ISSN 1828-5961

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… Per duplice terrore si trepida dunque nelle città:
di sopra temono le case, di sotto paventano le caverne,
che la natura della terra non le disgreghi d’un tratto,
e squarciata spalanchi ampiamente la sua voragine
e sconvolta voglia riempirla delle sue rovine.

Titus Lucretius Carus, De Rerum Natura, Liber VI

METHODS AND GRAPHICAL CODES FOR THE SEISMIC VULNERABILITY SURVEY AT ARCHITECTURAL AND URBAN SCALE

METODI E CODIFICHE GRAFICHE PER IL RILIEVO DELLA VULNERABILITA’ SISMICA ALLA SCALA ARCHITETTONICA E ALLA SCALA URBANA

The recent seismic events that occurred in Italy in 1997, 2009, 2012 and 2016 have made it clear that there is a need to develop and employ large-scale assessment tools on the vulnerability of local and built-up populations. The research presents a method based on the mapping of important maps based on which it is possible to carry out assessments of the vulnerability of urban areas.

Experience has shown that urban emphasis, as well as being an opportunity for the representation of levels of analysis and knowledge of the built up, can take on the role of a scientific tool able to induce cognitive analysis of the second and more in-depth level, namely the mass In relation to different levels of knowledge, and to become an efficient cause of a derived knowledge.

I recenti eventi sismici accaduti in Italia negli anni 1997, 2009, 2012 e 2016 hanno reso evidente la necessità di sviluppare e impiegare su larga scala strumenti di valutazione circa la vulnerabilità di popolazioni del territorio e del costruito. La ricerca presenta un metodo fondato sulla rappresentazione cartografica di mappe di rilievo in base alle quali risulta possibile compiere valutazioni riguardo la vulnerabilità delle aree urbane.

L’esperienza condotta dimostra come il rilievo urbano, oltre ad essere occasione per la rappresentazione di livelli di analisi e di conoscenza del costruito, può assurgere al ruolo di strumento scientifico capace di indurre analisi conoscitive di secondo e più approfondito livello, attinenti cioè alla messa in relazione di diversi livelli di sapere, e divenire causa efficiente di una conoscenza di tipo derivato.

Key words:
seismic vulnerability, survey drawing, graphic codes, expeditious methods

Parole chiave*:*
vulnerabilità sismica, disegno di rilievo, codici grafici, metodi speditivi

Fig. 1. Fernando Botero, Earthquake in Popayàn, 1999

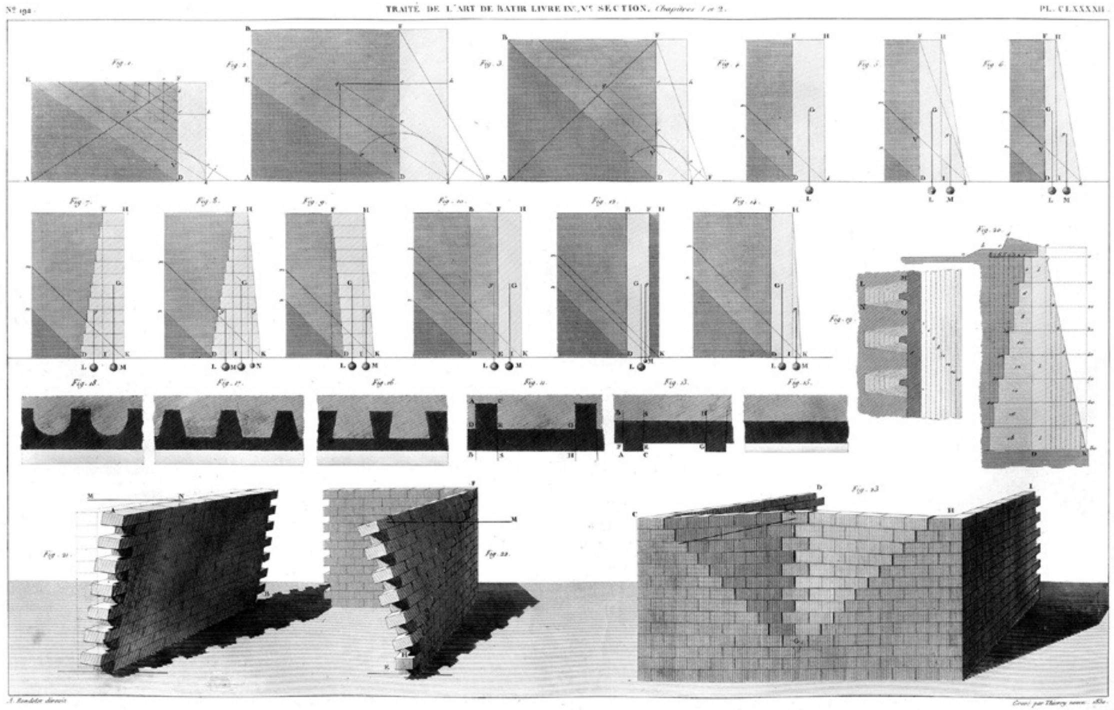

Fig. 2. Jean Baptiste Rondelet, 1814, Traité de l'art de batir, Parigi, Libro IX, Tomo V, Tavola CLXXXXII.

Analysis via graphic construction of the walls is particularly significant. The drawing indicated under number 21 represents the typical collapse of an isolated wall, while that indicated under number 22 represents the collapse of a wall clamped to another positioned orthogonally to it, and number 23 shows a case of a wall positioned and clamped between two walls positioned orthogonally to it. Segment MN, present in the three portrayals, expresses the force required to generate the tipping. It is a graphic portrayal which anticipates the code of the vectoral notation

1. THE SCIENTIFIC FOUNDATIONS OF RESEARCH (G. GARZINO)

Given the vastness of the analyzes to be conducted on a territory as strongly anthropized as Italy, and mostly characterized by historic buildings constructed without specific seismic prescriptions, this research aims to propose a methodology of quality and expedition analysis, such as to acquire, in a reasonably short time, sufficient information to activate a top-level decision-making process.

The proposed method is related to the important initiatives launched in the 1970s by scholars such as Salvatore Di Pasquale (a true innovator in theverification of the behavior of historical walls), followed by Antonino Giuffrè. These were followed by the studies of Davide Benedetti and Vincenzo Petrini (who developed a building assessment in 1984 to define a vulnerability index, later used as reference for the 1994 CNR-GNDT data sheet). In 2011 (Formisano et.al. 2011), the switch was made from analysis of the individual buildings to an urban aggregate dimension. However, it was only in 2012 (1) that the issue of seismic vulnerability on an urban scale became the subject of attention of national organizations, which are mentioned for the first time within the legislative framework of Stability Law. 147/2013.

ISSN 1828-5961

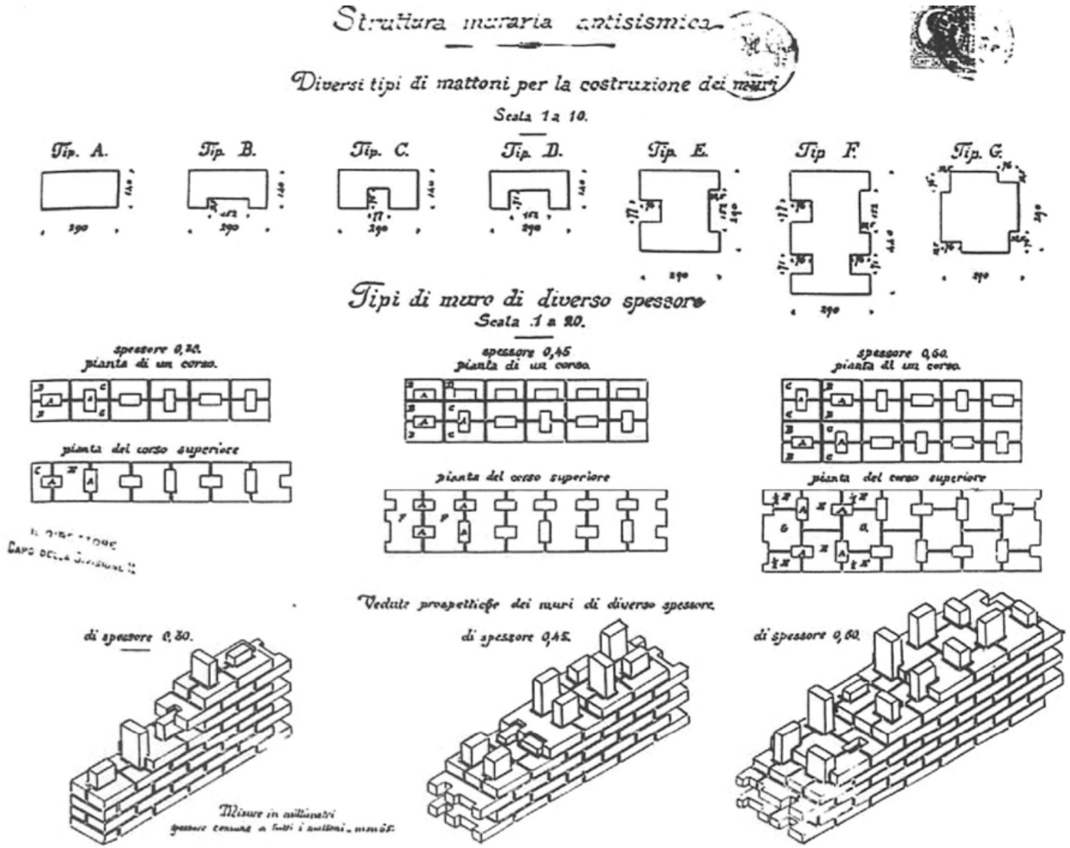

Fig. 3. Seismic masonry structure. Table taken from the Italian law dated 1909, issued in the wake of the Messina earthquake (1908)

2. IDEOGRAMMATIC SURVEY METHODS AND GRAPHIC ENCODINGS FOR ASSESSMENT OF SEISMIC VULNERABILITY ON A CONSTRUCTION SCALE (G. GARZINO)

