Cartography of profiles of sociospatial vulnerability in four neighbourhoods of the City of Barcelona

Vitruvio
International journal of Architecture Technology and Sustainability
Volume 4 Is 2

Socio-spatial analysis of the vulnerable urban fabric in the city of Barcelona

Sara Vima-Grau[1], Còssima Cornadó[1], Pilar Garcia-Almirall[1]

[1]Department of Technology in Architecture, Universitat Politècnica de Catalunya (UPC)

ABSTRACT

Socio-residential vulnerability is one of currently increasing challenges for cities and metropolitan areas in addressing the interaction between the vulnerable resident population and the need to improve the building stock, particularly after the financial crisis of 2008 and the consequent regression of public investments.
Recent studies have measured and described the levels of vulnerability in the city of Barcelona and their results highlight socio-spatial similarities between urban fabrics that happen to be morphologically, historically and geographically very different.
The present research focuses on the assessment of physical and social shortcomings of vulnerable areas in the city of Barcelona. With this purpose, a sample of buildings in some of the most vulnerable neighbourhoods is statistically analysed through a set of variables at building scale related to both the need of improvement of residential existing buildings and the characteristics of their inhabitants.
An extensive sample of cases is described through several profiles according to the simultaneity of indicators both from a physical and social perspective. As a result, the cross-analysis of indicators and profiles according to each neighbourhood and urban fabric, contributes to better understanding the specificities of each area. Moreover, the cartography of results provides information on how certain indicators and profiles manifest geographically in the urban fabric and the city.
The observation of the combination of shortcomings in the different urban fabrics is a helpful tool for the design of future polices that aim for the improvement of living conditions in vulnerable residential buildings from an integral perspective that aims at addressing both physical and social issues.

KEYWORDS

socio-spatial analysis, urban vulnerability, residential exclusion, residential building stock, housing pathology

https://doi.org/10.4995/vitruvio-ijats.2019.12559

1. INTRODUCTION

Within the current change of paradigm framed by increasing political, economic and environmental challenges, European and particularly Mediterranean cities are in urgent need to address rising territorial inequalities that result in forms of urban vulnerability.
In this context, the current debates regarding the obsolescence and deprivation of the existing urban fabric consider not only the decay of the built environment at different scales but also the increasing risk of residential exclusion affecting its inhabitants. The distinction between physical factors, related to the building stock material and technical processes, and behavioural factors, related to human actions, possibilities and struggles, is at the same time explanatory of the causes and descriptive of the effects of the progressive deprivation of the urban existing tissue. (Thomsen et al., 2011, 2015, 2017).
In this process, both physical and social factors are entwined and interact. Physical decay of the built residential stock is a constant process due to the aging of the buildings and the lack or impossibility of maintenance and renewal, which is in close relation to the lack of resources of the resident population. Misalignments between the needs and wills of inhabitants and the building physical performance as well as the conditions of housing spaces rise, contributing to the decay of the built and social tissue. Similarly, deprivation of the social tissue is a continuous process increased by the confluence of situations of social inequality, poverty, social exclusion, residential exclusion, etc. that tend to concentrate within an area shaping forms of urban segregation. Furthermore, global dynamics pressures of the real estate market often result into situations of population displacement that have a particular impact on already vulnerable neighbourhoods. (Tapada & Arbaci, 2011)
Consequently, socio residential degradation of vulnerable neighbourhoods is a two-way process that, hence, has double consequences on the built environment and the resident population. (Turkington & Watson, 2015).
The definition of urban vulnerability has been coined in the Spanish context in the recent years as "the potential that the population of a specific urban space is affected by some adverse circumstances, a concept that refers both to the existence of a critical situation currently contrasted and to certain situations of risk, fragility and disadvantage that would result into this critical situation, understanding the latter as the materialization of such risk in an already consolidated form of exclusion" (Alguacil et al., 2014). This conceptualization frames the previous elaboration of Atlas de Vulnerabilidad Urbana by the Spanish Ministry in 2011, a research of detection of most vulnerable areas in Spain that provides a methodology to analytically measure urban vulnerability.
Based on the preoccupation on the impact of the contemporary context of regression of public investments in urban and social matters as a consequence of the financial crisis of 2007, as expressed by both the public administration and social movements and neighbourhood associations (Ajuntament de Barcelona, 2016), the Council of the City of Barcelona has undertaken several studies addressing urban vulnerability and its geographic manifestation (Garcia-Almirall al., 2017), as well as the state of conservation of the residential built stock in vulnerable areas (Cornadó et al., 2017). These studies are currently guiding the implementation of innovative refurbishment and housing policies that focus on communities in buildings facing particularly high difficulties within the most vulnerable areas of the city (Diari Oficial de la Generalitat de Catalunya, 2018).
The present paper provides a further examination at neighbourhood and building scale, with the aim to address the specificity of each neighbourhood regarding a series of indicators related with the state of conservation of the building stock as well as the situation of the resident population. Besides, this research provides a deeper analysis of the shortcomings that overlap in one single building through the elaboration of profiles that incorporate aspects of both the physical and social order.
This process is relevant in order to provide an integral base of knowledge on the existing complexity that

Vitruvio
International journal of Architecture Technology and Sustainability
Volume 4 Is 2

highlights both the need of improvement of residential buildings and the characteristics of their inhabitants, and that can be useful to guide future public rehabilitation polices. Moreover, the cross-analysis of results and their cartography at neighbourhood and building scale provides a further step on the detection and description of urban vulnerability.

