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1. Introduction

The enhancement of the current contents of existing databases of buildings located in old city centres, including extended information about: construction materials, structural systems, technical documentation of the original project (when possible), and subsequent interventions; is particularly convenient for many purposes. Among others, it is well known that an extended building database is an essential tool to address large-scale studies such as municipal rehabilitation campaigns (facades and roofs, energy efficiency, architectural barriers), vulnerability analysis and evacuation plans in case of floods or earthquakes.

2. Case Study: Valencia's historic centre

Research activities of the authors required them to manage large amounts of information about the built heritage in Valencia's historic centre. To fulfil this requirement, a geo-referenced database of the building stock of the 1st district of this city was designed. Starting from the cadastral database, the following data for each building can be obtained: geometrical properties, number of floors, uses, age, and location on the map, it is essential to enhance this information adding technical data about original and current construction details and procedures (highly relevant to design energy retrofitting proposals) (Pérez-García, et al. 2018) plus structural system description and details (essential to evaluate the earthquake-resistance and the seismic response of the structure of each building) (Guardiola-Víllora & Basset-Salom, 2015).

In this paper the authors share the gained experience regarding the retrieval of information about the structural system of a sample of buildings when consulting several usual and supposedly reliable, databases. Among others

it has been consulted the Catalogue of listed buildings created by the City Council of Valencia (Ayuntamiento Valencia, 2014 and 2018), the archive of the Architectural Information Centre (CIA) of the School of Architecture of Valencia (ETSA), the Municipal Historic Archive of Valencia (AHCV), the Architecture Guide of the Chartered Association of Valencian Architects (CTAV) (VVAA, 2014), the Registry of Architecture of the XXth century in the Valencian Community (VVAA, 2002), and the Iberian DOCOMOMO (Docomomo, 1996). Additionally, some other less conventional sources of information have also been checked: private and public Architecture blogs or Google Street View. Finally, results from on-site visits have also been required because they have proved to be the most reliable source. Buildings included in the sample should supposedly be well documented because they are well known in the city and they are not too old. Figure 1 shows their location in the map.

2.1. Catalogues of Listed Buildings

Several protection plans such as PEPRIs (Ayuntamiento Valencia, 1992), PEP-EBIC (Ayuntamiento Valencia, 2014), and PEP (Ayuntamiento Valencia, 2018), (the last one under public display period) are focused on District 1 "Ciutat Vella", being the catalogue of listed buildings one of their documents.

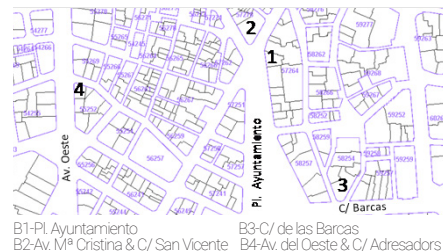


Figure 1. Location of the sample of buildings retrieved

Figure 2a shows a database record from the PEP-EBIC protection catalogue. It references the building B1 and it includes the cadastral reference, the plot area, the number of floors and age and, although unusual, the name of the architect, offering, sometimes, the possibility of finding more information. According to the catalogue, the horizontal and vertical structure is composed of reinforced concrete rigid frames. Attending to the year of construction, this information could be accurate, since it is assumed that the first building in the city of Valencia that was built using a reinforced concrete structure was the "Carbajosa building" (1929). The information about the construction of the roof and facades is scarce and only the compositional aspects of the building have been recorded. Figure 2b presents the information that can be found in PEP's catalogue related to the same building. Data about the structural system are similar but in this case it is explicitly mentioned the age of the building as the data source. Finally, it was considered essential to contrast this information against records provided by the Cadastral database. Figure 2c shows the cadastral database record of this building where the shape of the plot and the number of storeys are in agreement with the previous databases. Although the reference year of construction differs in one year the information can be accepted as valid.

However, it is not usual to find in these catalogues information about the structural system. As an example, in the record of the building B2 (residential building located at the corner of M^a Cristina Avenue and San Vicente street) obtained from the PEP-EBIC catalogue (Figure 3a,b,c) there is no information (or just mere assumptions) about the structure of such a singular building.

2.2. Architectural Information Centre of the School of Architecture of Valencia

The Architectural Information Centre (CIA) of the ETSA houses archives of some relevant architects, among others, the archive of the architect Joaquín Rieta Sister (Figure 4a, 4b and 4f). These archives can be accessed on-line and hundreds of digitalized documents can be easily searched by means of word sequences or using keywords.

Retrieving the 714 records of this institutional

repository, the structural plans of the building of Joaquín Rieta tagged as B3 (Figure 1) can be found under the header "Structure plan of the commercial ground-floor of the Gil Adán Building of the Plaza del Caudillo and Calle San Vicente, 1944." (Figure 4b). One of the documents, signed by the architect in December 1944, is the layout of the structure of the basement floor of a corner building. The drawing shows that this floor was intended to be built using frames of steel beams and columns.

