

# WP 1 – BE and SUOD: State of the Art (SoA), risks and human behavior

**T1.1 - SoA-based definition and characterization of BE as network of buildings, infrastructures, connecting space in reference to SUOD occurrence and users' typologies**

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## Abstract

The present report is focused on the classification of BE according to building-related typological and SUOD features. Based on the identification of the criteria for BE risk-related classification introduced in the previous working report (D1.1.1) the research activity focuses on the definition of a form for direct survey of open spaces of the BE. Since the wide variety of construction culture of the Italian territory, the research activity includes a process for validates the suitability of the form, applying it on eight case studies of Areal Space (AS): Caldarola (MC), Matera (MT), Narni (TR), Ostuni (BR), Rieti (RI), San Gemini (TR), San Giovanni in Persiceto (BO), and Trani (BA). After the validation activity an optimize form is presented. Moreover, in order to choose three representative case studies for the next phases of the research, the report analyzes and compares the collected data on the eight ASs and selects the most appropriate based on specific parameters. The report presents the three selected case studies in appendix (i.e. Caldarola, Narni, and Matera), describes their specific Built Environment and the related SUODs risk analysis using the form previously defined.

## Keywords

SUOD; disaster; risk; expeditious survey form; morphological system; Building Environment (BE); Open Space in the BE; Areal Spaces (AS).

## Approvals

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## 1. Introduction: identification of BE form-parameters according to selected criteria risk-informed

Disaster categorizations, such as official disaster statistics, are provided in the scientific literature from research institutions, statistical data collection agencies (CRED-EMDAT and START), international organizations (UNDP, UNISDR, the World Bank, WHO).

The most common classification divides disasters according to the cause identifying Natural Disasters on one hand and Technological / human-made (anthropic) disasters on the other one (CRED 2018; Centre for Research on the Epidemiology of Disasters (CRED) 2019). The Natural disasters are defined dividing them on the basis of the natural element that can cause it: Geophysical, Meteorological, Hydrological, Climatological, Biological and Extraterrestrial. The human-made indeed are divided into: Industrial accident, Transport accident, Terrorist attack and Miscellaneous accident.

Disasters could be classified also on consequences timing (PreventionWeb - UNDRR; WHO 2014): on one hand the Sudden-onset disasters (SUOD) are both “natural” disasters (e.g. earthquakes, hurricanes, floods) and man-made or “complex” disasters (e.g. sudden conflict situations arising from varied political factors), for which there is little or no warning; on the other one Slow-onset disaster (SLOD) are the ones that take a long time to produce emergency conditions, for instance natural disasters such as drought or socio-economic decline, which are normally accompanied by early warning signs.

Both of these kinds of disasters can generate significative and different impacts on the Built Environment. In this report SUODs are considered in detail and them are defined as Earthquake, Mass Movement (dry), Volcanic activity, Storm, Extreme temperature, Flood, Landslide, Wildfire, Industrial accident, Transport accident, Terrorist attack and Miscellaneous accident.

The complexity of BE located in disaster-prone areas means considering the interactions between its site-connected (i.e. site characteristics), physical (i.e., buildings, urban fabric and paths networks), human (i.e., hosted population), organizational (i.e., spaces planning and management also in ordinary conditions), intangible (i.e., cultural and social), population-based (i.e. number and features of the exposed individuals) factors and the type of disaster which can occur into it, so as to assess the possible risk levels and to determine which solutions should be adopted to mitigate the disaster impact (Spence 2004; Moore 2008; Kappes et al. 2012; Boshier 2014; Cerè et al. 2017).

In this context, the main attention on resilience and DRR research is focused on buildings, infrastructure and social community, as highlighted by recent literature review works (Koren e Rus 2019). Koren and Rus analyzed that there are some research activities focused on the role of open spaces in building resilience,

even if only a significantly reduced part of the analyzed studies deals with this issue (3% on 180 studies analyzed in total).

Today's BEs are the result, on the one hand, of deliberate and coordinated human effort and, on the other hand, of a spontaneous evolution, especially in references to those included in urban area. In fact, in such conditions, the coordination between the BEs (developed over time and spaces) is strictly combined to the overall system features. Hence, in such context, the shape of the BE and of the overall city structure, as well as of its components, have been studied from different points of view. For the aims of this research, the most suitable approaches seem to be the typological and the historical-geographical one. The first is rooted principally in the work of Saverio Muratori and Gianfranco Caniggia. The approach they developed seeks to inform their architectural and urban proposals with an understanding of the built environment by examining its detailed structure and the historical process of its formation (Caniggia and Maffei 2001).

According to the classification elaborated from (Koren and Rus 2019), this research focuses on built-up open spaces, by identifying, among these, two main morphological systems (see D 1.1.1, § 3.3.1): the areal spaces and linear spaces.

- **AREAL SPACES (AS):** open space or partially occupied by urban furniture or historical elements, enclosed partially or completely by constructions, with various urban functions, at the intersection of streets or along the route of a main road; it can have monumental character and to be indicated with a particular denomination (i.e. squares, park).
- **LINEAR SPACES (LS):** space of public use, delimited and mostly equipped with roadbed and flooring, intended for the passage and transit of people and vehicles (i.e. street, road, path).

The first element of BE open space, Areal Spaces (AS) could be identified in square, as a space that expresses the habitat of the city, a place of meeting, discussion and aggregation. From the urban point of view, the square can be defined as a free space, limited in whole or in part by buildings. The shape, the location, the function and the aesthetic expression of the square historically follow the urban evolution, with the main functions of place of passage, place of utility or place of the stay, functions that can also be combined or entirely grouped. The importance of the square further increases as urban space if it includes civil or religious buildings that are part of the monumental heritage.

According to the classifications present in the literature (also in reference to case studies), numerous morphological configurations of the open space emerged. For the purposes of the relationship with SUODs, these configurations can be traced back to some main types. 6 main categories can be identified by setting up the spatial classification proposed by Mandolesi (Mandolesi e Ferrero 2001) and the historical-procedural one proposed by Caniggia Maffei (Caniggia e Maffei 2001), and comparing them with the criteria for expeditious evaluation of urban vulnerability (Oliveri (a cura di) 2004) and the emergency limit condition (CLE) (Italian technical commission for seismic micro-zoning 2014). The nomenclature of these six categories are: Tending to quadrangle, Elongated with parallel sides, Tending to triangular and funnel-shaped, Trapezoidal and polygonal, Tending to circular, ovoid and ellipsoid, Composite.

The second element are the Linear Spaces (LS), identifiable as routes and roads. Streets are often the most vital public spaces in cities. They are critical arteries for transporting goods and people, but they are also the places where we live, work, play and interact. They play a fundamental role in the public life of cities and communities (Forbes 1999).

The main types of linear BE are elaborated starting from the Region of Hamilton-Wentworth Classification System analysed by Forbes (Forbes 1999). In this classification the types reported are 5: Passage, Traditional Street, Main Street, Gateway, Mobility Street. This classification system is the initial part of a wider



transportation study to develop a transportation plan that would be supportive of desired land uses and economic initiatives. The importance of this study is related to a new recognition that the street is a public space performing many functions and serving many users. Starting from their study, the classification proposed in this report considers 4 main types, specifically related to the BE of historical towns, where “gateways” and “mobility street” can be joint in a single type, excluding street section with more than 4 lanes of travel, for the aim of the proposed research. The types of LS in BE that are considered are: Passage, Traditional Street, Main Street, Gateway / Mobility Street.

The present work aims to define an operative tool to carry out direct survey of open spaces in urban context. The literature in the field of expedition survey form are taken into account. Works as CARTIS form (Italian technical commission for seismic micro-zoning 2014), CLE form or Aedes form, are examples of the importance of classification in analytical process whatever is the objective of the study: structural element, vulnerability of building, urban space or open spaces. The study of different survey forms, even if connected to different fields of research, is deeply useful to develop new forms connected to innovative spheres of analysis. The purpose of this report is to elaborate a survey form to classify the open spaces in Built Environment (BE), to identify representative case studies on which evaluate risk-mitigation strategies in the BE. In order to achieve the above objective, the research unit define a preliminary survey form, based on the criteria introduced in D1.1.1 at §3.3.2, validate it on eight case studies and propose a revised version of the form. The final survey form is then applied to classify eight selected areal spaces and to identify among those three representatives case studies.

## 2. Methodology

The survey form is structured in a preliminary version, validated on eight case studies and then proposed in a revised version aimed to classify the open spaces in Built Environment (BE). The final survey form is then applied to classify eight selected areal spaces and to identify among those three representatives case studies. The workflow of this research report is represented in Figure 1.

The criteria behind the preliminary form – defined in the previous part of the research (see “Criteria for BE Classification according to Building-related typological and SUOD features”, §3.3.2 in D1.1.1) – are the theoretical base to select and develop the parameters to include in the survey form.

According to the main area presented in the “Criteria for BE classification”, the form is structured in five thematic sections, each one sub-divided to report specific characteristics of open space in the BE (§2.2). Open-ended questions are avoided as far as possible, in order to prevent insufficient and inadequate answers. On the contrary, closed-ended questions and multiple-choice questions are included to facilitate the following comparative analysis of the results.

Before approving the form, it is necessary to evaluate its appropriateness by applying it to different case studies (§2.3). The validation process tests the preliminary form on a limited sample of eight areal spaces: the main squares of Caldarola (MC), Matera (MT), Narni (TR), Ostuni (BR), Rieti (RI), San Gemini (TR), San Giovanni in Persiceto (BO), and Trani (BA) (see the complete forms in §9). Since the wide variety of construction culture of the Italian territory, it is important to test the form on a sample as much representative as possible, checking whether the whole peculiarities of each case study are clearly included and described. The main goal is to understand if the criteria include in the form are suitable to report the whole aspects of open space characteristics and detect any potential misunderstanding in the interpretation. The research unit filled out the form for the eight case studies, reporting for each one significant comment.

The considerations on each case study are comparative summarized and described in Table 7, distinguishing the requests to clarify definitions and the suggestions to add, remove or modify certain parameters. The whole comments are critical analyze in order to reject or accept them (§2.4; Table 8).

The final form is defined in §2.5, updating the selected parameters and including the required new definitions, and then applied again to the eight mentioned case studies (§3). Accomplishing a parametric analysis of the data collected, it is possible to identify the three more relevant case studies. The values are evaluated as sum of single parameters. Then an analyse of the 25% percentile has been conducted and the case studies will be choice for values lower of 25% percentile and greater of 75% percentile, considered interesting because they represent a greater or lesser complexity within the sample.

BE S²ECURE - DRAFT

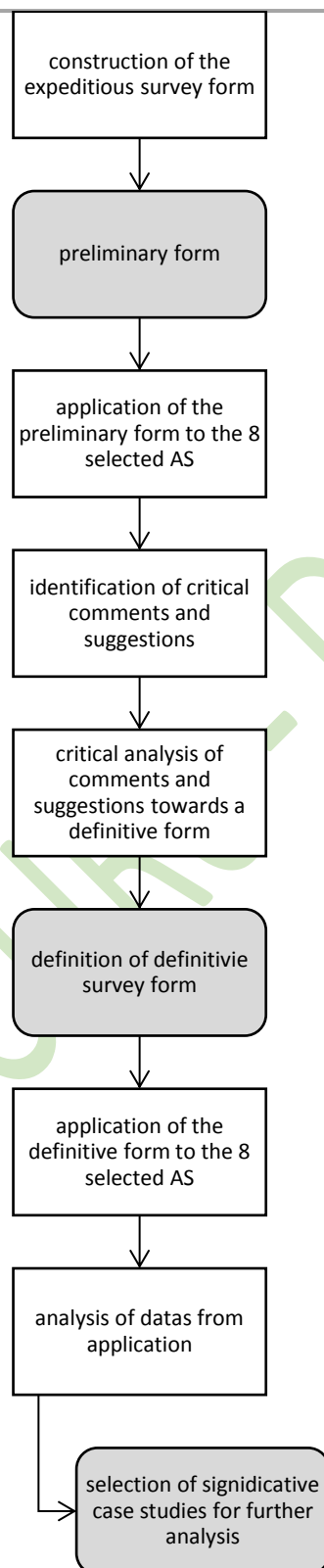


Figure 1: Workflow of research report methodology.

## 2.1 Proposition of a preliminary survey form for open spaces in the BE

In the previous deliverable two morphological systems of open space in the BE emerged as most representative for the compact historic town: Areal Space (AS) and Linear Space (LS). The investigation of the criteria for BE classification concerns the features of the historical urban centres. The macro areas identified are five (see D1.1.1, Table 5).

**Morphology:** identification of Morphological System under examination (Areal Space or Linear Space) and recording of dimensional aspects;

**Geometric-spatial characteristics:** identification of the characteristics of the frontier (the delimitation of the open space) and main elements contained in the open space;

**Constructive characteristics:** definition of the constructive characters both of the BE and the elements characterizing the public space;

**Characteristics of use:** description of space occupation (temporal and spatial);

**Environmental characteristics:** definition of the context in which the public space is located from an environmental, climatic, infrastructural and hazard point of view.

Table 1: Section 1 of the preliminary survey form for the identification of the morphological configuration.

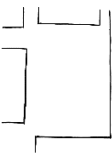

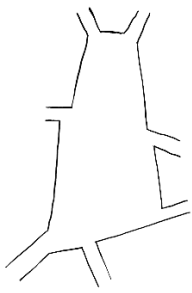
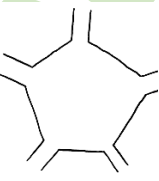
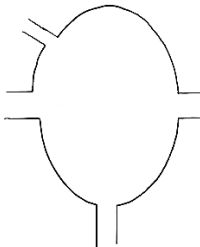
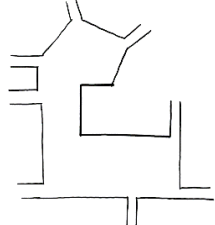
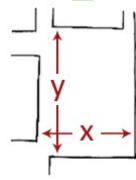
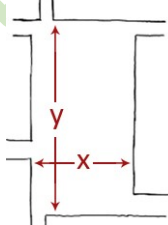
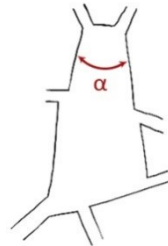
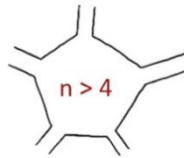
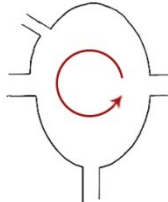

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					

Table 2: Geometrical criteria for choosing the type of AS.

Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					

These criteria drive to the definition of a preliminary form for direct survey of open space in the BE. Focusing in particular on Areal Space, in the present section the preliminary survey form is presented and each parameter defined.

The Section 1 (Table 1) of the form provides for the identification of the main type of open space in the BE. Comparing the numerous morphological configurations of the open space emerged from the literature with specific SUOD characteristics, it is proposed six categories for AS, defined as follow (see also Table 2).

- **Tending to quadrangle:** open space without a prevalent dimension in the planimetric development ( $X \approx Y$ ; Table 2). The effect is the proximity of evacuees to the emergency escape routes. For this reason, we consider the tending to quadrangle and the regular shapes in only one category. Ratio between dimensions is between 1 and  $2/3$ ;
- **Elongated with parallel sides:** open space with a prevalent dimension in the planimetric development and sides that can be considered parallel ( $Y > X$ ; Table 2). There is no constant distance between the evacuators in the square and the escape routes. Ratio between dimensions (minor over major) is less than  $2/3$ ;
- **Tending to triangular and funnel-shaped:** open space characterised by the presence an obtuse angle ( $\alpha$ ; Table 2) or shape similar to triangular geometry. Comparing to Mandolesi, we consider the triangular and the funnel-shaped in one type because they both has the problem of the funnel effect that could lead to a concentration of the evacuants in the direction of narrowing. Furthermore, there is the problem of overturning fronts overlapping where there is an acute angle in plan;
- **Trapezoidal and polygonal:** open space characterised by polygonal shapes with trapezoidal geometry, or with a number of regular borders greater than 4 ( $n > 4$ ; Table 2). This category represents particularly articulated open spaces with a centric conformation in which we can have a multitude of escape routes;
- **Tending to circular, ovoid and ellipsoid:** circular, ellipsoidal or ovoid open space that differ from previous category because they do not have polygonal front;
- **Composite:** complex structures that are configured as a composition of the previous types.

Table 3: Section 2 of the preliminary survey form for the recording of geometric and spatial characteristics.

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE		
parameters		
frontier	<input type="checkbox"/>	SA (Structural Aggregates)
	<input type="checkbox"/>	CBF (Continuous Built Front)
	<input type="checkbox"/>	SU <sub>i</sub> (Interferent Structural Unit)
	<input type="checkbox"/>	Access
	<input type="checkbox"/>	Special building
	<input type="checkbox"/>	Town walls
	<input type="checkbox"/>	Porticoes
	<input type="checkbox"/>	Water
	<input type="checkbox"/>	Quote difference/containment wall
	<input type="checkbox"/>	Green area
	<input type="checkbox"/>	
content	<input type="checkbox"/>	Special building
	<input type="checkbox"/>	Canopy
	<input type="checkbox"/>	Fontaine
	<input type="checkbox"/>	Monuments (obelisk)

<input type="checkbox"/>	Slope/Quote difference
<input type="checkbox"/>	Green area
<input type="checkbox"/>	Underground parking
<input type="checkbox"/>	Underground cavities

The Section 2 (Table 3) defines the geometric and spatial characteristics of the open space in the BE, identifying type and peculiarities of frontier that enclose it and the elements present into it. Regarding the frontier: four parameters are identified to define the built fronts, i.e. the number of Continuous Built Fronts (CBF), Interferent Structural Units ( $SU_i$ ), Structural Aggregates (SA), and the presence of special buildings; other parameters are introduced to characterize different types of fronts, such as town walls, porticoes, water and green area; two further parameters are introduced to include other features of the space, i.e. the presence of access and quote differences. All the parameters in Table 3 for the frontier are defined as follow.

#### Frontier:

- **SA (Structural Aggregates):** By structural aggregate we mean a not necessarily homogeneous set of buildings (structural units), placed in substantial contiguity (Italian technical commission for seismic micro-zoning 2014);
- **CBF (Continuous Built Front):** Front between 2 access; to consider 2 different CBF in case of deviation from straightness about  $90^\circ$  ( $\pm 15^\circ$ );
- **$SU_i$  (Interferent Structural Unit):** Similarly to what (Italian technical commission for seismic micro-zoning 2014) defines for Interfering Structural Aggregate, the Interfering Structural Unit ( $US_i$ ) size is defined in the research. Herein a Structural Unit is considered interfering when its maximum height ( $H$ ) is greater than the distance ( $d$ ) between the base of the aggregate at the measuring point of  $H$  and the perimeter of the AS. A structural unit in the frontier of AS ( $d=0$ ) is always interfering, unless an insurmountable respect zone is defined within the surrounding area and it verifies the above condition ( $H > d$ ).

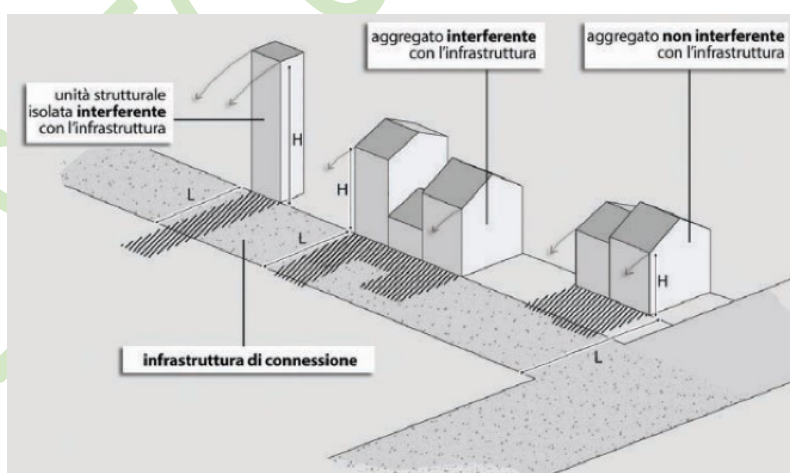


Figure 1 Structural Aggregates (Aggregati strutturali, AS) and Interferent Structural Unit (unità strutturali interferenti,  $USI$ ) (Italian technical commission for seismic micro-zoning 2014).



- **Access:** intersection between path and open space. It can be covered (strut, vault or slab passage, etc) or uncovered.
- **Special building:** By special building we mean all those buildings that stand out from the built context and constitute the emerging elements of urban qualification. In this research, the terms "Special Building" is linked to the concept of "particular, singular, of uncommon quality", that is more adherent to the meaning required in identifying emergencies and monuments (Maffei 2011). It is quite different from "Specialist Building" that rather has a link to the function present inside of the building. Examples are buildings, churches, convents, theaters, hospitals, etc. The buildings that have been designed by the architect are included in the special buildings because they are in contrast with the rest of the residential construction, which was for the most part directly built by the user without any plans until the end of the eighteenth century, and have a significative evolution process diversified from the ordinary buildings (Maffei 2011);
- **Town walls:** Historic line of walls that encircled a town and normally dates back to the Roman or Middle Ages;
- **Porticoes:** a covered walkway, in the form of vault supported by columns or pillars, at the ground floor of a building;
- **Water:** In this parameter we specify if one or more frontier of AS has a hydrographic element (lake, sea, ocean, river...);
- **High difference / containment wall:** presence of views, overhangs, cliffs and difference in altitude in general between AS and a generic lower altitude / presence of walls against the ground for containing parts of cities at a higher altitude than the AS;
- **Green area:** Presence of parks, gardens, orchards etc. as frontier of the AS.

#### Content:

- **Special building:** see "special building" (frontier);
- **Canopy:** Man made covering;
- **Fontaine:** Artificial water source with one or more jets intended to regulate the outflow of water from the source or from the aqueduct outdoors;
- **Monuments (obelisk):** sculpture, or decorative architecture, which is placed in public areas to celebrate illustrious people or in memory of glorious events;
- **Slope / High difference:** Generic difference in altitude as slope, terraced steps, hole, etc;
- **Green area:** Presence of flower beds, planters, plantings, etc;
- **Underground parking:** man made underground space for vehicles;
- **Underground cavities:** natural or man-made underground space (i.e. quarry).

Table 4: Section 3 of the preliminary survey form documenting of constructive characteristics.

SECTION 3: CONSTRUCTIVE CHARACTERISTICS			
parameters			
frontier	Homogeneity of built environment age		Yes
			No
	Homogeneity of constructive techniques		Yes
			No
content	Pavement materials and finishing		Slick
			Compact

	Urban furniture/obstacles	<input type="checkbox"/>	Disjointed
		<input type="checkbox"/>	Other: .....
		<input type="checkbox"/>	Benches
		<input type="checkbox"/>	Bumps
		<input type="checkbox"/>	Poles
		<input type="checkbox"/>	Flowerpot
		<input type="checkbox"/>	Railings
		<input type="checkbox"/>	Bike Rack
		<input type="checkbox"/>	Other: .....

The third section (Table 4) expresses the main construction characteristic of the frontier and content of the public space in term of their effect on the safety. A correlation between change in construction technique and vulnerability could be established as describe in the (D'Amico and Currà 2018).

#### Frontier:

- **Homogeneity of built environment age:** specify if the SUi facing the AS were built in the same historical period;
- **Homogeneity of constructive techniques:** specify if the buildings facing the AS were built with the same construction techniques.

#### Content:

- **Pavement materials and finishing:** Characteristics of materials used for AS flooring, specifying if they are slick, compact, disjointed, etc;
- **Urban furniture/obstacles:** Presence of diffuse obstacles in the AS that can interfere with the escape of people in an emergency. Examples could be benches, bumps, poles, flowerpot, railings, bike rack, etc.

Table 5: Section 4 of the preliminary survey form reporting the characteristics of use.

SECTION 4: CHARACTERISTICS OF USE parameters			
	Daily crowding	<input type="checkbox"/>	Morning (6:00-12:00)
		<input type="checkbox"/>	Afternoon (12:00-18:00)
		<input type="checkbox"/>	Evening (18:00-24:00)
		<input type="checkbox"/>	Night (24:00-6:00)
		<input type="checkbox"/>	.....
	Special use	<input type="checkbox"/>	Concerts
		<input type="checkbox"/>	Theater
		<input type="checkbox"/>	Festivals
		<input type="checkbox"/>	Parking
		<input type="checkbox"/>	Strategic buildings
	Accessible to	<input type="checkbox"/>	Other: .....
		<input type="checkbox"/>	Vehicle
		<input type="checkbox"/>	Pedestrian

		<input type="checkbox"/>	Bike
		<input type="checkbox"/>	Other: .....
	Vulnerable users		Tourists, aged people, children
	Sensitive targets to terroristic attack	<input type="checkbox"/>	Strategic buildings
		<input type="checkbox"/>	Significative people
		<input type="checkbox"/>	Other: .....

The fourth section (Table 5), related to the Characteristics of Use, regards users of the public space, describing the daily crowding, the vehicular and pedestrian accessibility and the type of users in term of vulnerability and risk.

- **Daily crowding:** People distribution in a day (Morning (6:00-12:00); Afternoon (12:00-18:00); Evening (18:00-24:00); Night (24:00-6:00)) depending on activities hosted in AS and by the facing buildings in AS;
- **Crowding index:** Ratio between the maximum number of people in the AS and the area of the AS itself cleared of obstacles [pp/m²];
- **Special use:** Possibility of special uses of the AS, also following the expansion with dehors of frontier buildings;
- **Accessible to:** Define the categories of vehicles or people who can access the AS;
- **Vulnerable users:** Presence of vulnerable users due to age, political, economic, etc;
- **Sensitive targets to terroristic attack:** Presence of strategic buildings and sensitive people who may be subject to terrorist attack.

Table 6: Section 5 of the preliminary survey form describing the environmental characteristics.

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Hazard assessment	<input type="checkbox"/> Earthquake <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood

		<input type="checkbox"/>	Landslide
		<input type="checkbox"/>	Wildfire
		<input type="checkbox"/>	Chemical
		<input type="checkbox"/>	Explosion/fire
		<input type="checkbox"/>	Transport accident
		<input type="checkbox"/>	Terrorist attack
		<input type="checkbox"/>	Miscellaneous accident

The fifth section (The fourth section (Table 5), related to the Characteristics of Use, regards users of the public space, describing the daily crowding, the vehicular and pedestrian accessibility and the type of users in term of vulnerability and risk.

- **Daily crowding:** People distribution in a day (Morning (6:00-12:00); Afternoon (12:00-18:00); Evening (18:00-24:00); Night (24:00-6:00)) depending on activities hosted in AS and by the facing buildings in AS;
- **Crowding index:** Ratio between the maximum number of people in the AS and the area of the AS itself cleared of obstacles [pp/m<sup>2</sup>];
- **Special use:** Possibility of special uses of the AS, also following the expansion with dehors of frontier buildings;
- **Accessible to:** Define the categories of vehicles or people who can access the AS;
- **Vulnerable users:** Presence of vulnerable users due to age, political, economic, etc;
- **Sensitive targets to terroristic attack:** Presence of strategic buildings and sensitive people who may be subject to terrorist attack.

Table 6) concerns the issues related to the context of the open space in the BE, considering the climatic zone, the type of infrastructures and the possible interactions of the disasters.

- **Climate classification:** identification of the climatic zone by DPR 412/1993;
- **Road network:** specify if the AS in the confluence of a particular road network;
- **Infrastructural network:** presence of infrastructure that can interfere with BE during hazard, as primary urbanization, uncovered pipes, high tension wire, etc;
- **Underground cavities:** see Characteristics of Geometry and Space, Content;
- **Hazard assessment:** risk assessment according to the national classification for each type of disaster (i.e. Seismic classification of the Italian territory for earthquakes; Alert levels for volcanoes activity; ISPRA's Hydraulic Hazard for floods and Hydrogeological Asset Plans for landslide; and Tsunami risk according to Italian National Institute of Geophysics and Volcanology).

