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Morphometry of Anti-Aircraft Shelters Under Ribalta Institute and Tetuán Square in Castellón de la Plana*

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Abstract: During the first years of the Spanish Civil War, the city of Castellón was attacked by numerous bombardments, mostly by air. In order to protect the inhabitants of the city from them, the Passive Defense Board (Junta de la Defensa Pasiva) was created in the municipality, which would be responsible for planning the construction of the necessary air-raid shelters as a measure to protect the population from shelling. Although some three hundred shelters were planned, most of them have been destroyed or abandoned. Fortunately, the Municipal Historical Archive of Castellón de la Plana holds much of the documentation carried out by the Passive Defense Board where you can find, among other information, the original plans of many of the shelters projected. Furthermore, the current Archaeological and Ethnological Heritage Catalogue includes two of these shelters as locally relevant goods: one was built under the Francisco Ribalta Institute and another is located under Tetuán Square. In order to preserve and contribute to a greater knowledge of this architectural typology, this article shows the graphic and constructive analyses that have been made of these two refuges, which constitute unpublished documents that allow researchers, compare them with other similar constructions.

Key words: Anti-aircraft shelter, Castellón, Ribalta, Tetuán

1. Introduction

From the beginning of the Spanish Civil War in July 1936 to June of the following year, Castellón de la Plana suffered the attack of 40 bombardments, most of them aerial [1]. In order to protect the inhabitants of the city, for those years exceeded the 45,000 [2], from these attacks, Passive Defense Board (Junta de la Defensa Pasiva) was established, with the mission of planning the construction of the air raid shelters necessary.

Nearly 300 shelters were planned, 47 of which were public and 211 private. The Historical Archive of Castellón preserves 199 documentation that could have

housed a total of 40,000 people, 43 are in public use and 156 are privately owned [3].

The initial objective of the government agencies was to create a complex underground network of shelters under the city [4], however, only 43 [5] would be carried out, the majority of them disappeared today.

The present work is part of a research project whose purpose is the “Formal and constructive analysis of the defensive architectures of the Civil War in the regions of Castellón”. Its objective is to generate an appropriate methodology that allows the cataloguing of the shelters of which there are still material testimonies in the city of Castellón de la Plana.

2. Material and Methods

The difficulty of access and the limited size of the galleries to the extent that they are scattered from one of the shelters leads to the establishment of a general methodology for the collection of data for the graphic survey, where the use of indirect systems such as the

* **The present work is part of the research project** “Formal and constructive analysis of the defensive architectures of the Civil War in the regions of Castellón” (Ref. UJI-A2017-13). Funded by Universitat Jaume I de Castellón.

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laser-scanner is excluded. Therefore, the use of manual means and photographs taken with a camera (NIKON D-810) has been chosen as a support system for the survey.

To obtain complete information, the data collection has been divided into different phases, so that in each of them one of the characteristics that define this type of constructions is studied.

In the first phase, the directions and lengths of the different sections that shape the route of the shelters are obtained.

The underground character of these constructions does not allow to have external references that serve to support the survey, so the process is carried out with the aid of a canvas, a laser level (TACKLIFE SC-L07), a compass of viewfinder C500 (GEONAUTE) and a laser distancemeter (LEICA 837031). The extension of the strings determines the direction and length of each section and the compass allows to establish the direction of each of them with respect to the magnetic north of the earth. At the same time, with the handheld laser distance meter, the longitudinal measurement is performed between the initial and final points fixed by the strings.

In a second phase the data defining the section of each of the sections are obtained. The greatest complexity corresponds to the first ones, since in them the descent to the refuge takes place and they are usually followed in zigzag traces. This work is carried out from the horizontal references established with a laser level (LASERMARK GIZMO LITE, CST/BERGER), which divide the descending sections into different levels, thus being able to obtain the necessary data from each level until reaching the last depth.

In a final phase, data are collected from the construction details that defined the different elements. In this phase the images obtained with the camera have been particularly useful.

The processing of the obtained data is carried out in the office, using the drawing up of the graphic software (AutoCAD 2019) and its free equivalent (DRAFTSITE).

