Lisbon University, the Library of the Association of Portuguese Architects, the Library of the Ministry of Education, the Archive of Parque Escolar, the Library of the Department of Civil Engineering and Architecture of the Instituto Superior Técnico, the Historical Archive and Library of the António Quadros Foundation, and the libraries and archives of various secondary schools. Also consulted were the personal papers of the architects Manuel Tainha and Cristino da Silva (Calouste Gulbenkian Foundation), Cottinelli Telmo and Carlos Ramos (Forte de Sacavém Archive), Jorge Segurado (Lisbon Academy of Fine Arts), and Maria do Carmo Matos (SGEC).

Accordingly, further research was undertaken internationally, both at the level of the main bibliographical production about the theme under study and in the digital archives available online.

All of the information that was gathered and digitised in the previous phase was inserted into a database, designed to allow for searches to be made according to distinct criteria, and based on the cross-checking of different data[5]. This database is available on an online public access platform, integrated into the site of the ASAP_EHC project, which is constructing the Atlas of School Architecture in Portugal. Access to this information forms the basis for our research. From a more global point of view, it functions as a support for the study of the transformations, continuities and ruptures occurring in the design and construction of school buildings, all of which are to be understood in different political, legislative, educational, social and economic contexts. In a more detailed analysis, this allows for a series of case studies to be undertaken, centred on their architectural, educational, technical and technological aspects, observed at different levels of proximity (urban context, school buildings, interiors).

Besides this present publication, the ASAP_EHC project also includes the organisation of the international conference on "*Educational Architecture – Education, Heritage and Challenges*" in May, 2019, the organisation of the seminar "*School Architecture – Rehabilitation of Primary Schools*" in May, 2017, participations in the writing of book chapters, the supervision of master's degree dissertations and PhD theses, and the organisation of seminars under the scope of the ATHENS programme in the form of workshops with international students[6]. It is also important to stress the participation of team members in several national and international academic meetings, which made it possible to disseminate partial results from the research in progress and provided valuable moments for engaging in discussions with other researchers and comparing results[7]. This information is available on the ASAP_EHC

5 See the Chapter «Design and Construction of the Atlas of School Architecture in Portugal: Objectives, Demands and Challenges».

6 These workshops were held at Instituto Superior Técnico in March and November, 2017, on the theme of "From School Memories to a School Architecture Manifesto Unfolding Lisbon's School Architecture Paradigm" and in March, 2019, on the theme of "Educational Architecture: Reinventing Spaces and Places in the City of Lisbon". Based on a series of theoretical modules designed to contextualise the thematic framework, the organisation of study visits to educational spaces in the city of Lisbon, the reading of theoretical texts, the analysis of international case studies, the participants' experience as secondary school students, and the viewing of films, the aim of these workshops was to promote discussion about the guiding principles behind the design of educational spaces in the twenty-first century, involving reflections on the nature of the influencers and the underlying requirements of a spatial, urban, educational, environmental and social nature. At the end of these workshops, the twenty students taking part (of twelve different nationalities, and originating from different courses at various European institutions) presented their own conceptual proposals for joint reflection, intended to serve as a support for the design of educational spaces.

7 These meetings covered different disciplinary areas: architecture, history of architecture, history of education, preservation of modern heritage, and history of art. The team's participation involved the presentation of papers, later published in conference proceedings, and the organisation of sessions at international conferences, such as the *14th International DOCOMOMO Conference*, the *Fifth International Meeting of the European Architectural History Network* (EAHN) and the *49th Annual Meeting of the International Society for Educational Planning*. Also under preparation at this moment is the submission of articles to peer-reviewed international journals, as well as the organisation of a special issue of the "Childhood in the Past Journal" in 2020.

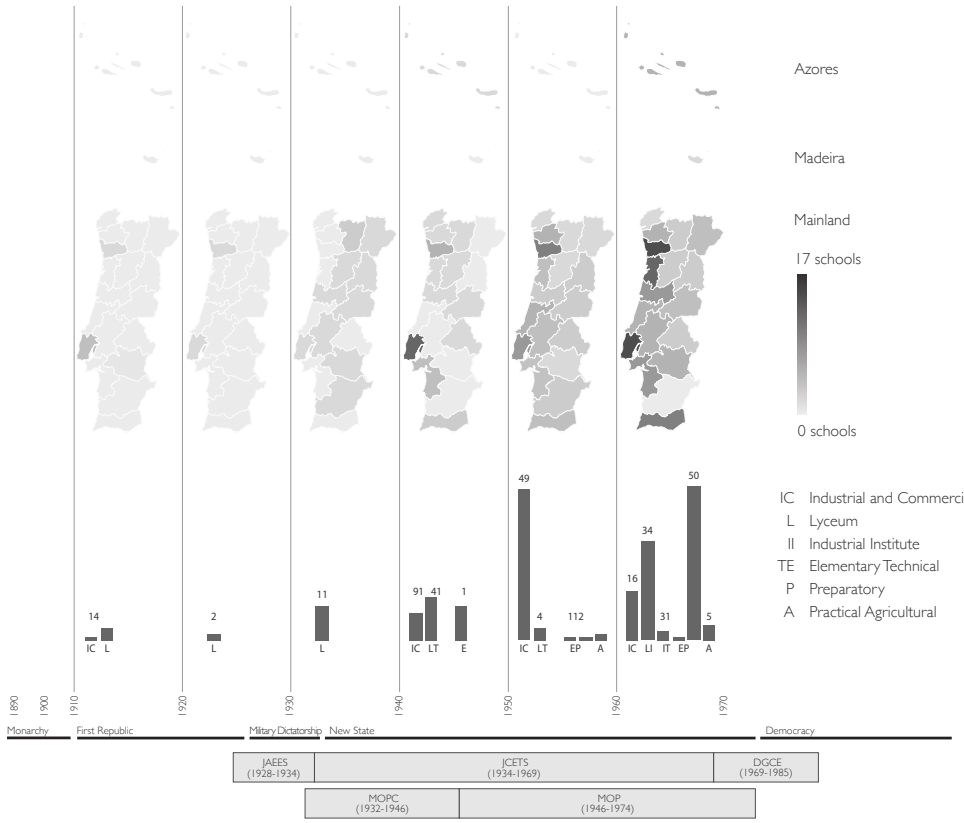

Figure 1: Evolution of the public school building network in Portugal: buildings built between the 1890s and the 1970s, by level of education and geographical distribution.

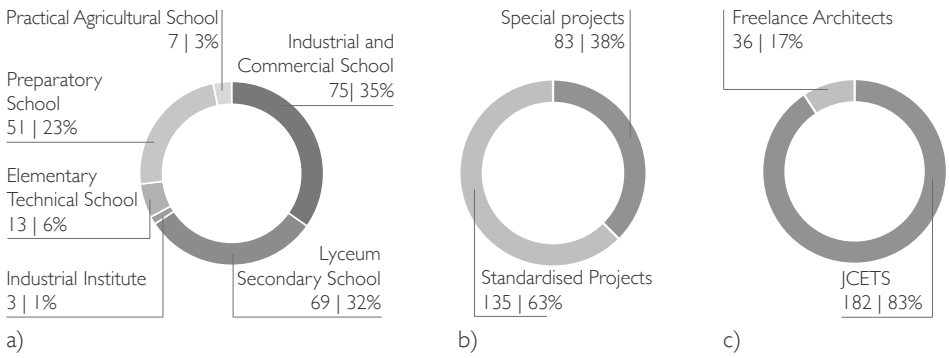

Figure 2: Evolution of the public school building network in Portugal:
a) Schools built between 1907 and 1974 by type of education b) Standard and special projects built between 1907 and 1974 c) Authorship of school buildings built between 1907 and 1974.

website[8], which, besides contextualising the work undertaken throughout the course of the research (with the presentation of the research project, the team and its consultants, and complementary information produced during the course of our investigation), also incorporates the database that includes all the archive information that has been processed and digitised. The development of the database and the project's website called for a continuous work of defining the contents and making them compatible with one another, as well as integrating the archive material. This work was undertaken with the support of scholarship holders with specific training in the area of architecture and documentation sciences.

The international conference "*Educational Architecture: Education, Heritage, Challenges*", held at the Calouste Gulbenkian Foundation, in Lisbon, from 6 to 8 May, 2019, was one of the project's main outcomes. Besides presenting the project's final results, this conference proved to be a valuable moment for debate and for sharing experiences at an international level, benefiting from the participation of both the project's consultants and other researchers. The conference proceedings were published in book form and are available online, where the complete articles are also presented[9].

Finally, this present publication, with separate editions published in Portuguese and English, brings together a series of texts written by the project's consultants and the members of the research team. It is structured in three different parts. In the first part, two texts are presented that contextualise the research project in terms of its objectives, research methods and results; the second part, "Education, Heritage and Challenges: Reflections", includes the texts by the consultants in a broader reflection designed to cross-reference the themes that constitute the title of the present book, by making comparisons with the architecture of the school space. The third part, "School Architecture for Secondary Education in Portugal: Readings" is centred on readings in different fields about the evolution and transformations of secondary school architecture in Portugal produced by the team members. The texts cover different themes – education, city, architecture, furniture, design processes, environmental comfort and construction – in an approach that is intended to be complementary and, at the same time, pays particular attention to a multidisciplinary reading of the theme.

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8 http://asap-ehc.tecnico.ulisboa.pt

9 http://asap-ehc.tecnico.ulisboa.pt/conference/ebook.php

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Two Intentions with the Same Goal: To Preserve and Disseminate the National School Heritage

Miguel Rui Infante

From its very beginning, the 'Atlas of School Architecture in Portugal – Education, Heritage and Challenges' research project was viewed as a way for the General Secretariat of Education and Science (SGEC) to disseminate its documentation in a serious manner, with technical and scientific rigour. The scope of the project allowed for the digitisation of an extremely important collection of documents, stored under the category of "School Constructions" and relating to the various levels of education from primary to secondary, including the so-called technical education (industrial and commercial schools). The chronological period that was presented, covering a part of the twentieth century, justified SGEC's participation in this project. Another important aspect of the proposal was that the documentation that was to be described and digitised reached far beyond the traditional interest in school building plans: in this case, the interest also extended to the schools' furniture and equipment, as well as to photographs and the personal papers of the architects involved.

By sheer coincidence, or perhaps not, SGEC had already begun work at that time on the modernisation of its reading room, based on the creation of a Virtual Counter[1]. This search facility would be used to make the archive's documentation, including its various descriptions and images, accessible to everyone via the internet. Consequently, this project was perfectly suited to this new orientation that was being planned for the archive, as it allowed for a large amount of information to be made available over the online information networks.

1 The SGEC archive can be accessed online at http://arquivo-ec.sec-geral.mec.pt/ and the Virtual Counter can be accessed at http://arquivo-ec.sec-geral.mec.pt/oservices

The important role that the archives would play in a project such as this one required its close involvement with our practices and guidelines, ranging from the choice of the archivist who would work on the project to the technical conditions that would be required for the digitisation of documents, as well as the forms adopted for the dissemination of the images on the website.

The partnership with SGEC took the form of a two-year agreement, which resulted in a valuable and fruitful collaboration that went far beyond the limited scope of the project's objectives.

The documentation involved in the "Atlas of School Architecture in Portugal – Education, Heritage and Challenges" project related to the school constructions produced in the period from 1922 to 1989 by the various bodies with specific powers and responsibilities in this area. It consisted of the administrative and technical documentation relating to the construction, expansion and repair of infrastructures for the three levels of education (primary, technical/secondary and university), namely about the classrooms, canteens, sports and cultural facilities, residences for teachers and university complexes, but also about the supply of equipment (furniture). We should also add to this documentation the collection of photographs taken by Horácio and Mário Novais, Joaquim Silva Nogueira Alvão (Álvaro C. Azevedo) and Teófilo Rego, among other photographers.

There are thousands of unique documents in this archive, which, besides their informative and legal contents, also have an important aesthetic value.

In consulting these documents, we can find out all about the different phases in the construction of a school building, as well as discovering how the interiors and exteriors of lyceums and technical schools were designed and built all across the country.

The important collection of photographs also enables us to learn more about the architects' models for the design of these constructions, with aerial and panoramic views of the school buildings, furniture and equipment, as well as about some of the school environments and the various people involved in their functioning, namely the teachers and students.

With the completion of the Atlas Project, all of this documentary collection will now be available for consultation by all those interested in this subject, both specialists and the general public. It will also have a huge impact on the conservation of the documentation, since its digital access will make it possible to safeguard the consultation of the physical copies, which are always so fragile in this type of documentation.

All of the documentation dealt with here will also serve as a spur for the treatment of the documentation not covered by the scope of this project, thus contributing to its final aim, which is to make all of the documentation from the Technical Archive of School Constructions (*Núcleo de Arquivo Técnico das Construções Escolares* – NATCE).

I cannot end these brief lines without expressing my gratitude to the architect and researcher Alexandra Alegre for inviting us to collaborate in the project and for accepting our conditions, and without also thanking the rest of the team for their excellent work and collaboration, namely the architects Maria Bacharel and Ana Fernandes, and the archivist Susana Marcos.

On the part of SGEC, mention should also be made of the work undertaken by the archivist Françoise Le Cunff and by our operator José Montenegro, who was entrusted with the arduous task of preparing the documentation to be digitised.

All that now remains is to thank Ana Almeida, the Assistant Secretary-General, and the Secretary-General himself, Raúl Capaz Coelho, both of whom gave me their support, from the very beginning, in the realisation of this partnership and of all my projects for the modernisation of the archives, not only in the treatment of our documentation, but also in its dissemination.

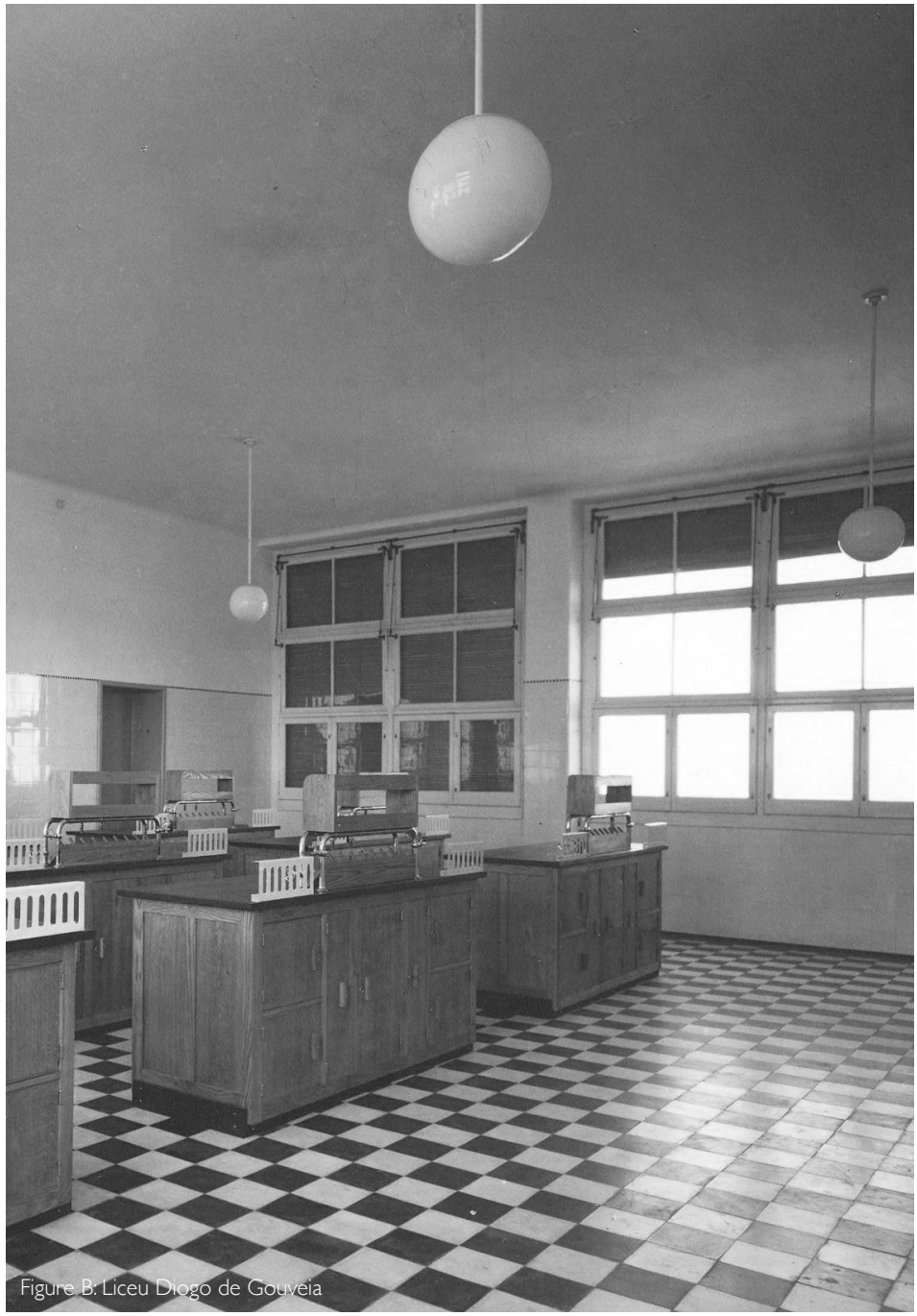

Figure 8: Liceu Diogo de Gouveia

Design and Construction of the Atlas of School Architecture in Portugal: Aims, Demands and Challenges

Alexandra Alegre, Teresa Heitor, Maria Bacharel and Ana Fernandes

Introduction

Although the first reform of Secondary Education was promulgated in 1836, by Passos Manuel, who approved the *National Lyceums Plan*, it was only towards the end of the nineteenth century, with the publication of Jaime Moniz' reform in 1894-95, and later with Eduardo José Coelho's reform in 1905, that the debate about school architecture truly began in Portugal, giving rise to a first period of construction that continued into the first decades of the twentieth century. Directly linked to the hygienist movement, the basic principles were established for the design of buildings intended to be used for the purposes of secondary education (lyceums), and a series of new spaces were introduced, dedicated to the scientific disciplines and to experimental teaching and further broadening their programmatic and functional complexity. This first group of such buildings, albeit not a very large one, represents an important legacy in the panorama of Portuguese architectural heritage.

Lyceum buildings were again the subject of a new reform in 1928, when, at the initiative of Duarte Pacheco, the then Minister of Education (April to November, 1928), the *Junta Administrativa do Empréstimo para o Ensino Secundário* (JAEES – the Administrative Board for the Loan for Secondary Education), was created, a body that was answerable to his ministry and would be responsible for relaunching the works that had been initiated during the period of the first republican regime and had been interrupted in the meantime. This same board would also be responsible for organising the public contests for the building of

the Lyceums of Beja, Coimbra and Lamego, as well as the Liceu Filipa de Lencastre in Lisbon and the Liceu Feminino de Coimbra, which were later postponed and then abandoned.

In this period, a series of measures were promulgated, intended to provide incentives for technical and vocational teaching. The Industrial and Commercial Schools had been created in the late 1880s, under the supervision of the Ministries of Public Works, Trade and Communications, and Agriculture, together with the Schools of Industrial Design and the Practical Schools (agriculture, viticulture and dairy farming), while agricultural and veterinary teaching was also reformulated[1].

1934 marked a paradigm shift in the construction of state schools destined for secondary and technical-vocational education. The *Junta das Construções para o Ensino Técnico e Secundário*[2] (JCETS – Board for Constructions for Technical and Secondary Education) was created. This body was incorporated into the Ministry of Public Works and Communications (MOPC), which centralised the whole production process until its subsequent disbandment in 1969, the year in which the *Direcção-Geral das Construções Escolares* (Directorate-General for School Buildings – 1969-1985) was created, a body which remained under the supervision of the Ministry of Public Works (MOP).

The activity of JCETS was to be governed by the educational policy of the *Estado Novo* (the New State), with this body being responsible for the design of important plans relating to the construction of school buildings to be used as lyceums and technical schools. Between the years 1950 and 1960, the technical department of JCETS developed strategies and methodologies for rationalising production and construction, based on the use of standardised designs, in order to respond to the shortage of buildings that was then beginning to be felt. In parallel to the intervention of JCETS, a small group of projects were handed to outside architects, who operated separately from the production of that state body. Besides constituting an important architectural legacy with significant heritage value, most of the buildings constructed during this period are still in use today, maintaining their original function and requiring sustained studies so that they can better support future interventions.

The documentation relating to the production of JCETS between 1934 and 1969 is kept in the Technical Archive for School Buildings of the General Secretariat of the Ministry of Education and Science (NATCE-SGEC), an institution that is one of the partners in the research project "Atlas of School Architecture in Portugal – Education, Heritage and Challenges (ASAP_EHC)", proving to be an important resource for the realisation of this study. It includes a series of different collections that, when joined together, are decisive for the study and understanding of the evolution of school architecture in Portugal. The

1 These schools were transferred to the Ministry of Public Education in 1929.

2 JCETS was created by Decree-Law No. 24337, of 10 August, 1934, replacing the Junta Administrativa do Empréstimo para o Ensino Secundário created in 1928 (Decree-Law No. 15942, of 11 September), by Duarte Pacheco, the then Minister of Public Education. See «School Buildings for Secondary Education: Their Architectural Evolution between the Late Nineteenth Century and the 1970s».

documents kept here consist of design and construction processes, photographs, varied documentation (official letters, catalogues, etc.), constituting an important legacy, which as yet remains largely unsystematised. Previous research has made it possible to understand the valuable potential of this group of documents and the significance of the various collections of which the archive is comprised within the historical context under which they were produced.

The existing material enables us to answer a series of questions that are asked in the field of both architecture and construction (the principal actors involved in the process, identifying standardised solutions at the design and construction level, authors, design guidelines and principles, construction solutions, the design of furniture and equipment, among others), as well as in relation to education policies, such as the legislation and regulations that formed the basis for the design and construction of school buildings, the main policies and educational reforms that influenced their production, and also the distribution of schools from different levels of education, at both the local and national level.

After the identification of the information existing at NATCE-SGEC, and its organisation, systematisation and classification in a database, an online platform was set up, which is intended to constitute an ATLAS of School Architecture in Portugal. Its main aim is to make the documentation existing in the archives available to the public. This information is not, however, organised as a digital archive, in the way that this is defined by Barbedo (2005, 12): «The Digital Archive is a structure that comprises technology, human resources and a set of policies for incorporating, managing and providing continuous access to digital objects of an archive-based nature». The digital resources available on this platform are regarded not as an end in themselves, but as an important means for making historical interpretations. It is, therefore, a tool that is designed to enable the undertaking of new studies, narratives and thematic readings based on the cross-referencing of different data – written and graphic material – suggesting possible avenues for new research about school architecture in Portugal and fuelling the discussion about the new challenges faced by school buildings.

Archive Research

The consultation of the NATCE archives of the General Secretariat of the Ministry of Education and Science represented the first fundamental phase of research under the scope of the ASAP-EHC project. In the course of this process, it was crucial to identify, analyse and discuss the constraints associated with the methodology used in the processing of the documentation and the provision of access thereto. Special attention was given to the selection of documents and the identification of important data relating to the different materials comprising the archive: their description, contents and state of conservation, the procedures followed in their classification and digitisation, as well as the most efficient means of access to all the information available online, with a view to improving our knowledge about school architecture.

Among the various collections existing in the archives, attention is drawn to the following in particular:

1) Collection of Projects for the Building of Lyceums and Technical Schools (1933-1969) – architectural designs (written texts and drawings) for 65 lyceums and 192 technical and preparatory schools. It also includes designs for industrial institutes and agricultural schools. Size: 192 installation units (bound albums and boxes), numbered; 87 linear metres;
2) Collection of Processes for Technical and Secondary Schools (1928-1984) – dossiers referring to plots of land, competitive tenders, contracts for the construction and equipment of buildings to be used for technical, secondary and middle education, including technical drawings. Size: 11000 installation units (bound albums and boxes), numbered; 820 linear metres;
3) Private Archive of the Architect Maria do Carmo Matos – Size: 15 boxes, 3 linear metres;
4) Archive of the Working Group for School Buildings – Size: 17 boxes, 2.5 linear metres;;
5) Photographic Archive – collection of photographs of school buildings used for lyceums and technical education (1933-1969) Size: approximately 3000 photographs (comprising photographs, negatives and slides), 3 linear metres.

Questions and Challenges

The Collections – Description, Classification and Digitisation of the Documentation

The description and digitisation of the documents existing in archives involved several different phases and, at the same time, raised quite distinct questions. Given the extent of the existing universe, it became necessary, in the first phase, to identify and select the documents (both written and graphic) from the collections under study, which are, in fact, decisive for achieving the project's goals.

In this particular regard, the research team's goals were considered together with the interests of the partner institution (SGEC), which is governed by special criteria for the selection of documents to be digitised, determined by its mission and specific interests (preservation of the documents, the value of a certain collection, authenticity, among others). The overriding need was therefore to create points of contact between the research questions and the priorities of digitising the archive documentation. The strategy followed in selecting the material to be digitised and made available online therefore depended on this specific collaboration between the two parties involved in the process.

The documents that were selected were those contained in the already-mentioned collections, in particular the Collection of Projects for the Building of Lyceums and Technical

Schools (1933-1969) and the Collection of Processes for Technical and Secondary Schools (1928-1984), mainly composed of the processes relating to the design of school buildings, including the preliminary drafts, the projects themselves and the projects for alterations (enlargement, rehabilitation,...). These design processes are composed of written texts and drawings that include the following information: a) written documents: opinions issued by official entities, the project brief, the functional programme/standards, building specifications, budget, estimations of costs, cost statement, structural calculations, furniture, equipment; b) drawings: maps of the school's location and implantation, floor plans, cross sections and elevations, detailed drawings, equipment plans, furniture distribution plans, stability drawings, drawings of water and sewage networks, perspectives. Complementary to these documents, there were also some processes containing photographs of the sites for the buildings, architects' models, watercolour drawings, among other elements.

The collections relating to the Private Archive of the Architect Maria do Carmo Matos and the Archive of the Working Group for School Buildings include documentation comprising internal and external reports, reports of visits undertaken abroad and programmes of international conferences held between 1963 and 1977, international journals, books, correspondence, working documents and varied documentation, with the documents that were considered relevant for research purposes having been duly scanned and converted into a digital format.

The approximately 3000 photographs of technical and secondary school buildings (1933-1969) that comprise the Photographic Archive of the photographers Horácio and Mário Novais, Joaquim Silva Nogueira Alvão (Álvaro C. Azevedo) and Teófilo Rego, among others, complement the earlier collections by providing additional information about the interiors and exteriors of lyceums and technical school buildings all across the country, different phases of construction, aerial and panoramic views of their integration into the urban fabric, architect's models and plans for the school buildings, furniture and equipment. The calendar established for this research project did not provide us with enough time to fully describe, analyse and classify this archive. A large number of photographs were, however, scanned, in the hope that future research opportunities will make it possible to organise this collection, by linking images to one another in different groups, and to establish a framework for their production, by contextualising them in terms of their architectural, historical, socio-political and educational aspects, thus affording the photographs a cultural significance.

Finally, mention should also be made of an important source of information that was not initially identified and which consisted of the different publications intended to promote and publicise the activity of the Estado Novo in the field of school architecture, with particular emphasis being given to the action of the *Secretariado da Propaganda Nacional* (SPN – Secretariat of National Propaganda), JCETS and MOPC. Besides providing an important historical and political framework for the period under study, this propaganda, which covered a variety of areas and had different objectives, also made it possible to study the role that JCETS played in standardising the architectural and urbanistic language of the lyceum

buildings and technical schools and in contributing to the establishment and implementation of a series of projects that proved to be decisive for the design of these buildings over the following decades[3].

Consulting this information allows us to understand the evolution of the design process of each school building: the evolution of the project until its actual construction, as well as the changes that this underwent in response to the different requirements expressed in the official opinions, the design principles established by rules and regulations, the evolution of the functional programme of the different school buildings, the solutions proposed by the different architects (if this was the case), the standardised solutions and the standardised designs, the most commonly applied details, among other items. Looking at the question from a broader perspective, a comparative analysis enables us to understand trends and exceptions in the whole process of design and construction.

It should be stressed that the joint reading of this documentation enables us to understand the evolution of the methods involved in the organisation of the design projects, as far as the drawings and written texts are concerned, also allowing for comparisons to be made between the processes produced by JCETS and those produced by architects from outside this state organisation. Mention should also be made of another reading that can be made concerning the evolution both of the contents of the different written components and of the various means of graphic representation (technical drawings, perspectives, photographs) that were used at different periods in the design process.

Another question also relates to the way in which the archive information was processed (whether it was made available in digital form or not), to its organisation and classification, and to the importance of systematising procedures and standardising the items of classification according to pre-defined criteria. The description of the documents followed procedures that were designed to be objective, clear and simple, insofar as they formed the basis for the different types of research. The aim was to provide a description and a thorough, rigorous and uniform classification of all the documents accompanying the digitised images, thus allowing for a useful search through the different user profiles (for example: date, author, location, contents, reference code, etc.). In defining the items of classification, an attempt was made to avoid any proposal for reading or interpreting the archive material that could be considered to have been previously made or pre-established (in other sources), such as, for example, the definition of its design, education or construction period. It was intended that these (or other) readings of the material should be made through the full or partial interpretation of the available information, complemented, if necessary, through the consultation of other sources.

In this way, the school buildings studied here are divided into different series depending on the level of education that was provided: Standard Design, Commercial and Industrial

3 For more information, see «School Buildings for Secondary Education: their architectural evolution between the late nineteenth century and the 1970s».

School, Lyceum Design, Industrial Institutes, Technical and Elementary Schools, Preparatory and Secondary Schools, and Practical Schools of Agriculture.

Each series includes a group of schools. The term "school" refers to the teaching institution and not to the physical space, so that each building represents a possible association of various composite documents, namely: Preliminary Design, Design Project, Extension/ Remodelling Project or others. These composite documents may comprise design projects proposed by various architects (whether built or not built) and for different plots of land.

Each composite document is characterised according to pre-established fields: date, author, opinion, description of contents, description of format, observations, coordinates, address, electronic references (web pages), design type, etc. The existence of certain elements that are common to most of the processes is also noted, in the case of both written documents (e.g. project brief, measurements, budget, building specifications, structural calculations, furniture and equipment) and drawings (e.g. index, ground plans, cross sections, elevations, implantation, construction details, emblematic spaces, perspectives, stability, water and sewage systems, furniture and equipment).

Finally, reference is also made to the procedures and criteria associated with the digitisation of the documents, which, whenever possible, complied with the international standards and conventions relating to the resolution and format of the image. Other questions that were taken into consideration relate to the dimensional limitations of the scanner, the scale of the scan in relation to the size of the original document, the questions associated with copyright and information privacy, access authorisations and the free (or not) provision of the source image, permitting (or not) the download of the maximum resolution image from the platform.

Database

The scanning of information, the processing of data, their organisation into a database and their conversion into a public-access online platform were all considered from the outset as the most effective ways of disseminating the information and results obtained from the research (Guerreiro and Borbinha 2014). The online platform also presents advantages by allowing for comparative readings and interpretations of the results of different searches.

This particular aspect called for the adoption of a working methodology, based on the time-phased scheduling of tasks, that would allow for the identification of the existing material, the selection of the material to be studied and processed, its cataloguing and scanning according to pre-defined criteria, and, finally, the design of a database. This database was created in keeping with the criteria and items already stated in the data processing activities. It allows for individual searches of each design project, through the presentation of a summary file, but also the cross-checking of the different data, providing the possibility of making comparative readings and undertaking searches based on thematic fields, such

as date, sponsor, architect, location, construction plan, etc. Special attention was given to the search mechanisms and the consequent presentation of results (through an effective attribution of tags and keywords), the simplicity and objectivity of information, as well as the organisation and cross-checking of all information, since this was meant to respond to the questions raised by the research to be undertaken, while also corresponding to the aim of the project.

It should, however, be stressed that, in this process, the online platform was designed in such a way as to disseminate the results of the project, and not as a digital tool for making the archive material available. The database and the support of the platform were formed from the archive documentation, although this was complemented with information and documentation gathered from other sources (bibliographies, archives, etc.), as well as with the presentation of other results from the project, namely readings and interpretations of the archive material made by the project members.

Potetial Users

Distinguishing between the profiles of future users, who will naturally have different research aims, was one of the main points underlying the reflections made about the organisation and public presentation of information. This led to a hierarchy being established for the presentation of information (ranging from the most general to the most detailed), although this was seen as an incentive to search for complementary information among different research interests (for example, in different disciplinary areas), allowing for a more comprehensive interpretation of the search data. An attempt was made to respond to the expectations of different types of users, seeking to build bridges and create complementarities between the different disciplinary areas, and thus providing a wider range of complementary information for the research subjects.

In parallel to the aims of the research project, and those of the partnership with the SGEC archive, it was also clearly intended that the atlas should reach a wider and more differentiated audience, with the hope that this would increase the number of physical and virtual users, as well as broaden the typical user profile to include people from different disciplinary areas and with distinct specific interests. Consequently, the online platform was created in Portuguese and English in order to enlarge the target audience. However, not all of the information presented in a digital format was translated.

Final Reflections

The development of the ASAP-EHC research project presented an opportunity for working simultaneously in such different areas as architectural research and archival research with the support of the new technologies. The greatest challenge was to find common aims and

effective working and research methodologies that would make it possible to overcome difficulties and successfully meet the expectations of each party involved in the process. From a broader perspective, the project sought to contribute to making access to information more democratic, while also making full use of the potentialities of the new technologies.

In pursuing these aims, the development of the research in the form of team work was decisive, being further complemented with the contribution of individual work undertaken by the different team members and the scholarship holders involved in the project, who came from different disciplinary backgrounds – architecture, information and documentation sciences, and computer sciences. International experience highlights the important contribution made by volunteers with different profiles working on different archives, in particular those involved in such tasks as providing support for the description and scanning of documents, as well as the important financial support obtained through broader collaborative activities such as crowdfunding (Frankot 2016, Hansen 2016).

The existing physical and human resources, the large volume and range of the archive material, the available financial resources and the duration of the research project (three years) obliged the research team, together with the partner institution, to establish priorities and lines of action that would guarantee the fulfilment of the proposed aims. The experience acquired with this project will certainly dictate the need to go into certain points in greater detail at a later stage, namely those questions that, by dint of circumstance, will not be developed in the research, as well as to open new lines of future research that will bring together, or form part of, new and different areas of knowledge.

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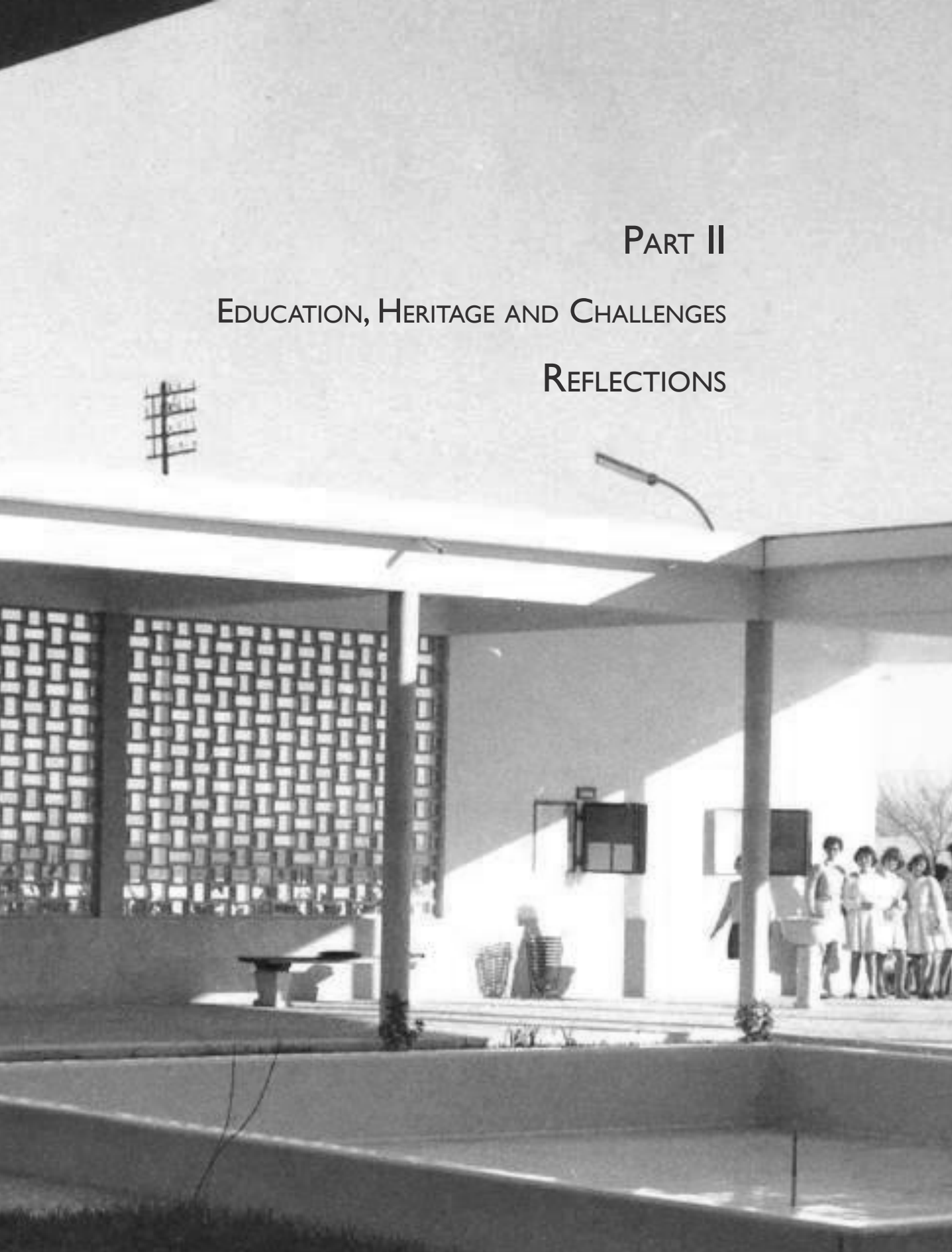
Part II

Education, Heritage and Challenges

Reflections



Legend

Figure C: Escola Industrial e Comercial de Beja

Stories of Schools
Towards a Pedagogy of Place

Catherine Burke

Introduction

For the architectural and cultural historian, Thomas Markus, a building can be thought of as a narrative. He suggests,

> *[...] from the moment it is conceived, through its design, production, use, continuous reconstruction in response to changing use, until its final demolition, a building is a developing story, traces of which are always present (Markus 1993, 5).*

When that building is a school, where generations of teachers and pupils have inhabited its many spaces, and rubbed against its many surfaces, inside and out, then the fabric will inevitably display traces of past pedagogical aspirations, habitual performances, practices, conformity and resistance. Whilst inevitable, this is not always recognised and the professional teacher largely accepts with little questioning the school environment that they are given to work with. However, an enlightened pedagogue can choose to illuminate and draw into telling the embedded narratives in school spaces, deepening the possibilities of discovery and reflection and emboldening the realisation of inheritance. In such hands, education, architecture and heritage can become a permanent unfolding of possible futures.

Heritage and a longing for a sustainable education.

I will return to the notion of the school building as a narrative shortly but first I'd like to turn our attention to a contemporary educational project which is not a school in the traditional sense, that enlists local heritage in promoting education in less usual ways. On the Llyn Peninsular in North Wales there is a tiny settlement where volunteers, mainly young people in their first decade after leaving school, come together from many places in the world to construct buildings, make and decorate furnishings and fittings, and grow their own food.[1] To do this, they draw on pre-modern forms of construction, art and crafts local to the area, utilizing traditional materials and tools. The work is slowly-paced, penetrated by conversation destined to weave into stories and occasionally songs. In the pedagogy, hierarchies are ignored: teachers and learners are hardly distinguishable one from another. One would have to describe the mode of living, working and playing together as a more or less efficient form of anarchy. The volunteers will eventually leave and move on to do many different things wherever they settle but the fact that at this point in their lives they are drawn to these collective endeavors tells us something about the education we are currently lacking and the education we need.

First, young people, who are skilled users and developers of digital technologies, are nevertheless (and possibly as a consequence) drawn to the making of things that are honest, tangible, pleasing to the eye and lasting. They partake in activities that meet fundamental requirements for shelter, warmth, nutrition, community and culture. They envisage future generations enjoying the fruits of their labours. This suggests a longing for an education that is designed not only to address individual needs, but also one that generates collective enrichment of generations yet to be born.

Second, the slow pace of making and growing reflects aesthetic delight in both the process and product. This suggests the possibilities of designing an educational process that gives time for the full engagement of all the senses in nurturing educational communities and environments — be they neighborhoods, cities or schools.

Third, bringing about real and lasting changes in the landscape creates new histories through reflective collective endeavor and appears to fulfill a human need to resonate with the environment through storymaking.

This example of an existing educational project serves to suggest that education can be designed to seriously address questions of authenticity and survival. At the heart of the education that we need now and in the future will be trust, choice and creative discipline framed by the nurturing of a critical capacity to evaluate claims of truth, detect dishonesty and resist falsehoods that ultimately threaten our humanity.

1 For more information, see http://www.felinuchaf.org

Traces, story-telling and 'going-on' to possible futures

Traces, as observed by the art critic and writer John Berger, are «[...] not only what is left when something is gone, but can also be marks for a project, for something to come» (Berger 2002, 144). Stories are what we bring in the process of making meaning from our relationships with material objects, things and environments. However, the anthropologist, Tim Ingold claims an important distinction between objects and things, reminding us that the apparent finality of objects - such as school buildings - contains the potentiality and possibilities of growth and change.

> *«The object stands before us as a fait accompli, presenting its congealed, outer surfaces to our inspection [...]»*

He pits the notion of 'object' against that of the 'thing' which is, in contrast, a 'going on', or better, a place where several goings on become entwined'. To observe a thing, he argues, is not to be locked out but to be invited in to the gathering (Ingold 2010, 4). To see school buildings as organic dynamic 'goings-on' is a challenge that the architectural historian Peter Blundell-Jones invites us to pursue when he argues,

> *«Society has suffered long enough from finished architecture: buildings must be allowed to grow and change» (Blundell-Jones 1987/2016, 1).*

For the professor of education and social futures, Keri Facer, traces of past schooling can be seen to constitute or contain the seeds of what she calls «the future building school» (Facer 2011). This metaphor suggests growth and life and the nurturing and cultivation of a going-on. The notion of the school building as narrative opens the door not to one single story but to many stories and the possibilities of the realisation of several stories becoming entwined. Each of us who have ever been schooled have the capacity to tell rich stories; parallel narratives that become even richer when generated by a sensory engagement with memories of the built environment and immediate school grounds. I want to suggest here that the ground is ripe for community engagement in the generation of existing school buildings as narratives and that both sustainable futures and an education that is attractive, meaningful and accessible to all relies on a reconsideration of the social meaning and role of school buildings.

Embodied memories in brick

School buildings stir the emotions and are hardly ever viewed or experienced as neutral containers. They are embodied memories in brick. They are remembered for good or ill.

Take a sensory tour around and through a school building from your own memories. The smell, the feel, the taste, the sound, the rhythms of the school day soon become apparent. When a school is threatened with closure, the likelihood is that there will be a community response; possibly a campaign to keep it open. It seems the more distinct the architecture, the more fervent the response. This goes for internal features too as examples from the decorated school project testify (Burke, Howard and Cunningham 2013). It is this response, when channeled as an educational heritage project that can transform an apparently ordinary school building into an extraordinary tapestry of memories and meanings. So one response to a project tracing the history of a nation's school buildings might be to engage with community memories that a particular site generates and, together with formal records, confront the tangled web of interpretations that this produces.

In Keri Facer's book, Learning Futures, the reader is taken on a journey to and through the school of the future. In 2035, we visit and experience «the future building school». There are many interesting parts of the building and its components include growing walls, roofs and gardens; laboratories; workshops; community facilities and at its heart there is a museum. But this is not a museum in the traditional sense of a fixed series of curated objects on display. Described as one of the most important parts of the school, it is « […] a place for capturing and building a shared history (that is) […] not a simple progression of inevitable change but a site of debate, contestation and choice» (Facer 2011, 114).

In this scenario each school museum in each school of the future is inevitably different reflecting its local context but there is one common element. In each school museum, one corner is dedicated to a space where an ever changing collection of «uninteresting objects» is displayed. Here, the very youngest children can debate and decide together what constitutes interest in an object or a thing and that discussion, debate and decision-making is a pedagogical feature designed to keep their minds active to the practice of making the familiar strange and the everyday fascinating.[2] In the process, the object, subject to interpretation, becomes a thing, a 'going on' in Ingold's sense of materiality in flux. Thus the past, present and future is signified in this inclusive and dynamic place that celebrates the collective building of a site supporting curiosity, culture and intergenerational teaching and learning.

According to Facer, imagining the school of the future is partly realised by means of embracing fully the school of the past. She argues that the seeds of «the future-building school» as she puts it, are present in that very inheritance.

The question of whether we can still imagine a place called school in the future has its own history. For at least a century, progressives have been questioning the design of schooling including the curriculum, the building and grounds and all the furniture, fittings and objects fashioned to promote learning. John Dewey mused that the most utopian thing in utopia was

2 The museum of uninteresting objects was a feature of Prestolee elementary school in Lancashire, explained in Gerard Holmes (1952) The Idiot Teacher. The story of Prestolee and its headmaster Edward O'Neill.

there were no schools (Dewey 1933). That the building and grounds mattered in signaling the philosophy of education applied has been long exemplified in radical departures from the mainstream in different parts of the world. There are traces here and there in the history of progressive education of pupils and teachers making schools together. A sustained and extensive example of this was achieved at a state school serving a poor working class community in the north of england at Prestolee (Burke 2005, Burke and Dudek 2010). But there are intriguing references elsewhere such as to a little school in Copenhagen, Denmark, mentioned by John Holt in his (1976) publication Instead of Education where pupils were encouraged to rearrange their classrooms on a weekly basis utilising beer crates from a local brewery (Holt 1976, 126).

What these examples have in common is the idea of the school building as traditionally thought of, designed as an assemblage of fixed halls classrooms and corridors, being unsuitably inflexible for an education in an atmosphere of freedom - the progressives' mantra. The notion that school spaces should be configured in such ways that encouraged as many varieties of learning and teaching behaviours to happen in synchrony characterised the avant-garde post-war school for younger children in the USA, England and in parts of Europe. There was a strong suggestion that movement was crucial and that children would be supported by school design that suggested choice of dispositions and environments in which to learn, play, create and dream. The imagined school as a dynamic entity breaking out, exploding into the community was projected through the BBC TV series The Expanding Classroom, featuring primary and middle schools of the late 1960s, as well as Colin Ward and Tony Fyson's Streetwork The Exploding School 1973.

The notion that school required a different identity if it were to help sustain a shift from the view of the child as a technician or passive receiver of knowledge to one as artist and creator of their world has a history too. When Kees Boeke opened his school De Werplaats in Bildhoven, the Netherlands, the place was designed to resemble a workshop rather than a school as work was considered to be a key aspect of humanity (Rawson 1956). At Oundle school, near Peterborough in England the original building was re-envisioned under the leadership of Frederick William Sanderson as a series of galleries, workshops and laboratories. Construction and display were regarded as having a place at the heart of the design for education. Learning through doing always required a reconfiguration of the environment. Many of these schools are well known and recognised as important examples of educational heritage. But what of the everyday school that is seemingly uninteresting at least architecturally. It may be rather bland; a box; a container where inhabitants ebb and flow over days, weeks, years and decades. Here, the school as narrative comes into its own and in a sense can be rebuilt through engagement of the community it serves. Features otherwise overlooked and taken for granted might thereby become renewed with meaning.

Objects become ongoing things.

Some years ago, the architectural historian Peter Blundell-Jones accompanied me on a site visit to a school for young children in Norfolk. The building was Victorian but had had several alterations and extensions added to it. After surveying the school with camera and notebook, Peter made the following observations.

> *With schools like this the temptation is to declare the fabric inadequate and to destroy and rebuild, with a tendency to move fast, implementing a standardised solution which staff and pupils have to adapt themselves to, suddenly changing their ways of doing things but also losing the accumulated memory of the institution as defined in built form. But if instead you convert the old school and maybe add to it, it would be possible to preserve recent memories and to rediscover earlier ones: for example to restore the best parts of the Victorian buildings and their daylighting provision. Such a project could be a wonderful subject for historical research by staff and pupils into what the school had been like at various periods, and the conversion/extension could be done a wing at a time with detailed participation, allowing continuity. The complexity would be preserved, the pragmatic efficiency greatly increased, and the memories carried by the building would be selectively reedited. "We rebuild our school" is an educational vehicle full of enticing possibilities, and if parents become involved so much the better.*[3]

More than a decade after these remarks were made, we are even more aware of the challenges of climate change and of creating sustainable futures. A recent report on sustainability in school buildings outlines some details of these challenges.

> *(In Europe) Most school buildings are old, dilapidated and poorly insulated. Heating systems too are old and often cannot be regulated. Ventilation systems, if any, are inefficient. Outdoor spaces and playgrounds are often restricted and of poor quality (Trachte e Herde, 2014: 9).*

Such a state of affairs seems to suggest demolition and new build. But, as Blundell-Jones suggests, a re-engagement with existing structures and their renewal might have both benefits for the planet as well as for school communities understood in the widest sense. The authors of the same report go on to suggest,

3 PBJ 15/10/05. The site visit was made as part of a EPSRC project, The view of the child: visual culture and the made environment. A Designing for the 21st Century research cluster.

> *School buildings, their technical equipment and operation can be used as a showcase for the pupils and their families: a showcase that, once experienced, can influence their attitudes and lead them to behave in a more responsible and public-spirited way (ibid, 8)*

This suggests that the project «We rebuild our school» can be a path towards the Future building school of 2035.

Returning to the notion and purpose of the museum in the school -the school museum- the school as museum. Like the traditional school, the modern museum was founded in its present form during the 19th century and has many common features, not least the categorisation of knowledge into distinct subject branches and a fundamentally passive stance of the visitor who views collections and is told what they are and how to think about them. And like schools today, museums are well aware of the value of design in encouraging more active engagement and participation. But at the heart of Keri Facer's «future building school» of 2035, the museum is subjected to constant reconfiguration and reconstruction by the school community, especially its youngest members. It is built around dialogue, dispute, disagreement and compromise. It is a never completed work in progress. The history of progressive education is consistent in envisaging school as a never completed work in progress.

So what does all of this mean for challenging and expanding the possibilities of heritage, education and school buildings?

The idea of heritage as applied to school architecture might in normal terms recognise quality and value via a conjunction of recognised architectural styles and / or personages. Heritage is always seen through a prism of reflected value. But whose values are dominant in this discourse and to what ends? What other ways are possible in interpreting the idea of heritage and must heritage and its sister, the museum, always be associated with the past? How can the conservation of what is, be married to a sustainable becoming, in a challenging context of planetary environmental crises? The notion of heritage can never be fixed in place or time but its interpretation is always close to the idea of belonging. In this sense, school buildings are the inheritance of the present community and their offerings to the future. Heritage is of course associated with preservation and conservation. Arguably in the future heritage will of necessity become more strongly associated with sustainability. For if we preserve what we have got, adapt and refashion rather than demolish and rebuild, the planet will benefit.

So the museum of uninteresting objects might give us a clue as to how to move forward. We are presented with the idea of the museum as an active living, ever changing and adapting cell integral to the future building school as well as the school site or buildings as heritage, subject to reevaluation by the communities it serves. Every school building is therefore a 'thing' a 'going-on', subject to interpretation and meaning. So the apparently

uninteresting school building (as object), when engaged in public dialogue, becomes quite the opposite (a thing). This classroom cupboard, this window ledge, this drinking fountain, however mundane or apparently uninteresting can not be dismissed in a context of dialogue embracing memory and emotion. Coupling sustainability in school architecture with heritage in designing education for the 21st century suggests that we think very carefully about the necessity of building new schools. Can we stop building schools? Can we look anew at our existing building stock and reevaluate through engaging in a form of public conversation; a form of building memories in brick? This process is demanding of time and skills and perhaps requires the shaping of a new kind of school professional; a specialist pedagogue of place, able to record and document how the school mattered and matters by users in the present and past.

I will end with a contemporary example of a 19th century school building that has been refashioned through the employment (rather than mere participation) of school pupils in the redesign of classrooms and their reconstruction. At the heart of this school is a museum, newly opened for the school and wider community. A major driver for this initiative was the discovery of school administration minute books that recorded evidence of racist responses to the changed demographic of the locality and school community after the arrival of immigrants in the 1970s. The curation of the school museum has the intention of confronting the contemporary rise in racial hatred through the display of unpalatable traces of racist attitudes among past teachers and school administrators. This is a courageous form of public engagement and one that recognises the value of stories in on-going school reconstruction that goes beyond the built fabric of the school. Nürtingen-Grundschule in the Berlin district of Kreuzberg reclaimed an old coach-house in the central courtyard of the 19th century building. As part of the project «Lokalhistorisches Museum» funded by the Social City program, more than 50 pupils participated in the construction of the first exhibition. It is envisaged that there will be a rolling programme of such exhibitions. Over the course of one year, the school's archives have been made accessible and the material processed creatively. Problems such as institutional racism towards Kreuzberg's guest workers and their families revealed that the school had been complicit. The curators worked on the school story on the basis of protocols and reports and inte-grated the making of film, recordings, collages and linocuts in making the displays. Head teacher Markus Schega had a clear vision of how addressing institutional racism in the school's history could powerfully illuminate and challenge contemporary populist racist expressions of opinion in the locality against a new population of immigrants. At the for-mal opening of the exhibition in February 2019 he welcomed a going-on of the museum by pointing to the spaces and openings that remained awaiting further community engagement.

