

DOCUMENTACIÓN DIGITAL DEL EDIFICIO DE PASAJEROS DE TURUÑANA MEDIANTE FOTOGRAMETRÍA

DIGITAL DOCUMENTATION OF TURUÑANA STATION USING PHOTOGRAMMETRY

Juan Villarroja Gaudó ⁽¹⁾

¹ Profesor Titular Escuela Universitaria Politécnica de La Almunia, Centro Adscrito Universidad de Zaragoza, España, juanvi@unizar.es

RESUMEN

La estación de Turuñana es un punto estratégico en la línea de Ferrocarril entre Zaragoza y Canfranc. Se une la línea que pasa por Huesca con el ramal directo que va desde Zuera hasta Turuñana. En el primer tercio del siglo XX, el desarrollo de las líneas de hierro suponía una posibilidad importante de crecimiento social y económico para las diferentes localidades por donde pasaba. Turuñana se convierte en un punto importante de la línea, ubicado en mitad de la nada.

Actualmente la estación y su entorno se encuentran totalmente abandonados en un entorno agreste y natural con un paisaje increíble entre campos, olvidada al transcurso del tiempo y de los años.

Con el trabajo y la investigación desarrolladas y que se presentan en esta comunicación se favorece la difusión y el conocimiento de la historia reciente del ferrocarril de Aragón y se ayuda a preservar el patrimonio ferroviario.

Tras una primera investigación y trabajo en archivos y bibliografía, así como en otros documentos históricos, se procede a la restitución precisa de la documentación gráfica del edificio estudiado, la estación de Turuñana.

Después de diferentes visitas al entorno y llevando a cabo un riguroso trabajo de campo, se procede a la restitución mediante técnicas de fotogrametría para levantar una nube de puntos para conseguir hacer una toma de datos precisa. Este trabajo, combinado con otras técnicas de tomas de datos, además del propio reportaje fotográfico, permite generar una documentación gráfica de gran precisión e interés, con gran nivel de detalle.

Palabras clave: Documentación histórica - Fotogrametría - Patrimonio ferroviario - Documentación digital - Estación de Turuñana

ABSTRACT

Turuñana station is a strategic point on the railway line between Zaragoza and Canfranc. It connects the line that passes through Huesca with the direct branch that runs from Zuera to Turuñana. In the first third of the 20th century, the development of railway lines represented a significant opportunity for social and economic growth for the various towns it passed through. Turuñana became an important point on the line, located in the middle of nowhere.

Currently, the station and its surroundings are completely abandoned in a wild, natural setting with an incredible landscape among fields, forgotten over time and years.

The work and research carried out and presented in this communication promote the dissemination and understanding of the recent history of the Aragon railway and help preserve its railway heritage.

After an initial investigation and work in archives and bibliography, as well as other historical documents, the detailed graphic documentation of the building studied, the Turuñana station, is restored.

After several visits to the area and rigorous fieldwork, the restoration process was carried out using photogrammetry techniques to create a point cloud for accurate data collection. This work, combined with other data collection techniques, in addition to the photographic report itself, allows for the generation of highly accurate and interesting graphic documentation with a high level of detail.

Keywords: *Historical documentation – Photogrammetry - Railway heritage - Digital documentation - Turuñana station*

1. CONTEXT OF THE ZARAGOZA–CANFRANC RAILWAY

The cross-border railway line from Zaragoza to Canfranc, with later connection to France via the Somport tunnel toward Oloron and Pau, has been a historical demand since the mid-19th century. In 1853, the manifesto *Los Aragoneses a la nación española: consideraciones sobre las ventajas del ferrocarril del Norte por Zaragoza y Canfranc* (“The Aragonese to the Spanish Nation: considerations on the advantages of the northern railway via Zaragoza and Canfranc”) was drafted, where several arguments were presented to defend the idea that the cross-border route through Canfranc was the optimal solution — better than those through the Basque Country or Catalonia — due to economic, geographical, political, or even historical reasons (AA.VV., 1853)

Nearby countries like France and Germany — with the exception of England, birthplace of the coal and steel revolution — had already experienced the social and industrial transformations driven by the railway system. The Spanish upper class quickly recognized the socioeconomic impact that was spreading across the Pyrenees (Lera-Aused & Medrano-Márqués, 2021).

