

# Economic and Environmental Viability of Building Recovery in Seville (Spain)

## Phase 1: Database in Arcgis

### Abstract

The main objective of this work is the design of a model for the technical, economic and environmental evaluation in the rehabilitation and renovation of buildings versus their demolition. A first analysis is performed on the rehabilitation and renovation of buildings versus their demolition in the historical centre of Seville, Spain. Considering that many European cities have a historical centre that in many cases also represents the most authentic part of the city, this project can be adopted as an assessment tool for many similar case studies. In a first stage, a database for Seville, Spain, has been created using ArcGIS, which identifies those buildings needing restoration.

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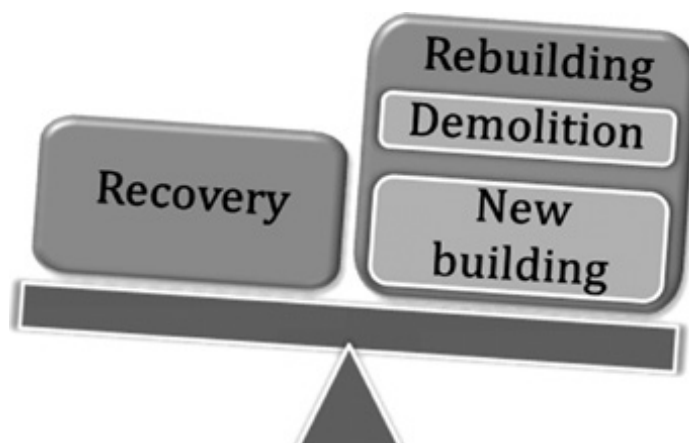
Keywords: renovation, rehabilitation, demolition, environmental viability, cost evaluation

### Introduction

Environmental protection has acquired high priority status, thereby intensifying the discussion on the recovery of buildings versus their demolition. The large and accelerated demolition of buildings fails to contribute towards the proper management of waste and may lead to other problems, such as the increase of the final cost of construction due to the additional costs of the demolition process. In contrast, the recovery of buildings offers clear benefits beyond simply contributing towards environmental sustainability (Fig. 1). These advantages include: the reduction of execution times, since most of the structure is maintained with or without reinforcement; the decrease in the impact on the community of the demolition and of the subsequent enforcement of new construction; the reuse of infrastructure; and protection of existing communities [1]. However, the restoration of buildings is not always the most

economical solution, mainly due to the particularities of the building environment to be recovered. Hence, except in cases where building recovery is motivated by heritage protection, cost remains the principal deciding factor, and the building is subsequently demolished [2].

In order to prevent the decision between these two processes from depending solely on the economic aspect, the proposed model enables the viability of the recovery of the building facing demolition to be both technically and economically assessed. The decision should take into account the costs of implementing the renewal on the one hand, and the costs of demolition



il. 1. Viability study: recovery vs. reconstruction



il. 2. Historical centre of Seville. Andalusia (7)



il. 3: Borders of the northern and southern areas of the city, constituting the historical centre of Seville (7)

il. 4. Hypothetical axis delimiting the northern part of the historical centre of Seville



and construction of the new building on the other. In short, all the costs associated with these processes should be borne in mind, either divided by the number of additional years of life of the building, in the case of recovery, or by the number years of the expected lifespan of the new building.

The model proposed is the result of the in-depth study of actual cases, thereby enabling not only a comprehensive cost analysis with a much tighter assessment, but also an analysis of all costs involved in the various processes of renewal through their systematic classification [3].

Furthermore, for this cost analysis to be integral, not only are economic variables taken into account, but also the environmental costs. Due to guidelines set by the EU [4, 5], the environmental profile has risen in importance, and therefore any building cost analysis must now include environmental factors in order to minimize the environmental impact of any decision. Hence the model enables the decision to be made, based on objective data, on whether the option of renewal or of demolition is the most coherent. Environmental analysis uses the ecological footprint indicator, which has been used successfully to assess the environmental cost of the construction of new buildings [6].