> *The small coach house is thus full of creative power - and yet the empty shelf remains for the unvoiced voices. The difficult part of the past is to be worked on fur-ther. The coach house will be a place of mourning and remembrance, as well as many other functions. Not everyone wants to talk about it, but everyone*

can [...] contemporary witnesses and residents are invited to find here a place of encounter and exchange. That's why the coach house opens its doors every Monday from 12 to 18 o'clock and acts as a flexible display for the neighbourhood [...] We look forward to many more projects that are possible through this place![4]

Conclusion

In addressing the question of heritage and the history of designing environments to support education, we might say that ruins are not the end of architecture but its origin. In addressing questions of heritage, pedagogy and school architecture, the proposal for a pro-ject 'We rebuild our school' has the potential to meet current challenges of local, national, international and planetary survival. All schools, whether or not they are recognised as iconic architecture, by their very nature are sites of layered histories of experience. A museum at the heart of the school can be thought of as a means of welcoming the creation and intertwining of parallel stories, memories in brick. Through attending to narratives of habitation embedded in the on-going everydayness of being and belonging in school, past and present, emotional and sensory engagement can be harnessed towards renewal and revival, sustainability and survival.

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4 The museum has a website http://qm-mariannenplatz.de/aktuell/nachrichtenarchiv/aktuelle-nachrichten/b175a3c7ad420a9b99ff4a76684c126f.html?tx_news_pi1%5Bnews%5D=283&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail

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Towards a History of School Architecture: Pedagogy, Art, Heritage

Justino Magalhães

Introduction

Both historically and pedagogically, school architecture has fundamentally been studied as a question of space(s), while also being viewed in terms of the relationship between these spaces (their size, layout and use) and the pedagogical and didactic solutions that they offer. But school buildings also involve a structure and contain clear elements of symbolism. The building as a whole and the façade in particular configure a layout consisting of functional and decorative features that offer us representation and communication. These elements have a historical meaning, serving to define the places where they have been built and the process of their implantation there.

Architecture is an integral part of the school itself and gives it consistency as an institution. In that sense, the school is not only the result of the expansion and improvement of the inhabited spaces and the original domestic mode of its construction, through a series of subsequent additions and adaptations. On the contrary, underlying school architecture, there is also a plan that is full of intentionality and symbolism. This plan was, as a general rule, inspired by the monumentality of religious and public buildings; although the school, by its own definition, was not simply "a large house".

The school's architectural plan was based on the traditional and modernist tenets of hygienism, spatial organisation and panoptic rationality, to which it then added a series of pedagogical principles – curricular, psychological, sociological and didactic considerations – and an aesthetics that was geared towards the public sphere.

1. About the unity of school architecture

A reading of the document about school reconstructions published in 2017[1], (even though this is fundamentally a recapitulation of an earlier version) highlights two structural aspects: firstly, the school is considered as an element designed for the purposes of teaching and learning; secondly, it is viewed as an architectural heritage that needs to be preserved, as well as upgraded and/or renovated. Achieving these aims involves an architectural intervention, which is duly regulated in the main body of the document, providing general guidelines and considerations about the adaptability of school buildings. Following this, the document systematises the relevant legal framework and also includes a specialised glossary. In referring to the composition of the school building, special importance is given to the library, since this represents a separate alternative space within the setting of the school per se. Or, to put it another way, the library is already largely seen as being a "school library", while simultaneously forming part of a pedagogical innovation. The same process can be observed in relation to the laboratories, the spaces used for physical education, and the spaces allocated to the school's governance and administration. In all of these spaces, an upgrade and (re)conversion is undertaken when necessary, with the aim of creating an institutional unit, if not actually reinforcing the sense and the effect of the school as an institution. This notion of a unitary complex gains further coherence and harmony with the linking together of the components of heritage, architecture and pedagogy.

The intervention that is recommended in the document is not just a form of engineering work involving the preservation and (re)arrangement of the building. It is a theory of permanence, since it aims at converting and updating the school. The appropriateness of the furniture, the provision of digital access and the multiplication of living spaces favour interaction, affording its users a habitat and atmosphere of openness and making a constant appeal for activity. The presence of digital equipment, as a source of information and a working tool, is repeated in all of the renovated spaces, whether these are classrooms, laboratories, the library or simple study areas. Strewn around the circulation areas and living spaces are display cases (showing materials that relate to teaching and administration). The space-function specificity that characterised the earlier pedagogical and didactic organisation of schools has tended to evolve into a form of trans-spatiality and interdisciplinarity. The places of the present are peopled by testimonies and marks from the past and by the appeal of the future.

It might perhaps be acknowledged that the binomial of 'pedagogical innovation/heritage conversion' can find a new meaning in architectural unity, marked by the prevalence of both the axis formed by comfort, aesthetics and functionality and the temporal axis that brings together testimonies from the past, displayed in specific places and in those areas where people frequently pass, with the comfort of being there and doing things, and with

1 Direcção-Geral de Projeto e Gestão de Ativos – Área de Projeto (coord.). Especificações Técnicas de Arquitectura para Projeto do Edifício Escolar, 2017. https://www.parque-escolar.pt/docs/site/pt/programa/Parque-Escolar-Manual-Especificacoes-Tecnicas-Arquitetura.pdf

the appeal of the future, namely through the use of digital devices. In these (re)constructed schools, there is a sublimation of monumentality, without in any way compromising the charisma and value of the institution, and a humanisation of the functional, pursuing a new harmonious effect that refreshes the sense of permanence. The curricular, psychological, sociological and organisational elements are all present in these overall plans.

This unity, evident in the preservation and conversion of school buildings with historical value, represents a return to an architecture that was tested in greenfield projects, in the course of the twentieth century. It can be said that the fundamental motive behind the Pilot Scheme for the School of Mem Martins, completed in the early 1970s, was the search for an architectural and pedagogical unity, converging upon a certain age group and initiating an interdisciplinary, integrated, systemic and progressive curriculum, inserted in a constellation of pavilions. The new school building plan was associated with the move to make the Preparatory Cycle of education universal and compulsor.

A similarly integrating, harmonious and innovative framework is the keynote of the Apollo Schools, in Amsterdam, designed by the architect Herman Hertzberger, in the early 1980s. Inspired by the Montessori approach to teaching, itself recreated and upgraded through an urban materiality and habitat, these schools humanise the institutional aspect. In these schools, knowledge, urbanity and interaction are prolonged by the halls and corridors. The withdrawn position of the classrooms does not interrupt the communication between them, and the corridors, with large windows on either side, bring the street closer to the classroom.

The same architectural and pedagogical unity characterises the Integrated Centres of Public Education (CIEPs) implanted in Rio de Janeiro, in the 1980s and 1990s. These centres were conceived in keeping with an educational programme created by Darcy Ribeiro; a government plan for modernisation and sociocultural promotion implemented by Leonel Brizola; and a standard floor plan designed by Oscar Niemeyer. The integrated curricular plan was intended to introduce a form of full-time schooling and education. The standard floor plan involved a combination of reduced costs and a simple architecture, since it was based on the use of only a few elements, which were essentially built of concrete (prefabricated). Each centre was composed of three structures: a central building (three storeys); a gymnasium; and a library building. The network of the CIEPs was implemented during the course of Leonel Brizola's two governments (1983-1987 and 1991-1994): during the first government, more than 500 centres were inaugurated.

Taking as our basis the complex formed by place, pedagogy and architecture, we can trace some lines of evolution in the history of school architecture. This combination lay behind the selection and adaptation of school spaces, which was the approach most commonly adopted until the late nineteenth century. Throughout the twentieth century, this complex was particularly accentuated in the buildings constructed from scratch, thus affording the teaching institution an overall unity through a modern architecture that was aesthetic, harmonious and functional in itself and duly integrated into the landscape. In response

to the massification of education, such internal and external harmonies were not always respected, namely in conventional and stylised contexts. It was hoped that this diversification in school building would not compromise the confluence between pedagogy/curriculum, the adaptation and functionality of the school spaces, and the inventiveness and design of new projects combining architecture, functionality and aesthetics.

In short, in searching for an evolutionary sense through the highlighting of a prevailing element, we may identify the following aspects as representing the main cycles in the history of school architecture: the school's setting and the constraints of its environment; the representation of education through an adaptation of the buildings/school; the unity of meaning and function, obtained in the schools/building. The charisma and the symbolic power of the education-institution were strengthened with the implantation of buildings that embodied a school architecture with style and aesthetic value.

Viewed over the long term, the history of school architecture involves a diversity of elements and a broad range of different aspects. It includes structural dimensions and features of permanence; and it has developed according to circumstances and conjunctures. Among the aspects to be considered, the following can be listed, albeit without any chronological concerns: aspects associated with cultural policies, such as missionary work and acculturation, scientific evolution, social and community development, and urbanism; aspects associated with territories, spaces and school structures, including expropriation/disappropriation, urbanisation; exploitation, preservation, adaptation, (re)conversion of buildings; greenfield construction projects; aspects associated with pedagogy and curricular plans, including the disciplinary spectrum, the mode and method of teaching; aspects relating to segments of teaching, the nature and specificity of the subjects taught and career opportunities; aspects associated with the different school audiences; aspects linked to hygiene, ergonomics, well-being; aspects more specifically associated with school architecture and the selection of spaces, the floor plan of the buildings, decoration, overall unity; aspects relating to permanence and change.

This vast list of elements and factors can be grouped together into three constellations. The first is related to materiality, spaces, and the construction, arrangement and organisation of the whole. The second relates to representation and functionality, which involves combinations between the dimensions of pedagogy, policy, curriculum, organisation, bureaucracy and bookkeeping. Finally, there is institutionalisation, whose main strength and symbolic value are to be found in the unity of the whole, at the architectural and pedagogical levels. Convention and stylisation, through standard designs, were compatible with the singularity of the school as an institution. The pedagogical and architectural cycles tend to replicate a dynamic of ideation/projection/convention/stylisation.

2. Notes for the history of school architecture

2.1. Modern legacy

The modern school was intrinsically linked to urban life and the history of cities. Cities largely expanded by expropriating land and arranging places to house new residents, as neatly inferred by Maurice Halbwachs, an author to whom Rossi (1998) was clearly indebted. The history of cities is thus associated with the history of architecture (Rossi 1998). Either because the modern school was a means for ensuring urban development or because the implantation of school units created a need to make new spaces available, expropriation and disannexation are an important part of the history of the school. In Modern Europe, the Religious Congregations contributed to the urbanisation and expansion of teaching. The installation of school units was ensured through the use of empty buildings, originating from Congregations that had either been suppressed or were in transit, but also through the occupation of manorial or monastic properties, expropriated for political and ideological reasons.

Having appeared within the context of the Catholic Reformation, the Society of Jesus associated missionary work with education, rapidly spreading through Catholic Europe in opposition to the Protestant Reformation. Yet, in Protestant Europe, too, missionary work and education were also foundational movements. The creation of schools or other teaching and missionary units dictated the need for the occupation of already existing buildings or the expropriation of new lands. Ever since the foundation of the first colleges in Italy, the Jesuits had established as a condition that these buildings should be erected inside walls (cf. Dainville 1978). When they arrived in Portugal in 1541, in the first phase of their existence here and in response to the requests of the bishops, they immediately began by occupying buildings leased to them by other Religious Congregations.

The implantation of a Jesuit Community from scratch resulted in a complex consisting of three adjoined and duly integrated buildings that established a hierarchy in terms of their volume, height and decoration. The most prominent building was the Church, which was opened to the outside and served the surrounding community. A second building was the College, which could also be accessed from the outside, given that, besides being open to those living inside the complex, the lessons could also be frequented by boarder students living in outbuildings and day students coming from outside. The third building, which was generally more austere and secluded, was the Spiritual Residence, destined for the members of the Society. The built complex was designed to fit into the landscape in such a way that it could be identified and seen from afar. Étienne Martellange, a French Jesuit architect, began his designs by making a set of drawings in which he idealised the landscape setting of the complex that was to be built. He gave the Colleges an interior dynamic that favoured the circulation of students.

Replicating the configuration of a cathedral, the Church stood high and proud in order to summon the worshippers and to distinguish it from the other buildings. The atmosphere and the decoration also contained elements that gave the impression of a religious and sacred building to people's eyes. The Jesuits gave preference to places that were already urbanised and located in inhabited areas. Although the implantation of some communities had to take place in a building that had been leased, expropriated or disannexed, the Jesuits adapted it so that it could house the three elements that constituted a Community. The Church and the College were designed to be accessible to the local population. The belfry had to stand high within the landscape. The organisation of the surrounding space would also allow for the holding of processions and other social and religious events staged on the outside.

Founded in 1551, the Roman College became the model that would be used for approving the designs of Jesuit Colleges, although it did not have to be replicated in a uniform way. Architecture continued to be an important concern for the Society of Jesus and when, in 1753, the Jesuit Père Marc-Antoine Laugier published *L'Essais sur l'Architecture* he could not fail to devote his attention to the lines of permanence, namely to the triad formed by three basic criteria: solidity (the choice of material and its suitable use); convenience (situation, planning, internal communication and preservation); and propriety (*bienséance*, suitability of the decoration). Similarly, another aspect of permanence that he stressed was the «primat de l'utile et du commode sur le beau ou le faste» (quoted in Dainville 1978, 156). Marc-Antoine Laugier remained faithful to the Hippocratic conceptions, warning builders about the choice of site, which had to be salubrious, well-ventilated, free of fog and mist, far away from swamps and marshes, protected against floods, and built on stable terrain (*ibidem*).

The tripartite complex was also cultivated in the Protestant World, where the model for the building of colleges was much the same. With the appearance of secondary schools, polytechnics, professional schools and military schools, the architectural configuration was being altered in accordance with the need for diversity and curricular advancement. Open to the technical component, these schools were installed in spaces that were suited to teaching purposes. The religious element continued to be heavily present, but pedagogy was enjoying a new lease of life. The encyclopaedic system idealised by the seventeenth-century pedagogue Comenius could be adapted for school teaching, combining the order of nature with the genesis of knowledge. The architectural units of the system that was inspired by Comenius were integrated and progressive, moving from the concrete to the nominative and the figurative. The encyclopaedic and progressive configuration, proposed by Comenius and the Christian Brothers, gave rise to schools with their own architecture, founded in mission territories.

Throughout the seventeenth and the eighteenth centuries, specialist classes began to appear, together with other forms of teaching that were installed in rented houses or in the homes of the teachers themselves. There were house-schools that belonged to the local authorities, namely the municipal councils, and others that belonged to the schoolmasters. In Portugal, the implementation of the Pombaline School Plan, created by the *Real Mesa Censória* (Royal

Board of Censorship), enjoyed the support of public buildings and other buildings rented by schoolmasters and teachers, with preference being given to central places. The expansion of the school system approved by Queen Maria II included the installation of Minor Studies in monasteries and convents, some of which were situated in the outskirts of the towns. Jerónimo Soares Barbosa, who was a Royal Visitor to the schools in the region of Coimbra that were entrusted to the University, reported that there were *Cadeiras de Primeiras Letras* (primary school subjects) being taught in the private residences of schoolmasters and that the appropriate hygiene, safety and study conditions were not always adequately ensured (Magalhães 2010, 148).

The small schools that were beginning to appear in the German States, the Netherlands, France, Scotland and the United States were buildings inserted in the urban or rural landscape with their own configuration. The teaching of reading and writing, associated with the Catechism – in both the Reformist and the Catholic worlds – was cultivated by Catholics and Reformists alike, being entrusted to the clergy or to those in whom they delegated their responsibilities.

2.2 The emergence of the school-house

From the turn of the eighteenth century and throughout the nineteenth century, in the different European states, the teaching that was provided in domestic residences (houses used as schools) gradually gave rise to the complete incorporation of the school into the house itself, resulting in the formation of school-houses. The structure and configuration of the school institution were reminiscent of Jesuit architecture. The modern (eighteenth and nineteenth-century) school continued to follow the same criteria relating to the choice of land and the urbanisation of the surrounding area, as well as the institutional aspects naturally involved in guaranteeing the salubriousness of the spaces and the harmony of the architectural complex. The site where the school was built had to be easily accessible and situated in an urbanised area. The school-house had to be reserved about its pedagogical specificity, but it also had to be visible, accessible and duly noted by the community that it served, in contrast to the house-home, whose domestic architecture and habitat tended to give privilege to seclusion and personhood.

Among the elements bringing continuity and uniformity, attention is drawn to the belfry, the careful choice of the site, the adaptation of the building to the respective teaching methods and, gradually, also to the respective audiences. One of the most prominent impositions, until the mid-nineteenth century, both in Portugal and in other countries, was the monitorial system of Mutual Instruction (the Lancaster method), taken as a way of organising students and as a teaching method. In Portugal, Mutual Instruction was enshrined in the Law of 31 October, 1835. It was practised in Regimental Schools and also had repercussions at Normalist Schools.

A summary reading of the book *School Architecture or Contributions to the Improvement of School-Houses in the United States* (1854), by Henry Barnard, the Commissioner of Public Schools on Rhode Island, reveals a diverse range of plans for school building. In 1830, the American Institute of Instruction offered a prize for the best essay "on the construction of School-Houses". Following this, the "Plan for a Village School-House" was published in 1831. This plan was associated with the Lancaster method and envisaged the creation of a room for 56 students, containing the teacher's desk, the teacher's dais, steps providing access to the dais, a stove for heating purposes (if necessary), individual desks for the students, entrances for girls and for boys, and a recital room that could also be used as a library. On the wall, behind the teacher's desk were cupboards for books.

In 1838, Horace Mann, in his capacity as Education Secretary of the Government of Massachusetts, presented a report on school architecture. In the five years immediately following this, 405 new schools were built in that State. In the group of different American school plans, there were common features relating to the location, nature and size of the land, and to the actual school building itself. Designed to warn the community about the beginning and end of school activities, the clock and the bell were commonly found features, just as it was also frequent to find a belfry to house the clock and the bell.

The buildings were designed to correspond to pedagogical requirements, varying in accordance with the educational methods applied and with their construction being duly adapted to the materials and climate of the different States. As mentioned, from the late eighteenth century onwards, there were buildings adapted to the requirements of Mutual Instruction. They were equipped with a spacious room that facilitated communication between the schoolmaster and the monitors. With the implementation of an intuitive pedagogy and a complete education, spaces for gardening were also incorporated into the school building and the walls were decorated with a variety of charts, maps and prints. For reasons of economy, some buildings had an octagonal floor plan, with their roof converging onto a central chimney designed to permit ventilation and the circulation of heated air. The buildings included an inner courtyard and gardens, which could be covered by the same roof as the building. Physical education took place in duly prepared outside areas, as well as indoors.

In France, before 1789, the school-houses were, generally speaking, run by the teachers themselves. The Convention passed legislation that regulated both the adaptation of already existing buildings and the construction of entirely new ones. Not only would these buildings be the teacher's home, but they would also be used to house the children, being equipped with gardens and respecting principles of safety and hygiene. A Regulation published on 29 February, 1816, drew attention to the shortage of schools and the fact that many of the existing schools were poorly sited and inadequately equipped. The Law of 5 December, 1820, entrusted the matter to the local authorities, making them responsible, among other aspects, for the choice of a convenient place, which, besides offering a classroom, could also provide a dormitory, refectory and courtyard (cf. Buisson 1911, 1175).

Of course, strictly speaking, this was not yet the School-House [*Maison d'École*]. It was the law of 28 June 1833 – the Loi Guizot – «qui assurera enfin à l'école des ressources nécessaires à sa fondation, à la construction et à l'entretien de la maison qui lui est destinée» (Buisson 1911, 1175). Following this, the Regulation of 16 July, 1833, created the so-called school plans, demanding that the General Councils produce budgets and projects that would be implemented by a technical department «et ne fussent pas abandonnées à la fantaisie des architectes» (*id*., 1178). Such plans would serve as a model for communal schools. The Circular of 30 July, 1858, was accompanied by standard forms and models for plans.

The concept of the *Maison d'École*, established in the Loi Guizot, led to a distinction being drawn between teaching that was administered at the schoolmaster's home and the construction of a new school building, with the latter practice gradually supplanting the former. This new building had to be suitable for students and to meet certain pedagogical requirements, besides continuing to provide an apartment for the teacher to live in. There could not be any direct link between the two parts of the building. The school courtyard and the teacher's garden were also to be kept separate. From the mid-nineteenth century onwards, the new French schools that were planned to be built presented a structure that would be integrated into the landscape and the surrounding region.

As already mentioned, in the United States, this institutional unity dated from the late eighteenth century. The same situation could also be found in the German Principalities. The construction of school buildings had to obey a number of pedagogical criteria, including the maintenance of a uniform layout, although they also had to be built in harmony with the landscape and the surrounding environment. The building materials that were used and the decoration that was given to these schools varied according to the region where they were implanted. At the level of their organisation, the buildings obeyed both pedagogical and mesological criteria. It was at the institutional level that school architecture maintained its specificity.

In Portugal, the Decree of 20 July, 1866, implementing the will of Count Ferreira, contained the rules to be respected by the municipalities and by the builders of schools. This philanthropist bequeathed the sum of 144,000$000 to the Portuguese State, which was to be used to pay for the construction of 120 Primary Schools. These new schools were to be installed in district capitals and all of them were to follow the same architectural plan, being located in a central area of the town. The plan included the classroom, the teacher's apartment, a pediment and a belfry, whenever possible. In short, it was a building that served as a counterpoint to the church, one that was made sacred in another way – a temple to education.

2.3 A School Architecture

Until the third quarter of the nineteenth century, the period that corresponded to the cycles of nationalisation and a greater state control of education (Magalhães 2010) – Loi Guizot in France and the beginning of the period of Regeneration in Portugal (resulting from the bequest left by Count Ferreira) – primary education had followed a plan inherited from the Enlightenment. After being nationalised and made universal throughout the nineteenth century, this plan included: 1) a basic literacy programme; 2) standardisation of teaching; 3) universalisation of the school network (parishes, communes); 4) bookkeeping and inspection; 5) rules and regulations for the approval and construction of school buildings [inspection and engineering]. The lesson in the classroom therefore became the central element.

The school would be built entirely from scratch and it would be a public building. In France, the Chamber of Deputies and the Communal School frequently shared the same building, where the consecration of the school space was an inherent part of the civil power. In Portugal, in the 1860s, models were presented for the primary school, including those designed by Mariano Ghira, in his capacity as Commissary for Studies in the District of Lisbon, which were made public in 1864 (cf. Silva 2002, 46-56). Under the terms of the Decree of 20 July, 1866, it was stipulated that the school would have its own building. The school plans were to contain indications as to the site (which was to be central), as well as the floor plan for the building, composed of a classroom, courtyard, and the teacher's apartment. The classroom was to be designed in accordance with the teaching method and the furniture that was used, as well as the expected total number of students. The school was also required to display probity and charisma. By being built in a central place, it would be close to the church, whose form it would replicate. Taking the form of a lay temple, besides resembling a small cathedral, it would also display a clock, a bell and a belfry.

The standard model of the Count Ferreira schools consisted of just a single classroom, and the design of the whole building would have ecclesiastical overtones. It was a plan for a parochial school that was to be built in the district capital, so that it immediately gave rise to some controversy. In fact, in the district capitals, people were already beginning to feel the need for a central school with different grades or levels.

In the *Inquéritos da Inspecção às Escolas Primárias* (Inspection Surveys of Primary Schools), which took place in 1866 and 1875, there was a section on School Buildings. By 1875, most of the Count Ferreira Schools were already in operation. According to the inspectors, this had brought a notable improvement in terms of school quality, in contrast to the situation in most of the other schools. These continued to operate in adapted buildings, many of which were provided and managed by the teachers themselves. In the ensuing decades, and following a greater involvement of the municipal authorities, under the terms of the legislation in force, schools were built from scratch, namely central schools for graded and higher primary education, in the district capitals.

In Portugal, as in other countries, in the last decades of the nineteenth century, pedagogues, politicians, scientists and teachers, all lamented and criticised the state of the nation's schools, seeking to change them for the better. School architecture was an important pedagogical condition and a civic, political and aesthetic requirement. It became a matter of experimentation, involving the circulation of knowledge and convention, shaped into model schools. J. Simões Dias, a pedagogist and teacher from the Lisbon Teacher Training College (*Escola Normal*), published a series of articles about School Buildings in *Educação Nacional*, whose first issue dates from 4 October 1896. He made use of the term "school architecture" to cover different types of buildings and, after making comparisons with schools from other countries, he highlighted the critical situation of Portuguese schools. Referring to the schools in Switzerland, J. Simões Dias (1896a, 90) wrote:

> *Anyone visiting, for example, the Swiss cantons, marvels at the elegance, cleanliness, comfort and facilities that are found in the different types of school architecture, as if the architect wished to manifest, in the artistic design of the forms and the harmony of the decorations, all the fondness and affection that the people feel for these houses, which are the complement of the home, for these enchanted temples, where young people could see the spiritual bread being shared.*

In the same comparative vein, he highlighted the school architecture of the United States, giving as an example the Schools of Baltimore and Chicago. As a particularly exceptional case, he referred to the Wardford Primary School, in Connecticut, which had cost 100,000$000, in 1874, at the same time as some Count Ferreira Schools had just been completed in Portugal, built at the modest cost of 120$000 per school.

In fact, the amount bequeathed by Count Ferreira was 144,000$000, which was to be used to build 120 schools, excluding the purchase of the land. Paraphrasing the already-mentioned Decree of 20 July, 1866, J. Simões Dias referred to the Count Ferreira standard school design as a «type of school construction that was cheap and comfortable, without any luxurious decorations, but which had the necessary capacity, and reasonable exposure, and sufficient material for educational practices» (Dias 1896, 90). After this, he lamented that a proposal which had been discussed in parliament had not been implemented, namely the granting of a loan of 2,000 contos to enable the Municipal Councils to meet their obligations in terms of school construction and maintenance. Analysing the State Report on Primary Instruction (1888-89), Simões Dias noted the small number of buildings that had been expressly constructed or adapted to form school-houses (buildings that were rented or loaned on a temporary basis to serve as schools). Altogether, there were roughly only 1,145 buildings that had been constructed, as opposed to the roughly 2,615 buildings that were rented or loaned. Around 2/3 of these had been rented «at the last minute». In short, of the 3,790 buildings, only 1,289 were considered to be in a good or remediable condition. The remainder were in a bad state of repair and did not have adequate hygienic and pedagogical conditions (Dias 1896b, 100).

As mentioned, in the last decades of the nineteenth century and until the First World War, the architecture of the new school buildings became the subject of an interdisciplinary debate and policy guidelines. School constructions had become a major concern of hygienists, pedagogues and politicians. Duly described and explained, the floor plan and the implantation of the school were a matter of progress and modernisation – the School had become a model and a centre for acculturation and civilisation, harmonising pedagogical, hygienist, psychological and architectural principles. The building's identity as a school was guaranteed by its architectural unity. The standard schools had the appearance of a (religious or civil) public building, seeking to create a sense of communication, sacralisation and prominence in the landscape. The construction of a school gave the idea of order, in its materiality, functionality, communality and identity, and the way it brought everyone and everything together in relation to the future. The school rhythm superimposed itself on that of traditional activities. When it existed, the school bell warned the community about the beginning and end of school activities.

In France, this same debate was associated with the Schools of the Third Republic. On 24 September, 1880, a Committee of School Constructions was formed to examine possible design projects. At the turn of the nineteenth century, and in the first decades of the twentieth century, the architect Jean-Marie Laloy, who designed primary schools, teacher training colleges and agricultural schools, developed, in Brittany, a picturesque regional style based on the school's insertion into its immediate environment, using local materials and adapting the aesthetics of the school building to the surrounding landscape. This architect succeeded Hippolyte Béziers-Lafosse, the official architect of the Third Republic, who had cultivated a neoclassical style and had designed 95 schools, including the École Normale d'Institutrices de Rennes, the École d'Agriculture and the École Politique de Saint-Goulay.

In Portugal, at the proposal of the Association of Portuguese Civil Engineers, on 2 March, 1898, the government launched a public contest for the approval of standard designs for school constructions. The contest was won by the architect Adães Bermudes. The buildings were to have one or two classrooms and a home for the teacher, a cloakroom, a covered courtyard, toilets and urinals. The estimated cost of construction was roughly 40 *réis* per student, not including the cost of the land itself. Each classroom could accommodate 50 students at most. It was planned that more than two hundred schools would be built in accordance with the approved model. Among other criticisms that were levelled at the standard design proposed by Adães Bermudes, one of the problems that was mentioned was the lack of spaces for physical education and others for manual work.

Another school architect was Raul Lino. In 1916, mention was made of his design for the Alcântara School, in Tapada da Ajuda, in which he sought to reconcile «the inventive spirit, on the one hand, and a thing called the budget, on the other hand. Anyway, [he] studied the subject just as everyone else would do, to satisfy the pedagogical demands, school hygiene, etc., etc.» (Lino 1916, 335). The school was designed for eight hundred students. Lino stated that, in order to calculate the costs, he availed himself of the studies contained in the book

of «a man from abroad». Thus, while, in this way, he did not hide the communal nature of school models, he similarly did not make it clear whether he agreed entirely with the cost control that was practised in Portugal. As far as his design was concerned, he stated that he had introduced adaptations, since he took advantage of the trees already existing on the land, and attempted to avoid «that unpleasant appearance (…) of the enforced uniformity of the window openings» (*id.* 334). He placed the school in the middle of the site, making the most of the sunlight, and gave the canteen the shape of a polygon opening onto the playground. By way of a general commentary, he stressed that the creation of a Portuguese architecture did not lie in the imitation of styles from the past, considering instead that «it is essential that we study and love all the beauty of past times (…) in order to be able to intuitively recognise the features that are common to all styles that are, in essence, profoundly national» (*ibid.*). He stressed that architecture is the art of proportioning, with it not being enough to use a typical element, namely the typical Portuguese azulejo (a glazed decorative tile), to characterise a style. Raul Lino had already designed the João de Deus Kindergarten in Coimbra (1911) and the Lisbon Kindergarten (1915).

To talk of a school architecture from the mid-nineteenth century is to recognise an architectural unity that reconciled pedagogical, economic, aesthetic and symbolic elements. The school buildings incorporated a patriotic civilisational order and symbolism.

Ferdinand Buisson, the inspector-general of French public education, had already referred, in *Dictionnaire de Pédagogie* (1882), to this educational function of architecture, in the following terms: «ce qu'a d'efficace ce langage des objets extérieurs, et sur l'importance dont seront, pour les nouvelles générations, ces habitudes de propreté, ce goût de l'ordre que l'on veut inspirer par le soin apporté à l'installation matérielle» (quoted by Willerval 1993, p. 122). Since the late nineteenth century, architecture had been recovering the primary function of education. In France, the new school plans from the 1890s, just like the Portuguese plans of the following decades, clearly reflected this aim.

2.4 Importance of the pedagogical criterion – the New School Movement

Reacting against the politicisation and regimentation of schools (which tended to centre education around nationalist ideologies), and adapting to the new scientific pedagogy, active teaching methods and an encyclopaedic curriculum, pedagogues, teachers and scientists all sought to create a new approach to the idea of the school, with immediate repercussions on its respective architecture. The main innovation was introduced by the New School Movement. This movement, which made its appearance in Europe in the last few decades of the nineteenth century and the first decades of the twentieth century, soon became established and exerted a major influence in the western world. The thirty characteristic features of the New School were systematised by Adolphe Ferrière and published as the Preface to the book *A New School in Belgium*, by Faria de Vasconcelos.

In this book, published in 1915, Faria de Vasconcelos gave a thorough description of the composition and pedagogy of the School, which, between 1912 and 1914, he had founded and run in Bierges. According to Adolphe Ferrière, the New School of Bierges met 28 of the 30 principles contained in that Convention. One of the innovative aspects was architecture. Through Faria de Vasconcelos' own choice, the School had been established and built in rural surroundings that were inhabited and cultivated, not far from Brussels, and served by train – «in the countryside, but close to a large city, seems to be the best site for a new School» (cf. Vasconcelos 2015, 29). The architectural structure of the Bierges (boarding) School comprised:

> *(…) a house, two buildings for lessons and annexes (farm). The kitchen garden, the orchard, the wood the cultivated fields occupy an area of six hectares, which is more than enough for the school's needs (ibid.).*

Of the two buildings designed for teaching purposes, one contained workshops and laboratories and the other classrooms, drawing rooms and a laboratory for natural sciences.

Invited by the then member of the Lisbon Municipal Council, Teófilo Ferreira, to present the "Bases for a Primary School. Municipal Type", Faria de Vasconcelos, who, at the New School of Bierges, had paid particular attention to the location, the characteristics of the terrain and the layout of the various pavilions, generating a complete education in an atmosphere of interaction, flexibility and interdisciplinarity, once again designed a constellation of pavilions. He recommended the use of light materials. The buildings would have just one storey, with stone foundations, and would be built of wood and covered with tiles or slate. The walls would be rounded and the rooms rectangular in shape, with 2/3 or 3/5 metres, with windows and light on one of their sides. They were to have good natural lighting and electric lighting as well.

The school would be composed of the following pavilions: 1 – pavilion for lessons and administrative services (six classrooms, a lecture hall, a library, a room for administrative services and accounts, board/meeting room, teacher's room, waiting room); 2 – pavilion for laboratories, rooms for manual work, workshops, small museum of Physics and Chemistry and crafts; 3 – pavilion for hygienic installations (cloakroom, shower, swimming-pool, school doctor, gymnasium); 4 – pavilion for canteen and kitchen. The land was to be dry, located on a slope with good water drainage. Besides the built area, there was to be sufficient land for gardening and an orchard (Vasconcelos 2006, 477-487).

Celestin Freinet, a pedagogue and teacher who exerted a major influence on the modernisation of schools in the first decades of the twentieth century, founded and implemented an active educational pedagogy centred on work. Work was to take on its own productive logic and would be the basis for intellectual, manual and artistic activities. The school was to be organised under a cooperative regime of self-government. It was intended

to be «a workshop that was simultaneously communal and specialised» (Freinet 1974, 71). Freinet conceived of an architectural plan for the conversion of the traditional classroom, to which he gave the name of "auditorium-scriptorium". The "workshop" school would include «a common room, specialised outdoor workshops (garden, vegetable patch, an annex with animals), and specialised indoor workshops»; in the traditional schools, workshops were to be built adjacent to the traditional classroom, since it was the «nature and form of the school work that must determine the structure of the buildings» (*ibid.*).

So that the school could become a complex, manual, intellectual and artistic workshop designed to harmoniously prepare and train the complete and active man of the future society, Freinet preferred «small schools of five or six classrooms instead of large barrack-like buildings» (Freinet 1974, 201). In contrast to large schools, he argued that «the construction of schools of five or six classes, the dispersal and the division of the large complexes into teaching units of five or six elements [seemed indispensable] for the modernisation and success of the school» (*ibid.* 202).

Pedagogues gave special emphasis to the architectural component as an institutional unit and foundational condition for an integrated, encyclopaedic and transformational pedagogy. In *Notas uma Excursão Pedagógica* (1930), Joaquim Tomás, a primary school inspector, the secretary and later the editor, of *Revista Escolar* (1921-1935), reported on his study visit to Spain, France, Belgium and Switzerland. He visited the main Pedagogical Centres and innovative Schools, having referred to the École du Mail, in the Canton of Geneva, in the following terms:

> *In this school, which has become one of the best in Geneva, there are two infants' classes in operation, twelve primary school classes, two complementary classes and two remedial classes, all of which are separated by gender, except for the infants' classes. It has a gymnasium, infirmary, library, changing room, and everything that is necessary for a modern institution of this nature. It is a grandiose building with a spacious playground annexed to it, although its construction has a rather harsh appearance (Tomás, 1930, p. 119).*

The building was composed of two storeys. It should also be said that the École de la Châtaigneraie, in the Canton of Vaud, was the first New School in Switzerland; it was installed in the countryside and operated under a boarding regime of self-government (Tomás 1930, 145).

These solutions in terms of modernisation were essentially characterised by the central focus that they gave to the pedagogical criterion; paying attention to the saving of resources; making use of the materials available in each region and, in short, creating an educational eco-system of complete schooling. The use of light materials brought to the school institution the idea of a humanisation of its resources, and an openness to change. Such architectural

solutions preserved an educational specificity and gave the school an institutional sense of promoting an interaction between individuals. In the adaptation proposed by Freinet, the notion of a "total educational institution" gained coherence in the association between the school's materiality and the type of activity that was practised here. The institutional sense was reinforced through cooperation, self-government and the implementation of a pedagogy that considered work as a motive and a form of self-realisation. The school complex spread out from around the central building (where the lessons took place and formal ceremonies were conducted): pavilions and laboratories for activities of observation and experimentation; a gymnasium and playing fields for physical activities and sports; an orchard and a place for gardening, an animal nursery.

2.5 Stylisation, planning, convention

With the universal spread of schools guaranteed by the state education systems, in the period between the two world wars, governments stipulated and agreed upon conventional architectural models to be implemented through national school building programmes. Departments were created to design, plan and supervise projects. Generally speaking, such plans contained an overall structure and a basic decoration that guaranteed uniformity. However, in order to be able to control costs and harmonise the buildings with the surrounding environment, the plans allowed for a regional adaptation, involving the incorporation of local materials and the adjustment of the buildings to regional climatic variations. The mesological component was taken into great store, especially in rural environments and isolated territories.

From the end of the nineteenth century onwards, and linked to the emergence and the structure of state school systems, policy guidelines had been implemented for the construction and harmonisation of school buildings. The states created bodies and departments for modelling and ratification that had the support of architects, hygienists and pedagogues.

In Portugal, the Order in Council of 1 March, 1898, launched a contest for the presentation of designs for primary school buildings. Following the Law of 30 June, 1898, the government was authorised to take out a loan of 400,000 *reais* for the construction of 200 buildings for primary schools. An Order in Council of 22 November, 1899, stipulated that the Department of School Constructions would begin to provide designs for school buildings free of charge. Thereafter, only the buildings that respected the guidelines of these standard designs would be approved. Decree No. 8, of 24 December, 1901, created the Technical Department of School Constructions, under the auspices of the Directorate-General for Public Instruction.

After the First World War, the explosion of education and the compulsory nature of school attendance, in Portugal just as in other countries, necessarily gave rise to a new dynamic in terms of school constructions, on a massive scale and in a uniform manner. From the second

decade of the twentieth century onwards, standard designs for school constructions were created, stipulated and implemented.

In Spain, it was stated in a Royal Decree of 23 November 1920, that «the construction of school buildings, both those destined for use as graded schools and those designed as unitary schools, will be undertaken by the State» (quoted by Lahoz Abad 1993-94, 121). The same decree created the *Oficina Técnica para Construcciones de Escuelas dependientes de la Dirección de la Primera Enseñanza* (Technical Office for School Constructions dependent on the Department for Primary Education), which created a set of seven standard plans. This group of plans formed a rational sanitary and pedagogical programme with a functional design and a national-regionalist style.

Portugal had arrived at the 1930s with a serious shortage of school buildings. The Estado Novo approved a building plan based on the architectural model of the standard designs presented in 1935 by the architects Raul Lino and Rogério de Azevedo. This School Constructions Plan, which was given the name of the *Plano dos Centenários* (Plan of the Centenaries), later came to be launched by Law No. 1,985, of 17 December, 1940, with the aim of building 12,500 classrooms. The architectural model recovered the standard designs of 1935, adapted by the architects Manuel Fernandes de Sá, Joaquim Areal, Eduardo Moreira dos Santos and Alberto Braga de Sousa. Two standard designs were approved by the government: one single building for both sexes; or one building for each sex. Plans were conceived for two, six or eight classrooms for the two sexes, as well as plans for one, two, three or four rooms for each sex. The reference unit was the classroom, designed for a maximum capacity of 40 students. It was supposed to be rectangular, measuring 8 x 6 metres and with a height of 3.5 metres, lit by large windows on one side. The main façade with the classrooms and covered playground were supposed to face in a south-south-west direction.

The architectural model was determined by factors relating to economy and functionality, replicating a framework of educational minimalism, and there was only one single model permitted, although this could be adapted from one region to the next. There would, however, be uniformity in terms of furniture and teaching material. The costs of building these schools would be covered in equal parts by the State and the local authorities, with the latter being responsible for providing the land and for building the schools. Under the terms of Decree-Law No. 35,769, of 27 July, 1946, those school buildings would become the property of the local administrative bodies, through a reimbursement paid to the Central Treasury and a guarantee of maintenance. The *Plano dos Centenários* was subject to some delays, as well as undergoing a series of adjustments. In 1959, when the official figures were released, the plan was roughly 50% complete. Under the *Plano dos Centenários*, the school was implanted with its own space and building, both of which were easily accessible, although it was not always installed in a central place. Being kept at some distance from the church and the traditional urban centre, the school became a new element in the habitat and landscape of the towns and villages. Even when it was built from scratch, the school did not always give rise to a new plan for the occupation and urbanisation of the locality.

The main distinguishing features of the buildings of the *Plano dos Centenários* are their pitched roofs with two, three or four slopes, with eaves and arcades that serve as covered porches. They have small turrets with spires, topped by an armillary sphere or weather vanes. The façades have stone bases, «the windows are rectilinear, with simple stone frames. The main façades are marked with a stone coat of arms» (Tereno 2016).

The cities of Lisbon and Porto were not directly included in the *Plano dos Centenários*. It was the responsibility of the respective Municipal Councils to lead the process for the construction of the school buildings. Between 1944 and 1961, the Lisbon Municipal Council ordered the building of 21 new School Centres. Thus, in 1948, the General Plan for the Urbanisation and Expansion of Lisbon was approved, with direct repercussions for School Constructions. The five new School Centres built between 1944 and 1950 followed the architectural model of the *Plano dos Centenários*. Meanwhile, as a result of Decree-Law No. 39,982, of 21 December, 1954, the Municipal Councils were authorised to directly contract outside architects to elaborate designs for the schools, which were considered as Special Projects.

Unlike the previous floor plans, the plans for Lisbon School Centres built between 1953 and 1956 were commissioned from architects from outside the local council. Their architecture displayed elements of modernisation, which combined and framed the building's appearance with its surroundings, harmonising its specific nature as a school. The decorative elements were also created in such a way as to take into account the building's urban environment. These projects presented an architectural unity. Each design was considered «in an overall way, covering all of the details of the school's interior and exterior, revealing a humanised and functional vision of the building, using an up-to-date repertoire adapted to the universe of children» (Tereno 2016). New School Groups were constructed, with attention being drawn in particular to Célula 7 of Alvalade, whose design was the work of Ruy Jervis de Athouguia, with an artistic contribution being made by Stela Albuquerque.

With the total of 13 School Groups built until then, plus the enlargements of others, the city of Lisbon had 188 new classrooms. The plans for the School Centres built in 1957-58 and between 1958 and 1961 were also commissioned from architects from outside the local council. The architectural and heritage value of the school buildings is consequently not uniform in nature[2]. Standing as testimonies of an unofficial memory of education and of a collective memory, those buildings challenge us to undertake a thorough study of the historiological and historiographical plans, namely with regard to criteria of representation and identity, as material and symbolic indicators of their value as historical education.

The unity of the design, based on principles of innovation, convention and stylisation, also made itself felt in the architecture of the lyceums. Decree-Law No. 28604, of 21 April, 1938, authorised the Programme of Constructions, Enlargements and Improvements of

2 On the classification of the Lisbon School Centres, please consult: http://www.patrimoniocultural.gov.pt/static/data/patrimonio_imovel/classificacao_do_patrimonio/despachosdeaberturaearquivamento/2018/escolasmiguel/er1.pdf

Lyceum Buildings. For the first phase, the idea was to build ten new lyceums, in addition to enlargements and improvements. The Plan was entrusted to the Board of Constructions for Technical and Secondary Education. The first report dates from 1941 and it included a General Programme for the Preparation of Lyceum Designs, with each lyceum being organised in accordance with the following groups: administrative services, educational services, special services, physical education services, communication and other services (cf. Alegre 2012, 302). Commenting on the plans of the lyceums built in the following years, Alexandra Alegre stresses:

> *(…) the elaboration of a basic programme, which explained all the spatial requirements that the architectural solution was supposed to respond to, standardised the organisation and arrangement of the programme at the already constructed lyceum buildings. Although they were not subject to a standard project, the design of the lyceum buildings also demonstrated a standardisation of the architectural and urbanistic language used, which served the historicist ideals and the representative character sought by the New State (id., p. 307).*

The lyceums built in the 1960s obeyed a standardised plan, organised by pavilions, which sought to correspond to a more active form of teaching. The expansion of lyceum teaching between the late 1960s and the early 1970s led to the approval of a standard design.

3. Institucional unity – memory, heritage, innovation

The importance and institutional significance of school architecture was not uniform in the discourse of the last two centuries, but it was a decisive factor in the institutionalisation of the school and the formation of an educational memory. Frequently, the fields of heritage and function are placed in opposition to one another. Heritage and function are also part of the institutional dialectics, combining durability and modernity, and, in short, underlining the relationship between education and history, in a dynamic of historicity and educability.

By combining the school structure with the question of aesthetics and well-being, on the one hand, and with the plasticity of materials and the pedagogical reorientation, on the other hand, it became possible, within a framework of curricular flexibility and polyvalences, to preserve those buildings considered to be of architectural value and convert them in such a way as to meet current pedagogical and didactic requirements. Since the late nineteenth century, architecture has been responding to «principles of a hygienic and sanitary nature, by calling for the transformation of the school space, consolidating and strengthening its presence in the design of school buildings throughout the twentieth century» (Alegre 2012, 67).

The notion of architectural unity, adjusting materiality, functionality and aesthetics to the pedagogical guidelines, was recovered in the constructions of secondary schools in the 1970s. The school building appeared integrated into its urban surroundings, as was the case with the Liceu de Benfica:

> *In urban terms, because of the way that it has been built upon the terrain, the Liceu de Benfica is integrated within its surroundings in such a way as to constitute a landmark within the landscape, reacquiring the symbolic value that is attributed to the school building within its urban context. (Alegre, 2012, p. 349)*

It can be argued that the history of architecture brought together a series of sociocultural, pedagogical and architectural considerations in order to form the educational institution. The building evolved from a space for representation, and architecture was to constitute a harmonious, polymorphic text that reconciled materiality, configuration and symbolisation. The building's influence is inseparable from its implantation and from the educational significance that is conferred upon it by observers, by the agents involved in the process and, above all, by its users. In the history of school architecture, there is an axis of institutionality, and this institutionalisation resulted from progressive combinations between the curricular, pedagogical and urbanistic aspects and the architectural configuration.

Agustin Escolano (1993-94, 100) refers to school architecture as

> *(…) a programme, a kind of discourse that, in its materiality, institutes a system of values, such as those of order, discipline and vigilance, some frameworks for sensory and motor learning and a whole semiology that covers different aesthetic, cultural and even ideological symbols.*

School architecture thus appears as an entity filled with sovereignty and significance, on which educational institutionality depends. Architecture kept pace with the pedagogical innovations and adapted the general environmental and technical conceptions of space and construction.

This same effect of institutionality is described and characterised by Antonio Viñao Frago (1993-94, 35 and 43) as follows:

> *School architecture generally combined enclosure with the stentorian ostentatiousness of a solid building whose walls constituted the frontier with the outside, or which found itself separated from this by a greater or smaller area of the school grounds and a wall or railings that marked the limits of the enclosed space (…).*

> *In this game of relations between the inside and the outside, the enclosed and the open, there were essentially two simplified models. One, which is U-shaped and in which the predominant feature is the façade, the sense of spectacle and ostentatiousness. It seeks to impress whoever contemplates it and it hides its interior. An interior into which one penetrates without any transition, directly from the outside. The other has the form of an inverted U-shape, the antithesis of the previous one, which is entered through a courtyard or garden and which simultaneously welcomes and protects its visitors, receiving them between two wings like a pair of open arms.*

The internal organisation and distribution of the spaces did not always follow a uniform pattern. While, in some buildings, one can observe a fragmentation, in others privilege was given to openness and circulation. At the curricular level, interdisciplinarity and flexibility frequently overrode the specificity of the spaces. Two major configurations that marked the history of architecture were the integrated and the modular forms of school building (Viñao Frago 1993-94, 52).

It can be suggested that there is an institutional matrix that runs through the history of school architecture and which includes the following aspects, among others: expropriation/disappropriation – utilization, adaptation, construction from scratch; a theory of permanence that enhances adaptation/reconstruction; an internal and external harmony that can be observed in the building's integration/town planning; a building that is constructed from scratch, in keeping with agreed and stylised standard plans, in which the autonomous school construction may appear isolated; a creative unit with a specific architectural plan, where the unity and harmony of the whole are obtained through painstaking architectural, material, functional and aesthetic work.

In Conclusion

School architecture integrates and gives consistency to the school as an institution. In this sense, it does not only result from the enlargement and improvement of the inhabited spaces and from the domestic style of the building – through addition and remediation. By way of contrast, there is a plan underlying school architecture, one that brings with it an intentionality and a symbolism. The school's architectural plan was, generally speaking, inspired by the monumentality of religious buildings and public buildings, but the school was not, by definition, 'a large house'. The school's architectural plan took the traditional and modernist postulates of hygienism, spatial organisation and panoptic rationality and associated them with the pedagogical principles (curricular, psychological, sociological and didactic).

After the First World War, the explosion of education and the compulsory nature of school attendance necessarily gave rise to convention and stylisation as a response to massification.

Such plans left room for some ethnocultural sensitivity, but, from the 1970s onwards, school architecture began to reflect the openness of the curriculum and adopted a certain amount of experimentalism. The educational crisis, which began to be felt from the 1980s onwards, and the preservation, conversion and innovation of school buildings accentuated the prime importance of architecture in the assignment of the school's institutional nature. The school's architectural unity was linked to the effect of its being an institution. The respect for diversity brought fresh life to the question of unity. Such importance is clear in those schools that were built from scratch, examples of which are the already-mentioned Apollo Schools, which recovered the Montessori pedagogy. The plans for the preservation of heritage, the redevelopment of buildings, together with their adaptation and modernisation, take as their basic principle to combine the preservation of the symbolic power, intrinsic to the institution and the memory, with new uses.

And, while the history of school architecture became associated with the expansion of the cities, the occupation of new spaces and the development of the school as an institution, safeguarding a theory of permanence, so also the preservation and redevelopment of the school buildings helped in the fight against the abandonment and desertification of the countryside and conferred a modern meaning upon the school as an institution.

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Figure D: Liceu Gil Vicente

How Architecture Learns from Children

Mark Dudek

How do children learn? This must be one of the most important questions of our age. At school they learn stuff which is currently viewed in somewhat sterile terms, normally emphasising the importance of the future well-being of the nations' economy, instead of that of the child. This is reflected in a primary school curriculum which is narrowly framed; priority is given to literacy and basic mathematical and scientific training, often to the exclusion of more creative subjects such as art, music and drama. Time, it seems, is too precious to waste on such ephemera. But how do children learn about more nuanced life qualities, such as friendship and collaboration, peace and environmental consciousness, creativity and reasoning, the things that will make them truly human?

This dichotomy is often described simplistically as 'learning and schooling'. Learning is what goes-on in the classroom, schooling often takes place in the hallways, the dining spaces and the playgrounds, sports-fields and beyond, as though they were two separate areas of study. In reality they are part of an over-lapping spectrum which constitutes childhood's progress in all of its rich kaleidoscopic breadth. But the intricate geometries of learning are not just confined to the school; inevitably architecture and the wider environment have a significant role to play in how and what children learn.

As if children were future units of production, their value is measured against the cost per square-metre of the school buildings they occupy, together with the salaries paid to their teachers, set against the school's SATS examination results. This is it seems is the sole mechanism of worth. Therefore in the current political climate of austerity, cheap as chips school buildings are, it seems, all the rage. This presentation challenges that thinking, arguing that architecture and its contents are of fundamental importance to the learning

project. However, the world beyond the school gates is where children learn most, with the application of their natural curiosity, experiencing architecture and the various environments to which they are exposed, as a continuous realm of rich, vibrant discovery.

With the benefit of hindsight, this was certainly the case when I grew-up during the 1960s and '70s, where the countryside beyond my back-garden lay open to me like an extended play-ground of natural discovery. Some of the most formative personal experiences in my education, and moments of broader understanding, emerged outside school. Today many people bemoan the constraints placed on the current generation of children, with over-safe environmental controls, due to fears of the streets and other public spaces outside the supposedly autonomous environments of home and school. Combine this with a new 'digital playground', with social media and gaming of the most addictive kind, all appealing strongly to children and the modern world of childhood is understandably viewed by many parents with great suspicion.

However, I would argue that there is something very interesting which has occurred over the past 25 years, transforming the ways in which we should look at childhood education today; a cultural effect which has the potential to transform learning and improve lives in the future. It has to do with the way in which architecture and space reflects the child's individualistic ways, their cultural leanings, and thereby has the scope to correlate a cognitive web which enables and sustains learning. It's partly the benign connectivity which has developed between commercialism and the everyday life of the modern child. It's a delicate and complex balance which needs to be held in check, however there is great value in playing one against the other. I will illustrate this anecdotally, by way of my own children's mini-story.