In this context, the emerging Aragonese bourgeoisie aimed to follow the example of modernizing European societies, viewing the railway as a mode of transport that promoted commercial relations and, ultimately, economic and social progress. Although since 1845 there had been a proposal to build a line connecting Madrid with Zaragoza and eventually France via Pamplona, the railway did not definitively reach Aragón until 1861, the year when the Zaragoza–Lérida line was inaugurated (Lera-Aused & Medrano-Márqués, 2021).

The construction of the Zaragoza–Canfranc railway line was carried out in several phases (Image 1):

- 1861: Zaragoza–Tardienta opened on September 18, as part of the Zaragoza–Lérida line, with later connection to Barcelona.
- 1864: Tardienta–Huesca (September 12).
- 1883: Huesca–Jaca (March 1).
- 1928: Jaca–Canfranc opened on July 11, completing the trans-Pyrenean section.
- 1929: Zuera–Turuñana: built by request of the French government, shortening the route by 44 km compared to the section through Huesca.

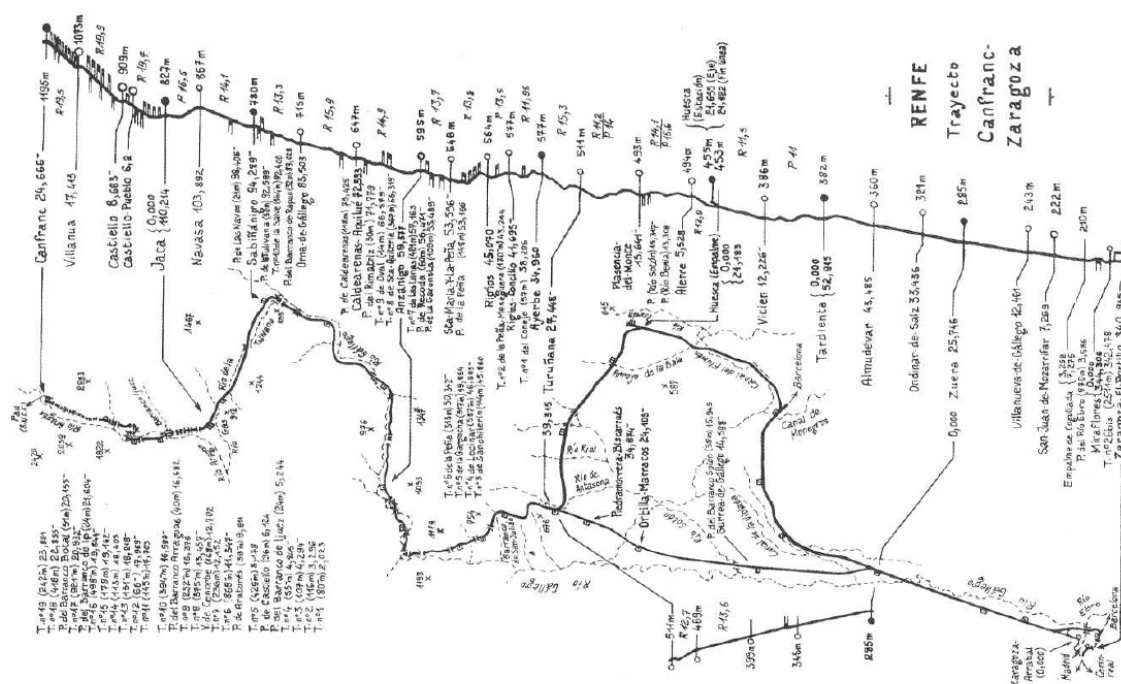


Image 1. Plan and section of the railway line between Zaragoza and Canfranc, showing the direct branch from Zuera to Turuñana. Period drawing of the route of the line. (CREFCO) (Parra-de-Más et al. 2005)

The original route from Zaragoza to Canfranc follows the Gállego River valley up to Sabiñánigo, then ascends toward Jaca, continuing along the Aragón River valley until reaching the Los Arañones plain — the site of the Canfranc International Station, which led to the development of the village known today as Canfranc Estación.