This paper concerns the study of the characteristics of current and historic buildings with a predominantly residential character (2). A survey code for the representation of the vulnerability of existing building assets is presented. The research proposes a method of investigation organized into phases. First, an analytical process is outlined to identify the constituent elements of each building or building module (3): each of them is associated with a graphic codde capable of describing and specifying their properties. Then, maps capable of representing an overview of a multifaceted level of knowledge are created. The surveying of buildings and their mutual aggregations, therefore, means that the persistence built up (the material archive, to use the words of Rosalba Ientile) (Intile, 2013) becomes document and witness, while the relative design on which the survey itself is based constitutes the language through which the process of knowledge sought is performed. The results obtained with this type of expedient analysis allow, particularly, classification of the building heritage of a given territory, according to a scale of vulnerability. The procedure consists in examining, with reference to the building being investigated, fifteen parameters representative of geometric and mechanical characteristics. Each of them is then assigned one of the four vulnerability classes (A - B - C - D), defined in increasing order of danger, with a corresponding score. Each parameter corresponds to a weighted factor and the vulnerability index comes from the sum of all the scores identified by the attribution of the classes multiplied by the relative weights (4). Until now, these indices have always been enclosed in tables attached to the assessments of each building. The purpose of the study is to develop, on the basis of the scientific and methodological point of view, a graphic code on which to formulate the assessments capable of portraying the seismic vulnerability of aggregate buildings. Conjectural maps have been created, based on geometric documents, such as cadastral sheets of urban agglomerations. During the performance of certain tests relating to the calibration of the proposed method, we found that the cognitive path is fulfilled and explained also by means of the development of graphic codes, which are by no means the only visual representation of otherwise expressible concepts in more articulate terms, but more of an opportunity to collect and analyze, to separate first and then to summarize, to discern how much has to be united and how much has to be separated. The language of representation becomes, in fact, a form of thought (the logos of the ancient Greeks) through which the cognitive process is performed.
The symbols identified respond primarily to the application of visual aids, as well as to the established cartographic tradition. The geometry of the mesh of isolated elements is supplemented with additional notations which, in the specific case, relate to the mechanical

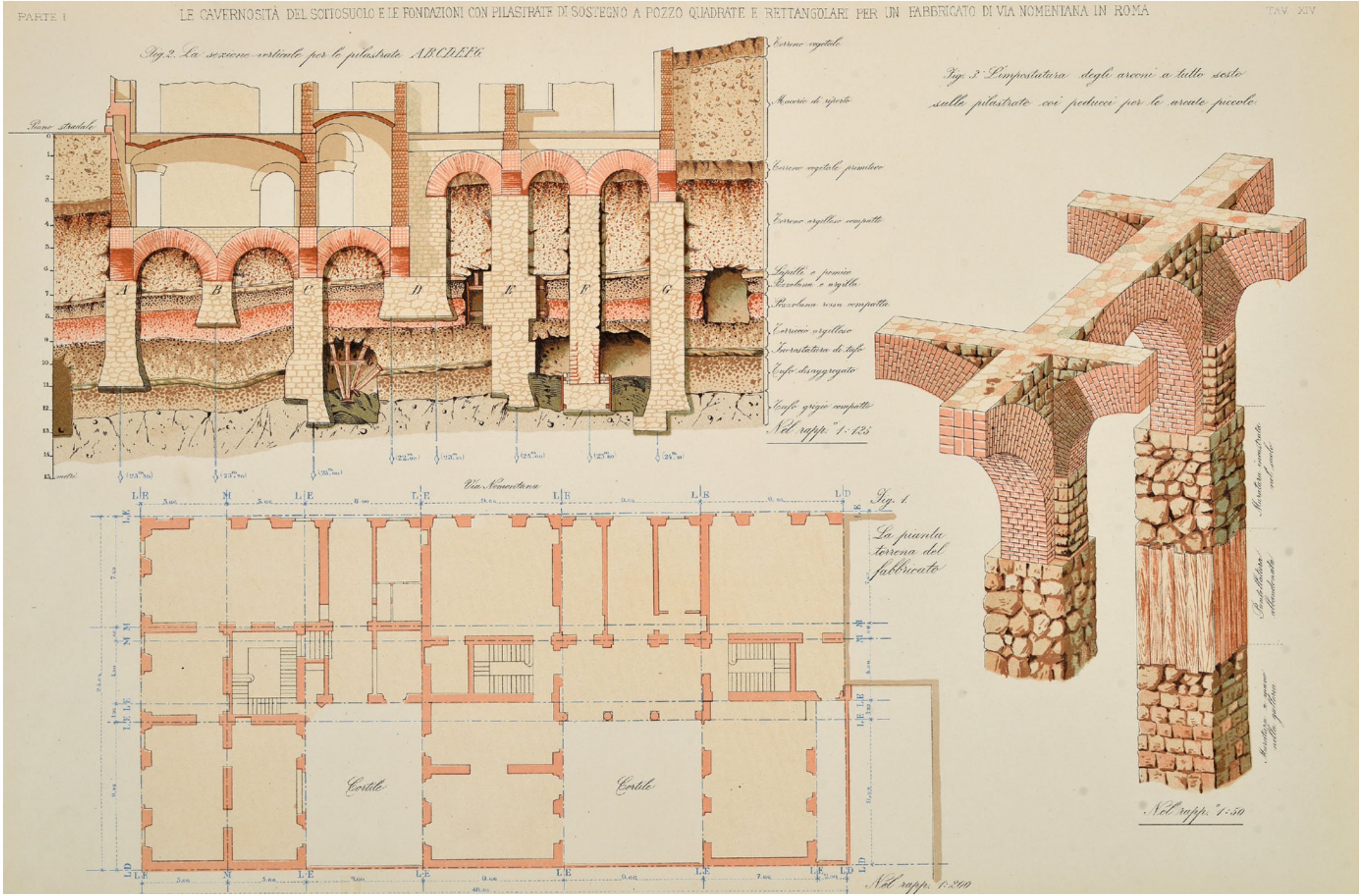

Fig. 4. Carlo Formenti, Formenti C., (1893), The practice of fabrication. Part one, TAV XIV, Ulrico Hoepli, Milan. Variety of the foundation system inside a single building, due to the type of ground.

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constructive nature of the buildings (see Fig. 2 and Fig. 3). In addition, the code proposed aims to reduce the survey data (which can be portrayed with stereometric maps, especially with regard to the analysis of interaction between the various buildings) to planimetric representation using ideogrammatic annotations. Their organization sometimes refers to the mechanical geometric concepts they wish to express. An example is the notation regarding the staggering of floors, the variation of heights or even the mutual planimetric position between adjacent buildings within the urban aggregate. It has been found that, in general, the adoption of ideogrammatic notation prioritises both simplification and standardization, as well as the ability to create maps on different themes. This aspect is functional to the computer processing of survey data.
In accordance with the RE.SIS.TO (Chinni et. al., 2013) method of investigation, we decided to portray, for each element, the type, organization and quality of the resistant system, as well as the location of the soil and the type of foundation system. In order to portray these characteristics, a kind of label has been developed, capable of collecting and organizing, in congruent notation, the elements that characterize it (see Fig. 9). As shown in Figs. 5, 6 and 7, findings relating to the cognitive analysis system are collected and critically organized into ideogrammatic notations which describe the mechanical characteristics of the apparatus. The use of thick, continuous lines rather than striped blocks allows the discretization of type and organization as well as the quality of the resisting system (see TAB 1 and TAB 2), while single or double continuous or dashed lines describe the foundation system (see TAB 3). The internal areas of the same building cells, where the different volumetric characterizations are readable by a change in orientation of the internal pattern of the different perimeter shapes, outline the predominant structure of the ceiling systems (see TAB 4). Particular attention is paid to the indication of a geometric parameter related to the nature and conformation of each building cell depending on its tendency to dissipate the horizontal actions. The letters written in a triangular frame, passing from A to D according to a growing vulnerability, express the relationship between the maximum longitudinal and transverse dimensions of structured portions confined to each other (see TAB 5). TAB 6, on the other hand, collects symbolic notations regarding the elevation configuration. The letter T placed within one or two concentric squares rotated with respect to each other by 45 degrees and with different organization of the sampling system, expresses the presence of a tower element with increasing heights over the building to which it is connected. The presence of an axis perpendicular to the façade of each building, at the ends of which there are single or double circumferences, circles or orthogonal sections (also single or double), indicates the presence of loggias, porticoes or other recessed elements with changes in shape. The letters written in two concentric circles, ranging from A to D according to a growing vulnerability level, refer to the parameter relating to the ratio between the distance between centers of the secondary transverse walls and the thickness of the master wall (see TAB 7). Given that the organization of the roofing system is a very important parameter of analysis, which, because of its specificity, characterizes the mechanical behavior of the whole building, we have decided to distinguish between flat and inclined elements. In the case of slopes, these are indicated by an arrow along the highest slope line. The continuous contour of the ridge lines, slopes and valleys, together with the maximum slope arrows, makes it possible to read the shape of the roof. The constructive nature of the roof is then deduced from the notation of the slope lines. The continuous line indicates a non-thrusting organization, while the dashed line indicates a thrusting system. The double dashed line indicates the presence of structural elements which are not connected to each other (see TAB 8). TABs 9 and 10 then indicate the nature of the non-structural elements and the state of conservation using alphanumeric codes. In this case too we have chosen to use letters A, B, C, and D. They express four levels of increasing vulnerability and are contained within a circumference, when referring to non-structural elements, or a square in the case of assessments of condition.
In order to consider the interaction between adjacent buildings, some specific survey data were introduced. The first parameter considered describes the mutual relationships between the vertical development of adjacent buildings. The notation presented represents the various cases grouped into four classes (see TAB 11). Another element of interest is the location of the building in relation to the aggregate: it is possible to distinguish between adjacencies on three sides, on two sides when the building is part of a curtain, bordering on two sides in relation to an angular planimetric layout and, lastly, the adjacent bond on one side only when it is an end building (see TAB 12). The presence of staggered floors between adjacent buildings can, in the event of an earthquake, generate un-contrasted thrusts on the common walls between two buildings, as well as hammering effects, which aggravate the stress. Table 13 presents a categorical representation of the various possible scenarios. Also in relation to the survey of the building and its mutual interactions with the context, the typological discontinuities and structural heterogeneities between adjacent buildings are analyzed (see TAB 14). TAB 15 allows representation of the variance in percentage of openings (parameter related to flexural rigidity and resistance to cutting) along contiguous façades. Again, we chose to discretize the parameters using the letters A, B, C and D placed inside a double triangular frame.
The urban survey therefore ceases to be an immediate activity with measuring sticks and maps and becomes a patient laboratory operation, the result of a series of prudent transports and detailed elaborations, tests, scientific hypotheses and experimental verifications (Cavallari, 1968).
Graphic elaborations, once based on the cadastral geometric plot, can then contribute to the creation of diagrams and to the creation of multi-relational databases, supported by several types of descriptive and metric information. This is how the contribution of the disciplines of representation in the urban survey activity goes way beyond the simple geometric description of the building context. The fact of organizing potentially disaggregated data in a coded chart constitutes the systemization of the investigations carried out, which can be assessed in their mutual interactions, thus becoming an opportunity for further cognitive insights.