How do my two young teenage children learn to dance, and more importantly how are they motivated to stick with it, attending classes two evenings a week after school, year after year? Initially there is an element of pop-culture in play; they regularly check the Instagram account of social media stars Maddie and Mackenzie, they have attended their mass dance event, (a Christmas treat), joining with thousands of other young girls at the highly architectural Copper Box building on the Olympic Park. They are now imbued with the spirit of these cartoon like people, who provide an immersive three-dimensional inner image which is very powerful. This turns them onto the creative possibilities of dance, suddenly it is cool. Now the architecture takes-over at a more local level.

There is a dance class at the gym attached to the school which has a number of purpose designed performance spaces. They can join-in with an age appropriate class of modern dance moves, led by an adult dance teacher. It is important that they can relate emotionally and stylistically to the space, (and the teacher). Together with a group of their own peers, they all dance together in their standard blue leotards. They are using the school's facilities which are publicly accessible after hours. The image and the space must resonate. It is a collaborative event, faintly tribal but in a positive way. It is unlikely that they will be able do

it alone, unless they are unusually self-motivated. Most importantly, they are modifying the space by the way they use it, individually and as a group. It is similar to my own experience 40 years previously when I was inspired by Jackson Pollock at work on his drip paintings, splattering paint in dance like movements across a huge canvas laid flat on the floor. Although I viewed it on a flickering black and white TV set, its what turned me onto art and poetry, interests which have lasted a lifetime. As Einstein said, 'Learning is experience. Everything else is just information'.

In How Architecture Learns from Children, I describe the most important historical moments since the invention of mass education, where education and architecture converged, including the London Board Schools from 1870 and the modernistic glass and steel structures which encapsulated the 'community school idea' during the post-war years. This is brought up-to-date with an analysis of the BSF Schools built between 1987 and 2012, which marked a change from paternalistic views - 'they will have what they're given'- to the more child orientated philosophies which brought a new generation of advanced school building design to the fore. Suddenly, architects were expected to observe and understand how children use space, not just in the school, and to embrace their research as an integral part of their design processes. As a consequence, many of them learnt from children, and children in turn loved their schools.

Thus evolved a natural form of learning, more in tune with the modern world, with architecture, and its varied layers, an essential part of the learning story. But what are these theoretical layers? Key prototypes will be illustrated by way of 16 case studies: for example, recent 'state of the art' schools will be featured including Hellerup School in Copenhagen and the Westminster Academy which show how design can fit more varied forms of group and individualistic activities outside the traditional classroom which create an appropriate image to which children can relate.

Also the very shape of the age-old classroom will be challenged as a form which can be more fluid and flexible, with a number of recent examples in use; they reflect the ways in which younger children use space, with body and mind more fully immersed within the architecture, always emphasising the importance of contemporary style within this equation. Each will be explained partly in educational terms, but also with rich architectural language and imagery.

In addition, learning spaces outside the school will be described and illustrated to show how sensory learning can aid cognition particularly in younger children. For example the watery wonders of the Princess Diana Memorial Fountain in use, will be delightfully illustrated and explained in terms of the child's youthful body and her developing brain, functioning harmoniously, at the very extremes of her capabilities. The space challenges her to take risks, the outcome is learning.

Corporate spaces will also be featured, such as shopping malls, urban zones where both adults and children hang-out. For example Xavier Lopez Arcona's 'Kidzania', children's

museums such as the recently opened example in Mumbai and other state of the art children's play spaces such as Discovering Kids and others with innovative children's features, which extend the realm of learning way beyond the nursery. Total urban environments like the Italian Reggio Emilia, home of Ferrari, with a town design which is focussed on the needs of the child, rather than the car, will be illustrated to show not only how architects learn from children, but how town planners learn too. If we design our public spaces through the eyes of the child, the result helps to form happy, functional citizens.

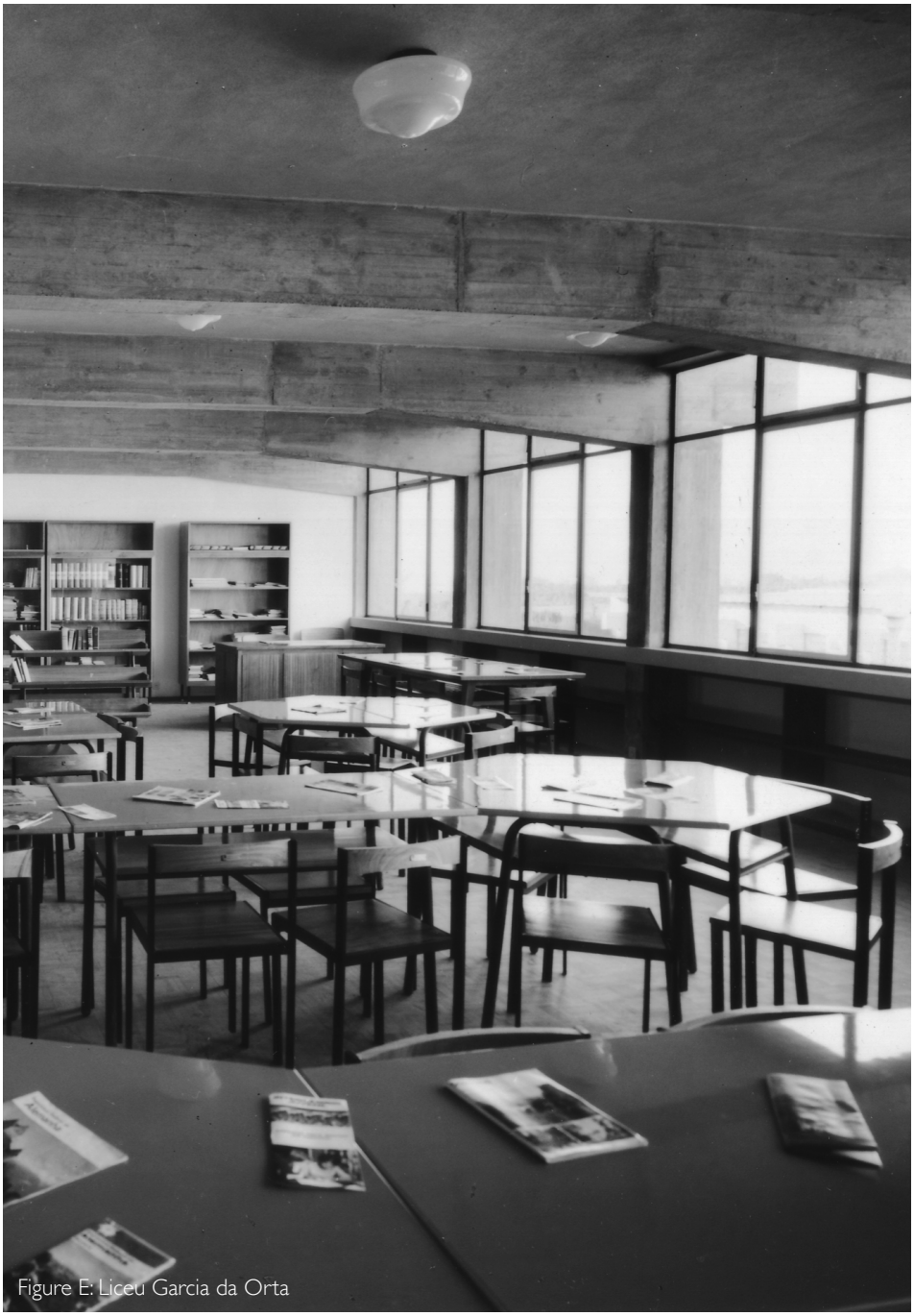
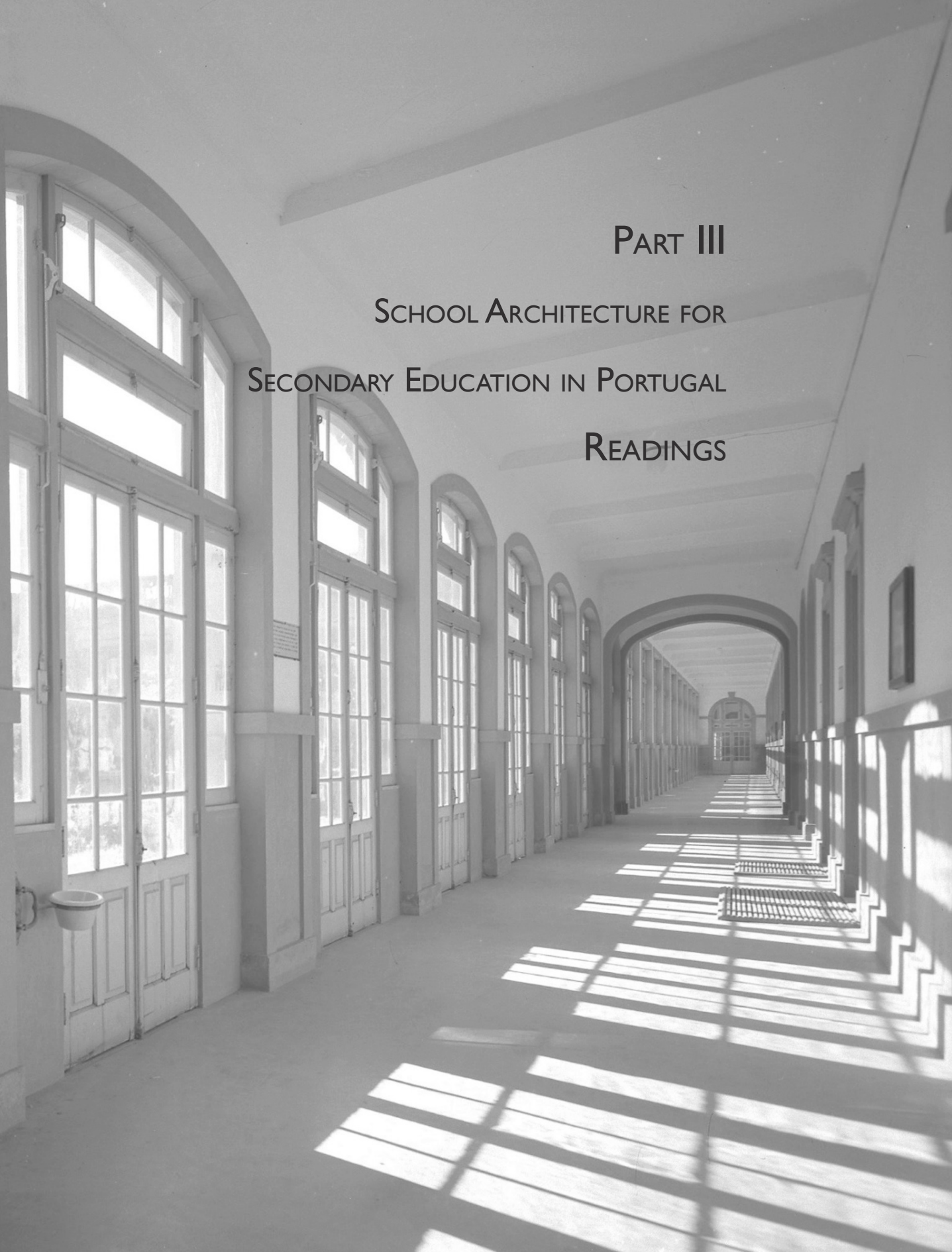


Figure E: Liceu Garcia da Orta



Part III

School Architecture for Secondary Education in Portugal

Readings

Figure F: Liceu de Alexandre Herculano

Lyceum and Secondary School Buildings in the time of the Constitutional Monarchy: From the Provisional to the Definitive

Áurea Adão

Introduction

«The material quality of lyceums is, therefore, bad with respect to their buildings, which is a matter of some concern, for a variety of reasons, especially those relating to the distribution of air and light, which, since this is poor, may affect the health and robustness of the children and consequently their state of mind for studying». These were the words of Deputy-Inspector Paim de Bruges, responsible for all inspections relating to the functioning of secondary education on the islands of Madeira and the Azores[1]. And, as was recommended by the Viscount of Benalcanfor, the buildings should be suitable «in their external appearance and in their internal divisions for the needs and decency of secondary education»[2]. Furthermore, as others recognised, «without well-equipped Physics laboratories, no experimental teaching is possible, and without experimental teaching there is no solid and profitable knowled»[3].

In order to describe the conditions under which Portuguese lyceums operated during the nineteenth century, both from a pedagogical perspective and from the point of view of their buildings and educational resources, historians of education have available to them

1 Report on the school year of 1881-1882, dated 15 October, 1882. (ANTT, Ministério do Reino, caixa n.º 3751).

2 Report of the Inspector of the 1st District, relating to the year 1880-1881, with the date of 12 February, 1882 (ANTT, Ministério do Reino, caixa n.º 3749).

3 Report of the Inspector of the 3rd District (Gonçalo Xavier de Almeida Garrett), relating to the year 1883-1884, with the date of 3 January, 1885 (ANTT, Ministério do Reino, caixa n.º 3755).

as primary sources not only the legislation that was promulgated at that time, but also the political speeches proffered, above all, in parliament, annual reports from headmasters and permanent inspectors (during the 1880s) and documentary collections originating from the archives of the schools themselves. For our own study, we therefore made use of some of these direct sources, as well as existing historiographical studies, above all in the form of monographs.

Until the late 1870s, a number of extraordinary inspections or inquiries were conducted in order to assess the functioning of the main lyceums, generally as a result of complaints made by the general public. However, the smaller lyceums, whose staff were more involved in local social and political circles, operated on their own, with their headmasters only providing information in the annual reports that they were obliged to present to the central government. The reports resulting from these extraordinary inspections do not include the complaints or praises that were made about the school buildings and facilities. At most, there is the occasional reference to the importance of school equipment and the respective educational resources with a view to ensuring greater efficiency in the teaching process. Almost at the end of his term of office, the Minister of the Kingdom António Rodrigues Sampaio appointed a Reform Commission to draw up a general plan for secondary education and to design the specific projects necessary for its implementation[4]. This Commission prepared a highly detailed questionnaire to be filled in by the boards of the lyceums and the governors of the colleges, but also accepting the collaboration of any other person, especially from the press. However, of the 38 questions that composed this questionnaire[5], none were concerned with the buildings themselves, nor even with the educational resources, which, in itself, shows that these aspects were not considered to be urgent matters in the agenda of the educational ministry.

1. Buildings and equipment planned for the lyceums

On 17 November, three months after the revolution of September 1836, it fell to Passos Manuel, in his capacity as Minister of the Kingdom, to promulgate an important reform of secondary education (this being the first time that this term had been used to refer to the level following elementary education), with the creation of a new type of school, the *lyceum*, whose attendance required the payment of a fee. Such schools were to be installed in the main cities of Lisbon, Coimbra and Porto, in the other district capitals[6] and on the islands of Madeira and the Azores[7]. This first reform of the Constitutional Monarchy theoretically meant a definitive break with the legislation that had been in existence since the eighteenth

4 Ordinance of 26 August, 1876.

5 Approved by the Ordinance of 4 November, 1876.

6 Aveiro, Beja, Braga, Bragança, Castelo Branco, Évora, Faro, Guarda, Leiria, Portalegre, Santarém, Viana do Castelo, Vila Real, Viseu.

7 Funchal, Angra do Heroísmo, Horta, Ponta Delgada.

century when, on 28 June, 1759, the Marquis of Pombal had created a middle level of state education (still referred to by the name of *estudos menores* – minor studies), introducing independent lessons in Latin Grammar, Greek, Rhetoric and, from 1772 onwards, Philosophy, administered by a staff of professional teachers.

The main aim of this new level of state-sponsored liberal education was to provide the sort of basic preparation that was indispensable for entering university and for training as a clergyman, as had already been the case until then, but also to contribute to the intellectual development of male students[8] and to provide them with the scientific and technical knowledge necessary for developing «living habits in the present-day state of societies». Or, in other words, the aim was not only to «educate the wealthy classes», or those who were destined for literary professions, but also to provide this same education to the members of the agricultural, manufacturing and trading classes of the provinces[9]. It would therefore be a secondary education that prepared people in advance for their future professional careers. In the period from 1837 to 1843, these legislative instructions were not complied with, and the Pombaline system of "minor studies" continued to operate in the traditional manner. Meanwhile, the minister Costa Cabral approved a new reform, on 20 September 1844, whose aims in terms of secondary education courses were limited to providing access to higher education and to an ecclesiastical career, as well as to training for the performance of functions within the civil service. And, consequently, the syllabuses were accordingly reduced in the lyceums of the less important regions.

The publication of a Regulation on 10 April 1860 corresponded to the end of a first phase in the installation and organisation of Portuguese lyceums. However, the law promulgated by Costa Cabral was to remain in force until 1880. In other words, for roughly 35 years, this was the sole reform that was discussed and approved by the Chamber of Deputies, although the successive governments made occasional changes, some of which were never even put into practice. This scattered introduction of unconnected measures created much instability and great dissatisfaction with the disordered way in which they replaced one another, but also with the lack of any strict definition in the process of their application. For this reason, in the following decades, the lyceums endured a period of general decline in the way in which they operated and functioned, with their performance being far removed from the aims that had been set out in the first reform of Passos Manuel. It was only roughly half a century later, with the appearance of the technical and professional schools, that the aims of the secondary education to be provided at the lyceums were definitively clarified: «1. To disseminate the general knowledge that is indispensable for all careers and social situations; 2. To prepare students for admission to the establishments of higher education and to the technical courses»[10].

8 The official secondary education for girls was created on 9 August, 1888.

9 Document of 14 May, 1839, about the creation of the Lyceum of Castelo Branco (Arquivo Histórico-Parlamentar, Câmara dos Deputados, caixa 132-VI).

10 Decree of 14 June, 1880.

At the end of the nineteenth century, the restructuring of education along more modern lines was definitively authorised with the reform of Jaime Moniz[11]. However, the physical conditions of the lyceums were not contemplated in this reform, which only dealt with the responsibilities of headmasters, establishing these as: «12. To request from the government the material that is indispensable for teaching, (…) 20. To supervise the cleanliness and hygiene of the lyceum»[12] among others. This was the last reform of secondary education to be introduced under the rule of the Constitutional Monarchy. Published on 29 August, 1905, it dealt with these aspects in greater detail, recognising that: «No one doubts that the education of young people can only be properly administered in good school buildings, with good teaching material and school furniture».

In the chapter entitled *On the discipline of schools*, the law of 17 November, 1836, which dealt with the creation of lyceums, established that these schools should be installed in public buildings that are «well situated and healthy, and, insofar as possible, are appropriate for the good order and economy of teaching» (article 56). However, the Ministry of the Kingdom, which was responsible for supervising the sector of Public Instruction soon recognised that it was very difficult to install these new teaching establishments in public buildings with conditions that could be recommended and that the country was not in an economic and financial situation that would allow for such constructions to be built[13]. In acknowledgement of the situation, Cabral's reform of 1844 safeguarded the possibility that the central power could authorise some lessons to be given in separate places (article 54) and that, in cities where there existed an ecclesiastical seminary, the respective lyceum could be located in that building (article 55).

In view of these difficulties, the installation and entry into operation of all the lyceums was a slow process, with the one at Viana do Castelo being the last to do so, in 1854-1855. At the end of that same school year, it was officially stated that «most of the lyceums are located in public buildings, with the only exceptions being those of Aveiro, Guarda, Viana and Vila Real»[14]. This was confirmed in a somewhat vaguer manner in the following year, with the information that «all of the national lyceums have been set up, but they have not yet all been located in public buildings»[15].

As far as the buildings were concerned, although, in the 1880s, the permanent inspectors made frequent complaints about their poor state, the regulations and reforms that were published during that time continually failed to mention this aspect. Nor, indeed, was this subject mentioned by the deputies in parliament, even though they were often very

11 Decree No. 2, of 22 December, 1894.

12 Regulation of 14 August, 1895. Article 129.

13 Report of the Minister of the Kingdom, relating to the year 1838, dated 22 February, 1839 (*Diário da Câmara dos Senhores Deputados*, No. 44, 26 February, pp. 408-416).

14 Report of the Higher Council of Public Instruction, dated 30 November, 1855 (Gomes, Joaquim Ferreira (1985). *Relatórios do Conselho Superior de Instrução Pública (1844-1859)*. (p. 209). Coimbra: Instituto Nacional de Investigação Científica, Centro de Psicopedagogia da Universidade de Coimbra).

15 Report of the Higher Council of Public Instruction, dated 02 December, 1856. (*Idem*, p. 228).

concerned about the needs of the territories that they represented, contrary to the concerns that they frequently displayed about the physical and material conditions under which the primary schools operated.

Although some of the lyceums were located in public buildings for many decades, the students attended teaching establishments that had not been built with such a purpose in mind. During the nineteenth century, the first two buildings to be constructed from scratch were inaugurated in Aveiro (1860) and Leiria (1894). But, as we shall see later on, within a short space of time, the sole function for which they were intended was altered and other public services were housed in these buildings, which greatly disturbed the normal functioning of the classes and school discipline.

In the late 1850s, the *Conselho Superior de Instrução Pública* (Higher Council of Public Instruction) was said to be «firmly persuaded that the material conditions of large and ample buildings, with a good appearance, well distributed in terms of space and with the annexes that their object required, not only work in their favour, but are a source of pride for those who work there, making their duties more pleasant and thus aiding their efforts in favour of teaching»[16].

As far as the equipment was concerned, the reform of 17 November, 1836, also provided for the organisation of a library in each lyceum, a garden to be used for the purposes of Botany, a Chemistry laboratory and another laboratory with three separate rooms to be used for experiments in Physics, Mechanics, Zoology and Mineralogy. However, in February, 1839, the Ministry of the Kingdom considered the purchase of this equipment to be entirely impractical, describing such laboratories as «ostentatious»[17]. The Regulations governing national lyceums, promulgated by Fontes Pereira de Melo on 10 April, 1860, confirmed the provisions of the 1836 reform, although it made a distinction in the case of the main lyceums. In other words, at the lyceums of Lisbon, Coimbra, Porto, Braga and Évora, there should be a library, a Physics laboratory and a Chemistry laboratory, as well as a «collection of objects relating to Natural History and instruments to be used for Planimetry». For the other lyceums, the new Regulations established that these «auxiliary teaching establishments» should be created according to the recognition for their need and when the sums of money allocated to secondary education were sufficient to pay for these improvements. The Physics laboratory was to be equipped with «indispensable instruments, apparatus and machinery» (article 80), the Chemistry laboratory would «simply have a collection of the main chemical products, reagents and apparatus considered indispensable for the experiments of the elementary Chemistry course» (article 81). It was also recommended that a small Museum of Natural History should be created, which, «insofar as possible, would correspond to the teaching needs» (article 82).

16 Report dated 29 April, 1859.. (*Idem*, pp. 268-269).

17 Report of the Minister of the Kingdom relating to the year 1838...

Due to the scarce or non-existent financial resources, and the frequent repetitions that were made about the current insufficiency of the equipment, a law was passed on 14 August, 1895, establishing that each headmaster should request from the central power the teaching material that was indispensable for the classes. And the last reform to be introduced in the time of the Constitutional Monarchy provided for the grant of an annual sum to each lyceum, designed to pay for «the conservation and gradual acquisition» of furniture and teaching material, as well as the remaining school equipment.

2. The precarious state of the lyceum buildings in the time of the Constitutional Monarchy

Except for the National Lyceum of Aveiro, all the remaining public lyceums operating in mainland Portugal and the Atlantic islands were housed in adapted buildings, in parts of episcopal palaces or seminaries, leased by the dioceses or rented from private individuals. Although the Aveiro Lyceum had had its own special building constructed in the 1850s, thanks to the political commitment of the parliamentary deputy José Estêvão, it is clear that, some years later, it was left with little space of its own, as can be seen from the successive reports issued by the Inspector of the 2nd Academic District. His very first report described the situation that was being experienced there:

> *[...] housed in its own building, specially constructed for that purpose: but, due to a misfortune that constantly besets the business of public instruction, the school is the worst served of all seven, not having enough classrooms, or even offices, despite the great amplitude of the building: because the public administration and the treasury have invaded the space, occupying the largest and best part of it, and pushing the lyceum into a far corner, where it does not fit![18].*

The inspector lamented the fact that the successive governments did not have enough power to oblige the Municipal Council and the *Junta Geral do Distrito* (General District Council) to free up the buildings. And, as far as his visits in the year 1886-1887 were concerned, he further informed that the Lyceum

> *[...] is invaded in its largest and best part by the public departments that usurped it, disturbing the peaceful life of the lyceum, to which they left just an insignificant part of the building, into which it does not fit! And there are no human forces that can expel the invaders! It is in a deplorable state for education and morality and it is shameful for the country[19].*

18 Report of the Inspector of the 2nd Academic District (Luiz Albano de Andrade e Moraes e Almeida), relating to the year 1880-1881, with the date of 23 February, 1882 (ANTT, Ministério do Reino, caixa n.º 3751)

19 Report relating to the school year of 1886-1887, with the date of 21 December, 1887 (ANTT, Ministério do Reino, caixa n.º 3765).

In the centre of Portugal, other lyceums were in the same conditions, or, to put it another way, they were operating side by side with the government departments. This was the case with the Viseu Lyceum, considered to be the «most insignificant» of the 2nd District and «the one that was most abandoned by the local authorities and by private citizens». In his first visit, the Inspector had found the lyceum to be «in the most deplorable state imaginable in all respects; the reform raised its category and yet it is in worse conditions than any other school in the District!»[20]. Furthermore, the classrooms were «insignificant in number, capacity and layout, with each of them being separated by means of indecent screens to offer just the slightest passageway»[21]. He warned of the impossibility of the Lyceum being able to function regularly, as long as there continued to be there an accumulation of the public services of the District – Law Court, Civil Government, Treasury and Public Works Departments. He also stressed the lack of cleaning.

> *It is inconceivable that the Viseu Lyceum should have been conserved for so many years in such inconvenient conditions as the ones that are to be found there. The fact that it is an extremely old building, that all of its wooden floors are broken, that there are piles of rubbish in every corner, that the walls are in such a deplorable condition that they seem like the walls of a dungeon, and that there is no air or light there (…) these are just the least of the defects of the lyceum*[22].

The same complaints continued to be made in the reports to which we had access. In the visit that was paid to the school on 17 May, 1883, it was the inspector himself who witnessed

> *[...] the sad spectacle (…) of finding the entrance to the lyceum, the stairs and the corridors completely obstructed with people; it was the day for the selection of recruits and for the auctioning of national property, so that the lyceum seemed to have been transformed into a public square and the students were distracted with various episodes, barely being able to pay any attention to the lessons of their teachers. This was not considered unusual, however, as this was a very common occurrence there*[23].

20 Report relating to the school year of 1880-1881…

21 *Idem, ibidem.*

22 Letter of 27 April, 1881 (ANTT, Ministério do Reino, caixa n.º 3747).

23 Report relating to the school year of 1882-1883, with the date of 26 December, 1883 (ANTT, Ministério do Reino, caixa n.º 3753).

In the 1st District, corresponding to the lyceums of the south of Portugal and the Atlantic islands, although none of them were operating in conjunction with other public services, there was not one single school that was considered by the inspector to be very suitable. The National Lyceum of Beja was one of the most flagrant examples, being situated:

> *[...] in a private palace, displaying reasonable architecture, but considerably damaged by the action of time and the lack of any building work. The rain leaks through the roofs and huge puddles are formed in the main courtyard, soaking both teachers and pupils alike [...] The classrooms are tiny, devoid of that serious and ample appearance that should be the hallmark of premises devoted to educational study*[24].

By way of contrast, the buildings of the lyceums in the north of the country did not merit a specific appreciation in the different reports that were consulted: two were installed in buildings belonging to the State (Braga and Bragança) and the other three operated in rented buildings (Porto, Viana do Castelo and Vila Real). Comments were sometimes made about the last of these insofar as «besides the inconvenience of having below it a grocery store, it is situated close to the city's fair or market, which, in reality, distracts the students and disturbs the peace and quiet of the classes»[25].

The three central lyceums, operating in the capitals of each academic district (Lisbon, Coimbra, Porto) did not enjoy any better conditions than the other lyceums. In the report referring to the year 1880-1881, the Viscount of Benalcanfor presented the central lyceum of Lisbon as follows:

> *[...] we should further add to the narrowness of the classrooms, the completely inadequate furniture – from the point of view not only of discipline, but also of comfort – the absence of appropriate study rooms; the fact that the laboratory used for Physics, Chemistry and the introduction to Natural History does not have the necessary capacity to properly house its instruments and apparatus. There is also a need for a small laboratory with the necessary conditions. For the classrooms, at least for those that are used most frequently, there is an evident lack of an amphitheatre [...] There is an absolute lack of desks and tables where students can take notes or prepare their lessons.*

24 Report of the Inspector of the 1st Academic District, relating to the school year of 1880-1881…

25 Report of the Inspector of the 3rd Academic District, relating to the school year of 1888-1889, with the date of 14 March, 1890 (ANTT, Minist.ª do Reino, caixa n.º 3771).

And he concludes by saying that, under such conditions, the educational processes of teaching and learning cannot take place, «the study rooms are so cold, uncomfortable, cramped and lacking in suitable furniture and all the accessories that might make them attractive».

The central lyceum of Coimbra was in no better condition. In the middle of the decade, the inspector reiterated that this secondary school

> *[...] lacked a more ample home that would be easy to police and in better conditions of hygiene. Paying attention to its large population and the greater development of school life, it is, however, the one that is housed in the most inappropriate building, made more dangerous by its ruinous state. It is more difficult to supervise, and it should further be added that the Faculty of Philosophy occupies an important part of the building from which it cannot be evicted*[26].

And the central lyceum of Porto was experiencing a similar situation. Gonçalo Xavier de Almeida Garrett reminded us that it was installed in a rented house, and «as a consequence of its large number of pupils, it in no way fulfils the purpose for which it is intended, because, as the classrooms are situated on different floors, it is difficult, if not impossible, to impose discipline and undertake inspections inside the lyceum, while there is also the aggravating circumstance of its being situated in a dreadful place»[27].

Besides the fact that most of the school buildings were highly deficient, the lack of equipment was common to all lyceums, not only in the experimental laboratories, but also in the drawing room and at the libraries. Just as the inspector of the 1st District had done in relation to the Lisbon Lyceum, so also the inspector of the 2nd District repeatedly drew the ministry's attention to this fact, considering «the state of their [the lyceums'] laboratories scandalous, some of which only exist in name, serving only to justify the appointment of a guard, who has nothing to guard and wouldn't even know how to guard it»[28].

Although the lyceums in the north of the country received some material acquired by the General District Council, they were far from enjoying sufficient equipment. The inspector reported on this in the late 1880s:

> *The poor state of the laboratories used for teaching Physics, Chemistry and the three kingdoms of Nature at the district's lyceums is lamentable, and it is even worse to note the extremely limited application and practice that is given to*

26 Report of the Inspector of the 2nd Academic District, relating to the school year of 1885-1886, with the date of 27 February, 1887 (ANTT, Ministério do Reino, maço n.º 3762).

27 Report relating to the school year of 1888-1889…

28 Report relating to the school year of 1882-1883…

the pupils in these courses. (…) it is a sacred duty to insist on having sufficient resources for practical studies in the laboratories used for teaching Physics and Nature[29].

And, as far as the existence of libraries was concerned, he suggested:

There would certainly be much to be gained from the effective installation of libraries, mainly composed of elementary and didactic books placed inside the lyceum building to be consulted by secondary school students. At the same time as they were being taught with the reading of these books, they could be there studying their lessons in the interval between one lesson and the next. This most important improvement would therefore be greatly desired, both for the advancement and even for the morality of the students[30].

There were some profoundly deplorable cases. By way of example, we mention here the Library of the Aveiro Lyceum, «obstructed with piles of books scattered all around the room» and which «is used there for everything, although less so as a reading room, for the school boards meet there, and the competitive examinations for primary school teachers are held there, as are the meetings of the General District Council, political meetings, elections of peers of the realm, etc., etc.»[31]. Or the Library of the Portalegre Lyceum, which is installed in a «cubicle […] and only has two or three classic books, the only ones of any value […] being composed of volumes devoid of any literary usefulness and any scientific advantage»[32].

The poor quality of the lyceums' buildings was highlighted as being one of the main causes of the lack of school discipline. The central lyceums of Lisbon and Coimbra represented two of the most problematic cases. As far as the first of these two schools was concerned, the press frequently reported on some of the events that took place there. The inspector himself confirmed these situations:

[...] the whole truth is that most of the vices imputed to the lack of police, the noise and uproar of the students in the courtyards and corridors of the central lyceum of Lisbon, the abusive presence of tobacco smoke inside the building and its nauseous effects have no other origin and cause than the dreadful state of the building in which that institute currently operates[33].

29 Report relating to the school year of 1888-1889…

30 *Idem, ibidem.*

31 Report of the Inspector of the 2nd Academic District, relating to the school year of 1885-1886…

32 Report of the Inspector of the 1st Academic District, relating to the school year of 1880-1881...

33 *Idem, ibidem.*

As far as the central lyceum of Coimbra was concerned, this was provided with various temporary buildings and its headmaster was already complaining in 1856 about the promiscuity that existed between the students and the patients from the hospital that occupied the upper floors of the building, especially the women's ward, «which took five classrooms from us; it is only separated from the general spaces of the lyceum by four doors, with there being two holes in each of them for ventilation purposes»[34]. And, some decades later, the inspector again insisted:

> *The building is crossed by long corridors and staircases, along which the students must pass in order to reach the upper floor, where there are classrooms, and only there are the school staff to be found who consider themselves to be dispensed from policing the entrances, (…) By virtue of this layout and their general abandonment, the walls of the corridors and stairs are always covered with obscene paintings and words that shame the institute, and if, one day, those paintings are wiped away in the morning, by covering them with lime, then they reappear, freshly reproduced the next day, without anyone knowing, nor even wishing to discover, who was their author!*[35].

As far as the Viseu Lyceum was concerned, the inspector of the 2nd District informed that «policing is impossible […] because of the shared entrance to the lyceum and the offices of the law court, administration and treasury, all of which make use of the same entrance and corridor, giving rise to great confusion and frequent conflicts between the various users». Furthermore, due to the bad conditions of the buildings, there were frequent conflicts at the door of the lyceum between students and soldiers[36].

Besides these manifestations of discontent, considered as attitudes of «insubordination» according to the ethical and disciplinary parameters of that time, it was often the case that the students of any of the lyceums would make collective demonstrations demanding what seemed to them to be fair and necessary. This happened with the students of the Lisbon Lyceum who, in 1888, demanded from parliament another building for their Lyceum, with pedagogically acceptable spaces and conditions.

Concluding…

Introduced only shortly before the fall of the monarchic regime, the reform of the teaching administered at the lyceums, which was promulgated on 29 August, 1905, publicly recognised

34 Representation addressed to His Majesty the King by the Board of Coimbra Lyceum, with the date of 15 May, 1856 (O Instituto, vol. V, No. 4, 15 May, 1856, pp. 39-40.

35 Report relating to the school year of 1885-1886…

36 Report relating to the school year of 1886-1887...

as follows: «But the state of our lyceum buildings is so bad, the material so poor, and the furniture so old that it might well be said that, in this most important chapter of school administration, we have progressed very little». And it recommended the construction of buildings solely for the use of lyceums, equipped with modern furniture and suitable material, as well as libraries, museums, Physics laboratories and Chemistry laboratories — «these are urgent measures that need to be implemented, so indisputable that it would be superfluous to have to justify them» it added.

The evolution of the state of the buildings in which the lyceums were installed in the nineteenth century not only reflected the policies of (dis)investment pursued by the different governments of the Constitutional Monarchy, but it also had an influence on the pedagogical dimension and the questions of discipline. On the other hand, there is no knowledge of benefactors leaving any bequests in their wills with the purpose of improving the physical situation of one or more lyceums, contrary to what happened in relation to primary education, for which the most evident case is to be found in the will of the Count of Ferreira, in 1866, which, because of its size, called for the elaboration of rules that had to be respected by the new constructions for primary schools, ranging from their location and capacity to the dimensions of each room and their conditions of ventilation.

In Portugal, the problem of the lyceum buildings only began to be resolved rather belatedly, with the Military Dictatorship (in 1928), but it was Decree No. 28,604, of 21 April, 1938, promulgated by a government led by Salazar, that finally established a programme of new constructions, enlargements and improvements of those buildings.

The School Building and Urban Infrastructure in Portugal An Analysis of the Modes of Architectural and Urban Articulation

Gonçalo Canto Moniz and Carolina Ferreira

Introduction

The main aim of this text is to analyse the relationship that school buildings designed for the purposes of secondary education established with their surrounding urban environment, examining the developments in their construction and the transformations that they underwent from the end of the nineteenth century until the 1970s.

In the European context, the nineteenth century was a period of great industrial progress that, in turn, unleashed an intense process of urbanisation, arising from the need to reorganise and expand the built environment. The unsanitary, degraded and precarious state of existing buildings and the lack of the necessary equipment and infrastructure were serious impediments to the economic and social flow. For this reason, attention was concentrated mainly on endowing the territories with the appropriate urban infrastructure and equipment – such as water and other supply networks, sewers, communications, transport, health and education – in order to respond to the new requirements of a modern society. The construction of these infrastructures afforded a much-needed fillip to institutions, providing them with a structure, making social networks more durable and patterns of behaviour more persistent, and thereby consolidating urban life (Gieryn 2002).

In Portugal, the first tool developed to guide this urbanisation process and the urban territorial expansion was the *General Improvements Plan*, which was created in 1864 and

remained in force until 1920. The second tool was the *General Urbanisation Plan*, which appeared in 1934, promoted by the Minister of Public Works of the *Estado Novo,* Duarte Pacheco, and remained in force until 1970. These plans introduced the idea of a combined overall development, or, in other words, the idea that the whole work of urbanisation should be interlinked and incorporated into a general plan and not thought of as something isolated and separate from the urban system itself. Furthermore, the plans made it possible to join together different urban infrastructures and equipment into an interdependent system through which urban life itself became feasible. These plans had as their aim the conception and representation of that same system in a design that would guide and regulate the urbanisation process, both through the redevelopment of town and city centres and through the expansion of the urban structure.

As educational equipment was considered to be part of the urban system, its construction and planning were incorporated into this overall logic of functional interdependence. The school building thus became the architectural medium through which the configuration and reconfiguration of the educational system could be stabilised in a material and spatial fashion. Thus, the school building came to be seen as a technical and social object and also as an infrastructure that shaped the structure of the urban territory according to an idea of technological innovation and modernity. The school building is a technical object that contains, within itself, the technological realisations of each period and is distinguished by its novelty (Votinov and Smirnova 2017). It is also a social object that connects people and institutions over time, and on different territorial scales, guaranteeing the existence of both the educational and the urban system. And, as Edwards (2003) stated in his studies on infrastructure and modernity, to be modern is to live within and through infrastructure.

The period under study was rich in typological and morphological experimentations and innovations, not only in the buildings themselves, but also in terms of urban design, with the aim of giving cities a new form and a new urban life. This new form would ideally offer a new relationship, interconnecting the city's different elements and integrating them into the territory in order to permit the expansion and modernisation of both the educational and the urban system. Thus, in order to reflect upon the transformations in the relationship between the school building and the surrounding urban environment, this analysis proposes to identify formal patterns and characteristics in this same relationship.

We shall choose as our criterion for analysis two features that are simultaneously architectural and urban in nature. These are the "limit" or the "boundary" between the school grounds and the rest of the urban space, and the "entrance" to the school itself. The characterisation of the limit/boundary enables us to identify the different and distinctive typological and morphological features to be found in the way in which the school building and the urban territory are interlinked. Furthermore, it also enables us to visualise different architectural modes of designing and materialising this limit or boundary with the public space. The architectural approach adopted for the design of the entrance to the school grounds illustrates different strategies in the functional connection between the building and

the urban space. To put it another way, we will identify the architectural modes governing the way in which the building invites people to enter into it or to perceive its presence from the public space.

The 1970s, which mark the final time limit of this study, brought a change in policy relating to town planning and the construction of school buildings. The 1970s thus represent the end of the Portuguese dictatorial regime, which also brought an end to the General Urbanisation Plans and to the work undertaken by the *Junta das Construções para o Ensino Técnico e Secundário* (JCETS – Board of Constructions for Technical and Secondary Education)[1].

The school building in the urban territory

Both the studies that were made of the physical form of the school building and the choice of its location and connections to the urban environment, naturally reflect the urban, architectural, political and educational ideals of each historical period. Each type of school architecture reflects a particular way of approaching the organisation of the urban space, the educational space and the actual relationship that people have with the building, all of which can be identified in the theoretical currents of town planning and the typology of the school building.

An example of this is the study by Alexandra Alegre and Teresa Heitor (2013), in which they categorised the different school buildings constructed for the purposes of secondary education during the course of the twentieth century, dividing them into four groups, arranged in chronological order and in accordance with the design principles, construction characteristics, international influences and sociocultural context of each historical period. In the first group, they identified the lyceum buildings constructed in the first decades of the twentieth century, under the influence of the French model of the *Lycée*. The second group corresponded to the modern buildings of the 1930s, in which they highlighted a particular modernist style, deriving from the experiments with, and the exploration of, the modern international architectural culture. This was followed by the group of 14 school buildings from the 1940s, built all over the country, resulting from the building programme launched by JCETS, in 1938. The fourth group consisted of the standardisation studies undertaken between 1947 and 1974, with new design processes, a systematisation of architectural solutions and a rationalisation of construction, already denoting the influence of the English school building programme from the postwar period and the programme of the Organisation for Economic Co-operation and Development (OECD), namely the Mediterranean Regional Plan (Moniz 2018).

1 Some of the legacy left by these working groups has been incorporated into the archives of the Ministry of Education (ME) and the Directorate-General for the Territory (DGT) and was one of the sources that we used for the analysis made in this text.

In parallel to this, Margarida Souza Lôbo (1995) studied the Portuguese urbanistic production, identifying three types. The first type corresponds to a more pragmatic vision of the urban form, based on the imposition of a grid design consisting of blocks of different sizes, with the aim of designing the structural basis for the expansion of the city's form. The second type was influenced by the concept of the garden city and was interpreted by Étienne De Gröer in the General Urbanisation Plans in Portugal. In this type of urbanistic production, the city forms part of a regional perspective of the urban territory, or, in other words, the form of the city is shaped by its articulation with the remainder of the national territory in accordance with the topographical characteristics of each region. The third type of urbanistic production was influenced by the modern model proposed in the 1941 Athens Charter and had as its benchmark Robert Auzelle's proposals for Porto or for Aveiro. This model marked European urbanism in the 1950s and 1960s, developing a morphology and structure that rendered the building autonomous in relation to the urban system and proposed a methodology of urban design that developed from the building itself, and in which the streets ceased to define the blocks that marked the limits of the constructions.

On the one hand, modern planning focused mainly on the importance of efficiency, technique and science for building the infrastructures that guaranteed institutional relations. On the other hand, it also played a reformist role in society with the creation of systems for public health, education, justice and housing (Marcuse 2011). These two guiding values for town planning were also to be found in the planning of the first lyceum designs developed according to the innovative concept of the modern form of teaching disseminated in Portugal by Passos Manuel, the minister responsible for education policies from 1836 to 1837. These buildings contained within themselves a complex new programme for the teaching of science, with classrooms, Chemistry, Physics and Biology laboratories, libraries, theatres, indoor and outdoor gymnasiums, and an indoor swimming pool, science museums and a meteorological observatory. It was a new technical object, a new machine planned for the modern system of education in Portugal.

The spatialisation of the educational territory thus began to be planned in cartographical terms and was regulated by the *General Improvements Plan*, created in 1864 by Decree-Law No. 10, of 13 January. Similar to the ideas prevailing in the restructuring of other European cities, such as Barcelona and Paris, the provisions of this decree reflected the hygienist movement's concern with the comfort and security of the inhabitants, freedom of movement and public salubriousness, everything that had to do with avoiding the unhealthy concentration of the population in small spaces (Lôbo 1995, 254). Modernity was being designed and implemented by the great urbanistic plans with the aim of building modern new cities equipped with the appropriate infrastructure. The public equipment, namely school buildings, already represented the anchors of this modern city that structured the organisation of society (Moniz 2011).

Together with the urbanisation plans and studies, the State created programmes for the building of lyceums from the north to the south of the country, and, by 1948, had already announced a total of 29 new lyceum buildings duly marked on the map of Portugal (Figure 1). This design formed part of the exhibition promoted by the Ministry of Public Works, a propaganda exercise held in Lisbon and entitled "15 years of Public Works" which revealed the structural thinking that the school buildings brought not only to the cities, but also to the national territory as a whole. The school building programmes expanded the spread of the infrastructure of the educational system, constructing a national system of lyceums.

The location of the lyceums was planned in such a way that their sphere of influence would cover the whole of the urban area. This intention was visible, for example, in the study for the location of new lyceums in Porto, undertaken by Robert Auzelle in the course of the implementation of the Master Plan for the City of Porto, in 1962 (Figure 2 and 3). Two plans were drawn up as part of this study: one plan analysing the existing lyceums and their area of influence, in which we can see the lyceum of the city's western area and that of the eastern area; and another plan proposing the expansion of the network of lyceums to the new urban parishes in such a way as to cover the needs of the whole urban territory (Moniz 2011).

As the school population increased, the urban development plans began to include in their studies new locations for primary schools, lyceums and technical schools. The location of the school buildings generally followed a logic of territorial expansion through their capacity to create an infrastructure for new areas of the city and to promote their development, particularly in terms of housing. For this reason, the school buildings were gradually moved away from the urban centre, thus marking the city's expansion. In some cases, the location of the school building obeyed a strategy of urban expansion through the integration into the city of "suburbs" or small peripheral urban agglomerations. This was the case with the Preliminary Design for the Mixed Lyceum of Coimbra (1959), the present-day Dom Duarte Secondary School, for which the project brief explained that «this location particularly benefits the students from the surrounding areas who use the nearby railway or bus routes to travel to the school». Furthermore «the old suburb will be more closely integrated into the city, not only because of the nature of its connection to this, but also because of the increase in the number of public roads», besides the «conditions of greater comfort, and the easier access and acquisition» of the land of Quinta da Várzea, in Santa Clara.

Besides its location in the city, the way in which the school building is related with, and interconnected to, the rest of the urban system is reflected in the design and the ways in which the building itself faces, delimits or absorbs the urban surroundings. In this sense, we may identify two distinct attitudes in the course of the architecture produced between 1900 and 1970. In a first phase, between 1900 and 1947, the school buildings were integrated into the urban design, acting as elements of urban articulation. In a second phase, from 1947 to 1974, the school buildings were conceived of as standard designs to be adapted to any terrain that was pre-defined in the urban development plan.

Figure 1: Pamphlet *15 Anos de Obras Públicas, Novos Liceus: Exposição de Obras Públicas (1948)* (15 Years of Public Works, New Lyceums: Exhibition of Public Works (1948)).

Figure 2: Master Plan for the City of Oporto: Technical and Secondary Education, existing Lyceums (1962).

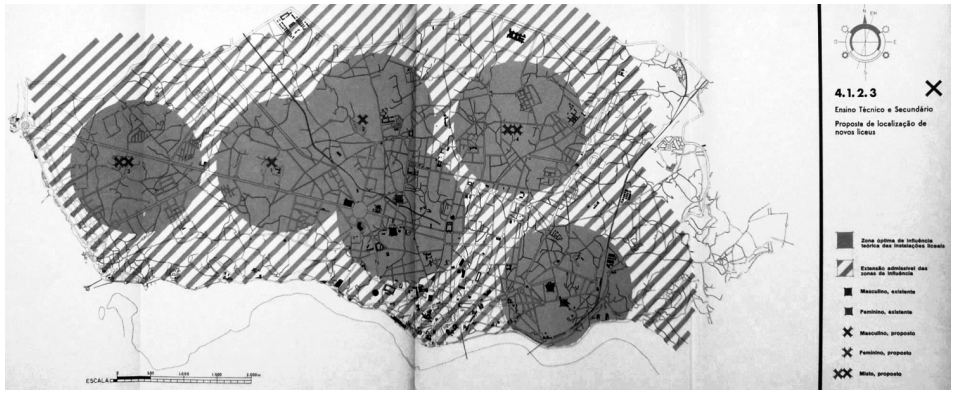


Figure 3: Master Plan for the City of Porto: Technical and Secondary Education, proposal for the location of new Lyceums (1962).

Architectural and Urban Articulation of the School Building

The first school buildings to be constructed from scratch in the form of lyceums were included in the studies and urban development plans for the city of Lisbon, first of all, and then later for Porto. In Lisbon, the four lyceums to be built from scratch defined the city's first school areas. They were located both in the centre of the city and in the new areas of urban expansion, close to the new avenues that were being built, and forming part of the city's new neighbourhoods. In Porto, the two buildings constructed to serve as lyceums were implanted on the eastern and western limits of the city, with the new Avenida dos Aliados in the middle. The articulation of these school buildings with the urban territory was defined in the urban development plans and studies, linking the buildings to avenues, squares and urban axes.

In Lisbon, Liceu Passos Manuel, built in the late nineteenth century and designed by the architect Rosendo Carvalheira, is located in the central part of the city between the Chiado district and the Parliament. The building of Liceu Pedro Nunes, designed by the architect Ventura Terra, runs along the side of an avenue that connects Largo do Rato to Jardim da Estrela, in the western part of the city. Designed by the same architect, Liceu Feminino Maria Amália, with its distinctive "comb" shape, marks out the boundaries of one of the regular blocks that structured the expansion of Lisbon's urban fabric to the north, while Liceu Camões organises the school area on the eastern side of Praça José Fontana.

In Porto, Liceu Rodrigues de Freitas was designed by the architect Marques da Silva to fit in with the semi-circular layout of Praça de Pedro Nunes. A new street was built from this square connecting it to Liceu Feminino Carolina Michaelis. Liceu Alexandre Herculano, also designed by the architect Marques da Silva, formed part of the project for a 30-metre-wide avenue intended to consolidate the city's expansion eastwards (Moniz 2011).

1930s

The location of some schools was also linked to the projects for social housing estates launched by the State at a time when the shortage of housing was already considered to be a serious social problem. An example of this is Liceu Dona Filipa de Lencastre, designed by the architect Jorge Segurado and built as part of the Arco do Cego social housing estate, in Lisbon. The main entrance to the building is from a square in the neighbourhood's residential area. These housing estates were designed according to a compact right-angled grid with clearly defined limits within the rest of the urban fabric (Figure 4). Besides houses and the school, these neighbourhoods also included shopping areas, a church, and a hall that could be used for meetings and social gatherings. These features strengthened new urban centralities, offering the estates a wider variety of uses and activities of an eminently social nature.

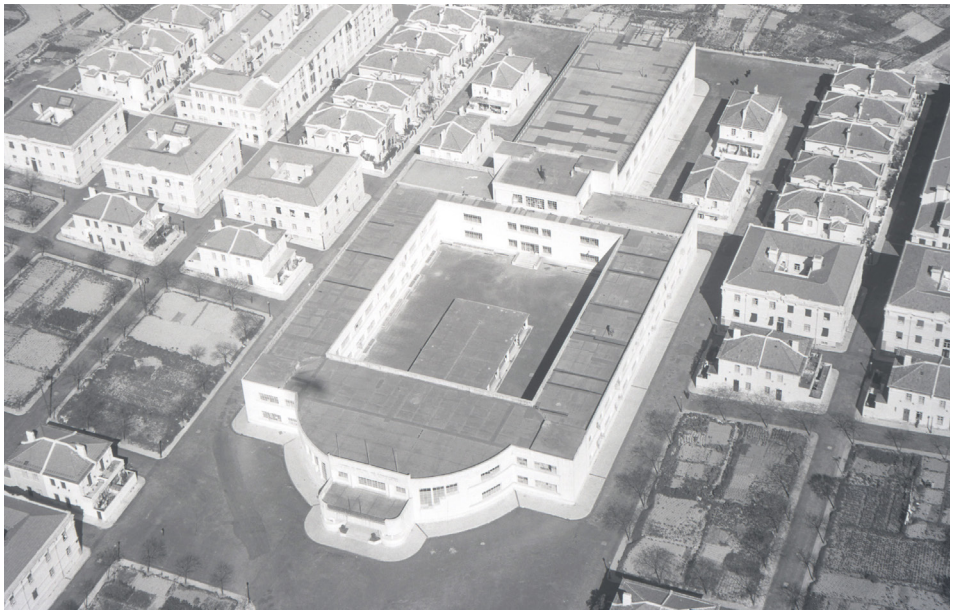


Figure 4: Liceu de D. Filipa de Lencastre: Aerial view.

Figure 5: Liceu José Falcão: Main entrance (1940).

In Coimbra, Liceu Júlio Henriques (present-day Escola Secundária José Falcão), designed by the team led by the architect Carlos Ramos, explored a typological solution in which, through the creation of two separate entrances in the corners of the block, the educational equipment creates a programmatic and functional mediation between the school and the city. In the western corner, the school entrance has a semi-circular composition, and it is here that the administrative offices and the library are situated. In the corner diagonally opposed to this, another entrance is designed in such a way as to ensure that the access to the gymnasium, swimming-pool and assembly hall remains separate from the rest of the school. This equipment has an asymmetrical composition with the aim of better linking the school's uses with the rest of the city. The fronts of the urban block are thus related with the public road and, therefore, with urban life. This way of linking the school building to the urban block presented new solutions and different architectural possibilities for relating it to its urban environment, since most of the back façades of the rest of the school equipment were treated as if they were the rear of the school, without any accessibility and without any links to the public roads (Figure 5).