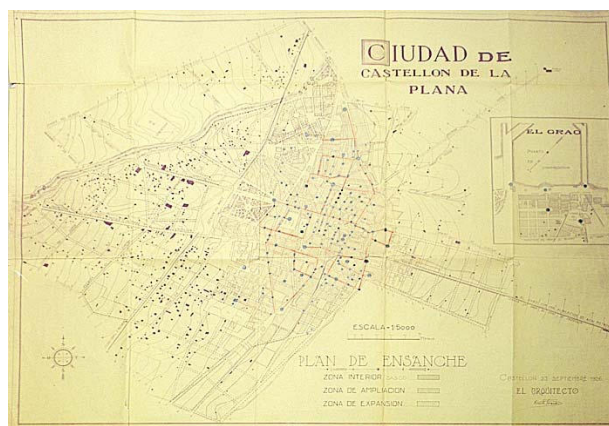


Fig. 1 Anti-aircraft shelter under the Francisco Ribalta Institute. Floor and section plan. December 1937. Arq. Francisco Maristany Casajuana. Source: Municipal Historical Archive of Castellón.

3. The Anti-Aircraft Shelters of Castellón de la Plana

In the city of Castellón there were anti-aircraft shelters of different types.

At first the semiburied type was raised, formed by walls of great thickness and inclined cover, built with reinforced concrete. Unfortunately, no case is currently preserved, however, it can be known as they were thanks to the archival documentation of a 1937 Project, which offered the same constructive solution for different capacities of 100 or 200 people [6].

The second type is solved by excavated galleries. Its appearance is a consequence of the difficulty to obtain the materials necessary to make reinforced concrete. In view of the large number of documents retained, it should have been the most widespread model. Currently most of the anti-aircraft shelters of the city of Castellón have disappeared, however two of them will be collected in the next Catalogue of the Archaeological and Ethnological Heritage of the PGOU of Castellón de la Plana [7], these are located under the Francesc Ribalta Institute and under the Plaza Tetuán, both object of this publication. In addition to these two, the building under Independencia Square is also partially preserved, and a thorough study is still pending. These three public shelters formed part of the extensive network of underground defenses designed

to ensure the protection of the entire population of the city.

4. Anti-Aircraft Shelter Projects

The Municipal Historical Archive keeps documentation of one hundred and ninety nine of these anti-aircraft shelters, forty-three are public ownership with a capacity for 27,200 people and one hundred and fifty six more are private ownership that could have taken shelter 10,677 individuals [8].

Generally, these are simple tunnelling into the earth at a depth between 12 and 15 meters which have two exits from which we can access to vaulted galleries 2 meters wide and 2.5 meters maximum height.

In some cases, the galleries are reinforced with masonry walls with integrate attached seats, covered by a half-foot brick vault and a layer of concrete as pavement. The two cases studied belonged to this type in their origins.

4.1 The Anti-air-Craft Shelter Under Ribalta Institute Project

The documentation studied is stored in a folder called “Project for the construction of an underground shelter for the service of the Institute of Secondary Education and the Normal School” dated December 1937 and signed by the architect D. Francisco Maristany Casajuana as a municipal architect, a position he held since 1927 [9].

The construction of the anti-aircraft shelter was built by solid ceramic bricks and Portland mortar, with vertical walls and lowered half-foot vaults, being limited the use of reinforced concrete to the stairways, the flooring and the integrate attached seats into the walls.

In the project report the position of the exits is indicated and the inner dimensions of the gallery are detailed, 69 m long, 2 m wide and 2.5 m free height. It was calculated for an occupation of 4 people each square meter (0.25 m²/person), which meant that it could take shelter 557 people. In addition, it was projected to be

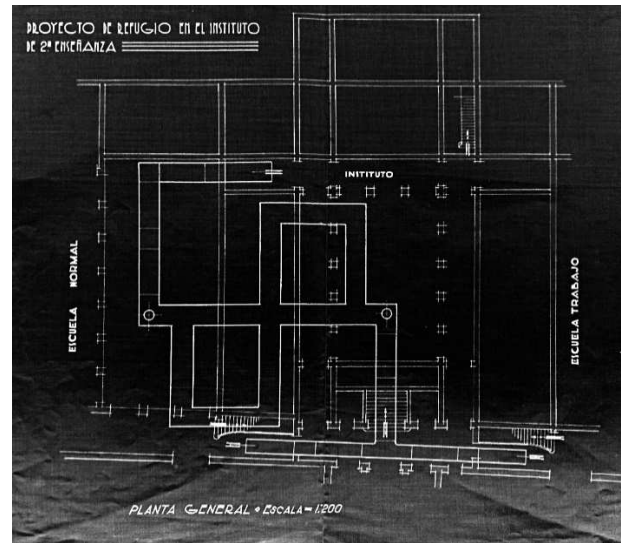


Fig. 2 Anti-aircraft shelter under Tetuán Square, Floor plan, 1951. Source: Municipal Historical Archive of Castellón.