2. OBJECTIVES

The objectives of this research are:

- To detect and test the relevance of physical and social indicators in order to describe socioresidential vulnerability in the city of Barcelona at neighbourhood scale.
- To define building profiles according to the simultaneity of indicators that can advance in the detection of socioresidential vulnerability at building scale.
- To detect and test the relevance of the geographic distribution of results not only among but also within different neighbourhoods and urban fabrics.

3. METHODOLOGY

3.1 SAMPLE OF STUDY AND DATA COLLECTION

The main sources for this paper are both the previous study on the detection of the most vulnerable areas of the city of Barcelona according to sociodemographic, socioeconomic, socio urban and socio spatial indicators (Cornadó et al., 2018), and the further study on the prediagnosis of the state of conservation of the building stock in the 16 most vulnerable neighbourhoods (Cornadó et altri, 2019). The present paper provides the results of a further research carried out in the master thesis Characterization and prediagnosis of the socioresidential vulnerable tissue in the city of Barcelona (Vima, 2018). It consists of an analysis of 11 neighbourhoods included in the previous studies, in which the number of studied buildings with available data is statistically representative of the full neighbourhood (Fig. 1, Tab.1, Tab.2).

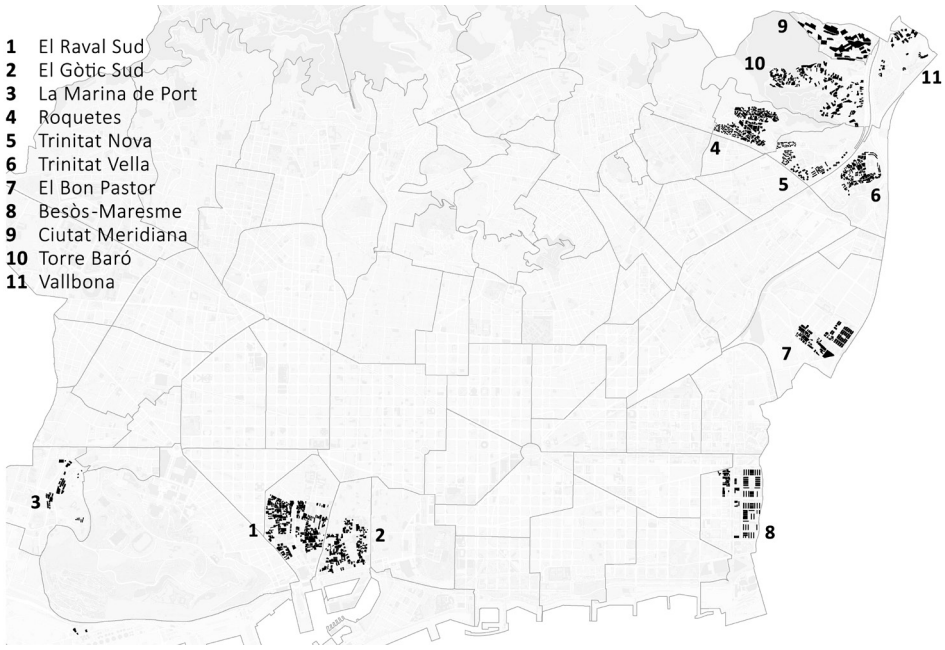

Figure 1.
List and geographic location of the areas of the eleven neighbourhoods included in this study.

Physical indicator	*Source (Garcia-Almirall, 2017)* *Statistical Data*	*Source (Cornadó, 2017)* *Fieldwork*
Damages of mechanic structural origin (D1)		• *Cracks in bearing walls* • *Façade buckling*
Risk of material detachment (D2)		• *Unstable elements in façades or roofs* • *Nets and other precautionary elements*
Dampness (D3)		• *Rising damp* • *Moisture* • *Rainwater leaks*
Damages in windows woodwork and carpentries (D4)		• *Broken window glasses* • *Degraded carpentries and woodwork*
Lack of accessibility (D5)	• *More than four storey buildings without elevator installation*	

Table 1.
Physical indicators in relation to the data available at building scale.

Social indicator	*Source (Garcia-Almirall, 2017)* *Statistical Data*	*Source (Cornadó, 2017)* *Fieldwork*
Lack of activity (S1)	• *Empty premises on the ground floors*	• *Empty premises on the ground floors* • *Private activities in ground floors*
Residential exclusion (S2)	• *Irregular occupancy* • *Eviction*	• *Irregular occupancy*
Risk of over-occupancy (S3)	• *Surfaces under 45 m^2* • *Less than 14 m^2/inhabitant*	• *Signs of over-occupancy*
Residential mobility (S4)	• *Immigration*	
Tenure difficulties (S5)	• *Horizontal structure of property* • *Rental tenure*	
Economic difficulties (S6)	• *Rental social aid* • *Punctual social aid* • *Non-contributory and disabilitypensions*	

Table 2.
Social indicators in relation to the data available at building scale.