#### Justification of the method

As stated above, the first step in the creation of the model is the study of real cases; therefore, in this first phase a test was carried out to ascertain whether the housing market is currently a candidate for rehabilitation of poorly conserved buildings. This test is focused on Seville, the capital of the autonomous community of Andalusia, and more specifically, on the historical centre of the city, which remains the largest in Spain and one of the largest in Europe (Fig. 2). The object of this preliminary study is the identification of the current buildings in order to obtain their evaluation indicators.

The reason for carrying out the first phase of study within the historical city centre is that there is a far greater density of ancient buildings, which provides a sample of major constructive and pathological interest for the study. More specifically, three age ranges were set: 50–75 years, 75–100 years, and more than 100 years, thereby establishing most common building types and their respective indicators.

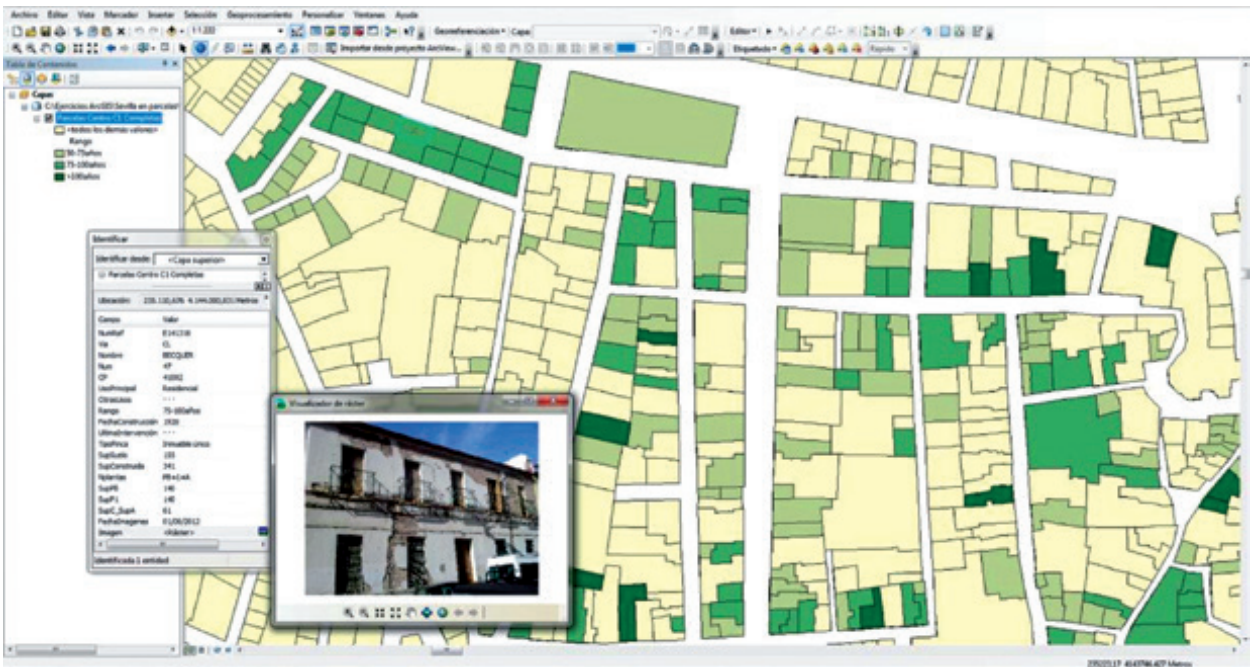
Due to the requirement of a minimum age of 50 years for the buildings, the first sampling of identification focuses on the northernmost area of the historical centre (Fig. 3). The area of this sample is bounded by Torneo Avenue, the Islamic wall of Macarena, and a hypothetical axis drawn by the Osario city gate and the Royal city gate (Fig. 4). The northern area of the city centre is traditionally the poorest and most degraded area of the historical centre, housing a large majority of the working-class sector, and, until recently, hosting many industries, such as factories, warehouses, and workshops. Despite covering an area smaller than that of the southern neighbourhoods, the northern part of the city has always presented a greater population (approximately 60% of the total) [8].