The railway line makes use of the original Zaragoza–Barcelona route, reaching Tardienta Station, from which a branch diverges toward Huesca, the provincial capital.

From Huesca, the line continued to Jaca in 1883, reaching Canfranc in 1928. At the request of the French government, a direct branch line from Zuera to Turuñana was authorized in 1927 and completed on February 18, 1928. The first official journey was made on March 4, 1929. This 44 km branch passed through stations such as Gurrea, Ortila-Marracos, and Piedramorrera-Biscarrués, ending at Turuñana, which became a key junction before rejoining the main line toward Canfranc.

While Zaragoza's press celebrated its inauguration due to the significant reduction in travel time between Zaragoza and Canfranc, Huesca perceived it as the loss of its role in international railway traffic. Turuñana Station thus became a strategic point where the tracks bifurcated — either toward Zaragoza via Zuera or via the original route through Huesca.

1.1 Turuñana station

Turuñana Station (Image 2) gained significance following the commissioning of the direct branch line between Zuera and Turuñana on March 4, 1929 (López-Pardo. et al., 2020). Historically, Turuñana had served as a stop on the stagecoach route between Zaragoza and Jaca. It lies within the municipality of Ayerbe. Beneath the ruins of Artasona Castle, the old roadside inn was the station's only neighbor—both buildings standing alone in a vast plain dedicated to cereal cultivation.



Image 2. View of the Turuñana station buildings and surrounding areas. Photo: Author

In this immense and tranquil landscape, the branch from Zuera converged with the line from Huesca, continuing on toward Canfranc and across the Somport Tunnel into France.

In the novel *Nadie se apeará en Turuñana, camino de Canfranc* (Galtier-Martí, 2020), the absurd events portrayed repeatedly reinforce the idea that “nothing ever happens at Turuñana Station.” Trains passed by on time, and the station had to house workers and railway staff who operated the line, along with their families.

Despite its apparent stillness, Turuñana was an important node on the line’s layout, as it was the junction point where the two branches—toward Huesca and Zuera—diverged or reconnected. It is located in the plains between Huesca and Ayerbe.

Although it has always been officially denied that “punishment stations” existed, certain stations, due to their isolated and singular location, have acquired a unique symbolic and historical character. Turuñana is one such case. Its isolation is not exceptional along the line: similar conditions can be found at Biscarrués-Piedramorrera Station, also on the branch from Zuera, or the nearby Riglos-Concilio Station, to name a few.

2. OBJECTIVES

This study forms part of a broader research project on the railway heritage of the Zaragoza–Canfranc line, with a particular focus on Turuñana Station, a building of singular character due to both its role within the railway system and its historical, symbolic, and architectural value.

The main objectives of this work are:

- To historically analyze the role of Turuñana Station within the layout of the Zuera–Turuñana branch line, considering its functional evolution and territorial context.
- To compare and systematize historical documentation (plans, photographs, technical records) with the current physical condition of the station.
- To develop a detailed digital model of the station using advanced graphic documentation techniques, with the aim of promoting its conservation, dissemination, and potential heritage reuse.
- To contribute to the preservation of railway heritage through the study, digitization, and graphic restitution of this type of singular building, which is often forgotten or at risk of disappearing.

3. METHODOLOGY

The methodology used in this study combines historical documentary sources with modern digital tools for graphic representation and analysis. It is structured into the following phases:

