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Modernism Outbound.
Architectures and Landscapes of Agrarianism
ed. by Axel Fisher, Aleksa Korolija & Cristina Pallini

Modernisme de plein air.
Architectures et paysages de l'agrarisme
sous la dir. de Axel Fisher, Aleksa Korolija & Cristina Pallini

Abstract In 1944, in the context of the electrification of Portugal, the *Hidroeléctrica do Cávado* company (HICA) started exploring the Cávado River. Over two decades, HICA constructed five hydroelectric systems, including dams and power stations, but also small settlements to house the company's workers, technicians, and managers.

Through a systematic analysis of these hydroelectric architectures, this paper identifies the underling rationale and principles involved in HICA's design decisions. It presents the initial studies that helped determine the location of the dams as well as the constructions built around them. The paper's argument is focused is on the settlements built for power station workers, which were fundamental to the construction and maintenance of the related infrastructure. The paper investigates the domestic nature of the settlements, the circumstances that surrounded their construction and the architects involved in the process.

Over and all, these projects initiated a process of deep transformation of the Portuguese landscape, in which the HICA's lacked a clear and identifiable vision for the Cávado Valley, whose main concern was to maintain absolute control over the landscape and the physical layout of their power plants and workers' settlements.

Keywords settlement, hydroelectric, landscape, housing, dam

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The Five Residential Settlements Built by Hidroeléctrica do Cávado. The Formation of a New Landscape

In 1944, the Portuguese state put in place a law that would enable large-scale electrification of the country and set in motion a plan that would divide Portugal into three main energy-producing areas: the north, on the Cávado, Douro, Paiva, and Lima Rivers; the centre, on the Tejo, Zêzere, Ocreza, and Mondego Rivers; and the south, on the Guadiana River. The study that was carried out established the basis for the creation of the hydroelectric companies that would be responsible for operations on the main rivers: the *Hidroeléctrica do Cávado* (HICA), the *Hidroeléctrica do Zêzere* (HEZ), and the *Hidroeléctrica do Douro* (HED). These three companies then began work on the large-scale hydroelectric projects that would initiate a process of profound transformation of the Portuguese landscape.

Between 1944 and 1965, HICA[1] constructed five hydroelectric systems: at the Venda Nova reach on the Rabagão River (1951); at the Salamonde and Caniçada reaches (1953 and 1955 respectively) downstream from the confluence of the Cávado and Rabagão Rivers; at the Paradela reach on the Cávado River upstream from Paradela (1958); and at the Alto Rabagão reach on the Rabagão River, upstream from Venda Nova (1965). Dams and power stations were built at each location, together with small settlements to house the workers, technicians, and managers. **(Fig. 1)**

This study considers how the HICA hydroelectric company used this territory. Via methodical analysis of hydroelectric architecture, it identifies the reasoning and principles involved in design decisions. Beginning with Venda Nova Dam, it presents the initial studies that helped determine the dam's location, and identify the constructions built for this first scheme as well as those for the following four schemes: Salamonde, Caniçada, Paradela, and Alto Rabagão. The subject we are looking at is housing, examining the settlements that were built for power station workers. Even though the creation of these settlements was fundamental to the construction and maintenance of the infrastructure of the Cávado hydroelectric scheme, the domestic nature of the settlements and the circumstances that surrounded construction led to an architectural production that was somewhat erratic.

The first dam: Venda Nova

The dam at Venda Nova is located near the village of the same name, now submerged by the reservoir of the Rabagão River,

1 **[Editors' note] The Cávado hydroelectric company was one of the companies created as a result of the 1944 national electrification law (see note 7) to implement a national electric network. In 1969, HICA and all the other Portuguese hydroelectric companies were merged into a single body, the *Companhia Portuguesa de Eletricidade* (CPE, Portuguese Electric Company), renamed *Eletricidade de Portugal* (EDP, Electricity of Portugal) in 1976.**

