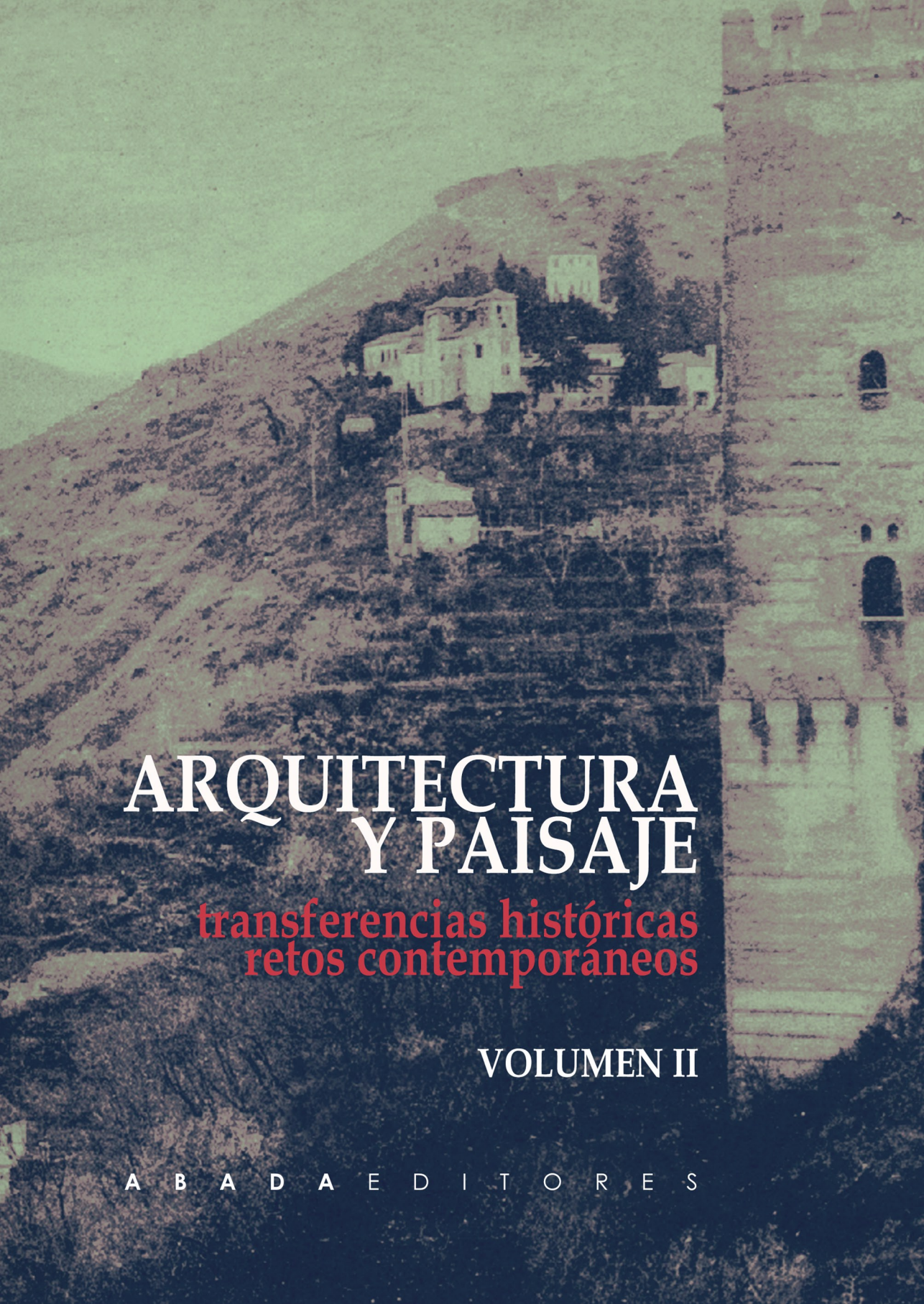

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transferencias históricas retos contemporáneos

VOLUMEN II

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La pertinencia de percibir lo visible: las torres del telégrafo óptico de la Línea de Castilla en el paisaje

The Pertinence of Perceiving the Visible: The Optical Telegraph Towers of the Castilla Line in the Landscape

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Abstract
Hoy en día, el telégrafo óptico sigue siendo un elemento poco conocido de nuestro patrimonio; sin embargo, tiene un valor innegable.
En España, el telégrafo óptico se materializó en forma de torre fortificada aislada; sin embargo, estas torres no pueden entenderse fuera de su contexto territorial. Su emplazamiento, orientación e incluso la elección de los materiales constructivos fueron el resultado de una serie de compromisos entre el tipo arquitectónico de Mathé, su condición de nodo dentro de una red lineal y las ventajas e inconvenientes creados por el entorno natural.
Las torres de telégrafo óptico tienen valor como referencia arquitectónica y como estadio de la historia de las telecomunicaciones. No obstante, antes de poder estudiar e intervenir en el edificio, debemos reconocer que las características particulares del diseño de las torres también les confieren un significado como claves visibles para entender e interactuar con el paisaje asociado en cada emplazamiento.