3. IDEOGRAMMATIC SURVEY METHODS AND GRAPHICAL ENCODINGS FOR ASSESSMENT OF SEISMIC VULNERABILITY ON AN URBAN SCALE. (G. GARZINO)

"The seismic vulnerability of an urban system is considered as susceptibility to physical damage and loss of organization and functionality due to earthquake"

TABELLA 1: TIPO E ORGANIZZAZIONE DEL SISTEMA RESISTENTE
(parametro 1 - G.N.D.T. - RE.SIS.TO - Scheda di vulnerabilità di 2° livello, Muratura)

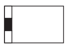
Notazione congetturale	Note descrittive	Classe	Punti	Peso
	Gli edifici sono consolidati e/o riparati secondo le prescrizioni normative.	A	0	1,5
	Gli edifici presentano a tutti i livelli e su tutti i lati liberi collegamenti realizzati mediante cordoli perimetrali o catene e presentano ammorsamenti in gradi di trasmettere azioni taglienti verticali.	B	5	1,5
	Gli edifici pur non presentando cordoli o catene sono costituiti da pareti ortogonali ben ammorsate tra loro.	C	20	1,5
	Edifici con pareti ortogonali non efficacemente legate.	D	45	1,5

TABELLA 2: QUALITA' DEL SISTEMA RESISTENTE
(parametro 2 - G.N.D.T. - RE.SIS.TO - Scheda di vulnerabilità di 2° livello, Muratura)

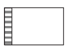
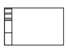
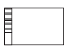
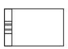
Notazione congetturale	Note descrittive	Classe	Punti	Peso
	Murature in laterizio, pietrame o tufo ben squadrate ma non omogenee, anche a sacco purchè dotate di collegamento tra i due fogli	A	0	0,25
	Murature in laterizio, pietrame o tufo ben squadrate ma non omogenee, anche a sacco purchè dotate di collegamento tra i due fogli	B	5	0,25
	Murature in laterizio, pietrame o tufo ben squadrate ma non omogenee, anche a sacco purchè dotate di collegamento tra i due fogli	C	20	0,25
	Murature in laterizio, pietrame o tufo ben squadrate ma non omogenee, anche a sacco purchè dotate di collegamento tra i due fogli	D	45	0,25

TABELLA 3: POSIZIONE DELL'EDIFICIO E FONDAZIONE
(parametro 4 - G.N.D.T. - RE.SIS.TO - Scheda di vulnerabilità di 2° livello, Muratura)

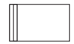
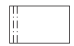
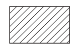
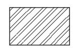
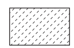
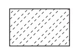
Notazione congetturale	Note descrittive	Classe	Punti	Peso
	Edifici posti su roccia o su terreni sciolti non spingenti con pendenze p≤10%, aventi piano di posa delle fondazioni a un'unica quota	A	0	0,75
	- Edifici posti su roccia con 10%<p<30%; - E. aventi piani di posa delle fondazioni con Δh≤1m posti su terreni sciolti senza spinte non equilibrate e caratterizzati dalle seguenti condizioni di pendenza del terreno: p≤10% e 10%≤p≤30%; - E. senza fondazioni posti su terreni sciolti senza spinte non equilibrate e poggianti su terreni aventi pendenza 10%≤p≤20%	B	5	0,75
	- Edifici posti su roccia con pendenza 30%<p<50% - Edifici aventi piani di posa delle fondazioni con Δh≤1m posti su terreni sciolti senza spinte non equilibrate e pendenza 30%<p≤50% - Edifici senza fondazioni posti su terreni sciolti senza spinte non equilibrate, con pendenza 20%<p≤30% - Edifici aventi piani di posa delle fondazioni con Δh<1m posti su terreni sciolti con spinte non equilibrate, con pendenze p≤50%	C	20	0,75
	- Edifici posti su terreni o roccia con pendenza p>50% - Edifici posti su terreni sciolti aventi piani di posa delle fondazioni con Δh>1m - Edifici senza fondazioni, posti su terreni sciolti con pendenza >30%	D	45	0,75

TABELLA 4: ORIZZONTAMENTI
(parametro 5 - G.N.D.T. - RE.SIS.TO - Scheda di vulnerabilità di 2° livello, Muratura)

Notazione congetturale	Note descrittive	Classe	Punti	Peso
	Edifici con orizzontamenti di qualsiasi natura caratterizzati da deformabilità trascurabile, collegamenti efficaci con le pareti, assenza di piani sfalsati.	A	0	0,5 (100/α*)
	Edifici con orizzontamenti di qualsiasi natura caratterizzati da deformità trascurabile, collegamenti con le pareti, ma con presenza di piani sfalsati.	B	5	0,5 (100/α*)
	Edifici caratterizzati da orizzontamenti con deformabilità significativa anche se ben collegati con le pareti.	C	20	0,5 (100/α*)
	Edifici con orizzontamenti di qualsiasi natura mal collegati alle pareti.	D	45	0,5 (100/α*)

* α = percentuale di orizzontamenti rigidi ben collegati

Fig. 5. Synoptic framework of the tables relating to the ideogrammatic notations pertinent to the resistant system of each individual building. (edited by G. Garzino)

TABLE 5: PLANIMETRIC CONFIGURATION - (parameter 6 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Conj. not.	Descriptive notes	Class	Points	Weight
	Planimetric configuration: - in the case of rectangular buildings, the regularity of the distribution is portrayed on the plan and indicates the ratio multiplied by 100 between the dimensions of the shorter side and the longer side. - in the case of buildings which, moving away from the rectangular shape, present planimetrically added bodies with respect to the main rectangular plan, we indicate the ratio multiplied by 100 between the dimensions of the added body with respect to the longer side of the rectangle of the main plan.			
A	n ≥ 80 e m ≤ 10	A	0	0,5
B	60 ≤ n < 80 and 10 < m ≤ 20	B	5	0,5
C	40 ≤ n < 60 e 20 < m ≤ 30	C	20	0,5
D	n < 40 and m > 30	D	45	0,5

TABLE 6: VERTICAL CONFIGURATION - (parameter 7 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Conj. not.	Descriptive notes	Class	Points	Weight
	Building with distribution of masses and resistant elements that are uniform all the way up or which decrease con-stantly as they rise, or which present recesses which result in a reduction of the area a dof the area A of the surface area in the plan so that a<10%A.	A	0	0,5 / 1*
	Buildings with arches and loggias of modest dimensions which involve an area a of the total floor area A so that a≤10%A	B	5	0,5 / 1*
	Buildings with recessed elements implicating a reduction a of area A of the surface area on the plan so that A<a≤20%A.	B	5	0,5 / 1*
T	Buildings with turrets or towers with a height h of the total height H of the building to which they are connected so that h≤10%H.	B	5	0,5 / 1*
	Buildings with arches or loggias which involve an area a of the total floor area A so that 10%A<A ≤20%A.	C	20	0,5 / 1*
	Buildings with recessed elements implicating a reduction a of area A of the floor surface area that a>20%A.	C	20	0,5 / 1*
	Towers or turrets with a height h of the total height H of the building to which they are connected so that 10%H<h≤40%H.	C	20	0,5 / 1*
	Buildings with arches or loggias which involve an area a of the total floor area A so that a>20%A.	D	45	0,5 / 1*
	Towers with a height h of the total height H of the building to which they are connected so that h>40%H.	D	45	0,5 / 1*

* 0.5 if the irregularity is created by ground floor arches only, otherwise 1

TABLE 7: MAXIMUM DISTANCE BETWEEN WALLS (parameter 8 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Con. not.	Descriptive notes	Class	Points	Weight
A	Ratio between the distance of the transversal centres walls and the thickness of the load-bearing wall > 15.	A	0	0,25
B	Ratio between the distance of the transversal centres walls and the thickness of the load-bearing wall between 15 and 18.	B	5	0,25
C	Ratio between the distance of the transversal centres walls and the thickness of the load-bearing wall between 18 and 25.	C	20	0,25
D	Ratio between the distance of the transversal centres walls and the thickness of the load-bearing wall included, higher than 25.	D	45	0,25

TABLE 8: ROOF (parameter 9 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Con. not.	Descriptive notes	Class	Points	Weight
	Geometry of the roof with indications of the ridge and the slopes.			
	The maximum slope lines, traced with a continuous line, indicate a non-thrusting roof with no under-roof string-courses or chains.	A	0	$*0,5+\alpha_1+\alpha_2$
	The maximum slope lines, traced with a double continuous line, indicate either a non-thrusting roof with no under-roof string-courses or chains, or a roof which thrusts a little and has under-roof string-courses or chains.	B	5	$*0,5+\alpha_1+\alpha_2$
	The maximum slope lines, traced with a dashed line, indicate either a slightly thrusting roof with no under-roof string-courses or chains, or a roof which thrusts and has under-roof string-courses or chains.	C	20	$*0,5+\alpha_1+\alpha_2$
	The maximum slope lines, traced with a double dashed line, indicate a thrusting roof with no under-roof string-courses or chains.	D	45	$*0,5+\alpha_1+\alpha_2$