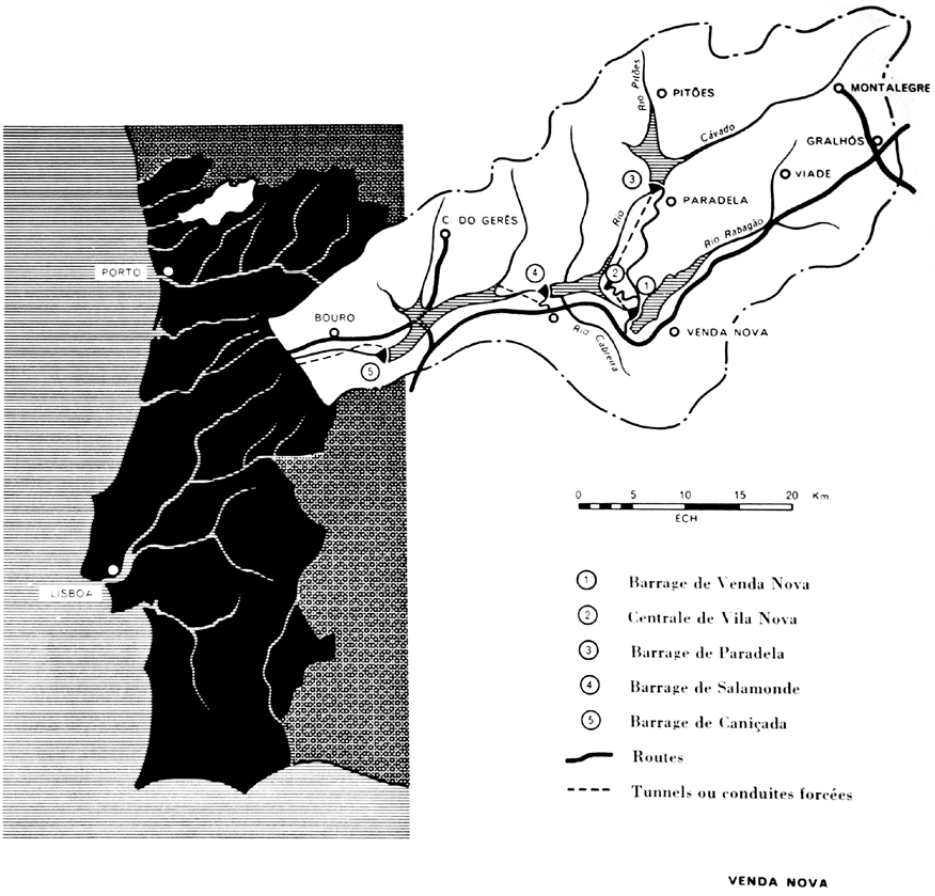

Fig. 1
Location of the hydroelectric facilities along the Cávado River. Source: HICA publication, 1955.

downstream from its confluence with the Borralha River. In 1944, the *Direcção-Geral dos Serviços Hidráulicos e Eléctricos* (DGSHE, Directorate-General for Hydraulic and Electricity Services) — the government department responsible for water and electricity — elaborated drafts and studies in order to establish the technical and economic conditions necessary for the construction of the Cávado hydroelectric scheme. As soon as HICA's technical departments were set up, the construction of the first hydroelectric scheme, Venda Nova, began, based on the government's plans and specifications.[2]

In 1944, Professor Maurice Gignoux[3] (1881–1955) carried out geological studies on the natural gorge that was chosen as the dam site. In 1945, the Casa Rodio company[4] subsequently carried out geological surveys at the site that presented the best topographical conditions for construction of the dam. The study concluded that further reconnaissance was needed downstream. Further analysis of this site was later undertaken by geologist Ernest Fleury (1878–1958).[5]

The conclusions of Professors Gignoux and Fleury, as well as engineer Walter Weyermann of Casa Rodio, were used to select the dam's location and final characteristics. The geological conditions were found to be suitable for the construction of a thick concrete arch dam, with a maximum normal top water level not exceeding an elevation of 700 metres.

HICA now had to decide on the layout of the three main bodies making up the hydroelectric development: the dam, the power station, and the spillway.[6] The layout of these three elements was determined by studies of the terrain's composition, structure, and physical properties. These studies determined the layout of the entire complex, including the positions of the penstock, the tunnel, the construction sites, the power station, and the housing settlement for power station employees.

From the outset, the dam's location, downstream from the confluence with the Borralha River, proved to be suitable for the construction of large-scale projects. A dam of normal curvature was planned, with a radius of 170 metres and a slope of the downstream parameter of between 50% and 80%. An alternative proposal was for a more pronounced curvature (a radius of 150 metres) and a slope of the downstream parameter of between 40% and 80%. These solutions required a level of technical knowledge that was beyond the capacities of Portuguese engineers at the time (Ferreira, 2004). This limitation led to the appointment of foreign, experienced engineers to carry out the dam construction project.

One of the actions that most influenced the construction of the hydroelectric systems built by HICA was the hiring of engineering firm André Coyne et Jean Bellier (ACJB). From the moment the national hydroelectric plan was published in 1944,[7] many foreign engineering firms showed interest in future dam construction projects. Foreign technicians were already active in Portugal before that time, carrying out preliminary

2 **" ... the President, referring to the matter of the studies already carried out, said that he had the following in his possession: general plan, geological survey and draft design for Venda Nova which were previously passed on to him by the sub-secretary of state for commerce and industry" (Acta 1, 1945: 3).**

3 **French geologist, professor of geology at the University of Strasbourg and the Université Grenoble-Alpes, and author of the treatise *Stratigraphic geology* (Gignoux, 1926).**

4 **Casa Rodio, which was set up for the purpose of supporting the construction of large hydroelectric plants in Portugal, carried out geological surveys in 1937 for the DGSHE relative to the dam for Castelo de Bode. The company specialized in geological and geotechnical surveys and reconnaissance, the treatment of embankments for excavations, and grouting for treatment of dam foundations. In 2013, the company was still in existence as *Rodio Portugal, S.A. – Geotecnia de Fundações*.**

5 **For further information on Ernest Fleury, see Ribeiro (1958–60) and Thadeu (1958).**

6 **In relation to the layout of these three main elements, Carvalho Xerez (1952: 400) wrote about the dam at Castelo de Bode: " ... with several solutions available for this layout, depending on the topography of the locale, the capacity needed for the spillway and the most feasible size of the power station."**

7 **Law no. 2002, 26 December 1944.**

Fig. 2 Casa Alvão (photographer), *Workers opening the first roads to access the Venda Nova Dam*, 1946.
Source: ATEDP (Arquivo Técnico EDP, Porto).

studies in the field. Engineer André Coyne[8] (1891–1960) had in fact been working with the DGSHE on a variety of projects since 1942. The first collaborations with foreign engineers were on surveys for the Santa Luzia and Castelo de Bode Dams, the first constructions in the Zêzere scheme (Segura, 1946: 170). This early relationship with the DGSHE may explain the choice of Coyne's firm for the construction of the dam at Venda Nova.

Coyne was at Rabagão on 3 April 1946 (ibid.), at the start of a relationship that lasted up to the construction of the dam at Salamonde (Acta 218, 1949: 1), the plans of which were also produced by his office. This close working relationship allowed HICA to make use of the knowledge and experience of the French engineers, which benefited the Portuguese engineers to the extent that the remaining dams, those of Caniçada, Paradela, Alto Cávado, and Alto Rabagão, were in fact designed by HICA's own in-house engineers.