1940s

Decree-Law No. 24802, of 21 December, 1934, made it compulsory for General Urbanisation Plans to be implemented in all of the country's urban territories. This measure was important for affording continuity to the thinking and design that linked school buildings to the urban structure. Thus, in the cities, the logic behind the implantation of school buildings was frequently associated with the construction of new avenues that linked the older urban fabrics to the new areas of expansion. This was the case with the Preliminary General Urbanisation Plan for Faro (1945), where the lyceum building was the element that closed off one end of the continuation of a long avenue (Avenida 5 de Outubro) running from the city centre to the square in which the school is situated (Figure 6). This design also resulted in the creation of a semi-circular park around the school grounds. The lyceum building thus assumes a prominent position in the urban layout, revealing the recognised social importance that was given to the teaching administered by lyceums during the period of the *Estado Novo*..

At the Viseu Lyceum, the entrance to the building was via a square already situated within the school grounds and acting as a continuation of the axis of the park that reaches as far as the Igreja da Misericórdia and the Town Hall. The same thing happens with the Viana de Castelo Lyceum and Liceu José Estevão, in Aveiro. In these examples, the point of entry is recessed – in other words, the U-shaped building is entered via a courtyard that is also a square connected to the street (Figure 7 and 8).

In the case of Liceu Feminino de Coimbra, the entrance to the school grounds and the building itself is at the very end of the axis that structures the urban sequence – the municipal sports stadium and the large urban square, where the *Escola Normal* (Teacher

Figure 6: Preliminary General Urbanisation Plan for Faro (1945) - Revision: plan, scale 1/2000, João António de Aguiar (Architect) (1963).

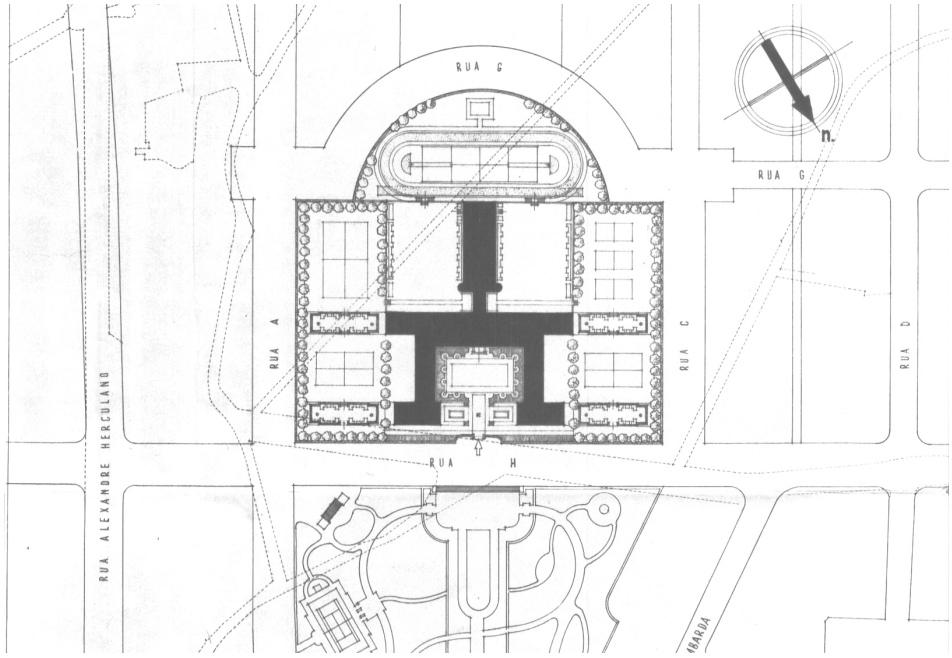


Figure 7: Liceu Alves Martins, Topographic Plant, scale 1:1000 (1941).

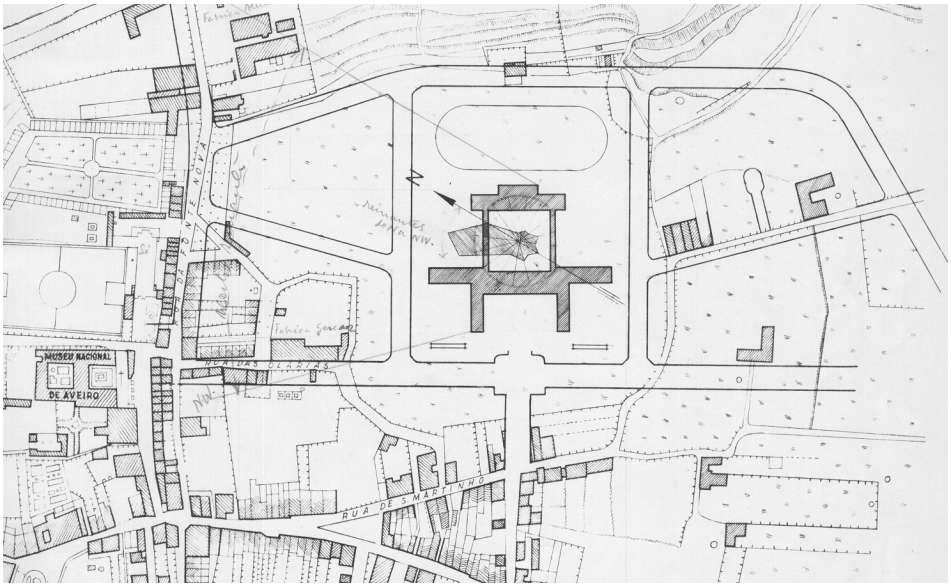


Figure 8: Liceu de José Estevão, Plan of school location, scale 1:2000 (1947).

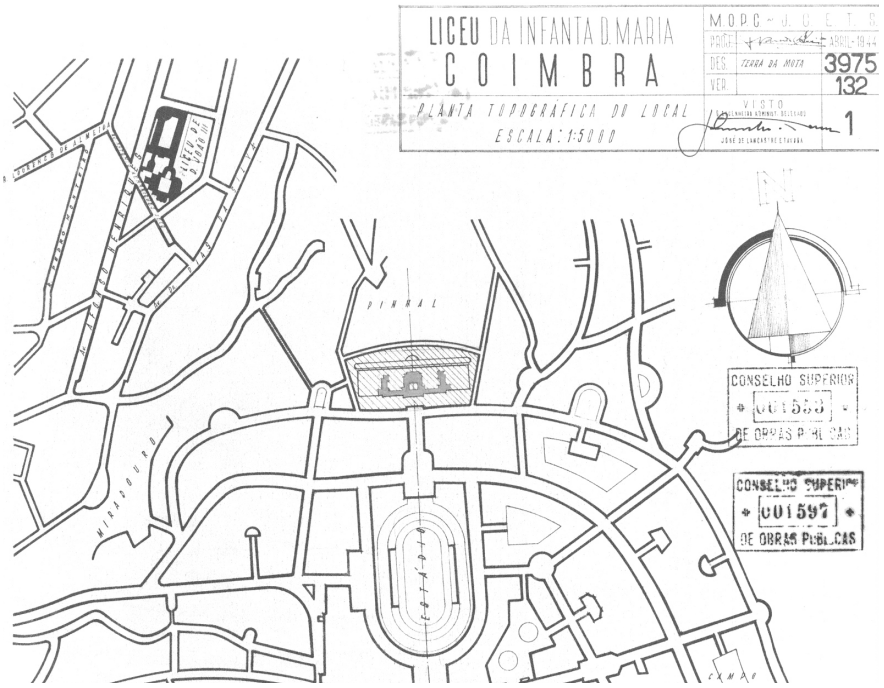


Figure 9: Liceu da Infanta D. Maria, Topographic Plant, scale 1:5000 (1944).

Training College) and the *Escola Técnica* (Technical School) are also situated (Figure 9). In the case of Liceu Feminino Carolina Michaelis, in Porto, the steep gradient of the urban axis was overcome with the building of a set of steps that accentuated the monumental nature of the entrance to the school building. In this case, the entrance also marks the end of the urban axis that connects this school to the already mentioned Liceu Rodrigues de Freitas.

This group of lyceums built all over the country display distinctive features both in their architectural typology and in the design of their urban implantation. In typological terms, the buildings are organised in the form of administrative blocks and classrooms, as well as a gymnasium and canteen, centred around an interior or exterior courtyard. This functional design always gives greater prominence to the administrative block where the entrance is situated. This building's interior organisation made it possible to adjust the location of the entrance module in keeping with the location and the continuation of the avenue that needed to be closed off. An example of this design is to be found at the Póvoa do Varzim Lyceum, where the entrance is not placed centrally in the building's façade, but is instead shifted to one of the sides, in order to close off the axis of an avenue.

As far as their urban design is concerned, these school buildings were generally located in such a way as to provide a continuation of an urban axis or to mark its end. These formal criteria reinforced the monumentality of the public equipment. The entrance was therefore a prominent feature, which accentuated the perspective of the building in relation to its urban surroundings. Furthermore, the appearance of the elevations was composed in accordance with the classical vocabulary of architecture, accompanied by the introduction of vegetation, such as large trees or bushes in order to provide a scenic closure to the urbanistic compositions. Setting the building back from the street brought some peace and quiet to the school grounds, or perhaps a certain sense of seclusion, thus creating an atmosphere that offered the necessary concentration for studying. In this sense, the whole of the architectural space was planned in such a way as to enhance these characteristics. As an example, the stone walls and iron gates were carefully drawn in the building's architectural design. In this way, the classical nationalist decoration played an important architectural role in the urban context (Figure 10).

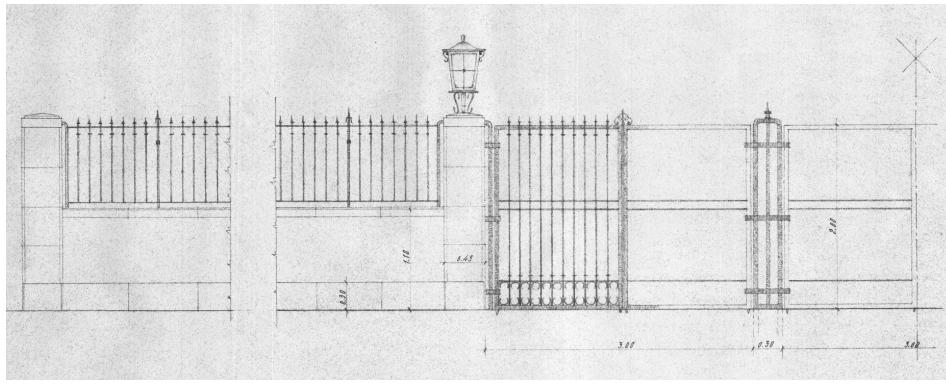


Figure 10: Escola Industrial e Comercial de Leiria, Details of the school wall and of the gate, scale 1:50 (1952).

The adaptability to the context: the standardised designs

From the end of the 1940s onwards, JCETS began, once again, to invest in the construction of schools, but, on this occasion, focusing on technical and professional education, with the aim of training human resources that could contribute to increasing the level and quality of industrial production. For this purpose, a series of studies were carried out in order to create standardised designs that could be easily replicated in any urban context and terrain. The idea was to develop designs that could be easily adapted, in each case, to the topographical conditions, the orientation of the terrain and the location of the access streets. Thus, the educational equipment ceased to consist of a single compact building and began to be broken down into groups of autonomous buildings adaptable to all kinds of terrain. The same logic was applied to the new buildings for lyceums and preparatory schools throughout the 1960s.

As was mentioned by Margarida Souza Lôbo (1995), most of the urbanistic plans and studies, drawn up above all in the 1940s and 1950s, were initially characterised by the fact that they presented a proposal for a rigid form of urban design, until they gradually came to be replaced by the management plan, which used more flexible resources, such as zoning and regulation. This trend was also reflected in the integration of the school grounds into the urban space.

There were significant changes to the logic not only of the implantation of school buildings, but also their integration into the urbanistic studies and plans for the development of cities. This idea of adaptability was accompanied by other ideas, such as productivity, the saving of costs in the design and construction of the school buildings, the rapidity with which this equipment was erected and assembled, and the effectiveness and rationalisation of the building programme. The school evolved in terms of its form, language and capacity to adapt to any context. Thus, the urbanisation plans and studies ceased to include any mention of the school equipment, and, instead, it was the school equipment that began to be integrated into the urban context. On even or uneven ground, with more regular or more sinuous boundaries, the new typologies and construction schemes expanded the possibilities of the location of the school equipment and its articulation with the site of its implantation.

The design of educational equipment adhered to the Fordist ideal (1914) in the sense that its architectural form was studied and transformed in such a way as to create a system of mass production. Just as the Ford company had as its aim to make the motor car so cheap that everyone would be able to buy one, JCETS developed architectural typologies and constructive systems for school buildings with the aim of lowering their production cost and building time as much as possible. In this way, more students would have access to education in state schools.

This system was based on a form of rationalisation that was grounded in technical and organisational innovations. Both modes of construction obeyed the principles of standardisation and simplification in their automated system of production and their

assembly lines. In the case of school equipment, the architectural solutions included new construction systems and new materials that allowed for the creation of modular systems that could be manufactured in series away from the building site and assembled at a later date. This system of pre-fabrication was thus introduced into the logic of architectural thinking and design.

The studies undertaken by JCETS for the standardisation of Elementary Technical Schools (1947), Professional Schools (1950), Technical Schools (1952) and Industrial and Commercial Schools (1960) presented a solution that consisted of three separate built volumes capable of being positioned in such a way as to adapt to any urban situation (Figure 11 and 12). The first building was designed to serve as the central body containing classrooms, the administrative offices and the museum. This building was responsible for establishing the connection with the public street outside. It therefore contained the main entrance to the school complex, which could be placed at the top, or on the longest face, of the volume. The other volume was designed to house the canteen and gymnasium/assembly room. In this latter case, an autonomous link was provided with the outside, making it possible to share the equipment with the urban community. The last volume was designed to house the workshops. The layout and arrangement of the volumes organised the outside space into separate playgrounds for boys and girls, and sports areas.

These solutions were standardised, but, at the same time, they could be adapted to each urban context. In Coimbra, for example, the Industrial and Commercial School was housed in a block next to the Girls' Lyceum, on the smallest side of the central square. As an option for the implantation of the building housing the canteen and gymnasium, this was turned to face the square. The body that housed the classrooms and the main entrance to the school complex was placed along the street on the largest side of the block. In Aveiro, the Industrial and Commercial School came to be implanted in the same avenue as the lyceum, next to the railway line, with the body housing the classrooms and the top of the workshops facing the avenue. In Leiria, the volumes of the Commercial and Industrial School are arranged in such a way as to emphasise the urbanistic connection with the avenue that runs up to the castle, creating an entrance square in the school grounds. The entrances to the body housing the classrooms and to the canteen and gymnasium/assembly room are located in this square. These examples highlight the capacity that this system of standardising the architectural design had for promoting links to the surrounding environment (Figure 13).

The next series of standardisation studies, which were undertaken in the context of the Mediterranean Regional Plan (Moniz 2018), had as their aim the creation of new building typologies for lyceums based on more democratic educational principles. In 1964, the Preliminary Designs were made for Liceu Nacional de Cascais and the Vila Nova de Gaia Lyceum. These lyceums were developed from small blocks, implanted at different levels, in order to separate the various cycles of education, the classrooms and the services from one another. Placed in a central position were the administrative and social areas, described as multi-purpose facilities. Kept totally separate from this group of buildings was the body used for physical education (Figure 14).

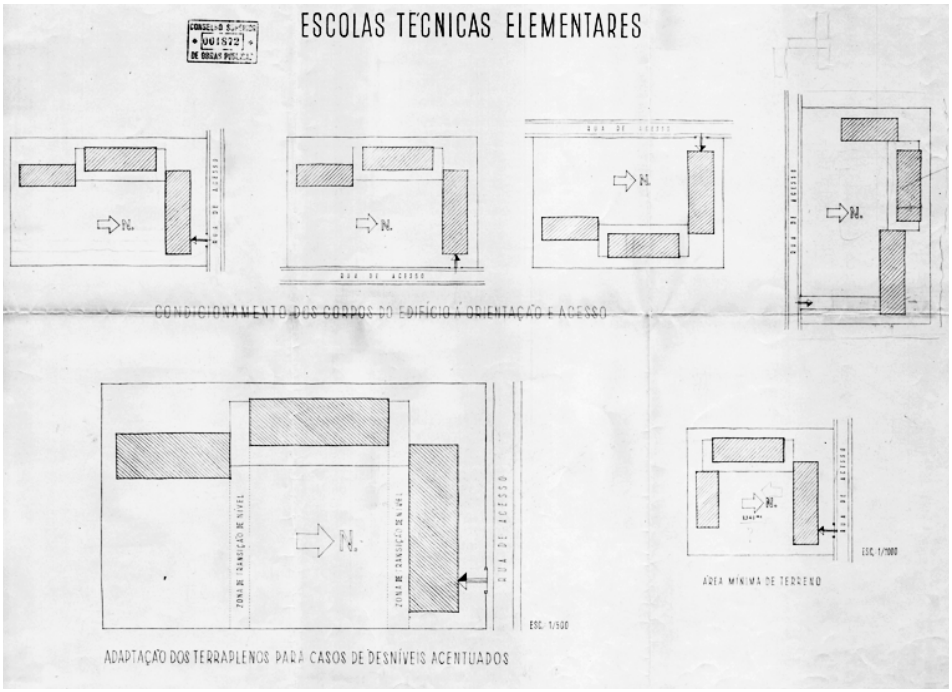


Figure 11: Standard Preliminary Design for Elementary Technical Schools, scale 1:1000 and 1:500 (1947).

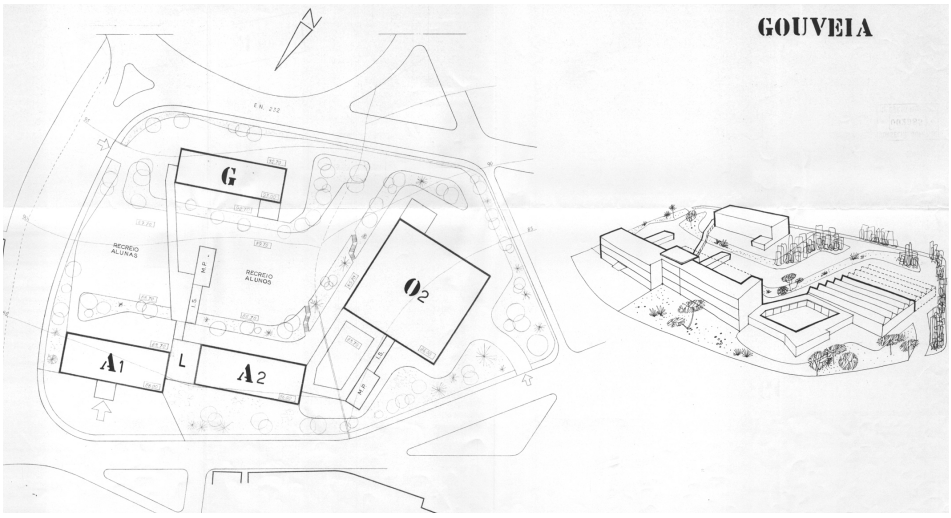


Figure 12: 1st Standardised Design for Industrial and Commercial Schools (1960) for Gouveia.

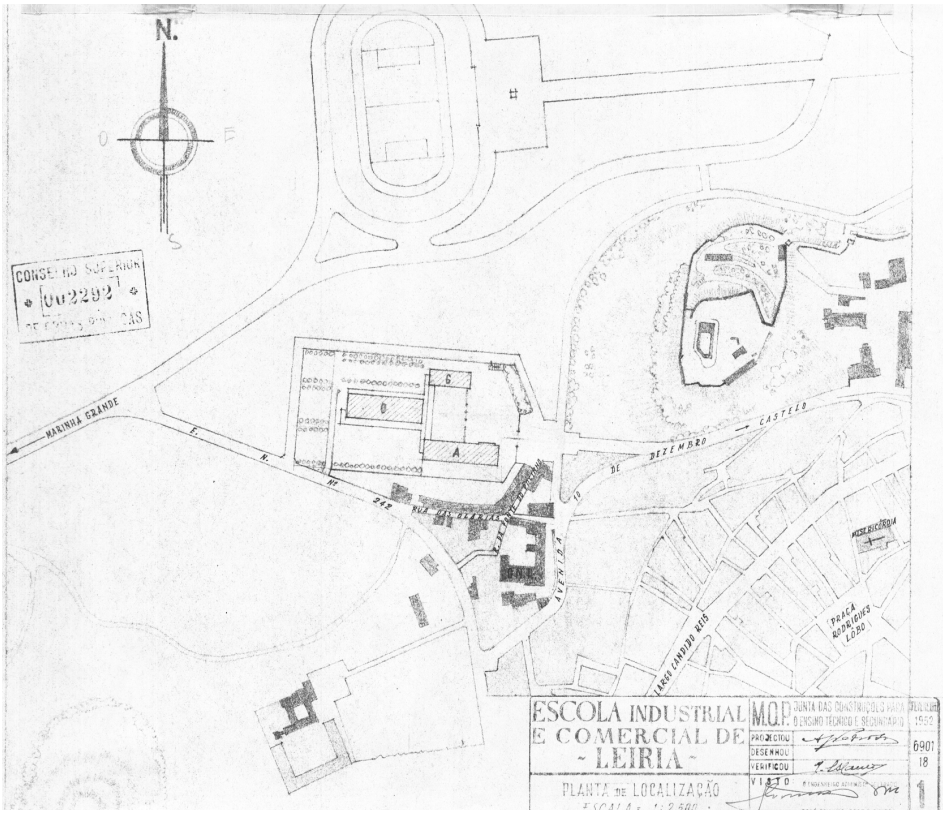


Figure 13: 1st Standardised Design for Industrial and Commercial School for Leiria, Plan of school location, scale 1:2500. António José Pedroso (Architect) (1952).

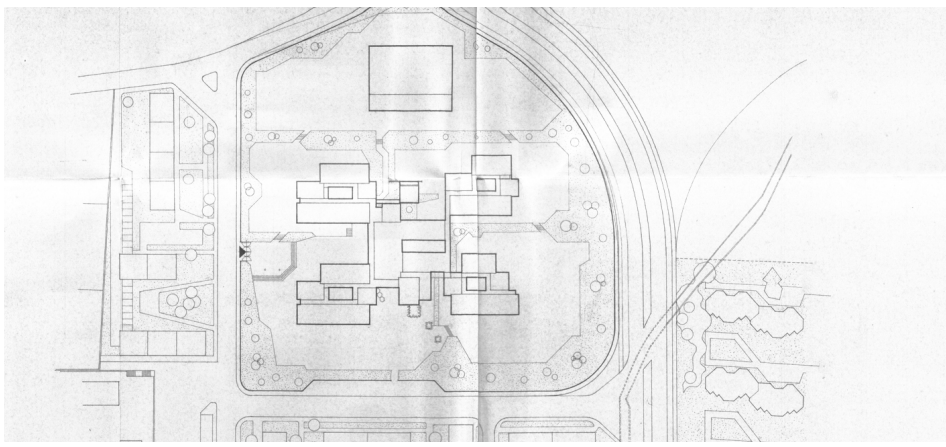


Figure 14: 2nd Standardised Design for the Lyceum of Cascais, Plan of school location, scale 1:1000 (1964).

The tendency of these solutions was to opt for small units, more or less unvarying in shape and size, connected by circulation areas whose design depended on the terrain on which the school building was implanted, as can be seen in the later experiments undertaken in 1966 with the construction of Liceu Garcia da Orta, in Porto, and Liceu Dom Pedro V, in Lisbon (Figure 15). In both cases, faced with steeply sloping terrain, the blocks are distributed around the school's social block on platforms built at different levels.

This solution continued to be developed in 1968, with the standardisation study for the Preparatory School for Secondary Education. This model appeared after the introduction of six years of compulsory education. To this end, in parallel to the complementary primary education, the State created the so-called Preparatory Cycle, with the plan being to build a school in each municipal seat. In this project, special attention was given to the outside space as an important part of the educational process. The project brief focused on the continuity of the indoor work spaces and their extension into the outside area. The central body containing the classroom was thus extended into adjacent areas by means of a small courtyard. Furthermore, it also mentions that the area remaining after the construction of the buildings was to be used as playgrounds, areas for physical education activities and as land to be dedicated to horticultural practices and gardening. The school grounds were to be bordered by large green areas (Figure 16).

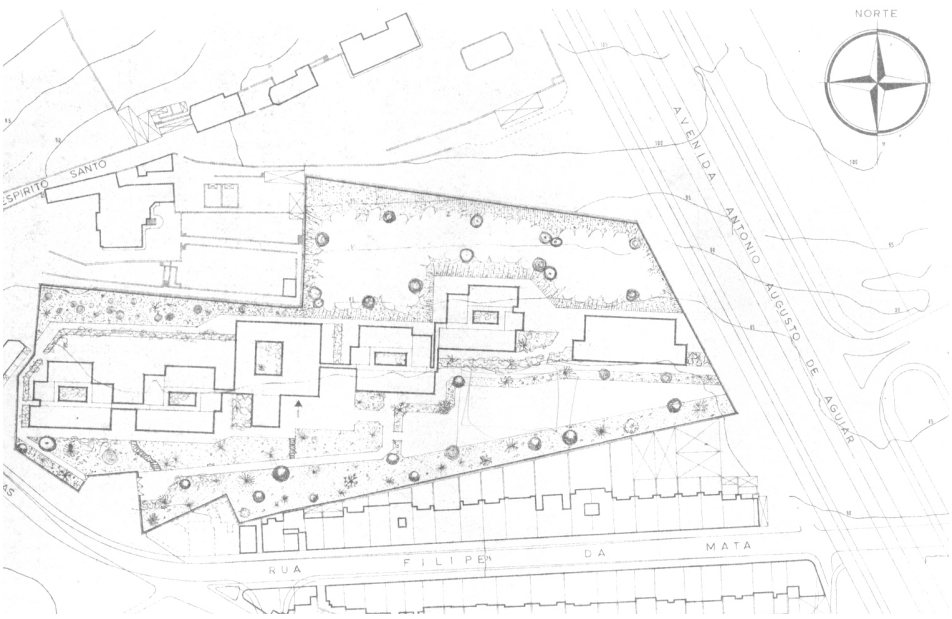


Figure 15: 4th Standardised Design for Liceu Dom Pedro V, Plan of school location, scale 1:1000 (1966)

Figure 16: Standardised Study for the Preparatory School for Secondary Education (1968), cover of the design process for a school in Aveiro (1969).

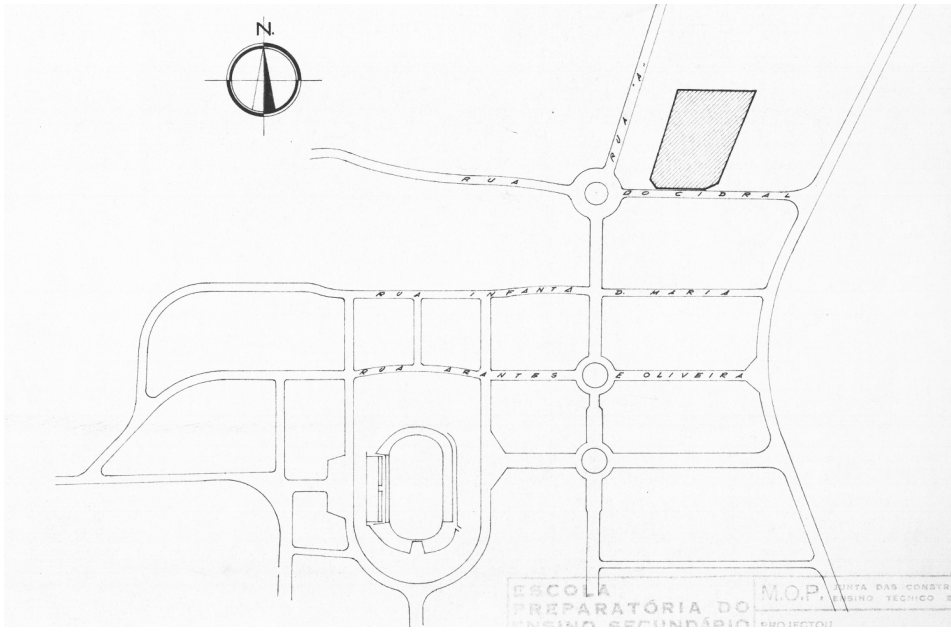


Figure 17: Preparatory School for Secondary Education in Coimbra, scale 1:5000.

These experiences showed the malleability of this typology in relation to its implantation. This model was successfully adapted to various forms and to terrains of varying degrees of unevenness. Furthermore, this structure based on the joining together of small units allowed for the premises to be increased if this were necessary. Besides enabling the use of spot elevations, it also made it possible to differentiate between themes, programmes, ages, interests, etc. Thus, one of the crucial aspects of this typology was that it could be implanted in any topography and allowed for different articulations according to the urbanistic layout, the configuration of the block, the position of the entrances and the orientation of the land. Furthermore, this solution was also intended to adapt the school space to the educational project in question, incorporating the student-centred pedagogical trends that focused on their autonomous learning.

The school entrance: From the building to the playground

As we have seen in the course of this text, from the late nineteenth century until 1970, the school equipment for secondary education significantly changed its typology and morphology. The way in which the school building was implanted and linked to its urban surroundings began to present different features that can now be synthesised according to the design of their school "entrances" and the "limits" of the school grounds.

As far as the different types of entrance were concerned, the following situations could be noted: schools with a direct entrance to the building; different entrances for the school community and for the urban community; entrances that form an evident continuation of a street or square; roads that enter into the school grounds through its gate; and, finally, the entrance directly into the playground. In this sense, the school entrance was shifted from the actual building to the playground. As the building is a more formal space than the playground, it can be said that the school space was looking for greater informality. However, the consequences of this transformation are, to a certain extent, reflected in the boundary between the school grounds and the urban space and in the articulation of this with the remaining urban system, or, in other words, in the wall.

The boundary of the school grounds was initially defined by the shape of the building, as can be seen in the first Lisbon lyceum, Liceu Passos Manuel, from 1898. It was materialised through buildings with regular compact configurations, opening onto inner courtyards. These built boundaries were always integrated into the rest of the urban systems, such as squares, streets, avenues or residential neighbourhoods. Later the buildings gradually began to be moved further away from the boundaries, making the school grounds less dense, but guaranteeing at least a well-defined front, drawn by the façade of the school building and its alignment with other urban features. Through avenues, squares and neighbourhoods, these boundaries continued to be aligned with other urban systems and public programmes. Finally, from the 1960s onwards, the boundaries of the school grounds evolved from built boundaries to the empty boundaries of the open-air playground.

As was identified by Margarida Souza Lôbo (1995), through the influence of the model proposed in the 1941 Athens Charter, the block ceased to be defined by the constructions that marked its borders and began to be defined by the surrounding streets. The methodology of the urban design was developed from the building that had been implanted on a portion of excess land. In this sense, the school building became detached from its surrounding area and the school grounds became independent from the rest of the urban system (Figure 17).

Conclusion

Through some examples and historical facts, this text has highlighted the urban and infrastructural role that the educational equipment played from the late nineteenth century until the 1970s. The logic of integrating the school into the urban space was developed both through architectural design and urban design. On the one hand, the architectural studies on the form and design of school equipment included the programmatic, educational, economic and urban challenges. On the other hand, the urbanistic studies and plans considered strategies for the location of the school equipment integrated with other public equipment, depending on the context and shape of each urban space in the cities, through areas of influence, in such a way as to cover the whole of the urban territory. In this way, the school building, through its programmatic wealth and the educational function that it provided to society, had the capacity to bring together both the school and the non-school communities. It also played a dynamic role in the city's development and the improvement of urban life.

Until the late 1940s, architectural solutions were based on an attitude of integrating the school building into the urban space, whereas the later standardised designs developed ideas and solutions based on its adaptation to its surrounding context. The ideas of integration and adaptation gave rise to distinct types of urban relations. In the first case, the architectural and urban studies had as their aim to make the school building part of an urban system, in such a way as to combine structures and bring them together. The second case reflected an idea of change, adjustment and adaptation to something different. These latter ideas were already part of the political change that was to happen in 1974, with the creation of the democratic regime in Portugal and the country's consequent openness to European strategies and policies.

In view of the current need for the restructuring and redevelopment of the network of school equipment, some recent studies have been exploring architectural solutions and attitudes that will reintegrate the school building into the urban space and readapt the spaces to new educational scenarios. The boundaries between the school grounds and the surrounding urban space, as well as the question of the school entrance, are being redesigned in such a way as to explore different forms of articulation between the school building and the urban environment (Moniz and Ferreira 2015, 2016). Thus, the dynamic, aggregating capacity of the school building opens up a whole field of study about the architectural and urban modes of articulation between the school and the urban territory. The relationship between the educational and urban spaces is assuming different architectural forms, with evident consequences for urban life.

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School Buildings for Secondary Education: Their Architectural Evolution between the Late Nineteenth Century and the 1970s

Alexandra Alegre and Teresa Heitor

Introduction

The definition and development of the building to be used for secondary education began in Portugal in the late nineteenth century and continued throughout the twentieth century. Liceu Passos Manuel, begun in 1882, was the first such building whose design embodied the intentions of Passos Manuel and his first reform of so-called Secondary Instruction in 1836, which approved the *National Lyceums Plan*. This was followed by the construction of a group of buildings that, despite their small size, were distinguished by their architectural and heritage value. It was in this way that the construction of buildings for secondary education began, sponsored by the State and built under the responsibility of different public bodies and institutions: Ministry of the Affairs of the Kingdom, Ministry of Public Works and Communications, Ministry of Public Works, Municipal Councils and the Directorate-General for National Buildings and Monuments.

Two main groups can be identified as leading the process for the design of buildings for secondary education. Firstly, there were the architects who enjoyed distinguished careers at different moments in the history of architecture in Portugal, such as José Luiz Monteiro (1848-1942), Rosendo Carvalheira (1861-1919), Miguel Ventura Terra (1866-1919), José Marques da Silva (1869-1947), Cristino da Silva (1896-1976), Cottinelli Telmo (1897-1948), Carlos Ramos (1897-1969) and Jorge Segurado (1898-1990), and later Manuel Tainha (1922-2012) and Hestnes Ferreira (1931-2018), who were responsible for the development

of special projects. And, secondly, there was the *Junta das Construções para o Ensino Técnico* e *Secundário* (JCETS – Board of Constructions for Technical and Secondary Education), a body created under the scope of the Ministry of Public Works and Communications in 1934, which took over responsibility for the design and construction of buildings for secondary education until 1969, the year when this body was abolished

The study of the architecture of the lyceums and technical schools, built by the State between the late nineteenth century and the 1970s, made it possible to identify five key moments that reflect different focuses and aspirations of a political, educational, social and economic nature: i) 1890-1920 (the school as an urban monument); ii) 1930 (the school as a modern icon); iii) 1940-1950 (the school as an ideological representation); iv) 1960-1970 (the school as an educational infrastructure) and v) 1960-1970 (the school as a social space). All of these periods also express moments of greater or lesser international influence.

The design principles that guided the architecture of the building for secondary education and the planning of its network were related with factors of a political and social nature, and, above all, with the educational policy that was in force in each particular period, expressed in the various modes of school organisation, teaching/learning methods and changes to the school curriculum, as well as the financial resources available for school construction. Also important were the aspects arising from the concerns with school hygiene and health that were a distinctive feature of the end of the nineteenth century and the first decades of the twentieth century, together with the architectural and constructive options of the different movements in the history of architecture and the history of construction.

1890-1920 The School as an Urban Monument

This period includes the group of schools (lyceums) designed and built between the late nineteenth century and the first decades of the twentieth century. These were constructed in privileged locations in the cities of Lisbon and Porto and are recognised as landmark urban monuments, not only prominent features within their most immediate surroundings, but also at the level of the city itself. They were designed by leading architects from the period, including such names as José Luiz Monteiro, Rosendo de Carvalheira, Miguel Ventura Terra and José Marques da Silva.

The design of this group of buildings finally brought into action the decree, dated 17 November, 1836, which approved Passos Manuel's *National Lyceums Plan* and instituted a reform of Secondary Instruction, as well as all the legislation produced until 1894/95, and which was intended to define that institution. It was, however, Jaime Moniz' 1895 Reform, establishing a class system, and Eduardo Coelho's 1905 Reform, in defence of physical education and experimental teaching, that were to make a significant contribution to the consolidation of the programme for the construction of *lyceums,* taking the classroom space as the basis for their design and as the quintessential space in the teaching/learning process,

complemented with a series of other spaces (gymnasium and laboratories) that together contributed to the «creation of a new order» (Ramos do Ó 2009, 35).

The first phase most notably brought both the Central Lisbon Lyceum (later given the name of Liceu Passos Manuel) and Liceu Camões, also built in Lisbon, whose design and construction process proved to be decisive in defining the lyceum building.

The design and construction of Liceu Passos Manuel (1882-1911) was a first important moment of debate and reflection about the spatial and functional conditions of the *lyceum* building, as it sought to achieve the pedagogical and hygienist objectives of that time. Examples of such reflection were the successive recommendations made by the commissions appointed to assess its design project, revealing a constant adjustment of the lyceum building to an institution that was itself also in the process of defining both its organisation as a school and its pedagogical aims and guidelines. Its design, whose first project developed by José Luiz Monteiro dated from 1882, was marked by successive projects adapting the building to the requirements of the curriculum, to the guidelines for the organisation and administration of lyceums proposed by the 1895 Reform, and to the spatial and programmatic requirements of a more active and experimental form of education, based on a technical and scientific curriculum and on the compulsory nature of physical education, in line with the 1905 Reform. This reform thus called for the creation of new spaces in the lyceum building: laboratories and science cabinets, a gymnasium and complementary spaces, besides the library, museum and experimental gardens.

The importance that was given to hygienist questions is expressed, in particular, in the opinion issued in 1902 by a commission whose members included, among others, Ricardo Jorge (Inspector-General of Public Health) and Sebastião Cabral Costa Sacadura (School Sanitary Inspector) (1903). This opinion mentions the necessity to accommodate, under the best possible conditions of hygiene, the needs of day boarders, providing appropriate places for outdoor games and exercises, as well as to adapt the courtyards/cloisters, which must be well ventilated and lit by natural sunlight, with galleries that are also well lit and ventilated, either because they open directly onto these spaces on the ground floor, or because they have large glass windows on the upper floor. The classroom is organised in the form of a rectangular space, where the hygienist concerns are catered for through the ample size of the spaces, through the height of the ceilings, through the spacious openings that allow for the correct lighting and ventilation, and through the design of a natural system of ventilation based on openings that provide inlets and outlets for fresh air located in opposite walls.

The final solution developed by Rosendo de Carvalheira in 1907, maintains the first typological option introduced by José Luís Monteiro, based on the organisation of the spaces around two courtyards or playgrounds. These playgrounds maintain the characteristics of the courtyards of the colleges in relation to the design of their circulation areas and accesses and in the way that they assume the role of a central element that organises the layout of the whole building. This courtyard typology then became the characteristic feature of the group of lyceums built during this period (Figure 1).

Figure 1: Liceu de Passos Manuel (1882-1911), Lisbon. Courtyard.

The design and construction of Liceu Camões (1907-09), by Miguel Ventura Terra, coincided with the final phase of the construction of Liceu Passos Manuel, benefiting from the knowledge acquired with its long development process. Considered by many authors as the model building in the field of school architecture, its design was innovative at a number of different levels. First of all, its privileged location fulfilled all the requirements of a hygienist nature, which called for open and salubrious spaces, located at some distance from the urban centre, but situated in the area of the city's future growth. Secondly, the architect reinterpreted the conventual typology of Liceu Passos Manuel and thus broke away from the structure of enclosed cloisters or courtyards, proposing a system of open courtyards and a gallery that opened onto the outside, without any glazing and serving the important functions of ventilation, lighting and communication, fulfilling the hygienist requirements and, at the same time, permitting and facilitating the needs for vigilance and supervision. In parallel to this, the design allowed for the creation of an educational environment that made it possible for students to remain inside the school space, with the aim of fulfilling the requirements of a day boarding school and offering a complete education at the physical, intellectual, moral and also social level: a canteen, study rooms and spaces for physical exercise (gymnasium, tennis court, roller skating rink), without forgetting the railings around the outside area (Figure 2).

As far as the organisation of the different spaces was concerned, there was clear evidence of a great rationality and a strong programmatic hierarchy, with greater attention being paid to the spaces that «best expressed the updating of educational programmes, such as the gymnasiums, laboratories, libraries, common social spaces and circulation areas» (Silva 1997, 20). The location of the gymnasium at the centre of the whole composition, forming

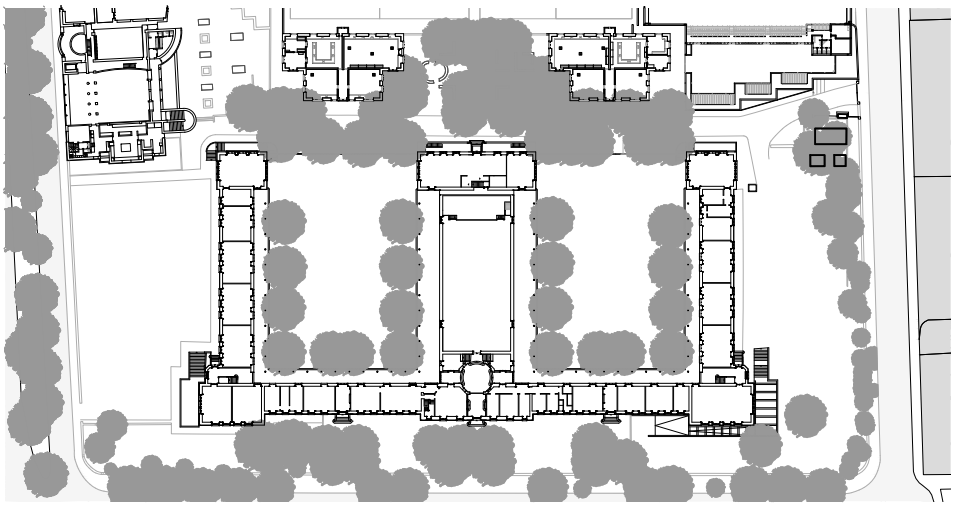

Figure 2: Liceu de Camões (1907-1919), Lisbon. Plan of the ground floor.

the main axis of the building and in contact with the main entrance hall, expressed the programmatic importance attributed to that space in the group of lyceums as a whole. This rationality can also be seen at the level of its construction, with the use of new materials and finishes, such as iron, glass bricks, *marmorite* (terrazzo) and mosaic, which made a decisive contribution towards cost-cutting and reduced the implementation time of the design project and its construction (21 months).

We should also add to these two buildings Liceu Pedro Nunes (1908-11) and Liceu Maria Amália Vaz de Carvalho (1915-34) in Lisbon, designed by Miguel Ventura Terra, and Liceu Alexandre Herculano (1914-31) and Liceu Rodrigues de Freitas (1918-33), in Porto, designed by José Marques da Silva. The design of a continuous façade, with a symmetrical composition, preserving the recreational areas of the urban surroundings, and their privileged location in the areas of the city's future growth, afforded these schools a sense of urban monumentality.

In this way, a series of educational and hygienist requirements were defined, which were to determine a spatial solution based on the more or less enclosed courtyard, the definition of a programme of educational spaces and support areas that sought to address the needs of the day boarding school and the intentions of a complete education, as well as a constructive solution supported by a rationale of heavy cost-saving. The design of these buildings expresses the strong influence of the models of the French *lycées*, built from the second half of the nineteenth century onwards, which the Portuguese architects had learned about during their training in Paris, in the period from the late nineteenth century to the early twentieth century. Essentially influenced by the learning that they acquired at the *École des Beaux-Arts*, these architects developed projects that clearly demonstrated these influences at the level of design methodology, typological questions, the option for an

architecture that resorted to the classical principles of composition, and the concerns of a hygienist nature that were then beginning to emerge.

This period during which the institution of the lyceum was defined also coincided with the promulgation of the first reforms intended to promote professional or vocational teaching in Portugal. In 1852, technical and professional education was given a powerful impetus, promoted by Fontes Pereira de Melo, who promulgated the first law regulating this type of education, and, in the 1880s, António Augusto de Aguiar proposed a restructuring of professional education, with the creation of professional schools all around the country. In 1888, the Marquês de Pombal School of Industrial Drawing was inaugurated in Lisbon, by the architect Pedro de Ávila, the first building designed to serve as a professional school that was constructed from scratch. This was followed in 1915 by the Machado de Castro Industrial School, in Lisbon, designed by the architect Vítor Bastos and completed in the late 1920s; and, in 1928, the António Manuel Gonçalves Industrial School, in Lisbon, later given the name of the António Arroio School of Decorative Arts, designed by the architect Norte Júnior, which was to occupy a plot of land next to Liceu Camões. These buildings adopted similar principles to those applied in the case of the *lyceum* building, not only with regard to the realisation of the pedagogical and hygienist objectives of that time, through the use of large openings in the classrooms and workshop spaces that allowed for the entry of natural light and regular renewals of the air, but also with the intention of representing the image of urban monumentality that was afforded to it through the use of a disciplined architectural language.

1930 The School as a Modern Icon

In 1928, Duarte Pacheco, the Minister of Instruction between April and November, 1928, created the *Junta Administrativa do Empréstimo para o Ensino Secundário* (*JAEES – the Administrative Board of the Loan for Secondary Education*)[1], which was dependent on that same Ministry. This body would be responsible for the drawing up of the general plan of construction works for lyceum buildings, the relaunch of public works begun during the republican regime and interrupted in the meantime[2], the organisation of the calls for tenders for the construction of the lyceums of Beja, Coimbra and Lamego, the construction of Liceu de Dom Manuel II (later Liceu Rodrigues de Freitas), and the acquisition of teaching material, new school furniture and meteorological stations for all lyceums.

The launch of the calls for tenders for the design of the three lyceums represented an opportunity to develop, for the very first time, a standard programme that determined

1 Decree 15942, of 11/09/1928. Decree 16279, of 22/12/1928, also referred to the repair of the State-owned buildings where lyceum teaching was provided, the installation of Students' Residences, and the plan for the acquisition of furniture and teaching material for use in secondary education.

2 In 1930, JAEES also relaunched the construction of Liceu Maria Amália Vaz de Carvalho, a work that had been brought to a halt in 1921 and was now placed under the responsibility of the architect António Couto, and Liceu Alexandre Herculano, in Porto.

the rules for the elaboration of design projects and, simultaneously, established the programmatic, hygienic and technical requirements for the lyceum building. Essentially, these rules were guided by the Reforms of 1894-95 and 1905, and by the 1918 Review of Secondary Education[3], by Sidónio Pais, with clear implications for the definition of the programme for secondary schools: the inclusion of a library for teachers and students, the adaptation of one of the rooms into a cinema, and, when possible, the existence of a gymnasium, changing rooms and a swimming-pool (Article 6).

The standard programme drawn up by JAEES for the call for tenders[4], consolidated the programme for the different spaces that had been implemented previously, now organising these areas according to their functional cores: head teacher's office and school administration services, library and study room, spaces destined for the teaching of the arts, spaces destined for the teaching of the sciences, spaces destined for the practice of sports and physical education (gymnasium, swimming-pool and new outside spaces for sports), spaces destined for experimental and active teaching (laboratories, drawing rooms, workshops) and the head teacher's residence. This organisation of the programme into functional cores heavily conditioned the proposals presented by the architects for the three *lyceum* buildings, which sought to distinguish between the spaces by dividing them into autonomous volumes, or by distributing each of them on different floors. The creation of an autonomous block for physical education, the head teacher's residence and the workshops was particularly evident, whereas the remaining functional cores, where the teaching areas were located, were distributed and organised by floors into a main central block, according to their programmatic, spatial, technical and pedagogical requirements. The conditions outlined in the standard programme called for a hierarchical and rational organisation of the different functional cores, resorting to the typological scheme that best responded to this requirement: differentiated, and sometimes autonomous volumes, in which the teaching areas were arranged along wide circulation areas.

The design of these buildings was clearly marked by the modern architectural language made possible by the use of a new material – reinforced concrete. The solutions present simple volumes, flat roofs, and bodies that are both functionally and formally autonomous. This formal clarity is reinforced by the absence of decorative elements, the uniform finishing of the buildings' surfaces (plastered and painted) and the rigorous geometry of their design. The design options were guided by a rational and hygienic organisation of the interior spaces, achieved through the strong natural lighting of the spaces and the use of materials such as marble, chrome rails and glazed tiles in the entrance hall and circulation corridors. The main architects involved in the design of these buildings were Cristino da Silva (Liceu de Beja, 1930-34), Cottinelli Telmo (Liceu de Lamego, 1930-36), Carlos Ramos, Jorge Segurado and Adelino Nunes (Liceu de Coimbra, 1930-36) (Figure 3, 4 and 5).

3 Decree 4650, of 14/07/1918.

4 Bases para a Construção de Liceus, Condições Especiais, artigo 1 (Cottinelli Telmo Estate).

Figure 3: Liceu de Diogo Gouveia (1930-34), Beja. Courtyard.

Figure 4: Liceu de Latino Coelho, (1930-36), Lamego. Hall.

Figure 5: Liceu de D. João III, (1930-36), Coimbra. Aerial view.

This confirms the thesis defended by such authors as Teotónio Pereira (1987, 324) that «the regime – at that time a Military Dictatorship – was not concerned with architectural expression, in the sense of seeking to guide or control» the exterior design of the buildings, both because it wished to distance itself from the early period of the Republic's existence marked by stagnation in the construction of public works, and because it was living through a period of ideological definition of the regime, «with the result that it lacked the doctrinal basis for direct intervention». This situation was to change in the following decade.

In fact, despite the modernity of its image, the educational model that guided the design of these lyceums followed the model that had guided the design of the lyceums built in the period of the First Portuguese Republic. They thus presented the same structure in terms of their spatial organisation: teaching areas distributed along long, wide corridors, with a rigid compartmentalisation of their spaces and without any direct contact with the

outside spaces[5]. Similarly, the investment in the design of the interior space, which we can clearly see in various international examples from that time[6], was not to be found in these lyceums, namely at the level of a search for a greater spatial fluidity, internal transparency and communication between the interior and the exterior, particularly with regard to the classroom space.

The absence of these spatial characteristics reflects a greater investment in the definition of a programme of spaces that could resolve the functional, pedagogical and hygienic questions that, generally speaking, represented a continuation of the programme of the republican system. It does, however, underline the urban importance of these lyceums in the new areas of urban development.

1940-50 The School as an Ideological Representation

This period coincides with the whole of the 1940s, continuing into the 1950s, and, as Portas (1982, 33) mentions, it corresponds to the period of «a profound cultural crisis that was already manifesting itself in the mid-1930s and from which the first tentative steps to emerge were taken above all from the early 1950s onwards». What could be seen at this time was a manipulation of architecture at the design level, which was now regarded as ideological propaganda, a privileged instrument for disseminating the values of the regime. The principles and language associated with the Modern Movement were abandoned and replaced by a standardisation of designs with a strong nationalist imprint, a reflection of the political and pedagogical ideals of the Estado Novo (New State).

This period essentially reflected two moments in the educational policy of the Estado Novo. The first moment, beginning in 1936, was prolonged until the postwar period and was marked by the actions of the Minister of Public Instruction, Carneiro Pacheco[7], in building a school that displayed «a nationalist affirmation of the primacy of education over instruction», in which a series of measures[8] were taken that accentuated this objective of «ideological inculcation and moral indoctrination», while mixed education was also

5 It is interesting to note that the visual permeability between the interior spaces and the outside of the building is, in fact, more visible in the lyceums of the First Republic, namely in the opening of windows in opposite walls of the classrooms at Liceu Camões and Liceu Pedro Nunes.

6 See the special thematic issues of the journal *Architecture d'Aujourd'hui* of January-February 1933, January 1935 and May 1936, and the issue dedicated to the *Groupe Scolaire Karl Marx* of André Lurçat, from 1933. See also the open-air schools of Amsterdam (Duiker, 1927-30) and Suresnes (Beaudouin and Lods, 1931-35), or the Corona Elementary School (Neutra, 1934-35).

7 Professor António Faria Carneiro Pacheco was Minister of Public Instruction from January to April 1936, the date when the name of this ministry was changed to that of the Ministry of National Education. He remained as the Minister of National Education until 1940.

8 The change of name from the Ministry of Public Instruction to the Ministry of National Education, the imposition of the policy of the "single textbook", the creation of the Mocidade Portuguesa (Portuguese Youth), the reform of the school curricula and programmes, etc. Mention should also be made of Decree-Law No. 27084, of 14 October, 1936, which introduced the reform of lyceum education.

abolished. The second moment corresponded to the promulgation of the reform of professional technical education, in 1947, by the Minister Pires de Lima[9], and the desire to «articulate educational policies with economic development and the need to train skilled human resources» (Nóvoa 1992, 455-519).