- Historical and documentary research, drawing on archives, specialized literature, period newspapers, and original plans, to understand the origin, uses, and transformations of the building. Special mention should be made of the work carried out in the AZAFT archive.
- Scanning and digitization of plans: the original documentation obtained from the AZAFT archive was digitized using plan scanners, with the aim of preserving these historical materials.
- Technical redrawing of available documentation, to create a coherent and precise base for study, conservation, and digital reproduction.
- Field visits and on-site work, including photographic recording and manual data collection, to contrast historical documentation with the current state of the building.
- Digital photogrammetric survey, using images captured with terrestrial cameras, processed with specialized software to generate point clouds and three-dimensional models (Buldo et. al. 2024). Among several tested options (Recap, RealityCapture), the standard version of Agisoft Metashape was ultimately chosen due to its workflow efficiency and the high definition of the final results.
- Graphic restitution of plans and elevations based on photogrammetry, producing representations consistent with the building's original construction techniques and architectural language.
- During the process, laser scanning was ruled out as a method for generating the point cloud, due to the limited accessibility of the station building's surroundings. This was the result of a particularly rainy spring and a dense environment overgrown with shrubs and brambles, combined with recent railway track improvement works that left construction materials and debris in several areas.

This methodological approach seeks to bridge past and present, combining documentation and technology to offer a precise and updated vision of the building. It contributes both to academic knowledge and to the station's preservation as a piece of railway cultural heritage (Quintilla-Castán, Agustín-Hernández, 2024).

4. ANALYSIS OF THE STATION AND DOCUMENTATION

Following the historical overview of Turuñana Station, and its context and significance within the Zaragoza–Canfranc railway line, the study moves on to the analysis of the consulted documentation.

Thanks to the work carried out in the Historical Archive of AZAFT (Aranda-Moya, 2019); (Roldán-Aranda 2023), a highly valuable document was located containing the original floor plans of the passenger building of Turuñana Station (Image 3). The conservation status of the document is good, and thanks to its digitalization, it has been possible to work directly on it, producing an accurate restitution and technical redrawing using CAD software tools.