Work in the field began on 1 February 1946, under HICA engineer Correia de Araújo, with surveys to find the best location for staff facilities. Araújo decided that ten of the houses of the hamlet of Venda Nova, which were to be submerged by the reservoir, should be expropriated to provide temporary housing for the site's construction workers. For the same reason, he also decided to relocate the cemetery and prohibited the construction of new houses (Acta 15, 1946: 1). Two months later, the HICA board decided to build a new settlement (and cemetery) to resettle the hamlet's population.

However, the new hamlet was not completed until three years later, in 1949, after HICA's December 1946 commissioning of architect Januário Godinho to design it (*Ledger…*, s.d.).

The following months, while waiting for the definitive plans for the dam, HICA employees stayed in the expropriated houses while building site access roads to the site. Work began with the construction of the

8 André Coyne, a French engineer, designed around seventy dams in fourteen countries and was head of technical services for large dams in France and president of the International Commission on Large Dams.

diversion tunnel, which is the first stage in the construction of all types of dams. The hamlet's new population of technicians and these two ongoing operations – the building of the access roads and of the diversion tunnel – marked the start of the physical and cultural transformation of the Cávado landscape. **(Fig. 2)**

The contract for this work was awarded before the final plans had been completed,[9] with work beginning in June 1946. The initial specifications considered the fact that adjustments would be made as the work progressed, as there would be a significant learning process resulting in on-site modifications to the plans. This *nuance* of the contract shows that when this process of transformation of the landscape began, there was a high degree of uncertainty about the methods to be applied and of the results to be achieved.

Immediately after the start of these preparatory works, engineer Jean Bellier (1905–86)[10] completed the final plans for the dam (Acta 41, 1946: 2). Due to the international economic difficulties of the time, which affected the purchase of equipment for the construction site,[11] work on levelling the land for the development of the dam site and the construction of employee housing did not begin until February 1948. At that time, work on the provisional diversion tunnel for drying out the riverbed was already underway.[12] This included work on the lining of the tunnel and the injections of cement, as well as the assembly of supports and of the tunnel conduit installed in the section downstream from the surge chamber.

9 Construction of the tunnel was awarded to *Sociedade de Construções Gouveia*, in conjunction with *Entrecanales y Távora*, S.A.

10 An engineer who trained at the *École Nationale des Ponts et Chaussées* in 1928, he was a partner in the ACJB engineering firm up to 1960, after which he was director of that same company.

11 In 1948, the emerging difficulties in monetary exchange between Portugal and the United States caused problems with the supply of materials for the construction site and of equipment for construction of the dam. See, on this subject, Rollo (2004).

12 The initial intention was to build two cofferdams and a provisional diversion tunnel, open on the right bank, but that idea was abandoned due to its complexity and the inherent costs.

In 1948, with the completion of the temporary on-site accommodation and the arrival of the workers, the building contractors were able to start on the construction of the dam and the power station.

Employee housing at the Vila Nova power station (1948–50)

In order to accommodate the staff responsible for operating the Vila Nova power station, HICA built a small hamlet of houses close to the power station building, as well as a Pousada (hostel) and a variety of service buildings. The first mention of the need for additional housing was made at the beginning of 1947 by Coyne, who advised

… locating the housing for the workers, and office buildings, on the right bank of the river. The matter must be carefully studied, as it might not be a good idea to create, so close to the dam, a group of houses that may become permanent once the work has been completed and the Vila Nova power station starts its operations. (Acta 68, 1947: 1)

At that stage, HICA was only discussing the plans for dam construction and was not concerned with building housing for construction workers or future power station employees. The lack of any mention of construction of a settlement in the documentation for 1947 implies that there was no intention to build permanent accommodation. A partial and temporary occupation of the houses that existed in the old settlement of Venda Nova was foreseen instead.

Despite the existence of some housing settlements related to the construction of water supply installations for agricultural use in Portugal after 1936, there are no records of housing settlements near dams in hydroelectric projects before HICA's. The fact that no settlements were included in the initial plans can only be attributed to the lack of experience involved in planning this first very large project. It took some time before HICA understood the necessity of constructing a settlement of this type.

Regardless of HICA's concerns and given the considerable distance between the dam and power station construction

sites, the two independent construction sites, managed by two different companies, provided facilities for both technicians and manual workers. The HICA teams occupied the houses in the hamlet of Venda Nova, with the facilities attached to the construction sites being the first new dwellings to be developed. This infrastructure was provisional, could be dismantled, and was intended for use during successive stages of the hydroelectric scheme.

The first version of the "general plans for the location of the settlement for housing employees of the Vila Nova power station" was discussed by the board of directors and the chief engineer of the civil engineering technical department in January 1948 (Acta 125, 1948: 1). The unsigned plans were drafted by Godinho. Given the characteristics of the regional terrain, with very steep areas of difficult access, the first choice for the location of the settlement was an area in which the valley of the Cávado widened, presenting a bank which could be used for the centre of the development. The project brief refers to a "pleasant, sunny spot, on a piece of mainly arable land, the orientation of which would permit placement of the buildings in an advantageous manner" (*Project brief…*, 1948: 2). The settlement was located on the riverbank opposite the power station. Access was achieved by a bridge with a 40-metre span downstream, from which, halfway up the right riverbank, a road that was approximately 400 metres long was built.