The reflection of these two moments on the design of secondary school buildings was determined by the action of the Board of Constructions for Technical and Secondary Education (JCETS)[10], que veio substituir em 1934 a JAEES. Este organismo, com uma equipa técnica própria, centralizou o processo de produção de edifícios escolares, desde a aquisição de terrenos até à sua construção, terminando praticamente com a colaboração de arquitectos exteriores. A criação da JCTES insere-se numa estratégia de criação de organismos administrativos que cobriram todos os sectores de actividade (escolas, hospitais, quartéis, prisões, estações dos Correios, delegações da Caixa Geral de Depósitos, entre outras) e que centralizavam todas as obras referentes a edifícios públicos, assegurando assim a criação de uma arquitectura própria do regime. Como afirma Pereira (1987, 329), estes organismos, que integravam nos seus quadros arquitectos, «asseguravam com eficácia uma abundante produção arquitectónica dentro da linha estabelecida, que rapidamente ia polvilhando o país, no âmbito de uma política que continuava a privilegiar as obras públicas como um sector fundamental para atestar a capacidade do regime».

In 1938, an ambitious programme was approved for the construction, enlargement and improvement of lyceum buildings[11], which would be mainly developed by the technicians of JCETS. The plan was to construct eleven new lyceum buildings from the north to the south of the country, and undertake interventions on thirteen lyceum buildings, centred mainly on the improvement of the spaces used for physical education. The implementation of this plan, which was completed in 1952, underwent successive alterations and postponements, caused by the delay in selecting, acquiring and urbanising the land and by the shortage of raw material, labour and transport in some regions of the country, as well as by the increase in the prices of construction work after 1939. Consequently, work continued during the period of the Second World War, as stated in the report drawn up by JCETS (JCETS-MOPC 1941).

9 Professor Fernando Pires de Lima was the Minister of National Education from 1947 to 1955.

10 Decree-Law No. 24337, of 10/08/1934. Marques (1999, 133) distinguishes four periods in the activity of this body: 1) 1928-1937 (*The first steps*), which corresponds to the activity of JAEES and its replacement with JCETS, ending with the completion of the works on the *lyceum* buildings of the 1930s; 2) 1938-52 (*The high point of the Lyceums*), which covers the whole period of the design and implementation of the 1938 Plan, the first structured plan for the construction and improvement of *lyceum* buildings; 3) 1952-1958 (*The time and place of the Technical Schools*), which gave priority to the construction of technical schools through the development of the first standardised projects; 4) 1958-1969 (*The return to the Lyceums*), which covers the implementation of the second programme for the construction of *lyceum* buildings, under the scope of the 1958 Plan.

11 Decree-Law No. 28604, of 21/04/1938. New lyceums: Castelo Branco (Liceu Nuno'Alvares, mixed), Chaves (not built, mixed), Coimbra (Liceu Infanta D. Maria, female), Faro (Liceu João de Deus, mixed), Lisbon (Liceu Dom João de Castro, mixed, Liceu Gil Vicente, male, adaptation of the primary school of Bairro do Arco Cego to Liceu Dona Filipa de Lencastre, female), Porto (Liceu Carolina Michaelis, female), Santarém (Liceu Sá da Bandeira, mixed), Viana do Castelo (Liceu Gonçalo Velho, mixed), Viseu (Liceu Alves Martins, mixed). In 1944 and 1945, it was decided that four more new lyceum buildings should be constructed: Setúbal (Liceu Bocage), Aveiro (Liceu José Estevão), Oeiras (Liceu Sebastião e Silva) and Póvoa do Varzim (Liceu Eça de Queiroz).

In this same document, the General Programme for the Development of Lyceum Design Projects was presented, which was to be implemented in the design of new buildings (JCETS-MOPC 1941, 52-74). This programme reflected the spatial representation of the curricular organisation of lyceum teaching, establishing the nature, characteristics and layout of the various services of a lyceum. These services were now organised into a group of administrative services, a group of school services, a group of special services, a group of physical education services, communication services and various miscellaneous services (Figure 6). It also simplified the standard programme drawn up previously by JAEES, which resulted in a reduction in the number of subjects taught and a re-organisation of the curriculum that was now based on a system of disciplines[12]. The design of the lyceum buildings was supposed to guarantee a separation of the sexes at mixed lyceums and the separation of the different cycles of education at all lyceums.

The work developed by JCETS was presented ten years later, in 1948, in the catalogue and leaflet accompanying the "New Lyceums" display, which formed part of the larger exhibition of *15 Years of Public Works 1932-1947*[13]. The photographs presented here mostly focused on exterior views of the lyceum buildings, and clearly expressed the desired standardisation of the architectural language, which also served the representative image that the *Estado Novo* was seeking to transmit, based on the greater embellishment of the façades and the use of traditional materials such as stone and roof tiles (Pereira 1987, 328) (Figure 7 and 8). The use of a common architectural vocabulary, together with a careful insertion of the buildings in the cities' new areas of growth, reinforced their prestige and their symbolic value in the collective memory and guaranteed the desired monumentality of school buildings «as dominant pieces in the local urbanisation plans» (Pinto and Távora 1948, 72). The requirements in terms of the design of the interiors were outlined by the Board's Chairman himself in an official letter, dated 07/02/1938 and addressed to the Minister of Public Works (JCETS 1944): «In the interior, due modesty and hygiene are called for» (Figure 9).

Without there yet being a systematised process to follow, the first steps were nonetheless being taken towards the standardisation of designs that would lead to the development of the so-called Standardisation Studies in order to respond to the growing need for the construction of technical schools, as a consequence of the 1947 reform of industrial and commercial professional education[14]. This reform divided this branch of education into two levels: the 1st level consisted of an elementary preparatory cycle lasting two years, and the 2nd level comprised different industrial and commercial courses that were intended to last no longer than four years. The same law established the classification of schools into *Elementary Technical Schools, Industrial Schools, Commercial Schools and Industrial and Commercial Schools*.

12 Decree-Law No. 27084, of 14/10/1936.

13 This exhibition was held at Instituto Superior Técnico, from 28 May to 7 November, 1948, intended to celebrate the works built by MOP(C) – Ministry of Works (and Communications) between 1932 and 1947.

14 Law No. 2025, of 19 June (which also regulated agricultural professional education) and the promulgation of Decree-Law No. 36409, of 11 July 1947.

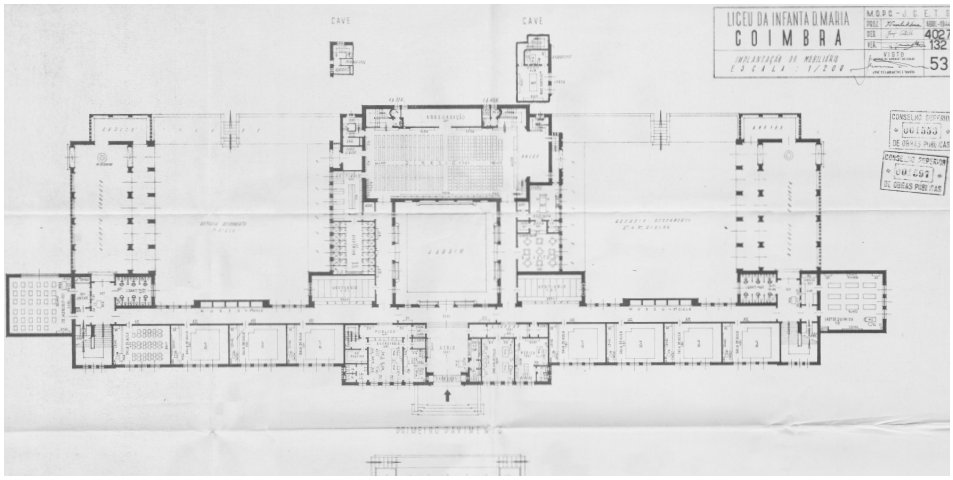

Figure 6: Liceu Infanta D. Maria (1944-48), Coimbra. Plans of the ground floor and first floor.

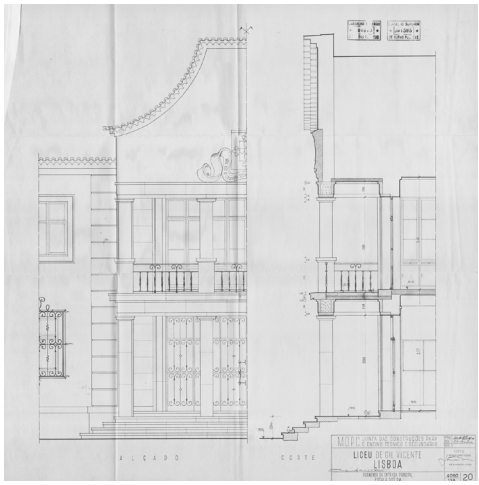

Figure 7: Liceu de Gil Vicente (1944-49), Lisbon. Detail of the façade (main entrance).

Figure 9: Liceu de Viana do Castelo. Corridor.

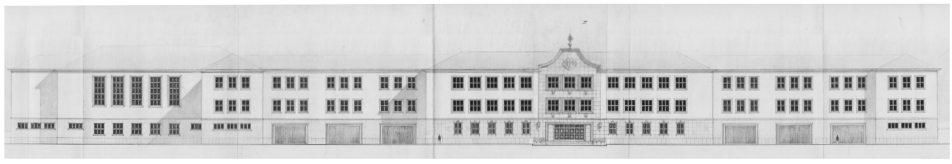

Figure 8: Liceu de D. João de Castro (1944-49), Lisbon. Main façade.

The encouragement given to technical and vocational education meant that this form of teaching was adapted to the requirements of a skilled labour force, a move that further accentuated the separation between lyceums and technical schools: the former functioned as a way of gaining privileged access to a university education, while the latter were geared towards training a specialised labour force and providing access to what was then known as the "middle" level of education, equivalent to a latter-day college of further education. In 1948, a programme for the construction of buildings designed for industrial and commercial professional education was approved[15], which gave way, throughout the 1950s, to an increase in the construction of technical schools for the different levels (elementary, secondary and "middle") and branches of education[16] (agricultural, industrial and commercial). In this way, elementary, industrial, commercial, industrial and commercial, practical agricultural, agro-industrial, agro-industrial technical (industrial, commercial and agricultural) schools were created, together with schools for decorative arts, as well as schools for agricultural science and management, and industrial and commercial institutes. The studies were undertaken in collaboration with the Directorate-General for Vocational Technical Education, based on programmes provided by this body with the specification of each school's programme and characteristics (Costa 1971).

The first standardisation study, *Anteprojecto Tipo das Escolas Técnicas Elementares* (Standard Preliminary Design for Elementary Technical Schools), was also developed in 1947, launching the design principles that were to mark the following studies: distribution of the different areas into three autonomous blocks (teaching and administrative areas, gymnasium and canteen, and workshops) which allowed for the design to be adapted to different-shaped plots of land and hilly terrains (Figure 10 and 11). This solution had already been tried in the design of some lyceums from the 1938 plan[17]. The uniformity of this preparatory cycle allowed for such systematisation, which, on the one hand, facilitated the construction of school buildings and, on the other hand, enabled the administrative control of their design and construction process (Costa 1971, 292). In 1950 and 1952, this study was expanded to include professional schools and technical schools. The sequence of studies made it possible to establish the organisation of the different blocks, based on principles relating to the concentration of functional spaces, which was mainly guided by economic considerations[18]: a central corridor for the distribution of the classrooms, thus avoiding overly scattered solutions and a larger construction area, the concentration of the facilities for physical education in the same body, as well as the necessary complementary spaces and the canteen, and the use of a "shed" roof that also made it possible to concentrate the spaces of the workshops in the same area. The use of sloping tiled roofs, in detriment to flat

15 Decree-Law No. 37028, of 25/08/1948 and Decree No. 37029, of 25/08/1948 (Statute of Industrial and Commercial Professional Education)..

16 The buildings designed for technical education could house either just one branch of education or two branches of education, or, exceptionally, more than two branches.

17 For example, at Liceu Dom João de Castro and Liceu Gil Vicente, in Lisbon.

18 In comparison with the lyceum buildings plan, the technical schools programme required a larger construction area, in particular for the installation of the workshops, which needed an entire floor for themselves.

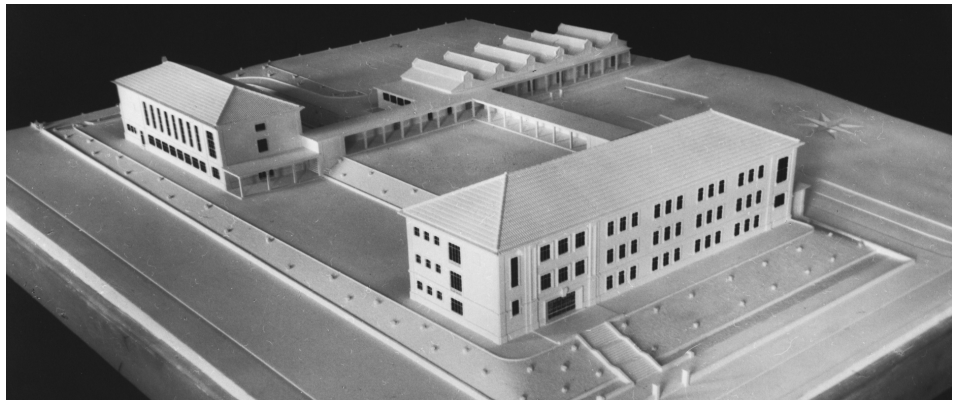

Figure 10: Escola Técnica Elementar Eugénio dos Santos (Standard Preliminary Design for Elementary Technical Schools, 1947). Model.

roofs made of reinforced concrete, was also a decision based on the need to control costs. These studies marked the beginning of the development of standard designs in the field of school architecture in Portugal that would continue to be used for several decades.

Internationally, this period was marked by the challenges arising from the destruction caused by the Second World War and by the need to overcome the problems associated with the deficient conditions of the existing buildings, to reconstruct the destroyed schools and construct new schools in response to the increasing birth rate and the increase in the number of years of compulsory schooling, as well as the increased number of students in the new areas of urban expansion. These questions called for a new approach that would permit the construction of schools in a regular fashion, through the adoption of new systems and building techniques, resorting to the standardisation and prefabrication of the construction elements, and the adoption of planning strategies and cost controls, while simultaneously promoting a design that was suitable for the new educational principles. In this process, it was essential to form multidisciplinary teams composed of architects, teachers and professionals from the construction industry, as well as to receive the support of the municipalities and ministries. The school construction programme undertaken in Hertfordshire, in the second half of the 1940s, was exemplary in its development of an industrialised construction (Saint 1987).

At the same time, a series of international initiatives served to promote a debate about school architecture, giving greater visibility and meaning to this theme in the educational field and alerting people to the social and economic urgency of building schools. The importance of modern pedagogy and children's human and learning capacities, the reflections taking place about the classroom space and the other areas within the school as spaces of learning (library, entrance hall, auditorium, circulation areas), the contribution of the outside space as a further extension of the teaching space, technical studies about the improvement of

Figure 11: Escola Técnica Elementar Nuno Gonçalves (Standard Preliminary Design for Elementary Technical Schools, 1947). Teaching and administrative block and gymnasium and canteen block.

"living" conditions (lighting, acoustics, ventilation, air quality, thermal comfort), dimensional and ergonomic studies centred on a better performance of school furniture, studies about the colour of equipment and educational support material, the rationalisation of the design and construction process and constructive solutions that could improve safety at different levels, were just some of the themes debated. Attention is drawn in particular to the publications of Stillman (1949) and Roth (1950), the debate about the *Volksschule,* presented by Scharoun at the *Mensch und Raum* conference in Darmstadt, in 1951, or the contribution of the International Union of Architects (UIA 1955) and the School Buildings Charter (UIA 1959), among other initiatives (Alegre 2012, 84-104).

These actions soon became widely known among the different sectors involved in the process of school construction, namely among some Portuguese architects, although their influence would only become visible from the late 1950s/early 1960s onwards, with the gradual opening up of the country to the outside world.

1960-1970 The School as an Educational Infrastructure

This period is distinguished from the previous one through the country's opening up towards the outside world, which had begun with Portugal's participation at the Economic Conference in Paris for the organisation and management of the Marshall Plan (1947-1948), but which only acquired a more systematic shape from the late 1950s onwards. For the first time, Portugal had access to the international debate and the exchange of information that was taking place in the field of school architecture. At the same time, there was a new direction being taken in the educational policy of the *Estado Novo*, which had been introduced previously by the Minister Pires de Lima, guided by the relationship between education and economic development, and whose main instigator was the Minister

Francisco Leite Pinto[19] (Nóvoa 2005, 119). The heavy influence of the experiments being undertaken in the North of Europe, and, in particular, the English experience, together with the contacts established with international working groups (UNESCO, World Bank, OEEC/OECD, UIA) called for the implementation of new practices in the field of school architecture, as mentioned previously.

The discussion about the country's educational backwardness, which had been revived in the late 1950s (Santos 1990, Reis 1993, Barreto, 1996), highlighted the need to expand the school network and questioned the effectiveness both of the working methodologies and of the models for the school buildings constructed in Portugal by JCETS. With the support of the OECD, and counting upon the participation of technicians from the Ministry of Education (ME), new strategies were discussed and proposed, related to the pedagogical models and experiments taking place abroad, whose repercussions on school architecture contributed to their affirmation in Portugal. These strategies were then tested in the form of pilot projects, later leading to the development of standard solutions with a broader application at the national level. Efforts were made to renew the architectural language, creating an architecture that, although it remained disciplined, nonetheless renounced much of its previous formality and monumentality.

Although the political system of that time was extremely sluggish in adapting to the challenges and needs arising from the country's economic and social development, the educational planning that was introduced was seemingly "contracyclical" in nature, defining new strategies to be adopted in the expansion of the network of primary and secondary schools. Designs and models were "hatched" that served as the basis for planning the expansion of the school network that would take place in the 1960s and the first part of the following decade, and which would later be implemented in the second half of the 1970s and throughout the 1980s[20] (Heitor 2014, 495-529).

It is important here to underline an initiative promoted by the Minister Francisco Leite Pinto: the Mediterranean Regional Project, which involved the technical and financial support of the OEEC (the present-day OECD), leading to the establishment of a series of educational objectives for a period of 15 years (1960-75) and giving a fresh impetus to the education sector. This initiative involved the participation of Spain, Greece, Italy, Turkey and Yugoslavia, as well as Portugal (Instituto de Alta Cultura 1964). Under the scope of this project, the Minister Leite Pinto stressed the aim of «increasing labour productivity» and highlighted the relationship existing between cultural development and economic development. The influence of 'human capital' theory is expressed in his statement: «A nation is worth more because of its people than because of its natural wealth. Indeed, it is not possible for any

19 The engineer Francisco Leite Pinto was Minister of National Education from 1955 to 1961.

20 This process began formally with the increase in the period of compulsory education from 4 to 6 years, established in 1964. However, these 6 years of schooling were not made compulsory for that section of the population that was already of school age as the conditions did not yet exist for the expansion of the school network. The conditions for fulfilling the six-year period of compulsory education were only definitively established in the late 1970s (Decree-Law No. 538/79, of 31 December), after which this period was extended to 9 years in 1982.

nation to be considered cultured if its productive mass has only 4 years of compulsory education» (Grácio 1990, 233). As Carvalho (1986, 795) noted, «Education now appeared as the decisive factor in the progressive evolution of the Economy».

Achieving the aims of this project called for an additional effort in the sector of school construction, above all at the level of post-primary education. Part of the investment in education was directed towards the design, construction and maintenance of school buildings, and, in line with this strategy, studies were undertaken in order to find the most financially effective constructive solutions, through research into new forms of design and construction. For this purpose, the *Grupo de Trabalho Sobre Construções Escolares*[21] (GTSCE – Working Group for School Construction) was created, integrated into JCETS at the Ministry of Public Works. This group enjoyed the technical support of the architect Guy Oddie from the Ministry of Education of the United Kingdom, in his capacity as a consultant expert. Solutions were tested in pilot projects[22], based on principles linked to the standardisation of construction components. The initial team of architects from JCETS was strengthened with the incorporation of the architects Augusto Brandão and Maria do Carmo Matos, in the late 1950s, whose involvement in the GTSCE was to prove decisive for altering the paradigm of school construction throughout the 1960s, marked by the new premises of the standardised studies and standard designs.

The familiarity that the JCETS technicians had with the international developments taking place in the field of school architecture also contributed to this paradigm shift in Portugal. The visits to technical schools located in France, Holland, Germany, Switzerland and Italy, made in 1959 by José Costa Silva and Jerónimo Monteiro do Amaral, respectively an architect and an engineer at JCETS (Amaral and Silva 1959), and the internship that Maria do Carmo Matos undertook in 1966 (Matos 1967) with the *Development Group* of the *Department of Education and Science*, in England, are just some examples of these interchanges.

Thus, during the 1960s, the following projects were developed: the 1st Standardised Design for industrial and commercial schools (1960); the 2nd Standardised Design for the lyceums of Cascais and Vila Nova de Gaia (1964); the 3rd Standardised Design for industrial and commercial schools (1964); the 4th Standardised Design for Liceu Dom Pedro V and Liceu Garcia da Orta; the Standardised Study for the Preparatory School for Secondary Education (1968); and the Standardised Study for Lyceums (1968)[23]. The development of these designs provided a response, on the one hand, to the need to construct buildings for

21 Similar working groups to the GTSCE were also created in the other countries involved in the Mediterranean Regional Project. Such groups were obliged to incorporate representatives from all sectors of school construction: architects and engineers, teachers and administrators (OECD 1966, 327).

22 The pilot schemes for school construction developed at that time in the municipality of Sintra involved three distinct situations: 1) Pilot project for an Elementary Primary School in Mem Martins for 160 students, coordinated by the architect Maria do Carmo Matos; 2) Pilot project for school furniture for the building in Mem Martins (as a complement to the previous project); 3) Pilot project for the School of the Preparatory Cycle for Secondary Education in Mafra, for 704 students, coordinated by the architect Augusto Brandão.

23 All the documentation relating to the standardised designs can be consulted at: http://asap-ehc.tecnico.ulisboa.pt/database/standardizedproject.php

technical education, contemplated in the 1948 legislation, and, on the other hand, to the new plan for the construction of sixteen new lyceums, promulgated in 1958[24]. In 1967, the creation of the preparatory cycle for secondary education[25] also required the construction of a vast group of schools in Portugal.

The 1st Standardised Design of industrial and commercial schools for between 800 and 1220 students represented a first response to the large number of schools that needed to be built. The title of the design expressed both its applicability to all buildings of the same programme and the modulation of its constructive structure, as well as the standardisation of the elements of construction, in particular the exterior and interior frames for the doors and windows. The advantage of the distribution of the building programme into different blocks was now fully acknowledged, only requiring the study of its implantation on sites with different topographical characteristics, the connections between the buildings and the exterior arrangements. The exterior image of these schools reflected the principles of constructive modulation and the standardisation of the elements of construction (Figures 12 and 13).

The Standardised Design for the Lyceums of Cascais and Vila Nova de Gaia, developed in 1964 under the responsibility of Augusto Brandão, involving the creation of schools for roughly 1500 students, marked a new stage in the design of school buildings in Portugal, both at the architectural and constructive level and in functional and economic terms. This architect's work was to prove decisive in altering the paradigm of school architecture, with his design of the school building being based on two fundamental principles: the development of a spatial solution that was heavily conditioned by the pedagogical objectives of the educational level for which the school was intended; and the realisation of a typological, spatial and constructive solution whose costs were suitably controlled – the pavilion.

The pursuit of an active form of teaching in which the building plays a major role in the educational process, the promotion of the participation of the students in social activities that also take place in the spaces outside the classroom, the importance given to the social life of the school through the design of a central space for meetings between the different members of the school community, the opening up of the school spaces to the surrounding community, all contributed to a new conception of the school. The strategies

24 Decree-Law No. 41572, of 28/03/1958. The new lyceums were: Porto (Liceu Feminino Santa Isabel and Liceu Garcia de Orta); Lisbon (Liceu Rainha Dona Leonor, Liceu Masculino Padre António Vieira and Liceu Misto Dom Pedro V); Guimarães (Liceu Martins Sarmento); Évora (Liceu Feminino); Coimbra (Liceu Dom Duarte); Covilhã (Liceu Heitor Pinto); Portimão (Liceu Infante de Sagres); Figueira da Foz (Liceu Bissaia Barreto); Braga (Liceu Feminino Dona Maria II); Bragança (Liceu Emídio Garcia); Guarda (Liceu Afonso de Albuquerque); and Viseu (Liceu Feminino). Later, this plan was extended, providing for the construction of three more lyceums: Angra do Heroísmo (Liceu Nacional de Angra do Heroísmo); Cascais (Liceu Nacional de Cascais); and Vila Nova de Gaia (Liceu de Vila Nova de Gaia).

25 Decree-Law No. 47480, of 02/01/1967, which merged the First Cycle of Lyceum Education and the Preparatory Cycle of Technical Education to form the Preparatory Cycle for Secondary Education. This cycle, which lasted for two years, was taught in its own buildings, with the two sexes being separated from one another. Together with the increase in the period of compulsory education from 4 to 6 years, in July 1964, this fact made it necessary to construct school buildings to house the students who would attend this new cycle, with new educational principles and objectives.

for reducing costs were based on decreasing the construction area and increasing the teaching area per student, the multipurpose use of some spaces and, mainly, a new system of spatial organisation that eliminated the corridor and proposed functional cores organised, according to specific interests, into autonomous pavilions, in which the classrooms were arranged around covered courtyards, intended to be used for exhibitions, debates or as meeting places. The new teaching methodologies that it was hoped would be more active and centred on the student's work were also reflected in the design and arrangement of the furniture that evolved into more ergonomic solutions and was adapted to the new pedagogical guidelines. The area that was allocated to physical education was now made autonomous for the first time, being housed in a pavilion specifically designed for this purpose, whether for reasons associated with the new demands of the programme of that discipline or because of its functional incompatibility with the new central space of the school and the canteen. Externally, the building expressed the rhythm of the structural

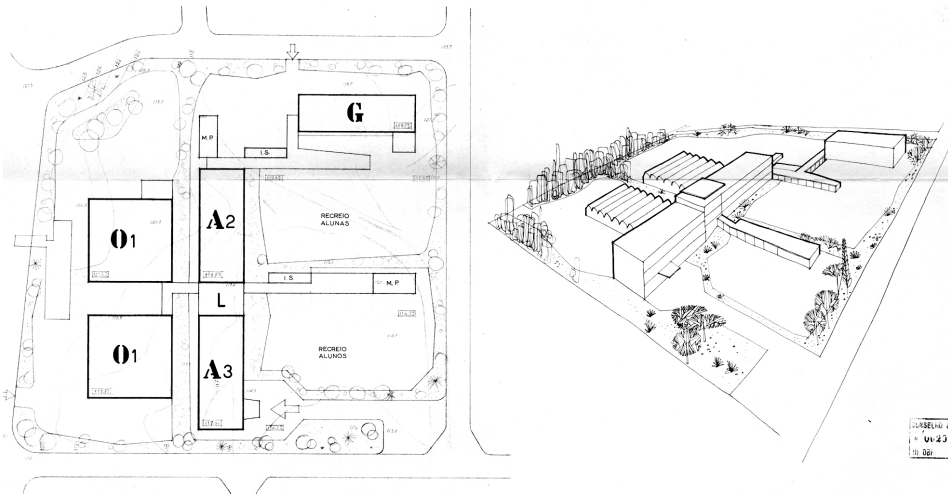

Figure 12: 1st Standardised Design for industrial and commercial schools (1960). Study for a school in Cacém.

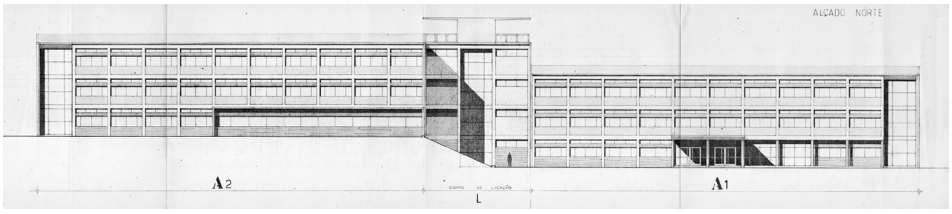

Figure 13: 1st Standardised Design for industrial and commercial schools (1960). Main façade.

modulation of the exposed concrete porticoes, interrupted by the wooden frames of the doors and windows, standardised in terms of their design and size, and roofs made of fibre-cement profiled sheets supported by reinforced concrete elements (Figure 14).

A similar principle was adopted in the 1968 standardised study for the Preparatory School for Secondary Education, coordinated by the same architect, in collaboration with the Department of Services for the Preparatory Cycle and with the technical support of the company 'Profabril'. The aim of this cycle of education was to broaden the vision acquired by students in the primary school, identifying three educational principles: informing, training and integrating, and directing the students' development according to their aptitudes and skills. The response to these objectives was based on a strong correlation between all the disciplines. The choice was therefore made to break down the school building into separate pavilions that could easily be implanted at different levels, in keeping with the distinct configurations of the terrain (Figure 15). Kept separate from the other buildings were the classes of physical education, which had their own indoor and outdoor facilities (Brandão 1968).

At the same time, Maria do Carmo Matos developed the so-called Standardised Design for Lyceums, intended for the construction of lyceum buildings in different areas of the country, as listed in the 3rd Development Plan (1968-73). The solution afforded continuity to the typological solution developed in the previous designs of autonomous pavilions connected by external covered galleries, and it was essentially governed by a reduction in costs, based on the search for new constructive solutions and the alteration of the structure for the building's functioning, so that its use could be more intense and its occupation optimised. In constructive terms, the teaching blocks were characterised by the use of a reticulated concrete structure, whose measurements (7.20m x 7.20m) were based on the size of the classroom space, with a single beam opening and a single-sized pillar (excluding the large-sized openings of the multi-purpose room) (Figure 16). The standardisation of the constructive elements and their reduced number (three types of standardised bricks and two types of interior doors) made it possible to use pre-fabricated modules if the contractor so wished. For the first time, the design adopted a scheme of rotating classes, with each class ceasing to be linked to its own classroom, which would be left empty whenever the class occupied a specialised space (laboratory, gymnasium, amphitheatre, etc.). This made it possible to take maximum advantage of the temporarily unoccupied spaces, providing for the intensive occupation of all the school's spaces. For the same reasons of economy, the inner courtyards were abandoned in the pavilions containing the classrooms, being replaced, instead, with the staircases connecting the different floors, consequently reducing the potential for conviviality and the pedagogical nature of this space.

Figure 14: Liceu Nacional de D. Pedro V, Lisbon (4th Standardised Design for Liceu Dom Pedro V and Liceu Garcia da Orta, 1966).

Figure 15: Standardised Study for the Preparatory School for Secondary Education (1968). View of the classroom blocks.

Figure 16: Liceu Nacional de Queluz, Queluz (Standardised Study for Lyceums, 1968)

1960-1970 The school as a Social Space

Internationally, besides the English school construction programme, the work developed by Herman Hertzberger and Hans Scharoun made a notable contribution to the debate about school architecture in the decades immediately following the war in Europe. In response to the challenges and the social and urban changes brought by the war, and in a European context marked by criticism of the modern functional programme, emphasis was placed on the contribution that could be made to architecture by the social sciences, history and the interest in the «physical circumstances of the context» (Bandeirinha and Figueira 2010, 451), simultaneously incorporating new construction processes and methods. This new conceptual approach was directed towards interpreting the needs and aspirations of the user, or, in other words, in the case of school architecture, towards understanding the new educational requirements and progressively integrating the child into the school space, as a social and autonomous being. The emphasis was placed on the meaning of the place as opposed to the abstract notion of the modern space.

With these aims in mind, Scharoun's schools sought spatial solutions that promoted the gradual social integration of the child into the school community, through a strong hierarchical organisation of the spaces. Scharoun organised the school into three teaching nuclei: clusters of classrooms with complementary spaces, whose scales and spatial qualities were duly adapted to the specific requirements of each age group. By controlling the relationship established between classrooms, transition spaces and circulation areas, he promoted the creation of areas where students could meet and interact, allowing for greater flexibility in the use of the space. In this way, he sought to create a spatial network, designed to promote the children's sharing of their living experiences, similar to the social networks existing in a vaster community.

Hertzberger also worked on the question of social integration by developing the concept of a 'Learning Street' as the heart of the school: a multifunctional, central space that promoted social encounters, allowing for the realisation of teaching work in what amounted to an extension of the classroom, and developing activities such as exhibitions, theatre, etc. Through the manipulation and articulation of the classroom module, Hertzberger created a space that would only acquire the sense of a place when it was appropriated by the school community. The transition spaces between the school's interior and exterior were also designed to promote encounters between different members of the school community (students, teachers and parents).

These conceptual principles were disseminated and discussed in Portugal through international publications, as well as in articles published in national journals, being further developed by architects in the rare opportunities that they had to participate in designs for secondary school buildings. The large amount of work that had to be realised obliged JCETS to commission designs on an ad hoc basis from outside architects. Architects such as Januário Godinho, Ruy d'Athouguia, Luís Benavente, Manuel Tainha and Hestnes Ferreira

had the opportunity to design school buildings that deviated from the official solutions suggested by the standard designs and to propose new spatial, typological and constructive solutions. Based on their profound reflections about the programme for school spaces and their requirements, the relationship between the individual and the collective, and the physical and cultural reality of the place where these buildings would be implanted, these architects tested more specialised solutions, promoting spaces where people could meet and interact in circulation areas and entrance halls, redesigning common areas such as the library or amphitheatre as spaces for study and meetings, and enhancing the building's external image and insertion in its urban surroundings.

At the *Escola de Regentes Agrícolas de Évora*[26] (Évora Agricultural Technical School, 1960-66), there was a profound change in the basic design of the models typically applied at technical schools. The joining together of the classrooms along a central axis of circulation, at superimposed levels, was abandoned and replaced by several blocks organised according to axes of circulation that converged to form a central core around which the social spaces were located, promoting encounters and social interaction between the school population. Manuel Tainha experimented with this cluster of classrooms by following the 'Schuster' system'[27], and thus guaranteeing direct sunlight and cross ventilation in these spaces. Albeit with some reservations, this solution was accepted by JCETS because of the need to experiment with an internationally accepted system, in Portugal, in keeping with an opinion that had been issued by the board regarding the preliminary design developed in 1960 (JCETS 1960). This grouping together of the classrooms resulted in the drawing of an incomplete circular line, reinforced by the covered gallery affording access to the rooms and the covered playground, developing a solution that was centred on the use and enjoyment of the open air. According to the architect (Tainha 1960) «the main intention was to use the architecture in order to derive maximum benefit from the singular nature of the place, unique within the splendid whole of the agricultural estate». Situated at one end of the gallery was the library/teachers' room and, at the opposite end, the toilets. At the eastern end of this group of buildings was the body housing the gymnasium and the administrative offices (Figure 17). Also at the *Escola Agro-Industrial de Grândola* (Grândola Agro-Industrial School, 1959-63), the same architect was to propose a unique solution for the organisation of the spaces, in the form of a 'turbine' with four axes that functioned as distribution galleries, with their central core being chosen as the

26 This design followed a specific school programme. Integrated into an environment that consisted of a typical Alentejo *montado* (cork and holm-oak grove and pastureland), it operated as a boarding school. Together with the classroom blocks, the programme also took into account dormitories and other installations designed to support agriculture and cattle-rearing activities.

27 This is a reference to the typological solutions developed by Frank Schuster for the Heinrich-Kromer Schule (1928) in Frankfurt, where access to the classrooms on the upper floor was provided via a central staircase inserted between every two classrooms, allowing for the circulation corridor to be done away with. This solution, which resulted in a smaller area of construction, guaranteed the use of the full depth of the teaching areas of the classrooms and provided both bilateral lighting and cross ventilation.

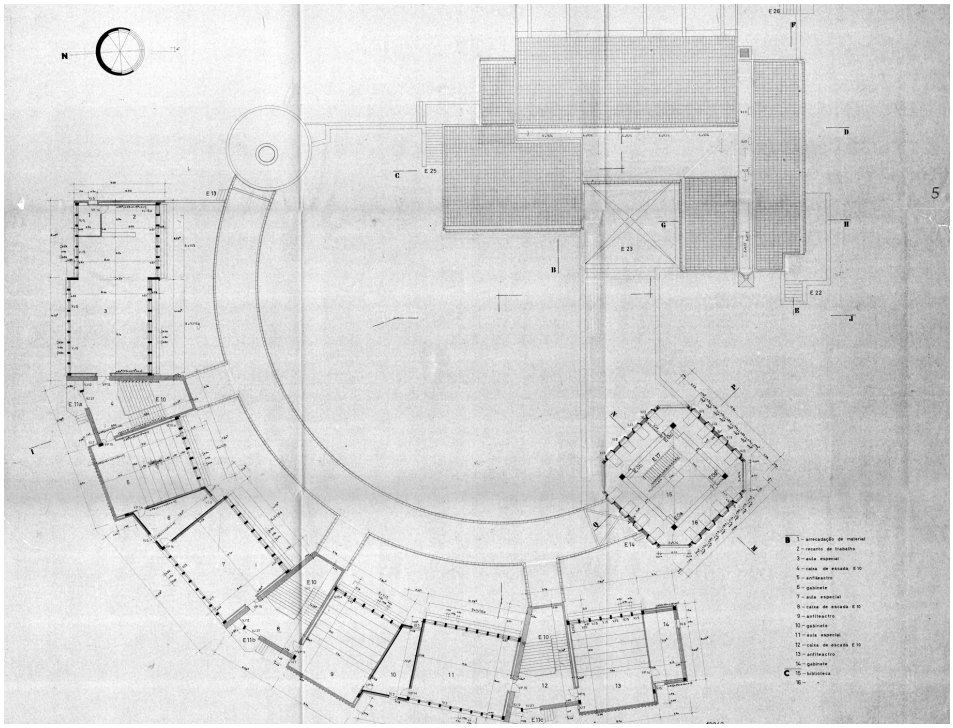

Figure 17: Escola de Regentes Agrícolas de Évora (Évora Agricultural Technical School, 1960-66). Plan of the third floor.

Figure 18: Liceu de Benfica (1974-1978), Lisbon. Exterior.

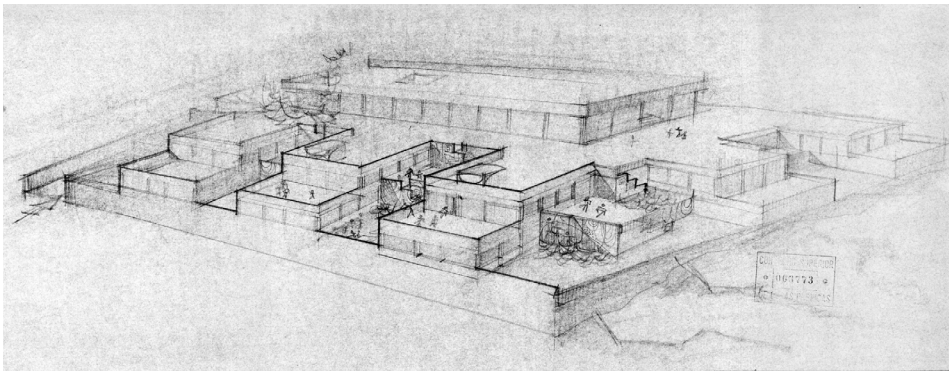

Figure 19: Escola Preparatória Pero Vaz de Caminha (1970). Perspective drawing.

school's common area, which was also open for the use of the community, and their branches serving as the different functional nuclei. The classroom was extended into the outside, renouncing its condition as an autonomous cell and being transformed into a more complex pedagogical and spatial mechanism (Tainha 1965).

Similar to the 1968 Standardised Study for Lyceums, the design for Liceu de Benfica was developed with the idea of making the model repeatable and simultaneously capable of being adapted to the different factors conditioning its implantation in the terrain. Applying the same design principles based on the intensive use of the spaces, the recourse to new building systems, such as the use of prefabrication and the standardisation of the construction elements, and using the same-sized module of 7.20m x 7.20m, it proposed a new solution, with the clear intention of identifying the building with the site on which it was implanted. This spatial and typological solution was based on a group of isolated functional bodies, placed extremely close to one another, which, when projected in cross section were adapted to the difficult morphological conditions of the terrain, recovering the concept of centres of interest, and attributing a new spatiality and functionality to the circulation areas. In urban terms, the mass construction of lyceum buildings of the 1960s (based on the option for the pavilion typology, the resulting scale and an implantation that established little relationship with the surrounding area) stripped the lyceum building of its function as a structural feature and landmark in the urban context, as well as of its symbolic and monumental function. The Benfica lyceum was to regain these functions, presenting itself as a striking feature within the surrounding landscape (Figure 18).

Also unique was the solution developed for the Pero Vaz de Caminha Preparatory School, in Porto, designed by Augusto Brandão, in 1970. The difficult topographical and geological characteristics of the terrain where the school was implanted dictated the need to develop a special design for this building. In basing his design on the same principles as those outlined in the standardised study for the Preparatory School for Secondary Education,

which included reflections upon the aims of this cycle of education and the requirements of its pedagogical practices, the space's capacity for accommodating different groups of students (class, smaller-sized group, student) and the importance of extending the teaching area outside the building, the architect occupied the whole of the terrain with a 'cascade' construction in which the roofs themselves are used as the playground or as a teaching space (Figure 19).

Final considerations

School architecture is conditioned by a range of different factors, including political aspects and educational policies, social questions, economic conditions, territorial and urban measures, pedagogical and curricular aspects, developments linked to hygiene, health and well-being, technical and constructive advances and aesthetic and cultural values. While, at the very first moment of its conception, its design is determined by these conditions, its physical realisation (the building-school) in turn reflects distinct historical moments. A close examination of the changes taking place in lyceum buildings and technical schools, promoted as part of state-sponsored construction programmes in Portugal between the late nineteenth century and the 1970s, enabled us to identify five key-moments that characterised its architecture.

The first period, *1890-1920 The School as an Urban Monument,* was marked by the political context that extended from the end of the Monarchy to the time of the First Portuguese Republic, when the objectives of the lyceum as an institution were established not only in terms of its organisation as a school, but also in the definition of its programme, shaped in particular by the public debate taking place around hygienist questions and matters of school health. The lyceum-institution was to be physically realised for the first time in accordance with the following criteria: teaching spaces that were organised in the form of closed or open courtyards (sanitation of the school space), the leading role attributed to classroom spaces (the class system) that were well ventilated and lit by natural sunlight, the incorporation of the gymnasium space (the practice of physical education), laboratories and science cabinets (the impulse of experimental education) and the inclusion of a set of complementary spaces (all-round education and day-boarding). The buildings that belong to this period are heavily marked by principles of functional, spatial and constructive rationality, being composed in keeping with the standards of the *Beaux Arts*, and by a typological scheme that was efficient in the organisation of its spaces. In urban terms, these buildings accompanied, and sometimes structured, the new plans for the development of the city, occupying privileged locations in the urban environment.

The second period, *1930 The School as a Modern Icon*, expresses the fresh impetus that was given to the construction of lyceums, as decided by Duarte Pacheco, the Minister of Public Instruction, in 1928. It fell to JAEES, a body created in the same year under the supervision of that ministry, to organise calls for tenders for the construction of three new lyceums

and the building of a new lyceum in Lisbon. For this purpose, the standard design for the lyceum was organised into functional cores, establishing its programmatic, technical and constructive requirements for the first time. This represented a first attempt to systematise the programme of lyceum spaces that also corresponded to a functional specialisation (teaching, administrative, sports and social spaces, as well as services and circulation areas) and the definition of different modes of inhabiting the school space (teaching/learning, studying/working, sports, hygiene, socialising, eating, recreation, extra activities). The proposals presented bodies that were autonomous in terms of both their function and volume, built with the new material (reinforced concrete), and designed according to the formal principles of the new architecture. This modern language did not, however, question the building's internal spatiality, at the level of the search for a greater fluidity in the use of space, internal transparency and communication between the inside and the outside, expressing the maintenance of a *grammar of schooling* (Tyack and Cuban 1995), based on a pedagogy that was essentially constructed inside the classroom.

The third period, *1940-1950 The School as an Ideological Representation,* was marked by the political and pedagogical ideals of the Estado Novo, which was now beset with a cultural crisis that would mark the whole decade of the 1940s. The educational policies pursued by Carneiro Pacheco in 1936, which were geared more towards educational objectives (ideological and moralistic) rather than matters of simple instruction, and the impulse given to technical and professional teaching in 1947 by Pires de Lima, were reflected in the implementation of the plans for the building of lyceums in 1938 and technical schools in 1947/48. These schools were designed under the responsibility of JCETS, which meant that this body guaranteed the institutional image sought by the *Estado Novo,* by giving greater importance to the façades of the buildings and ensuring that they were carefully integrated into their urban surroundings. The simplification of the programme and the functional organisation of the lyceum buildings constructed under the scope of the 1938 plan expressed the less rigorous demands of the 1936 reform of that branch of education. Already in the context of the period after the Second World War, the ambitious programme for the construction of technical and professional schools announced in 1947/48 guaranteed the fulfilment of the State's ambitions to strengthen this branch of education as an alternative to the teaching that was provided at lyceums, adapting it to the needs of the labour market. In order to implement this programme, JCETS began to produce designs based on *standardised studies* (grounded in the standardisation of the functional programme and typological, spatial and constructive solutions), which were to remain part of the school architecture produced over several decades. Internationally, new approaches were being tested, based on a rationalisation of the design and construction process, the involvement of multidisciplinary teams and the incorporation of new educational principles, which would only have repercussions in Portugal in the following decade.

This international influence was to mark the period *1960-1970 The School as an Educational Infrastructure*. Study visits, international publications and projects, contact with intergovernmental organisations and, above all, the research undertaken under the scope

of the Mediterranean Regional Project, profoundly influenced the action of JCETS in the field of school architecture. This period corresponds to a time when there was serious questioning of the models for school buildings that had been applied until then by the Ministry of Public Works (MOP) and of their effective capacity to respond to contemporary challenges. The standardisation of programmes for the different spaces made it possible to apply principles of uniformity to the elements of construction, with structural modulation based on the module of the classroom and the standardisation of the solutions in the form of autonomous blocks/pavilions. New learning models that were more active and experimental, and more student-centred, were applied to the design of the initial standard projects, although these were rapidly replaced by strategies centred on the control of costs and the intensive occupation of the school space that would make it possible to respond to the growing numbers of school students. The uniformity and the urban scale of the solution,

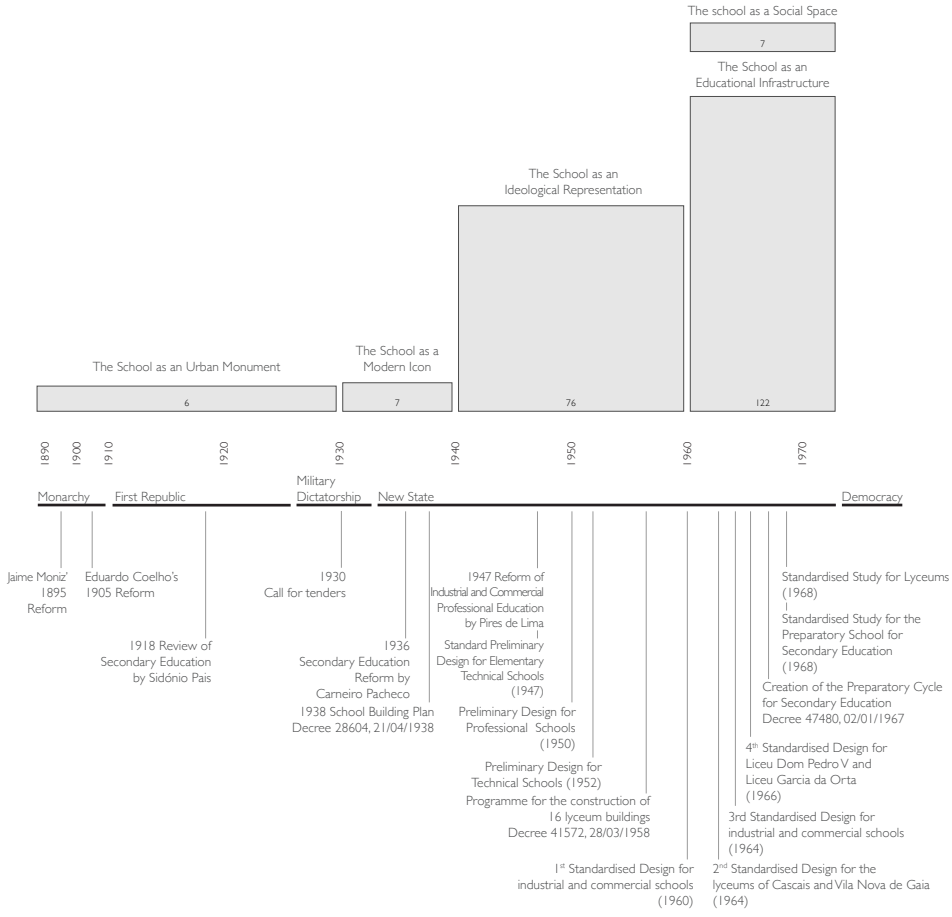

Figure 20: Time line with identification of the four periods and the corresponding number of school buildings.

which was repeated in different cities around the country, gave the programme a less rigid and less formal nature, in keeping with the principle of the "*democratisation of education*", which was being implemented at that time, with equal opportunities and an equal education being made available to all concerned.

In parallel to the activity of JCETS, a limited number of designs for secondary schools were also produced and implemented by freelance architects. These designs resulted in the realisation of new spatial, typological and constructive solutions and marked the period known as *1960-1970 The School as a Social Space*. Their work was based on a series of principles that caused their designs to differ from the official standard design produced by JCETS, which was now almost completely concerned with strategies for controlling the costs of school construction. Such principles included a defence of the contribution of the social sciences and history, the physical and cultural interpretation of the site where the building was to be implanted (including, in this case, the understanding that came from the architectural and technological experience that these architects had), together with a profound reflection on the programme of school spaces whose organisation was supposed to express a child-centred pedagogy, respecting both their individual and their collective needs, as well as to promote new teaching methodologies. There was also a return to a sense of spatial hierarchy, which had become lost from the 1940s onwards, giving primacy to the central positioning of the common and collective spaces, both through the control of the scale and layout of the school spaces and through the enhancement of the school's external image.

The strategies and experiments developed by JCETS between 1960 and 1970 were to be put into practice from the 1970s onwards, at a time when there was a sudden explosion in the student population and a consequent growth in the network of schools, ranging from nursery to secondary education. The need to overcome widespread shortages and respond to the emerging critical situations, due to the new political goals established for education after the revolution of 1974 (namely compliance with the six years of compulsory schooling and the expansion of the rates of school attendance), was to function as an "accelerator" of the work undertaken by JCETS, with the transformations that were taking place through the increased spread of the overall design depending on the capacities of the bodies responsible for school construction and the financial resources that were made available for their completion.

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Espólio José Cottinelli Telmo

Bases para a Construção do Liceu (Acabamentos, Condições Gerais, Condições especiais). Programa Geral da Junta das Construções para o Ensino Técnico e Secundário

School Buildings for Secondary Education: The Architectural Means of Representation of the School Space

Francisco Teixeira Bastos and Ana Fernandes

> *If the designer is no longer a craftsman actually making the object, then he or she must instead communicate instructions to those who will make it. Primarily and traditionally the drawing has been the most popular way of giving such instructions. (Lawson 1997, 24)*

Introduction

In this text, we analyse the architectural design processes of school buildings to be used for the purposes of secondary (lyceums and technical schools) and middle (high-school) education, built between the 1930s and the early 1970s, laying particular emphasis on the period of activity of the *Junta das Construções para o Ensino Técnico e Secundário* (JCETS – Board of Constructions for Technical and Secondary Education) between 1934 and 1969.

The research that we conducted into these design processes, which are now housed in the documentary archives of the *Núcleo de Arquivo Técnico de Construções Escolares da Secretaria-Geral do Ministério da Educação e Ciência* (NATCE-SGMEC – Technical Archive for School Buildings of the General Secretariat of the Ministry of Education and Science), sought to interpret the information available in the archives from two points of view: (I) the organisation of the design process as a logical proposal for understanding more about the planned building; (II) the means of representation used in the drawings, analysed individually and as a whole.

Through the ways in which the processes were organised, we sought to understand whether the solutions advocated, for a certain period and programme, expressed a greater or lesser gap between the ideas proposed and the possibility of their being realised. At the same time, through the means of representation adopted in communicating the architectural designs and construction techniques, the aim was to recognise the degree of completeness, the type and complexity of the representation and the scope of its respective communication, bearing in mind the need for it to be understood by whoever would be constructing the building. With this aim in mind, the design processes prepared by technicians from JCETS and those prepared by architects from outside this body are presented and compared with one another.

This reading and interpretation involved gathering together scattered information and organising it systematically, highlighting the most striking solutions and contextualising them according to the period when they were prepared. In parallel with the architectural designs, the preliminary drafts (when available) were analysed with the aim of understanding possible alterations that were made to the designs at different stages of the process.