Knowing that in 1979 the "Plaza del Caudillo" changed its name to "Plaza del Ayuntamiento", the search of building B3 in the cadastral database should be done using the last address: building located at the corner of "San Vicente" and "Plaza del Ayuntamiento". The retrieved record has been marked with a red arrow in Figure 4d and it is evident that the structure layout obtained from the ETSA's repository does not correspond to building B3 (Figure 4e). Therefore, we have a structural plan, being the building to which it corresponds unknown. Finally, checking carefully the metadata of the drawing (document shown in Figure 4c) can be confirmed that it corresponds to a building located in "Calle de las Barcas" (Figure 4f). A new request in the ETSA repository using the new location retrieves new structure plans (Figure 4i) that are consistent with the previous one and revealing that in 1947 two floors were added to the building and steel structure was also used.

2.3 Municipal Historic Archive of Valencia

The visit to the Municipal Historical Archive of Valencia (AHMV), located at Cervelló palace, is always the last resort because there is no digitalized version of the stored documents and archive boxes must be requested, one by one, in order to review the projects contained in each one. Taking into account the short gap of opening hours, this is a highly time-consuming source of information. Moreover, the expectancy of obtaining useful results is usually low. After many visits to the AHMV, information about building B2 was unsuccessfully searched. Nevertheless, the project of building B1 was encountered and reviewed. The layouts and elevation plans (Figures 5a and 5b respectively) were useful complementary information. However, the constructive report (Figure 5c) described the structure as beams and columns

made of hot rolled steel and this data were inconsistent with the Catalogues of listed buildings that reported a structural system composed of reinforced concrete frames. Moreover, a project of a building in "Adresadors" (also within the study area) was found (Figure 6a). The structure seems to be load-bearing walls and circular columns but it was not possible to deduce the structural material from the graphical information. It was necessary to

review the constructive report to find out that all columns and beams were intended to be made of iron (Figure 6b). With the help of the location plan (Figure 6c) and taking into account several changes of street's name, consequence of the opening of the new street called "Avenida del Oeste", the building, tagged as B4 in Figure 1, was finally located on plot 01 of block 55252 (Figure 6d) of the Cadastre (2018). This is a clear example of no georeferenced information.



Figure 2. Data records of building B1. Source: a) PEP-EBIC (2014), b) PEP (2018), c) Cadastre (2018)

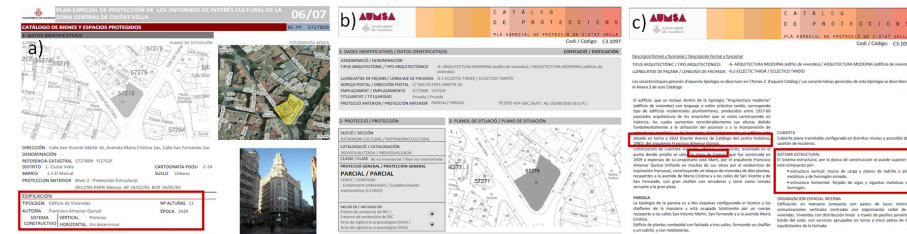


Figure 3. Data records of building B2. Source: a) PEP-EBIC (2014), b) c) PEP (2018)

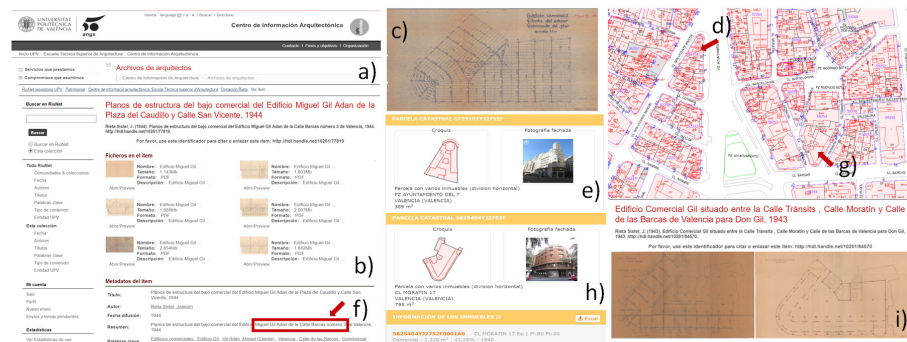


Figure 4. Data records of building B3. Source: a) b) f) CIA Archive, c) Joaquín Rieta archive (1944), d) e) g) h) Cadastre (2018), i) Joaquín Rieta archive (1943)

2.4 Other institutional sources

Structural information has been searched in the Valencia's Architecture Guide, in the Iberian DOCOMOMO database, and in the Registry of Architecture of the XXth century in the Valencian Community. Nonetheless, the information included in all three sources basically refers to layout and the facade compositions, making reference to the structural elements only in very specific cases.