It was expected that the power station, once up and running, would employ a total of thirty-six employees. This included different categories and levels of staff and given the power station's location (several kilometres away from the nearest towns), the ambitious plans included both family dwellings and supporting buildings. The basic plan included one or two houses for the chief engineers,[13] eight for managerial staff, twenty-eight dwellings for workers, a hostel for managers and workers, a school, a social centre, an administrative building, and a chapel (*Project brief…*, 1948: 1). This plan was substantially larger than the settlement of ten houses, church, and school which was being built at that time in the new village of Venda Nova.

Although the plan had been approved by the directors and the green light given for work to begin, construction of the settlement did not take place. In May 1948, a new location was chosen for the settlement, which was now substantially reduced in size compared to the initial plans. The location was also moved to the left riverbank, 800 metres from the power station building. Two months later, the question of settlement location was still undecided, and in a 7 July board of directors meeting, engineer Paulo Marques reported that he had had

… discussions with the civil engineering department, and it was hoped that the settlement could be located in a more appropriate place than the one chosen. The department would, within a short time, get back to the board of directors with the results of their research on the subject. (Acta 150, 1948: 1)

Although Godinho had worked for HICA since 1947, this was the first time that his name appeared in company board meeting minutes (Acta 159, 1948: 1). The underlying concerns about this problem are not readily understood, but a decision was taken on the issue by joint agreement between engineer Paulo Marques, HICA's civil engineering department, and Godinho. In September 1948, the location was finally determined and the following month Godinho presented his plans accordingly. The directors were responsible for choosing the quantity and type of houses, and the phasing of the building work. As government officials and external entities paid frequent site visits, a Pousada was also included in the plans. The draft designs for the Pousada were the first to be drawn up and were always treated as a special case in relation to the other plans for the settlement (Acta 166, 1948: 2).

The plans for the buildings making up the settlement were drawn up over a six-month period, during which the architect

13 HICA continued to discuss the need to hire a chief engineer to be in charge of the department of electrical engineering.

would occasionally attend board meetings to discuss and report on his work. In October of that year,

… the President informed the board that this meeting had been convened to discuss the plans for the settlement at the Vila Nova power station, presented by architect Januário Godinho. In the presence of the chief engineer of the civil engineering department and the architect himself, the issue of the types of houses and their layouts was discussed in depth and modifications introduced, after which the board gave their general approval to the plans for the settlement, with it only remaining for architect Godinho to complete the plans. (Acta 167, 1948: 1)

In the end, the settlement was placed very close to the original location, on the hillside of the left bank of the Cávado River, around 800 metres from the power station building and facing the future reservoir on the Salamonde reach, the second dam to be built by HICA. In January, Godinho presented

… detailed plans of the houses to be built in the power station settlement, with the board of directors having definitively chosen the types of houses for managers and workers and requested the drawing up of plans for the engineer's residence, in accordance with the draft sketches presented, and decided to open the work up to tender. (Acta 182, 1949: 2)

In February, the board of directors approved, with a few changes, the plans for the Pousada and the draft design for the social centre and administrative services building, which was not built (Acta 184, 1949: 2).

Even before the start of construction, the board of directors chair suggested constructing the Pousada in Corisco next to the workers settlement. The reasons for this suggestion are unknown, but "given the urgency in the construction of the settlement, it was not considered appropriate to revisit the problem" (Acta 198, 1949: 1).

The implementation plans handed in by Godinho in April 1949 included two dwellings for chief engineers, four groups of two dwellings for managerial staff, thirteen sets of two dwellings for workers, a Pousada, a chapel, a school, and the social centre and administrative services building. The settlement was to be surrounded by a perimeter strip of private land of around 60,000 square metres between elevations of 360 and 450 metres, in the form of four terraces laid out in accordance with the topography. HICA's Civil Engineering Department presented draft specifications for the settlement construction tender, and the board decided, for an initial stage, on the construction of the Pousada, a type A house, two groups (of two houses each) of type B houses, and five groups (of two houses each) of type C houses (Acta 192, 1949: 1). The board's chair was authorized to award the work to the construction company that presented the best proposal.

The implementation plan was presented in April and work began in June, with earth-levelling already having started. At this point, a new plan arose, which altered the first. This new plan divided the work between Godinho's designs (the Pousada and the first row of houses) and the other, unsigned blueprints. The formal features of the second group of buildings also confirms that this part of the settlement was not designed by Godinho.

The changes had a profound effect on the settlement, causing the design to lose much of its initial coherence. Road layouts were shortened, and only the second row – for the houses of workers and managers – remained unchanged. The social support building was removed, and a terrace was created around the Pousada. At the higher elevation, the second line of houses was scattered, without apparent alignment, across the terrain. The houses no longer had front doors with direct access to the road, access now being achieved by means of small, irregular pathways, adapted to the topography. These pathways radiated outwards from the road, connecting to small platforms at various elevations on which the houses were placed. This transformation placed greater value on the autonomy of each dwelling, in detriment to the road's urban character. It is possible that this change was made in response to the high cost of the first solution, which had

been brought up at a board meeting. The location of the type B and C houses, which fitted into the landscape (with the upper road coming in at an elevation close to that of the roof line), necessitated large-scale movements of earth and rock. The changes substantially simplified construction of the second line of houses.

