The “Banuelo” at the ancient entrance of Granada

Survey and analysis in a fully digital approach

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Abstract: As the meaning of spas in the classical period, the public baths were a reference point for social life in the medieval Islamic culture, where the relation between Muslim citizens and water was a very important aspect. In addition to the hygienic aspect, the water had also two strong symbolic values: the first, in “sure” which referred to a paradisiac premium; the second was for its purifying value as an important part of rites of ablution required before praying. The result is that public baths become an important urban element and they can reveal ancient traces about the urban context.

The Hamman of Granada, called “Banuelo”, is one of the most representatives because of many factors: its good state of preservation and its considerable size allow well to take the suggestion that its plan fits in a perfect rectangle.

The aim of the study presented here is to compare, starting and exploiting the digital survey techniques, the conformity of this Hamman with the known case studies of the baths and to focus on the urban-environmental relations in this area.

These aspects are very important for the purposes of this research: the presence of an archetypal and so great bath, confirms that the typical model, with the entrance not in line with the main road, is certainly indicative of the presence of an important street, slightly away from the current one (Carrera del Darro).

Considering the distribution of this Hamman in the city, the lack of mosques in the area, the proximity of to the city walls and the size of the bath, it is plausible to hypothesize the presence of a single complex with its own city door. This study will present a specific hypothesis about the ancient shape and organization of Granada in this part of the town.

Keywords: Survey, Granada, Banuelo, Bath, Urban-environmental relations

Analysis of the urban structure

The complex topography of Granada and the division into separate areas due to the maintenance of previous tracks of the ancient walls of the Ziri age are characteristic features of the city, which remained until the end of the Naziride reign.

The main communication routes of each sector were independent and a hierarchical system distinguished them for their width and intensity of bearable flow.

The most important roads, characterized by the greater presence of commercial activity, connected the main gates of the city with a square or a cross.

Because of the Great Mosque's (Aljama) particular location, the real communication center was located between the end of the main city road, "Calle Elvira", and the square called "Cuchilleros", joined by the "Bano de la Corona" bridge, over the "Darro" river.
This connection had such great importance that persisted over time until the fifteenth century, when the square was built in place of the bridge, the "Plaza Nueva" that buried the "Darro" river.
Inside the walls, communication between the two banks of the river was secured by five bridges. Commercial activities were concentrated in the "Calle Elvira" and in the area near the Great Mosque.
This area could also count on the trading market, a specialized commercial establishment where merchants who came from out of town could work and stay.
Granada, the "Naziride" capital, possessed specific buildings, such as the "Maristan" (hospital) and an official "madrasa" (school), that no other city of the emirate had.
Only some major cities such as Malaga, Almeria and Velez-Malaga had structures such as "the alcaiceria" (bazaar), thus few archaeological remains have great historical value being the only examples today in Andalusia. This is the value we need to assign to the "alhondiga Nueva", better known as "Corral del Carbon", the only example left in the entire Iberian Peninsula of a building that was common in all major commercial cities.
The districts around the city have grown steadily since the Naziride reign.

Fig. 1 – Two historical photographs where is possible to see the bath fronted by the "Bab al-Difaf ".

The Alfareros and Loma areas were protected by a common fort, built before the thirteenth century.
Only a few sections of this fort and some southern towers have been preserved, so it is impossible to trace the entire path of the wall. It is assumed that the fort enclosed an area of about 35 hectares.
The Arenal (al-Ramla) district, west of the central area of the Medina, took shape during the reign, but no trace of the wall has reached us.
The most densely populated area, that has also been the most important area for the history of the city itself, is the "Albayzin", an area covering approximately 44.5 hectares that contained several districts inside.

This area also enjoyed a considerable autonomy. It had its own mosque (aljama), of which the only surviving part today is the courtyard of the Salvador church, and a “Qadi”, who administrated ordinary justice.
The area was surrounded by walls during the Yysuf reign (1333-1354), not only to protect the area but also to better defend the northern front of Madina.
For this reason the walls reached the highest point of the city, about 850m above sea level, where later the Tower of Aceituno and the current chapel of San Miguel Alto were built, incorporating the cemetery of Albayzin, Rawda, and areas used for orchards.