$*\alpha_1$ = 0,25 if the roof is made of brick and concrete or weighs at least 200 Kg/m², 0 otherwise - α_2 = 0,25 ratio between the perimeter of the rood and total length of the resting areas is > 2.0, 0 otherwise

TABLE 9: ROOF (parameter 10 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Con. not.	Descriptive notes	Class	Points	Weight
A	Buildings with no doors and windows,protrusions or false ceilings.	A	0	0,25
B	Buildings with doors and windows well connected to the walls, with small chimneys, well-connected false ceilings and balconies forming an integral part of the structure.	B	5	0,25
C	Buildings with doors and windows and signs poorly connected to the walls, poorly connected small false ceilings.	C	20	0,25
D	Buildings with chimneys and other appendixes poorly connected to the roof, characterised by balconies, protrusions and para-pets added on and poorly connected to the main structure, presence of extended and poorly connected false ceilings.	D	45	0,25

TABLE 10: ROOF (parameter 11 - G.N.D.T. - RE.SIS.TO - Level 2 vulnerability, Walls)

Con. not.	Descriptive notes	Class	Points	Weight
A	Walls in good condition without visible damage.	A	0	1
B	Buildings with occasional capillary damages, with the exception of cases in which these have been caused by earthquakes.	B	5	1
C	Buildings with damages of medium extent (size of the damage: 2-3 mm) or with capillary damages of seismic origin. Building which, despite not presenting damages, are characterised by a state of repair of the walls such as to determine a sig-nificant reduction in resistance.	C	20	1
D	Buildings with walls that are not plumb or which present severe if not widespread damage. Buildings characterised by severely deteriorated materials. Building which, despite not presenting damages, are characterised by a state of repair of the walls such as to determine a sever reduction in resistance.	D	45	1

Fig. 6. Synoptic framework of the tables relating to the ideogrammatic notations pertinent to the geometric conformation and the condition of each individual building. (edited by G. Garzino)

TABLE 11: INTERACTIONS IN HEIGHT WITH ADJACENT BUILDINGS
(parameter 11* - integrative proposal for buildings in aggregate Formisano et alii G.N.D.T. Level 2 vulnerability)

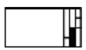
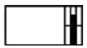
Conjectural notation	Descriptive notes	Class	Points	Weight
	The building is positioned between buildings of equal height.	A	-20	1
	The building is adjacent to higher buildings or to a higher building and one of equal height.	B	0	1
	The building is adjacent to a lower building and one of equal height or to a higher building and a lower one.	C	15	1
	The building is adjacent to two lower buildings.	D	45	1

TABLE 14 PRESENCE OF DIFFERENCES IN TYPE BETWEEN ADJACENT BUILDINGS
(parameter 14* - integrative proposal for buildings in aggregate Formisano et alii G.N.D.T. Level 2 vulnerability)

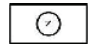
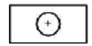
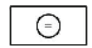
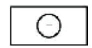
Conjectural notation	Descriptive notes	Class	Points	Weight
	The building presents structural differences with respect to the other adjacent buildings.	A	-15	2
	The building borders with others with better characteristics.	B	-10	1,2
	The building borders with others with the same characteristics.	C	0	1,2
	The building borders with others with worse characteristics.	D	45	1,2

TABLE 12: PLANIMETRIC INTERACTION WITH ADJACENT BUILDINGS
(par. 12* - integrative proposal for buildings in aggregate Formisano et alii G.N.D.T. Level 2 vulnerability)

Conjectural notation	Descriptive notes	Class	Points	Weight
	The building occupies a position restricted on three sides.	A	-45	1,5
	The building occupies a position restricted on two sides.	B	-25	1,5
	The building occupies a corner position in the aggregate.	C	-15	1,5
	The building occupies an end position in the aggregate.	D	0	1,5

TABLE 15 DIFFERENCE BETWEEN PERCENNTAGES OF OPENINGS IN THE FACADE BETWEEN ADJACENT BUILDINGS
(parameter 15* - integrative proposal for buildings in aggregate Formisano et alii G.N.D.T. Level 2 vulnerability)

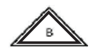
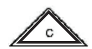
Conjectural notation	Descriptive notes	Class	Points	Weight
	The building presents a difference between the percentages of openings with respect to those of the adjacent building. p≤5%	A	-20	1
	The building presents a difference between the percentages of openings with respect to those of the adjacent building. 5%≤p<10%	B	0	1
	The building presents a difference between the percentages of openings with respect to those of the adjacent building. 10%≤p<20%	C	25	1
	The building presents a difference between the percentages of openings with respect to those of the adjacent building. p≥20%	D	45	1

TABLE 13 PRESENCE AND NUMBER OF FSTAGGERED FLOORS BETWEEN THE BUILDING EXAMINED AND THOSE ADJACENT (parameter 13* - integrative proposal for buildings in aggregate Formisano et alii G.N.D.T. Level 2 vulnerability)

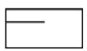
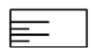
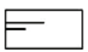
Notazione congetturale	Note descrittive	Classe	Punti	Peso	Notazione congetturale	Note descrittive	Classe	Punti	Peso
	Complete absence of staggered floors.	A	0	0,5		Presence of two pairs of staggered floors.	C	20	0,5
	Presence of a pair of staggered floors.	B	5	0,5		Presence of several pairs of staggered floors.	D	45	0,5

Fig. 7. Synoptic framework of the tables relating to the ideogrammatic notations pertinent to the interaction between adjacent buildings forming in building aggregate. (edited by G. Garzino)

HOMOGENE TERRITORIAL UNITS

CLASS	COLOR	SCORING OBTAINED FROM THE FORMS OF THE CNR-GNDT GUIDELINES UPDATED ACCORDING TO THE CRITERIA OF INTERACTION BETWEEN BUILDINGS BELONGING TO THE SAME ISOLATED
I		0 ÷ 199
II		200 ÷ 299
III		300 ÷374
IV		375 ÷ 424
V		425 ÷ 515

TABLE 17: MORPHOLOGICAL AMPLIFICATION FACTORS RELATING TO MECHANICAL CLASSIFICATION OF HOMOGENE TERRITORIAL UNITS

Area affected by the possible collapse of towers / bell towers and church or basilica's pediments	2
Adjacent / proximity to gates of murals and / or triumphal arches	1,5
Contiguity with building arches crossed the streets	1,3

TABLE 18: CRITERIA FOR THE MECHANICAL AND MORPHOLOGICAL CLASSIFICATION OF THE VIARY SYSTEM AND THE PUBLIC SPACE

CLASS	COLOR	TYPE OF ROAD SYSTEM	POINTS
I		Flat roard and predominantly straight / open flat plane constituent a square or a widening (p ≤8%)	0 ÷ 199
II		Street with limited slope and predominantly straight / open space with limited slope (p ≤ 8%) constituent a square or a widening	200 ÷ 299
III		Road predominantly in slope (p> 8%) with curve	300 ÷ 374
IV		Road in slope (p > 8%) located alongside a slope / cliff	375 ÷ 424
V		Road in slope (p> 8%) located alongside a slope / cliff characterized by a change of direction, supported by male walls and buttresses	425 ÷ 515

CLASSIFICATION OF THE VIARY SYSTEM AND THE PUBLIC SPACES

ROAD WIDTH AND PRESENCE OF BUILDINGS	MECHANICAL CLASSIFICATION OF BUILDING UNITS				
	I	II	III	IV	V
Buildings on one side of the road with a width greater than the maximum height of the construction faces	1	1	1	1,2	1,3
Buildings on both sides of the road having a width greater than the sum of the heights of the forward facing facades	1	1	1	1,3	1,5
Buildings on both sides of the road having a width equal to the sum of the heights of the forward facing facades	1	1,1	1,1	1,4	1,5
Buildings on both sides of the road having a width equal to or less than the sum of the heights of the forward facing facades	1	1	1,2	1,5	2
Buildings on both sides of the road having a width less than the sum of the heights of the forward facing facades	1,1	1,2	1,4	1,7	2

TABLE 20 : CONVENTIONAL SYMBOLS CONCERNING THE CHARACTERIZATION OF THE SUBSERVICES

TYPE OF SUBSERVICE	CONVENTIONAL SYMBOL
Black sewers	■■■■■
Foul water sewers	□□□□□
Aqueduct	- - - - -
Gas network	++++++
underground elettrical line	* * * *
aerial elettrical line	o o o o