HICA went ahead with the changes to the plan, as well as with the plans for the type A house. This house would serve as the residence of the chief engineer in charge of the work during construction and would later serve as the residence of the chief engineer of the Vila Nova power station (Acta 205, 1949: 1). In November 1949, Godinho presented plans for the type A house, which unlike the simplicity of types B and C houses, had a level of complexity comparable only to that of the Pousada, with many identical details. In December, the house was included in the general building plans. In February, however, a new draft design was made which, despite maintaining the location, included several alterations to keep costs down (the house became smaller and cheaper, with simplified details).[14] After making a few small changes, the plans were accepted by the board of directors and included in the first phase of construction work. **(Fig. 3)**

In August 1950, the first inhabitants had moved into the houses planned in the first phase, and the Pousada's construction was in its final stage. The construction of additional buildings, roads, and retaining walls designed by Godinho altogether radically altered the original topography. As a result, a place that used to be bare of any vegetation and quite inhospitable was transformed into a small and lively urban centre, which would become densely populated with trees just a few years later.

In June 1953, the technical departments at HICA discussed the "need to construct the second phase that was initially planned for employee housing at the Vila Nova power station" (Acta 416, 1953: 1). The reason for this was the arrival of the fourth auxiliary power unit, powered by the Paradela Dam.

For this second phase, taking into consideration the altered plans, the board of directors decided to build the chapel and twelve more houses.[15] This phase did not necessitate as much earth-moving and no large retaining walls was needed, which reduced the building costs for this part of the settlement's works. One half of the single-storey houses were built on suitable, unaltered land whereas the other half was built on displaced earth contained within a two-wall foundation. These houses, which are formally similar to those of the first phase that were not designed by Godinho, are detached and set back from the main road at various elevations.

Godinho's original plan was based on a progression of parallel row houses arranged according to contour lines in order to overcome differences in elevation. Part of the plan was carried out, but the plan's hierarchical distribution of buildings was altered. The first plan only included dwellings for managerial and auxiliary staff. The transformation of the second line of houses into smaller houses for lower-category employees emphasized, by their degree of closeness to the facilities, the hierarchical differences involved. **(Fig. 4)**

In 1956, with the settlements at Salamonde and Caniçada already inhabited, HICA decided to build a *Centro de Alegria no Trabalho* (CAT, centre for well-being at work)

14 The first version, in November, in the location initially foreseen in the plan, occupied an area of 29.6 by 12.8 metres on a very steep incline. The structure of the second version, in February, was similar but smaller, at only 20 by 8.1 metres. Despite the alterations, the project, which had an unusual design, followed the premises of the setting of houses B and C, but distanced itself from the types used for housing for workers. Given the extreme slope of the terrain, the project made alterations to the existing topography, cutting into the hillside to fit in the volume of the house and to create a flat area on the outside. The three floors establish a distinct relationship with the terrain. The upper floor is at the same level as the road which passes to the east. The first floor is at an intermediate level and has the main entrance on a terrace carved into the hillside which permits access to the house on the northern side. The ground floor has an independent entrance on the southern side and is where the garage and services are located.

15 Six houses of type C1 and six houses of type C2.

Fig. 3
Casa Alvão (photographer), *Settlement of Venda Nova*, 1951. Source: ATEDP (Arquivo Técnico EDP, Porto).

Fig. 4
Teófilo Rego (photographer), *Inauguration of the Venda Nova Dam*, 1951. Source: Casa da Imagem, Fundação Manuel Leão.

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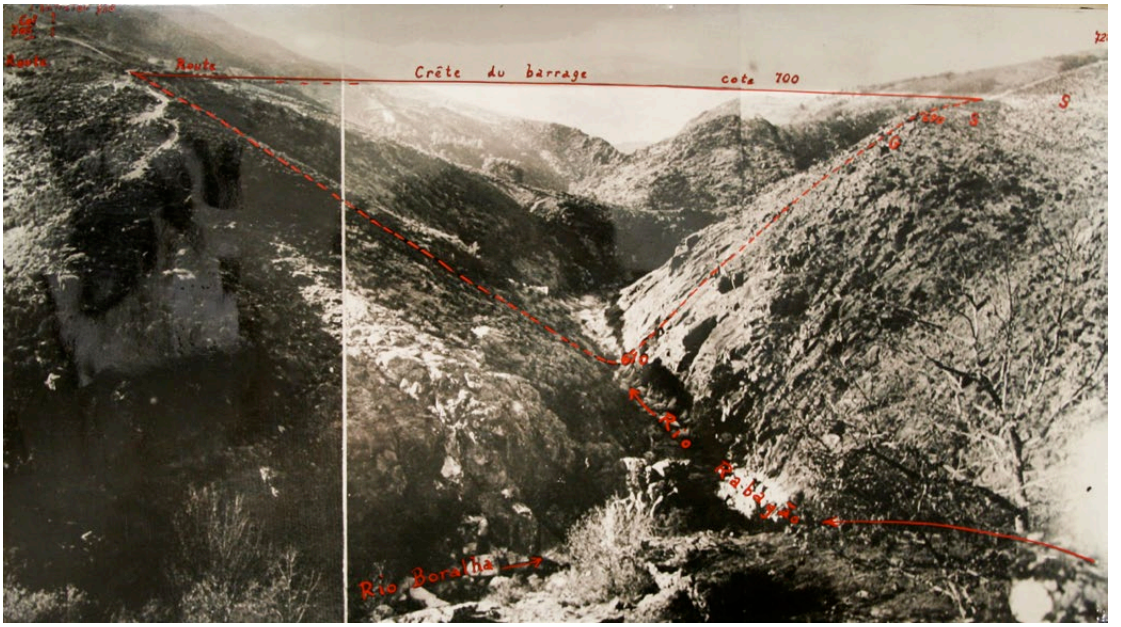
Fig. 5
André Coyne, *Salamonde Dam implantation study*, 1948. Source: ATEDP (Arquivo Técnico EDP, Porto).



and a swimming pool in the settlement.[16] As there was no building available that could be adapted for this purpose, as had occurred at the other power stations (Acta 567, 1956: 2), a new building had to be constructed. The plans were designed by architects José Costa Pereira (1920–93) and João Castelo Branco (1928–2012), who became part of the team at HICA as the works progressed at Salamonde and Caniçada.