In order to make the first identification sampling in the northern area, buildings in a deficient condition where classified within the three age ranges.

Based on this first strategic sampling, a broad vision of the building market is attained, which presents those characteristics suitable for

Table 1: Fragment of Spreadsheet containing building information

N° Ref.	Address			Use		Date		Land type	Surface Area		N° floors
	Via	Name	N°	Main	Secondary	Construction	Last Intervention		Floor	Total constructed	
E342019	St.	Becquer	16	Residential	...	1950	...	Single property	60	147	GF+1
E441214	St.	Becquer	17	Residential	Commercial	1950	...	Single property	292	426	GF+1
E342020	St.	Becquer	18	Residential	Commercial	1950	...	Single property	57	164	GF+2
E342022	St.	Becquer	26	Residential	Commercial	1950	...	Single property	138	302	GF+1
E241214	St.	Becquer	31	Residential	...	1960	1989	Single property	72	153	GF+1
E239040	St.	Peral	2	Residential	Commercial	1940	...	Horizontal split	58	146	GF+2
E140436	St.	Peral	3	Residential	Commercial	1940	...	Single property	149	490	GF+2+A
E239041	St.	Peral	4	Residential	Commercial	1945	...	Single property	133	391	GF+2
E140435	St.	Peral	7	Residential	Commercial	1950	2005	Horizontal split	145	516	GF+2+A
E140431	St.	Peral	15	Residential	...	1950	2005	Horizontal split	109	323	GF+2
E240013	St.	Escobero	2	Residential	...	1940	...	Single property	199	665	GF+2+A
E240014	St.	Escobero	4	Residential	Commercial	1940	2000	Horizontal split	186	586	GF+2
E340018	St.	Escobero	18	Residential	...	1940	2005	Horizontal split	165	477	GF+2
E340019	St.	Escobero	20	Residential	...	1960	...	Horizontal split)	153	463	GF+2
E340020	St.	Escobero	22	Residential	...	1960	...	Horizontal split	155	465	GF+2



il. 5: View of the data of the programme

a technical, economic, environmental and social evaluation of the viability of demolition to be performed.

**Preliminary stage: Information Capture**

Once the identified constructions have been classified into ranges, information referring to their general construction characteristics is then determined, extracted from the official Cadastre of the Local Government and Public Administration [9]. All this information is collected on a spreadsheet (Table 1), the content of which, in columns from left to right, reflects: The reference number which allows this general information to be appended to that of the graphical information of one hundred and fifty-five parcels of land analysed through the ArcGIS geospatial processing programme; The exact address of the property for its correct location; Its primary and secondary uses; The construction date and, where applicable, the date of the last intervention; Type of land; Whether it is a single property or horizontal split; Ground surface area and total constructed area; Number of floors.

This information is employed to identify the property by means of its most significant aspects, in order to establish, in later stages of research, the most significant building type and to serve as a prototype on application of the model developed. Once buildings have been defined constructively, the information revealing the condition in which they are found is completed. To this end, it is considered that the most visual and effective way is through general photographs of the facade taken in situ, which enable the state of preservation to be verified.

**Creation of the database in ArcGIS**

The next step of this phase is to dump the information in the ArcGIS programme using ArcMap, the main component of the processing program.

il. 6. Identification of areas for priority action (7)





il. 7. Rehabilitated dwelling in Beker Street (left) and Plaza San Gil

The procedure carried out for the creation of the database is comprised of 4 steps:

1. Append the constructive information contained in the spreadsheet with graphical information on the parcels of land of Seville in ArcGIS.

The constructive information obtained from the parcel of land is based on the planimetry provided by the Planning Department of Seville, where details of all the parcels of land of Seville are held in ArcGIS, together with details of the housing estates that make up these parcels, which constitute a necessary requirement for the prior information to be associated with the parcel. The information is now attached to the estate, and by simply clicking on the estate icon, an attribute table appears in which all the constructive information on the property that defines the estate in the plans is reflected.