The Architectural Means of Representation in the Designs of School Buildings

> *At the heart of successful projects lies the design teams' ability to communicate abstract ideas to site and the ability of those on site to translate information into a physical artefact. (Emmitt and Gorse 2003, 20)*

1. The Designs of the Board of Constructions for Technical and Secondary Education

JCETS[1] played a fundamental role in the study, development and realisation of the country's school network. Between 1934 and 1969, this board developed a set of rules, programmes, standardised studies and standard designs that guided the process for designing school buildings, contributing to the definition of a specific language of its own, which was gradually adopted for design projects in view of the growing need to build new schools efficiently and rapidly, through solutions that were economically advantageous.

It was after the approval of the Plano das Novas Construções dos Edifícios Liceais (Plan for the New Constructions of Lyceum Buildings) in 1938[2] that the technicians of JCETS drew up a document with the guidelines for the organisation and communication of a school building design project, which was entitled *Normas para a Organização dos Projetos* (Rules for the Organisation of Design Projects). The purpose of this document, published in 1941,

1 JCETS was created in 1934 at the Ministry of Public Works and Communications, replacing the Junta Administrativa do Empréstimo para o Ensino Secundário (JAEES – Administrative Board of the Loan for Secondary Education) created in 1928, by Duarte Pacheco. It was disbanded in 1969. On this subject, see Chapter "School buildings for secondary education: their architectural evolution between the late nineteenth century and the 1970s".

2 Decree-Law No. 28604, of 21/04/1938.

was to standardise the design projects for which JCETS was responsible. It established the contents that all design projects were obliged to include, as well as the rules and procedures to be adopted in their preparation, in order to introduce greater rigour into the budget estimates drawn up at the different stages of the project[3]. Although these rules cannot be considered to have been «indisputable and rigid», the compulsory elements for inclusion in the process were supposed to guarantee the understanding of the «complete idea of what is intended [to be built]» and to «allow for the exact pricing of the various work units» (JCETS-MOPC 1941, 77–78).

The design processes were mostly composed of written texts and drawings. The former comprised. a table of contents, project brief, overall costs, programme and/or rules, map of finishes, calculations, building specifications, measurements and budgets. The latter generally contained a table of contents, implantation[4], floor plans, cross sections, elevations[5], zones and details[6], drawings of structures and, sometimes, water and sewage networks, electricity and wiring systems, and the implantation of the furniture. This organisation of the processes was continued throughout the duration of JCETS' period of activity.

This way of organising the architectural projects did not bring any major changes to the model that was in use at the time. In fact, it was in the calls for tenders launched in the early 1930s by the Administrative Board of the Loan for Secondary Education (JAEES)[7] that a set of technical documents was developed for the first time to support the preparation of architectural designs, namely the *General Conditions*, composed of the *Special Conditions and the Bases for the Construction of Lyceums*. The *General Conditions* explained the organisation of the architectural design, which was composed of: the project brief and the stability calculations of the planned constructions; the general plan and the plans of all the floors, including foundations and roofs; cross sections and elevations, and the façades of the buildings; the main decorative details of the main façade; a detailed budget with the respective measurements and price schedules, organised according to the rules adopted by the Department of Public Works. It was further stated that the floor plans and elevations of the projects should be painted in water colours. From the point of view of their subsequent construction, the designs should define modern building processes that made use of customary regional materials.

The design for **Liceu Júlio Henriques** in Coimbra (1931), developed by the architects Carlos Ramos, Jorge Segurado and Adelino Nunes, clearly expresses these recommendations.

3 Drawings now had to be formally accompanied by Building Specifications, Measurements, Prices and Budgets.

4 Also referred to as the General Plan or Outline Plan, on the scales of 1:1000, 1:500 and 1:200.

5 Floor plans, cross sections and elevations corresponded to the overall design project, represented on a scale of 1:200 (preliminary design) or 1:100 (design).

6 The zones (entrance, staircases, classroom, toilets, etc.) were generally presented on the scales of 1:50, 1:20, while the details were presented on a scale of 1:10 and 1:1.

7 JAAES was created by Decree-Law No. 15 942, of 11/09/1928, with the aim of using a loan of 40,000,000$00 in the construction of new buildings for lyceums, as well as the completion of those already begun, repairs to schools already in operation, the purchase of furniture and teaching materials and the installation of student residences.

Figure 1: Liceu Júlio Henriques. Photograph of the building showing the composition of "pure" volumes and the large openings.

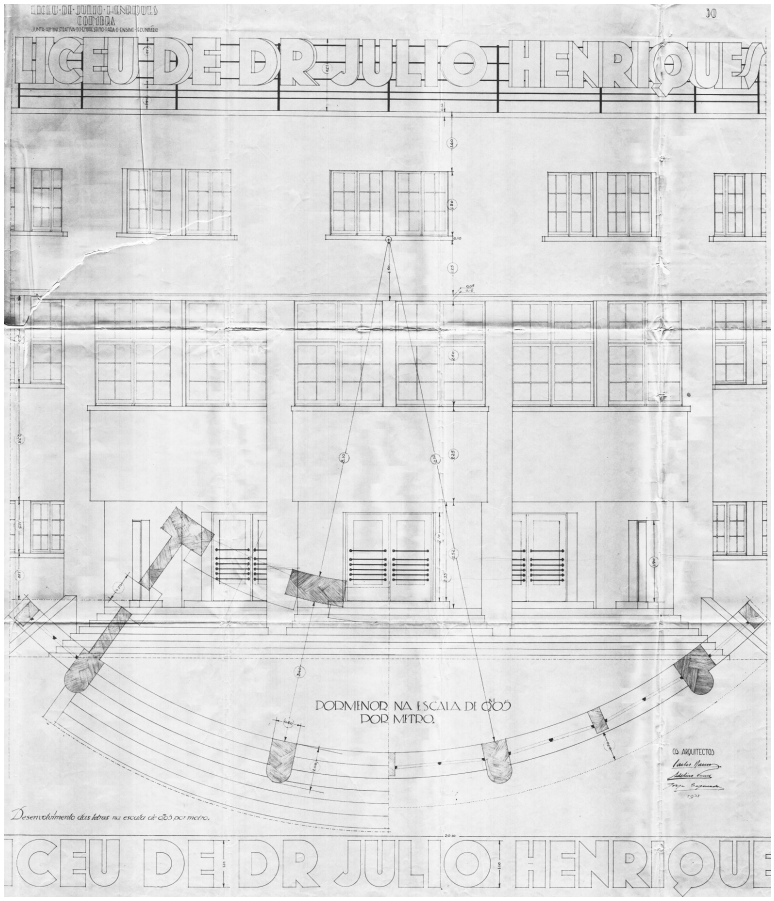


Figure 2: Liceu Júlio Henriques. Overlaying of the representations of the floor plan and elevation for a better understanding of the design. Design Project (1931).

It was organised hierarchically from the general, represented on a scale of 1/100 (floor plans, elevations and cross sections), to the particular (zones, carpentry and metal work), represented on a scale of 1/20, with some details being drawn on a natural life-size scale. Certain features were also represented according to scales of greater proximity, because of the specific nature of the work to be done: the carpentry work of window frames, doors and floors, the metal work of frames, railings and gutters. The drawings exhaustively represent the design in both altimetric[8] and planimetric terms, showing the structural axes, the names of the spaces and the contours of the land in cross section. But the most notable features in terms of the communication of the design are the notations cross referencing different drawings and the inclusion of different scales in the same drawing.

In the rules established by JCETS in 1941, however, one can detect a clear effort to streamline the coordination of the design project with the building systems and components adopted, through the development and cataloguing of standardised solutions, together with the commitment to provide an appropriate and speedy response to the needs and requirements of each project.

In the **Standard Preliminary Design of the Elementary Technical Schools** (1947), the organisation of the design process and its representation followed the guidelines established in the previous legislation and rules. As far as the representation itself is concerned, attention is drawn in particular to the extensive information provided in the notations added to the drawings of floor plans and cross sections[9] , in contrast to those of the elevations: these latter drawings were documents that established the composition of the buildings without the inclusion of any additional information. Again, compliance with the guidelines of this Standard Preliminary Design, which referred to the use of «parallelepiped blocks, which are easily erected», made it unnecessary to specify the construction type, for it was based on the "know-how" of the construction[10] techniques commonly used at that time in Portugal. In contrast to this, the concrete construction elements, carpentry and metal work for the doors and windows and the stonework for the frames of the exterior openings were drawn in great detail, containing technical guidelines that were intended to guarantee an overall understanding of the design project, in such a way that all of the systems functioned correctly and were in harmony with one another.[11] (Figure 2).

The various processes relating to the **Standardised Preliminary Design for Elementary Technical Schools** (1947) demonstrate JCETS' concern with publicising the school buildings, anticipating the presentation of the design by introducing a view of such buildings on the cover of the respective dossiers. (Figure 3 and 4) This same strategy was already being used with regard to the designs for the new lyceums.

8 Except for the elevations that only show the building in the form of a drawing.

9 Except for the roof area, which was represented in cross section only in terms of its outline, without any additional information.

10 Decree-Law No. 36353, of 17/06/1947, considered building projects that obeyed «the types of current construction sanctioned by practice» to be technically standardised».

11 It was their insertion in the parallelepiped boxes that guaranteed control of the school's image.

Figure 3: Escola Industrial Feminina Josefa de Óbidos after its construction: there is a visible contrast between the predominantly horizontal large glazed openings and the tiled roof with eaves, highlighting the compromise between the construction based on the use of traditional methods and the features suggesting a more modern image, as established in the Standardised Preliminary Design.

The practice of developing standardised studies for technical schools, which began with the Standardised Preliminary Design for Elementary Technical Schools in 1947, was continued over the following decades (Vaz 2008). The studies for Professional Schools (1950) and Technical Schools (1952) sought to simplify and control construction costs. However, at the level of the design processes, nothing new was introduced with regard to the detailing of the constructive elements.

In 1958, a new programme was launched for the building of sixteen new lyceums[12]. During the preparatory phase of this programme, JCETS developed an experimental study for Liceu Rainha Dona Leonor in Lisbon (1957), coordinated by the architect Augusto Brandão and the engineer Quadros Martins. Under the scope of this programme, and affording continuation to the model of "standardised studies", new designs were developed, which would be tested in the form of pilot schemes, later converted into a "Standardised Study" and applied on a national scale (Costa e Silva 1971). This was the case with two pilot projects for lyceums and technical schools: *the 2nd Standardised Design for the Lyceums of Cascais and Vila Nova de Gaia (1964)* and *the 3rd Standardised Design for Industrial and Commercial Schools (1964)*, both of which made use of the standards established by the

12 Decree-Law No. 41572, of 28/03/1958.

Figure 4: Cover of the dossier relating to Escola Industrial Feminina Josefa de Óbidos. Design Project (1949).

School Constructions Working Group[13] and the pavilion model. This was followed by the *4th Standardised Design for Liceu Dom Pedro V*, in Lisbon, and *Liceu Garcia da Orta, in Porto (1968)*, the *Standardised Study applied to the Preparatory School for Secondary Education (1968)*, and the *Standardised Study for Lyceums (1968)*. This last design, developed by the team led by the architect Maria do Carmo Matos, was previously tested at the Sintra Lyceum, with later adaptations being made at the level of the applied modulation (Heitor 2014).

The Design Project for **Liceu Rainha Dona Leonor** in Lisbon (1957) was distinguished by the use of new design principles based on the programmatic and structural rationalisation of the project. The architect Augusto Brandão referred to the combination of the «constructive part» and the «aesthetic part» as a positive consequence of the constructive

13 This working group was created under the scope of the Mediterranean Regional Project (PRM) and then later incorporated into JCETS, with the aim of developing research into the school building, which permitted the establishment of rules relating to the process of school design and construction, suitably adapted to the pedagogical requirements then in fashion and compatible with the sums set aside for investment in school construction (Alegre 2012).

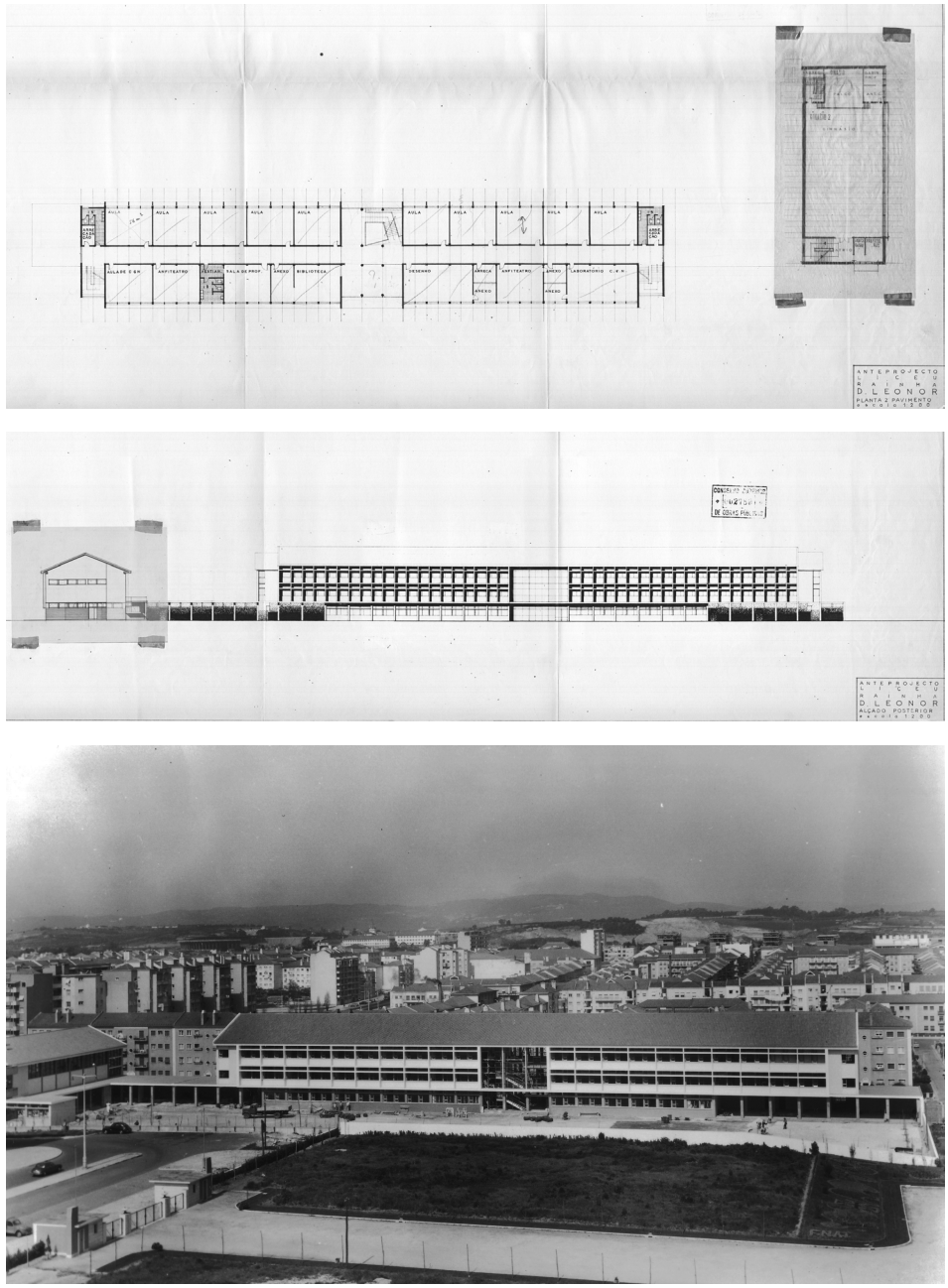


Figure 5: Liceu Rainha Dona Leonor. Floor plan, south elevation and photograph illustrating the importance of structural modulation. Preliminary Design Project (1956).

system adopted (Brandão 1957, 13). The rhythm of the concrete structure organised the building and conferred upon it its «architectural language», a way of «harmonising the building's aesthetic whole with the modern buildings constructed in that area». This structural modulation was created from the classroom module and was clearly represented in the general design (Figure 5).

In its various phases[14], the architectural design project was centred on the representation of the general and detailed drawings of the constructive elements, such as the (wooden, iron and concrete) frames or doors[15]. The main emphasis, however, was placed upon the design of the structures, where the representation of all the elements (pillar, beam or roof truss) is rigorously detailed in order to guarantee a correct geometrical production of the concrete used in the course of the building work, demonstrating an evident coordination between the architecture and the structure. As a complementary measure, new rules of measurement were tested in this project, which were then subjected to successive developments and updates by JCETS.

In the **2nd Standardised Study**, the school building was, for the first time, formally individualised in the form of several pavilions with an identical architectural configuration and constructive solution, which could be adapted to differently configured and sloping terrains. The reinforced concrete portico structure was an integral part of the aesthetic side of the design, which sought to make use of appropriately treated raw materials (JCETS-MOP 1964, 5–7).

In the Preliminary Design, only the floor plans were presented (which comprised the functional distribution and dimensions of the inner spaces and the connections between the separate blocks), together with the elevations, where the sense of composition and repetition were highlighted, without any notes being provided as to the dimensions or the materials that were to be used. The absence of cross sections meant that no indications were given regarding the design of the interior spaces of the different parts of each block (such as the central hall or the auditorium) or the form of the roofs. It was only considered important to represent and communicate the functional details and the exterior appearance of the lyceum for an overall understanding of the design.

The cross sections were only introduced during the design stage of the project, being represented in various scales while containing some notes about the dimensions and some information about the materials to be used. Areas such as stairs and the amphitheatre were represented, while detailed indications were also given about the openings. (Figure 6). The structural design, developed by technicians from JCETS, was completely controlled and fully detailed in the various sections of the constructive elements, since this was crucial for the building's architectural expression. With a highly rational use of materials and an economy of means, a type of school building was represented that could be easily understood and replicated all across the country.

14 Original preliminary design for expansion in 1959 and designs for expansion in 1966-67.

15 This observation is constrained by the fact that the drawings of the original architectural design do not exist in the archives..

The **4th Standardised Study**, developed in order to rectify the construction problems of the 2nd Study, was based on the same scheme of «small blocks, at different heights, with an identical architectural configuration and an identical constructive spirit» (JCETS-MOP 1966, 8). The representation of the design contained more extensive notes and a greater level of detail, with the importance of the structural design being maintained as the defining element of the proposed architecture and of the way in which the building would be constructed in material terms. (Figure 7).

The **Standardised Study of Lyceums** (1968), coordinated by the architect Maria do Carmo Matos defended the adoption of modular coordination principles, based upon a pavilion typology. The design was guided by the «[…] great repetition and flexibility of construction elements […] through their standardisation and the reduction in their number […]» (Matos 1969, 17), which determined a modular rationality for the structure, frames, doors and types of wall to be used.

In the design process, the drawings were organised in accordance with the operational phases, increasing the level of detail, with an indication of the quantities of the elements that would have to be ordered. Attempts were made to coordinate all the drawings and written texts in order to construct a «[…] technically correct» design (Matos 1969, 32). The design therefore sought to respond to all the technical determinants that had been studied over the last decade by JCETS. This gave the organisation and representation of the design an exhaustive technical sense, with the aim being to provide an integrated representation, in which the meshes for the implantation of the structure were shown together with a codification of pillars, doors and openings in the general drawings and the construction details. (Figure 8).

In this essay, which sought to use the design project to control all the operations of the building work and the consequent costs, the various components of the design were systematised in advance in accordance with the structural proposal for the organisation of building projects presented by Reis Cabrita (1974) in "Regras para a elaboração de projecto" (Rules for the Preparation of a Design Project) and "Método e Modelo do Projeto de Comunicação à Obra" (Method and Model for Communicating the Design to Site)[16].

Finally, the design processes that followed the **Standardised Study for the Preparatory School of Secondary Education** (1968), developed under the coordination of the architect Augusto Brandão, normally included the project brief, the programme sent out by the Directorate of Services for the Preparatory Cycle of Secondary Education, the calculations, building specifications, measurements, measurement charts, budget and drawings of the architecture and of the "reinforced concrete".

16 «The critical aspects of the problem of preparing designs for buildings are fundamentally: a) guaranteeing the coherence of the information […]; b) suitably adapting the division and gathering of information […]; c) providing more exhaustive and detailed information to the builder and the inspectors […]» (Cabrita 1974, 3–4)

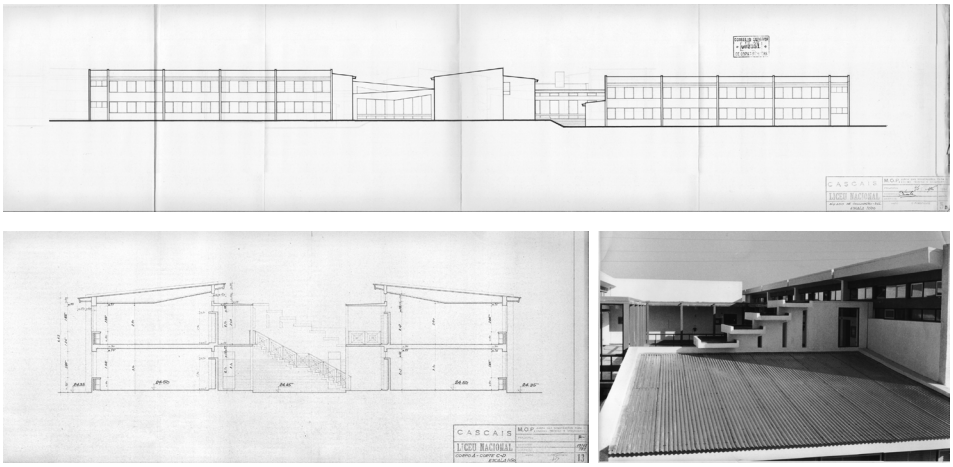


Figure 6: 2nd Standardised Study. Elevation, cross sections and detailed photograph of the Cascais Lyceum (1964).

Figure 7: 4th Standardised Study. Photograph of Liceu Garcia de Orta.

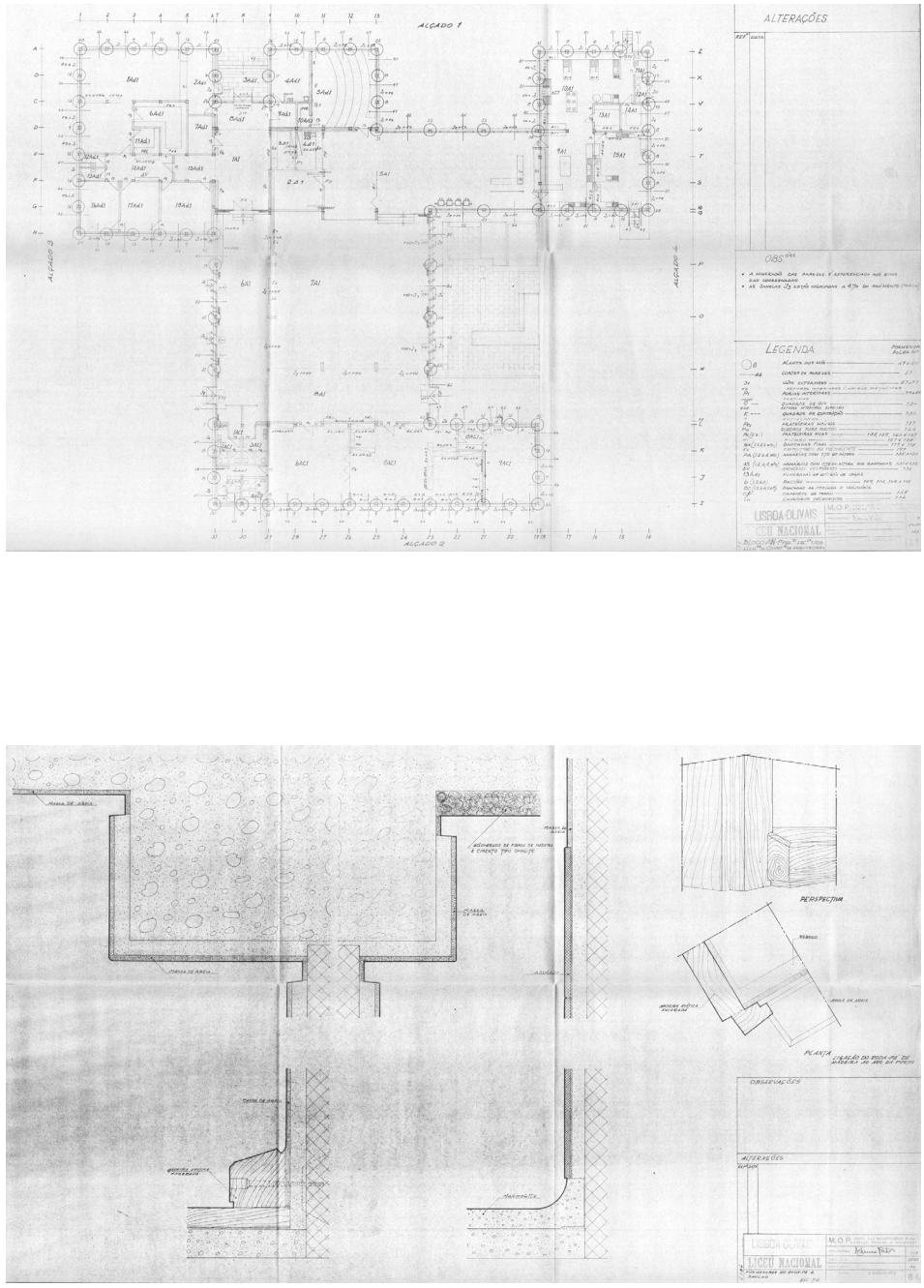


Figure 8: Two levels of information in drawings of the Olivais Lyceum (1969).

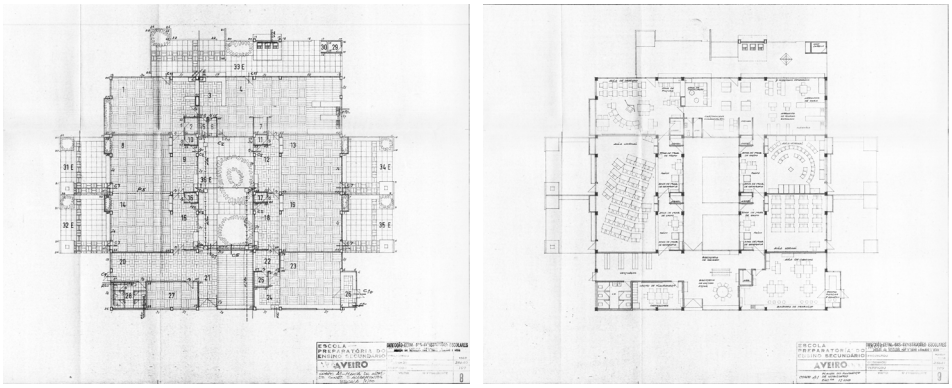


Figure 9: Plans of the construction and finishing elements and furniture of the Preparatory School of Secondary Education in Aveiro (1968).

A set of identical plans were presented with structured and codified information, depending on the final purpose of the construction: flooring, roof, construction and finishing elements, and furniture. (Figure 9). In the case of these latter two items, the reading of the interior/exterior spaces is made clear, both through the distinctive identification of the flooring and the characterisation of the garden areas, and through the filling in of the structural elements in cross section.

The elevations and cross sections were sometimes presented on the same sheet, with the latter being cross referenced occasionally. Attention is drawn, in this study, to the exhaustive definition of the classroom, from the scale of the whole area to the smaller details and the fixed furniture[17] (Figure 10).

2. The designs presented by Architects from Outside the Board of Constructions for Technical and Secondary Schools

> *Due to the great volume of work, it was necessary […] to resort to architects from outside the Board […]. The use of these architects […] ceased […] to be so satisfactory due to the fact that an ever greater difference was noted in comparison with the results obtained with the studies drawn up by the Board's technicians, whose specialisation and expertise in this area was already becoming manifest […]. (JCETS-MOP 1960, 2)*

17 Detailed instructions were given about cupboards, the dais, the wooden bench, the office counter, cloakrooms and the kitchen worktop.

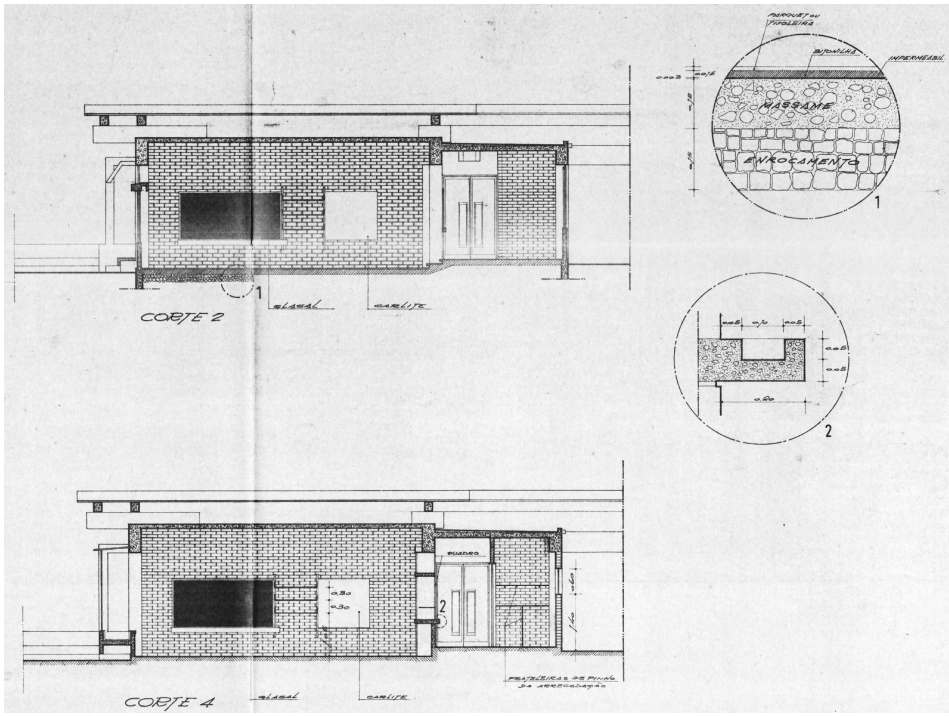


Figure 10: Partial drawing, details of a classroom, idem (1968).

During JCETS' period of activity (1934-1969), special design projects were occasionally commissioned from architects from outside that body. Although such designs were relatively few in number, their analysis here is justified with the aim of identifying the consistencies and divergences between these and other projects developed by JCETS.

Under the scope of the 1938 Plan for the *New Constructions of Lyceum Buildings*, the architect Januário Godinho was invited to design **Liceu Gonçalo Velho** (1942), in Viana do Castelo. The programme and organisation of the process followed the *Rules for the Organisation of Design Projects* and the architectural design was accompanied by the projects for the electrical installations and for the reinforced concrete and iron structures, as well as an in-depth geological study.

The relationship between the drawings and the building specifications and measurements guaranteed the compliance with the budget imposed on the building operations[18]. This choice determined that the overall design would contain all the codes of representation, as well as cross- referencing between drawings and distinct specialities.

18 «[…] the system of measurement and the building specifications are so painstakingly detailed […] that there is entirely no need for the project brief». However, the brief itself mentioned «[…] the simple character [that is closely linked to the rational function of the floor plan and [that] is in perfect harmony with the place […]» (Godinho 1942, 33)

Figure 11: Detail of the vestibule. Design Project (1942).

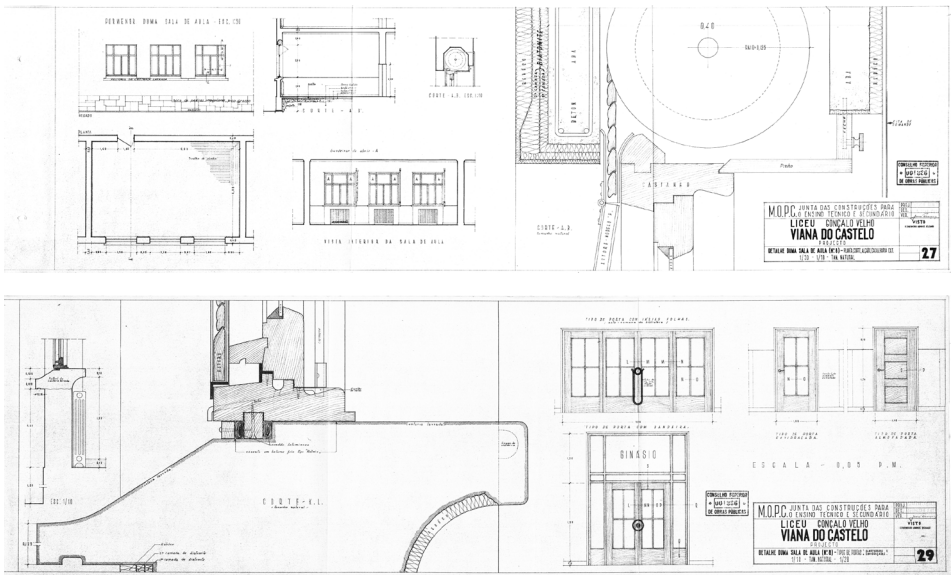


Figure 12: Liceu Gonçalo Velho. Details of a classroom: flooring, stonework, carpentry and integration of the heating system.

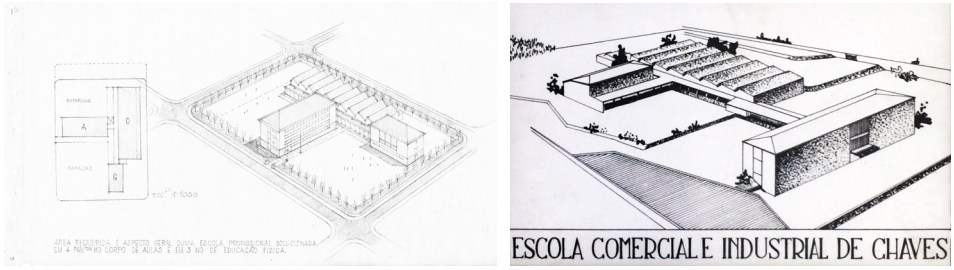


Figure 13: Overall perspectives of the Study on Technical Schools and the Design Project by Januário Godinho.

In the same way, for the «details for the arrangement of the different parts» imposed by the Rules, the architect opted for the use of various scales of representation, joining them together on the same sheet for a complete understanding of the way in which the building should be constructed.

Attention is also drawn to the care that was taken over the areas of the "entrance" and the "classroom". The main entrance not only related to the representation of the façade, as was the case in the other designs prepared by JCETS, but also to the intermediary area between the school and the city (Figure 11). A detailed description was made of all the constituent parts of the classroom (Figure 12). In this way, the architect demonstrated his concerns with ensuring that the finished work remained faithful to the design, as well as his profound knowledge about construction work, with the burden being placed on the contractor to guarantee the presence of technical experts at the building site who were capable of reading and understanding this information.

The design of **Escola Industrial e Comercial de Chaves** (1958), which was also commissioned by JCETS from the architect Januário Godinho, introduced variations and improvements to the building's spatial organisation, with a clearly modern image (Figure 13).

In the organisation of the design, the decision was made to represent all the bodies together in the general drawings, establishing the various connections that were sought for the school. The variations that were proposed in relation to the models adopted by JCETS

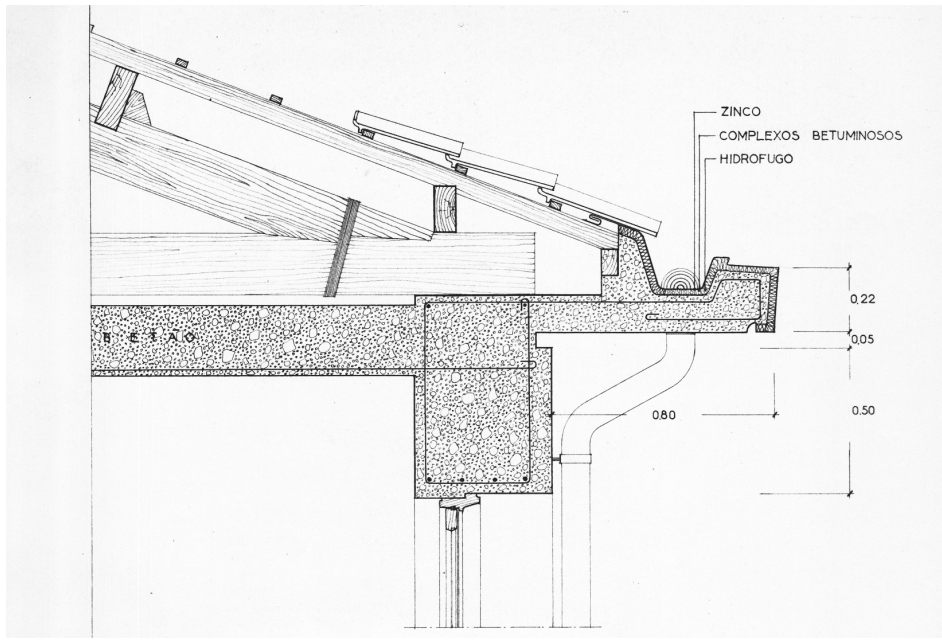


Figure 14: Escola Industrial e Comercial de Chaves: detail of the cornice. Design Project (1958).

were accompanied by detailed explanatory drawings, as was the case with the replacement of the concrete frames with wooden and iron frames and the alteration of the finishing cornice of the buildings, with these variations being based on the transformation of the traditional building standards into an innovative proposal and a more modern image for the school (Figure 14).

Under the scope of the plan for the building of new lyceums launched in 1958, the architect Ruy d'Athouguia was invited to design **Liceu Padre António Vieira**[19]. In the project brief of the Preliminary Design, Athouguia criticised the type of "school building" that JCETS was seeking to promote, preferring, instead, to explain the architectural nature of his proposal[20]. In the same document, the environmental conditions of the classroom were given greater value, underlining the importance of natural lighting, the way in which the design sought to control this in the various spaces and its influence on the architectural and constructive solutions.

The application of these principles in the preliminary design was made clear in the representation of the general design, which was centred on the geometrical clarity of the spaces and the structure: in the floor plan, in the interior compartmentalisation and in the cross sections and elevations, in the composition of the openings, and in the form and expression of the constructive elements and finishes. But it was, for example, through the inclusion of a view from the street and a study of the exposure to the sun that the ideas that he was trying to put forward were defended (Figure 15).

In the design project, the general drawings reinforced the architectural option that was taken for the functional organisation, formal definition and material expression of the building, in parallel with the chart of the finishing work and the detailed drawings. In direct response to the rules and standards, drawings were included for each of the different areas (stairs, classrooms, laboratories, bathrooms), in which the introduction of perspectives was fundamental for their understanding. In the same way, the constructive details defined solutions and systems that were different from the standard type of construction, namely for the roof of the body housing the classrooms, which was built in a concrete structure covered with zinc[21] (Figure 16).

Following the same guidelines as his peers, the architect introduced an innovation into the way that the design was communicated, using elements of perspective to explain the drawings.

19 With a Preliminary Design Project from 1958 and a Design Project from 1961.

20 «We sought to avoid resorting to pseudo-monumental effects and instead resorted to the game of architectural composition: the contrast in the volumes, the empty and filled spaces, the light and shade and the materials» (Athouguia 1958, 4).

21 In the General Rules for the Installations of Lyceums, it was established that: «in the bodies of the buildings, for both technical and economic reasons, preference will be given to the use of a tiled roof […] and, in the exceptional case of wishing to use a flat roof, that solution will have to be justified […] through the presentation of the respective details that guarantee its absolute effectiveness»(JCETS-MOP n.d., 1).

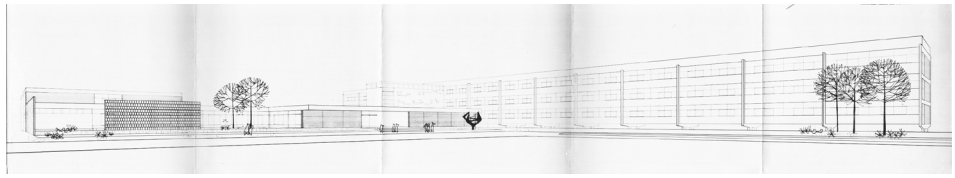


Figure 15: Liceu Padre António Vieira. View from the street, emphasising the relationship between the volumes of the whole building. Preliminary Design Project (1958).

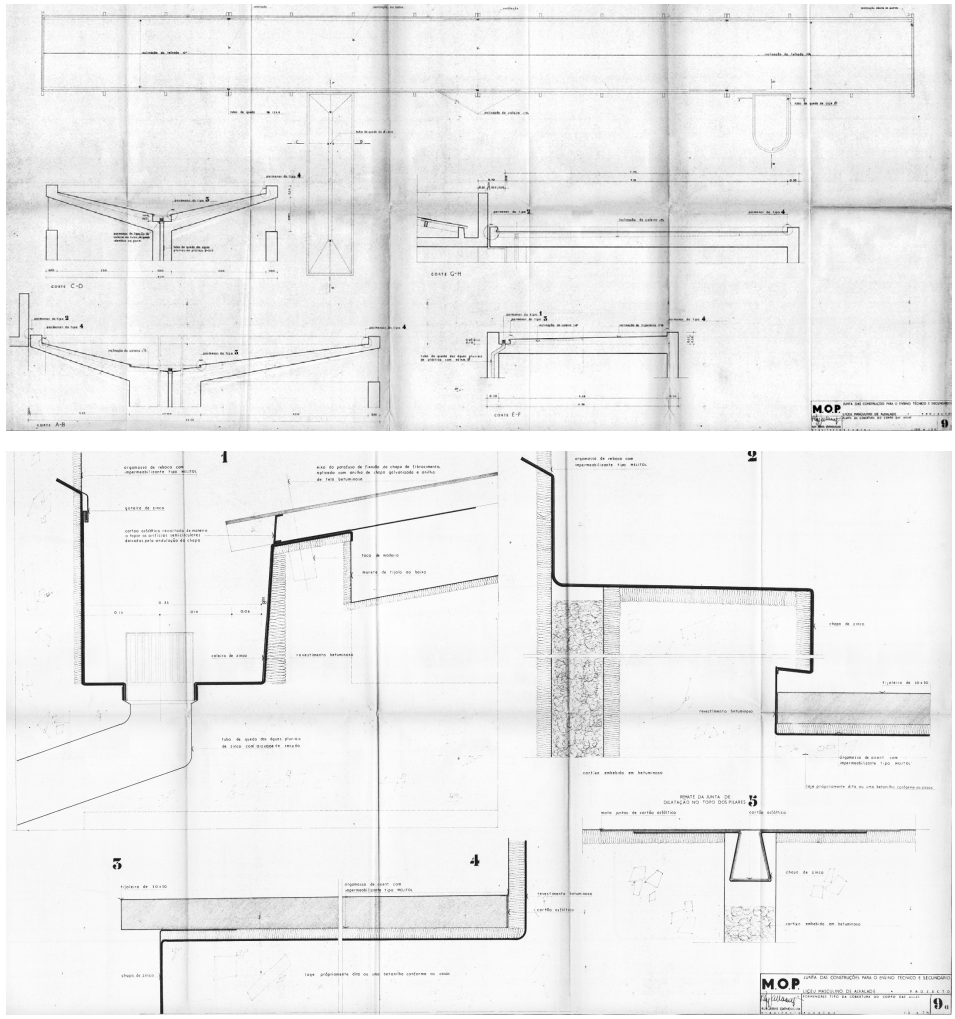


Figure 16: Liceu Padre António Vieira. Floor plan, cross sections and details of the roof of the body housing the classrooms. Design Project (1961).

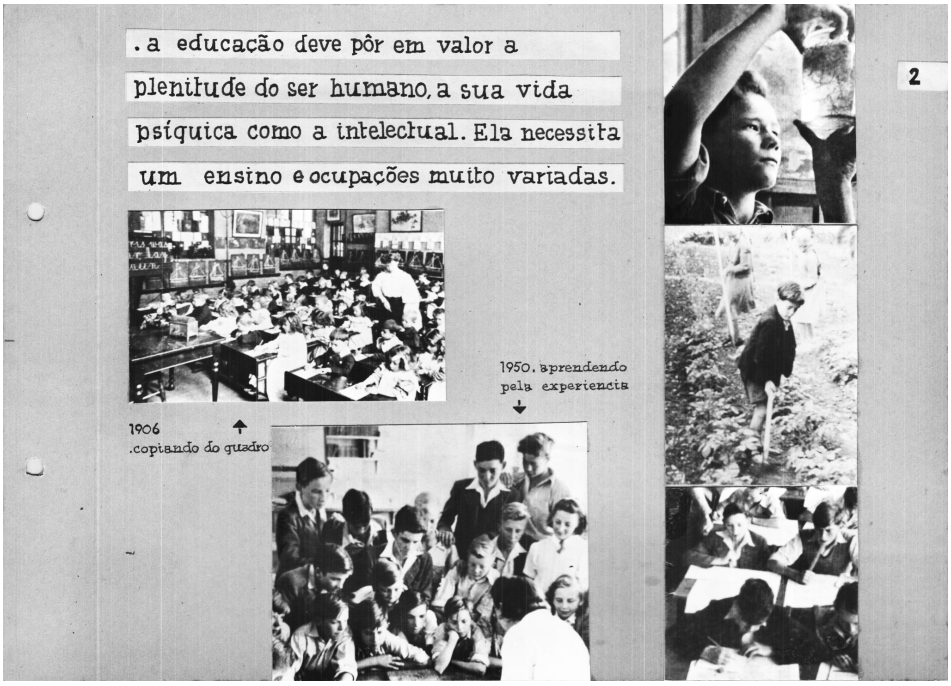


Figure 17: Summary of the inspiring principles. Preliminary Design Project (1958).

But it was, above all, in the designs commissioned from the architect Manuel Tainha for **Escola Industrial e Comercial de Castelo Branco** (1958) and for **Escola de Regentes Agrícolas de Évora** (1960) that a greater deviation from the rules and standards was to be noted.

In the design for **Escola Industrial e Comercial de Castelo Branco**, a series of texts and illustrations were presented. These were inserted in the project brief, in which Tainha reflected on the role of the school and explored different pedagogical models through the use of photographs of the architectural model and graphic compositions (Figure 17).

The drawings are rich in materials and environments, in their expressiveness and their communication of the architectural design project, which incorporates the external landscaping arrangements in both the general plan and the ground floor plan. The perspectives promote the understanding and characterisation of the intended environments, explaining and justifying the concepts of «familiarity and intimacy» introduced into the project brief (Figures 18 e 19). This design ended up not being constructed and was replaced by a design elaborated by JCETS' technical team.

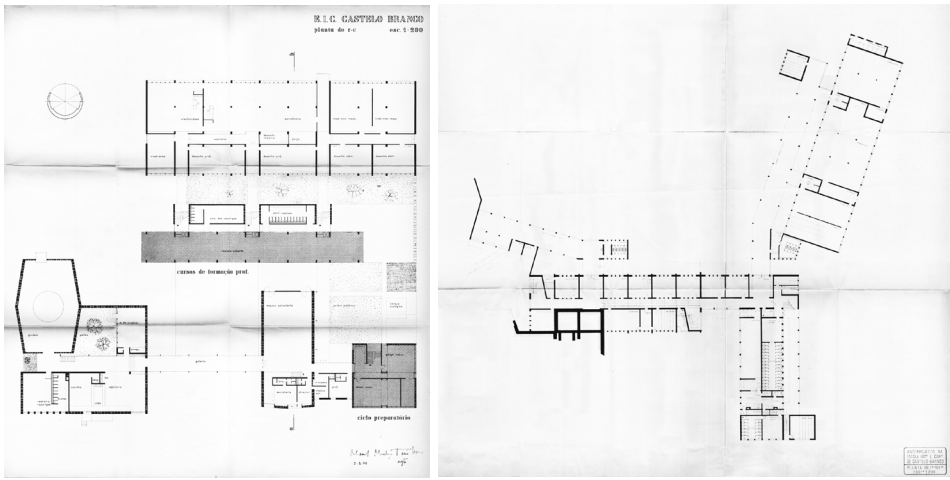


Figura 18: Escola Industrial e Comercial de Castelo Branco. Comparison between the plans of the unbuilt preliminary design (1958), left, and the built design (1958), right.

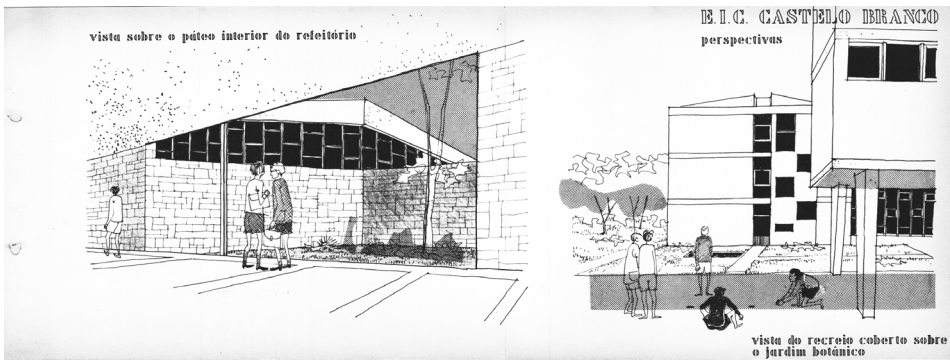
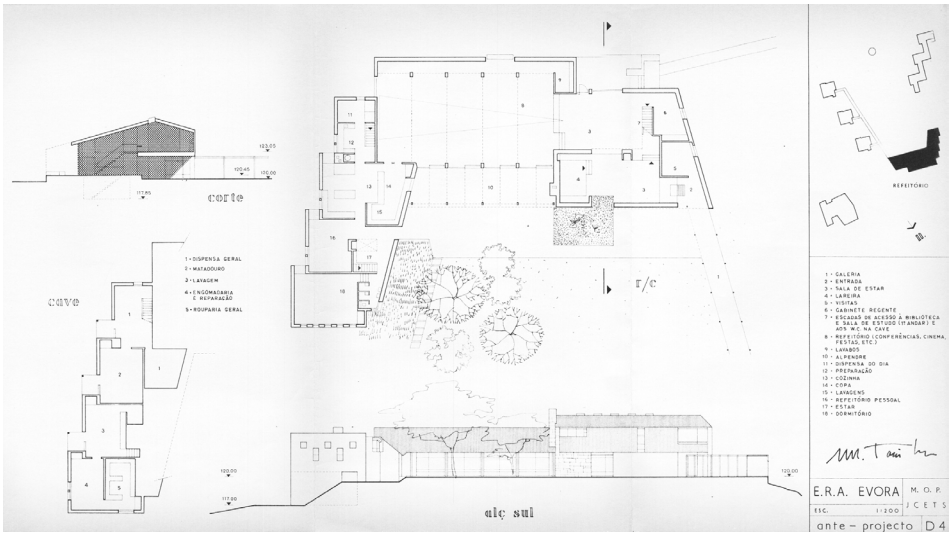


Figure 19: Escola Industrial e Comercial de Castelo Branco. Perspectives. Preliminary Design Project (1958).

The design for **Escola de Regentes Agrícolas de Évora** is notable for the diversity of its drawings and its methods of representation[22]. The complexity of the design and of the architectural forms that it proposed were expressed in the drawings through a range of different representational approaches. The drawings were organised according to the various buildings that compose the school.

22 In the project brief, Tainha constructs a concise and pragmatic discourse, supported by his research into School Architecture, to justify the choices that he made in the design.



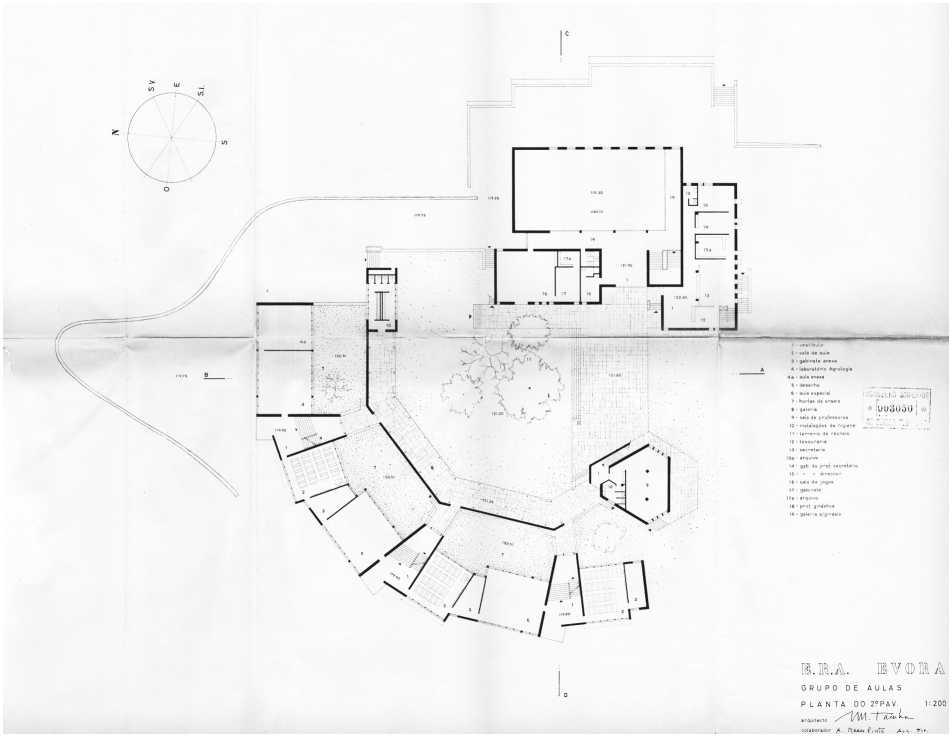


Figure 20: Escola de Regentes Agrícolas de Évora. Refectory, Preliminary Design (undated), and the group of classrooms, plan of the second pavilion, Preliminary Design Project (1960).