## 2.2 Validation process of the preliminary survey form for Areal open space in the BE

In this section, the preliminary survey form is applied to eight case studies, choosing Areal Spaces (AS) as different as possible in term of geographic location, type of urban fabric, extension, and settlement size. The selected AS are: Piazza Vittorio Emanuele II in Caldarola (MC), Piazza Vittorio Emanuele in Matera (MT), Piazza dei Priori in Narni (TR), Piazza della Libertà in Ostuni (BR), Piazza Vittorio Emanuele II in Rieti (RI), Piazza San Francesco in San Gemini (TR), Piazza del Popolo in San Giovanni in Persiceto (BO), and Piazza Re Manfredi in Trani (BA) (see § 10). For each one, the research unit reported significant comments to suggest modifications in the parameters, whose results were analyzed in Table 7. The proposed modifications allow to upgrade the preliminary form to the definitive one, presented in section §2.5.

The Table 7 records and compares the whole comments and suggestions that was highlighted applying the form to the mentioned case studies. As it shown:

- **Section 1 “Main Type”:** only the case study of Ostuni indicates an uncertainty about the category;
- **Section 2 “Characteristics of Geometry and Space”:**
  - **Frontier:** better define the parameters “Structural aggregates”, “Access” and “Quote difference/containment wall”;
  - **Content:** better define the parameter “Slope/quote difference”; add “Dehors” as sub-parameter; add “archaeological sites” as parameter; add spots to report dimension data (i.e. surface, perimeter etc) of the AS;
- **Section 3 “Constructive Characteristics”:**
  - **Frontier:** add a row to include “Urban furniture/obstacle” in the frontier;
  - **Content:** reorganize the “Pavement materials and finishing” parameters, introducing different sub-parameter for material, finishing, and lying of the pavement;
- **Section 4 “Characteristics of Use”:** the observations in this section show that is necessary to add a row to identify the “Strategic buildings” and “Sight” for tourism; reorganize the section “Sensitive target to terroristic attack” to better define the sub-parameter; add a row to clarify the uses of public buildings along the frontier; add a sub-parameter for “electric scooter” in “Accessible to”; remove “Crowding index” parameter.
- **Section 5 “Environmental Characteristic”:** it is suggested to add spots to report also seismic, hydrogeological, flood, volcanic risk classification; redundancy of the “underground cavities”.

Table 7: Comments and suggestion on sections of the validation form.

	SECTION 1 MAIN TYPES	SECTION 2 CHARACT. OF GEOMETRY AND SPACE	SECTION 3 CONSTRUCTIVE CHARACTERISTICS	SECTION 4 CHARACTERISTICS OF USE	SECTION 5 ENVIR. CHARACT.
CALDAROLA					
Piazza Vittorio Emanuele II	The example confirms the correctness of the form: all the aspects characterizing Vittorio Emanuele II square in Caldarola were already considered.				
MATERA					
Piazza Vittorio Emanuele	x	<b>Frontier:</b> - Question: should <u>panoramic balcony</u> and <u>stairs</u> be included in <i>Quote differences</i> ?  <b>Content:</b> - Suggestion: a row should be added to include <u>dehors</u> (temporary expansions of shops on the square); - <i>Quote differences</i> : Should <u>stairs</u> be included here?	<b>Frontier:</b> - Suggestion: a row should be added to include <i>Urban furniture/obstacle</i> in the frontier. The presence of panoramic balcony, stairs and barriers for vehicles determine the presence of special urban furniture also along the frontiers (see also Trani).  <b>Content:</b> - Suggestion: a row should be added to include <i>Archaeological sites</i> in the frontier.	- Suggestion: a row should be added to include "sight" for tourism. - Suggestion: a row should be added to indicate the <u>uses related to the public buildings</u> that are along the frontier; - Suggestion: a row should be added to include "electric scooters" in <i>Accessible to</i> ;	x
NARNI					
Piazza dei Priori	x	<b>Frontier:</b> - Suggestion: in the parameter <i>Structural aggregates</i> should be indicated if there are any isolated blocks; - Suggestion: the parameter access should be clearer. <b>Content:</b> - Suggestion: some slots should be added to report the surface of the AS (m2), the perimeter (m), the length of CBF, the access width; - Suggestion: for the parameter <i>Special building</i> different type of structure could be better	<b>Frontier:</b> - Note: the parameter <i>Homogeneity of built environment age</i> and <i>Homogeneity of constructive techniques</i> seems too general to describe the historical evolution of the AS. <b>Content:</b> - Suggestion: for Pavement materials and finishing we should enter just the objective data of the type of flooring (materials and laying i.e. cobblestones, slabs ...) and consider a separate study on the effects of the material, without listing them directly on the form.	- Suggestion: the "Crowding index" parameter seems not effective, it is suggested to remove.	- Suggestion: some rows should be added to include seismic, hydrogeological, flood, volcanic risk classification (not only climatic one); - Note: the parameter <i>Underground cavities</i> is both in Environm. Charact and Charact. Of geometry and space.



described in term of dimension.

(see also San Gemini)

## OSTUNI

### Piazza della Libertà

Complex example: should it be considered *composite* or *triangle* type?

#### Frontier:

- Question: should stairs be included in *Quote differences*?

#### Content:

- Suggestion: a row should be added to include dehors (temporary expansions of shops on the square);  
- *Quote differences*: Should stairs be included here?

#### Frontier:

- Suggestion: a row should be added to include *Urban furniture/obstacle* in the frontier. The presence of panoramic balcony, stairs and barriers for vehicles determine the presence of special urban furniture also along the frontiers (see also Trani).

#### Content:

- Suggestion: a row should be added to include difference in materials.

- Suggestion: a row should be added to include "sight" for tourism.  
- Suggestion: a row should be added to indicate the uses related to the public buildings that are along the frontier;  
- Suggestion: a row should be added to include "electric scooters" in *Accessible to*;

x

## RIETI

### Piazza Vittorio Emanuele II

Note: Piazza Vittorio Emanuele II is included in a system of three squares.

#### Frontier:

- Suggestion: a row should be added to define boundaries of the case study, in order to focus the study on a single square;  
- Suggestion: an integration in the definition of *Continuous Built Front* should be given. The current definition does not consider the case in which there is a slight offset of two adjoining facades, which could be considered or not as additional CBF.

#### Content:

- Suggestion: a row should be added to include dehors and temporary expansions of shops on the square.

#### Frontier:

x

x

x

#### Content:

x

SAN GEMINI					
Piazza San Francesco	x	<b>Frontier:</b> x <b>Content:</b> - Suggestion: a row should be added to include more options for <i>High Difference</i> . In San Gemini we have stairs and the whole square uphill.	<b>Frontier:</b> x <b>Content:</b> - Suggestion: for <i>Pavement materials and finishing</i> we should enter just the objective data of the type of flooring (materials and laying i.e. cobblestones, slabs ...) and consider a separate study on the effects of the material, without listing them directly on the form. In this way the correlation between material and effect on the evacuation can be updated with the development of the state of the art on the subject.	- Suggestion: more importance should give to the <i>Strategic building</i> row. It is proposed to bring it from sub-parameter to parameter, replacing it with the <i>Sensitive target</i> row.	x
SAN G. IN P.					
Piazza del Popolo	x	The main square of San Giovanni in Persiceto is an example confirming the correctness of the data sheet; all the aspects characterizing Vittorio Emanuele II square were already considered.			
	x	x	<b>Content:</b> - Note: The type of flooring is not easily identifiable among those proposed.	x	x
TRANI					
Piazza Re Manfredi	x	<b>Frontier:</b> - Question: should <u>trench and balcony of the seafront</u> be included in <i>Quote differences</i> ?  <b>Content:</b> - Suggestion: a row should be added to include <u>dehors</u> (temporary expansions of shops on the square); - <i>Quote differences</i> : Should <u>stairs</u> be included here?	<b>Frontier:</b> - Suggestion: a row should be added to include <i>Urban furniture/obstacle</i> in the frontier. The presence of the balcony on the seafront determine the presence of special urban furniture also along the frontiers (see also Matera).  <b>Content:</b> - Suggestion: a row should be added to include <u>difference in materials</u> ; - Suggestion: a row should be added to include the presence of <u>barriers for vehicles</u> dividing streets and square or two adjacent squares.	- Suggestion: a row should be added to include "sight" for tourism. - Suggestion: a row should be added to indicate the <u>uses related to the public buildings</u> that are along the frontier; - Suggestion: a row should be added to include "electric scooters" in <i>Accessible to</i> ;	x

### 2.3 Critical analysis of the comments and suggestions

The critical analysis of the comments (summarized in Table 7; see also § 10) Table 7: Comments and suggestion on sections of the validation form. was carried out classifying the suggestions among those in which it was proposed to add, remove and modify parameters (Table 8). Focusing on the main goal to collect and describe the relevant characteristics of open space in the SUOD-affected BE, some suggestions show the need to introduce other factors, not currently comprised.

In Section 1 is included new sub-section to record dimension data. In Section 2, in the sub-section "Content", are added "Dehors" and "Archeological sites" parameters, since they occupy portion of the open space, likewise other elements already included (i.e. "Monument", "Fountain", and "Canopy"). In Section 3, the suggestion to add "Urban furniture/obstacle" in the sub-section of "Frontier" - as already be in "Content" - was accepted, since this circumstance occurred in the case studies of Matera, Ostuni, and Trani. Lastly, in Section 4, the addition of "Strategic buildings" is accepted, introducing it with the definition included in the current report of Italian Department of Civil Protection; "Sight" is added to characterize with tourist interest the "Special buildings" mentioned in Section 2; "Scooter" is added as sub-parameter in "Accessible to", without the not relevant specification of "electric". Instead, the suggestion to add "Public buildings use" is rejected, highlight that the parameter "Strategic building" and "Sight" compensate it for the purpose of an expeditious analysis. Moreover, in Section 5 "Crowd index" and "Underground cavities" are removed, the former due to its complex estimation for an expeditious survey and the latter because already present in Section 2.

Other suggestions show the necessity to modify certain elements and, in a few cases, clarify their definition too. In Section 2, in the sub-section "Frontier", the remarks state how a clarification of the parameter "Quote difference" is essential, therefore this factor is structured in "upward quote difference" from "downward quote difference". Also, the parameter "Structural Aggregates" and "Access" are better specified, introducing sub-parameters. In Section 3, in the sub-section "Frontier", the comment reports several comment concerning the opportunity to improve the "Pavement" factors. Thus, the parameter is subdivided in three different part to define separately materials, lying, and finishing. Moreover, in Section 4, the recorded data in "Sensitive target to terroristic attack" shows no occurrences for "Sensitive people" sub-parameter, instead "Vulnerable users" occurred in each case. This distribution of the data collected suggest to reorganize these elements. A definition for "Sensitive target" is introduced, articulating this factor with three sub-parameters - derived from the principles determined by Woo (Woo 2015) - : "High profile people", "Symbolic buildings" and "Tourists or crowd of them", including in the latter the vulnerable users no constantly present. Lastly, in Section 5 the suggestion to clarify the risk class in "Hazard assessment" according to related national classifications for seismic, hydrogeological, flood, volcanic risk is accepted and the associated definition expanded.

Table 8: Summary of the accepted and rejected suggestion on each parameter updated in the definitive survey form.

Parameter and suggestion		Accepted	Rejected	Update
<b>SECTION 1</b>				
-	-	-	-	Added spots to record dimension data
<b>SECTION 2</b>				
Frontier:	Structural Aggregates	clarify	V	Separated “aggregated” and “isolated”
	Access	clarify	V	Indicated “Vehicular”, “Pedestrian”, and “Controlled /with obstacles”
	Quote difference / containment wall	clarify	V	Separated “upward” from “downward”
Content:	Slope / quote difference	clarify	V	Separated “upward” from “downward”
	Dehors	add	V	Added
	Archaeological sites	add	V	Added
	Underground cavities	remove		V Kept in Section 2 and removed in Section 5
	Report dimension data	add	V	Added and moved in Section 1
<b>SECTION 3</b>				
Frontier:	Urban furniture/obstacle	add	V	Added and specified
Content:	Pavement materials	clarify	V	Separated materials, lying, and finishing
<b>SECTION 4</b>				
	Strategic buildings	add	V	Added parameter and definition
	Sight	add	V	Added parameter and definition
	Sensitive target	clarify	V	Modified and add an updated definition
	Public buildings use	add		V “Strategic building” and “Sight” compensate this parameter for expeditious analysis
	Electric scooter	add	V	Introduced as “Scooter” in “Accessible to”
<b>SECTION 5</b>				
	Hazard assessment	clarify	V	Add specification of the class according to related national risk classifications
	Crowd index	remove	V	Removed
	Underground cavities	remove	V	Removed

## 2.4 The definitive survey form for AS

After the critical analysis of comment and suggestion, the expeditious survey form for open spaces was changed as follow, adding new definition for new parameters.

### SECTION 1:

In the definitive form, area of AS together with H max and min of built front (m) in AS are introduced. The first part of the form ends with a scheme of the open space with the main dimension and accesses location reported.

- **Area (m²):** For the calculation of the area, the perimeter to be considered is formed by all CBF and a straight line in correspondence of every different couple of CBF separated by an access.
- **H max built front (m):** Maximum height of built front considering only the façades of  $SU_i$ .
- **H min built front (m):** Minimum height of built front considering only the façades of  $SU_i$ .

### SECTION 2:

#### Frontier:

- **SA (Structural Aggregates):** By structural aggregate we mean a not necessarily homogeneous set of buildings (structural units), placed in substantial contiguity (Italian technical commission for seismic micro-zoning 2014). In the definitive form we distinguish between Aggregated if  $SU > 1$ , and Isolated if  $SA = SU_i = 1$ . The latter is frequent for special building (church, tower, etc).
- **CBF (Continuous Built Front):** Front between 2 access; to consider 2 different CBF the deviation from straightness has to be about  $90^\circ (\pm 45^\circ)$ . Furthermore, in case in which there is a slight offset of two adjoining facades, which could be considered as additional CBF, an integration in the definition is proposed. If an offset between 2 fronts is less than  $1/10$  of the total front length or 1.50 meters, the wall between the offsetting should not be considered as an additional CBF.
- **Access:** intersection between path and open space. It can be covered (strut, vault or slab passage, etc) or uncovered. They can be vehicular, pedestrian, controlled /with obstacles.
- **Quote difference:** presence of views, overhangs, cliffs and difference in altitude in general between AS and a generic lower altitude. The sub-parameter specify if the difference is upward or downward.