2. Highlight the plots by age range.

Once the information has been attached, those plots which fall within the age ranges are highlighted on the map. This is carried out by setting a different colour for each age range, so that all the parcels of the same age range are in the same colour. This provides a means of immediate identification of the approximate age of the properties under study.

3. Insert a sample photograph of the properties.

In order to introduce sample photographs which give an insight into the state in which the property can be found, a new field, called a raster field, is created within the attribute table for each property, thereby including photography as part of the information contained in the attribute table.

Thanks to the functionality of the program, an easy, clear, and effective visualization of the information is achieved, in such a way that, in the data view of the programme, simply by addressing the plot in question, it is possible to obtain not only its constructive information, but also a photographic visualisation of the state of conservation of the building (Fig. 5).

This new database facilitates the easy and reliable identification of the most degraded zones, neighbourhoods and streets of the city that require priority action. Within the first identification sampling carried out in the northern part of the city, the northwest area has been identified as a priority area for action, specifically the blocks bordered by Conde de la Mejorada street, Marques de Esquivel street, Becquer street, and Pacheco-Núñez del

Prado street (Fig. 6). By coincidence, this area is the closest to the largest public garden in the centre of Seville, the Alameda de Hércules, which constitutes a meeting place for the inhabitants of the city.

In figure 7, some examples of refurbished dwellings in the city centre are shown, the result is a well preserved historical style from the Southern part of Spain, which incorporates new installations, a restored envelope, new energy efficient windows, etc. The house of tomorrow can be the one we already inhabit by transforming it, in order to make it more safe, secure, energy efficient and comfortable, finally transforming it into a contemporary dwelling, even when they are part of a historical city centre.

## Conclusion

A first analysis is performed on the rehabilitation and renovation of buildings versus their demolition in the historical centre of Seville, Spain. Considering that many European cities have a historical centre subjected to continuous action, this project can be adopted as an assessment tool for other similar case studies. In this first stage, a database for Seville, Spain, has been created using ArcGIS, which identifies those buildings needing restoration.

The procedure to take place in the subsequent phase of research is outlined. From the data obtained in the first phase of the project, the evaluation indicators of the buildings are obtained. These evaluation indicators are the constructive units, such as the foundation, structure, roofs, walls, woodwork, and partitions, that constitute the building typology identified as the most representative by means of the survey in the first phase.

A cost analysis will be carried out on these characteristic constructive elements. This analysis will lead to the base model, since the analysis will be made either in the case of renovation, or in the case of construction (demolition + execution of new construction).

The innovation of the model is that the analysis of the base model will not be limited to only an economic cost analysis of the elements, but it also integrates the social and environmental costs. For the economic cost analysis, the Andalusian Construction Cost Database (10) will be used as reference. This database of prices refers to the cost of elements of new construction, and not of partial demolition or of total demolition (11), and hence the cost analysis in cases of recovery of elements should be developed extensively.

The analysis of the environmental costs will be based on the basic tool Simplified CE3 procedure for Energy Certification of Existing Buildings

(12). This tool will provide information on the most likely constructive solution of the elements that constitute the chosen building type and, in the environmental analysis, will also yield data on the energy performance of the constructive solution analysed. The social cost analysis will allow introduction of the social implication of the decision into the method by taking into consideration issues of vital importance, such as: the need for the relocation of users; a provision for the duration of said relocation; protection of existing communities; improvement in the quality of life (habitability, accessibility, social welfare and comfort), and reduction of that known as the “migrant syndrome”, suffered by people who are forced to leave their neighbourhoods. Following the execution of these analyses on the three types of costs mentioned, the comparison may be made to determine which decision is the most favourable. This comprehensive cost analysis will provide the basis for the creation of the cost feasibility model, which will answer the question posed at the beginning of the project: Is the recovery of the building a viable proposal? The house of tomorrow maybe the one we already inhabit by transforming it with the renovations necessary in order to make it more safe, secure, energy efficient and comfortable, finally transforming it into a contemporary dwelling, even if they are part of a historical city centre.

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