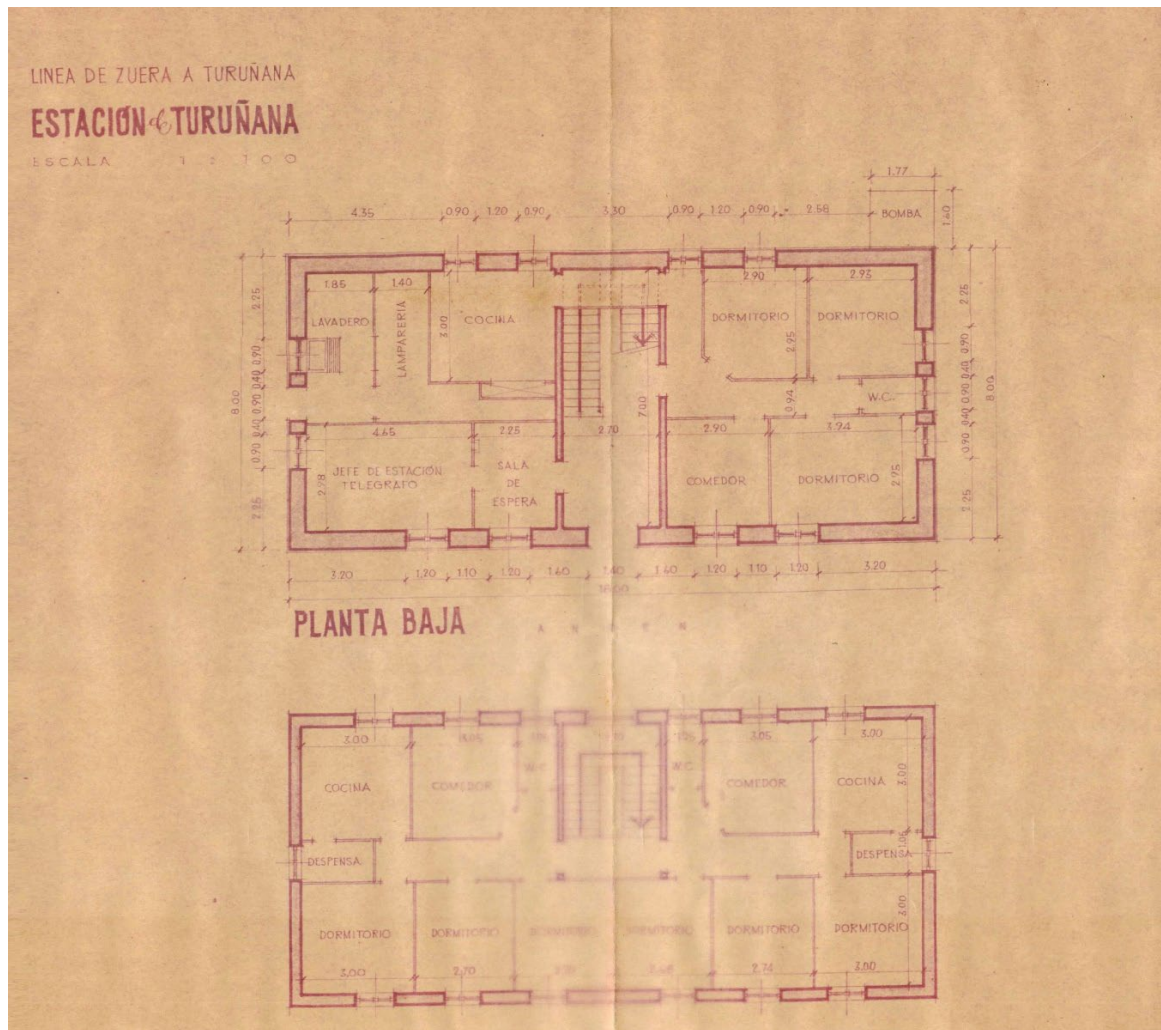


Image 3. Floor plans of the Turuñana station passenger building. Source: AZAFT Archives

Moreover, the opportunity to access the station in its current abandoned state allowed for direct observation and comparison between the original design, the archival plans, and the present-day condition, which is one of partial ruin.

Through multiple field visits and a carefully executed photographic survey, photogrammetric work was successfully carried out using Agisoft Metashape. For various practical reasons, the standard version of the software was used, and due to the available computing resources at the time, the point cloud was generated at medium quality. Given that the final aim of the 3D model is the promotion and preservation of heritage, it was considered that higher-definition output was not necessary at this stage.

From the resulting point clouds, and their corresponding meshes and textured models, orthophotos and orthoplans could be generated. Combined with the previous CAD work, it became possible to reconstruct nearly all elevations and other graphic documents of the building, enabling its dissemination and study in both academic and heritage contexts.

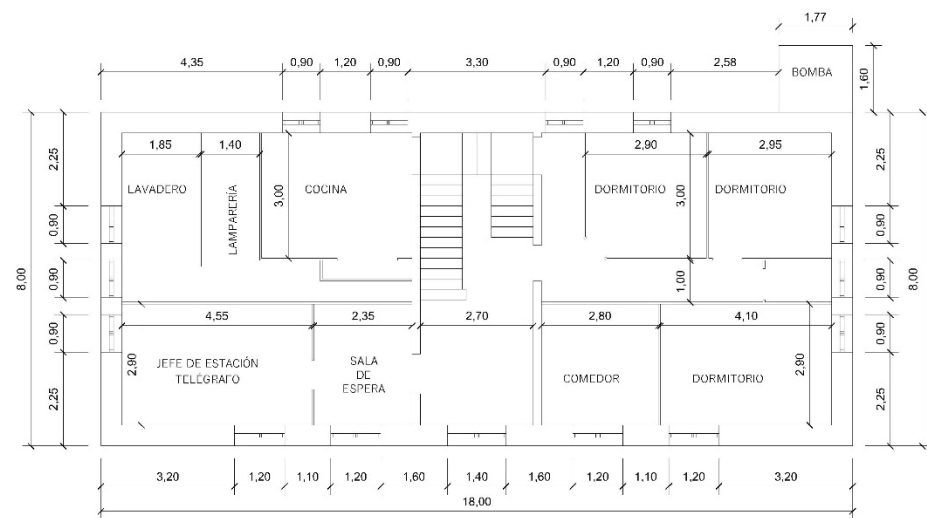
5. GRAPHIC RESULTS, PHOTOGRAMMETRY, AND SURVEYS

Below are the various graphic documents obtained throughout the research process:

- Floor plans of the Turuñana station passenger building (Image 4)
- photogrammetry work for generating the point cloud (Image 5)
- 3D model: point cloud, solid, mesh and texture (Image 6)