Figure 2.
From left to right, indicators D1, D2, D2, D3, and D4 observed during the fieldwork.

Figure 3.
From left to right, S1, D5, D5, S2, S2, and S3 observed during the fieldwork.

The present research is based in a set of available data at building scale that provides different indicators. According to their relevance and their characteristics, each indicator corresponds to either the state of conservation of the built stock (spatial and physical factors) or the situation of the resident population (social aspects).

3.2 SOCIO-SPATIAL ANALYSIS

First, this paper presents the significance of each described aspect (be it physical or social) within each of the neighbourhoods, based on a frequency analysis of the available indicators.
Secondly, a statistical process of clustering developed with SPSS data analysis provides a classification of profiles that describe different combinations of selected indicators in each building. In order to operate the clustering of cases, only some of the available indicators are selected (Tab. 3) according to previous research results and with the aim to avoid repetitive data and information (Vima, 2018).
Results are analysed at neighbourhood scale, by comparing the significance of each profile among the different neighbourhoods according to a frequency analysis.
Finally, the cartography of the results of building profiles in different neighbourhoods and urban fabrics, elaborated using Geographic Information Systems, enables to foresee the geographical concentration of profiles and their different forms of aggregation.

Physical indicator	*Social indicator*
• *Damages of mechanical structural origin* • *Risk of material detachment* • *Dampness* • *Damages in windows and carpentries* • *Lack of accessibility*	• *Lack of activity* • *Residential exclusion* • *Risk of over-occupancy* • *Immigration* • *Horizontal structure of property* • *Rental tenure* • *Economic difficulties*

Table 3.
Selected indicators for the elaboration of building profiles of vulnerability.

4. RESULTS

4.1 SOCIO-SPATIAL INDICATORS AMONG NEIGHBOURHOODS

First, the graphic in Figure 4 presents a comparative measure of the percentage of buildings presenting some indicators of physical damage showing the proportion of each indicator per neighbourhood.
Remarkably, there is an important variation of results among different neighbourhoods. The two neighbourhoods in the historic centre (El Raval sud and El Barri Gòtic sud) together with Trinitat Nova and El Bon Pastor, present the highest percentages of buildings with observed physical damages (over 90%). While some peripheric neighbourhoods, especially Besòs-Maresme, Torre Baró and Vallbona, present lower percentages (under 50%).
Regarding the type of observed damages, the highest variation among neighbourhoods is the significance of accessibility deficits, which are especially relevant in the historic central neighbourhoods. The observation of dampness also varies significantly, yet it is present in all studied areas, particularly in El Bon Pastor. Degradation of carpentries and woodwork is quite relevant in all studied areas, with the exceptions of Roquetes, Trinitat Nova, El Bon Pastor and Besòs-Maresme, where other aspects are a lot more important. Being a more severe damage, the risk of material detachment on the street is extremely important in Trinitat Nova and considerable in El Bon Pastor, La Marina de Port and El Barri Gòtic sud, and it is still important in the rest of neighbourhoods. Nevertheless, damages of mechanical structural origin (cracks and facade buckling) are found homogeneously in all studied neighbourhoods in rather low percentages.
Most of the physical damages observed in vulnerable areas are closely related with an evident lack of maintenance, as it is the case of the risk of material detachment and degradation of carpentries and woodwork, or even dampness. Nevertheless, accessibility deficits are more related to the building type and urban morphology of each neighbourhood.
The observation of dampness population, Figure 5 shows the relevance of each indicator of shortcomings according to the neighbourhoods. Even if social indicators appear to be more homogeneous among the different areas, it is clear that neighbourhoods in The historic centre are among those presenting highest percentages of weaknesses, together with, once again, Trinitat Nova and Ciutat Meridiana.
The most abundant problematic is the risk of over occupancy as a result of insufficient housing surfaces. The lack of activity in ground floors is proportionally more relevant in monofunctional residential neighbourhoods like Torre Baró and Vallbona, even though empty premises in ground floors are mostly found in areas where the ground

floor is not residential, such as the historic central neighbourhoods. Indicators that relate to a risk of residential exclusion are also important and more variable among neighbourhoods: eviction, irregular occupancy and demand for rental social aid are extremely relevant in Ciutat Meridiana, and exceed the average in Trinitat Nova, Besòs-Maresme, El Bon Pastor and El Raval sud. Most neighbourhoods have high proportions of horizontal property, with the exception of El Bon Pastor, Torre Baró and Vallbona where, additionaly, the proportion of immigration is lower. Finally, indicators of economic difficulties are extremely high in Ciutat Meridiana, and still very relevant in Trinitat Nova and El Raval sud, while they are less important in Vallbona, Torre Baró and El Bon Pastor.

In the case of social indicators, most of the problematics relate to the risk of residential exclusion, such as evictions and demand for social rental aid, which clearly correspond with the concentration of residents facing higher economic difficulties. Other relevant problematics have a direct relation with spatial aspects, as it is clearly the case of the risk of over-occupancy. The morphologic and typological conditions of the existing urban fabric result into housing units with insufficient surfaces in relation to the number of occupants.