Salamonde Dam

The filling of the reservoir began in August 1950, and it was inaugurated in April 1951. Of the four dams planned in the 1944 draft design (Caniçada, Lavandeiras,[17] Venda Nova, and Paradela), the second to be built was that of Lavandeiras, which from 1950 became known as *Salamonde*. With the go-ahead being given for work at Salamonde, a difficulty was encountered with the departments:

… the issue of the technicians being unable, at this moment, to go ahead with the creation of the respective draft plans, given the intensification of the construction work on the first reach, and having looked at the suitability of having technical support for the Lavandeiras reach provided by a competent entity, the board has decided to make contact with the engineer who is currently consultant at the Venda Nova Dam, engineer André Coyne, for the creation of the aforementioned draft plan and to provide indispensable technical assistance. (Acta 212, 1949: 1)

The following month, HICA got in touch with Coyne, who in October 1949 went to Portugal to look at the location and present his fees for the different types of dams that could be built (Acta 222, 1949: 1). **(Fig. 5)**

In early 1950, the office of Coyne & Bellier delivered the draft plans for the dam at Salamonde (Acta 237, 1950: 2). The design that was planned was a thin arch dam, in concrete. Its maximum height was 75 metres, and the width of the valley at the elevation of the top of the dam was 220 metres. Work started in December 1950, with the installation of the dam construction sites.

With the experience gained at Venda Nova, HICA was already aware of the need to create accommodation close to the dam site for technicians and workers during its design and construction, as well as for its permanent operators. With the locations of the dam and the power station determined, HICA engineers studied the location for accommodation. They chose the south bank of the Cávado River, upstream from the dam, on a hillside facing south-west, which would be accessed from the new road.

In June 1950, Godinho presented an initial proposal, with the plan encompassing a group of buildings that could house the 500 or so workers that the construction company estimated would be required, including married men's families. The group of buildings was based alongside the alternative access road, which was connected to the new dam access road. Temporary constructions that could be dismantled were located at lower elevations with less exposure to the sun. The Pousada and the permanent houses for managers were located at higher levels and benefited from a south-western exposure. The "indicated buildings will be constructed with characteristics suited to their purpose, with the best locations saved for those buildings to be used by the employees who will be operating the future power station" (*Project brief…*, 1950: 1).

As had already occurred at Venda Nova, the area set aside for the definitive buildings was used during the construction phase to house the company's senior managers and, in a second phase after the work was completed, would be used to house the power station workers. Given the importance of the definitive development, HICA asked Godinho to draw up plans for the hostel and for housing for managers. The Surveying and

16 HICA created, in all the developments, buildings for recreation and leisure for the workforce and their families, often more than one per development, due to the distance between the construction sites and the housing settlements.

17 On the 1994 draft design, the reach at Salamonde was designated "Lavandeiras". It was only in 1950 when construction of this part of the scheme was already at an advanced stage that the name was changed to "Salamonde", due to its proximity to the village of the same name.

Planning Department (SEP) was being set up within HICA at that time, and it was this department that undertook the remaining planning work for the settlement, including that of the church, designed by architect Costa Pereira.

In Godinho's plans, the ten houses are divided into two groups in accordance with the slope of the terrain. The detached buildings, which are elevated in relation to the terrain, face south-west to make the most of the valley landscape. The remaining buildings, at a lower elevation, are set into the hillside or sit on granite foundations, solutions similar to those used in the settlement for the Venda Nova power station. The overall solution is however very different, given that the houses are set back from the main road, which encircles the settlement and ends at the Pousada building before branching off into narrow pedestrian access paths. In addition to this differentiation relative to the settlement's layout, the houses are positioned to respond to the specific topography and the levels of sun exposure and visual orientation. Work began in the summer of 1950, as soon as the board of directors had approved the plans.[18]

With the start of the work at Salamonde, HICA carried out studies to decide which reach would be developed next. Caniçada, the reach furthest downstream from the main part of the river, and Paradela, the furthest upstream, were considered, with Caniçada eventually winning out. The design and planning process of the first two reaches was instrumental, as it allowed HICA's technicians to gain the necessary experience in this area, and effectively enabled HICA to manage the planning and construction of the third reach autonomously.

Once a suitable dam location was found, the engineers spent a year working on the proposal (Acta 321, 1951: 1) and in September 1951 handed in the new draft plans for Caniçada, which had a design similar to Salamonde's (Lobo, 1953). With the completion of the preparatory work in February 1953, SEOP was able to begin construction of the installations and accommodation for the employees constructing the dam and power station.

Caniçada houses (1951–56)

Caniçada did not benefit from a similar settlement to Salamonde, despite there being many similarities in how the construction process was managed. Its proximity to the towns of Gerês and Amares led to an initial proposal which contained fewer houses than at the previously built reaches, and no Pousada was built. This led to a configuration that initially lacked the characteristics of an autonomous settlement,[19] even though subsequent adaptations during the building phase granted it a comparable status (Acta 333, 1951: 1). As the nearby towns were also supplied with schools and chapels, these facilities were not part of the plans created by HICA for the Caniçada settlement, which was reduced to a small collection of houses spread out along national road 308, at kilometre 67 and in the immediate vicinity of the power station. In contrast to the options chosen between 1945 and 1947 for the villages of Vila Nova and Venda Nova, HICA did not base its solution for Caniçada on the principle of segregation and separation of the new inhabitants from the existing rural population.