connected with another public anti-aircraft shelter located to the west, in the rear street of the Institute.

To be able to make use of it, three exits were projected. From each one, it is possible to reach to four flights of stairs with 15 steps each. One of the exits is located at the end of the gallery, behind the cloister and the other two symmetrically arranged next to the secondary stairs close to the main stairway of the Institute.

The galleries would be formed by lowered vaults supported by walls, whose lower part bench seats are set up. Two thin layers would form the concrete slab. The vault would be made by solid bricks, while the walls and bench seats would be made by masonry. On the other hand, the graphic documentation specifies the following dimensions: galleries of 2.00 meters wide, and 2.60 m free height in the midpoint and 2.20 m close to the walls. The represented walls are 30 cm wide, reinforced on their first rows by the bench seats with 35 cm wide and 40 cm height. Furthermore, the vaults are half-foot thickness, with an inner reinforcement of concrete of 7 cm thickness, a few more than 5 cm of the concrete slab.

4.2 The Anti-Aircraft Shelter Under Tetuán Square Project

Due to the landslides produced all around the city of Castellón de la Plana in the early 50 s, the City Council decided to carry out the necessary inspection work to evaluate the conservation status of the more than 200 anti-aircraft shelters of the city, as well as the drafting of a consolidation and reinforcement project for three of these anti-aircraft shelters, located in Tetuán Square, Independencia Square and Del mar Avenue [10].

In this project, signed by the municipal architect, Manuel Romani, are the plans of floor plan and cross sections of the anti-aircraft shelter under Tetuán Square, in which it is possible to see the original route of the anti-aircraft shelter built in the years of Civil War, as well as the areas affected by landslides and the proposed intervention to repair it.

The original design had three exits, one located in Tetuán Square, another in Rey Don Jaime Avenue, previously named Donoso Cortés Street and the third under the Post Office building. It is possible to appreciate too what might have been a fourth exit in Trullols Street drawn with dashed line.

In the plan are shown the descending galleries from the exits in Tetuán Square and Donoso Cortés Street but not those under the Post Office building of which it is only possible to appreciate the connection with it. These two descending galleries are solved with several flights of steps in zig-zag, four on Tetuán Square exit and only two on the other, through it is possible to reach a depth of 11.5 meters.

There were under Tetuán Square, in addition to the above mentioned exit, a network of galleries adopting the two directions of the urban pattern, so that three galleries run in the direction of Zaragoza Street and four more in perpendicular direction and intersecting previous galleries, so it is created four rectangular shapes. Each one was composed by four sections of galleries, of which three were placed sequentially going on the direction of the Zaragoza Street and the fourth in perpendicular direction, towards Tetuán Square exit.

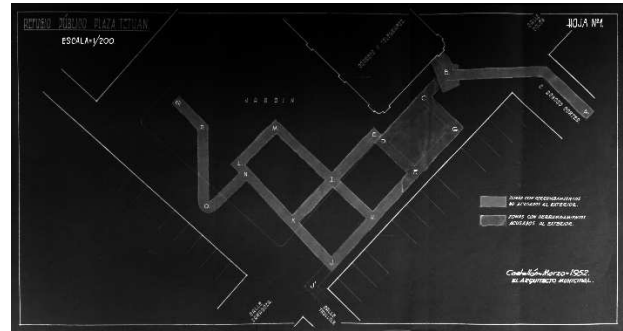


Fig. 3 Anti-aircraft shelter under Tetuán Square. 1951 project floor plan. Source Municipal Historical Archive of Castellón.