The optical telegraph is a little-known element of our national heritage; nonetheless, it possesses undeniable value.
In Spain, the optical telegraph materialised as a freestanding fortified tower; however, these towers cannot be understood outside of their context. Their emplacement, orientation and even the choice of constructive materials emerged from a series of compromises between Mathé's architectural type, their condition as a node within a linear network and the advantages and disadvantages created by the natural environment.
The optical telegraph towers have value as an architectural reference and as a stadium on the history of telecommunications. However, before we can study and intervene in the building, we must acknowledge that the particular characteristics of the towers' design also give them meaning as visible and significant keys to understanding and interacting with the associated landscape of each specific site.

Keywords
Telégrafo óptico, paisaje, contexto territorial, España
Optical telegraph, landscape, territorial context, Spain

Introduction

Immediate transmission of data on a global level is an unquestioned reality of the modern world. This is, however, a very recent development, the result of a long and complex process in the quest for long-distance communication. One of the steps in that process was the optical telegraph.

Though the theoretical tenets of the optical telegraph were proposed as early as 1684 by Sir Robert Hooke[1], the first viable prototype did not appear until the late 18th century, when Claude Chappe demonstrated the efficiency of his model and secured the sponsorship of the French government. Over the next few decades, the optical telegraph would be adapted to other countries and spread throughout most of the European territory and beyond. This success was relatively short-lived, as the electric telegraph would swiftly displace its predecessor; nonetheless, it was a success. For the first time in human history, the development of the optical telegraph made it possible to send complex messages whose meaning had not been established in advance across long distances in comparatively short time-frames[2]. This was achieved by the unique combination of a new, more precise telescope, a deceptively simple technological system, sophisticated encryption, a particular administration and, in the Spanish case, an architectural solution specific to the environment and the social and military context[3].

The design of the optical telegraph stations in Spain was heavily influenced by security and military concerns, especially within the context of the first Carlist war (1833-1840). Thus, it was decided to construct fortified towers in specific, partially isolated locations, which contributed to instilling in those freestanding buildings a strong identity of their own. These buildings were primarily a functional unit that did not seek to generate a rapport with the territory. However, they are not just a landmark disconnected from their environment.

The influence of the associated landscapes appears in all of the towers' features, from their location, to their constructive materials and characteristics and even to their survival. The optical telegraph network in Spain constitutes a clear example of the connections that can arise between a building and its environment regardless of any aesthetic consideration.

This article will attempt to characterize the influence that the varied natural environments and the presence of a national network had on the design, the location and the construction of the optical telegraph tower. It aims to explore these factors as an interconnected ensemble. Despite the existence of a singular typology, the individual buildings cannot be interpreted, nor can we intervene on them, without a complete understanding of the context and the particular circumstances.

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[1] David John Cole et al., *Encyclopedia of Modern Everyday Inventions* (Westport: Greenwood Publishing Group, 2003), 93.

[2] Laura Lalana-Encinas, "La línea de Castilla del telégrafo óptico: Historia, arquitectura y patrimonio industrial" (Final Degree Project, Universidad de Valladolid, 2019), 29.

[3] Laura Lalana-Encinas and Luis Santos y Ganges, "Las líneas del telégrafo óptico y la primera organización contemporánea de las comunicaciones en España", *Transportes Servicios y Comunicaciones [TST]*, no. 45 (2021): 115.

The materialization of the Spanish optical telegraph

The optical telegraph network in Spain was introduced later than most. Though there had been previous attempts throughout the early 19th century, the project to connect "all the capitals of provinces and notable points of the coasts and borders in direct communication with that of the kingdom in the degree of perfection that other countries have"[4] did not materialize until 1844, under the supervision of José María Mathé. The electrical telegraph was known and was already starting to function in other countries[5]; however, it was considered impractical, not only due to the increased costs but also because it depended on cable lines that could be cut, drastically reducing the efficiency of the system[6].

In the period between 1844 and 1857, there were three lines built and operating in the Spanish territory: the Castilla Line (connecting Madrid to Irún), the Barcelona Line (Madrid to La Junquera via Valencia), and the Andalucía Line (Madrid to Cádiz). Though there were plans for further expansion, they would never come to fruition (fig. 1).