TABLE 21 : MORPHOLOGICAL AMPLIFICATION FACTORS RELATED TO THE COMPRESENCE OF SUBSERVICE NETWORK

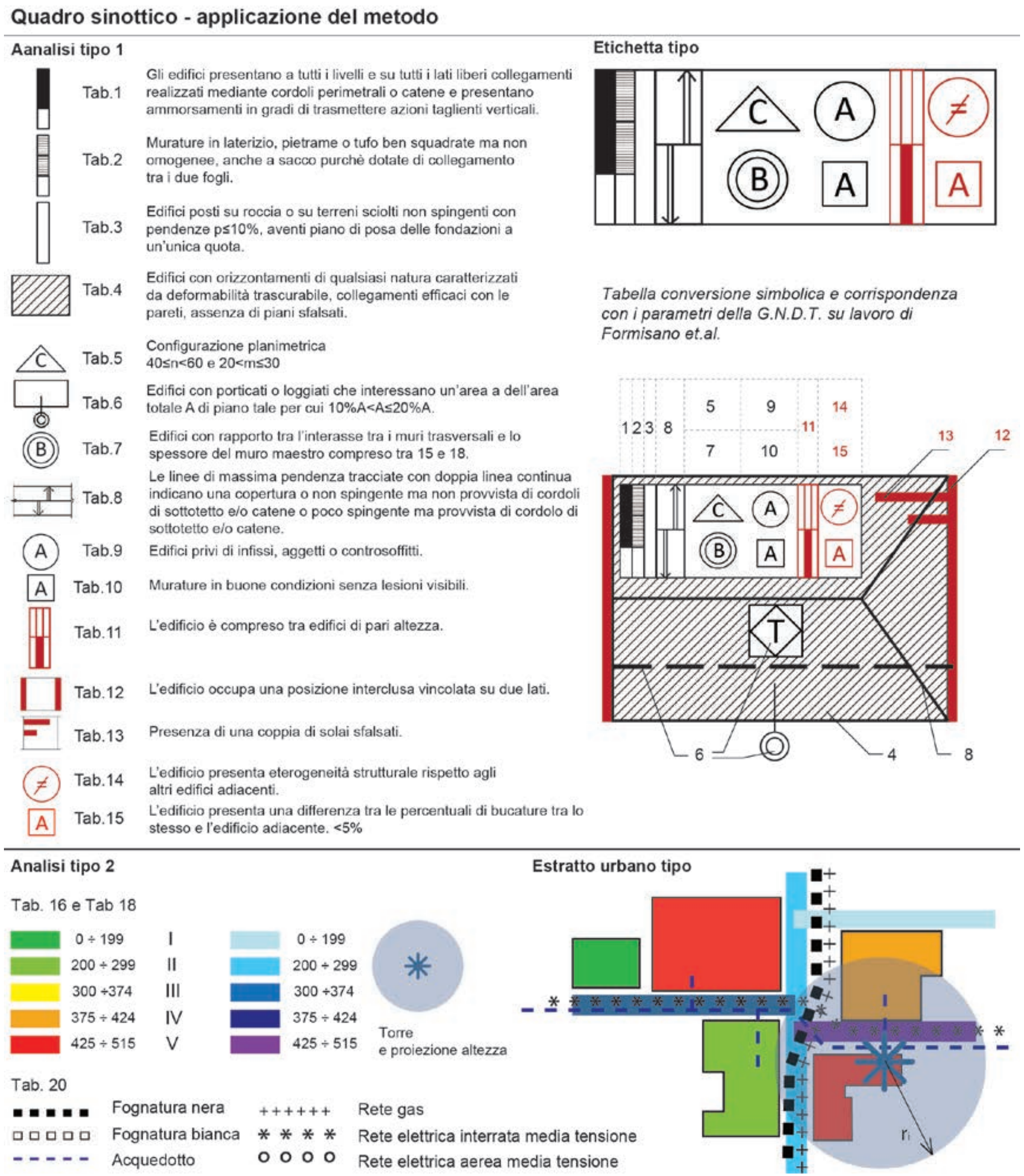
CONTEMPORARY PRESENT OF SUBSERVICE NETOWRK TYPE	ROAD WIDTH (l)			
	l<4m	4m<l<7m	7m<l<10m	l>10m
Black and foul water sewers	1,1	1	1	1
Aqueduct and mains medium voltage underground	1,3	1,1	1	1
Gas network and underground electrical line	1,5	1,3	1	1
Aqueduct, gas network and aerial electrical line	2	1,5	1,3	1
Black sewers, aqueduct, gas network and aerial electrical line	2	1,5	1,3	1

Fig. 8. Synoptic framework of the tables relating to the ideogrammatic notations pertinent to seismic vulnerability on an urban scale. (edited by G. Garzino)

(5). QThe first step is to identify homogeneous territorial units within the urban settlement (6) , so that the seismic vulnerability analysis of individual buildings, also studied within an aggregate system (Formisano et. al., 2011), allows us to express an assessment of the seismic vulnerability of the complex. For example, it is conceivable to add the values corresponding to the seismic vulnerability of each cell that is part of the urban aggregate. The result obtained is divided by the number of constituent cells and we have an average value of the vulnerability of the aggregate. We decided to portray homogeneous territorial units characterized, mechanically, according to five decreasing conditions. Cartography can highlight the worst situations (indicated in bright red), the intermediate ones, in orange, light green and green, and those with the best guarantee (dark green). See the classification contained in TAB 16. It should be noted that the categorization (same as that of the RE.SIS.TO methodology) is not carried out on a linear basis: we decided to take into account a realistic situation in view of the fact that it is unlikely that there will be homogeneous territorial units which, while presenting good conditions overall, have a score close to zero. Similarly, the 425-point threshold is believed to represent a high level of vulnerability. However, following a more detailed analysis, we can see that this first level of investigation is not sufficient to fully describe the complexity of an urban system. Indeed, as far as mechanical behavior is concerned, it is necessary to distinguish between direct vulnerability, consisting of the different attitude to the damage of a building or complex of buildings, and vulnerabilities induced into the system by certain elements characterized by singular behavior.

The latter depends as much on the specificities of the individual manufactured articles as on the morphology of urban systems. Recurring examples are towers, whether they belong to medieval buildings or more simply bell towers belonging to different historical periods, as well as the particular conformation of the access gates to walled cities or triumphal arches, or even the arches of residential buildings that cross the streets. Last but not least, we have the tall façades of Baroque churches. It may happen that, due to the layout of the urban fabric, a tower, bell tower or a building element can add to the vulnerability of a territorial unit adjacent to the one where it is located due to possible involvement if it collapses. It is necessary, as proposed in TAB 17, to increase the average score for the mechanical classification of the compartment, or portion thereof, in relation to the area affected by the collapse and indicated in cartography by a perimeter of competence, which depends on the height and geometry of the building element concerned. We decided to graduate the amplification factors in relation to the intensity and destruction capacity estimated in relation to the potential collapse of the building elements involved.

The construction of roads and public spaces in general is in a category of its own. A road can be analyzed in the light of multiple aspects. For example, it can be considered in relation to its constructive nature (flat, near a slope, supported by buttresses, etc.) and is thus cataloged within a vulnerability class. On this matter, we propose, as indicated in TAB 18, a coding system organized according to a discretized score with five levels of decreasing vulnerability, from violet to pale



blue. However, a road can also be subject to induced vulnerability caused by the possible collapse of the buildings that look out over it: the narrower the road the worse the situation. Consequently, for roads too, it is necessary to envisage a multiplicative factor of vulnerability, expressed with a double input matrix (see TAB 19) which contemplates both the geometric parameter related to the width of the road and that of the mechanical vulnerability of adjacent buildings. The latter are considered in relation to the mechanical vulnerability of each cell, given the weight, in this particular behavior, of the main characteristics of each building with respect to the average value of the homogeneous territorial units.

Another very important aspect is the interaction between built system and infrastructure networks. Most historical urban systems were built in the absence of infrastructure networks. The presence of underground and overground medium voltage networks, the development of gas networks, the provision of drinking water supply systems or collection systems for black and white sewage are mostly additional works, often built in a difficult context, where numerous canalizations are jumbled up, crossing and overlapping. A seismic event could trigger technological vulnerability, such as explosions, fires, pollution, etc. In addition, underground canals, once disconnected due to seismic action, may become sources of flooding. The presence of dense infrastructure in a very limited space can therefore lead to an increase in the vulnerability of the road network and public spaces within urban systems (see TAB 20 and TAB 21). Each urban morphology is therefore characterized by its own specificities in terms of modalities and intensity of interaction between buildings, infrastructural networks and open spaces (Cremonini, 2015).

Fig. 9. Synoptic framework of the tables relating to the ideogrammatic notations pertinent to the preparation of a standard survey for a building in relation to surveys on a construction and urban scale. (edited by G. Garzino, M.M. Bocconcino e V. Donato)

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4. SURVEYING SEISMIC VULNERABILITY ON A CONSTRUCTION AND URBAN SCALE: OPERATIONAL METHODS AND PROCEDURES. THE CASE STUDY OF PIAZZA SANTAROSA IN SAVIGLIANO (G. GARZINO)

The first part of the activity takes place by applying a process of analysis aimed at dismantling the structure of the buildings, which are analyzed in their individual characteristics and mutual interaction based on the criteria governing the organization of the attached tables. There is then a second moment, during which the aspects investigated are explicated by the elaboration of charts capable of portraying an overview by virtue of the graphic language adopted / invented. The breakdown by structural characteristics of the manufactured elements related to the individual building cells constitutes a first step to define the constructive layout of the context. The case study shows how the critical situation is created by the need to transfer the cognitive heritage, generated by the analysis process carried out on the building cells, to a graphic language which has to be at the same level not only in terms of context, but also capable of sustaining and supporting further

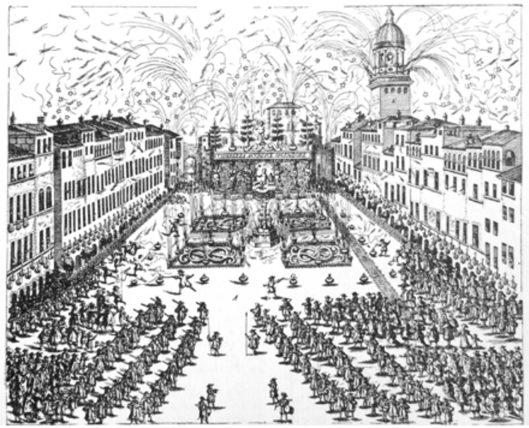

Fig. 10. Historic view of piazza Santarosa. Entrance of the dukes of Savoy into Savigliano. Joyful Fireworks. (Etching on copper, punched, 388x221 mm, not dated but assignable to the second half of 1668, not signed but with drawing attributed to Giovenale Boetto and probably etched by Tasniere).

degrees of investigation. The two scales of investigation are in fact different: the first is analytical and is related to a phase of deconstruction for components, while the second is synthetic, resulting in a critical operation of identifying those components that, with their recurrent presence, fall into a hierarchical composition of elements that characterize an urban fabric (Coppo, 2010).

On the basis of the program outlined above, it is evident that the research in progress aims to develop a tool with which to analyze the building heritage, where empirical, experimental and logical-deductive data (supported by an analytical assessment that presides over the governance criteria) mutually contribute to the result. The role of representation, as a means of definition and transmission of knowledge through images, plays different roles in this context, which are related, of course, to the method of investigation applied, at the specific time of the path of knowledge and critical judgment. We can, however, say that the graphic documents produced, regardless of the processing technique, constitute the language in which the whole path of analysis and knowledge is formalized.