Water: symbolism and supply

The cities’ water needs, as mentioned before, have always been a major problem in urban design.
In Arab culture, and in particular in those cities in the western part of the empire, water assumed a double value.
On one hand it meets the requirements for the population’s sustenance, especially in a city like Muslim Granada, which has always seen its borders threatened.
On the other hand the importance of this element is to be found in the relationship between the Arab people, its religion and its origin.
Islam was founded in the seventh century of the Christian thanks to the preaching of the prophet Muhammad and the book that Archangel Gabriel revealed to him in the year 610: the Koran.
Born among the Arabs, Islam found in the language and culture of this people its first major vehicle of propagation and, especially in the Medina suras, imposed itself immediately in a very prescriptive way.
Proof of this can be found in the many rules derived from the sacred text that relate to the most diverse spheres of public and private life.
Great importance is given to the relation between Muslims and water.
Besides the promotion of the hygienic value, water also takes on a strong symbolic value. The Sure indicate the water as part of the heaven’s “award” (a fact that testifies the Arab heritage, and the constant concern about water, in a territory where it was worth much more than gold). Water also has a purifying value, so it was an important part of ablution rites required before praying.
As already seen in the comparison between the Arab city and the Greek and Roman cities, water’s distribution and supply has remained a crucial aspect. The public baths became an important urban element both for their intrinsic value and for their role inside the city that can reveal, thanks to their regulated position, valuable clues about the areas surrounding them.
This is the context in which we have to read the complex and diverse water distribution system created by the Ziri dynasty.
This system was composed of four irrigation canals or “acequias” deriving from a spring and two rivers, and made it possible for the city to expand into new areas that have been supplied by these channels for more than four centuries.
The Albayzin was fed by the Aynadamar irrigation canal as well as southern areas of Ciudad. To nourish the upper parts of these neighborhoods, a new irrigation canal was created, known as the Cadi or Tinajas.

Today this channel is fed by the waters of the river Genil on Cenes de la Vega and runs parallel to the Acequia Gorda entering the Loma area, thirty meters above the irrigation canal Ciudad.
In the fourteenth century the “acequia real” of Alhambra, the complex system of water canals that from the “ Dam-Dike “ six kilometers from the Alhambra carried water into the city of Darro distributing it to the Alhambra and Generalife, was divided in two parts. One third of the water flow was directed towards a high point above the Generalife to irrigate orchards.
Both branches gathered into a single branch before entering the Alhambra transporting the extra water to the city. The water used to reach the Mauror district (Mawrýr), inside the walls of the Madina fortress under the Torres Bermejas.
The southern areas also used the Cadi acequia for supplies even though they were a bit higher.
In the fourteenth century several “Almunias” (farms) were built on the dry hill above the Alhambra. That requi- red the construction of a new irrigation canal called “Arquillos” that took water from the Beas river, a tributary of the Darro.
Tanks of different sizes were used to store water, along with public and private tanks (aljibes) and large clay pots.
The public cistern system was particularly outstanding and had no equal in any other city in al-Andalus.
Today there are still twenty-eight tanks: eleven tanks in the old Alcazaba, fourteen in Albayzin and only three in the “medina”, due to the fact that renovations are higher in urban areas than in hilly districts.
In ancient times, however, the distribution in the city of the aljibes had to be homogeneous and we know this thanks to numerous historical testimonials.
Particular attention should be paid to public baths and their role in the Arab and Andalusian town and, as mentioned at the beginning of this paragraph, in the whole Islamic culture.
Although numerous studies are devoted to the Andalusian baths, the predominate aspects are always architectural, artistic or archaeological: urban aspects are always treated superficially.
However, analyzing the documents you can identify at least five points with great importance in their urban implications.
We will discuss these points individually, given their importance within the definition of the study area.
The first refers to the distribution of the bathrooms on the whole urban surface; as much on the inside of the Medina as in the surrounding areas.
The distribution model documented by medieval texts, by archeology and by the distribution of the traditional medina that we can observe in northern Africa, has similarities with the mosques’ one. They are distributed in a more or less homogeneous way in all the districts of the city.
The second emphasizes its proximity to mosques, a fact that is considered accepted, although some historians tend to reconsider the “Hamman-mosque” cliché.
We know that in the twelfth century in Damascus there was a bathroom for six mosques and at the same time in Baghdad there was one for five mosques. It’s clear that with these proportions we can hardly imagine a direct relationship between the baths and mosques.
The third highlights the closeness between the bathrooms and a water source or an “acequia”.
This consideration appears to be plausible given the need of the baths for current water to power the boiler and the pools.