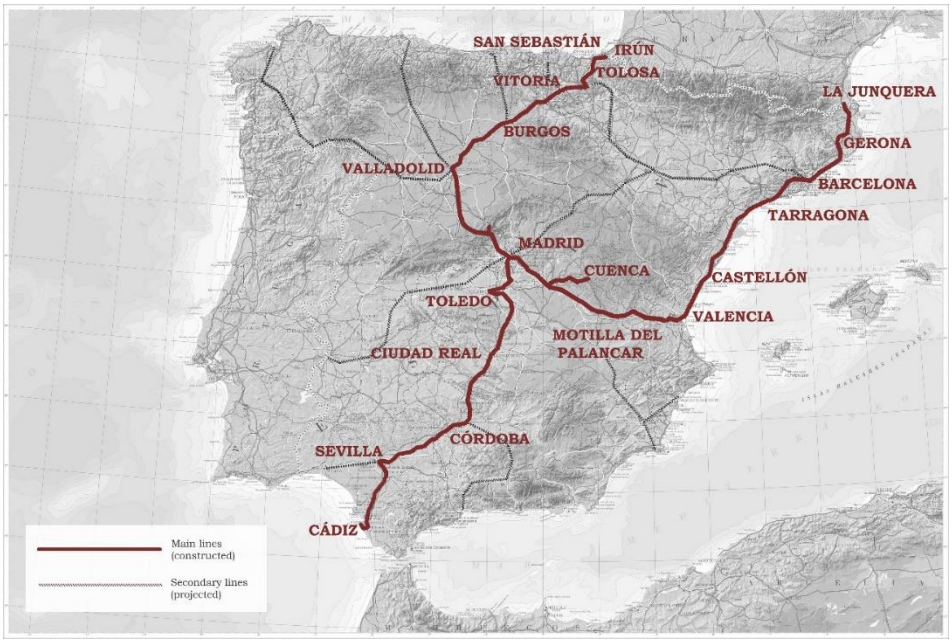

Figure 1: Laura Lalana-Encinas, *General distribution of the Spanish optical telegraph network*, 2021.

[4] Real Orden of March 1st, 1844 published in the Boletín Oficial de Caminos Canales y Puertos. Sebastián Olivé Roig, "Distintas etapas de la telegrafía óptica en España", *Cuadernos de Historia Contemporánea*, no. 29 (2007): 26.

[5] Pablo Schnell Quiertant, "Torres fortificadas del telégrafo óptico en la comunidad de Madrid", *Revista Castillos de España* (2005): 64.

[6] Iban Roldan-Bergaratxea, Gorka Martín-Etxebarria and Sergio Escribano-Ruiz, "The archaeology of civil conflict in nineteenth century Spain: material, social and mnemonic consequences of the Carlist Wars", *World Archeology* (2020):7.

Although each of these lines exhibits unique idiosyncrasies and elements of interest, we can draw some general conclusions on the nature of the interaction between the building, the network and the landscape and how the latter two influenced and are still influencing the former. For the sake of conciseness, this paper will focus on the particular circumstances of the Castilla Line, the first line to be constructed.

Design strategies of the optical telegraph network

The distribution of the network over the territory resulted from several factors, including administrative, physical and technical considerations. Since the optical telegraph was exclusively for governmental use, it was imperative to ensure that it would be cost-effective. Therefore, two major questions had to be addressed before building the towers: where should the information go? And how should it get there?[7] These considerations lead to a series of 'fixed points' on the territory that would, by necessity, define the layout of the network.

Let us consider the first category of fixed points, those determined by which locations would have access to relevant information or would benefit the most from a direct connection to the capital. This is exclusively a political, military and administrative affair. From the birth of the project, the Castilla Line had a defined origin, Madrid, and a destination, Irún, which was also one of the connections to France. Additionally, six other stations could receive or send messages. This were Valladolid, Burgos, Vitoria, Tolosa, San Sebastián and Granja de San Ildefonso[8] (fig. 2).

With the exception of Tolosa — whose importance was almost completely derived from its strategic value within the context of the first Carlist war[9] — and Granja de San Ildefonso, which had been a royal retreat since the 15th century, the other nodes corresponded with cities with considerable weight. They were provincial capitals, though the governmental power had only consolidated in the figure of the provincial council in the previous decade (since 1836). In the case of Valladolid and Burgos, they were also military administrative hubs, or *capitanías.*[10] They concentrated relatively high populations. Unsurprisingly, the electric telegraph and the railway would also gravitate towards these centres, for many of the same reasons. On the other hand, most optical telegraphs located in administrative points did not follow the typology and logic of those in intermediate locations, as they were often subsumed into pre-existing buildings.

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[7] Lalana-Encinas and Santos y Ganges, "Las líneas del telégrafo…", 108.

[8] The intermediate stations could temporarily receive the status of main station, or 'comandancia', for various reasons, such as contested elections or visits from the king, as was the case on the towers of Villacastín and Labajos. Sercam, Servicios Culturales y Ambientales, S.C., *Torre a torre. La línea del telégrafo de Castilla* (s.l.: El Árbol de Alicia, 2012), 46.

[9] F. Javier Ajamil Baños, *Las torres de telegrafía óptica de la línea Madrid-Irún a través de la Comunidad Autónoma Vasca* (Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco, 2014), 23.