As easily deduced from the case study presented, the extremely complex structure of the city, though limited to the geographic dimension of the so-called historic city, requires a survey developed for multiple thematic areas and themes, each related to a process of destructuring parts of the system. This is hard to assume within a single type of survey, or maybe it would be better to say that it requires detailed analysis depending on the individual case and the reòative specificities. Consequently, it is therefore necessary for all the information gathered to be appropriately structured and made congruent, by building relationship networks between data that be can questioned at any time. Hence the need to use information systems, as in the case study in hand, where the information collected is available and relatable. Most of the time, availability and relatability are obtained through the construction of databases connected to computerized cartographies that allow systemization of the information and the analyzes carried out. In the light of the above considerations, it is clear that the contribution of the disciplines of representation within the project regarding the definition of the seismic risk of a town involves aspects ranging from the knowledge of surveying to the establishment of multi-relational banks for the processing of data, and to interaction with GIS systems. On one hand, it is necessary to create maps capable of summarizing logical and deductive conceptual elaborations, but at the same time, it is necessary to instantly provide uninterpreted data and tools to analyze said data which are capable of allowing the various players to carry our analyses that can not necessarily be predicted in the research project, as assumed at the start.

5. FIRST ARRANGEMENT OF AN ANALYTIC-GRAPHIC IT SYSTEM FOR THE SURVEY OF SEISMIC VULNERABILITY, THE CASE STUDY OF PIAZZA SANTAROSA IN SAVIGLIANO. (M.M. BOCCONCINO)

The survey of seismic vulnerability is articulated in relation to the significant parameters identified in the arrangement indicated above, differing therefore from the expected results. The aims of development of the research include the “systemisation” of the various components (surveyors, scholars, designers, tools, data and informative heritage), exploiting the efficiency that can derive from the IT formalisation of the aspects linked to the support of the analysis and the relative graphic-numeric result. In this first analytical phase of this operational aspect, we require the IT system to be created to enable us to produce:

- a **systemised archive** of base elements (historical documentation, field surveys, meta-documented photographic supports) and raid survey data;
- a **picture** that comprises all the measurements surveyed, transparently related to the various players, where possible within a single graphic frame; this image has to be supported by the archive of elements, a consistent and constantly updated and updatable database (geometries, parameters, topologies, metadata);
- the quantitative comparison between different buildings and urban systems (automatic algorithms for the weighting of the parameters);
- cognitive instruments for measuring the quality of seismic vulnerability using different reading filters:
    - a first, basic informative layer, based on the highlighting of factors relating to the load-bearing system and the connected components (also in relation to exterior elements);

Fig. 11. Diagrams of the DB-GIS_WEB system: areas of elaboration and graphic representation. (edited by M.M. Bocconcino)

- simultaneously, also as a basic contribution, identification of the strengths and weaknesses and of the opportunities and threats of the situation investigated, or a graphic-numeric and qualitative analysis, presented in the form of a thematic plan which comprises interior and exterior factors;
- a second plan of synthesis, linked to the possibility to compare different planning/design solutions using well-defined and communicated frameworks and conditions.

This last consideration (relating to transparency, dissemination and participation) is a discriminating aspect for the successful outcome of the analytical processes behind the assessment of the seismic vulnerability of urban spaces; design is a field of comparison within which it is possible to activate comparisons and debates in that, by its nature, it highlights different points of view using an adequate graphic language which descends from an orderly combination of elements and procedures.

Starting with the archive associated with the summarised picture, the stratification of the data within the IT system for seismic vulnerability (temporally and spatially defined) allows us to:

- record, permanently and consistently, locally or on supports distributed via web, the field and study considerations and the relative photographic repertories, and associate the integrations of the basic IT heritage resident in historical and specialised archives;
- extract asynchronous frameworks of data, meaning the single parameters read in their spatial distribution;
- define partial snapshots of the cognitive heritage, allow us, for example, to check which parameter has the biggest impact on the overall weighting of vulnerability, and therefore supply the intervention priorities;
- supply progressive levels of synthesis, which become gradually more defined as they progress, in compliance with a process of refinement which can also be measured in relation to the analyses; this last consideration refers particularly to the

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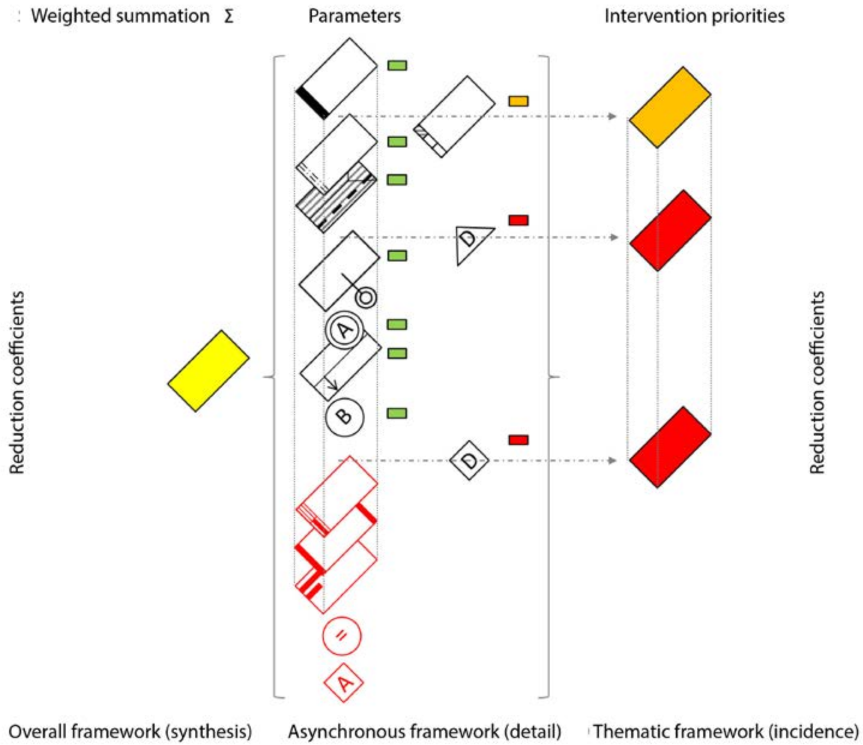

Fig. 12. Layers, cognitive levels, synthesis, framework of impact (intervention priority) (edited by M.M. Bocconcino)

definition of the degree of reliability of the observations and tracking of sources (official, unofficial, conjectural and hypothetic, etc): the survey priority is to supply the qualitative or quantitative extent of its reliability in order to allow its aware reuse.

The following figure shows a first applicative development of the code, a first point of definition within the overall research undertaken; the case study presented here is the outcome of successive experiments, confirming the reviews of the methodological part.
The first job of the tools put in place by the study is at operational level; if the survey looks like being expeditious, many of the actions that will follow the on-site inspection are dedicated to the slavish presentation of the facts observed and their integration with the heritage of critical pre-knowledge gradually formed and consolidated. We have thought about how to make this first collection and reconstruction process efficient, trying to reduce the times of mere compilation to devote more time to detailed checks and analyses. The characteristics of the method chosen are very close to those used to conform the devices we use every day (mainly smartphones and tablets), through the interaction and constant exchange with the telecommunications network.

Two areas of elaboration have been identified:

- one more specifically dedicated to the preparation of the urban reporting system and "hard" processing of data (production system or back-office);
- the other related to the graphic interface (the front-office), which allows interaction between the various players, surveyors and scholars, supplying a consist recording tool (which transmits its textual, numeric and photographic findings to the databases) and constantly updated area of comparison.

Taking the graphic interface of this production system:

- the epidermis with all the nerve endings capable of carrying signals, arousals, to the brain to be processed
- in a shared web space, requires and first substantial implementation of the tools: besides the machine on which the basic services operate, the data flow has to envisage the presence of server and a series of devices, connected to the web.

Without going into the problems relating to the digital formats that allow interaction via web with geometries and associated data, we can confirm that these are numerous, different and of widely varying efficiency. What we want to highlight here is how the arrangement of a graphic interaction environment asks the science of design to "set the table" for the collection and portrayal of knowledge, i.e.: an appropriate design of the space that will be both container and showcase of the data to by surveyed.
Via the interface, the surveyor has the possibility to record the observations on a "sensitive technical map" and to associate or linking the photographic memory and archive and bibliographic documentation to these. In other words, the surveyor can activate the parts of the cartographic portrayal that have been preventively made available and associate the semantic characterisation to them, in compliance with the tables indicated above, and all the data considered useful to support or allow verification of the details programmed. This possibility makes the expeditious vocation of the sur-

Fig. 13. The case study of Piazza Santarosa – Savigliano (Cuneo) (edited by V. Donato and M.M. Bocconcino)

vey imagined in its methodological arrangement even more evident, leaving it more time to express itself, having delegated the data processing and association of the graphic code to the IT automatisms. The consistency of the system also lies in the fact that, supported by the methods and instruments specific to the science of the automatic data process, it is possible to produce alternative scenarios and new visits of the situation investigated. It is also possible to put the results of the analyses (those in progress and those more defined) online, and to supply and receive data also from other areas of elaboration and interdisciplinary study (psychosomatic studies connected to the perception of urban wellbeing, statistic elaborations of the subjects appointed to carry out the social investigation, etc.).

The graphic code illustrated above sustains, as mentioned, the methodological arrangement; in addition, it allows the extraction of the results, an applicative rule which comprises the parameters and the indicators identified in a syncretic vision, which almost pertains to perception (that mental synthesis mentioned above) as determinant for the pluri-level definition of the values of wellbeing and quality of life in the places. The combination of data, in the step-by-step definition of the method, has been reconfigured to comprise different types of source. The diversity of the levels of reading is comprised within the synthetic vision sustained by the map, but requires in its elaboration of integrated areas of elaboration (systems) aimed at the analytical-graphic presentation of the single elements.

The opportunity to access complex databases has made it necessary to create a processing environment which exonerates the surveyor from all those operations involving registration on paper (the dressing of the basic cartographic plans). The widespread application of the survey method and graphic portrayal of seismic vulnerability requires the systemisation of a series of investigative and presentative elements. If, on one hand, the progressive refinement of the parameters to be surveyed and the method with which these could be synthetically collected and portrayed with "a single glance" has been supported by elaboration instruments which we now consider to be "artisan", put together case by case, set up manually and attentively, through to the definition of the correct proportions between the symbols, notations and graphic signs, on the other, the need to make the number of case studies to be verified consistent and to standardise the use of graphic rules, required the preparation of specific IT protocols, which allow assignment of the aspects connected to the graphic synthesis and to the analytical weighting of the results of the expeditious survey to computers.