The cross section used to solve the galleries is constant throughout the route with 1.8 meters wide and 2.5 meters height in the midpoint of the lowered vault that covers them. According to the project report of the 1952 consolidation and reinforcement project, these galleries were directly tunneling in the earth with no additional reinforcement to support the land.

The floor plan shows how one of the four rectangular shapes that made up the galleries, the closest to the Donoso Cortés Street exit and close to the Post Office building exit, was affected by the landslides produced in 1951.

On the other hand, in the sections plan can be seen, in addition to the affected areas, the proposals to repair it, consisting in the filling of the collapsed galleries and the elevation of those close to them, building the necessary steps to connect with those that remain the original level.

As a result, the original pattern becomes a set of three independent galleries connected in its beginning by a fourth gallery which is perpendicular to them. The connection with the Post Office building has disappeared, as well as the possible fourth exit in Trullols Street.

To carry out these repairs and reconstruction works, the galleries were reconstructed using concrete to reinforce all walls, as well as the barrel vaults that would replace the original lowered vaults but they would keep 2.5 meters maximum height at their midpoint.

5. Current State

5.1 The Anti-Aircraft Shelter Under the Francisco Ribalta Institute

The building works of the anti-aircraft shelter located under the Francisco Ribalta institute barely reached the construction of an exit and half of other, most of the galleries are a rough excavation or not even that and they also lacks ventilation and electricity supply.

Morphologically, the anti-aircraft shelter plan can be defined as the addition of 3 sectors. One horizontal and slightly rectilinear, which continues at one end with a sloping gallery at the same direction, and two slopes in L-shaped, one united at the beginning and the other one in the middle.

The galleries should have 3 points of connection with the exterior; however only the one located at the southwest of the cloister is accessible. It is in a small stay next to the teacher's room, in this way, at present the access to the anti-aircraft shelter is a rectangular hole on the floor about 60 cm sideways. The second access is walled and partially covered by rubble, and the third is hidden behind a large amount of land and large stones.

Regarding size, the anti-aircraft shelter is almost 30 m length, of which only about 9 m are horizontal. The



Fig. 4 Anti-aircraft shelter under the Francisco Ribalta Institute, Floor plan, 2018. Source: Self-elaboration.

horizontal flight is partially excavated, being delimited by the terrain itself, which provides free dimensions about 75 and 92 cm wide, at the beginning and towards the end respectively, and about 0.80 and 2.05 m height. Three of the flights of the access sectors are built by walls which are made with 14×19×3 cm solid bricks which are placed on sailor position to reinforce the natural terrain. Barrel vaults cover the galleries, solved with the same type of brick but on soldier position (one of the lower flights) and with hollow bricks placed on sailor position (the upper flights). The width of these flights is 1.5 m, and the free height between 1.5 m at the start and 2.1 m. at the key of the vaults. The slope from the access level to the horizontal section is solved by steps about 23 cm tread and 15 cm riser. The fourth flight has only carried out the drilling of the terrain, providing an irregular dimension about 85 cm wide and 1.85 m free height [11].

5.2 The Anti-Aircraft Shelter Under Tetuán Square

The anti-aircraft shelter is currently can be visited thanks to the rehabilitation and refurbishment that the City Council carried out in 2017, with a project signed by the current municipal architect Angel Beltrán Roig. The main objective has been the conditioning of the galleries for its new use as a museum, as well as the opening and new design of Rey Don Jaime Avenue exit suitable to the current urban pattern [12].

Thanks to this intervention, the anti-aircraft shelter has once again has two exits, a main one located at the northwest corner of Tetuán Square, and a secondary one that is located on Rey Don Jaime Avenue, near to Zaragoza Street. Both exits have a generous rectangular opening flush with the pavement and whose width coincides with that of the first sloping flights which are developed in zigzag way until they connect to the underground galleries.

The slope is solved with stairs of 28 cm tread and 18 riser. At the main exit the stairs are arranged in four flights of 24, 18, 22 and 5 steps, while at the second exit there are two flights with 27 and 13 steps respectively.

This arrangement creates a height difference between the two ends that is solved inside the galleries with additional flights of stairs.

The underground galleries are developed on three different levels of depth, and are organized following a comb scheme. Three of them are noticeably parallel at the start, joined at the beginning by a fourth gallery with rectilinear development which is perpendicular to the other three.