[10] Since the 18th Century, they were the administrative centre of the Military Regions of Castilla la Vieja and Burgos, respectively.

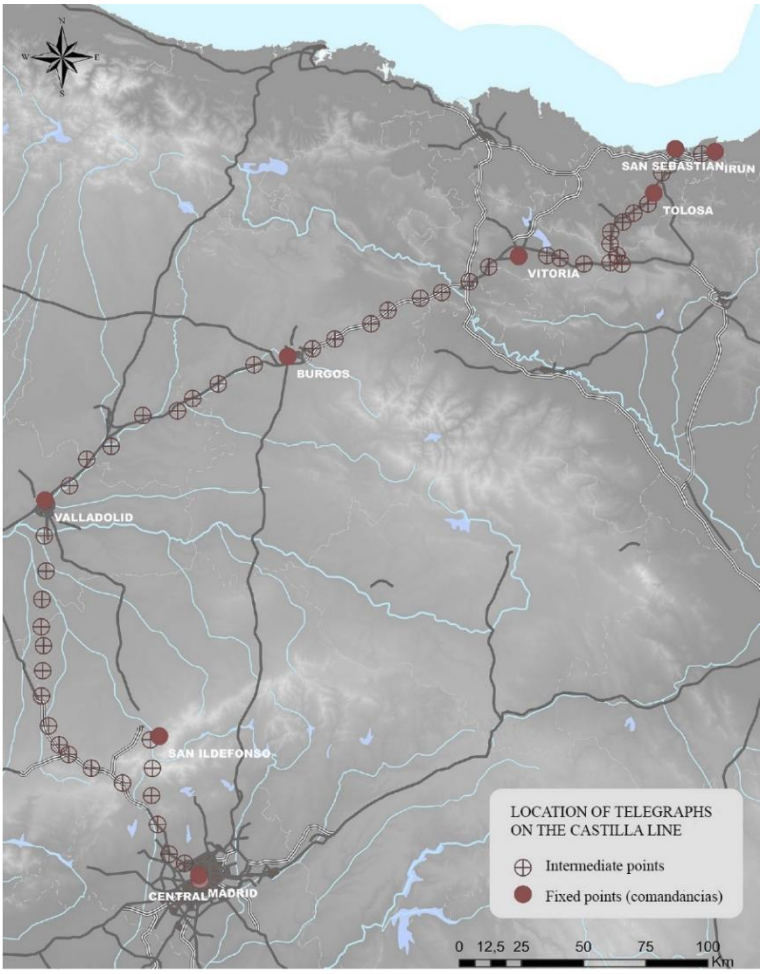

Figure 2: Laura Lalana-Encinas, *Main and intermediate stations of the optical telegraph in the Castilla Line*, 2019 (Lalana-Encinas, "La línea de…", 42).

The second category of fixed points refers to the physical obstacles or other geomorphological conditions that compromised the capability of the system. In essence, the mountain passes, passages or gorges that had to be traversed by every communication and transport network. In the Castilla Line those were the Guadarrama pass, the Brújula pass, the Pancorbo gorge, Conchas de Oca and the Etxegarate pass.

The layout of the optical telegraph network resulted from a series of compromises between these administrative and physical fixed points. For example, from a purely technical perspective, the shortest route between Madrid and Irún would have been a relatively straight line, going through the populations of Soria and Pamplona; however, neither of those had the political and economic pull of Valladolid and Burgos. Hence, a more 'rational' design was discarded in favour of increasing the benefits of the communications system.

Design strategies of the optical telegraph towers

On a smaller scale, the location of the stations responded to technical and economic concerns rather than political ones. In particular, it was necessary to ensure a visual correlation between neighbouring stations and protect the integrity of the message by protecting the operators within the station. Though the operators rarely inhabited the tower, it seems that accessibility or quality of life were not significant factors of design. The stations could be located several kilometres away from populations, which in many cases could not respond to the medical or residential needs of the operators[11].

Intervisibility

The Spanish optical telegraph used a relay system set on top of each tower. The mechanism had two mobile weighed pieces, actioned by pulleys from the second floor. The central piece had eleven positions that transmitted the primary message, and the secondary piece informed on the state of the network and the general characteristics of the message (for instance, its origin and destination)[12] (fig. 3).