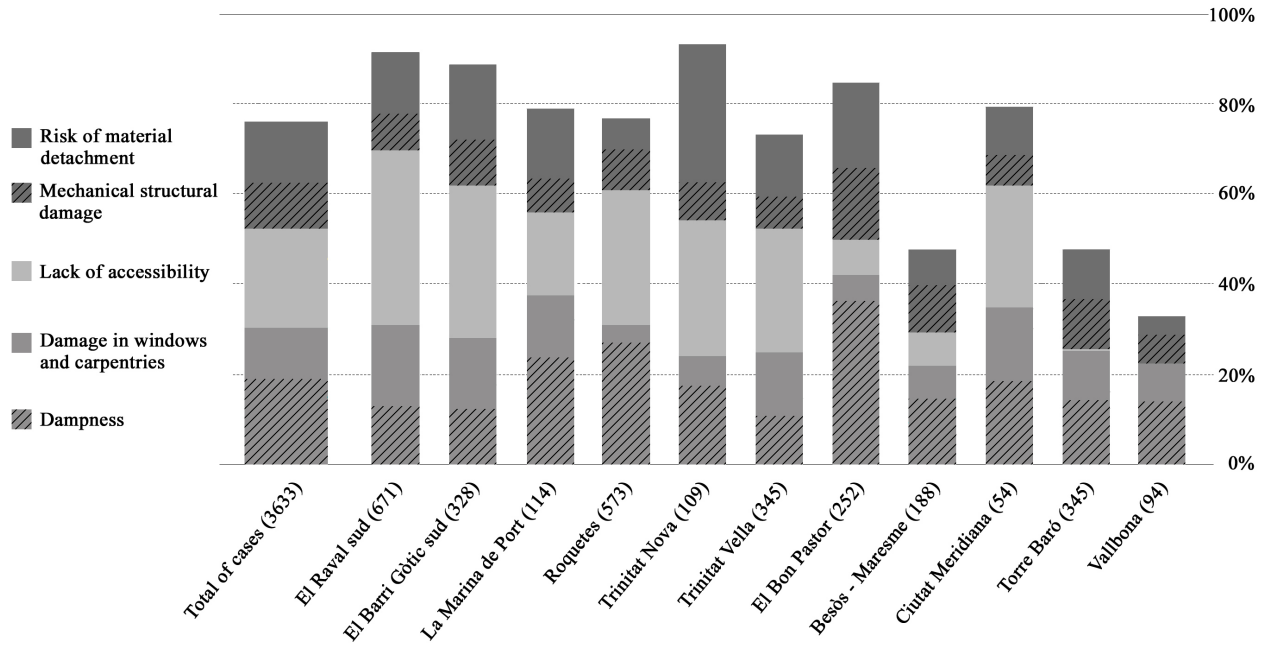

Figure 4.
Percentage of buildings with physical damages and relevance of indicators per neighbourhood Regarding those aspects that refer to the resident.

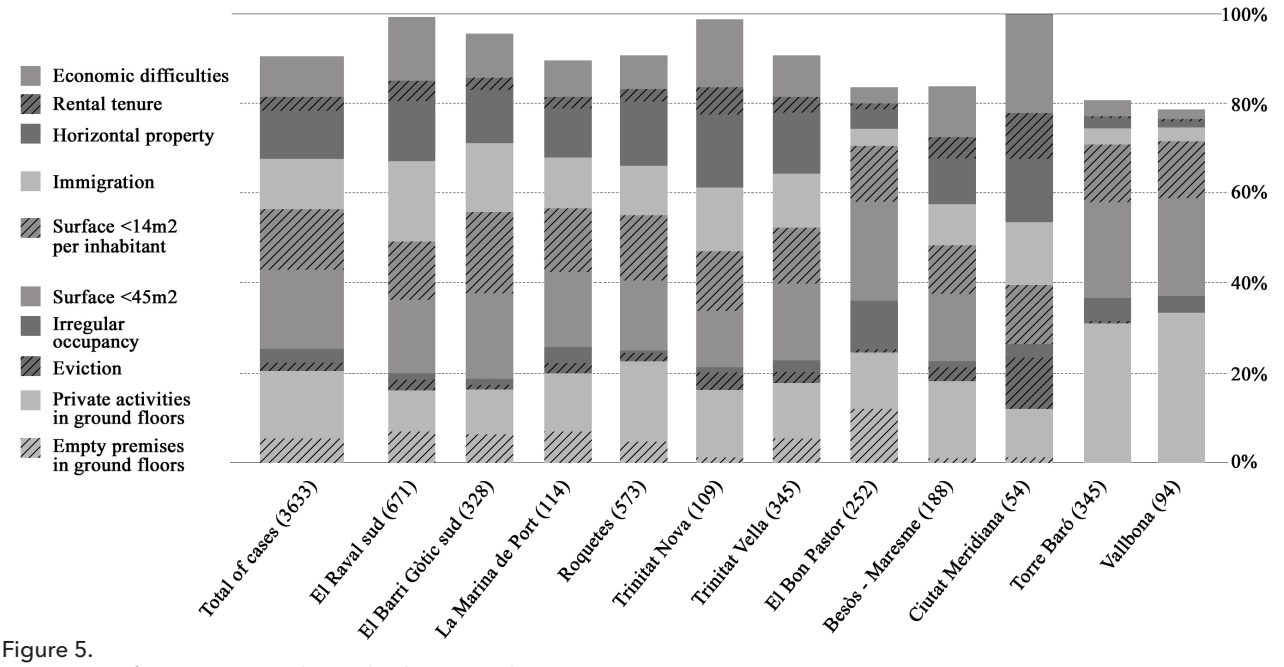

Figure 5.
Percentage of communities with social indicators and relevance of indicators per neighbourhood.