The case study has permitted the graphic definition of a reference framework for the support and presentation of the seismic vulnerability seen initially at building level, then at the level of the construction agglomerate, lastly weighted as the sum within the whole, standardised urban space.

The working process for the definition of the graphic codes, application to the various scales of analysis, calibration of the graphic components (types and thickness of the lines, sizing of the texts in compliance with informative hierarchies).

The almost manual creation of the graphic arrangement allowed the time to mature on paper, and to settle there, in that place, the observations gathered with the practical experiences (and with the conspicuous photographic archives set up for the purpose, variegated and distributed in time).

ISSN 1828-5961

THE CASE STUDY OF PIAZZA SANTAROSA IN SAVIGLIANO: THE REFINEMENT OF GRAPHIC CODES RELATING TO THE SEISMIC VULNERABILITY OF THE HISTORICAL CONSTRUCTIONS (V. DONATO)

It has been illustrated how the definition of the method of investigation has undergone subsequent integrations in terms of content; this has implicated a substantial passage from almost exclusively “visual” surveys (analogue system traced back to the discreet combination formalised in the first versions of the tables shown above), mediated by the scholar’s sensitivity, to the opportunity to integrate into that first large combination of data other “pre-processed” data.

Brining the urban vulnerability survey method and procedures within the IT information system requires careful planning of the relative exchange formats. For the on-site verification of the method being defined, the research team has progressively identified, in view of the constant results, significant areas of elaboration that represent the construction system at national level. A first consistent application has been portrayed by the centre of a town in the metropolitan area of Turin, Chieri, related to the old part of the town (analysis on an urban scale) (Garzino, 2016).

The category of “buildings with arches overlooking a square” considered in this new refinement of the method, meets the criteria highlighted (cit 1) and the considerations that emerge can be made general, albeit needing to locally specify, case by case, the singularities and peculiarities that Italian historicised environments present constantly. It contains structural types and diagrams which can be applied extensively in urban centres, with more evident common specifications for the cases of a vast area in the towns adjacent to that considered.

The medieval piazza Vecchia, now piazza Santarosa, presents a continuous curtain façade (tower houses which date back to the 13th and 14th centuries), much of which has been restored, and some details and architectural highlights.

Built on previously existing constructions, it has an irregular and elongated plan, following numerous transformations and additions to the buildings. The origin of the urban layout dates back to the beginning of the 13th century, when Savigliano became a free commune and the noble families that moved to live there set-

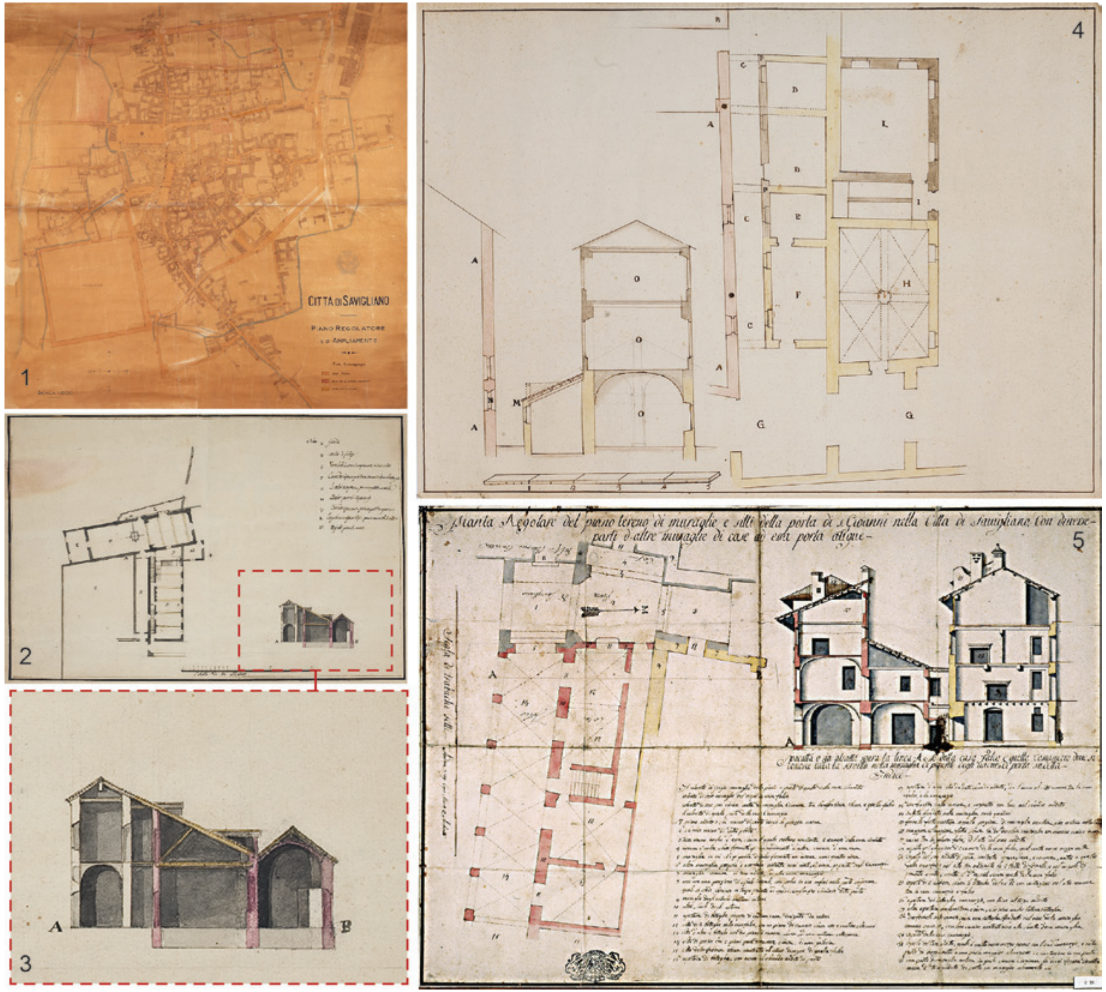

Fig. 14. Archive analysis for the survey of the construction types and original load-bearing structures (1. Regulatory and expansion plan - first half of 20th century. 2 – Plan and prospect of the “filanda del Cristo”, then Cinea Ritz – first quarter of the 19th century. 3 – Enlargement of section 4 – Plan and prospect of three-storey house with lean-to, 18th century. 5 – Regular plan of the ground floor of walls of the gate of S. Giovanni of the City of Savigliano, with different parts of other walls of houses next to it. With a view of the Falco and Canavero houses, 18th century.) (edited by V. Donato and M.M. Bocconcino)

Fig. 15. Overview relative to the case study of Piazza di Santarosa – Savigliano: resistant system, geometric conformation and conditions relating to the single building and interaction between adjacent buildings forming a standardised aggregate (ref. Tab. 1 – 15). (edited by V. Donato)

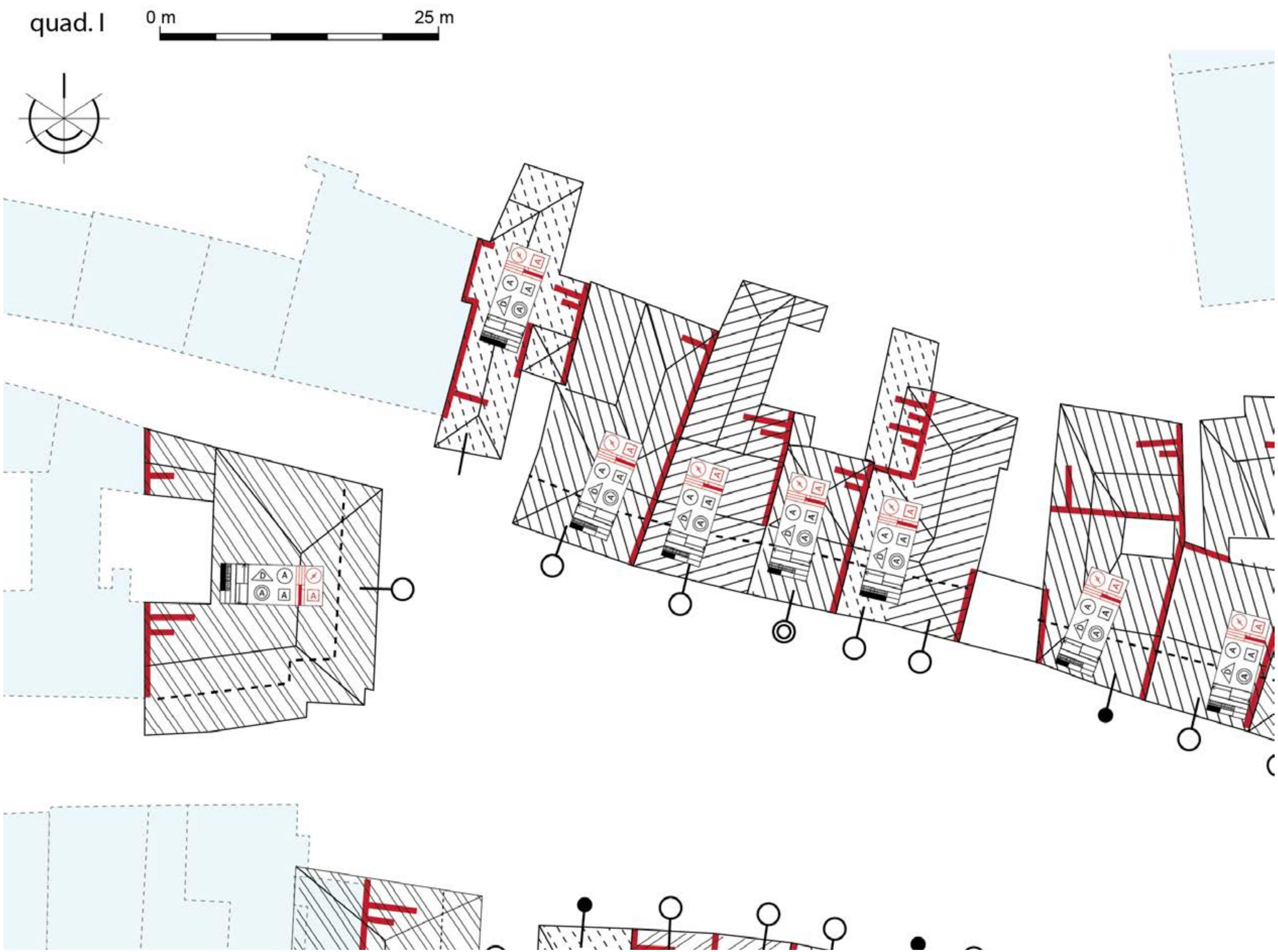

Fig. 16. Enlargement of quadrant I: case study of Piazza di Santarosa (ref. Fig. 15) - (edited by V. Donato)