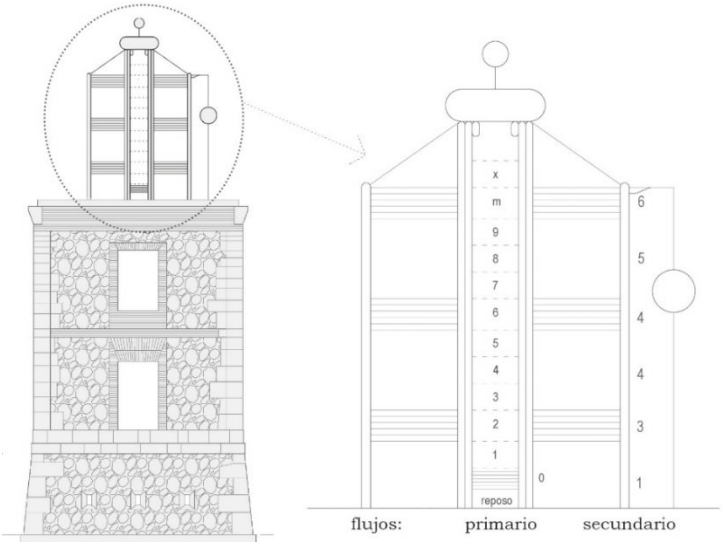

Figure 3: Laura Lalana-Encinas, *Representation of the optical telegraph tower and the relay mechanism*, 2021 (Lalana-Encinas and Santos y Ganges, "Las líneas del telégrafo…", 114).

To communicate the information throughout the network, the positions of these two elements had to be clearly visible from the neighbouring stations at any given moment during the day. Nowadays it is difficult to corroborate this factor, as the loss of integrity in the buildings and the new vegetation have changed the original conditions of the sites. However, it is still apparent in some cases (fig. 4).

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[11] Sebastián Olivé Roig, *Historia de la telegrafía óptica en España* (Madrid: Secretaría General de Comunicaciones, 1990), 81.

[12] Olivé Roig, *Historia de la telegrafía*…, 47.

Figure 4: Laura Lalana-Encinas, *Optical telegraph towers of Tariego and Quintanilla seen from the neighbouring towers of Transilla and Campajares respectively*, 2019.

Thus, there was a dual logic behind the tower's emplacement, regarding its relative position within the linear network as well as the specific characteristics of the site.
The position within the network influenced the tower's location and orientation. In regards to the location, intervisibility between towers decreased with distance and could be impeded by other factors, such as adverse weather. Although the original project had proposed a general distance of two or three leagues[13] (11.2 to 16.7 km), the average distance within the Castilla Line was often outside of this threshold and, though it varied significantly, can be correlated to the characteristics of the associated landscape (fig. 5).

Telegraph tower	Associated landscape	Average altitude (m)	Average distance (km)
01 - 04	Cuenca del Tajo	756	7,2
04 - 10	Sistema Central	1201	10,8
10 - 30	Cuenca del Duero	871	12,1
30 - 40	Cuenca del Ebro	693	10,3
40 - 46	Montes Vascos	606	5,0
46 - 49	Montes Vascos	408	6,6
49 - 52	Montes Vascos	133	9,0

Figure 5: Laura Lalana-Encinas, *Average distance of optical telegraph towers according to their general location*, 2019 (Lalana-Encinas, "La línea de…", 54).

[13] Real Orden of March 1st, 1844. See Olivé Roig, *Historia de la telegrafía…*, 62.

In regards to the orientation, the mechanism did not have to be in a strictly perpendicular plane to the line of sight between towers[14], but this arrangement was preferable in order to minimise errors. In the Castilla Line, almost every trio of stations form an obtuse triangle. The only exception is the Ziordia, Basalen and Engara trio, in Navarre: due to the characteristics of the terrain, they form an acute triangle to enter the valley. This trio also presents the shortest distance between stations, less than 5 km apart (fig. 6).

Once the constraints imposed on the building due to its character as a node within a network were established, it became necessary to adapt to the particular conditions of each site.

For instance, it was preferable to orientate the tower so that operators would not be blinded by the sun when this was feasible[15]. Constructors also tried to find a site capable of resisting the tower's weight, although on occasion they had to erect a stone platform to ensure the building would be level. Yet, the two main factors to consider were vegetation and altitude.