4.2 PROFILES OF VULNERABILITY ACCORDING TO THE SUPERPOSITION OF INDICATORS AT BUILDING SCALE

It is important to note that the results exposed up to this point provide no information on the superposition of indicators at building scale.
Thus, there is no qualitative measurement on the risk or severity of the detected shortcomings. With this regard, Figure 6 and Table 4 show the results of a procedure of clustering that provides several profiles of simultaneity of the selected indicators within each single building. As a result, and in coherence with the clustering method, no profile is purely homogeneous, so the percentage of each aspect enables to define its relevance within the profile.
The obtained profiles are grouped according to the similarity of the combination of indicators shown in figure 6.

Group I includes profiles with high percentages of cases with accessibility deficits in addition to a combination of social indicators (mostly immigration, horizontal property and economic difficulties).
Group II includes the only profile in which there is no indicator that exceeds the 50%.
Group III includes profiles in which dampness is combined with several different social indicators (mostly risk of over-occupancy).
Group IV includes profiles with a combination of situations in group I and III. Physical observed damages are dampness and lack of accessibility, combined with several social indicators.
Group V includes profiles in which the combination of indicators in one same building includes both physical and social aspects. Profiles 12, 13 and 14 include cases with very high percentages in simultaneously almost all indicators, whereas profile 15 presents mostly physical damages, in combination with only one social aspect (over-occupancy).

GROUP I			
Profile 1	**Profile 2**	**Profile 3**	**Profile 4**
Lack of accessibility	Lack of accessibility	Lack of accessibility	Lack of accessibility
Risk of over-occupancy	Immigration	Lack of activity	Immigration
Immigration	Horizontal property	Immigration	Horizontal property
Horizontal property	Rental tenure	Horizontal property	
Economic difficulties	Economic difficulties		

GROUP II
Profile 5
-

GROUP III		
Profile 6	**Profile 7**	**Profile 8**
Dampness	Dampness	Dampness
Lack of activity	Risk of over-occupancy	Risk of over-occupancy
Residential exclusion	Immigration	
Risk of over-occupancy	Horizontal property	

GROUP IV		
Profile 9	**Profile 10**	**Profile 11**
Dampness	Risk of material detachment	Risk of material detachment
Lack of accessibility	Lack of accessibility	Lack of accessibility
Horizontal property	Immigration	Immigration
Economic difficulties	Horizontal property	Horizontal property
	Economic difficulties	

GROUP V			
Profile 12	**Profile 13**	**Profile 14**	**Profile 15**
Mechanical structural damages	Mechanical structural damages	Mechanical structural damages	Mechanical structural damages
Risk of material detachment	Risk of material detachment	Risk of material detachment	Risk of material detachment
Dampness	Dampness	Dampness	Dampness
Damages in windows and carpentries	Damages in windows and carp	Damages in windows and carp	Damages in windows and carp
Lack of accessibility	Lack of accessibility	Lack of accessibility	Risk of over-occupancy
Residential exclusion	Risk of over-occupancy	Lack of activity	
Risk of over-occupancy	Immigration	Immigration	
Immigration	Horizontal property	Horizontal property	
Horizontal property	Economic difficulties		
Rental tenure			
Economic difficulties			

Figure 6.
Indicators taken into account in each profile.

	Mechanical structural damages	Risk of material detachment	Dampness	Damages in windows and carpentries	Lack of accessibility	Lack of activity	Residential exclusion	Risk of over-occupancy	Immigration	Horizontal property	Rental tenure	Economic difficulties	Total of cases
Group I													1162
Profile 1	-	-	10%	15%	85%	30%	30%	100%	100%	80%	45%	100%	257
Profile 2	-	-	15%	10%	70%	25%	30%	-	95%	70%	70%	100%	267
Profile 3	-	-	-	10%	75%	100%	10%	10%	80%	80%	-	25%	235
Profile 4	-	-	10%	10%	90%	-	-	20%	80%	90%	-	20%	403
Group II													757
Profile 5	-	-	-	-	-	-	-	50%	-	10%	-	-	757
Group III													650
Profile 6	35%	50%	85%	-	-	100%	95%	70%	-	-	-	10%	267
Profile 7	20%	-	85%	10%	25%	10%	10%	80%	90%	70%	-	10%	129
Profile 8	20%	10%	100%	14%	-	-	-	60%	-	-	-	10%	254
Group IV													350
Profile 9	15%	10%	85%	-	65%	20%	10%	-	30%	100%	-	60%	130
Profile10	15%	100%	45%	10%	60%	20%	20%	20%	90%	90%	30%	95%	121
Profile11	-	70%	20%	20%	90%	10%	45%	35%	80%	80%	-	-	99
Group V													714
Profile12	70%	90%	90%	95%	90%	30%	55%	80%	95%	85%	100%	95%	168
Profile13	65%	90%	90%	100%	100%	40%	35%	55%	90%	70%	-	100%	125
Profile14	60%	95%	85%	90%	95%	60%	20%	35%	80%	70%	-	-	180
Profile15	90%	90%	90%	80%	-	-	40%	75%	-	-	-	10%	241

Table 4.
Groups of Profiles of vulnerability according to the superposition of indicators at building scale.