2.5 Google Street View, architecture blogs, real state agencies and other private sources

Nowadays, the Internet is a very powerful tool when looking for information, provided that you know what concepts to search and you are lucky with "the words you Google". Sometimes it is enough to write an address and information from a real estate agency appears (Figure 7a). Some others you can unexpectedly find in Google Street View the inside of a commercial space or a bar, where structural information is revealed (Figure 7b and 7c). Googling "Plaza del Ayuntamiento buildings", we found links to the blog of J. Diez Arnal where a picture shows a building that was under construction (Figure 7d) and another more recent picture (Figure 7e) shows the current appearance of the that building. Surprisingly, the building in these pictures is the building B2, known as "Los Sótanos", and this documents show without any doubt that the structure was made of steel in clear contradiction with the assumptions made in PEP (2018) (Figure 3c).

2.7 On-site visits

Once all the records have been completed and the information about the structure has been obtained, from more or less reliable sources, it is essential to carry out an on-site visit to the buildings that raise doubts either for the year of construction, the number of floors, the external appearance, etc. Sometimes, the structure can be seen in the ground floors, if they have public use (commercial premises, offices ...). In these cases, it is advisable to take a georeferenced picture. Images obtained from authors during on-site visits are shown in Figure 8.

Nevertheless, it must be taken into account the existence of misleading "structures" (Figure 8f).

3. Discussion

The number of records in the abovementioned database is circa 3200. Around 2000 are residential buildings and the rest are institutional buildings, commercial or office buildings, ruins or just land plots. The authors have developed a database including information from many sources (some of them have been mentioned in this paper) that refers to all the residential buildings, containing data about their structural system, guaranteeing that at least 50% of the included structural data have been checked (the rest has been inferred from the age). In the compilation process, sources such as: history books of the city, publications on interventions in "Ciutat Vella", research articles, Degree final Theses, Master Theses, and PhD Theses; have also been consulted. However, gathering information about the structural system or the constructive solutions of buildings is a laborious and sometimes unsuccessful task. One of the main reasons is that, traditionally, the specialised literature has only considered relevant aspects like the architectural style or the compositional aspects of layouts and elevations, remaining the more technical issues, related to structure and construction, in the background. Although the size of the sample described in this paper is small, it has been checked that the lack of information or the data inaccuracy related to the stock of residential buildings located in the "Ciutat Vella" of Valencia is significant.

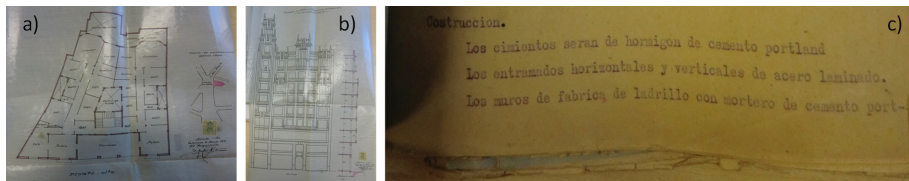


Figure 5. Data records of building B1. Source: a) b) and c) AHMV año 1930 caja 5

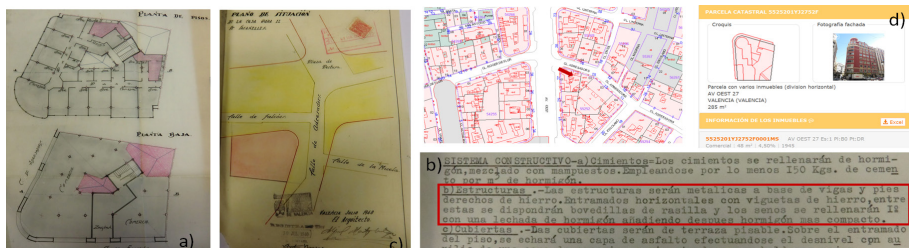


Figure 6. Data records of building B4. Source: a) b) c) AMHV año 1940 caja 1, d) Cadastre (2018)



Figure 7. Images from the Internet. Source: a) b) c) Google Street View, d) e) Building B2 in construction blog of J. Díez Arnal (2018)



Figure 8. Uncovered structural elements. Source: the authors (2017)

4. Conclusions

Considering the results obtained in the study of the structural systems of buildings in the district "Ciutat Vella" of Valencia, a small sample of cases is presented in this paper. The results show that there is a great dispersion of the information related to the technical characteristics of this built heritage, being fundamental to complete, check and gather all data in a single and comprehensive database of public access.

This situation seems that will be amended after the publication of decree 53/2018 of April 27, which regulates the creation of an autonomous registry of "Building Evaluation Reports", which have to describe, among others, the constructive characteristics and structural system of each building. These reports, which are compulsory for all listed buildings or for buildings older than 50 years, will complete the existing gaps and will provide coherence to the current listed buildings catalogues of Valencia, namely the PEP (2018).

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