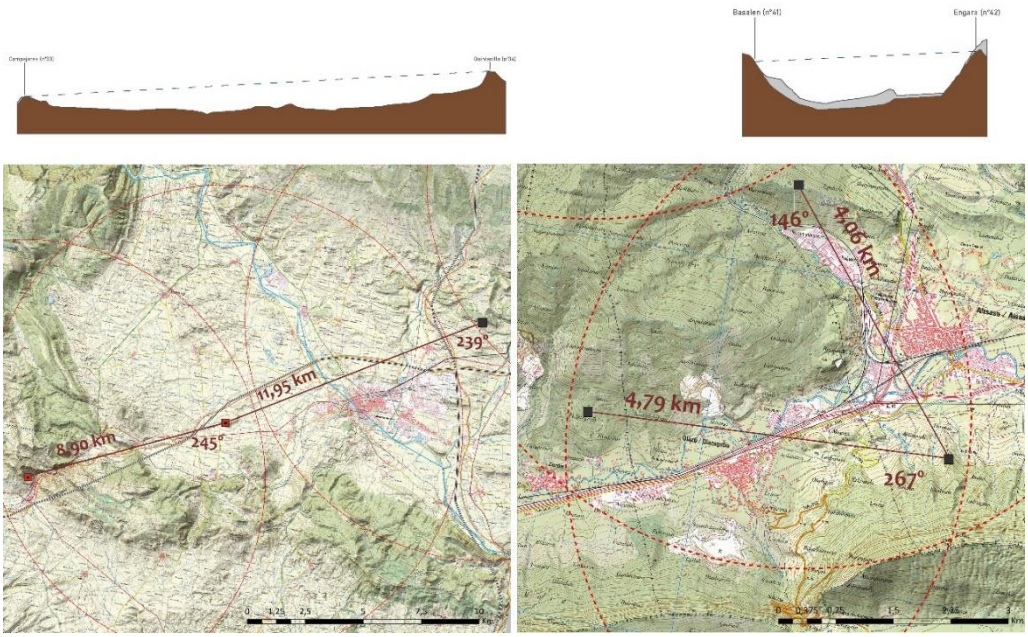

Figure 6: Laura Lalana-Encinas, *Alineations and distances in the towers of Campajares and Basalen*, 2019 (Lalana-Encinas, "La línea de…, 68, 81).

[14] Schnell Quiertant, "Torres fortificadas…", 68. See also: José Zufiaurre, "Torres de telégrafo", *Anuario de Eusko Folklore*, no. 34, (1987): 159.

[15] María Linarejos Cruz Pérez, dir., *Estudio de la red de telegrafía óptica en España* (Madrid: Ministerio de Educación, Cultura y Deporte, 2014), 44.

The presence of vegetation, particularly tall trees, was a universal concern for optical telegraphs across Europe[16], as they could obscure the line of sight within a few years. Certain locations required constant maintenance: after decades of neglect, several towers in the Basque Country are extremely difficult to locate without previous knowledge of their emplacement. Lower but dense vegetation did not impede the use of the telegraph but would still constitute a security risk, as it could hide attackers or put the operators at risk by causing a fire.

The relative altitude on the site presented its own set of challenges. Too low altitudes would affect intervisibility by increasing the number of obstacles in the line of sight and making the tower blend with the background[17]; too high altitudes carried a greater risk of adverse weather, and the presence of steep terrain increased the risk of accidents, as the operators often travelled to the towers before dawn[18]. Therefore, the constructors had to locate intermediate locations, neither on valley beds nor on mountain summits. Despite this, several of the towers were considerably higher than the neighbouring populations or infrastructure. Thus, even though they were not specifically designed to overlook their environment[19], in several cases this has been the result. This condition influences the current potential of these stations as a significant element within their landscape.

Security

In order to preserve the reliability of the network, it was imperative to ensure that the message arrived at its destination without tampering. This was achieved partially through the figure of the fortified tower and the decision to arm the operators with rifles; however, it was also a factor in the location of each tower in its landscape. For instance, the Real Orden of March 1st, 1844, which launched the project, explicitly stated that it was preferable to ensure the presence of nearby roads, even if they did not lead directly to the telegraph towers[20].

In addition to the physical measures of fortification, information security was achieved through encryption. The operators were not able to decipher the message; they transmitted it as a series of numbers that would later be cross-referenced in a master dictionary[21]. In

[16] In France, the government gave Chappé's administration permission to "remove any tree that interfered with the line of sight of the telegraphs". Gerald J. Holzmann and Björn Pehrson, *The Early History of Data Networks,* (n.p.: EEE Computer Society Press, 1995), 68.

[17] Schnell Quiertant, "Torres fortificadas…", 68.

[18] Olivé Roig, *Historia de la telegrafía*…, 82.

[19] Cruz Pérez, dir., *Estudio de la red…,* 47.

[20] Schnell Quiertant, "Torres fortificadas …", 68.

[21] In Spain, this was the *Diccionario Fraseológico Nacional,* written in 1846. It included a gazetteer of prominent names as well as eleven chapters classing the data packets by topic (stock exchange, popular unrest, etc). Ángel Bahamonde Magro, Gaspar Martínez Lorente y Luis Enrique Otero Carvajal, *Las comunicaciones en la construcción del Estado contemporáneo en España: 1700-1936* (Madrid: Ministerio de Obras Públicas, Transportes y Medio Ambiente, 1993), 131.

truth, this encryption was not only a security measure but also a necessary trade-off that accepted loss of flexibility in meaning to increase transmission speed[22].

Materiality

Mathé's original project of 1844 and the revision of 1848 proposed a standard model of optical telegraph tower. It had an overall height of 15.32 metres, with three floors and the signal mechanism on the roof; three embrasures on each wall of the ground floor and windows on the first and second floors, on all its sides (mainly in the Castilla Line) or on the two sides that faced the next station (in the Barcelona and Andalucía Lines).

However, there were several variants in the architectural type. Though some of them may be explained by unrelated reasons, such as the period of construction[23], the location played a decisive role in the materialization of the buildings. This becomes apparent regarding the material of construction, which could be stone (usually limestone or granite), solid brick, or a mix between the two.