The stream didn’t have to be very abundant but at least stable enough to recharge the aljibes and the deposits in the bathroom’s closing hours.
For this reason the presence of a water source (rio or acequia) or the possibility of extracting it from the subsoil or easy transportation, were conditions that favored the choice of the site for the construction of a bathroom. The fourth considers the possibility of situating them near the city gates.
Also this hypothesis makes sense, because as with other public buildings, a bathroom requires good accessibility and acts as a prophylactic element for those coming from the outside.
Obviously not all the bathrooms were located near gates. As we saw earlier, one of its features is to have a homogeneous distribution throughout the fabric of the city, to meet the needs of each district.
Despite this, it seems logical to assume that those intended to serve the neighborhoods positioned near the walls, were built near the city gates in order to better fulfill this dual function.
This view is supported by many examples, and also in Granada, close to major accesses in the Medina we find the bathroom of “Ernando de Zafra” or “Casa de las Tumbas” (Puerta de Elvira) and “Banuelo” (Puerta de los Tableros) that we will analyze in the next section.
The fifth aspect emphasizes the preference for the construction at sites near important roads. This also happens with other public buildings, to facilitate access for more customers.

3D Campaign

The choice to adopt a 3D Photogrammetric survey was done to allow an easy and quick approach to the monument and its surroundings. The survey campaign was realized using two digital SLR cameras, a Canon 40D (10.1 Mp) and a Canon 450D (12.2 Mp). The overall campaign produced a total of almost 6000 shots, all the shots were taken in raw format with a difference of 3 step of exposition, using different lenses stopping them down to have a convenient depth of field in each shot. Because of the idea for the further post processing was aimed to the use of Agisoft Photoscan, the new campaign was oriented to produce set of shots optimized for the division in the so called “chunks” inside the software workflow.