The first of these three galleries is made up of two straight flights with approximately the same length arranged in an L shape. The second gallery, the longest of the three, is developed less deeply, solving the height difference with a flight with 18 steps. Its layout is made up by different straight flights that change their direction to meet the second exit. Besides, the only straight flight of the third gallery, which is solved with 15 steps, and is developed at a less deeply than the previous one.

The sloping flights of the main exit, next to the first of the galleries arranged in a comb, and the one that joins them, are solved with a cross section 1.60 m. wide and 2.50 high at its midpoint. With this same cross section are solved the beginning of the second and third galleries that widens to 2.5 meters from interior stairs

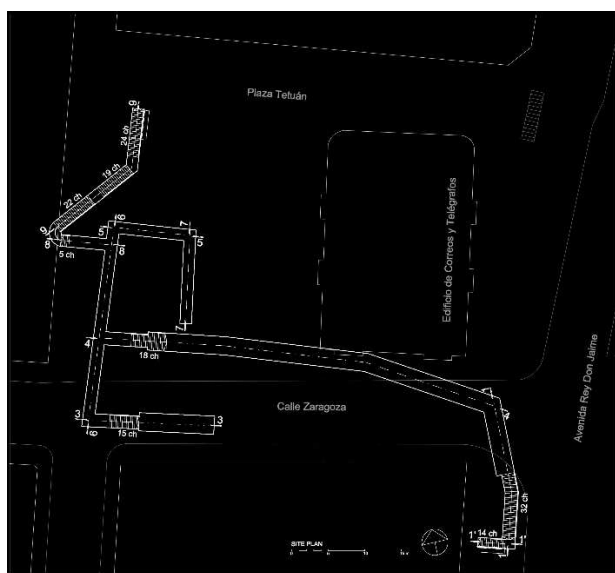


Fig. 5 Anti-aircraft shelter under Tetuán Square. Current status, 2019. Source: Self-Elaboration.

flights, changing its height to 2.3 meters in the case of the second gallery and 2.55 in the case of the third gallery. The transition between these two flights is solved in the sloping flights, with a lower height, more pronounced in the case of the second gallery where it decreases to 1.8 meters to recover the original 2.5 at the top. The two final flights of this central sector, sloping flights to the exit, reduce their width from 2.5 to 1.8 and 1.3 m respectively.

The anti-aircraft shelter has two blinded conduits that were used to evacuate the rubble generated during the 1952 repair work [13]. The whole anti-aircraft shelter has been rebuilt with reinforced concrete, executed with wooden formwork that provides its characteristic texture to the surface, as well as providing unity to the whole section and helping the construction of the barrel vaults that cover the galleries.

6. Project Versus Current State

6.1 The Anti-Aircraft Shelter Under the Francisco Ribalta Institute

The overlap of the floor plan obtained over the 1938 project floor plan allows the visual confirmation of the scarce scope of the works which were made, about 30 m of galleries of the 69 m which were projected. In addition, the current status of the anti-aircraft lacks the two loop circulations designed in the project.

On the other hand, it is also possible to appreciate a slight deviation in the layout, both in the direction of some of the flights and in their route, as well as the displacement of the exit situated close to the imperial staircase of the building, which would have been reconsidered at the end of the straight flight. Likewise, the sections executed are 50 cm narrower than those of the project.

However, the number of steps has been maintained, 15, which allows us to affirm that the projected depth was reached, as well as the location of the flight located next to the cloister, which has been taken as a key point in the overlapping of both the projected floor plan and the one of the current status.

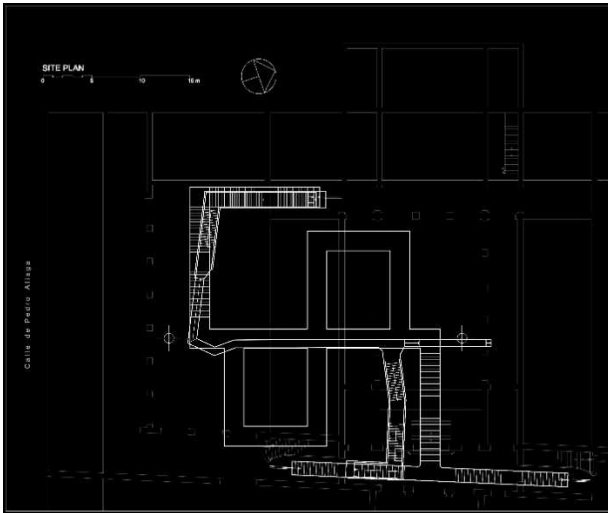


Fig. 6: Anti-aircraft shelter under the Francisco Ribalta Institute. 1938 Project and current state. 2018. Source: Self-elaboration.