Fig. 17. Enlargement of quadrant II: case study of Piazza di Santarosa (ref. Fig. 15) - (edited by V. Donato)

Fig. 18. Enlargement of quadrant III: case study of Piazza di Santarosa (ref. Fig. 15) - (edited by V. Donato)

Fig. 19. Enlargement of quadrant IV: case study of Piazza di Santarosa (ref. Fig. 15) - (edited by V. Donato)

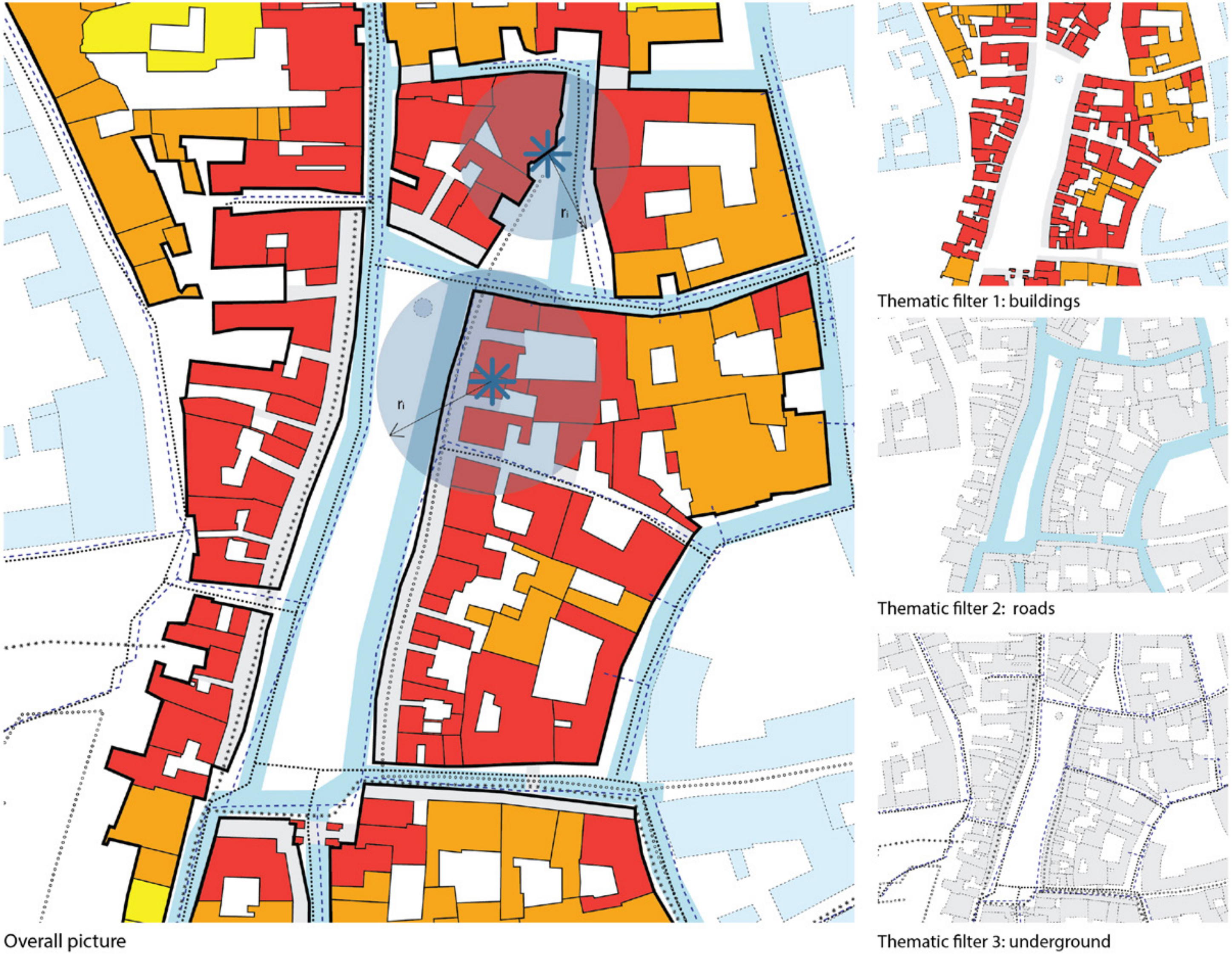

Fig. 20. Summary of the application relating to the seismic vulnerability on an urban scale (ref. Tab. 16-21) - (edited by V. Donato)

tled in the outer area, building "strongholds" facing the square. There were no archways at the time, the buildings developed on two storeys and the ground floor was occupied by shops.
As of 1470, a municipal order gave the go-ahead for a progressive rearrangement of the square, which had become the administrative and economic centre of the town. New buildings were erected in front of the existing façades, creating the existing arched space, reducing the area of the square; part of the pre-existing façades can still be seen on the interior walls of the houses.
During the 15th century, the Municipal Council carried out restoration work, regulated the market and the advancement of the houses, opening the arches and building new prospects.
Other transformations tool place in the 17th century, especially with the construction of loggias, and in the 19th and 20th centuries, when there was a tendency to standardise the façades of the buildings.
Beginning in the 1990s, the area underwent important architectural recovery operations involving the buildings and pedestrian area. The square is now entirely surrounded by arches. With covered public spaces dedicated to trade, socialising and leisure activities.
The transformations and changes that have taken place on the buildings in the square have determined the methods and procedures of analysis, as well as the critical considerations for developments subsequent to the research, particularly relating to the quality of the expeditious survey and its efficiency (fig. 14).
The application of the method of investigation requires on-site and archive, bibliographic and iconographic data collection activities in compliance with the traditional method that sustains the urban survey. Its final aim is related, as mentioned, to the identification of the structuring elements for the seismic vulnerability analysis via deductions triggered by the geometric and topological identification of the elements.
For the case study in question, the operational flow regarded:

- identification of a first significant case study for the category of "buildings with arches overlooking a square";
- critical pre-comprehension of the case study:
- sourcing of bibliographic and iconographic references;
- identification of historical stratifications at urban and construction plan level;
- basic cartographic analysis (municipal technical map as at the last available update);
- on-site inspections aimed at verification
- drawing of ground level plans;
- association of the cognitive elements of the survey;
- application of the graphic support code.

This first operational exploration attempted to establish the reference framework, with a first applicative draft; in the conclusive considerations we attempt to prefigure the subsequent development of the research actions.

CONCLUSIONI
(G. GARZINO)

The research carried out shows how visual communication is the form of language to be preferred to represent dimensions that are not of a specifically geometric nature, so much so that it is often much more effective than alphanumeric language. The latter is actually ineffective in the case of the vision based on spatial signs that are stable over time. In this context, histograms, Cartesian charts, pie charts, etc. are useful but you have to know how to transfer them using an appropriate language and drop them into the map context. The research carried out falls under the full autonomy of symbolic notation with respect to iconic representation and is characterized in this sense by a continuous tension towards the furthering of knowledge Of course, within the scope of representative disciplines, the introduction, through drawing, of conjectural notations, has always marked the shift from documentary-type representation to one imprinted according to an intellectual and speculative knowledge.The experience pursued, also through the practical application of the case study related to piazza Santarosa in Savigliano, shows how graphic language is not just a vehicle, but becomes a player of knowledge. It weaves the web of conceptualization right from the acquisition of the data and becomes the perpetrator of a selective, additive and corrective synthesis, but also of a formative, systemic and incorporative nature (Nunziata, 2016). In this way, the knowledge of the space is accomplished by dimensions and extra-subjective characters, and cartography assumes scientific rigor. It becomes possible to build a territory where space is organized according to principles of knowledge, and the more indirect this knowledge, the more important it is.
During the research, a graphic language was set up based on a representative coding capable of extending beyond the physical range visible by the eye, considered as a summary of the knowledge gained through direct experience (Greek autopsy, meaning the ability to see directly with our own eyes), and mediated experience (akuein, meaning the acquisition of data from indirect sources), thus gaining access to a deeper level of knowledge.

ISSN 1828-5961

NOTE

(1) Cf. Study in preparation for the processing of instruments for application of seismic regulations to the historical settlements presented at the General Assembly of the Higher Council of Public Works on 02/04/2012.

(2) As regards monumental buildings, please see a subsequent contribution. The P.C.M. Directive of the 9th of February 2011 constitutes an analytical scientific and technical reflection on the matter, as much in methodological terms and in relation to historical-critical matters.

(3) The minimum unit of study is identified as every construction cell that makes up the urban fabric subject to study and it is agreed that the definition of construction cell can be applied to an element originally built on a single lot or a unified combination of several lots, equipped with a specific functional motivation and still recognisable. Cf. Coppo Secondino, (1994)

(4) The lower the score assigned the less vulnerable the building. The updated assessment card, consisting of fifteen assessment factors, sets the maximum vulnerability score that can be achieved as 515.25 points. Cf. Formisano et. al. 2011. cit., Table 1.

(5) Cf. Study in preparation for the processing of instruments for application of seismic regulations to the historical settlements, work cit, p. 7.

(6) Before the Higher Council of Public Works formalised the lines of address mentioned, several researches were carried out in this sense. For example, after the seism in 2009, a cooperation was set-up between the National Urbanistic Institute - INU and the Universities of Chieti-Pescara and l'Aquila, which led to the creation of the method of investigation applied for the study of Poggio Picenze and published in "Poggio Picenze INTERLAB – Università abruzzesi per il terremoto", Aracneditrice, Rome, 2010.

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