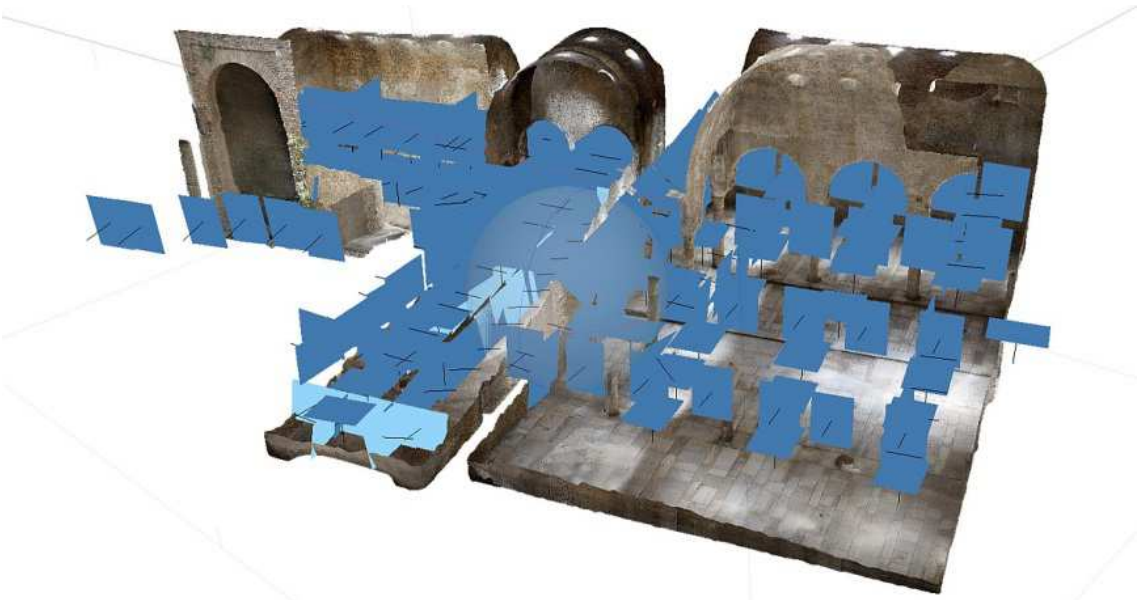

Fig. 2 – graphic scheme of the camera’s position.

The possibility to reference different group of pictures into a single alignment creates a basic condition to allow this kind of operation. The group of pictures coming from the front, the sides and the rear parts of the Hamman were aligned into an unique model.
This process took time from the operators and long calculation hours, the alternative should be the exporting of single parts to other alignment software to complete the work, but completing the whole task in a single software was in certain way more interesting in the meaning of a better exploitation and exploration of its possibilities. The resulting model was very high quality and very rich in texturing, meaningfully enhanced in front of the “first approach” model, the produced meshes were created at the maximum available resolution, with a resulting set of about 30.000.000 faces for each room. The overall aligned model was so made of a little more than one hundred million faces. Obviously this very heavy weight model was quite far from being really usable nor easy to manage, so at this point it was preferred to export it and operate the whole process of optimization, hole capping, smoothing and decimation in Raindrop Geomagic Studio, taking the advantages of a more complete and versatile set of options for the whole post processing sequence. The final model, usable for analysis, reconstruction and study, was made by one hundred million faces, so it is not a model easily usable for multimedia and or real time purposes, but it was characterized by a good balance between quality of the architecture details and the possibilities to operate with reasonable quickness for the virtual study of this ruin. Starting from the complex model produced from the campaign, a set of post processing activities started.
The need to produce a lightweight model for multimedia and dissemination purposes was faced using common procedures based on the extraction of a normal map from the high resolution model, applying the procedures of decimation and optimization on this same model and then using the normal map over the simplified model to create a virtual enhancement of the level of detail. In the case of the Hamman it was preferred to extract and apply both a normal map and a displacement map, to have a more extended set of enhancement maps for further processing. In this way the original model made of one hundred million faces was the base to produce two different resolution models, a first 55% decimation created a model with 22.500.000 faces, while a second 84% decimation (applied starting from the original full resolution model) produced an even lighter mesh made by eight million faces. Once applied back the normal map and/or the displacement map over these two simplified models, the overall results show a good visual quality, with minimal differences for the user if not the fact to be able to manage the whole model with reduced time and using more common interactive tools. The whole map extraction and application was done using Maxon Cinema 4D and Autodesk 3D Studio Max obtaining similar results.