Vitruvio
International journal of Architecture Technology and Sustainability
Volume 4 Is 2

As observed, there is no profile presenting physical or social indicators exclusively, all profiles present a combination of the both even if in some cases one category is more predominating. Nevertheless, the groups in which indicators of social shortcomings are more prevailing than observed physical damages include the major number of analysed cases. Group V is the only one in which physical aspects are more relevant and it includes 19,6% of cases.
Finally, it is important to note that several indicators are common in almost all obtained profiles, and thus they are considered key in order to describe vulnerable building profiles. It is the case of: accessibility deficits, dampness, risk of over-occupancy, immigration and horizontal property, followed by the risk of material detachment and economic difficulties. Once more, the most relevant observed aspects happen to be related with the lack of maintenance and the concentration of most vulnerable groups, as well as the mismatches between the morphological and typological conditions of the building stock in relation to the needs of the resident population.

4.3 PROFILES OF VULNERABILITY ACCORDING TO NEIGHBOURHOOD

The obtained profiles of vulnerability are presented according to neighbourhood in Figure 6, where an enormous diversity within the total sample of analysed buildings in the vulnerable areas of the city can be observed. The relevance of each group of profiles according to the number of cases is quite balanced. If profiles in Groups III and IV are considered together, they have a similar relevance as profiles in Group I, while profiles in Groups II and IV appear in relatively lower percentages.

However, this balanced proportion on the total sample manifests very important variations according to each neighbourhood. The two historic central neighbourhoods present similar distributions, and they differ from the rest of studied areas and particularly to Trinitat Nova, el Bon Pastor and Ciutat Meridiana, which present similar results according to the percentages and type of problematics that have been previously stated in this paper. According to the profiles, Trinitat Vella is the neighbourhood that has higher similarities with the central neighbourhoods, although it happens to be very different in geographical and urban morphological terms.
The areas included in El Raval and El Barri Gòtic are clearly integrated mostly by profiles of Group I, in which accessibility deficits are combined with many other socioeconomic weaknesses. Group II, including buildings with barely no significant deficiency, has the smallest proportions observed among all analysed neighbourhoods. Group III, including profiles with dampness in combination with different social weaknesses is also not relevant in comparison with other areas. Moreover, the proportion of Group V and particularly of profiles 12, 13 and 14 exceeds significantly the average among all vulnerable areas. This group include profiles in which there is high percentages of physical deficiencies combined with also high percentages of social shortcomings. Particularly, profiles 12, 13 and 14 present the highest combination of weaknesses simultaneously in one single building.
Remarkably, the historic centre concentrates a higher proportion of cases of an assumable higher risk of physical decay. The higher concentration of physical damages and a still considerable number of social shortcomings possibly turn into a higher difficulty when facing the need of implementing rehabilitation and maintenance actions.