#### Content:

- **Dehors:** Temporary expansions of activities in the AS frontier inside the AS. They could be laterally opened or totally closed.
- **Quote difference:** Generic difference in altitude as slope, terraced steps, hole, etc. The sub-parameter specify if the difference is upward or downward.
- **Archaeological sites:** Presence of ruins of historical value in AS, at a quote that can differ from the AS main one.

### SECTION 3:

#### Frontier:

- **Urban furniture/obstacles:** Presence of obstacles in the frontier of AS that can interfere with the escape of people in an emergency. Examples could be benches, bumps, poles, flowerpot, railings, bike rack, etc.

## Content:

- **Pavement materials:** Material used for AS flooring, specifying if it is marble, travertine, etc.
- **Pavement lying:** Type of lying used for AS flooring, specifying if it is in big slabs, small tiles, cobblestones, etc.
- **Pavement finishing:** Characteristics of materials used for AS flooring, specifying if they are slick, compact, disjointed, etc.

## SECTION 4:

- **Strategic buildings:** definition as reported in D.G.R. n. 1384/2003 and *Decreto del Capo del Dipartimento di Protezione Civile* n. 3685 of 21/10/2003.
- **Sights:** Sights are attraction systems defined as 'any feature or characteristic of a place that a traveler contemplates visiting or actually visits' (Leiper, 1990). In detail, Sights are all the urban constructions or elements that generate tourism, independently to the construction or symbolic features (special buildings for geometric characters and strategic buildings for uses characters).
- **Sensitive targets:** focus on the definition at the basis of Terrorism Risk evaluation of Gordon Woo, the "*central principle of quantitative terrorism risk modelling is that terrorists seek to maximize loss, subject to counter-terrorism security constraints*" (Woo 2015) from which derives the several metrics useful for the quantification: the casualty toll, destruction of property, economic loss, and damage to iconic symbols. Focus on the BE, Sensitive targets should be considered as the elements (both constructions and users) of urban area that support the maximization of effect in term of symbolic effect or loss. For these reasons three types of sub-classes are chosen highlighting the differences between human and built environment values:
  - **High profile people:** here, the option expresses the high relevance of symbolic effect on human character for the presence – in AS or LS – of private buildings directly related to people politically or religiously exposed (e.g. dwellings) (Woo 2015);
  - **Symbolic urban elements:** the option expresses the relevance of symbolic effect on BE for the presence – in AS or LS – of representative urban elements in a political, religious and/or cultural point of view; here, strategic buildings or cultural representative buildings (e.g. Sights or monuments) should be considered;
  - **Tourists or crowd of them:** the option is referred to the maximization of human losses for the presence – in AS or LS – of activities or buildings that caused crowded areas.

## SECTION 5:

### Hazard assessment

For hazard assessment, where possible, the form has been implemented by inserting the classification to the specific type of risk according to Italian regulations since all the case studies are in Italy. This approach can be implemented by choosing broader classification.

- **Earthquake**

### Zone 1; Zone 2; Zone 3; Zone 4 (decreasing risk)

The seismic classification of the Italian territory is currently set, distinguishing the following four seismic areas: Zone 1 has high seismic intensity and it is the most dangerous area where strong earthquakes can occur; Zone 2 has medium seismic intensity and quite strong earthquakes can occur in the municipalities



included in this area; Zone 3 has low seismic intensity and Municipalities classified in this area may be subject to modest shaking; Zone 4 has very lowest seismic intensity and the chances of seismic damage in the municipalities included in this area are reduced.

- **Tsunami**

**1; 2; 3; 4 (decreasing risk)**

As evidenced by European project TSUMAPS-NEAM (TSUMAPS-NEAM) the Mediterranean Sea is prone to tsunami and, in particular, some regions of Italy, such as Eastern Sicily, Ionian Calabria, Taranto Gulf and Salento. The map elaborated by a group of research coordinated by the Italian National Institute of Geophysics and Volcanology, showed which are the most subject areas.

- **Volcanic activity**

**Red; Orange; Yellow; Green (decreasing risk)**

In Italy, as well as at international level, emergency plans related to the active volcanoes were elaborated in detail, Vesuvius, Campi Flegrei, Etna, Stromboli and the island of Vulcano have been identified with "Alert levels" that describe the state of activity of each volcano, indicating whether it is in a state of equilibrium or imbalance.

The alert levels are identified based on the combination of monitoring parameters and data relating to any ongoing events. They are represented through four colours - green, yellow, orange and red - which indicate the possible evolution of the state of activity of the volcano towards "nationally relevant" event scenarios.

- **Flood**

**P1; P2; P3 (decreasing risk)**

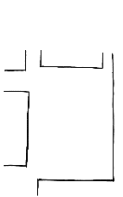
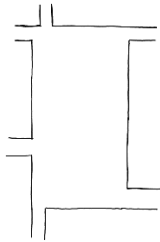
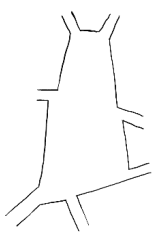
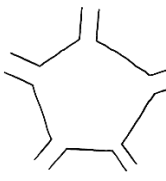
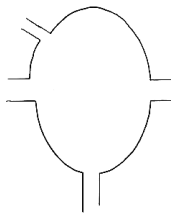
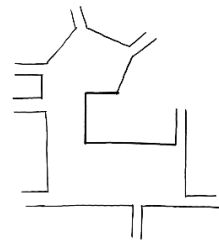
Referring to Italy case, with the aim of providing a map of the hydraulic hazard on the national territory and elaborate national risk indicators (Par. 5.4), ISPRA has created a mosaic of the areas with hydraulic hazard defined by the Basin Authorities, Regions and Autonomous Provinces (ISPRA 2015). Mosaic was carried out for the three hazard scenarios: high P3 with a return time between 20 and 50 years (frequent floods), average P2 with a return time between 100 and 200 years (infrequent floods) and low P1 (low probability floods or extreme event scenarios).

- **Landslide:**

**AA; P1; P2; P3; P4 (decreasing risk)**

Referring to Italy, in order to obtain a picture of the landslide hazard throughout the country, ISPRA mosaic the hazardous areas of the Hydrogeological Asset Plans that are drawn up by the Basin Authorities, Regions and Autonomous Provinces (ISPRA 2015). This mosaic made possible to obtain a map of the landslide hazard on a national scale which was used to produce landslide hazard and risk indicators.

## SECTION 1: MAIN TYPE

Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					

dimensions		scheme*
Area (m <sup>2</sup> )		
H max built front (m)		
H min built front (m)		

*\*draw a scheme of the open space with the main dimension and accesses location reported*

## SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE

	parameters	sub-parameters	n.
frontier	SA (Structural Aggregates)	Aggregated (SU≥1)	_____
		Isolated (SA=SU)	_____
	SU <sub>i</sub> (Interferent Structural Unit)		_____
	CBF (Continuous Built Front)		_____
	Access	Vehicular	_____
		Pedestrian	_____
		Controlled /with obstacles	_____
	Special building	Church	_____
		City Hall	_____
		Theatre	_____
		School	_____
		Museum	_____
		Other: .....	_____
	Town walls		_____
	Porches		_____
	Water		_____
	Quote difference	upward (i.e. stairs, ramps, containment walls)	_____
		downward (i.e. stairs, ramps, balconies)	_____
	Green area		_____

content	Special building		
	Canopy		
	Fontaine		
	Monuments (i.e. obelisk, statues)		
	Dehors		
	Quote difference		upward (i.e. stairs, ramps)
			downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites		
	Green area		
	Underground park		
	Underground cavities		

SECTION 3: CONSTRUCTIVE CHARACTERISTICS			
	parameters	sub-parameters	
frontier	Homogeneity of built environment age	<input type="checkbox"/>	Yes
		<input type="checkbox"/>	No
	Homogeneity of constructive techniques	<input type="checkbox"/>	Yes
		<input type="checkbox"/>	No
	Urban furniture/obstacles	<input type="checkbox"/>	Benches
		<input type="checkbox"/>	Bumps
		<input type="checkbox"/>	Poles
		<input type="checkbox"/>	Flowerpot
		<input type="checkbox"/>	Railings
		<input type="checkbox"/>	Bike Rack
		<input type="checkbox"/>	Traffic barriers
		<input type="checkbox"/>	Other: .....
content	Pavement materials (i.e. marble, travertine...)		
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		
	Pavement finishing (i.e. smooth, coarse, irregular...)		
	Urban furniture/obstacles	<input type="checkbox"/>	Benches
		<input type="checkbox"/>	Bumps
		<input type="checkbox"/>	Poles
		<input type="checkbox"/>	Flowerpot
		<input type="checkbox"/>	Railings
		<input type="checkbox"/>	Bike Rack
		<input type="checkbox"/>	Traffic barriers
		<input type="checkbox"/>	Other: .....

#### SECTION 4: CHARACTERISTICS OF USE

parameters	sub-parameters
Daily crowding	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night
Special uses of open space	<input type="checkbox"/> Concerts <input type="checkbox"/> Theater <input type="checkbox"/> Festivals <input type="checkbox"/> Parking <input type="checkbox"/> Other: .....
Accessible to	<input type="checkbox"/> Vehicle <input type="checkbox"/> Pedestrian <input type="checkbox"/> Bike <input type="checkbox"/> Scooter <input type="checkbox"/> Other: .....
Strategic buildings	<input type="checkbox"/> City Hall and administrative bldgs <input type="checkbox"/> Operational headquarters for emergency management <input type="checkbox"/> Law enforcement offices <input type="checkbox"/> Healthcare facilities <input type="checkbox"/> Other: .....
Sights	<input type="checkbox"/> Overall Area of Linear Space <input type="checkbox"/> Church <input type="checkbox"/> City Hall <input type="checkbox"/> Theatre <input type="checkbox"/> Museum <input type="checkbox"/> Other: .....
Sensitive targets	<input type="checkbox"/> High profile people <input type="checkbox"/> Symbolic buildings <input type="checkbox"/> Tourists or crowd of them

#### SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters
Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
Infrastructural network	<input type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire <input type="checkbox"/> Other: .....

Hazard assessment

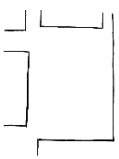
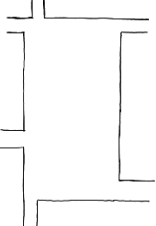
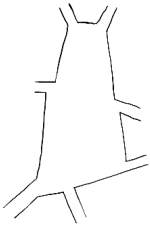
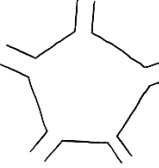
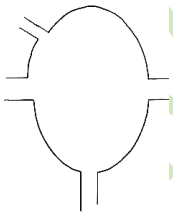
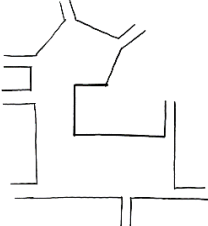
- |                          |                        |
|--------------------------|------------------------|
| <input type="checkbox"/> | Earthquake             |
| <input type="checkbox"/> | Tsunami                |
| <input type="checkbox"/> | Mass Movement (dry)    |
| <input type="checkbox"/> | Volcanic activity      |
| <input type="checkbox"/> | Storm/tornado          |
| <input type="checkbox"/> | Extreme temperature    |
| <input type="checkbox"/> | Flood                  |
| <input type="checkbox"/> | Landslide              |
| <input type="checkbox"/> | Wildfire               |
| <input type="checkbox"/> | Chemical               |
| <input type="checkbox"/> | Explosion/fire         |
| <input type="checkbox"/> | Transport accident     |
| <input type="checkbox"/> | Terrorist attack       |
| <input type="checkbox"/> | Miscellaneous accident |

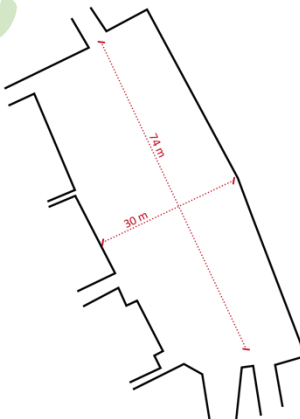
### 3. Results

The definitive survey form has been applied to the selected eight case of ASs. Firstly, the filled forms are reported, then a descriptive analysis is elaborated.