Fig.3 – 3D view of the main room of the Banuelo

Fig.4 – perspective cross-section view

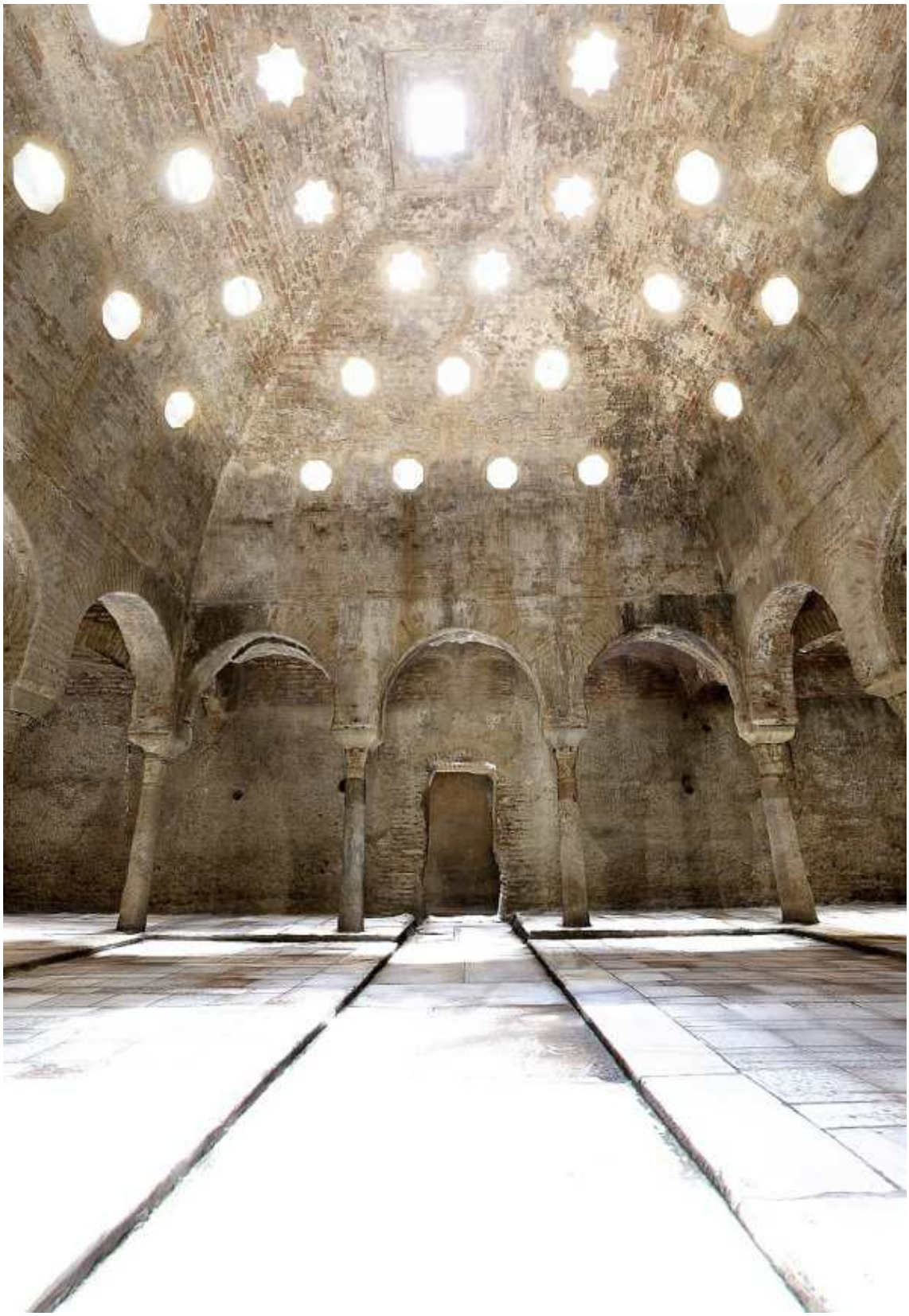

Fig.5 – 3D view of the main room of the Banuelo

Conclusions

The result of the survey combined with the study of documents, revealed that the Hamman of Granada, called “Banuelo”, is one of the most representative because of many factors: its good state of preservation and its considerable size allow well to take the suggestion that its plan fits in a perfect rectangle.

But in the numerous studies dedicated to the baths Andalusian always predominate the architectural, archaeological or artistic aspects, and urban aspects are always treated superficially. However, from the analysis of many documents you can identify at least five important points in their urban implications. We will discuss these points individually because of the importance in the definition of the study area.

The first refers to the distribution of the bathrooms throughout the urban area such as inside the Medina in the periphery. The location in the city has some equivalence with the one of the mosques, distributed in a homogenous way throughout the urban area.

The second aspect is related to the constant presence of the baths next to the mosques, although some historians doubt the cliche “Hamman-mosque” based on examples of Damascus, Baghdad, etc.

The third highlights the closeness between the baths and a water course.