In the Castilla Line, stone was used in 23-31 % of the towers, which are concentrated almost exclusively in the Basque Country and the Guadarrama pass; brick appears in 20-28 % of the towers, particularly in Ávila, Valladolid and Palencia; and mixed materials were used in 21-32 % of the towers, mainly located in Burgos and transitional areas between distinct topographies[24] (fig. 7).

The current situation

In Spain, initiatives to implement the electrical telegraph started as early as 1852[25], though both models coexisted for a few years. Excluding punctual circumstances, such as a partial reactivation in the Basque Country during the third Carlist war[26] or the restoration of other towers as residences, pigeon lofts, or simply as a snapshot of the past, they were abandoned to slow decay. Today, only 52 % of the stations maintain at least part of their materiality, and most of them have partially collapsed or are at risk of collapsing[27].

Just as the environment of the towers played a major role in their initial design, it also influenced their evolution. Nowadays, most of the towers that remain are located in sparsely populated areas, whereas the stations that were located in an urban centre or in the path of a major infrastructure[28] have disappeared. Though the towers constructed in brick

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22 Alexander J. Field, "French Optical Telegraphy, 1793-1855: Hardware, Software, Administration", *Technology and Culture,* no. 35 (1994): 329.

23 Cruz Pérez, dir., *Estudio de la red…,* 45.

24 Lalana-Encinas, "La línea de…", 63.

25 Bahamonde Magro, Martínez Lorente y Otero Carvajal, *Las comunicaciones*… 17.

26 Carlos Ortiz de Urbina Montoya, *Vestigios militares de las Guerras Carlistas en Álava: el "Fuerte y las torres de Vayagüen, El Encinal y Almoreta en Nanclares de Oca* (Vitoria-Gasteiz: Departamento de Cultura, Juventud y Deportes, 2005), 174.

27 Cruz Pérez, dir., *Estudio de la red*…, 35.

28 For instance, the towers of Revilla-Vallejera or Cavia (Burgos). See Líneas generales: Línea de Castilla, s.v. "LC026 - Cabia", consulted on March 20th, 2021, https://forohistorico.coit.es/index.php/wiki-telegrafia-optica/item/lc026.

have suffered more in the intervening years, some of the towers in stone have been dismantled to reuse the materials.
Sometimes the optical telegraph has left other traces behind. As of 2019, over a third of the locations of telegraph towers in the Castilla Line is reflected in their toponymy, as the site is named after a variant of 'telegraph', 'castle' or 'tower'.