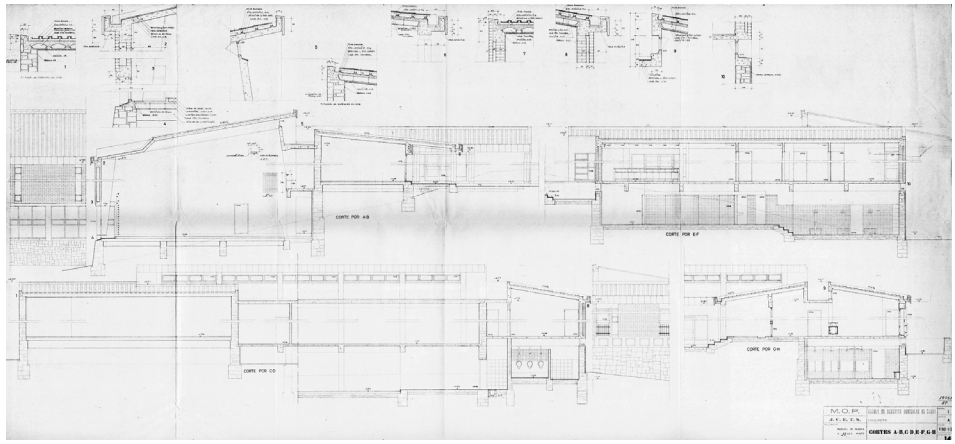


Figure 21: Escola de Regentes Agrícolas de Évora. Cross sections on a scale of 1:50 and details on a scale of 1:20. Design Project (1969)

A freer representation was adopted in the Preliminary Design, incorporating various projected views in the same drawing, with the representation of the outside spaces, shades and materials (Figure 20).

The representation of the design includes several scales on the same sheet, allowing for closer approximations to the drawings and the presentation of constructive details, with attention being drawn to the cross sections presented (Figure 21).

The detailed presentation of the prescribed constructive solutions in direct relation to the cross sections reflects the need to clarify the reading of the design through the introduction of uncommon and complex architectural solutions.

Although it was produced after the period of activity of JCETS, it is important to mention here the design for the **Liceu de Benfica** (1976) by the architect Raúl Hestnes Ferreira, because of the unusual nature of the process of the design's development. In the Preliminary Design, preference was given to a summary representation that did not contain any notes. First of all, the simplified and more accessible technical representation showed the school in its urban setting, and only afterwards was it defined as a whole, showing the various blocks that formed the school.

The means of representation of the overall design showed great visual clarity, allowing for an easier understanding of the spaces and their connections between one another, the forms and volumes of the blocks, of the whole group that these formed together and of their articulation with the surrounding urban environment. For this purpose, privilege was given in the drawings to the treatment of the line and the patches (in elevation) in detriment to the annotations, which were limited to the definition of the spaces. The design process was completed with the presentation of the specialities that were fundamental for the building's functioning and the introduction of the design for the exterior arrangements (Figure 22).

Figure 22: Liceu de Benfica. General plan of the exterior arrangements. Design Project (1976).

Conclusions

The analysis of a representative sample of the architectural design processes of the buildings to be constructed for technical, lyceum and preparatory education, currently housed in the documentary collection of NATCE-SGMEC, has made it possible to chart the evolution that took place in terms of the organisation of the processes, the written texts and drawings, and the means of representation adopted for communicating the information that they contained. It further made it possible to observe that this renewal of the architectural language called for the designers involved in these projects to make an additional effort in their instructions and their explanations of the design processes. The further removed that the ideas proposed by the designers were, both from the "know how" embedded in the technologies of traditional construction and from the models and practices adopted by the public bodies responsible for school constructions, the greater was the need to explain the systems idealised during the design stage, through the reinforcement of information and the recourse to different strategies of representation, particularly in the form of highly detailed drawings, which facilitated the understanding of these processes.

The first rules introduced by JCETS and published in 1941 show the efforts that were made to standardise the organisation of designs. Over the period of JCETS' existence, these standards were gradually replaced, either by other standards or by Studies, which were more precise and focused on the standardisation of designs, particularly with regard to the architectural, structural and economic aspects of the building work. This meant that there

were very few constructive representations included in most designs, since the constructive solutions that were adopted in this area were in line with current building practices, which were not supposed to be altered.

The principle used in the organisation of the design processes led to an ever greater convergence of designs, moving from the general to the particular (or the detail) at three levels. Firstly, the building or the group of blocks that formed the school was represented; secondly, the school was defined in spatial and functional terms; and, finally, the zones or the (constructive) elements that were considered most significant were represented. The way in which each designer dealt with these three levels of representation demonstrated their knowledge of the school programme and their skill in organising the spaces and linking them together. At the same time, it demonstrated the knowledge that they had of construction work and their capacity for representing it for the building of the proposed architecture, as well as the extent of the technical and constructive innovativeness that was implicit in this.

In comparing the designs prepared by architects belonging to the technical team of JCETS with those drawn up by architects commissioned from outside the Board, what was clear, on the one hand, was the compliance of all the designers with the models and the rules introduced by the successive regulations that were published, and, on the other hand, the different positions adopted by each group in relation to the architectural language that they used: more conservative in the case of the former and freer in the case of the latter.

The designers that worked for JCETS showed, in the older cases, the importance of representing those spaces of the building that had a certain symbolic value, such as the main façade or the entrance. Gradually, greater importance began to be given to the technical representation of (constructive) solutions, implemented in the construction of school buildings in the 1960s and 1970s. They were also the group that best mastered the rules and standards, since, in many cases, they themselves were the tenderers for the contract. The designers who came from outside the Board tried to include in their designs a reflective and critical approach to the architectural realisation of the school programme and some technological and constructive innovations, as defended by the actual representations themselves. Initially, these innovations were achieved through the modern language of the architecture, and then later on through the proposal of exceptional configurations, spaces or connections between the buildings, and, finally, through the inclusion of exterior arrangements in keeping with the logic of the design.

Regardless of the advances that had been made in constructive and technological terms at the date of the design of each school, the buildings designed by the architects working on a freelance basis distanced themselves from the norm, as far as their organisation and graphical representation were concerned, with an emphasis on the representation referenced between different drawings. Furthermore, over time, there was a greater depth afforded to the representation of the design, common to both groups, both in the type and scale of these drawings, as well as in the organisation of the design. This greater depth was accompanied by an increase and a greater definition of the designs for the specialities.

In conclusion, the standardisation of the school building projects focused primarily on the representation and organisation of their design, later being directed towards an extensive programmatic and distributive definition, and ending by assuming a standardisation of modular constructive systems, made possible by prefabrication (with reinforced concrete), and shifting from everyday construction to another form of construction with an industrial origin. In this process, it fell to the designers to manage the compromise between the architectural aesthetics and the consequent use of the construction systems. Whereas JCETS' designers largely based their work on everyday construction, and later on the information and experience of the manufacturer, transferring this information to the representation of their designs, the designers who came from outside the Board based their work on the research that they conducted into international models and their respective experience of building work, finding themselves obliged to discover new forms of representation to justify the solutions that they would ideally like to construct.

Processes Consulted

Developed by JCETS-Ministry of Public Works

Estudo para Escolas Técnicas Elementares. Anteprojecto Tipo (1947)
Estudo para Escolas Profissionais. Anteprojecto (1950)
Estudo sobre Escolas Técnicas (1952)
1º Estudo Normalizado para as Escolas Industriais e Comerciais, denominado de Projecto Mercúrio (1960)
2º Estudo Normalizado para os Liceus (1964)
3º Estudo Normalizado para as Escolas Industriais e Comerciais (1965-66)
4º Estudo Normalizado para os Liceus (1966)
Estudo Normalizado dos Liceus Tipo (1968)
Estudo Normalizado para a Escola Preparatória do Ensino Secundário (1968)
Escola Industrial Josefa de Óbidos, de José Costa e Silva (1947)
Liceu Rainha D. Leonor, de Augusto Pereira Brandão (1957)
Escola Industrial e Comercial de Castelo Branco, de José Costa e Silva (1959)
Escola Industrial e Comercial de Torres Vedras, de José Costa e Silva (1960)
Liceu Nacional de Cascais de Augusto Pereira Brandão, António José Pedroso e José Sobral Blanco (1964)
Liceu Nacional D. Pedro V, de João Teixeira de Abreu Bernardes de Miranda (1966);
Escola Preparatória de Aveiro de Augusto Pereira Brandão (1968)
Liceu dos Olivais, de Maria do Carmo Matos (1968);

Developed outside JCETS-Ministry of Public Works

Liceu Júlio Henriques, de Carlos Ramos, Jorge Segurado e Adelino Nunes (1931);
Liceu Gonçalo Velho, de Januário Godinho (1934-43);
Liceu Padre António Vieira, de Ruy Jervis d'Authougia (1958);

Escola Industrial e Comercial de Chaves, de Januário Godinho (1958);

Escola Industrial e Comercial de Castelo Branco, o Anteprojecto de Manuel Tainha (1958);

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School Buildings for Secondary Education: Evolution of the Principles and Requirements of Environmental Comfort

Patrícia Lourenço and Maria Bacharel

Introduction

This chapter examines the evolution of the principles relating to the environmental comfort of school buildings for secondary education (lyceums and technical schools) and middle education (further education colleges), and the public requirements that were imposed on the construction of such schools between the late nineteenth century and the beginning of the 1970s.

The chapter is divided into two parts. In the first part, we introduce the notions of environmental comfort, developed in keeping with national and international guidelines, while mention is also made of the application of these principles to school buildings throughout the period under analysis. In the second part, we illustrate the evolution that took place in relation to the question of environmental comfort in Portugal, based on a sample of buildings that are representative of the main periods in the design of lyceums: Liceu Passos Manuel and Liceu Camões, spanning the period from the end of the Monarchy to the early stages of the First Portuguese Republic; Liceu Diogo de Gouveia, a lyceum from the modern period of the early 1930s; Liceu Rainha Dona Leonor and Liceu Padre António Vieira, from the 1960s, designed by the team from the *Junta das Construções para o Ensino Técnico e Secundário* (JCETS – Board of Constructions for Technical and Secondary Education) and by Ruy d'Athouguia (an architect from outside JCETS) respectively; and Liceu Dom Pedro V, a standardised pavilion-type design, developed by Augusto Brandão (JCETS).

Based on the schools chosen, the designs and their project briefs were analysed, while, at the same time, a reading was made of the main technical guidelines recommended at the time when these same designs were being developed. From the analysis of the designs and from visits to the schools, it can be understood how the different principles were applied relating to the ventilation of school spaces, their exposure to the sun, natural lighting, the orientation of the buildings, etc.

Some general conclusions are drawn relating to the visits and the measurement of parameters of environmental comfort, undertaken at the schools with the aim of promoting the environmental comfort and sustainable use of the buildings, as well as responsible rehabilitation practices, considering that all of the selected schools are still in use today.

Environmental Comfort: the Main Concepts and their Evolution

A documentary analysis of the principles of environmental comfort at schools during the twentieth century, namely in the period established for this analysis, demonstrates that until the last decades of the twentieth century there were few legal requirements in place.

The first international reference to environmental comfort in school buildings appeared in 1874, with the publication of "School Architecture. Being Practical Remarks on the planning, designing, building and furnishing of school houses" written by the architect Edward Robert Robson. Based on the survey and study of hundreds of school buildings in Europe and the USA, Robson wrote about the conditions of use of school buildings, relating their architectural expression and corresponding spatial, formal and constructive design with their environmental comfort. He highlighted their heating and ventilation, quantified their lighting levels and discussed the solar orientation that was most suitable for the different functional areas.

In the early twentieth century, in keeping with the international line of hygienist intervention in defence of both public and school health[1] (Baudin 1907, Dufestel 1909) and the principles defended by the New School Movement, there were several international rules that emphasised the improvement of the material and environmental conditions of school buildings and, in particular, the levels of comfort to be considered in classrooms. It was proposed that the classrooms should be reorganised into blocks that opened onto courtyards, in order to allow for better conditions in terms of ventilation and natural lighting. The quality of natural ventilation was also guaranteed by the width of the classrooms. Requirements were also stipulated for the regulation of mechanical ventilation and heating systems, cross ventilation, sanitation, the number of students per classroom, the volume of air per student, minimum ceiling height, classroom shape, the position of windows and doors with natural lighting (to the left of the student), type of construction, solar orientation and the materials to be used (Alegre 2012).

1 In the early twentieth century, there were five international conferences on school hygiene (Nuremberg – 1904, London – 1907; Paris – 1910; Buffalo – 1913 and Brussels – 1915), which were decisive for the development of health and environmental comfort requirements in schools.

In Portugal, these orientations were mirrored in various studies about school hygiene, with attention being drawn to the work of the hygienist Doctor Sacadura (1906) "Breves Considerações sobre a Hygiene das nossas escolas". In the chapters dedicated to the school building, guidelines were presented about the criteria that should govern the choice of the land on which the school was to be built, the way in which the respective plot was to be occupied, the measurements of the classrooms, the spaces for circulation and the building materials, as well as recommendations for the production and layout of the school furniture. Special attention was given to the air quality and lighting of the different spaces by the hygienist doctors (in terms of quality), describing the appropriate cross ventilation, the openings to the outside and the care that should be taken in the implantation of the schools on salubrious sites as measures to be adopted. The lighting should preferably be natural and unilateral (coming from the left), in order not to hinder vision, with the classrooms being provided with wide and spacious windows, placed at a height of 1.5 metres above the floor. The classroom should have a rectangular shape, so that the sun's rays could enter through one of the larger sides of the rectangle, thus making it possible to light the whole room. The dimensions of the classroom should be calculated by taking into consideration the number of students using the room, in such a way that each student would have a minimum of 1.25 square metres available.

The publication *Labor*, which first began to be printed in 1926, disseminated the critical reading of international and national documents about lyceum teaching, as well as presenting several examples of national and international schools. The questions of comfort were understood in an integrated fashion, being associated both with health and salubriousness and with social comfort, considering the social development of the students in the school community and the family. It further underlined the importance of inserting the school in the urban environment, as well as considering accessibilities to be critical factors in the environmental quality of the schools.

Regulations governing environmental comfort in school buildings first appeared in 1930 in the form of the rules and standards produced by the *Junta Administrativa do Empréstimo para o Ensino Secundário* (JAEES – Administrative Board of the Loan for Secondary Education) in order to support the construction of buildings to be used as lyceums. Besides the general conditions, a description was also made of the explicit rules of a functional, constructive and environmental nature, which emphasised the correct implantation of the building on its terrain, with attention being paid to sunlight, prevailing winds, gradients and drainage, as well as easy access to the drainage system for rainwater. These rules set minimum lighting areas for the different buildings, as well as establishing the choice of materials. Emphasis was given to the implantation and consequent solar exposure, without ever being explicit about the consequences of these measures in terms of environmental comfort. As far as air quality was concerned, the standards only made general specifications about the need to provide natural or artificial ventilation for the buildings, with the use of appropriate equipment and devices.

The regulations established that

> *Buildings must be oriented in such a way that the [normal] classes preferably receive the sunlight from the east. Drawing classes, arts and crafts and the laboratory of natural sciences must be lit from the north, while libraries, offices and chemistry and physics laboratories must be lit from the south, east or west. (JAEES, no date 2 e).*

Under the scope of these regulations, the solution of building the first modern lyceums in purely geometrical forms of reinforced concrete implied a significant reduction in the thickness of the walls, a reduction in the volume of air in the classroom and the introduction of flat roofs, which lowered the thermal inertia of these new schools. Reducing the building's thermal inertia compromised its thermal comfort, as no other measures were planned for achieving this particular aspect.

The General Programme for the Development of Lyceum Design Projects, drawn up by JCETS in 1941, presented rules relating to the necessary functional relationship between the various spaces and their relative position, preferential orientation and the specification of their finishing work, adding little to the questions of environmental comfort.

Despite the existence of a reinforced concrete structure, the use of traditional constructive systems and building materials was imposed, such as masonry walls and sloping ceramic-tiled roofs. The size of the openings was reduced, thus diminishing the natural lighting of the spaces. Specific areas and ceiling heights were imposed for the various spaces, as well as maximum and minimum lighting areas, correlated with the area of the space in question and thus defining the corresponding maximum and minimum window areas. These documents denoted a concern with controlling costs through a rationalisation of processes, the conditioning of the materials to be applied and the dimensions of the different spaces.

The buildings destined for Technical Education were governed by the "General Rules for the Premises of Schools of Technical and Professional Education" drawn up in 1947 and reformulated in 1950. In these documents, there continued to be very few references to parameters of environmental comfort, with the only indication that was given being to take care with regard to the air quality and natural lighting of the spaces.

These buildings thus adopted a rigid constructive discipline, dictated by standardisation strategies, arising from the need to cut costs and increase productivity, in order to fulfil the planned execution times. The use of sloping roofs was imposed, in which the attic space served as an air gap, optimising the thermal comfort of the teaching space. The lyceums were divided into two groups according to their geographical location: those where there was an immediate need for heating; and those where there was no immediate need for heating. In the first group, central heating was to be installed throughout the interior of the building. In those lyceums where there was no immediate need for heating, the designs only needed to consider the interior plumbing that was strictly essential in the largest rooms.

In the late 1940s, various international organisations became involved in the discussions about the production of school equipment. In 1949 (LNEC 1979) the concept of cost per place was developed, relating the area per student with the cost per square metre of building. This concept had an impact on the design of school buildings in England and in the countries where it was introduced, such as Portugal. The first mechanical ventilation systems began to be implemented in the schools and the heating conditions were improved. Various parameters were subjected to regulation, such as the maximum number of students per room, the establishment of ratios relating to area/student, volume of air/student, size of glazed openings/area, the definition of a minimum ceiling height, the position and location of the glazed openings. At the level of environmental comfort, the main impacts were related with the reduction in the volume of air per student, the increased need for renewing the air, and the multiple orientations of the classrooms. Throughout the 1950s, particularly in England and the USA, there was a great increase in research relating to the quantification and standardisation of the requirements in terms of lighting and air renewals. The concerns were mainly related with achieving a balance between natural and artificial lighting, the orientation and distribution of the sunlight, problems with its direct shining and reflection, the field of vision and shadows and acoustic conditions (materials, echoes and the functional layout according to the noise source).

In 1959, the "School Buildings Charter", which would later be published in Portugal in the architectural magazine *Binário* in 1965, defined the principles relating to the distribution of the schools in the territory and the factors that influenced their location, the natural conditions that the terrain should obey and the area of land that was needed for the building of a school, stressing the importance of its solar exposure. The charter defended the creation of schools with just one storey, not only at the level of pedagogy and the comfort that this provided for the smaller children, but also in order to avoid problems of lighting and ventilation. It tolerated the creation of schools with two (or exceptionally three) storeys, provided that these contemplated the need for «bilateral lighting, cross ventilation and comfort». Solutions were given for environmental comfort, such as the use of distribution galleries, with lower ceilings than in the classroom, so that this could also have direct lighting and ventilation from that same façade. It was also stated that the openings should provide abundant (but not excessive) multilateral lighting and that it should be possible to regulate the protection from the sun. It was advised that the volume of the classroom should vary according to the subjects that were being taught, the number and age of the students and the climate. New benchmarks were proposed for the size of the classrooms (area, area/student and number of students), which contrasted with the one that was practised in Portugal. The article made a critical analysis of the charter, stating that Portugal did not respect the international benchmarks (UIA 1965).

In Portugal, the "Normas Gerais e o Programa para as Instalações dos Liceus" (General Rules and Programme for Lyceums) (1958), which accompanied the "First Standardisation Study. Industrial and Commercial Schools" (1960), again reinforced the preference for the

use of sloping roofs[2], taking advantage of the attic space, instead of using flat roofs, which would have to be fully justified from an economic and technical point of view. However, there was no mention made about the thermal effectiveness of this constructive solution. The rules also recommended the use of a lateral corridor in the area used for theoretical lessons, which would be south-facing, and the use of a central corridor in the area of the laboratories and drawing rooms, justifying the strategy of this orientation and circulation system with the fact that it provided greater environmental comfort to the users, since the classrooms used for theoretical lessons were supposed to face south and the rooms used for drawing and for arts and crafts were supposed to face north. The function, dimensions, orientation, lighting and finishing of all the different spaces were also specified. A significant part of the national recommendations and requirements relating to thermal comfort derived from the studies and standards applied in France. These Rules were later revised, in 1968, although they maintained a structure and recommendations that were identical to those of the initial version of the "General Rules and Programme for Lyceums" (1958).

The requirements relating to the environmental comfort and energy performance of buildings intensified significantly after the oil crises of the 1970s and 1980s. The concern with reducing energy spending led to the thermal insulation of constructions, significantly reducing infiltrations of outside air. Health problems associated with deficient air renewals then began to be reported, sometimes aggravated by a deficient maintenance of the air-conditioning systems. Legislation was then passed to regulate and quantify the needs for air renewal in interior spaces, as well as the location of exterior air intakes, while attention was drawn to the danger of using materials and equipment that contained volatile organic components.

In the case of Portuguese school buildings, these problems did not arise with the same intensity as in other countries, for the technologies and construction materials that were used were still the traditional ones and the door and window frames were of poor quality, so that there continued to be a relatively high level of infiltrations of outside air into the interior spaces. The main problems relating to deficient air renewals were linked to the reduced volume of air per student in the classrooms, and frequently the only possible means of renewing the air was through the outside windows, whose use in winter implied a dilemma between thermal discomfort and saturation of the interior air.

In 1975, a technical report about thermal insulation was published by the *Centre Scientifique et Technique du Bâtiment* (CSTB), defining the specific requirements for schools and taking into account their range of different uses and functional areas and their respective requirements (refectory, classrooms, gymnasiums, etc.), the timetables for the use of the different spaces and their varying densities.

2 Problems of leaks and the accelerated wear and tear of the flat roofs of the lyceums dating from the first modern period, such as Liceu Diogo de Gouveia, lay at the origin of this recommendation.

In Portugal, school constructions were the first classes of buildings to be given specific benchmarks in terms of requirements for thermal behaviour. In 1979, the National Laboratory for Civil Engineering (Laboratório Nacional de Engenharia Civil – LNEC) published its "Quality Rules for the Thermal Comfort of School Buildings", which were included in the report of its Plan for the Study of Buildings (Plano de Estudos no Domínio dos Edifícios). Unlike the French documents, this report was an essentially prescriptive document, in which no concepts or models of calculation were presented, with mention being made essentially of the fixed temperature reference values for the heating equipment (considering the possibility of obtaining thermal comfort in the summer based on natural ventilation, through recourse to cross ventilation and the shading of glazed openings), namely 18° C in classrooms and similar spaces, 21° C in changing rooms and toilets and 15° C in circulation areas and gymnasiums. The document also defined solar factors for glazed areas and thermal transmission coefficients for the main building elements. The requirements in terms of ventilation referred to air renewals expressed in litres per person or per area.

The publication CIB-W45 (from the W45 group of the *Conseil International du Bâtiment*) refers to 20° C as the desirable temperature, expressed in terms of a resulting dry temperature and a relative humidity of 60% (referring to a permitted minimum of 35%). The temperature in any place and of any surface should range between 16° C and 30° C, except for that of the floor, which must not exceed 27° C. It was accepted that, «for reasons of economy», this value could not always be met for a period of up to five days/year. The document also mentioned that the air velocity should not exceed 0.15m/s.

LNEC's translation of this document from the CIB-W45 working group was to become an important benchmark for the execution of the lyceum construction programmes in Portugal. Similarly, in the area of lighting, LNEC's translation of the list of «requirements of users relating to school buildings» was a fundamental reference for defining the performance standards and requirements to be included in building specifications for the design of lyceums.

As the Portuguese translation was published in 1982, already after two oil crises, the national document demonstrated concerns about energy consumptions. It is mentioned that «with the aim of saving energy, school spaces should have natural lighting». Parameters were established, such as the daylight factor, a maximum value for natural light, the spectrum of both transmitted and diffuse light, surface lighting, colour rendering index, lighting fixtures, light diffusers, cleaning and maintenance, control systems and their flexibility. The document related aspects of energy management in school buildings with the requirements in terms of visual comfort and stressed the importance that windows also had as «a means of visual communication with the exterior». It also mentioned the relationship between the dimensions of the windows and their implications for energy consumption, directly affecting heat transmission, the penetration of solar radiation, ventilation and lighting. The pertinent and important recommendations of this publication with regard to the management of lighting were based on more recent case studies, which identified the same questions

about the efficiency gains associated with an efficient lighting management, quantifying and supporting the conclusions of the previous studies (Lourenço, Pinheiro and Heitor 2019, 990-1010).

In the report of the CIB W45 working group, published in 1978, the «olfactory and respiratory requirements» were also dealt with in an essentially qualitative fashion, with it only being mentioned that «the occupants are satisfied when the air is renewed twice per hour». The limits for gases and other harmful airborne particles were the values established by the World Health Organisation.

In the late 1990s, with the publication of the European Energy Performance of Buildings Directive (EPBD), a diagnosis was made of energy consumption in buildings in Europe. In the case of schools, energy consumption for heating and water consumption were the main areas of concern.

Nowadays, the main concerns about environmental comfort in schools are linked to poor air quality and high concentrations of CO_2 (Almeida and Freitas 2016, Bakó-Biró *et al.* 2012, Dascalaki and Sermpetzoglou 2011) and to the quality of lighting, which is considered the factor that has the greatest impact on the learning process of students (Barrett *et al.* 2015, Edwards and Torcellini 2002, Higgins *et al.* 2005).

The Incorporation of the Main Concepts of Environmental Comfort into Lyceums and Technical Schools in Portugal

Liceu Passos Manuel, inaugurated in 1911, incorporated into its design several strategies associated with environmental comfort. A first version of the lyceum, designed by José Luís Monteiro in 1882 and which was never built, contemplated the placement of a huge dome on top of its main vertical circulation areas. Besides accentuating the monumentality planned for the building, this dome also served as a large chimney offering natural ventilation (Figure 1).

In its final built version, the design joined the four courtyards of the initial plan together to form two rectangular courtyards. These courtyards were designed to guarantee conditions for the renewal of the interior air through cross ventilation and to improve the lighting conditions in the circulation areas, favouring the development of a better air quality throughout the day. Because of their size and high ceilings (5.4m), the classrooms have a greater volume of air per student than the reference values recommended by the various documents of the time; the windows are of a generous size and have a vertical development that improves the efficiency of the cross ventilation (Figure 2). In the summer, in view of the high thermal inertia associated with the constructive system (stone masonry), the temperatures are kept within the comfort interval. But, in winter, because of the difference in temperature between the circulation areas and the classrooms, it is difficult to obtain comfort temperatures. The design of a natural ventilation system based on openings for air intakes and outlets in opposite walls of the classrooms guarantees the suitable ventilation of the spaces.

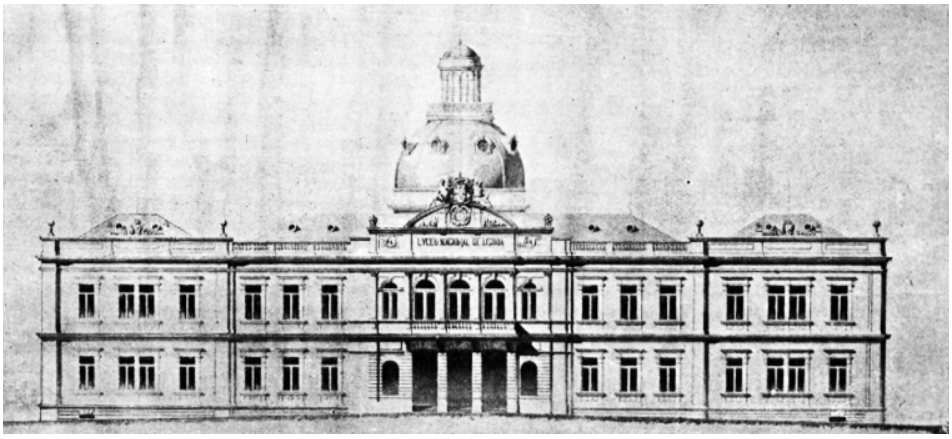


Figure 1: José Luís Monteiro's Design for Liceu Passos de Manuel (main elevation)

Figure 2: . Gallery leading to the courtyards; Corridor providing access to the classrooms on the first floor; interior of a classroom.

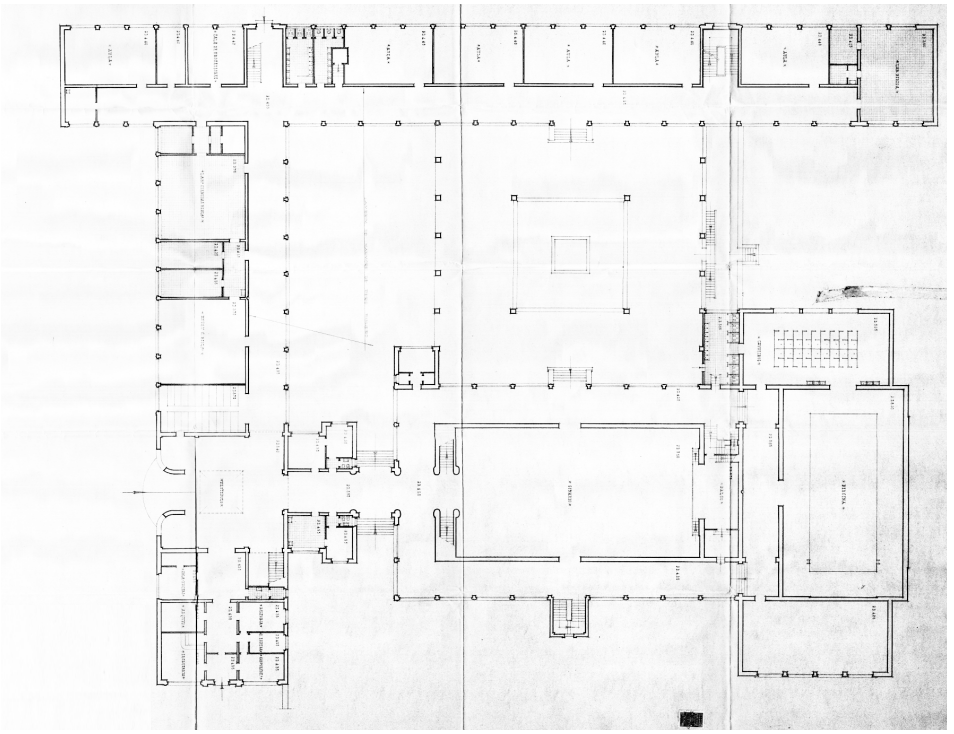


Figure 3: Ground floor plan of the design for Liceu Diogo Gouveia, in Beja.

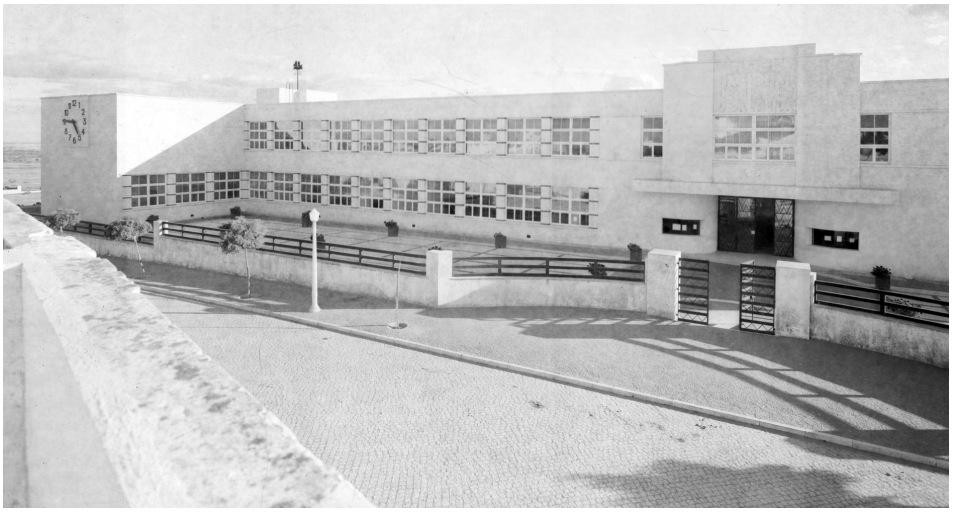


Figure 4: Main Façade of Liceu Diogo Gouveia in Beja.

In typological terms, **Liceu Diogo Gouveia** in Beja, built in 1930, follows the models produced earlier, which were based on the organisation and distribution of the different spaces along the circulation corridors (Figure 3). The abundant lighting of the spaces is achieved through classrooms with large glazed openings measuring 9 metres in length (Figure 4), circulation areas with large glass windows all along their length, with larger openings in special spaces such as the school board's meeting room, and the use of glass bricks (placed horizontally between beams to illuminate the gymnasium space from above). The solution proposed by Cristino da Silva, composed of pure geometrical shapes and flat roofs, was based on the modern architectural language, simultaneously expressing the pedagogical and hygienic requirements for lyceums (Alegre et al. 2018, 352–3). The first modern lyceums introduced the use of reinforced concrete as the main building material for the first time. The walls were significantly less thick, the volume of air in the classroom was reduced with the use of flat roofs, significantly reducing the thermal inertia in these new schools. On the other hand, the glazed areas maintained similar dimensions to those of the first lyceums, with natural lighting being one of the prime concerns in terms of environmental comfort. As a consequence of these alterations, the thermal amplitudes increased significantly in the interior spaces. Some strategies that were essentially focused on the natural lighting ended up proving to be inadequate as far as thermal comfort was concerned, with the south-facing rooms showing a tendency to overheat.

In **Liceu Padre António Vieira**, designed by the architect Ruy d'Athouguia and inaugurated in 1965, it was decided to make greater use of cross ventilation. The corridor providing access to the classrooms is north-facing, while the classrooms are south-facing (Figure 5). The greatest concerns with environmental comfort were experienced in winter. As the classrooms are south-facing and have outside blinds and shades, the system is effective in Summer (Figure 6). However, the original glazed areas were composed of simple panes of glass and did not provide adequate conditions of environmental comfort in the cold months. The school has since been rehabilitated, presenting a thermal performance (in the classrooms) that is within the range of the current comfort standards (Alegre et al. 2018).

At **Liceu Rainha Dona Leonor** (1956), the school's reinforced concrete structure made it possible to free up the façades, with the exterior elevation of the classrooms consisting of a glass front that begins a metre above the ground and reaches to the full height of the room. The openings are subdivided, incorporating fixed parts and movable parts that open and can be tilted (Figure 7). A central corridor was introduced that prevents direct cross ventilation between façades (Figure 8). As an alternative, small openings were created in the upper part of the classroom walls bordering on the circulation areas. Later, the systems that were used for opening these windows were gradually removed, preventing the cross ventilation of the classrooms.

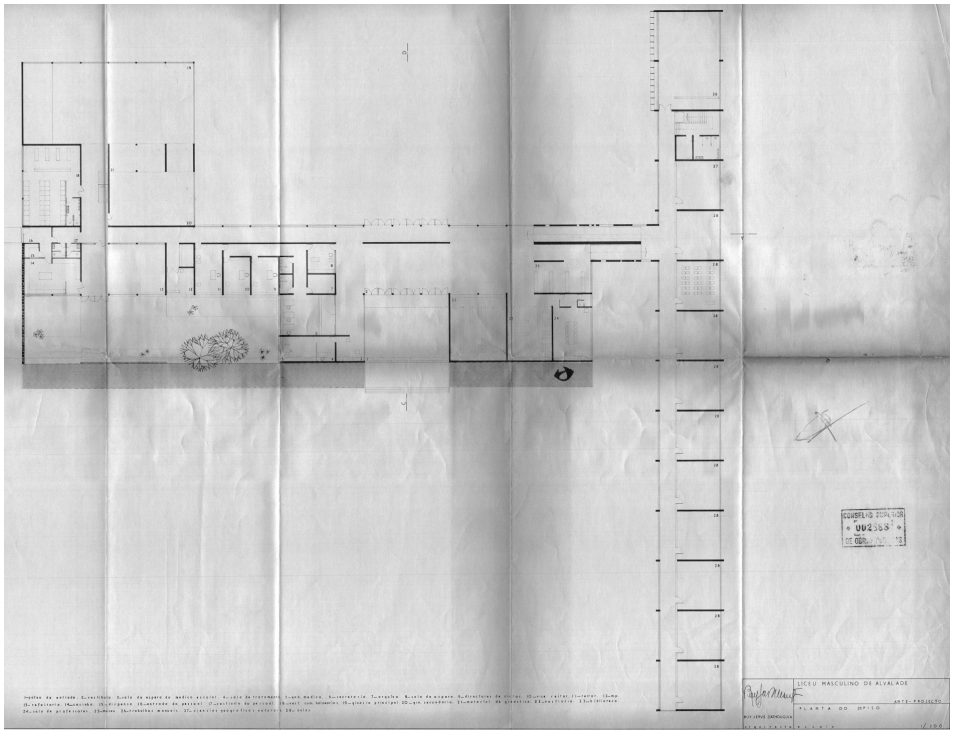


Figure 5: Ground floor plan of the design for Liceu Padre António Vieira.

Figure 6: View of the south façade, with the shades above the classroom windows.

Figure 7: Rear façade of the building and detail of a window of the classrooms of Liceu Rainha Dona Leonor.

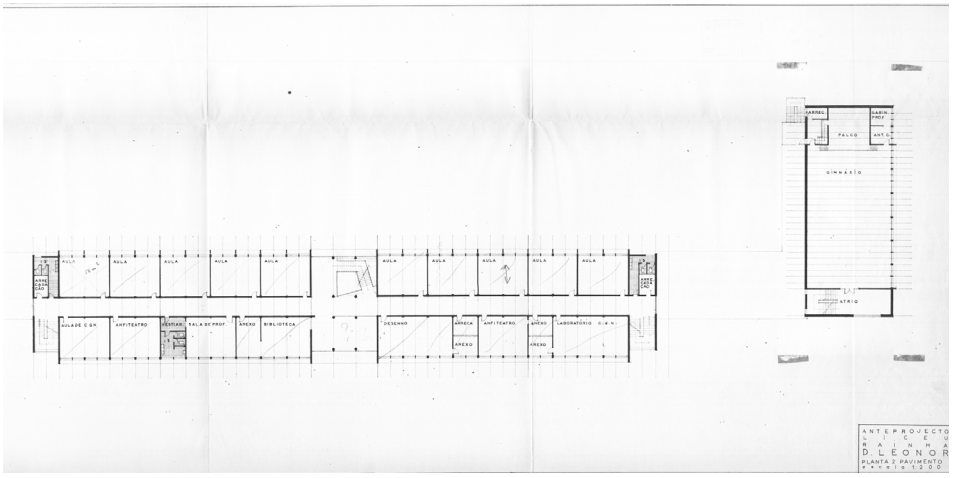


Figure 8: Plan of the first floor, showing the development of the rooms along both sides of a central corridor.

The design of **Liceu Dom Pedro V** (1966), with the adoption of a new model for functional distribution based on the use of pavilions, organised the classrooms around an entrance hall, with the rooms being accessed through galleries (Figure 9). The central hall received natural lighting from above and allowed for cross ventilation (Figure 10).

Figure 9: Floor plans of the pavilions. The classrooms are arranged around a central hall.

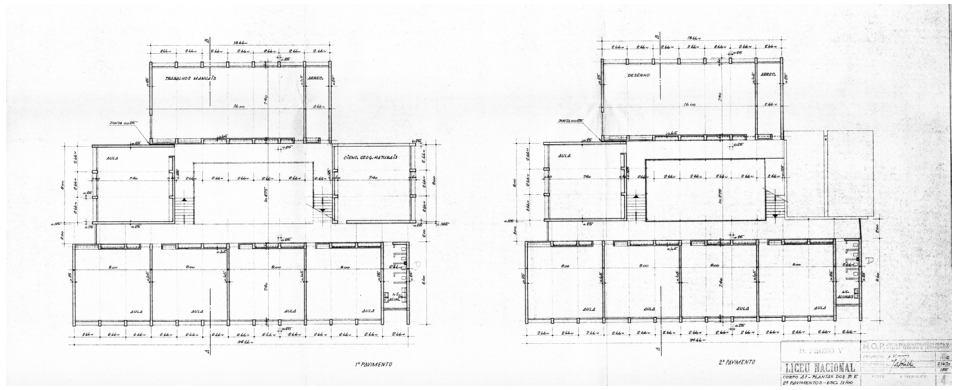
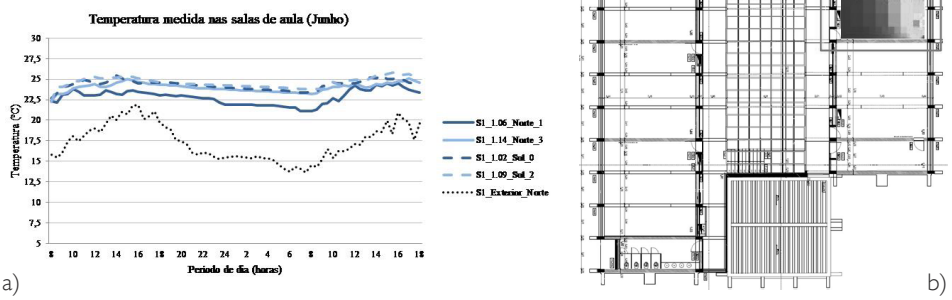


Figure 10: View of the central hall providing access to the rooms, arranged vertically in half floors.

The use of the pavilion typology and its proposed constructive and material solutions reduced the mass of the building and therefore its thermal inertia. The classrooms were now organised around interior halls and began to be oriented in such a way as to face various cardinal points, increasing the thermal range between the rooms oriented towards different quadrants (Figure 11a). In the pavilion models, there was also a significant reduction in the size of the window openings, leading to a reduction in the natural lighting in the interior. Figure 11b presents a simulation of the distribution of the natural lighting in a classroom.

In compiling the different dimensions of the classrooms, representative of the main lyceum construction periods during the twentieth century in Portugal, and comparing these with the ones that were prescribed in the rules in force at the construction date of each school in Table 1, it can be seen that the reference area imposed in the applicable plans or rules grew smaller over the years, being reduced by about 24% (12m^2) between 1930 and 1968, although the lyceums designed in the 1960s present significantly larger areas than those that were prescribed in the plan (roughly 10m^2 larger). The volume was reduced by about 34%, whereas the number of students (classroom capacity) remained relatively stable over the years. As far as the clear ceiling height is concerned, there was also a significant reduction throughout the twentieth century, from the 5.4m of Liceu Passos Manuel to the 3.2m of Liceu Dom Pedro V. Although the reference value for the ceiling height was only lowered by 13%, the real values of the schools were reduced on average by 38% between the first and last lyceums built in the second half of the twentieth century.



a) b)

Figure 11: a) Graph showing temperatures measured in the classrooms of a pavilion in the month of June b) Measurements of natural lighting, in lux, in a classroom (south-facing).

	Length [m]	Width [m]	Ceiling Height [m]	Area [m^2]	Area/student [m^2/student]	Volume [m^3]	Volume/student [m^3/student]	Capacity
Liceu Passos Manuel	7,40	8,30	5,40	61,42	1,54	331,67	8,29	40
Liceu Camões	9	6,25	5	63		239,40		
Bases for the construction of Lyceums General Conditions (1930)			3,80	63,00		239,40	6,84	35
Liceu Diogo de Gouveia	9,80	6,30	4,30	61,74	1,76	265,48	7,59	35
1938 Plan Lyceums of the *Estado Novo*	9,00	6,00	3,40	54,00		183,60	5,25	35
Rules for the Building of Lyceums (1958)	7,80	6,80	3,30	53,04		175,03	-	
Liceu Rainha Dona Leonor	8,15	6,48	3,30	52,81	1,47	174,28	4,84	36
Liceu Padre António Vieira	7,80	6,85	3,30	53,43	1,48	176,32	4,90	36
Liceu Dom Pedro V	7,42	7,77	3,20	57,65	1,44	184,49	4,61	40

Table 1: Comparison between the real dimensions of the case studies and the normative reference values, showing their evolution throughout the twentieth century.

Figure 12 presents the floor plans and cross sections of the standard classrooms for each of the lyceums analysed, where it is possible to see the ratio between length and width, the ratio between the glazed area and floor area and the depth of the room. These dimensions are related with the environmental comfort of classrooms and were identified as being crucial in the learning process in various reports about education (Barrett *et al.* 2015, OECD 2014).

The requirements in terms of dimensions changed in the course of the various plans, being related both with the educational dynamics and practices and with questions of environmental comfort, mainly associated with the volume of air available in the classroom and the quality of the lighting. Similarly, as far as the visual comfort was concerned, the intensity of the natural light was very heterogeneous in the classrooms, with the areas furthest away from the façade not reaching the minimum values at certain times of the day.

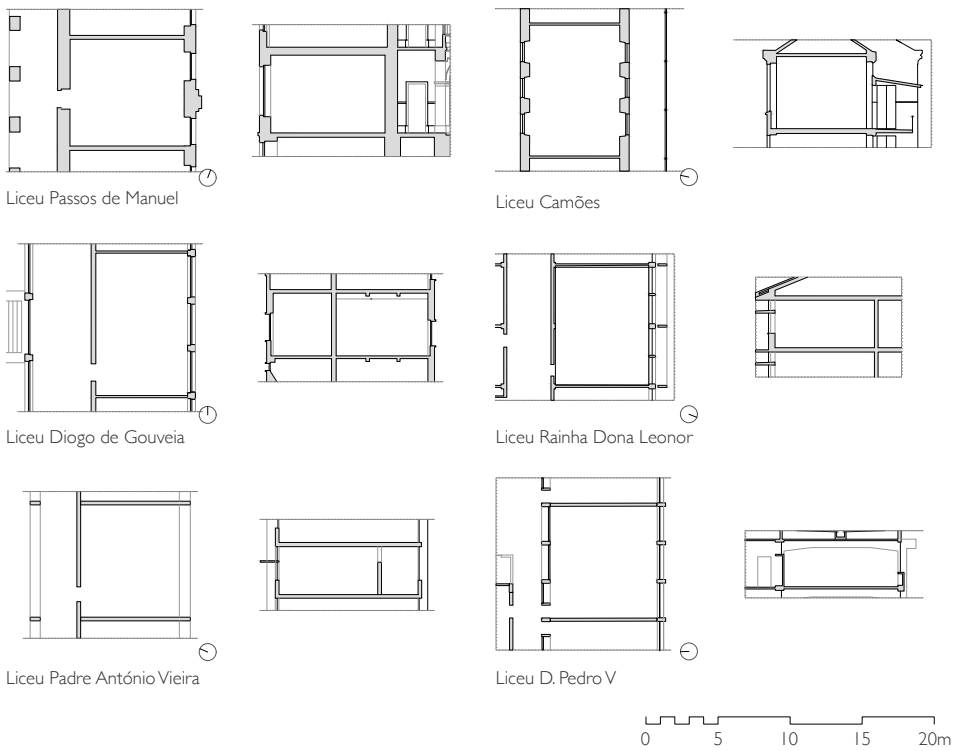


Figure 12: Floor plan and cross section of a classroom of the schools presented.

Conclusions

The current regulatory requirements relating to environmental comfort result from laboratory studies and simulations of models. These studies have largely been undertaken in countries from central and northern Europe, being subsequently transposed to European standards and then adapted by other countries, especially those from the south of Europe. Consequently, the reference values adopted are out of step with other geographical and cultural contexts. It is therefore important to highlight certain research studies that have sought to study the buildings in use in the national context and to consider the direct perceptions of their users, as is the case with studies undertaken at LNEC and various Portuguese universities (Guedes, Matias and Santos 2009, Barbosa, Vicente and Santos 2015, Lourenço, Pinheiro and Heitor 2019). These authors attempted to understand the comfort requirements and perceptions of the buildings' users, as well as the impacts of these on the consumption of resources, particularly in the case of energy performance and water consumption.

The classroom has remained as the basic unit for the spatial organisation of the school building and the main area of support for learning dynamics.

Throughout the period under analysis, it can be seen that the classroom was the functional space most directly affected by most of the requirements laid down in terms of environmental comfort. From the morphological analysis of the schools and the measurement of the temperature in their various spaces, it can be concluded that the design strategies and the consequent relationship between circulation areas and classrooms are crucial in determining environmental comfort.

It can further be seen that, despite the dimensions of the school buildings having changed as a result of the alterations in their capacity and the different ratios introduced at different times between the classroom area and student numbers, their shape always continued to be that of a regular parallelepiped, with the lighting and natural ventilation being situated on one of the vertical faces, possibly also with smaller openings onto the adjoining circulation space, on the opposite side, although these were rarely used.

In the 1958 and 1968 plans, the area and ceiling height were made smaller in order to reduce building costs. After the extinction of the lyceums and the creation of new secondary schools already in the post-revolutionary period, the «school space requirements», as conceived by the LNEC, proposed a ceiling height of 2.70m for spaces with more than 20 students and 3.00m for spaces with more than 60 students.

Interior air quality has more recently become a theme of major importance in the scientific research being undertaken into environmental comfort in schools, after the presentation of evidence linking academic performance to the air quality inside classrooms (Bakó-Biró et al. 2012). Current air renewal requirements have led to the adoption of mechanical ventilation systems in rehabilitated schools. However, the implementation of hybrid systems of natural and mechanical ventilation (the air is taken in through grilles in the façade and then mechanically extracted to the circulation areas) had a better performance (Almeida and Freitas 2014). In this way, considering the obvious interest in always resorting to passive strategies whenever possible, the volume of air available in the classroom and the capacity for guaranteeing cross ventilation remain critical factors for the environmental quality in schools.

However, another study has revealed that the school community does not yet recognise interior air quality – namely the concentration of CO_2 and the potential existence of dangerous Volatile Organic Compounds (VOCs) in the classroom – as factors of environmental comfort (Lourenço, Pinheiro and Heitor 2014).

Considering the size of classrooms in the more recently built schools and an average number of 30 students per room, the average air volume per user is 4.5m^3. If ventilation strategies are not adopted during lessons (which is frequently the case at schools in winter), then concentrations close to the maximum limit of 1250ppm will be reached in roughly 30 minutes. In Portugal, the maximum limit for the concentration of CO_2 is 1250ppm, with lessons lasting between 45 and 90 minutes on average.

Although most of the schools presented here were designed in such a way as to offer the possibility of cross ventilation, this important feature is not always promoted by the users, nor by the technicians responsible for its management, maintenance or redesign, and, in some cases, the original windows have been replaced by fixed glass panes. Studying the possibility of creating openings for the circulation areas may be a simple strategy for improving the environmental conditions of the classroom, in terms of both air quality and lighting. However, the users now have to work with complex systems, whose operation they frequently do not understand and which have proved to be difficult in ensuring the efficient management of air conditioning and ventilation systems (Lourenço, Pinheiro and Heitor 2014).

The design and implantation of the school must be connected with the community, integrating it into its site and surroundings. There must be a perception of continuity between the public space and the space of the school, creating a relationship between the inside and the outside, and maintaining a relationship with the community and with the built and natural environment. The school's sustainability is related with the capacity to structure the physical spaces in such a way as to meet the needs of users, guaranteeing their health and safety, contributing to an increase in the quality of teaching and promoting environmental and social responsibility, from a long-term perspective. In order to achieve this, users must be given training that will enable them to ensure a responsible and sustainable management of the school's conditions of comfort on a daily basis.

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School Buildings for Secondary Education: Evolution of the Construction and Structural Systems

António Sousa Gago, Jorge Proença and Teresa Heitor

1. Introduction

The evolution in the construction of school buildings in the twentieth century was marked by the introduction of new materials, namely steel and reinforced concrete, which gradually began to replace the traditional materials of wood and stone or brick masonry.

Before the introduction of reinforced concrete and steel, the structural system of buildings was based on the use of vertical elements, made of stone or brick, and horizontal elements, beams and floors, made of wood. In certain cases, as an alternative to wood, small openings were sometimes spanned with masonry arches.

The new materials had greater resistance, rigidity and durability than wood and were particularly resistant to traction, when compared to the limited resistance of masonry. They thus allowed for the use of linear structural elements which were far larger than the ones that it had been possible to manufacture previously. Thus, it became possible to build much more slender structures, with larger openings, which were less deformable, had greater resistance and were more durable, a change that was to revolutionise construction habits and the design of buildings.

The initial phase of the introduction of reinforced concrete and structural steel into civil construction coincided with the building of the first lyceums. At first, these materials were used, above all, in the construction of floors and roofs, being accompanied by the use of traditional building techniques based on vertical structural elements made of masonry. In

the following decades, the new materials, especially reinforced concrete, gradually gained greater prominence and, by the late 1950s, the use of structural masonry had already been abandoned and replaced by vertical (pillars) and horizontal (beams) linear systems. Thereafter, new buildings, especially those of greatest importance (as was the case with secondary schools) began to adopt reticulated frame structures or porticoes, with beams and pillars supporting the floors, which were also made entirely of reinforced concrete.