The quarter saw the opportunity to place them near the gates of the city. The fifth aspect highlights the preference for building sites close to roads of considerable importance, the system used for other public buildings, with the aim of facilitating access to larger numbers of people.

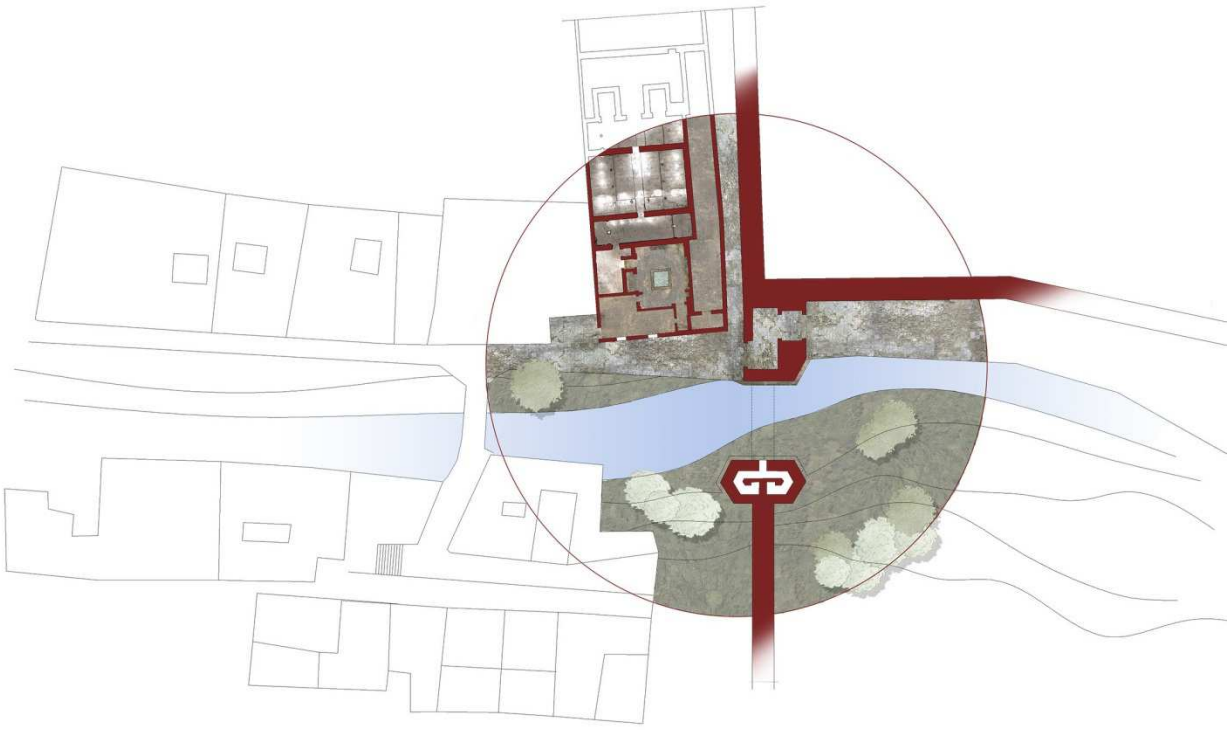

Fig. 6 – plan view according to our hypothesis

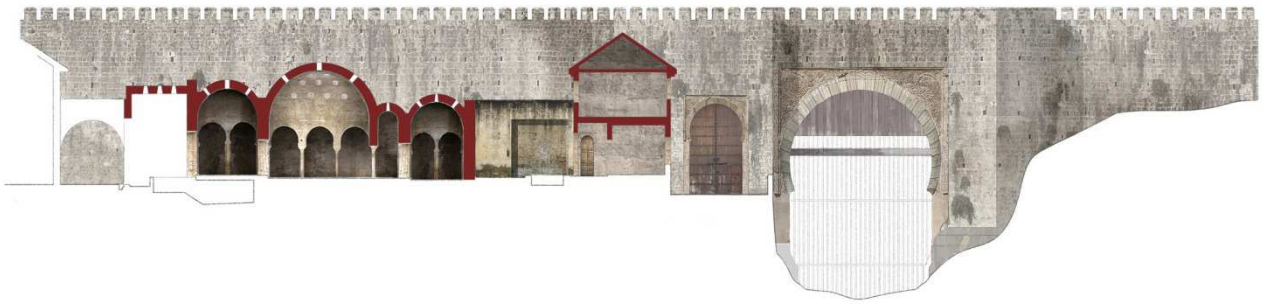

Fig.7 – cross-section of the eviroment according to our hypothesis

Obviously not all baths were located close to the city doors, it seems logical to assume that the bathrooms for the outer districts located near the walls, were built near the city doors so as to better accomplish their dual function.

Considering the distribution of this Hamman in the city, the lack of mosques in the area, the proximity of to the city walls and the size of the bath, it is plausible to hypothesize the presence of a single complex with its own city door. This study will present a specific hypothesis about the ancient shape and organization of Granada in this part of the town.

These aspects are very important for the purposes of this research: the presence of an archetypal and so great bath, confirms that the typical model, with the entrance not in line with the main road, is certainly indicative of the presence of an important street, slightly away from the current one (Carrera del Darro).

Our research is also influenced by the remains of a Moorish arch supported by a large tower that is part of the old Moorish walls of Granada called “Bab al-Difaf” So it is possible to imagine the Cadi as a part of a defensive system composed of a double door protecting the urban tissue, closing the flow of the river and defending the town from opponents coming along the banks. Along with archival research, has been of fundamental importance the collaboration with the LAAC (Laboratory Architecture and Archeology of the city) and in particular with Prof. Julio Navarro y Palazon and has been possible to identify a new morphological hypothesis related to the presence of the Arab bath in the area.