#### 3.1 Survey form of the eight case studies

**Caldarola:** Piazza Vittorio Emanuele II

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
	✓				

dimensions		scheme*
Area (m <sup>2</sup> )	2008 m <sup>2</sup>	
H max built front (m)	42	
H min built front (m)	12	
*draw a scheme of the open space with the main dimension and accesses location reported		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE				
	parameters		sub-parameters	n.
frontier	SA (Structural Aggregates)	✓	Aggregated (SU≥1)	5
		✓	Isolated (SA=SU)	1
	SU <sub>i</sub> (Interferent Structural Unit)	✓		1
	CBF (Continuous Built Front)	✓		6
	Access	✓	Vehicular	5
		✓	Pedestrian	2
			Controlled /with obstacles	
	Special building	✓	Church	2



	<input checked="" type="checkbox"/>	City Hall	1
	<input type="checkbox"/>	Theatre	
	<input type="checkbox"/>	School	
	<input type="checkbox"/>	Museum	
	<input type="checkbox"/>	Other: .....	
Town walls			
Porches	<input checked="" type="checkbox"/>		2
Water			
Quote difference	<input checked="" type="checkbox"/>	upward (containment walls)	
		downward (i.e. stairs, ramps, balconies)	
Green area			
<b>content</b>			
Special building	<input checked="" type="checkbox"/>	Bell tower	1
Canopy			
Fontaine			
Monuments (i.e. obelisk, statues)			
Dehors			
Quote difference		upward (i.e. stairs, ramps)	
		downward (i.e. stairs, ramps, balconies, parapets)	
Archaeological sites			
Green area			
Underground park			
Underground cavities			

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters
frontier	Homogeneity of built environment age	<input checked="" type="checkbox"/> Yes
		<input type="checkbox"/> No
	Homogeneity of constructive techniques	<input checked="" type="checkbox"/> Yes
		<input type="checkbox"/> No
	Urban furniture/obstacles	Benches
		Bumps
		Poles
		Flowerpot
		Railings
		Bike Rack
		Traffic barriers
		Other: .....
content	Pavement materials (i.e. marble, travertine...)	Asphalt Grey limestone blocks
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)	Compact Cobblestone

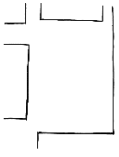
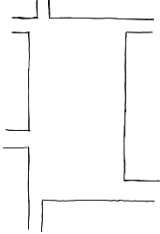
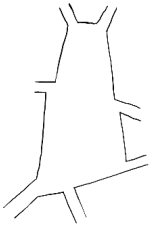
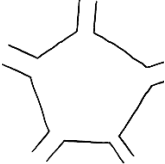
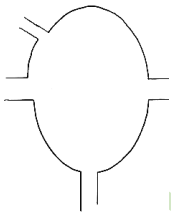
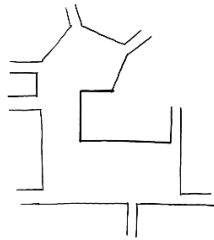
Pavement finishing (i.e. smooth, coarse, irregular...)	Smooth
Urban furniture/obstacles	Irregular
	<input type="checkbox"/> Benches
	<input type="checkbox"/> Bumps
	<input type="checkbox"/> Poles
	<input checked="" type="checkbox"/> Flowerpot
	<input type="checkbox"/> Railings
	<input type="checkbox"/> Bike Rack
	<input type="checkbox"/> Traffic barriers
	Other: .....

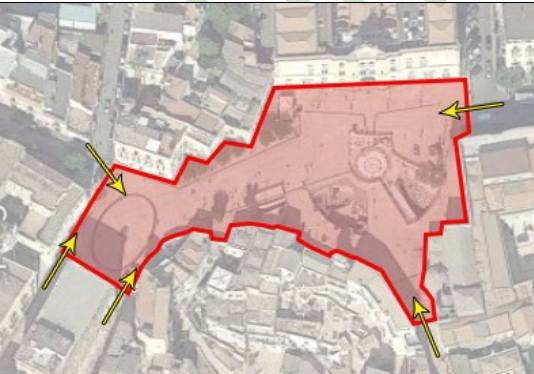
SECTION 4: CHARACTERISTICS OF USE	
parameters	sub-parameters
Daily crowding	<input checked="" type="checkbox"/> Morning <input checked="" type="checkbox"/> Afternoon <input checked="" type="checkbox"/> Evening <input type="checkbox"/> Night
Special uses of open space	<input type="checkbox"/> Concerts <input type="checkbox"/> Theater <input checked="" type="checkbox"/> Festivals <input checked="" type="checkbox"/> Parking Other: .....
Accessible to	<input checked="" type="checkbox"/> Vehicle <input checked="" type="checkbox"/> Pedestrian <input checked="" type="checkbox"/> Bike <input checked="" type="checkbox"/> Scooter Other: .....
Strategic buildings	<input checked="" type="checkbox"/> City Hall and administrative bldgs <input type="checkbox"/> Operational headquarters for emergency management <input type="checkbox"/> Law enforcement offices <input type="checkbox"/> Healthcare facilities Other: .....
Sights	<input type="checkbox"/> Overall Areal o Linear Space <input checked="" type="checkbox"/> Church <input checked="" type="checkbox"/> City Hall <input type="checkbox"/> Theatre <input type="checkbox"/> Museum Other: .....
Sensitive targets	<input type="checkbox"/> High profile people <input checked="" type="checkbox"/> Symbolic buildings <input checked="" type="checkbox"/> Tourists or crowd of them

## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters		
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A	
	<input type="checkbox"/>	B	
	<input type="checkbox"/>	C	
	<input checked="" type="checkbox"/>	D	
	<input type="checkbox"/>	E	
	<input type="checkbox"/>	F	
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization	
	<input type="checkbox"/>	Uncovered pipes	
	<input type="checkbox"/>	High tension wire	
	<input type="checkbox"/>	Other: .....	
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake	Zone 2
	<input type="checkbox"/>	Tsunami	
	<input type="checkbox"/>	Mass Movement (dry)	
	<input type="checkbox"/>	Volcanic activity	
	<input type="checkbox"/>	Storm/tornado	
	<input checked="" type="checkbox"/>	Extreme temperature	
	<input checked="" type="checkbox"/>	Flood	P1
	<input checked="" type="checkbox"/>	Landslide	
	<input checked="" type="checkbox"/>	Wildfire	
	<input type="checkbox"/>	Chemical	
	<input checked="" type="checkbox"/>	Explosion/fire	
	<input checked="" type="checkbox"/>	Transport accident	
	<input checked="" type="checkbox"/>	Terrorist attack	
	<input type="checkbox"/>	Miscellaneous accident	

**Matera:** Vittorio Emanuele square

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

dimensions		scheme*
Area (m <sup>2</sup> )	5000	
H max built front (m)	16	
H min built front (m)	5	
*draw a scheme of the open space with the main dimension and accesses location reported		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE			
	(parameters)	(sub-parameters)	N.
frontier	SA (Structural Aggregates)	Aggregated (SU≥1)	5
		Isolated (SA=SU)	1
	SU <sub>i</sub> (Interferent Structural Unit)		6
	CBF (Continuous Built Front)		6
	Access	Vehicular	
		Pedestrian	6
		Controlled /with obstacles	6
	Special building	✓ Church	2
		✓ City Hall	1
		✓ Theatre	1
		✓ School	1
		✓ Museum	1
		Other: Bank	
	Town walls		

content	Porches	✓	As the access to the panoramic overlook (above the Sassi)	1
	Water			
	Quote difference		upward (i.e. stairs, ramps, containment walls)	
		✓	downward (i.e. stairs, ramps, balconies)	2
	Green area			
	Special building			
	Canopy			
	Fontaine	✓		1
	Monuments (i.e. obelisk, statues)	✓		1
	Dehors	✓		8
	Quote difference		upward (i.e. stairs, ramps)	
		✓	downward (i.e. stairs, ramps, balconies, parapets)	2
	Archaeological sites	✓		2
	Green area			
	Underground park			
	Underground cavities	✓		

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters		
frontier	Homogeneity of built environment age		Yes	
		✓	No	
	Homogeneity of constructive techniques		Yes	
		✓	No	
	Urban furniture/obstacles		Benches	
			Bumps	
		✓	Poles	
			Flowerpot	
		✓	Railings	
			Bike Rack	
		✓	Traffic barriers	
			Other: .....	
content	Pavement materials (i.e. marble, travertine...)		Calcareous pavement	
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		Compact and Big slabs	
	Pavement finishing (i.e. smooth, coarse, irregular...)		Slick	
	Urban furniture/obstacles	✓	Benches	

	<input type="checkbox"/>	Bumps
	<input checked="" type="checkbox"/>	Poles
	<input checked="" type="checkbox"/>	Flowerpot
	<input checked="" type="checkbox"/>	Railings
	<input type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....

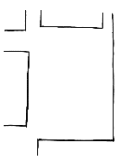
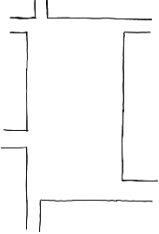

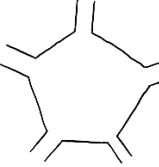
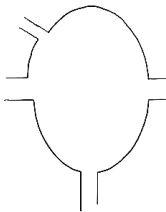
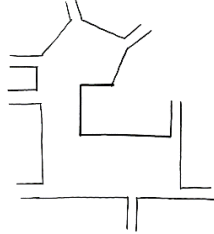
SECTION 4: CHARACTERISTICS OF USE	
(parameters)	(sub-parameters)
Daily crowding	<input checked="" type="checkbox"/> Morning <input checked="" type="checkbox"/> Afternoon <input checked="" type="checkbox"/> Evening <input type="checkbox"/> Night
Special uses of open space	<input checked="" type="checkbox"/> Concerts <input type="checkbox"/> Theater <input checked="" type="checkbox"/> Festivals <input type="checkbox"/> Parking <input type="checkbox"/> Other: .....
Accessible to	<input type="checkbox"/> Vehicle <input checked="" type="checkbox"/> Pedestrian <input type="checkbox"/> Bike <input type="checkbox"/> Scooter <input type="checkbox"/> Other: .....
Strategic buildings	<input checked="" type="checkbox"/> City Hall and administrative bldgs <input type="checkbox"/> Operational headquarters for emergency management <input type="checkbox"/> Law enforcement offices <input type="checkbox"/> Healthcare facilities <input type="checkbox"/> Other: .....
Sights	<input checked="" type="checkbox"/> Overall Area of Linear Space <input type="checkbox"/> Church <input checked="" type="checkbox"/> City Hall <input checked="" type="checkbox"/> Theatre <input type="checkbox"/> Museum <input type="checkbox"/> Other: Archeological Sites, Panoramic overlook
Sensitive targets	<input checked="" type="checkbox"/> High profile people <input checked="" type="checkbox"/> Symbolic buildings <input checked="" type="checkbox"/> Tourists or crowd of them

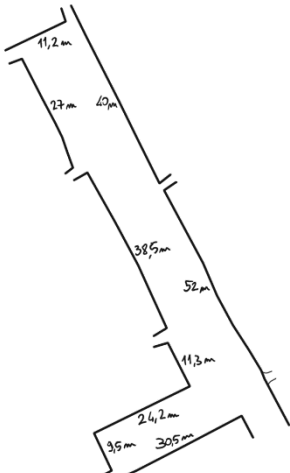
## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

(parameters)	(sub-parameters)	
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A
	<input type="checkbox"/>	B
	<input type="checkbox"/>	C
	<input checked="" type="checkbox"/>	D
	<input type="checkbox"/>	E
	<input type="checkbox"/>	F
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization
	<input type="checkbox"/>	Uncovered pipes
	<input type="checkbox"/>	High tension wire
	<input type="checkbox"/>	Other: .....
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake Zone 3
	<input type="checkbox"/>	Tsunami
	<input type="checkbox"/>	Mass Movement (dry)
	<input type="checkbox"/>	Volcanic activity
	<input type="checkbox"/>	Storm/tornado
	<input checked="" type="checkbox"/>	Extreme temperature
	<input type="checkbox"/>	Flood
	<input checked="" type="checkbox"/>	Landslide
	<input type="checkbox"/>	Wildfire
	<input type="checkbox"/>	Chemical
	<input checked="" type="checkbox"/>	Explosion/fire
	<input type="checkbox"/>	Transport accident
	<input checked="" type="checkbox"/>	Terrorist attack
	<input type="checkbox"/>	Miscellaneous accident



Narni: Priori square

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

dimensions		scheme*
Area (m <sup>2</sup> )	1'650	
H max built front (m)		
H min built front (m)		
<p><i>*draw a scheme of the open space with the main dimension and accesses location reported</i></p>		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE				
parameters		sub-parameters		n.
frontier	SA (Structural Aggregates)	✓	Aggregated (SU≥1)	8
		✓	Isolated (SA=SU)	0
	SU <sub>i</sub> (Interferent Structural Unit)	✓		17
	CBF (Continuous Built Front)	✓		10
	Access	✓	Vehicular	6
		✓	Pedestrian	2
			Controlled /with obstacles	
	Special building	✓	Church	1
		✓	City Hall	1
		✓	Theatre	1
			School	
			Museum	
			Other: .....	

content	Town walls		
	Porticoes	✓	
	Water		
	Quote difference	✓	upward (i.e. stairs, ramps, 2 containment walls)
		✓	downward (i.e. stairs, 2 ramps, balconies)
	Green area		
	Special building		
	Canopy		
	Fontaine	✓	1
	Monuments (i.e. obelisk, statues)		
	Dehors	✓	
	Quote difference		upward (i.e. stairs, ramps) downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites		
	Green area		
	Underground park		
	Underground cavities	✓	

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters	
frontier	Homogeneity of built environment age		Yes
		✓	No
	Homogeneity of constructive techniques		Yes
		✓	No
	Urban furniture/obstacles		Benches
			Bumps
			Poles
			Flowerpot
			Railings
			Bike Rack
			Traffic barriers
			Other: .....
content	Pavement materials (i.e. marble, travertine...)		Porphyry
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		Sanpietrini
	Pavement finishing (i.e. smooth, coarse, irregular...)		Irregular
	Urban furniture/obstacles	✓	Benches
			Bumps

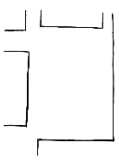
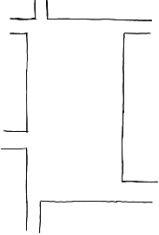
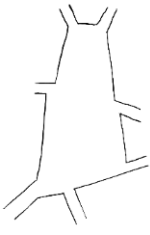
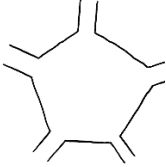
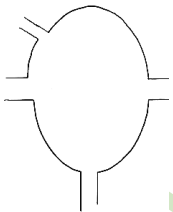
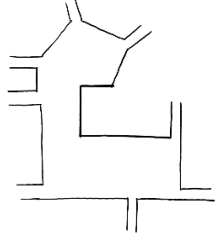
	<input type="checkbox"/>	Poles
	<input checked="" type="checkbox"/>	Flowerpot
	<input checked="" type="checkbox"/>	Railings
	<input type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....