Like the building techniques, the principles applied in the conception and design of reinforced concrete structures evolved from the experimental phase in the early twentieth century to the beginning of the 1960s, when the first regulatory codes for structural analysis were published. The *Regulamento de Segurança das Construções Contra os Sismos*[1] (RSCCS – Code for the Safety of Buildings against Earthquakes), dating from 1958, and the *Regulamento de Solicitações em Edifícios e Pontes*[2] (RSEP – Building and Bridge Code), from 1961, gave rise to greater demands in the building's design and structural dimensioning, specifically taking into account seismic activity, which, until then, had not normally been considered.

At the beginning of the 1980s, new regulations were introduced to replace those from the 1960s, most notably the *Regulamento de Segurança e Acções em Estruturas de Edifícios e Pontes*[3] (RSAEEP - Safety Code for Building and Bridge Structures), published in 1983, which reflected the most up-to-date knowledge about earthquakes and the seismic behaviour of buildings. These new structural regulations, the RSAEEP, the *Regulamento de Estruturas de Betão Armado e Pré-Esforçado* (REBAP – Code of Reinforced and Pre-Stressed Concrete Structures)[4] and the *Regulamento de Estruturas de Aço para Edifícios* (REAE – Code of Steel Structures for Buildings)[5], have remained in place until today and are only now beginning to be replaced by the Structural Eurocodes. With the new regulations of the 1980s, and with the use of new tools of analysis and structural dimensioning, further enhanced by the use of information technology, the dimensioning of structures entered into a new phase that allowed for new architectural solutions.

Thus, taking into account the various phases in the construction of school buildings, the evolution of construction methods and the publication of the structural regulations (which greatly influenced their structural and architectural design), the secondary school buildings constructed during the period considered under the Atlas of School Architecture in Portugal

1 Decree-Law No. 41658 of 31 May.

2 Decree-Law No. 44041 of 18 November.

3 Decree-Law No. 235/83 of 31 May.

4 Decree-Law No. 349-C/83 of 30 July.

5 Decree-Law No. 211/86 of 31 July.

project – namely between the late nineteenth century and the end of the 1960s – may be divided into the following five groups:

a) Buildings with wooden floors and masonry load-bearing walls, built between the late nineteenth century and the 1930s;
b) Buildings with reinforced concrete floors and masonry load-bearing walls, built between 1930 and the late 1950s;
c) Buildings from the early days of the widespread use of reinforced concrete, prior to the regulations governing seismic safety, built between 1950 and the beginning of the 1960s;
d) Buildings constructed entirely of reinforced concrete, after the introduction of the RSCCS in 1958, and prior to the introduction of the RSAEEP in 1983;
e) Buildings constructed entirely of reinforced concrete, after the introduction of the RSAEEP in 1983.

We should also add to this list of buildings, those that were built in the 1970s using industrialised methods (pre-fabricated elements, constructed in reinforced concrete or steel), which are not referred to here.

It should further be mentioned that roughly 23% of the schools constructed for the purposes of state secondary education in mainland Portugal were built before the end of the 1960s, which means that, in the period under analysis in this project, roughly 46% were built in the 1980s, and that a significant part of these buildings replicated the model known as the 4th Standardisation Design, described in section 2.4.

2. School Buildings for Secondary Education

2.1 Buildings with wooden floors and masonry load-bearing walls

The construction of the first lyceums began at the end of the nineteenth century, with the design project for the Central Lisbon Lyceum, later given the name of Liceu Passos Manuel, designed by José Luiz Monteiro (1882), and subsequently altered by Raphael da Silva Castro (in 1888) and Rosendo Carvalheira (in 1896 and 1907), and continued with the lyceums of Camões (1907-1909), Pedro Nunes (1908-1911) and Maria Amália Vaz de Carvalho[6] (1915-1934), in Lisbon, designed by the architect Miguel Ventura Terra, and the lyceums of Alexandre Herculano (1914-1931) and Rodrigues de Freitas (1918-1933), in Porto, designed by the architect José Marques da Silva.

6 The construction of Liceu Feminino de Maria Amália Vaz de Carvalho, designed by the architect Miguel Ventura Terra, began in 1915 and was interrupted in 1921. The construction work was restarted in 1929, already under the supervision of the *Junta Administrativa do Empréstimo para o Ensino Secundário* (JAEES – Administrative Board of the Loan for Secondary Education), and was completed in 1934, incorporating adaptations that had been proposed by the architect António Couto.

Figure 1: Liceu de Pedro Nunes (1908-1911), Lisbon. Main façade.

The knowledge that these architects had of the rationalist compositional principles of the École Nationale de Beaux-Arts, in Paris, as well as the professional contacts that they enjoyed with contemporary French architects, meant that they were familiar with the new materials and techniques, such as the use of reinforced concrete and structural steel in civil construction. The design of these buildings coincided with the transitional period that characterised the beginning of the century in Portugal, when the traditional values of architecture were confronted with the new challenges brought by the industrialisation and mechanisation of the construction sector. Metal elements, steel profiles, ceramic hollow blocks for floors and hollow bricks gradually replaced the more traditional solutions in stone and wood. There was, however, some resistance to the solutions in reinforced concrete, even though some experimental studies were developed, such as the two structural solutions in concrete developed for Liceu Passos Manuel in 1908, subsequently altered to more traditional solutions with metal elements (Appleton and Ribeiro 2011, 111). The decision to use new materials and the corresponding faster and cheaper construction processes was a choice made from the outset by the Technical Department of School Constructions, as indicated by the opinion issued by a specialist commission in 1902 (Guerreiro 1903, 144).[7]

7 The commission consisted, among others, of the Inspector-General of Public Health, Ricardo Jorge, the School Health Inspectors, António de Almeida Dias and Costa Sacadura, and the architects Rosendo Carvalheira, from the Ministry of Public Works, and Adães Bermudes, the Director of School Buildings.

Figure 2: Liceu de Maria Amália Vaz de Carvalho (1915-1934), Lisbon. Main façade.

In these early applications, the structural elements made with the new materials were used in tandem with traditional techniques and materials and, apart from the gymnasium roofs, followed conceptional criteria that were very similar to the traditional ones. On the whole, the structures of these buildings consist of peripheral and interior walls made of stone masonry and solid brick, which support the floors and roofs. The stone masonry exterior walls are usually very robust and may be up to 1.10m thick at their foundations, with heights varying between 0.80-0.90m and 0.60-0.70m. The interior walls, which, in most cases, are made of brick masonry, are less robust, usually no more than 0.30 to 0.40m thick, at most.

The floors consist of wooden beams, covered by wood flooring, except in the ground floors, corridors, galleries and damp areas, where, in general, the choice was to use steel profiles and ceramic hollow blocks, filled with mortar made of sand, lime and pozzolana. The linear elements, wooden beams and steel profiles of the floors are supported directly on masonry structures or intermediate steel joists, usually referred to as the main beams or girders, which, in turn, are supported on the masonry walls.

The roofs of the buildings are covered in tiles, consisting of wooden slats and beams supported either on steel trusses or placed directly on the masonry walls, the exception being the roofs of the gymnasiums, which were spaces that the hygienist movement of that time had indicated as being central to the spatial structure of the lyceums for the practice of physical education. The use of very light structures supported on steel trusses made it

possible to bridge the gap between the façades of the buildings, as well as to construct the galleries of the upper floor, without any intermediate supports. This solution was already widely used internationally, especially after the 1878 Paris Exhibition (Appleton and Ribeiro 2011). The aesthetic expression of this metal building system was also to be found in the exterior galleries of the courtyards of Liceu de Camões, designed by Ventura Terra, in this way responding to the specific requirements for ventilation and natural lighting that were imposed at that time. This lyceum is, in fact, considered as the model for the later design and construction of secondary school buildings in Portugal. Its construction was completed in less than two years, between January 1907 and October 1909 (Almeida 1982, Silva 1997, Moniz 2002). Other new industrially manufactured materials, such as metal elements, hydraulic tiles, glazed ceramic tiles and terrazzo, also helped to guarantee a more hygienic and safer environment.

It should also be mentioned that, despite the fact that the vertical structural system consisted of masonry walls, in certain circumstances some alignments were interrupted, in which cases the walls were supported on metal profiles. The foundations of these buildings were either direct or consisted of masonry-filled shafts joined together by masonry arches.

2.2 Buildings with reinforced concrete floors and masonry load-bearing walls

This group of buildings includes those that were constructed by the *Junta Administrativa para o Empréstimo do Ensino Secundário* (JAESS – Administrative Board of the Loan for Secondary Education) (JAEES), established in 1928 at the *Ministério da Instrução Pública* (Ministry of Public Instruction), replaced in 1934 by the *Junta das Construções para o Ensino Técnico* e *Secundário* (JCETS – Board of Constructions for Technical and Secondary Education), built between the beginning of the 1930s and the end of the 1950s.

In 1930, JAEES launched a series of public calls for tenders for the construction of new lyceums in Beja, Lamego and Coimbra and contracted the architect Carlos Ramos for the design of Liceu de Dona Filipa de Lencastre in Lisbon. The following lyceums were built in the wake of these calls for tenders: Diogo Gouveia (1930-1934) in Beja, designed by the architect Cristino da Silva; Latino Coelho (1930-1936) in Lamego, designed by the architect Cottinelli Telmo, and Dom João III (1930-1936) in Coimbra, designed by the architects Carlos Ramos, Adelino Nunes and Jorge Segurado. The initial design by the architect Carlos Ramos for Liceu de Dona Filipa de Lencastre was not implemented. Instead, the present-day building (1932-1940) was constructed in accordance with a design produced by the architect Jorge Segurado.

The use of the new material of reinforced concrete in the floors made it possible to implement a series of new formal, spatial and functional solutions conveyed through the language of the modern movement: pure, geometrical volumes that were functionally autonomous and had a uniform finish (plastered and painted) without any decorative

Figure 3: Liceu de D. João de Castro (1944-1949), Lisbon. Main building under construction.

Figure 4, Figure 5 e Figure 6: Liceu de Sá da Bandeira (1939-1943), Santarém. Horizontal structural elements (beams and floors) in reinforced concrete and vertical structural elements made of masonry.

Figure 7: Liceu de D. Filipa de Lencastre (1932-1940), Lisbon. Horizontal structural elements (beams and floors) in reinforced concrete.

elements. The incorporation of new materials, such as stone, chromed elements and glazed ceramic tiles guaranteed the hygienic conditions required for the school space. However, the deficient construction and inadequate design of these lyceums (leaks, overexposure to sunlight) reveals the lack of technical knowledge about constructions with reinforced concrete, which was just being introduced to Portugal at that time.

With the disbandment of JAEES in 1934 and the creation of JCETS, the designs of lyceums mainly began to be developed by the technical team of JCETS, as was the case with the lyceums of Dom João de Castro and Gil Vicente, in Lisbon, Carolina Michaelis, in Porto, Infanta Dona Maria, in Coimbra, Sá da Bandeira, in Santarém, João de Deus, in Faro, Nuno Álvares, in Castelo Branco, Gonçalo Velho, in Viana do Castelo, Alves Martins, in Viseu, Bocage, in Setúbal, José Estevão, in Aveiro, Sebastião e Silva, in Oeiras, Eça de Queiroz, in Póvoa do Varzim, and the completion of the lyceums of Dona Filipa de Lencastre and Maria Amália Vaz de Carvalho, in Lisbon, and Alexandre Herculano, in Porto. The modern language expressed by the lyceums built in the 1930s was abandoned and replaced by an official language that expressed the nationalist values of the dictatorial regime of the Estado Novo (New State). The same solution was maintained from the structural point of view: reinforced concrete floors and masonry load-bearing walls, now covered with decorative stone elements that enhanced the appearance of the main façade. The flat roofs were now replaced by traditional tiled roofs.

From the architectural point of view, these are buildings with linear configurations, composed of various bodies grouped together, giving the impression that they form just one single building. Their predominant feature is the use of a "side corridor", in which the linear bodies are generally two or three stories high, consisting of a longitudinal corridor that serves a row of classrooms. Normally, the positioning of the corridors and the classrooms is repeated from one floor to the next, except when there are courtyards or entrance halls on the ground floors.

In these buildings, the earthquake-resistant structure is mostly composed of load-bearing walls made of stone masonry (the exterior walls have a thickness of more than 0.60m), ceramic brick masonry or cement blocks (the interior walls are less thick, measuring between 0.25 and 0.30m), which support reinforced concrete slabs (generally lightened and reinforced in just one direction) and reinforced concrete beams. The stairs are also made of reinforced concrete, but in solid blocks.

In areas where an open space was required, generally in the entrance hall and covered playgrounds, there were usually reinforced concrete substructures consisting of grids of (primary and secondary) reinforced concrete beams, supported on pillars and bearing the load of the floor above. Load-bearing masonry walls supporting the slabs of the upper floors and the roof slab were often built on top of these reinforced concrete main beams.

The roofs of these buildings are tiled and supported by wooden structures. Where there is a roof slab (nearly always with inverted reinforced concrete beams), these structures are directly supported by the slab (or by the beams). In the absence of a roof slab, the roof usually consists of steel or wood trusses supported by the exterior walls of the building.

2.3 Reinforced concrete buildings prior to the 1958 Seismic Code

This group of buildings refers to those constructed by JCETS, whose structure was made entirely of reinforced concrete (slabs, beams/lintels and pillars/columns), but whose dimensions were decided upon without any kind of seismic checks. The number of school buildings belonging to this group is quite small since the widespread use of structures made entirely of reinforced concrete only began in the 1950s and the first code to include seismic safety checks was only published in that same decade, in 1958.

In terms of architectural design, the concept of a single building was retained (apart from the possible addition of a second building to house the canteen, kitchen, changing rooms and gymnasium, or other isolated buildings or groups of buildings), with a linear configuration and a "side corridor" or "central corridor". In the first case, the layout is similar to that of the preceding constructive type, with a masonry structure, and, in the second case, the corridor runs down the middle with a line of classrooms on either side.

The structural system of the buildings that form the main body containing the classrooms and administrative services generally consists of a reticulated reinforced concrete structure, with longitudinal porticoes running along the façade and corridor, made of pillars and beams that support the loads associated with the slabs. As a rule, the building has no cross beams and the connection between the longitudinal porticoes is only guaranteed by the reinforced concrete slabs. The floor slabs are generally lightened in the classroom areas, while the ones in the corridors are solid. The buildings are divided lengthwise into bodies measuring between 15 and 25 metres, separated by narrow expansion joints of reduced thickness (usually 1 to 2cm). The sloping tiled roofs are supported on reinforced concrete porticoes built on the extension of the lower porticoes, or on precast reinforced concrete trusses supported on these same lower porticoes. In these reticulated reinforced concrete structures, situations are frequently found in which pillars are supported on beams, particularly when the layout of the various spaces differs from floor to floor.

The dimensioning of the pillars only took into consideration simple compression, without considering bending moments. The steel frames of the beams and pillars are smooth, revealing a deficient detailing and a lower density of stirrups, which suggests limited ductility.

In the façades and longitudinal interior walls, the solution adopted for the lighting and ventilation of the classrooms and corridors was based on continuous windows interrupted only by pillars, in the upper parts of the walls, and supported on smaller walls in their lower parts. This arrangement of the masonry braces the pillars laterally in their lower part, while keeping them free in their upper part. In the event of an earthquake, such an arrangement may favour the occurrence of the short column effect.

As far as the seismic behaviour of the buildings is concerned, mention should also be made of situations where the arrangement of the masonry work sometimes creates horizontal irregularities due to its asymmetrical distribution, or vertical irregularities because the floors are totally or partly open.

2.4 Reinforced concrete buildings after the introduction of the 1958 Seismic Code but before the 1983 RSAEEP

The school construction programme, together with the models for the mass construction of school buildings developed in England in the postwar period, influenced the conception of the Portuguese programmes for responding to the need for the mass construction of school buildings from the mid-1960s onwards.

In the development of the British programmes and the respective designs for school buildings, working groups were set up to interpret the new pedagogical requirements and to establish criteria for a rigorous control of costs. Designs were naturally closely linked to the production phase and involved research into new architectural and construction solutions supported by the prefabrication and rationalisation of the construction components.

The English case was distinguished by the technological developments that it proposed, based on prefabricated construction elements, which led to the creation of a modular construction system. The multiple hypotheses of assembling these components made it possible to design different types of buildings for educational purposes. In parallel to this, a set of rules were developed for buildings that were constructed in the traditional manner, in order to rationalise their construction process (dimensional control of the materials used, standardisation of their components, limited and standardised components).

The experience of the mass construction of school buildings in England in the postwar period had become an important benchmark because of the way in which it reconciled architectural solutions that were highly effective in both constructive and economic terms, based on prefabrication and the rationalisation of construction, with the newly emerging pedagogical requirements. International cooperation with intergovernmental bodies enabled the sharing of experiences with other working groups responsible for the construction of school buildings in different countries, as well as with such bodies as the OECD Development Section, Building Research Station or the CLASP Consortium (Alegre and Heitor 2013).

In Portugal, where school construction made use of traditional methods, the designs that were studied were themselves based on the English experiences in regard to the rationalisation of this process, adopting the same principles of standardisation and uniformisation of the construction components. The Portuguese case did, however, differ from the English experience by proposing a standard design to be implemented in all of the different regions of the national territory (Saint 1987, Alegre and Heitor 2013).

In the period in question (1958 to 1983), the school buildings that formed part of the network of secondary schools consisted of what were then called "lyceums", "technical schools" and "preparatory schools". These schools were designed at JCETS until 1969, and thereafter at the *Direcção-Geral de Construções Escolare*s (DGCE – Directorate-General for School Constructions), under the supervision of the Ministry of Public Works. Subsequently, after this, these buildings were designed at the *Direcção-Geral de Equipamentos Escolare*s (DGEE – Directorate-General for School Facilities), under the supervision of the Ministry of Education.

There was some diversity in the designs, reflecting the transformations that had taken place in the conception and construction of school buildings. In order to achieve greater rationality, speed and economy in the construction process, a standardisation strategy was followed, based on the conception of a standard design. This involved the creation of the following designs: the 1st Standardised Design, also known as the "Mercury Project" (1960); the 2nd Standardised Design for the lyceums of Cascais and Vila Nova de Gaia (1964), the 3rd Standardised Design for the industrial and commercial schools (1964) and the 4th Standardised Design for Liceu Dom Pedro V, in Lisbon, and Liceu Garcia da Orta, in Porto (1968); the Standardised Study applied to the Preparatory School for Secondary Education (1968); and the Standardised Study for Lyceums (1968), which was given the name of the "lyceum base". The 1st to the 4th Standardised Designs would later be made completely uniform, giving rise to the design known as the "technical base".

Also drawn up was the Basic Study for the Preparation of Designs for the Premises of Preparatory and Secondary Schools (EPI-2 – 1976-77), which gave rise to the "3x3" standard design, resorting to the use of prefabricated modular components and industrialised construction systems.

From the late 1960s onwards, in order to respond to the growth in the school population and the need to expand the school network, the solution based on the construction of pavilions, which had started with the 2nd and 4th Standardised Designs, assumed ever greater importance. The "lyceum base", "technical base" and "3x3" standard designs were continuously replicated nationwide, with their structures being based on a group of autonomous blocks linked by covered external galleries, which enabled the building to be adapted to different situations.

Some special projects were implemented at the same time, most notably the present-day secondary schools of José Gomes Ferreira in Lisbon, designed by the architect Raul Hestnes Ferreira (1974-1980), Professor Herculano de Carvalho, also in Lisbon, designed by the architect Manuel Tainha (1972-1984), and Padre António de Macedo, in Vila Nova de Santo André, designed by the architects Maria do Carmo Matos and José Maria Torre do Vale (1978).

2.5 The 1st Standardised Design for industrial and commercial schools, "Mercury Project" (1960)

The 1st Standardised Design, intended for Industrial and Commercial Schools, also known by the name of the "Mercury Project" (1960), was developed by the technicians from JCETS, being based on a linear configuration of the main building with several bodies joined to it. The building took the form of a "central corridor", which was to be used for teaching and administrative purposes, connected, either directly or by means of a covered gallery, to a secondary two-storey body, with a gymnasium on the upper floor, while the canteen, kitchen and changing rooms were located on the ground floor.

The blocks that formed the main building spread lengthwise with three to seven openings, being separated by expansion joints that were roughly 2cm thick. In most cases, the blocks had two floors, a roof slab and a sloping roof. The solution was dictated by the need to save costs, consisting of rigorous structural measurements that coincided with the classroom module (7.0 by 8.0 metres), thus allowing for a standardisation of the constructive elements (window and door frames, carpentry work, roof, finishes, etc.) and a better and more economical technical planning of the construction. Besides the economic benefits that this design brought, the aim was also to achieve greater speed in the building's construction.

Figure 8: Liceu de Rainha D. Leonor (1957-1961), Lisbon. Diagonal structural element in reinforced concrete portico designed to ensure adequate seismic resistance of the building in the transverse direction.

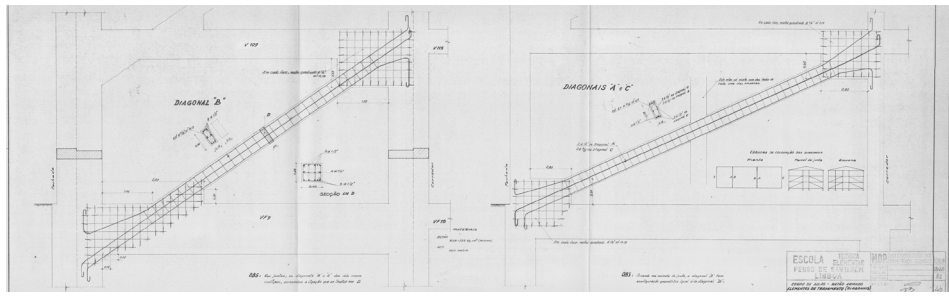

Figure 9: Escola Secundária Pedro de Santarém (1959-1970), Lisbon. Drawing of the original design with the diagonal structural element in reinforced concrete.

A reticulated reinforced concrete structure (pillar-beam) was considered, whose measurements were established by dividing the space of the classroom into two equal parts (4.00m). The classroom was also sometimes divided into three parts (2.7m), in order to standardise the exterior frames of the doors and windows in the façades.

Between 1957 and 1960, this solution was studied by the National Laboratory of Civil Engineering, which examined the building's behaviour when subjected to horizontal forces resulting from the effects of winds and earthquakes.

Liceu de Rainha Dona Leonor (1957-1961) was designed by the architect Augusto Brandão from JCETS, with a structural project drawn up by the civil engineer João Manuel Madeira Costa. Its development represented a trial of the solutions that would then be incorporated into this 1st Standardised Design, anticipating the structural solutions that later came to be adopted and widely used in this standard design.

The main building, intended for classrooms and administrative services, has a reticulated structure, with longitudinal reinforced concrete porticoes in the façades and on each side of the corridor. These porticoes support the slabs of the floors, which are lightened in the classrooms and solid in the corridors.

The structural system considered for withstanding seismic activity along the length of the building consists of two porticoes in the façade and two porticoes in the corridor, which were designed to withstand horizontal forces in this direction, with a seismic coefficient of 0.10.

For transverse seismic activity, the designers planned a more unusual structural system in which the solid corridor slab takes the form of a horizontal beam, making it possible to absorb the transverse inertia forces and redirect them towards transverse reinforced concrete porticoes placed at the ends of the blocks (separated by the expansion joints).

The reinforced concrete porticoes (with two placed in each expansion joint between the blocks) are braced diagonally by reinforced concrete structures that significantly increase their capacity to withstand horizontal forces. This bracing thus makes it possible to redirect the forces of inertia from the floors to the building's foundations.

Leaving aside the solid slabs in the classrooms under the respective end walls, the only cross beams to be found in the building are situated in the alignments of the joints, in other words in the porticoes with the already-mentioned diagonal bracing.

2.6 The 2nd, 3rd and 4th Standardised Designs (1964, 1966)

These studies were developed by JCETS, once again under the responsibility of the architect Augusto Brandão. They represent a new typological approach, by proposing a new design for the circulation of people within the building, eliminating the corridor as a space of distribution between the teaching areas and doing away with the linear organisation of the school building. The teaching and non-teaching areas are organised into functional nuclei housed in autonomous pavilions.

In the 2nd and 3rd Standardised Designs, the blocks are constructed in the form of a reticulated reinforced concrete structure (based on the system of beams-pillars-slabs) and a roof with a translucent sheet. The slabs are solid both on the stairs and in the circulation areas, corresponding to consoles in the interior galleries of the pavilions containing the classrooms.

In the 4th Standardised Design, a structure is proposed that consists of a modular set of flat reinforced concrete porticoes, spaced at a distance of 2.66 metres, braced and held solidly in place through floor slabs (prefabricated elements) supported on the beams of the porticoes. The dimensions for the spacing of the structural elements were based on the size of the classroom, corresponding to a third of its length (8 metres), a solution that had already been used in the 1964 study.

The reinforced concrete elements are left visible, both outside and inside the pavilions and the dividing walls have no structural function. Inside, the finishing of the dividing walls is in visible brick, while the masonry exterior walls are plastered and painted white.

The roofs are made of fibre-cement profiled sheets, directly supported on the structural elements and gutter beams, which are in fact overly large for this purpose and are thus a prominent feature in the exterior image of the pavilions.

Outside, the building expresses the rhythm imprinted by the structural modulation of the visible reinforced concrete porticoes, interrupted by the joinery work of the window and door frames, standardised in terms of their design and dimensions. The vertical elements in visible reinforced concrete have small cross beams at their ends, which support another beam running the whole length of the building, on which the roof is supported.

2.7 Standardised Study for Lyceums (1968)

The structural solution employed in these school buildings was made of reinforced concrete, with slabs covering a large opening, supported on reinforced concrete porticoes. It is a flexible solution from the architectural point of view, allowing for alterations to the interior compartments, if necessary.

The construction and design options that this solution presented sought to respond to the requirements imposed at the level the building's execution and the reduction of the respective costs. First of all, the choice was for the pavilion-type construction, worked on vertically and taking advantage of the division of the bodies through expansion joints to adjust the heights and establish a difference between the bodies. Such a strategy made it possible to adapt the school building to different topographical and geological characteristics, as well as its exposure to sunlight and its different accesses.

On the other hand, the reinforced concrete structure was designed with narrow gaps and supported on continuous spread footings, enabling the building to be constructed on terrains with inferior geotechnical characteristics and thus dispensing with the need for indirect foundations (Matos 1968).

The modulation of the buildings made it possible to reduce the diversity in the number of constructive elements, namely the existence of a single beamed opening, a single dimension for the pillar, two types of walls and two types of interior doors, and the use of three types of standardised bricks and walls. As a whole, with the establishment of a maximum weight of 500 kg for each element, this option made it possible to resort to the use of prefabricated elements. In the design phase, the prefabricated pieces were designed in such a way as to take into consideration the efficiency of their transport and their protection during the construction work, the gaps in their assembly and their connections with the construction work undertaken according to traditional methods.

The construction of the roof made use of a waterproof membrane of thick rubber (1mm), covered with prefabricated slabs, supported on isolated points that protected the membrane against the direct action of the sun's rays.

The development of this design took into account a new philosophy with regard to reducing the variety of constructive elements, facilitating their ordering and storage and the execution of the building work, through a modelling of the various construction components.

3. Conclusions

From the beginning of the twentieth century until the beginning of the 1980s, the construction of school buildings for secondary education accompanied the evolution of pedagogical criteria and the corresponding hygienic and architectural requirements, as well as the economic and social development of Portuguese society and the technological evolution of the civil construction sector.

In its initial phase, when secondary education was directed towards urban and economically privileged environments, the buildings were designed and constructed with great quality, resorting to traditional solutions (in masonry and wood) and some innovative solutions (such as the recourse to steel elements (trusses and beams) and some experiments

with reinforced concrete). Later, accompanying the ideology of the Estado Novo, the construction of school buildings was extended to practically the whole of the national territory, resorting to austere, but robust architectural solutions of good constructive quality. The use of reinforced concrete elements for beams and slabs, which were already being used in many other contemporary constructions, allowed for significant alterations in the architectural layout of school buildings. With the need for the mass construction of school buildings from the mid-1960s onwards, studies were initiated for the creation of standardised solutions in which the constructive choices sought to respond to a series of requirements generally imposed by solutions that brought advantages at the level of the execution of the buildings and a reduction in the respective costs. As was the case in the rest of the civil construction sector, widespread use was made, in these solutions, of structural elements made of reinforced concrete, in which masonry walls were only used as partitions and had no structural function. The use of prefabricated structural elements, which was unusual in other areas of civil construction, arose from the need to rationalise costs and was made possible by the design of modular solutions that were then replicated all across the national territory.

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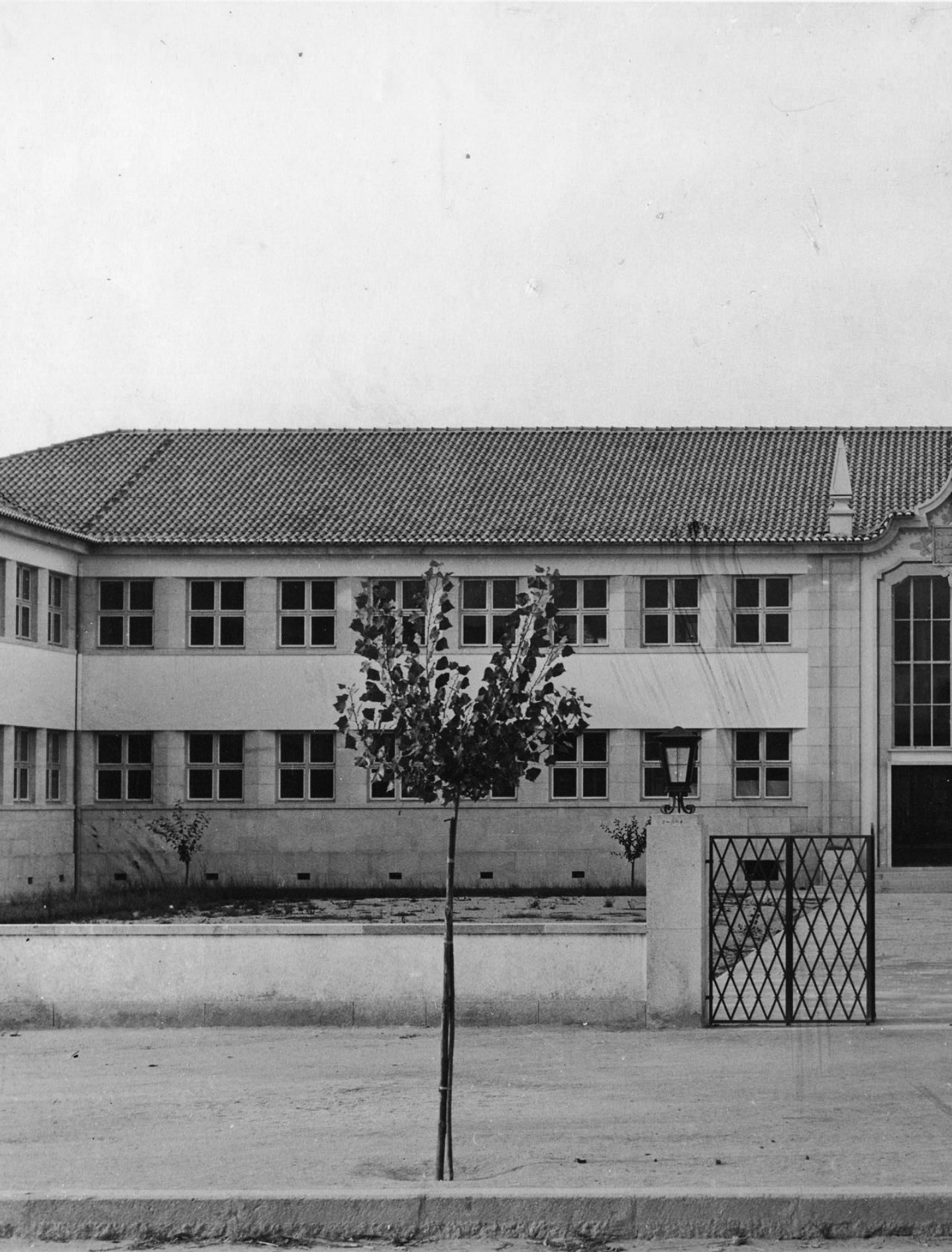
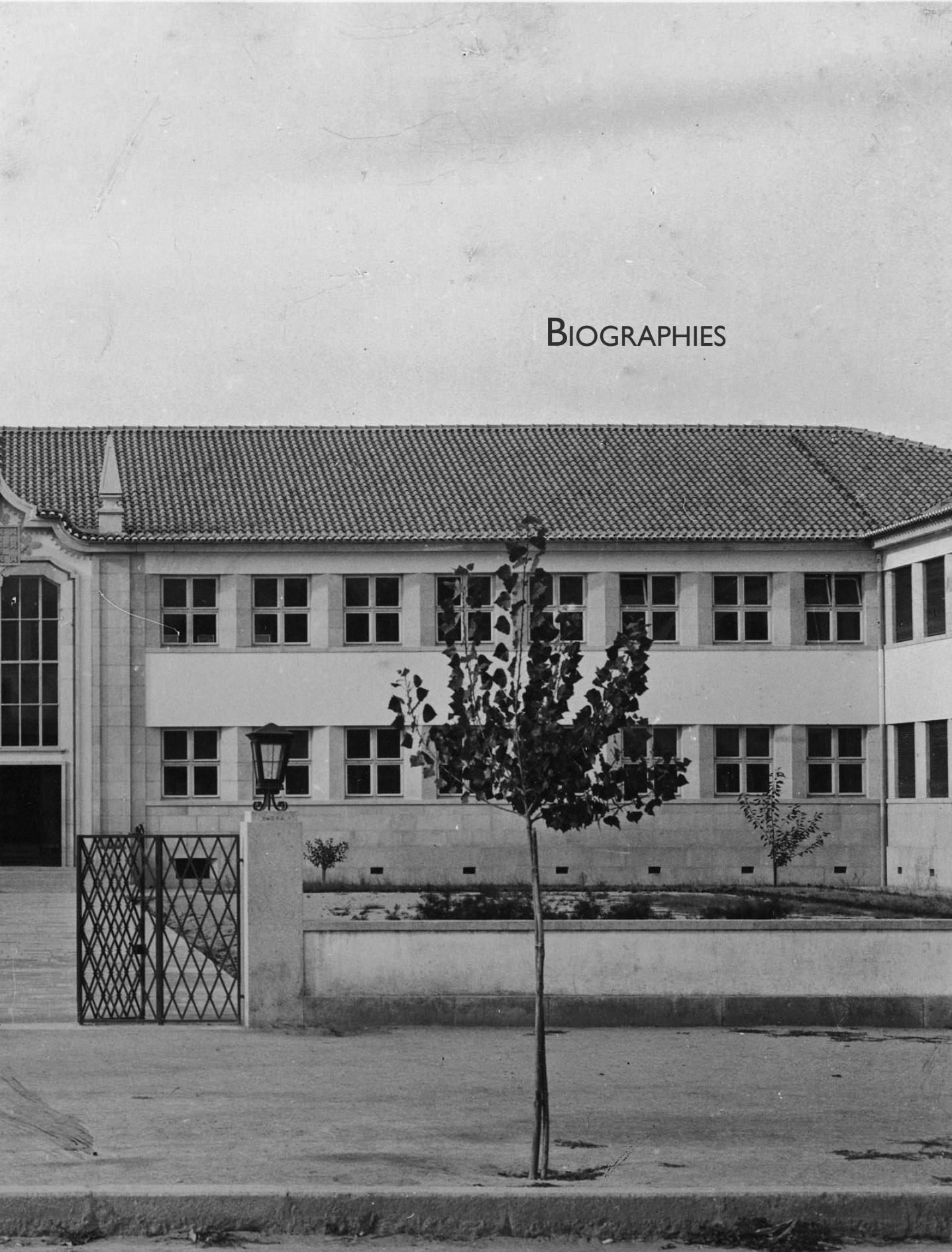


Biographies



Legend

Figura G: Liceu Alves Martins

Biographies

Alexandra Alegre

Alexandra Alegre is an assistant professor of architecture at Instituto Superior Técnico, University of Lisbon. Her research interest is in the field of Portuguese architecture, focused on the history of architecture, construction and urban history, planning and design project process, and issues related to educational and recreational architecture and childhood studies.
Between 2010 and 2013 she participated in the research project IN_Learning and since 2016 she is a researcher of the international project Re-Use of Modernist Buildings - Design Tools for Sustainable Transformations, Programme Erasmus+ Keyaction: Cooperation for innovation and the exchange of good practices. She is the principal researcher of the project Atlas of School Architecture in Portugal _ Education, Heritage and Challenges (PTDC/ATP-AQI/3273/2014), funded by Fundação para a Ciência e Tecnologia.
Author of several national and international papers published in journals such as Construction History Journal and Planning Perspectives, and session chair in international conferences (Docomomo 2016, EAHN 2018). Author of the book Arquitectura Escolar. O Edifício Liceu em Portugal (1882-1978), published by Fundação Calouste Gulbenkian in 2012.

Ana Fernandes

Ana Fernandes is an architect and researcher at Instituto Superior Técnico.
Graduated with a Master degree in Architecture in 2013, with the thesis entitled "BNU Headquarters Building. Adaptive reuse in the context of Baixa Pombalina: from Bank to Museum" aiming at contribute to the preservation of the memory and integrity of the building and to inform architectural projects of renovation and refurbishment that were being planned.
Ana started working as an architect in the Atelier Teresa Nunes da Ponte, from 2013 to 2016 collaborating in architectural competitions, editorial projects and other works.
In 2016, Ana initiated her research activity, in the multidisciplinary team of the Atlas of School Architecture in Portugal - Education, Heritage and Challenges, which aims to provide a deeper understanding of school architecture in Portugal.
This project is funded by the Portuguese Foundation for Science and Technology – FCT and is developed in Instituto Superior Técnico with the collaboration of the General Secretary of the Ministry of Education and Science.

António Sousa Gago

Assistant Professor at Instituto Superior Técnico (IST), Department of Civil Engineering, Architecture and Georesources (DECivil).
He is, currently, Executive Director of DECivil and Director of DECivil Laboratories and a Senior Fellow with the Specialist Degree in Structures of the Portuguese Engineers Society.
He was the founder and is currently the Vice-President of the Portuguese Society for Construction History Studies (SPEHC).
He develops research activity at IST, as a member of the CERIS research center, with work in the scientific areas of Structural Analysis, Seismic Assessment of Construction and Construction History.
He teaches at IST the structural courses of the master courses in Civil Engineering and Architecture and supervised several master's and doctoral studies in Civil Engineering and Architecture.
In the scope of his activity in analysis and design of structures (design of new constructions and strengthening of old constructions) has worked with special emphasis on masonry structures. Nevertheless, is author of several design projects of reinforced concrete structures, structural steel and timber structures. He was consultant for Seismic Assessment of Masonry Buildings in the recently "Parque Escolar" rehabilitation program of the secondary schools. He is author of several publications in National and International Scientific Journals, as well as, in National and International Scientific Conferences.
He organized, and taught, several courses on rehabilitation and structural reinforcement of old buildings and was lecturer in scientific and technical events.

Áurea Adão

Áurea Adão holds a degree in History from University of Lisbon, the "Docteur du 3ème cycle en Sciences de l'Éducation" from the University of Bordeaux II (France) and a doctor degree in Education (History and Philosophy of Education) from the University of Lisbon.
She is a retired researcher from Calouste Gulbenkian Foundation and still works with UIDEF of Institute of Education from the University of Lisbon.
She was Professor at the Lusófona University oh humanities and Tecnologies (1997-2009) and deputy-dean for Research and Technology (2008-2009).
She was Dean of the Lusófona University Baltasar Lopes da Silva, em Cabo Verde (2006-2007).
She was awarded with the "Dr. Rui Grácio" Prize in 1997 by the Sociedade Portuguesa de Ciências da Educação.
From 1993 to 1995 she was a member of the Board of the International Standing Conference for the History of Education (ISCHE).
Member of the Associação de História da Educação de Portugal e da Sociedade Portuguesa de Ciências da Educação.
She Co-organizes national and international scientific events in the field of Educational Policies and History of Education.
She author, co-authors and is responsible for a diverse field of studies, focused on History of Education, published in several books and national and international journals.

Carolina Ferreira

Carolina Ferreira is an architect and a PhD Student at the Faculty of Sciences and Technology, University of Coimbra, in Portugal, where she attends the PhD program Architectural Urban Culture, with the support of FCT. She also collaborates with the project "ATLAS of School Architecture in Portugal – Education Heritage and Challenges" and with the multidisciplinary research group "DRAPES – Design, Research and Practice in Educational Spaces European Network".
As a researcher she is working together with Gonçalo Canto Moniz on educational spatialities by analysing school and urban design from the students' perspective, in central region of Portugal, from a cross-disciplinary approach. In this sense, she is developing cartographic analysis and participatory methods so as to build a new tool for future school and urban design towards an alternative concept of school. She is mainly interested in the way architecture research can improve educational spatialities, as well as improve the public system bases on a complex network where schools, urban space, educational policies and people take place.
She has presented her research findings in international conferences namely in Santiago do Chile (AIHU, 2016), Copenhagen (NERA, 2017), Coimbra (RMB, 2108) and New York (AERA, 2018).

Catherine Burke

Catherine Burke is Professor of the History of Education. She is an historian currently researching cultural and material histories of educational contexts and of childhood in the 19th, 20th and 21st centuries. Her research examines the relationship between innovation in teaching and the design of formal and informal learning environments; the view of the child and young person in the design of education; the history of 20th century school architecture and its pioneers. A major focus of the research is bringing an historical awareness to current initiatives to 'transform' education via school building renewal.She has published widely on the history of school architecture, the participation of children in the design of school, as well as on contemporary school architecture. For many years she was editor of the Sources and Interpretations section of History of Education Journal and is currently, with Professor Jane Martin of the University of Birmingham, joint series editor of the Routledge Progressive Education series. Catherine's book, A Life in Education and Architecture. Mary Beaumont Medd 1907-2005 published by Ashgate in 2013, won the History of Education Society UK Book prize in 2014.

Francisco Teixeira Bastos

Francisco Teixeira Bastos is Assistant Professor of Architecture at Instituto Superior Técnico (IST), University of Lisbon. He his involved in teaching at both the undergraduate and graduate levels as well as in research and other outreach activities. As a CiTUA membe, his research activity is concentrated on Practice-based research, and involves a reflection upon the state of architectural and urban education and practice and outcome measures for the future; evaluation of design protocols, strategies and procedures; development of integrative design platforms and collaborative design tools. Francisco is a registered Architect in Portugal with practice experience since 1986. After practicing with Manuel Vicente (1989-1994), he created the Atelier dos Remédios in 1997, together with Madalena Cardoso de Menezes. They are involved in private and public works such as housing and schools. Their work has been featured in several international magazines and has been presented in lectures in Europe, China, and Latin America. They won the Prémio Valmor 2011 prize (Lisbon City Council, Portugal). In 2012 integrated the OCDE SITE for Good Practices for Education with Dona Leonor High School Modernization, and was highly commended award 2013 (WAN prize) and 2015 (AR prize) for education with "Dona Leonor High School Modernization".
Francisco is a member of the Portuguese comity for BIM normalization, since 2015.

Gonçalo Canto Moniz

Gonçalo Canto Moniz (Porto, 1971) is a researcher of the Cities, Cultures, and Architecture (CCArq) Research Group and was member of the Executive Board of the Centre for Social Studies of the University of Coimbra (2014-2017). Graduated on Architecture at the Department of Architecture of Faculty of Sciences and Technology of the University of Coimbra in 1995, where he is Assistant Professor and editor of e|d|arq editions and JOELHO, Journal of Architectural Culture. Obtained his PhD degree in Architecture at the University of Coimbra in 2011, based on his academic thesis: "Modern Architectural Education.
He coordinates the european project URBiNAT "Healthy corridor as drivers of social housing neighbourhoods for the co-creation of social, environmental and marketable NBS", with 28 international partners, supported by H2020. He is researching and teaching about the reuse of modern buildings and its impact on the urban context, in the frame of the european project Reuse of Modernist Buildings, supported by Erasmus Plus. He participates in the national project "Atlas of school buildings in Portugal, supported by FCT. He has been publishing about modern architecture in Portugal, namely about school buildings and architectural education. He is author of the book "Arquitectura e Instrução: o projecto moderno do liceu, 1836-1936" (e|d|arq, 2007).

Jorge Proença

Associate Professor at Instituto Superior Técnico, University of Lisbon (IST-UL), Department of Civil Engineering, Architecture and Georesources (DECivil). Since he obtained his PhD in Civil Engineering in 1997, he has been involved in different university management positions, the latest being the coordination since 2015 of the integrated master course in Civil Engineering at IST-UL. He develops his research activity at IST, as a member of the CERIS research centre, with work in the scientific areas of the Vulnerability and Risk Assessment, Design and Strengthening of Building Structures, Structural Dynamics and Experimental Methods in Structural Engineering. His research activities in the areas of the Seismic Vulnerability Assessment and Strengthening of Building Structures can be exemplified by the scientific and technical consultancy he carried out both for ACSS, IP (Central Administration of the Healthcare System) and for the General Secretariat of the Ministry of Education / Parque Escolar, EPE. These activities have led to the seismic assessment of different major hospitals in mainland Portugal, to the development of an expedite seismic vulnerability assessment method for building structures (ICIST-ACSS methodology), to the seismic vulnerability assessment of numerous school buildings and to the scientific and technical consultancy for the seismic vulnerability assessment and strengthening of school buildings (for Parque Escolar), together with António Gago. He has been lecturing graduation and master classes in the Civil Engineering; Architecture; Engineering and Industrial Management; and Mining and Georesources courses at IST-UL. He has been involved in book publishing and contributed chapters to published works, in addition to publishing articles in the proceedings of scientific meetings and in national and international journals. He is author of over 100 technical reports.

Justino Pereira de Magalhães

Justino Magalhães is Historian of Education; Full Professor at the Institute of Education of the University of Lisbon Member of the Research and Development Unit in Education and Training (UIDEF); Contributor of the History Center of the University of Lisbon Main Areas of Research and Publication: History of Education; History of the School; History of Literacy; History of School Manuals; History of Educational Institutions; History of the Educational Site; History of the Pedagogical Municipality.

Maria Bacharel

Maria Bacharel is a post-doc researcher in Architecture at Instituto Superior Técnico. She holds a Master Degree in Architecture from IST (2007), after which she practiced as an architect for several years, focusing mainly on the rehabilitation or refurbishment of public buildings.
She was awarded an individual doctoral FCT grant for the pursue of her PhD in Architecture, which was completed in 2015 at IST under the title "In-between Formality and Informality. Learning Spaces in University Context". It was awarded the "Glenn Earthman Outstanding Dissertation Award" by the International Society of Educational Planning in 2016.
Her research interests are focused on the morphology and characteristics of knowledge transmission scenarios, as well as their practiced pedagogies, social and cultural behaviours.
She has worked in the IN_LEARNING research project, which focused on the space-use analysis applied to university learning spaces. Since 2016 she is part of the ASAP-EHC – Atlas of School Architecture in Portugal – Education, Heritage and Challenges research team.
She was chair of the 49th Annual Meeting of the International Society for Educational Planning in October of 2019 (http://isep.info), member of the organizing committee of the 11th International Space Syntax Symposium held in Lisbon, 3rd to 7th July 2017 (www.11ssslisbon.pt). among others.

Mark Dudek

Mark Michael Dudek is a British architect, designer, writer and educator. Dudek is the founder and principal of Mark Dudek Associates, established in London in 1991 with considerable expertise in the design of schools, children's centres and early-years facilities. His built projects include The Glasshouse Café for the Royal Horticultural Society in Surrey, UK, The Wyndham Nursery and School for Children with Learning Difficulties at Wyndham, Richmond upon Thames, UK and Thomas MacDonagh's Heritage Centre in Cloughjordan, Irish Republic.
He has been key-note speaker at numerous conferences all-over the world on the subject of schools and children's spaces, and was a Research Fellow at the School of Architecture, University of Sheffield between 2002 and 2014. He has written a number of influential books on school buildings and children's urban culture, the most recent being How Children Learn from Architecture and the Environment, (to be published 2019 by Routledge). Dudek's research is recognized as providing some of the strongest evidence of the links between architectural space, pedagogy and educational outcomes.

Patrícia Lourenço

Patricia Lourenço is an architect and invited assistant professor at IST, lecturing Architecture Project in the second year of the integrated master in Architecture. She obtained her degree in architecture in 1996 from Faculdade de Arquitectura da Universidade Técnica de Lisboa. In 2002 she obtained her master degree in Architecture at IST, Universidade de Lisboa, researching on sustainable construction materials, with a thesis on the economic and technical viability of re-using raw earth construction in Portugal. Since then she has been involved in the research and dissemination of practices to promote raw earth heritage conservation as well as its construction techniques mapping and updating, by participating in research groups, books and articles writing and revision, conferences and workshops.
In 2015 she concluded a PhD in Architecture, at IST, researching on enhancing buildings' sustainability through user oriented strategies and use data monitoring. Case study: School buildings.
The current primary areas of research include 1) Evidence Based Sustainable Architecture, 2) Post occupancy evaluation & buildings in use monitoring 3) Users behaviour data for modeling and simulating buildings' energy performance.
Dissemination of results include journal and conference articles, participating as guest consultant for the European Council of Architects regarding the theme "Responsible Architecture".
She is currently participating on the following research projects at IST: 1) RMB – re-use of modernist buildings (www.rmb-eu.com); 2) ATLAS of School Architecture in Portugal – Education, Heritage and Challenges (PTDC/ATP-AQI/3273/2014).
She is a licenced professional architect since 1999, maintaining a professional practice since then.

Teresa Heitor

Teresa Heitor was born in Lisbon, Portugal in 1959. She is Full Professor of Architecture at University of Lisbon, Instituto Superior Técnico (IST). She obtained a first degree in Architecture (1982, Escola Superior de Belas Artes de Lisboa, PT), a Master degree in Urban Design (1984, Joint Centre for Urban Design, Oxford Brooks University, UK); a PhD in Territorial Engineering (1997, Technical University of Lisbon, Instituto Superior Tecnico, Lisbon, PT) and habilitation in Architecture (2007, University of Lisbon, Instituto Superior Tecnico, Lisbon, PT).
Currently she is the chair of Architecture at IST. She has been teaching post- and undergraduate students in Architecture at IST for the past 20 years. In that time, she has been responsible for both the IST 5-year Master Program in Architecture (1999-2003; 2005-08; 2010-16) and the Doctoral Program in Architecture (2008-13) and has also supervised a large number of PhD students as well as dissertation projects from Master programs. She has been appointed to examine a large number of PhD thesis and to take part in Habilitation Committees both internally and externally.
She has research expertise in the area of spatial analysis within the theoretical and analytical framework known as 'space syntax' for studying the relationship between people and their built environments. Her research interests are focused on the relationship between space, form and function and the development of models capable to simulate the implications of new social demands as well as on self-assessment tools to be applied along the occupancy stage. Her current research activity aims at the understanding of contemporary socio-spatial aspects of learning in urban settings, i.e., the places where structured and unstructured modes of learning, social interactions and re-presentation of knowledge can take place. Particular attention is given to technology-enabled active learning and research environments.

She has also an interest on innovative learning practices applied to real-world design problems for which she has published a range of articles.
At the IST Doctoral Program in Architecture she runs the Space-use Analysis module, which examines the interface between built form and social outcomes and the impact of spatial design on people and social behaviors inside a range of complex buildings such as schools, universities and workplaces.
She has been involved with the OECD Directory of Education through the Centre for Effective Learning Environments (CELE) in different research and consultancy activities in the field of educational buildings performance and quality. Since 2005 she integrates the Group of National Experts on Evaluation of Education Facilities (GNEEEF) and coordinated the International Pilot Study on the Evaluation of Quality in Educational Spaces (EQES) (2007-2010). Between 2010 and 2012 she served as the Portuguese Delegate to OECD-CELE.
She integrates the steering committee of the International Space Syntax Symposia network and chaired the organizing committee of the 11th International Space Syntax Symposium held in Lisbon, 3rd to 7th july, 2017 (www.11ssslisbon.pt).
In addition to her teaching and research activity she is regularly invited to disseminate knowledge to policy-makers and the general public.
She regularly undertakes higher education strategic evaluations and peer review assessments for European and national research/scientific councils.

Images Sources

Abbreviations

AF - Arquivo Fotográfico

AH - Arquivo Histórico

ASAP_EHC - Atlas da Arquitectura Escolar em Portugal_ Educação, Património, Desafios

CMP-GU - Câmara Municipal do Porto - Gabinete de Urbanização

DGOTDU - Direcção Geral do Ordenamento do Território e Desenvolvimento Urbano

EMN-FCG - Colecção Estúdio Mário Novais I FCG –Biblioteca de Arte e Arquivos

NATCE - Núcleo de Arquivo Técnico de Construções Escolares

SGEC - Secretaria-Geral da Educação e Ciência

Pages	Figures
Cover	NATCE-AF-SGEC, undated
Part I	A: NATCE-AF-SGEC, undated
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14	B: NATCE-AF-SGEC, undated
Part II	C: NATCE-AF-SGEC, undated
60	D: NATCE-AF-SGEC, undated
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