LÍNEA DE ZUERA A TURUÑANA

ESTACIÓN de TURUÑANA



PLANTA BAJA

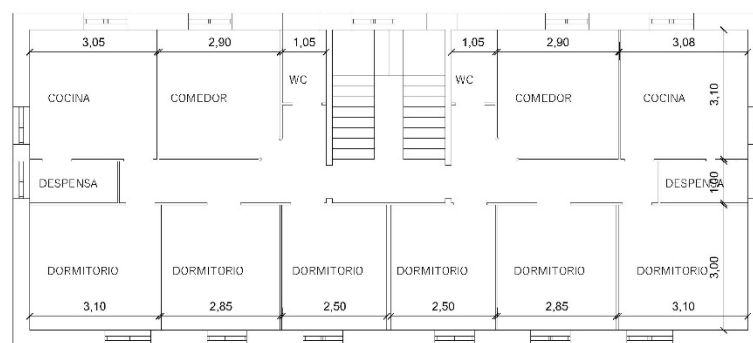


Image 4. Floor plans of the Turuñana station passenger building. Source: Author

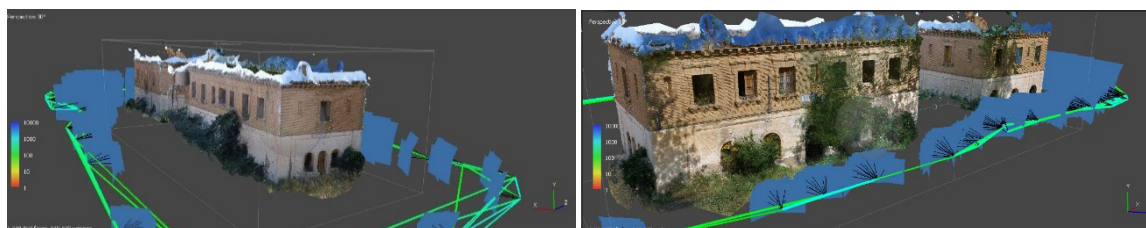


Image 5 Views of the photogrammetry work for generating the point cloud. Source: Author

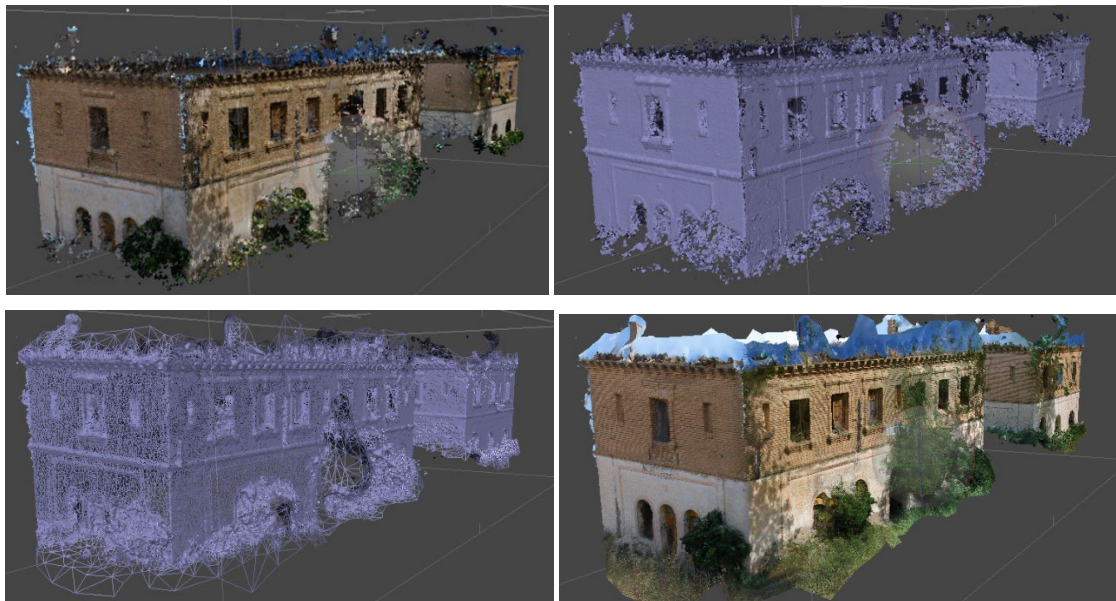


Image 6. Different views of the 3D model: point cloud, solid, mesh and texture. Source: Author