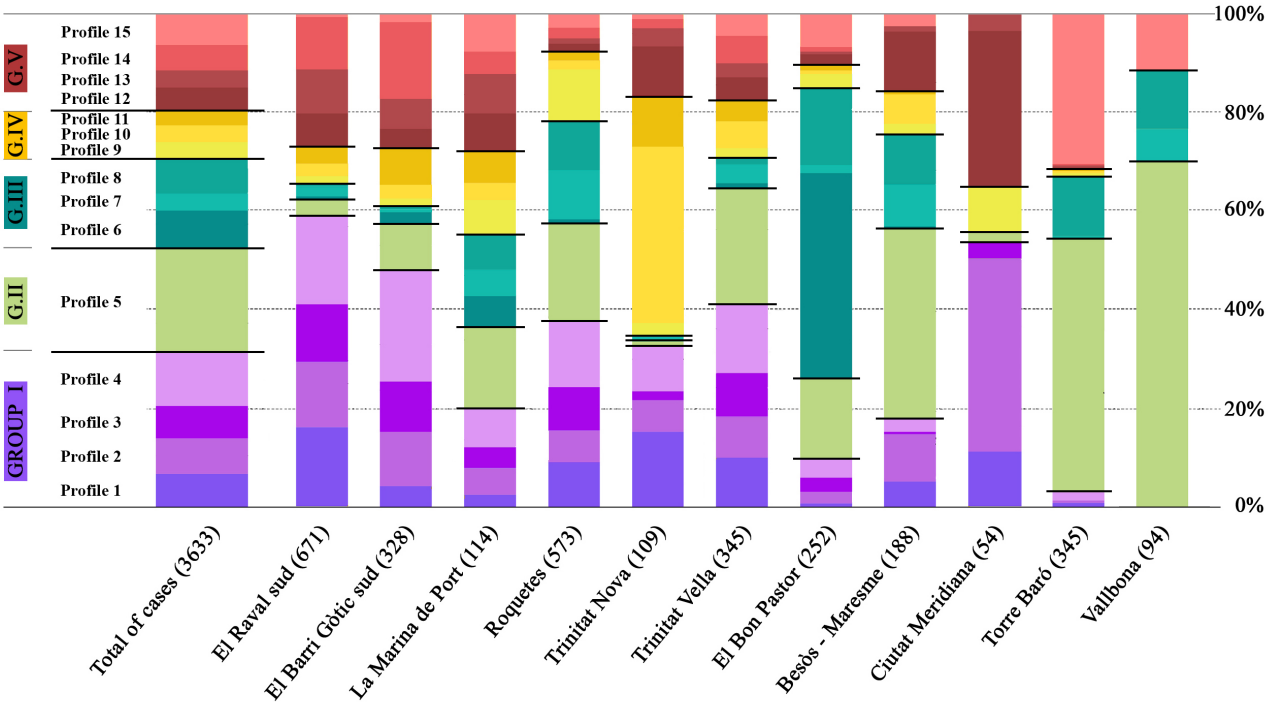

Figure 7.
Relevance of each profile and group of profiles according to the neighbourhoods.

4.4 CARTOGRAPHY OF THE OBTAINED PROFILES OF VULNERABILITY ACCORDING TO CONTEXT AND URBAN FABRIC

The previously described diversity materializes into a high complexity within the urban fabric even at very small scale and considering quite homogeneous urban fabrics such as the cases of Besòs-Maresme and El Raval sud, as well as more variable urban fabrics like Trinitat Vella and Roquetes (Fig.8).
Generally, it is possible to distinguish different patterns of profiles in zones of a certain scale that are typologically different, such as the northern area of Roquetes, the western side of Besòs-Maresme, or even the typologies of low attached houses in Besòs-Maresme. A certain convergence of profile groups tend to appear within similar building types in each neighbourhood. Rather homogeneous neighbourhoods like El Raval sud and the largest southern part of Roquetes present more homogeneous cartographies than neighbourhoods with higher typological variety such as Besòs-Maresme and Trinitat Vella.
Nevertheless, the diverse qualities of each profile within one same group maintain a certain diversity that can be observed in the cartographies. Moreover, the localisation of profiles in Groups IV and V result into a high dispersion within each neighbourhood and even within very similar or identic typologies. Although it is possible to detect patterns and aggregations, these profiles appear scattered in small concentrations of usually not more than 3 buildings. Their dispersed location with similar proportions in each different neighbourhood is key to configurate a patchwork of high complexity that does not allow for a simplistic delimitation of homogeneous zones or building types.

Vitruvio
International journal of Architecture Technology and Sustainability
Volume 4 Is 2

Figure 8.
Cartographies of resulting Profiles of vulnerability in El Raval sud, Besòs-Maresme, Trinitat Vella and Roquetes.

5. CONCLUSIONS

First, the most observed physical damages observed among and within vulnerable areas in the city of Barcelona are mainly related to the lack of maintenance of an aging building stock. Besides, some of the observed physical and social shortcomings are a consequence of some predetermined conditions of the urban and building morphology (building types with small housing unit surfaces or urban morphologies in which the installation of an elevator is technically complex) and do not achieve to meet the needs of the resident population. In social terms, the concentration of residents with economic difficulties and at risk of residential exclusion explains the difficulty or impossibility to involve in refurbishment or maintenance interventions to upgrade the state of the building stock. Furthermore, forms of tenancy with considerable percentages of rental and horizontal property, all of them within a private property framework, contribute to further restrain the management and implementation of any action of maintenance and upgrade of spatial conditions at building scale.

Secondly, the obtained profiles of the combination of indicators at building scale highlight a great heterogeneity and simultaneity of weaknesses within each single building. Excepting buildings in Group II, in which no relevant problematic is detected, all other groups include profiles where some physical damages appear in combination with a great amount of social shortcomings. Hence, the translation of vulnerability measures at building scale provides an inherently socio-spatial character; in which no profile manifest exclusively physical and technical or not only social indicators. This fact highlights the importance of designing public refurbishment polices that take into account the social particularities of vulnerable areas, in line with the most recent innovative rehabilitation programs of the Barcelona City Council.

Additionally, the obtained results confirm that there is a close relationship between physical decay and sociodemographic and socioeconomic inequality and vulnerability. Therefore, rehabilitation polices implemented over the last decades have been insufficient or have not succeeded to address the most vulnerable zones and degraded buildings in an integral and resilient way that can persist in improving living conditions over longer periods of time after the implementation of public investments.