The designs of the houses are practically identical to those designed by Godinho two years earlier for the settlement at Vila Nova, including the materials and architectural

18 **The project was awarded to A. Mesquita & Passos, Lda. for the sum of 4.5 million escudos (Acta 261, 1950: 1; Acta 269, 1950: 2).**

19 **Given that the understanding of the meaning of the term *settlement* is very wide and the subject of many studies, it is possible to think about it in different ways: an inhabited area, with a defined and partitioned area, generally dependent on or on the outskirts of an urban development, a defined and planned residential area, aimed at a determined group or social class; a consolidated urban area, recognized as a neighbourhood from a socio-anthropological point of view; an urban area that has been defined for administrative, taxation, or legal purposes, a definition that covers the workers' settlements created by HICA. In the case of Caniçada, despite the small number of houses, their dispersion, and the fact that they were not provided with any supporting facilities, meaning that they were just a very small hamlet, it was still recorded in the records kept by HICA as a *settlement*. On the designation of *bairro* (settlement), see Conceição (2014).**

Fig. 6 Casa Alvão (photographer), *Restaurant designed by Januário Godinho in the settlement of Caniçada Dam*, 1952. Source: ATEDP (Arquivo Técnico EDP, Porto).

expression adopted: tiled and gabled roofs, rendered walls, granite facings on the basement areas, and wood window frames and blinds. The differences are only notable in the relationship between the houses and the landscape. The houses were laid out in accordance with the hierarchical divisions determined by HICA. The houses for auxiliary staff, located above the national road, are anchored to the steep terrain by granite walls that surround the basements of the buildings. The group of dwellings that stands out most is that for managerial staff. It is located closer to the power station in a sheltered area and is distinct from the other groups in its distance from the main road and its access road, which ends in a cul-de-sac. With no evidence being shown of favouring the relationship of the space with the landscape, Godinho changed the layouts so that the living rooms of the houses faced a small square around which the group of houses was centred. Given that the living rooms in all of the houses faced the square, it can be understood that the structural element of the plan is not the relationship of the buildings with the landscape but the establishment of a structure of relationships that are homogeneous and equivalent to those of the urban space. This is even more evident in cases where such a rotation does not allow the desired relationship, leading to some of the houses having an inverted layout, as can be seen in a plan in which the architect pointed out the need for this option. Inversion of the layout also contradicts the practice of seeking the best orientation for sun exposure in each room, with homogeneity and representation of the urban setting being given precedence.

In the absence of a Pousada acting as a reference point for the settlement, in Caniçada, it was the restaurant that fulfilled the symbolic function of unifying the HICA buildings into a whole. Built on a rocky outcrop, its curvilinear form emphasizes its special character. **(Fig. 6)**

In 1956, three further buildings of general use were planned and built to provide support for the new inhabitants. These were a chapel, a school, a swimming pool, and the CAT (centre for well-being at work).

Fig. 7 Teófilo Rego (photographer), *Settlement of Alto Rabagão Dam*, 1962. Source: Casa da Imagem, Fundação Manuel Leão.

The settlement therefore ended up being similar in size and complexity to previous settlements, even though this had not been originally envisaged. These complementary buildings were not designed by Godinho, but rather by the HICA architects Costa Pereira and Castelo Branco. The chapel was given a secluded location at the western end of the settlement, set in the upper part of the hill that is bordered by a curve in national road 308. The school and the swimming pool were built at the eastern end of the settlement, with direct access to the national road, which forms the other outer limit of the village. No new building was constructed to house the CAT. Instead, HICA converted an auxiliary staff dormitory to house the CAT.

As the plans were developed internally by HICA, it is difficult to attribute precise authorship to most of these works. The swimming pool plans were drawn up by Castelo Branco, who tried to "give the pool a shape that most closely resembles the contours of the terrain for which it was designed", resulting in a curvilinear form with the changing rooms located underneath the main platform, making use of the natural slope of the terrain (*Project brief*…, 1956: 1).

From 1956 onwards, most of the architectural projects undertaken by HICA were designed by their own internal departments, and not by Godinho or other external entities, as was the case for the first two plans for the power stations at Vila Nova and Salamonde.

Paradela construction sites (1952–58)

The reach at Paradela was a very different proposition to those of Venda Nova, Salamonde, and Caniçada. The construction of a rockfill dam, as opposed to the concrete-walled dams that had been built to date, as well as the lack of a specific power station (the Paradela reservoir water powering the turbines of the Vila Nova power station in Venda Nova), led HICA technicians to rethink the location of the site and housing needed for the construction and subsequent operation of the dam. As this reach did not have its own power station, there was no need to create accommodation for workers,

and therefore no plans were made for a permanent settlement.

HICA's increased capacity to act (1951–66)
With the completion of the work on the Paradela Dam, the hydroelectric scheme that was initially planned was able to start operating. This meant that HICA's responsibilities were now limited to the operation and production of energy in the three hydroelectric power stations and the management of the infrastructure essential for operations. This change of direction suggested the company might have to close its SEP department, but the board of directors wanted to save it.