Studying the aerial images from the area it is possible to notice a system of ancient walls connecting the “Bab al-Difaf” structure to the main Alhambra fortress; this obviously gives even more meaning to this ruin, opening further questions about the construction sequence and the overall urban system.

References

Luis SECO DE LUCENA, “Plano arabe de Granada”, Granada, 1968. Fernando Valdes, “La edad oscura de la Alhambra”.

Antonio ORIHUELA UZAL, ”Granada, entre Ziries y Nazaries”, Granada, 2013. Leonardo Benevolo, “Storia della città: la città medievale” Bari, 1993.

Paolo BRANCA, “Introduzione all’Islam”, Milano, 2001. AA.VV. “L’Alhambra e il Generalife”, Granada, 2006. Rafael Lopez Guzman, “La medina mussulmana”

Julio NAVARRO PALAZON y Pedro JIMENEZ CASTILLO, “Arqueologia del bano Andalusì: nota para su comprention y estudio”. Granada.

Julio NAVARRO PALAZON y Pedro JIMENEZ CASTILLO, “The islamic Bath in al-Andalus, a survay of its morphological and urban aspects”, Tetuan.

Julio NAVARRO PALAZON y Pedro JIMENEZ CASTILLO, “El Banuelo de Granadaen su contexto arquitectonico y ur- banistico”, rivista numero 45 el legado andalsì, 2012.

Julio NAVARRO PALAZON y Pedro JIMENEZ CASTILLO, “La gestion de l’agua en la ciudad Andalusì: el caso de Mur- cia”, Murcia.

AA.VV. “Granada: su trasformacion en el siglo XVI” Granada, 2001.

A. MALPICA CUELLO, “Las murallas de Granada”, Nuevos Paseos por Granada y sus contornos, Caja General de Ahorros de Granada, Granada, 1992.

G. VERDIANI (editor), Il ritorno all’immagine, nuove procedure image based per il Cultural Heritage, lulu.com, 2010.

Pablo RODRÍGUEZ-NAVARRO, “Automated Digital Photogrammetry versus the systems based on active 3D sen- sors”, Revista EGA, nº. 20, año 17, Valencia, 2012

Antonio ALMAGRO, “De la fotogrametria a la infografia. Un proceso informatizado de du documentacion”, Gra- nada,

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