SECTION 4: CHARACTERISTICS OF USE		
parameters	sub-parameters	
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input checked="" type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input checked="" type="checkbox"/>	Parking
	<input type="checkbox"/>	Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
	<input type="checkbox"/>	Other: .....
Strategic buildings	<input checked="" type="checkbox"/>	City Hall and administrative bldgs
	<input type="checkbox"/>	Operational headquarters for emergency management
	<input type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
	<input type="checkbox"/>	Other: .....
Sights	<input checked="" type="checkbox"/>	Overall Areal o Linear Space
	<input checked="" type="checkbox"/>	Church
	<input checked="" type="checkbox"/>	City Hall
	<input checked="" type="checkbox"/>	Theatre
	<input checked="" type="checkbox"/>	Museum
	<input type="checkbox"/>	Other: .....
Sensitive targets	<input checked="" type="checkbox"/>	High profile people
	<input checked="" type="checkbox"/>	Symbolic buildings
	<input checked="" type="checkbox"/>	Tourists or crowd of them

## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters	
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A
	<input type="checkbox"/>	B
	<input type="checkbox"/>	C
	<input checked="" type="checkbox"/>	D
	<input type="checkbox"/>	E
	<input type="checkbox"/>	F
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization
	<input checked="" type="checkbox"/>	Uncovered pipes
	<input checked="" type="checkbox"/>	High tension wire
	<input type="checkbox"/>	Other: .....
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake Zone 3
	<input type="checkbox"/>	Tsunami
	<input type="checkbox"/>	Mass Movement (dry)
	<input type="checkbox"/>	Volcanic activity
	<input type="checkbox"/>	Storm/tornado
	<input checked="" type="checkbox"/>	Extreme temperature
	<input type="checkbox"/>	Flood
	<input checked="" type="checkbox"/>	Landslide
	<input type="checkbox"/>	Wildfire
	<input type="checkbox"/>	Chemical
	<input checked="" type="checkbox"/>	Explosion/fire
	<input checked="" type="checkbox"/>	Transport accident
	<input checked="" type="checkbox"/>	Terrorist attack
	<input type="checkbox"/>	Miscellaneous accident

**Ostuni: Square of Liberty and St. Oronzo square**

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

dimensions		scheme*
Area (m <sup>2</sup> )	4.500	
H max built front (m)	20	
H min built front (m)	6	
*draw a scheme of the open space with the main dimension and accesses location reported		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE			
frontier	parameters	sub-parameters	n.
	SA (Structural Aggregates)	Aggregated (SU≥1)	8
		Isolated (SA=SU)	1
	SU <sub>i</sub> (Interferent Structural Unit)		9
	CBF (Continuous Built Front)		6
	Access	Vehicular	7
		Pedestrian	
		Controlled /with obstacles	1
	Special building	Church	1
		City Hall	1
		Theatre	
		School	
		Museum	

content			Other:
	Town walls		
	Porches		
	Water		
	Quote difference	✓	upward (i.e. stairs, ramps, 1 containment walls)
			downward (i.e. stairs, ramps, balconies)
	Green area		
	Special building		
	Canopy		
	Fontaine		
	Monuments (i.e. obelisk, statues)	✓	Obelisk of St. Oronzo
	Dehors	✓	
	Quote difference		upward (i.e. stairs, ramps) 1 downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites	✓	1
	Green area		
	Underground park		
	Underground cavities		

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters
frontier	Homogeneity of built environment age	Yes
		✓ No
	Homogeneity of constructive techniques	Yes
		✓ No
	Urban furniture/obstacles	Benches
		Bumps
		✓ Poles
		Flowerpot
		✓ Railings
		Bike Rack
		Traffic barriers
		Other: .....
content	Pavement materials (i.e. marble, travertine...)	Calcarous Stone, Sanpietrini and Asphalt
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)	Big slabs, disjointed for big slab Small tiles, disjointed for sanpietrini continuous for asphalt
	Pavement finishing (i.e. smooth, coarse, irregular...)	Smooth and irregular for big slab and sanpietrini Coarse for asphalt

Urban furniture/obstacles	<input type="checkbox"/>	Benches
	<input type="checkbox"/>	Bumps
	<input checked="" type="checkbox"/>	Poles
	<input type="checkbox"/>	Flowerpot
	<input checked="" type="checkbox"/>	Railings
	<input type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
		Other: .....

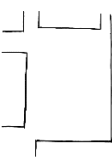
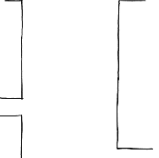
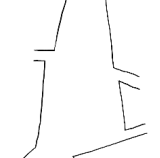
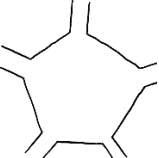
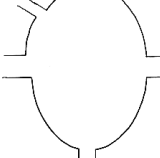
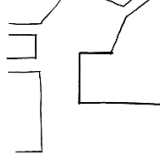
SECTION 4: CHARACTERISTICS OF USE		
parameters	sub-parameters	
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input checked="" type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input type="checkbox"/>	Parking
		Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
		Other: .....
Strategic buildings	<input type="checkbox"/>	City Hall and administrative bldgs
	<input type="checkbox"/>	Operational headquarters for emergency management
	<input type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
		Other: .....
Sights	<input type="checkbox"/>	Overall Area of Linear Space
	<input checked="" type="checkbox"/>	Church
	<input type="checkbox"/>	City Hall
	<input type="checkbox"/>	Theatre
		Museum
		Other: .....
Sensitive targets	<input type="checkbox"/>	High profile people
	<input type="checkbox"/>	Symbolic buildings
	<input checked="" type="checkbox"/>	Tourists or crowd of them

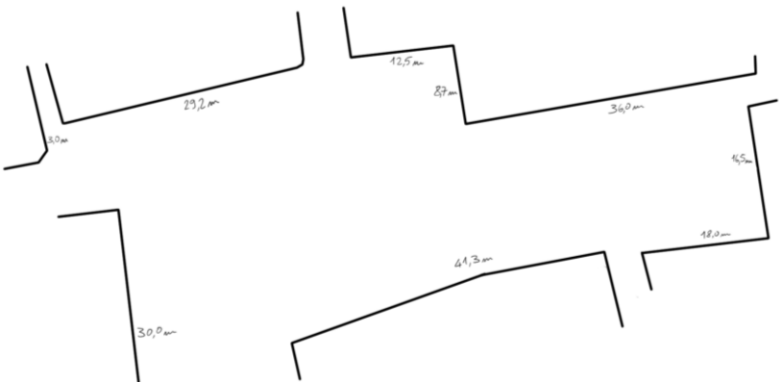


## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters		
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A	
	<input type="checkbox"/>	B	
	<input checked="" type="checkbox"/>	C	
	<input type="checkbox"/>	D	
	<input type="checkbox"/>	E	
	<input type="checkbox"/>	F	
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization	
	<input type="checkbox"/>	Uncovered pipes	
	<input type="checkbox"/>	High tension wire	
	<input type="checkbox"/>	Other: .....	
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake	Zone 4
	<input type="checkbox"/>	Tsunami	
	<input type="checkbox"/>	Mass Movement (dry)	
	<input type="checkbox"/>	Volcanic activity	
	<input type="checkbox"/>	Storm/tornado	
	<input checked="" type="checkbox"/>	Extreme temperature	
	<input type="checkbox"/>	Flood	
	<input checked="" type="checkbox"/>	Landslide	
	<input type="checkbox"/>	Wildfire	
	<input type="checkbox"/>	Chemical	
	<input checked="" type="checkbox"/>	Explosion/fire	
	<input checked="" type="checkbox"/>	Transport accident	
	<input checked="" type="checkbox"/>	Terrorist attack	
<input type="checkbox"/>	Miscellaneous accident		

**Rieti:** Piazza Vittorio Emanuele II, in the system of Piazza Mariano Vittori, Cesare Battisti, and Vittorio Emanuele II

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

dimensions		scheme*
Area (m <sup>2</sup> )	2'450	
H max built front (m)		
H min built front (m)		
*draw a scheme of the open space with the main dimension and accesses location reported		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE			
parameters		sub-parameters	n.
frontier	SA (Structural Aggregates)	✓ Aggregated (SU≥1)	5
		✓ Isolated (SA=SU)	0
	SU <sub>i</sub> (Interferent Structural Unit)	✓	9
	CBF (Continuous Built Front)	✓	9
	Access	✓ Vehicular	6
		Pedestrian	
		Controlled /with obstacles	
	Special building	Church	
		✓ City Hall	1
		Theatre	
		School	
		Museum	
		Other: .....tower.....	1

content	Town walls		
	Porticoes	✓	
	Water		
	Quote difference		upward (i.e. stairs, ramps, containment walls)
		✓	downward (i.e. stairs, ramps, balconies) 2
	Green area		
	Special building		
	Canopy		
	Fontaine	✓	1
	Monuments (i.e. obelisk, statues)		
	Dehors	✓	
	Quote difference		upward (i.e. stairs, ramps)
			downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites		
	Green area		
	Underground park		
	Underground cavities		

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters	
frontier	Homogeneity of built environment age		Yes
		✓	No
	Homogeneity of constructive techniques		Yes
		✓	No
	Urban furniture/obstacles		Benches
			Bumps
			Poles
			Flowerpot
			Railings
			Bike Rack
			Traffic barriers
			Other: .....
content	Pavement materials (i.e. marble, travertine...)		Porphyry
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		slab
	Pavement finishing (i.e. smooth, coarse, irregular...)		Regular
	Urban furniture/obstacles	✓	Benches
			Bumps

	<input checked="" type="checkbox"/>	Poles
	<input checked="" type="checkbox"/>	Flowerpot
	<input type="checkbox"/>	Railings
	<input checked="" type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....

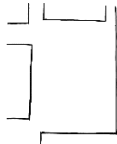
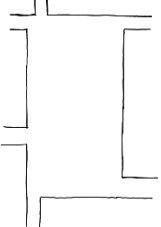
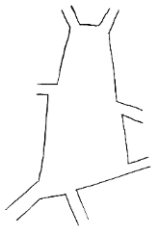
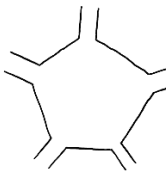
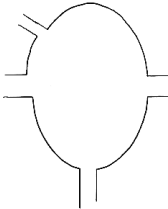
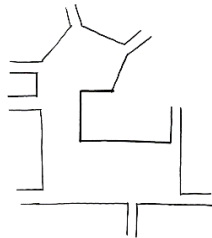
SECTION 4: CHARACTERISTICS OF USE		
parameters	sub-parameters	
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input checked="" type="checkbox"/>	Parking
	<input type="checkbox"/>	Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
	<input type="checkbox"/>	Other: .....
Strategic buildings	<input checked="" type="checkbox"/>	City Hall and administrative bldgs
	<input type="checkbox"/>	Operational headquarters for emergency management
	<input type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
	<input type="checkbox"/>	Other: .....
Sights	<input checked="" type="checkbox"/>	Overall Areal o Linear Space
	<input type="checkbox"/>	Church
	<input checked="" type="checkbox"/>	City Hall
	<input type="checkbox"/>	Theatre
	<input type="checkbox"/>	Museum
	<input type="checkbox"/>	Other: .....
Sensitive targets	<input type="checkbox"/>	High profile people
	<input checked="" type="checkbox"/>	Symbolic buildings
	<input checked="" type="checkbox"/>	Tourists or crowd of them

## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters	
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A
	<input type="checkbox"/>	B
	<input type="checkbox"/>	C
	<input type="checkbox"/>	D
	<input checked="" type="checkbox"/>	E
	<input type="checkbox"/>	F
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization
	<input type="checkbox"/>	Uncovered pipes
	<input type="checkbox"/>	High tension wire
	<input type="checkbox"/>	Other: .....
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake Zone 2
	<input type="checkbox"/>	Tsunami
	<input type="checkbox"/>	Mass Movement (dry)
	<input type="checkbox"/>	Volcanic activity
	<input type="checkbox"/>	Storm/tornado
	<input checked="" type="checkbox"/>	Extreme temperature
	<input type="checkbox"/>	Flood
	<input checked="" type="checkbox"/>	Landslide
	<input type="checkbox"/>	Wildfire
	<input type="checkbox"/>	Chemical
	<input checked="" type="checkbox"/>	Explosion/fire
	<input checked="" type="checkbox"/>	Transport accident
	<input checked="" type="checkbox"/>	Terrorist attack
	<input type="checkbox"/>	Miscellaneous accident



### San Gemini: San Francesco square

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
		✓			

dimensions		scheme*
Area (m <sup>2</sup> )	1'240	
H max built front (m)		
H min built front (m)		

\*draw a scheme of the open space with the main dimension and accesses location reported

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE				
	parameters		sub-parameters	n.
frontier	SA (Structural Aggregates)	✓	Aggregated (SU≥1)	3
		✓	Isolated (SA=SU)	0
	SU <sub>i</sub> (Interferent Structural Unit)	✓		12
	CBF (Continuous Built Front)	✓		10
	Access	✓	Vehicular	4
			Pedestrian	
			Controlled /with obstacles	
	Special building	✓	Church	1
			City Hall	
			Theatre	
		School		
		Museum		
		Other: .....		

content	Town walls	✓	
	Porticoes		
	Water		
	Quote difference	✓	upward (i.e. stairs, ramps, 1 containment walls)
		✓	downward (i.e. stairs, 3 ramps, balconies)
	Green area		
	Special building		
	Canopy		
	Fontaine	✓	1
	Monuments (i.e. obelisk, statues)		
	Dehors	✓	
	Quote difference		upward (i.e. stairs, ramps) downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites		
	Green area		
	Underground park		
	Underground cavities		

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters	
frontier	Homogeneity of built environment age		Yes
		✓	No
	Homogeneity of constructive techniques		Yes
		✓	No
	Urban furniture/obstacles		Benches
			Bumps
			Poles
			Flowerpot
			Railings
			Bike Rack
			Traffic barriers
			Other: .....
content	Pavement materials (i.e. marble, travertine...)		Porphyry
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		slab
	Pavement finishing (i.e. smooth, coarse, irregular...)		Regular
	Urban furniture/obstacles	✓	Benches
			Bumps
			Poles

	<input checked="" type="checkbox"/>	Flowerpot
	<input type="checkbox"/>	Railings
	<input checked="" type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....