6. DISCUSSION

The historical and graphic analysis of Turuñana Station reveals a singular case within the set of railway buildings on the Zaragoza–Canfranc line. Unlike larger or better-known stations such as Canfranc, Huesca, or Jaca, Turuñana is modest in scale yet highly strategic in its role. It served as the connection point for the direct branch from Zuera, built to reduce travel times and improve the efficiency of the international route. This functional character, together with its primary role as a technical node rather than a passenger stop, makes it an underrated yet essential example within the Pyrenean railway network of the early 20th century.

From a heritage perspective, Turuñana Station embodies a transition between two paradigms: the 19th-century regional transport model based on indirect routes, and the rationalized system of the 20th century, which prioritized direct cross-border connections to France via Canfranc. In this sense, its construction reflects a logic more aligned with functional engineering than with the symbolic monumentality of other stations. Nevertheless, its austere architecture, defined by straight lines and constructive rationality typical of the 1920s, preserves the architectural language of the railway era and stands as a valuable testament to the modernization of infrastructure in rural settings.

The comparison between recovered historical documentation (original plans, line projects, technical descriptions) and the data obtained through photogrammetric surveying has allowed for the validation of part of the original design. It has also helped to identify alterations, material losses, and functional transformations. These differences between the planned and the current state underscore the need to preserve not only physical elements but also the technical and territorial memory embedded in such buildings.

Furthermore, the use of digital techniques such as terrestrial photogrammetry, three-dimensional restitution, and scanning of historical drawings adds a layer of precision and documentary rigor, while opening new possibilities for the active conservation and dissemination of railway heritage. As noted by authors like Murphy et al. (2009), the application of HBIM environments (Heritage Building Information Modeling) enables effective management of heritage buildings throughout their lifecycle, integrating historical, graphic, and material information.

In the case of Turuñana, the detailed digital reconstruction and graphic restitution of the station aim not only to visually replicate the building, but also to provide a technical and cultural foundation for its physical conservation and potential reuse as an interpretive element of the Aragonese railway landscape. Thus, this study contributes not only to the academic understanding of railway heritage, but also proposes a concrete strategy for its appreciation and future preservation.

7. CONCLUSIONS

The study of Turuñana Station, within the context of the Zaragoza–Canfranc railway line and the direct branch from Zuera, highlights the value of a railway building that has been largely undocumented until now, yet proves essential to understanding the technical and territorial transformations of transportation in Aragón during the first third of the 20th century. Its construction responded to operational efficiency criteria and to international demands stemming from the Franco-Spanish agreement for the opening of the trans-Pyrenean corridor, making this station more of a logistical milestone than a symbolic one.

From a methodological standpoint, the approach proposed—based on the comparison between historical documentation and digital architectural documentation techniques—has proven effective in recovering the building's original technical knowledge, identifying changes and losses, and generating a digital model useful for its conservation and dissemination. The application of photogrammetry, plan scanning, and technical redrawing has enabled the development of a precise graphical restitution, potentially integrable within an HBIM environment, as recommended by international standards for heritage management.

Beyond the specific case of Turuñana, this research emphasizes the importance of paying attention to secondary buildings within large historical infrastructures. Modest stations, logistical junctions, and forgotten branch lines like Zuera–Turuñana are also part of railway cultural heritage, and their study, documentation, and preservation are key to achieving a comprehensive understanding of the network and its historical evolution.



Image 7. Final elevation comparing originals and point cloud. Source: Author

Finally, this work reinforces the notion that digital tools not only complement historical analysis, but can also become a strategic instrument for the protection, enhancement, and reuse of endangered architectural heritage. In this regard, the digital reconstruction of Turuñana Station is not merely a technical representation (Image 7), but a way to ensure its permanence in memory and in the cultural landscapes of Aragón.

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