6.2 The Anti-Aircraft Shelter Under Tetuán Square

By overlapping the original floor plan obtained from the 1952 consolidation project and the current one obtained from the 2017 project, it is possible to appreciate not only the differences already mentioned caused by the work carried out in 1952, but also small deviations that affect above all the gallery that joins the two current exits which is different in its final layout from the missing flights, going further into Rey Don Jaime Avenue, so a new perpendicular flight had to be added at the end to redirect the way to the exit.

Other minor deviations occur in the gallery that follows the perpendicular direction to Zaragoza Street and serves the purpose of the other three galleries, which currently appears closer to the building than it is indicated in the original layout, as well as the only parallel flight to this that remains today and the one that runs through Zaragoza Street.

As regards the cross section, it maintains its correspondence in the access galleries through Tetuán Square exit and is increased in width in the main flight joining the two exits and the gallery that runs under Zaragoza Street, both of them from the inner stairs of the galleries.

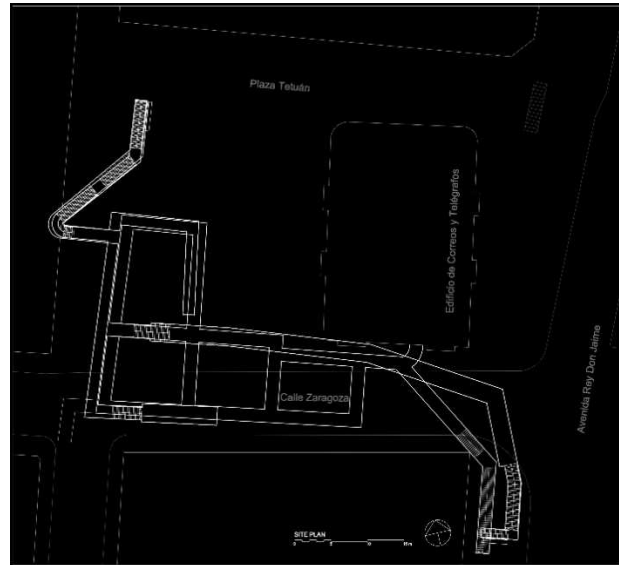


Fig. 7 Anti-aircraft shelter under Tetuán Square. 1951 project floor plan and current status, 2019. Source: Self-Elaboration.

7. Conclusion

In the first place, the results obtained make it possible to advance in the knowledge of these forgotten constructions in the time, helping to recover not only their history, but also helping future reconstructions like the one carried out in the anti-aircraft shelter under Tetuán Square.

Secondly, the comparison between the original documentation and the surveys carried out to the present state, show deviations in the resulting routes with respect to the projected ones that, although they can be motivated by different causes, it seem to indicate the existence of similar deviations in the rest of the anti-aircraft shelters of the city and with a greater probability in those of private ownership.

In this way, the joint study of the two cases presented, allows to have a complete reading of the development and use for which these constructions were projected. Consequently, the anti-aircraft shelter under Ribalta Institute is a testimony of special relevance to understand the different phases of execution of this type of constructions, since its construction seems to have been paralyzed in an initial level of excavation phase. Only the first flights of stairs have the steps,

lateral walls and the vault. The rest of the galleries, whose reduced height prevents standing, are delimited by the natural terrain and lack pavements, walls or vaults that would guarantee better stability.

On the other hand, in the anti-aircraft shelter under Tetuán Square it is possible to check the dimensional limits with which these buried spaces worked, being able to be considered as minimum habitat units.

In either case, the greatest contribution of the research carried out is to be able to highlight the change in layout, reflected in the graphic survey by means of a floor plan, and consequently, the differences found between the project and what was actually executed, that together with the lack of maintenance and deterioration of the first of the cases, make it necessary to catalogue these constructions.

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