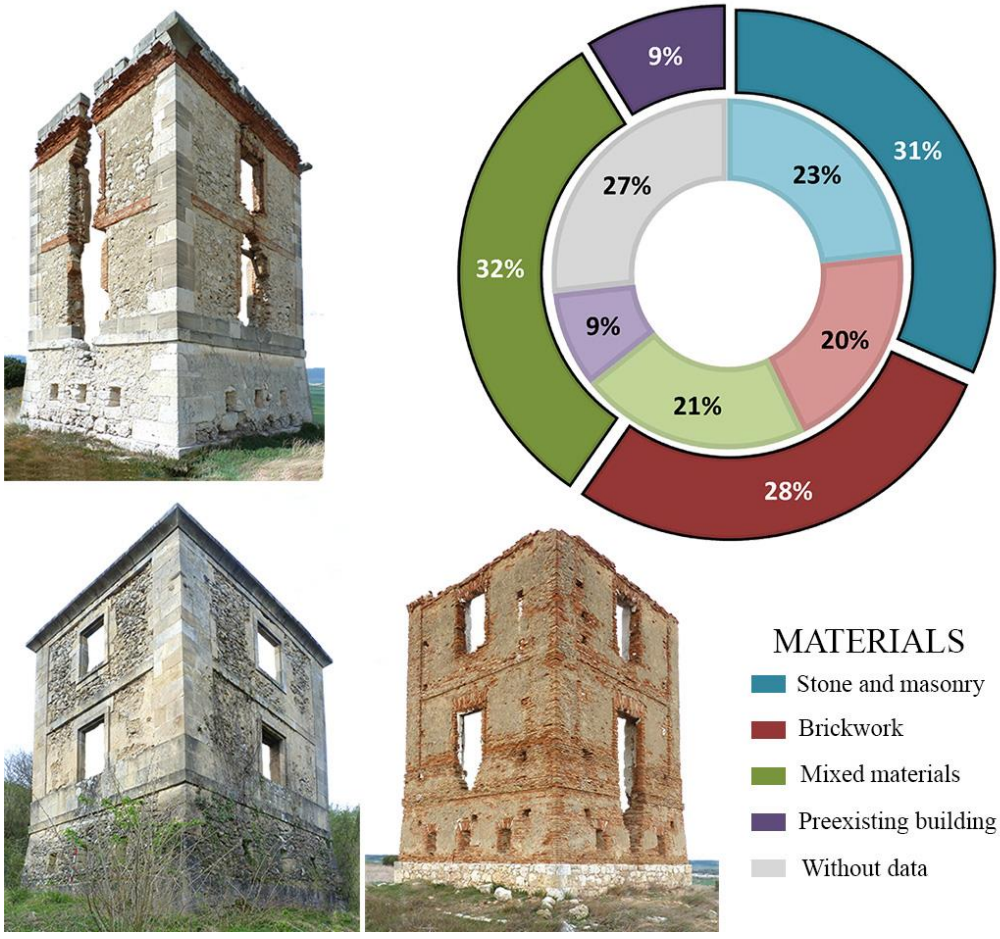

Figure 7: Laura Lalana-Encinas, *Graphic of materials employed in construction; the outer ring is an extrapolation but cannot be confirmed. Rendition of optical telegraph towers: above, with mixed materials (Campajares, Burgos); lower left with stone (Basalen, Altsatsu; before restoration), and lower right with brick (Transilla, Palencia),* 2019 (elaboration by the author, based on Lalana-Encinas, "La línea de…", 63).

Furthermore, though it was not part of the original design, their pre-eminent locations have created a situation where, today, most of the towers that remain are very visible from

afar[29]. Even when that is no longer the case, they are still a witness of the past characteristics of their landscape[30]. As such, they are not only a valuable tool to understand the landscape but also one of the elements that contribute to its internal coherence and identity[31].

Conclusions

More than a century after losing the use for which they were conceived, the towers that remain standing constitute a visible and significant key to understanding their associated landscapes. They are a testament to an important stage in the field of telecommunications, but perhaps their principal value resides in their peculiar identity as buildings that, while standing alone, can only be understood as part of an ensemble: as nodes of a national network in the past and as a cultural ecosystem service in the present. Although they have gone relatively unremarked, they are part of the identity of their landscapes and they have the potential to add significant value to their regions and neighbouring populations.

Even though there have been instances of architectural restoration in some of the towers of the Castilla Line, it is dubious whether they can be considered a success. For the most part, they have ignored the complex, unseen reality of the station in favour of the building in front of their eyes. Even when other uses have been considered, this discussion has often been done from a detached perspective that has not garnered enough support to become a reality[32].

To truly preserve their character, it is imperative to look beyond the material and technical concerns[33] or even the exceptional value of the Spanish optical telegraph system. We must ask ourselves *why* they were and still may be relevant to their associated landscapes and populations rather than simply *how* to restore the architectural embodiment of each node as a singular unit. Any intervention undertaken in these elements must reconcile the respect for their materiality with the technical, historical and social choices that led to their design. We must consider not only heritage and architecture but also landscape and environment as parts of an indissoluble whole. Before the optical telegraph towers are lost to disinterest, or before they are changed irrevocably in the name of historical preservation, we must learn to see them for what they are. We must learn to perceive what is in front of our eyes, but also what exists beyond the visible.

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[29] While we have referred to intervisibility as the visual relationship between the stations, their visibility would be defined as the relationship of the tower with its environment.

[30] Marc Antrop, "Why Landscapes of the Past are Important for the Future", *Landscape and Urban Planning*, no. 70 (2005): 32.

[31] Marc Antrop, "Why Landscapes…", 27.

[32] Marco Antonio Garcés Desmaison, "Las torres de telegrafía óptica. Diez años después de la primera", *Papeles del Partal*, no. 6 (2014): 127.

[33] Javier Pérez Gil, "La cuestión de la conservación de la materia en la arquitectura vernácula: teoría, autenticidad y contradicciones", *Conservar Património*, no. 35 (2020): 117.

El paisaje es hoy un tema crucial en el debate arquitectónico, urbanístico, artístico, territorial, político, ecológico y antropológico. En la pregunta sobre qué es un paisaje se entrecruzan muchas de las grandes cuestiones que tienen que ver con la construcción y con la percepción de nuestro entorno, en un momento determinado por una crisis global que convierte a la mirada sobre nuestro hábitat en un asunto marcado por la urgencia. La centralidad del paisaje en la cultura contemporánea es un fenómeno tan reconocido que ha dado lugar a elaboraciones teóricas específicas tendentes a dar cuenta del mismo. Está claro que hoy las cuestiones relacionadas con el paisaje, en su sentido más amplio, constituyen uno de los núcleos conceptuales en los que en mayor medida se entrecruzan naturaleza, cultura, historia y contemporaneidad.

La complejidad y variedad de temas que el paisaje convoca solo puede abordarse desde una mirada transversal y desde la complementariedad de diferentes saberes y disciplinas. Tal fue el objetivo que se propuso el Congreso Internacional *Arquitectura y paisaje: transferencias históricas, retos contemporáneos*, celebrado en Granada del 26 al 28 de enero de 2022, cuyas aportaciones se recogen en el presente volumen.

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