According to neighbourhoods, both physical and social indicators manifest important variations that cannot be easily associated with geographical patterns such as the difference between peripheries and centre, nor the period of construction or evolution of certain neighbourhoods. There is a high concentration of physical indicators in the central areas of El Raval sud and El Barri Gòtic sud as well as in Trinitat Nova and El Bon Pastor, whereas highest proportions of social indicators, particularly those related with the risk of residential exclusion, remark Ciutat Meridiana together with Trinitat Nova and El Raval sud. According to the obtained profiles of vulnerability, the variation and heterogeneity between different neighbourhoods increases. Profiles defining Ciutat Meridiana, Trinitat Nova, El Bon Pastor and El Raval sud and El Barri Gòtic sud respectively manifest a much higher complexity and diversity. The distribution and proportion of profile groups in all analysed neighbourhoods is very variable in respect to the average results of the whole sample.

Finally, the cartography of results manifests a great heterogeneity and dispersion of profiles at building scale. Many different profiles characterize each neighbourhood, even if broken into small zones. Even if a certain correspondence of profiles can be observed in coherence with changes of urban fabric or building typologies, as it happens in the different urban fabrics of Roquetes or typologies of Besòs-Maresme, rather homogeneous urban fabrics like El Raval sud and Besòs-Maresme still present a high heterogeneity. Moreover, the diverse qualities of each profile within one same group maintain important diversities even in zones that appear to be morphologically quite homogeneous.

Remarkably, profiles in Groups IV and V, with a higher concentration of weaknesses both physical and social, appear in very small concentrations and highly dispersed among the whole neighbourhood in comparison to other profiles. This fact highlights the

difficulty or even impossibility of zone delimitation when addressing the design of public policies that aim to focus in most degraded areas.
Clearly, rehabilitation policies that aim to address the existing complexities and heterogeneity in an integral way need to develop innovative tools that provide enough flexibility to take into account the great heterogeneity and dispersion of most vulnerable communities within small areas. Further research on the field could elucidate which tools are preferable in order to adapt to particularities at neighbourhood, zone and building scale that can differ extensively among one delimitated area, street or even among groups of adjoined buildings.

ACKNOWLEDGMENTS

The main sources of this research have been provided or supported by the Council of Barcelona, by means of several contracts that have been crucial for the development of fieldwork and database elaboration.
The present paper has been written with funding of the Ministry of Education thanks to an FPU Grant for Doctoral research.
Finally, this research has been carried out in the framework of the ongoing R&D Project: Re-Inhabit. Indicadores socio-espaciales para la mejora del stock habitacional en zonas vulnerables. Criterios de actuación en los casos de las áreas metropolitanas de Barcelona y Bilbao. RTI 2018-101342-B-I00, supported and funded by the Ministry of Science and Innovation.

REFERENCES

Alguacil, J., Camacho, J., Hernández, A. (2014) La vulnerabilidad urbana en España. Identificación y evolución de los barrios vulnerables. EMPIRIA. Revista de Metodología de Ciencias Sociales 27: 73-94.

Ajuntament de Barcelona (2016). Pla pel Dret a l'Habitatge de Barcelona 2016-2025. Resum executiu.

Garcia-Almirall, P., Vila, G., Vima-Grau, S., Uzqueda, A. (2017). Estudi i detecció a la ciutat de Barcelona d'àmbits de vulnerabilitat residencial. Ajuntament de Barcelona.

Cornadó, C., Garcia-Almirall, P., Vima-Grau, S. (2017). Prediagnosi de l'edificació residencial en els àmbits de vulnerabilitat de la ciutat de Barcelona. Ajuntament de Barcelona.

Cornadó, C., Garcia-Almirall, P., Vima-Grau, S., Vila, G., Uzqueda, A. (2017) Methodology for the Detection of Residential Vulnerable Areas – the Case of Barcelona. IOP Conf. Series. Materials Science and Engineering 245. DOI:10.1088/1757-899X/245/4/042062.

Cornadó C, Vima-Grau S, Garcia-Almirall P. Assessment of the Residential Building Stock in the Vulnerable Areas in the City of Barcelona. XVII International Forum. Gangemi Editore, 2019; 174-183. http://hdl.handle.net/2117/166252

Diari Oficial de la Generalitat de Catalunya (DOGC). 2018. Anunci de la Convocatòria del Programa de Finques d'Alta Complexitat. Núm 7642-14.6.2018. CVE-DOGC-A-18157071-2018.
Tapada, M.T., Arbaci, S. (2011) Proyectos de regeneración urbana en Barcelona contra la segregación socioespacial (1986-2009): ¿solución o mito? ACE: Architecture, City and Environment 6, 17: 187-222.

Thomsen, A., Van der Flier, K. (2011). Obsolescence and the end of life phase of buildings. Management and Innovation for a Sustainable Built Environment. Amsterdam, The Netherlands.

Thomsen, A., Van der Flier, K., Nieboer, N. (2015). Analysing obsolescence, an elaborated model for residential buildings. Structural Survey 33, 3: 210-227.

Thomsen A., Nieboer, N., Van der Flier, K. (2017). Obsolescence – understanding the underlying processes. ENHR 2015 Conference Lisbon.

Turkington, R., Watson, C. (2015). Renewing Europe's Housing. Policy Press, Great Britain.

Vima, S. (2018). Caracterització i prediagnosi del teixit socioresidencial vulnerable a la ciutat de Barcelona. Master thesis MBARCH. Universitat Politècnica de Catalunya.