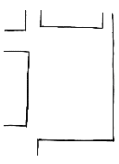
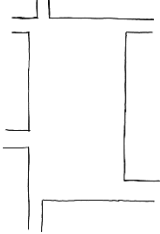
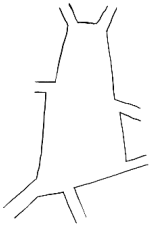
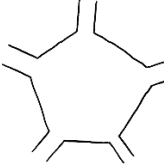
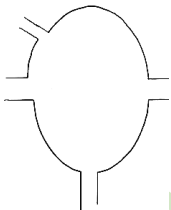
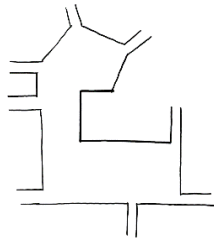
SECTION 4: CHARACTERISTICS OF USE		
parameters		sub-parameters
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input checked="" type="checkbox"/>	Parking
	<input type="checkbox"/>	Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
	<input type="checkbox"/>	Other: .....
Strategic buildings	<input type="checkbox"/>	City Hall and administrative bldgs
	<input type="checkbox"/>	Operational headquarters for emergency management
	<input checked="" type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
	<input type="checkbox"/>	Other: .....
Sights	<input checked="" type="checkbox"/>	Overall Areal o Linear Space
	<input checked="" type="checkbox"/>	Church
	<input type="checkbox"/>	City Hall
	<input type="checkbox"/>	Theatre
	<input type="checkbox"/>	Museum
	<input type="checkbox"/>	Other: .....
Sensitive targets	<input type="checkbox"/>	High profile people
	<input checked="" type="checkbox"/>	Symbolic buildings
	<input checked="" type="checkbox"/>	Tourists or crowd of them

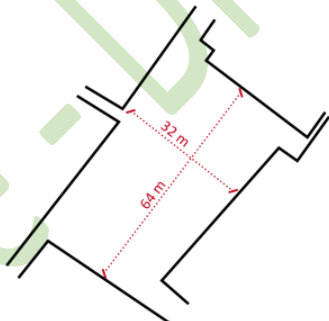


## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters	
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A
	<input type="checkbox"/>	B
	<input type="checkbox"/>	C
	<input checked="" type="checkbox"/>	D
	<input type="checkbox"/>	E
	<input type="checkbox"/>	F
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization
	<input type="checkbox"/>	Uncovered pipes
	<input type="checkbox"/>	High tension wire
	<input type="checkbox"/>	Other: .....
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake Zone 2
	<input type="checkbox"/>	Tsunami
	<input type="checkbox"/>	Mass Movement (dry)
	<input type="checkbox"/>	Volcanic activity
	<input type="checkbox"/>	Storm/tornado
	<input checked="" type="checkbox"/>	Extreme temperature
	<input type="checkbox"/>	Flood
	<input checked="" type="checkbox"/>	Landslide
	<input type="checkbox"/>	Wildfire
	<input type="checkbox"/>	Chemical
	<input checked="" type="checkbox"/>	Explosion/fire
	<input checked="" type="checkbox"/>	Transport accident
	<input checked="" type="checkbox"/>	Terrorist attack
	<input type="checkbox"/>	Miscellaneous accident

San Giovanni in Persiceto: Piazza del Popolo

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
✓					

dimensions		scheme*
Area (m <sup>2</sup> )	2000 m <sup>2</sup>	
H max built front (m)	20	
H min built front (m)	10	
*draw a scheme of the open space with the main dimension and accesses location reported		

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE			
	parameters	sub-parameters	n.
frontier	SA (Structural Aggregates)	✓ Aggregated (SU≥1)	5
		Isolated (SA=SU)	
	SU <sub>i</sub> (Interferent Structural Unit)		12
	CBF (Continuous Built Front)	✓	5
	Access	✓ Vehicular	4
		✓ Pedestrian	1
		Controlled /with obstacles	
	Special building	✓ Church	1
		✓ City Hall	1
		Theatre	
		School	
		Museum	
		✓ Other: Police station	1
	Town walls		
	Porches	✓	4
	Water		

content	Quote difference		upward (i.e. stairs, ramps, containment walls)
			downward (i.e. stairs, ramps, balconies)
	Green area		
	Special building		
	Canopy		
	Fontaine		
	Monuments (i.e. obelisk, statues)		
	Dehors	✓	2
	Quote difference		upward (i.e. stairs, ramps)
			downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites		
	Green area		
	Underground park		
	Underground cavities		

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters	
frontier	Homogeneity of built environment age		Yes
		✓	No
	Homogeneity of constructive techniques		Yes
		✓	No
	Urban furniture/obstacles		Benches
			Bumps
			Poles
			Flowerpot
			Railings
			Bike Rack
			Traffic barriers
			Other: .....
content	Pavement materials (i.e. marble, travertine...)		Porphyry blocks
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)		Compact Cobblestone
	Pavement finishing (i.e. smooth, coarse, irregular...)		Irregular
	Urban furniture/obstacles		Benches
			Bumps
			Poles
		✓	Flowerpot
			Railings

	<input type="checkbox"/>	Bike Rack
	<input type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....

SECTION 4: CHARACTERISTICS OF USE		
parameters	sub-parameters	
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input type="checkbox"/>	Parking
	<input type="checkbox"/>	Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
	<input type="checkbox"/>	Other: .....
Strategic buildings	<input checked="" type="checkbox"/>	City Hall and administrative bldgs
	<input checked="" type="checkbox"/>	Operational headquarters for emergency management
	<input type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
	<input checked="" type="checkbox"/>	Other: Police headquarters
Sights	<input type="checkbox"/>	Overall Areal o Linear Space
	<input type="checkbox"/>	Church
	<input type="checkbox"/>	City Hall
	<input type="checkbox"/>	Theatre
	<input type="checkbox"/>	Museum
	<input type="checkbox"/>	Other: .....
Sensitive targets	<input checked="" type="checkbox"/>	High profile people
	<input type="checkbox"/>	Symbolic buildings
	<input type="checkbox"/>	Tourists or crowd of them



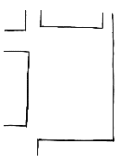
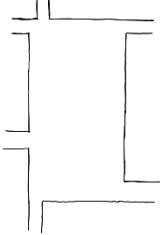

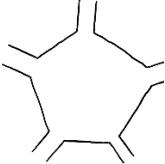
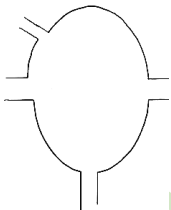
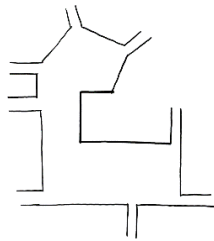
(make) Built Environment Safer in Slow and Emergency Conditions through behaviorUral assessed/designed Resilient solutions

Grant number: 2017LR75XK

## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters		sub-parameters	
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A	
	<input type="checkbox"/>	B	
	<input type="checkbox"/>	C	
	<input type="checkbox"/>	D	
	<input checked="" type="checkbox"/>	E	
	<input type="checkbox"/>	F	
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization	
	<input type="checkbox"/>	Uncovered pipes	
	<input type="checkbox"/>	High tension wire	
	<input type="checkbox"/>	Other: .....	
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake	Zone 3
	<input type="checkbox"/>	Tsunami	
	<input type="checkbox"/>	Mass Movement (dry)	
	<input type="checkbox"/>	Volcanic activity	
	<input type="checkbox"/>	Storm/tornado	
	<input checked="" type="checkbox"/>	Extreme temperature	
	<input checked="" type="checkbox"/>	Flood	P1
	<input type="checkbox"/>	Landslide	
	<input checked="" type="checkbox"/>	Wildfire	
	<input type="checkbox"/>	Chemical	
	<input checked="" type="checkbox"/>	Explosion/fire	
	<input checked="" type="checkbox"/>	Transport accident	
	<input checked="" type="checkbox"/>	Terrorist attack	
<input type="checkbox"/>	Miscellaneous accident		

**Trani: Duomo and Re Manfredi squares**

SECTION 1: MAIN TYPE					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

dimensions		scheme*
Area (m <sup>2</sup> )	11.000	
H max built front (m)	59	
H min built front (m)	4	
		

*\*draw a scheme of the open space with the main dimension and accesses location reported*

SECTION 2: CHARACTERISTICS OF GEOMETRY AND SPACE			
	parameters	sub-parameters	n.
frontier	SA (Structural Aggregates)	Aggregated (SU≥1)	3
		Isolated (SA=SU)	3
	SU <sub>i</sub> (Interferent Structural Unit)		5
	CBF (Continuous Built Front)		6
	Access	Vehicular	4
		Pedestrian	2
		Controlled /with obstacles	1
	Special building	Church	1
		City Hall	
		Theatre	
		School	
		Museum	

content		Other: Castle; 2 Courts; Public Prosecutor's office
	Town walls	
	Porches	
	Water	sea
	Quote difference	upward (i.e. stairs, ramps, containment walls)
		downward (i.e. stairs, ramps, balconies) 1
	Green area	
	Special building	
	Canopy	
	Fontaine	
	Monuments (i.e. obelisk, statues)	
	Dehors	
	Quote difference	upward (i.e. stairs, ramps) 1
		downward (i.e. stairs, ramps, balconies, parapets)
	Archaeological sites	
	Green area	
	Underground park	
	Underground cavities	

### SECTION 3: CONSTRUCTIVE CHARACTERISTICS

	parameters	sub-parameters
frontier	Homogeneity of built environment age	Yes
		✓ No
	Homogeneity of constructive techniques	Yes
		✓ No
	Urban furniture/obstacles	✓ Benches
		Bumps
		✓ Poles
		Flowerpot
		✓ Railings
		Bike Rack
		Traffic barriers
		Other: .....
content	Pavement materials (i.e. marble, travertine...)	Asphalt and Calcarous Stone
	Pavement lying (i.e. compact, disjointed, big slabs, small tiles, cobblestones...)	Big tiles, disjointed and slick or continuous for asphalt
	Pavement finishing (i.e. smooth, coarse, irregular...)	
	Urban furniture/obstacles	Benches

	<input type="checkbox"/>	Bumps
	<input checked="" type="checkbox"/>	Poles
	<input type="checkbox"/>	Flowerpot
	<input type="checkbox"/>	Railings
	<input type="checkbox"/>	Bike Rack
	<input checked="" type="checkbox"/>	Traffic barriers
	<input type="checkbox"/>	Other: .....

SECTION 4: CHARACTERISTICS OF USE		
parameters	sub-parameters	
Daily crowding	<input checked="" type="checkbox"/>	Morning
	<input checked="" type="checkbox"/>	Afternoon
	<input checked="" type="checkbox"/>	Evening
	<input checked="" type="checkbox"/>	Night
Special uses of open space	<input checked="" type="checkbox"/>	Concerts
	<input type="checkbox"/>	Theater
	<input checked="" type="checkbox"/>	Festivals
	<input checked="" type="checkbox"/>	Parking
	<input type="checkbox"/>	Other: .....
Accessible to	<input checked="" type="checkbox"/>	Vehicle
	<input checked="" type="checkbox"/>	Pedestrian
	<input checked="" type="checkbox"/>	Bike
	<input checked="" type="checkbox"/>	Scooter
	<input type="checkbox"/>	Other: .....
Strategic buildings	<input checked="" type="checkbox"/>	City Hall and administrative bldgs
	<input type="checkbox"/>	Operational headquarters for emergency management
	<input checked="" type="checkbox"/>	Law enforcement offices
	<input type="checkbox"/>	Healthcare facilities
	<input type="checkbox"/>	Other: .....
Sights	<input type="checkbox"/>	Overall Area of Linear Space
	<input checked="" type="checkbox"/>	Church
	<input type="checkbox"/>	City Hall
	<input type="checkbox"/>	Theatre
	<input type="checkbox"/>	Museum
	<input checked="" type="checkbox"/>	Other: Castle
Sensitive targets	<input checked="" type="checkbox"/>	High profile people
	<input checked="" type="checkbox"/>	Symbolic buildings
	<input checked="" type="checkbox"/>	Tourists or crowd of them



## SECTION 5: ENVIRONMENTAL CHARACTERISTICS

parameters	sub-parameters		
Climate classification [DPR 412/1993]	<input type="checkbox"/>	A	
	<input type="checkbox"/>	B	
	<input checked="" type="checkbox"/>	C	
	<input type="checkbox"/>	D	
	<input type="checkbox"/>	E	
	<input type="checkbox"/>	F	
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization	
	<input type="checkbox"/>	Uncovered pipes	
	<input type="checkbox"/>	High tension wire	
	<input type="checkbox"/>	Other: .....	
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake	Zone 3
	<input checked="" type="checkbox"/>	Tsunami	3
	<input type="checkbox"/>	Mass Movement (dry)	
	<input type="checkbox"/>	Volcanic activity	
	<input type="checkbox"/>	Storm/tornado	
	<input checked="" type="checkbox"/>	Extreme temperature	
	<input type="checkbox"/>	Flood	
	<input checked="" type="checkbox"/>	Landslide	
	<input type="checkbox"/>	Wildfire	
	<input type="checkbox"/>	Chemical	
	<input checked="" type="checkbox"/>	Explosion/fire	
	<input checked="" type="checkbox"/>	Transport accident	
	<input checked="" type="checkbox"/>	Terrorist attack	
	<input type="checkbox"/>	Miscellaneous accident	

### 3.2 Descriptive analysis of the survey forms data

The ASs analyzed are diversified for main type: two tending to quadrangle (San Gemini and San Giovanni in Persiceto - SGP), one elongated with parallel sides (Caldarola), one tending to triangular and funnel-shaped (Ostuni, that is a combination of two different tending to triangular squares) and four of composite type (Rieti, Narni, Matera and Trani). A mean of 3731 m<sup>2</sup> of space has been analyzed [min 1240 m<sup>2</sup> of San Gemini; max 12000 m<sup>2</sup> of Trani] (Figure 2). A sum of 48 Structural Aggregates (SA) interacting with the ASs have been considered [median 6; min 3 San Gemini, max 9 Ostuni] (Figure 3). Accesses to the ASs have been investigated, divided into vehicular, pedestrian and controlled ones [median 7, min 4 San Gemini, max 12 Matera] (Figure 3). Special buildings on the ASs are reported [median 3, min 2 Rieti, San Gemini e Ostuni, max 7 Matera] (Figure 4).