In 1951, HICA made efforts to this end. While the work at Caniçada and Paradela was being carried out, HICA's technical departments undertook surveys of the headwaters of the basins of the Cávado and Rabagão Rivers, in order to assess the scope and possible interest of work that could be assigned to HICA in the future. This new study was made on the upper sections of the two rivers, which were not included in the initial concession awarded to HICA. The overall plan created by the DGSH in 1944 had not included the study of those areas. HICA technicians later found that there was a

… possibility to create a large reservoir on the Alto-Rabagão, which would be inexpensive to build, and combined with the possibility of the waters of the Alto-Cávado being rerouted back to the Alto-Rabagão, would confer to this scheme a surprisingly high level of importance. (Project brief…, 1955: 5)

At the start of 1956, the *Conselho Superior de Obras Públicas* (CSOP—Superior council for public works) discussed the "new programmes for hydroelectric schemes, to go beyond the scope covered by the first development plan". Despite the reluctance of some members, the board gave priority (Acta 561, 1956: 2) to the creation of a scheme on the Alto Rabagão (Acta 551, 1956: 1). Work commenced in 1959.

Settlement at Pisões (1958–60)
Work on the fifth reach was the largest project undertaken by HICA. During construction, the total workforce of all companies involved in the project was more than 4,000 people, who, with their families, made up a resident population of more than 12,000 (Acta 551, 1956: 15). This led to the creation of hundreds of new temporary and permanent dwellings. After carrying out the initial studies in 1955, in 1958 SEP technicians created the first general plans for the installations at the large construction site to be located at Pisões. The housing settlement plans were created by HICA's technical department and by its architects Costa Pereira, Castelo Branco, and Rui Leal. The design of the Pousada in the settlement at Alto Rabagão was, however, awarded to Godinho. **(Fig. 7)**

The Pisões permanent settlement's plans called for buildings on a plateau on the north-south slope, facing the reservoir and the dam. The settlement, which occupied an area of more than 8 ha, included both detached and semi-detached houses, as well as service buildings and facilities. Its structure was defined by two main roadways, which divided the social areas from the houses. Entry to the settlement was by means of a main square containing the hostel,[20] the social centre,[21] and the shopping centre. The school and the chapel were nearby.[22] In the plans, a circle on a small hill to the north marked the location of the future

20 This building hosted accommodations for unmarried employees, as a complement to the Pousada, and consists of a basement and two floors. Its materials and construction techniques are identical to those of the houses.

21 The social centre was located on the northern side of the square. It was a two-storey structure, with internal passages between the floors. It contained a large area for sitting and games, a bar, an events room, and bathrooms, all located on the lower floor. The library, office, barber shop, and storage were all located on the upper floor.

22 Built to serve the inhabitants of the settlement as well as local people, it consisted of a nave, a chancel, a vestry, and toilets. It is an unusual building, distinct from the others in the group. The exterior was built in rustic schist stonework, with buttresses of prefabricated materials. Inside, the mortared stonework was roughly rendered, conferring on it an enigmatic air.

Pousada, but no indication of an actual building was given.

The second roadway, to the south, provided access to the houses. These were to be occupied by different grades of employees, and were therefore arranged in groups according to four types — A, B, C, and D. They differed from each other in both area and internal layout, although they shared characteristics of design and finish.[23] The location of the houses was determined by the position of the road that was built along the hillside and that extended into small, levelled terraces on which the different house types were built. The size of houses decreased according to their location along the hill's slope. The largest houses, type A, were built on the highest part of the hillside; smaller houses, type B, were built lower on the hillside; and still smaller houses, type C, were built on the hillside's lowest part. The smallest houses, type D, were arranged in pairs and grouped to define the outer limits of the settlement. The interiors of all the different types of houses were very similar, with most of the rooms facing south, looking out over the landscape. Service areas in the houses faced north, and the main entrances were on the eastern façades. The permanent settlement was completed in 1960.

Conclusions

Between 1947, with the initial recommendations made by Coyne, and 1960, with the completion of the settlement at Pisões, the policy of the HICA hydroelectric company on worker settlements was unstable and constantly changing. This makes it clear that HICA did not have a specific policy to guide and organize land use in the Cávado Valley based on a clear and identifiable vision for the terrain.

The design of settlements attached to HICA's hydroelectric schemes was based on the number of power station workers remaining forever constant.[24] Thus the plans did not foresee future expansion. This was in stark contrast to usual practice in the planning of most large, developing industries, as well as in town and city planning, which must consider the potential growth of the population and of the urban landscape.

The building of the settlements was an act of sovereignty over the landscape on the part of the hydroelectric companies, whose main concern was to always maintain absolute control over their decisions.

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23 The specifications for the definitive settlement included the construction of one hostel, two type A houses, four type B houses, ten type C houses with a type I basement, eighteen type C houses with a type II basement, six blocks of type D houses, one chapel, one school, one shopping centre, one health centre, and one garage (*Tender programme*..., 1958).
Type A: consisting of dining room, living room, office, four bedrooms, bathroom, kitchen, pantry, and storeroom on the main floor. The basement contains a maid's room, a bathroom with shower for the maid, a laundry and a garage. Outside there is a chicken coop and storage space next to the kitchen.
Type B: consisting of a general living room, an office, three bedrooms, a bathroom, a kitchen, a pantry, and a storeroom on the main floor. The basement contains a bedroom and bathroom for the maid, a laundry, and a garage.
Type C: consisting of a general living room, three bedrooms, a bathroom, a kitchen, a pantry, and a storeroom on the main floor. There were two types of basement: a type I basement contained a bedroom and bathroom for the maid, laundry, and storage; a type II basement combined laundry and storage in one room.
Type D: joined together in twos, they consist of a sitting room, two bedrooms, a kitchen, a storeroom, and a bathroom on the main floor. The basement, accessed from outside, consists of one room only.

24 This premise was not fully realized: the estimates made by HICA were not always entirely accurate, and more workers were needed to operate each power station than was originally estimated. This meant that interventions and enlargements had to be carried out on the settlements at a later date.

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