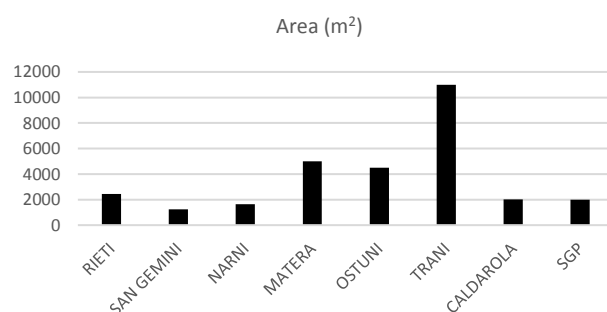


Figure 2: Case studies analyzed by area.

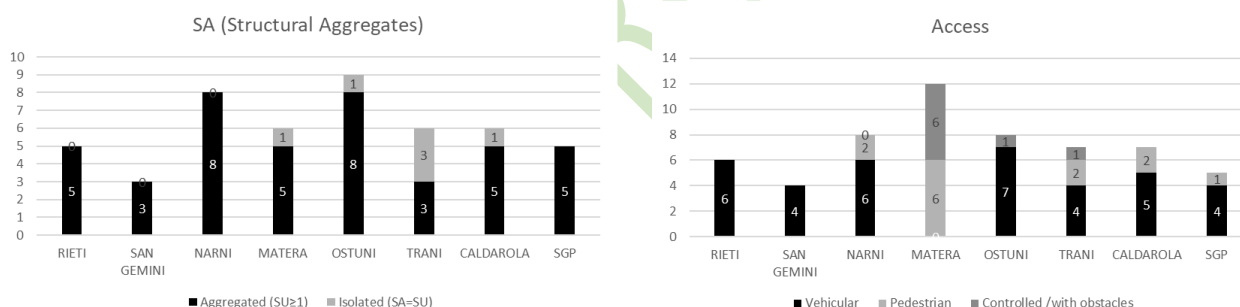


Figure 3: SA (Structural Aggregates) on the left. Access types on the right.

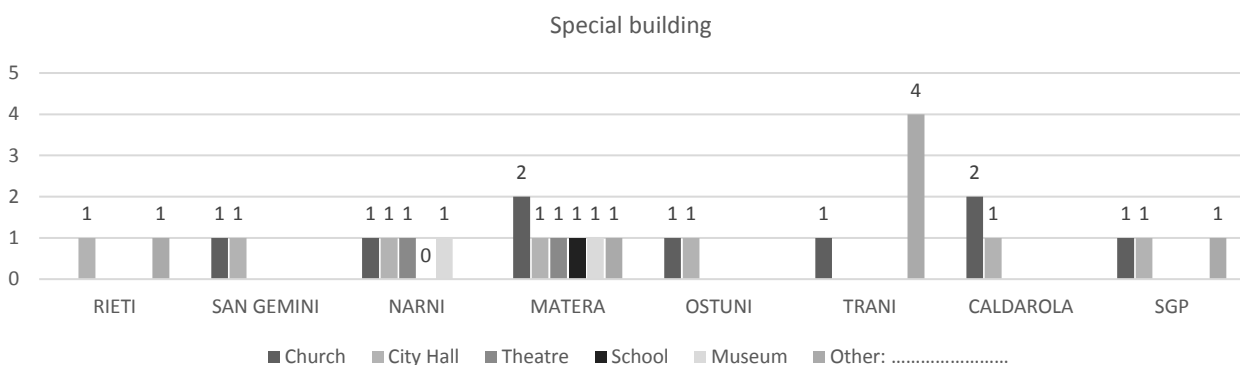


Figure 4: Special Buildings on AS

Referred to Section 3 (Characteristic of Use), the 8 cases present a quite constant use of the ASs: all the cases are used in morning, afternoon and evening, while Trani and Ostuni present a significative use also in the nighttime (Figure 5). The special uses of the open space are reported in Figure 5, highlighting the use for concerts in all the ASs, except for Caldarola, the use as festival for all of them, the use as theatre only for Narni square and the use as parking for 5 of them. The presence of Strategic Buildings represents another significative data on ASs [median 1; min 0 Ostuni, max 3 San Giovanni in Persiceto] (Figure 6). Sights present a median value of 2 in the analyzed cases [min 0 San Giovanni in Persiceto, max 5 Narni and Matera] (Figure 7).

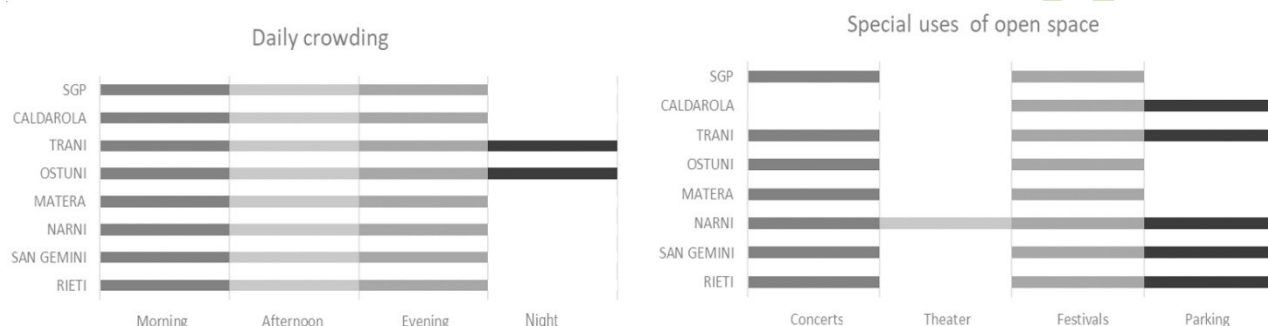


Figure 5: Characteristic of Use of analyzed AS. Daily crowding on left and Special uses on the right.

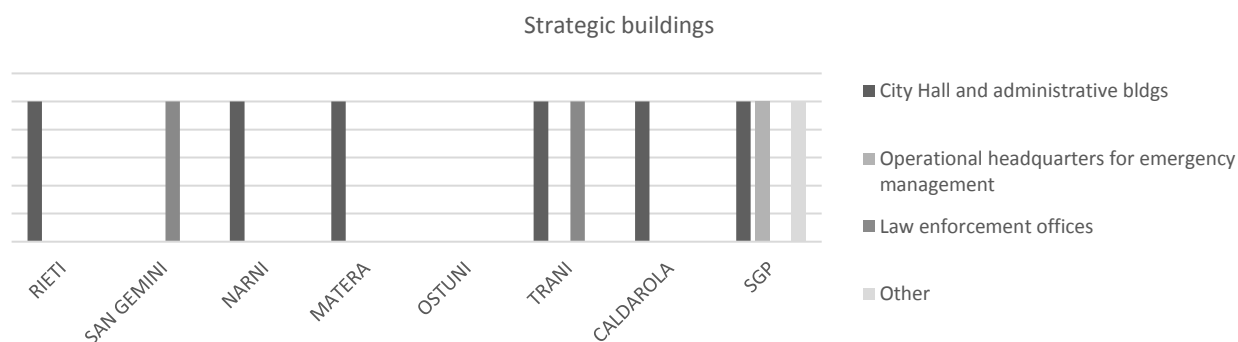


Figure 6: Strategic Buildings on ASs.

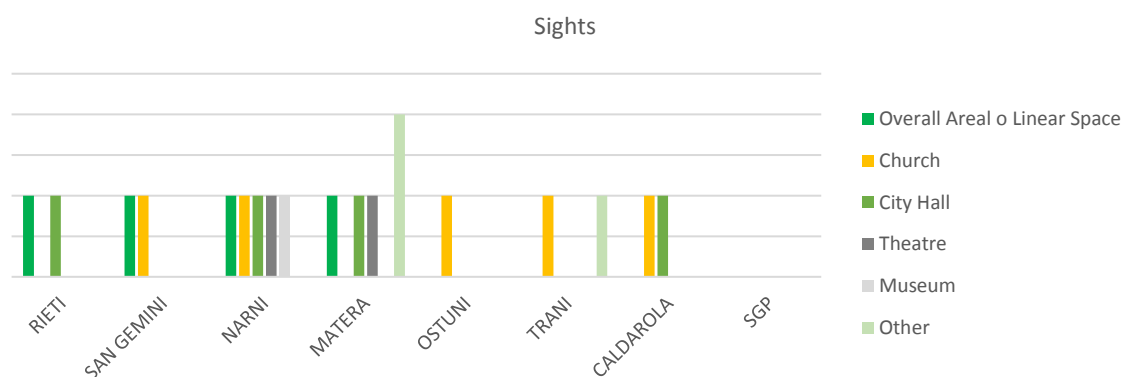


Figure 7: Sights on ASs.

In the last section (Environmental Characteristics), are analyzed the hazard assessment of the ASs, among other parameters. The 8 cases present a median value of overlapping of 6 type of SUODs [min 5 in Matera, max 7 in Caldarola]. According to national classification the analyzed cases are in class 2 (Rieti, San Gemini, Narni and Caldarola), 3 (Matera and San Giovanni in Persiceto) and 4, the lowest class (Ostuni e Trani).

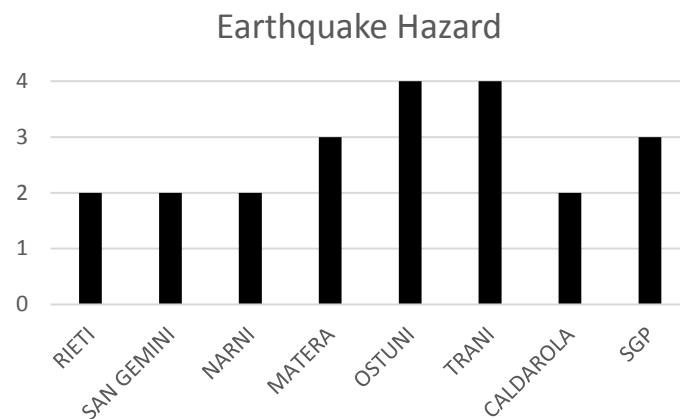


Figure 8: Earthquake hazard of analyzed AS.

#### 4. Discussion and selection of case studies

After the process of validation of the form, the three most relevant case studies are selected. The values as sum of single parameters are reported in the Figure 9 divided into sections and in the total value in Figure 10. Sections are considered from the second to the fifth one, excluding the first one in which is identified the main type of AS according to morphological aspects and the dimensional data.

For section 2 – Characteristics of Geometry and Space – median value is 38,5 [min 26 for Caldarola, max 58 for Narni]. In section 3 – Constructive Characteristics – median value is 8.5 [min 5 for SGP, max 11 for Matera]. Section 4 is relative to Characteristics of Use and have a median value of 15 [min 12 for Ostuni, max 20 for Narni]. In the end, the last section concerns the Environmental Characteristics, and present a median value of 8 [min 7 for Matera, max 10 for Narni].

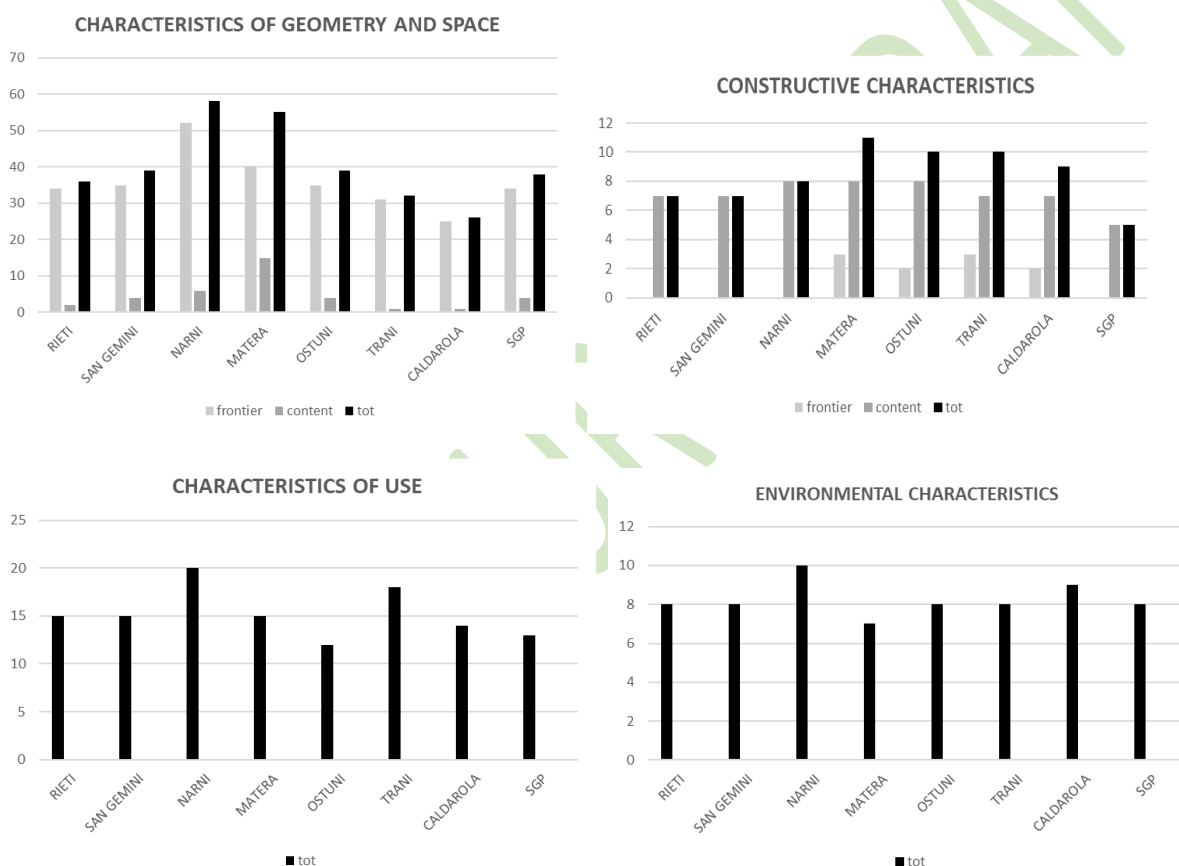


Figure 9: Charts of sum of values divided into sections of the survey form for the selected ASs.

The total values as sum of single parameters are reported in the final chart (Figure 10). An analyse with 25% percentile has been conducted [Q1 Percentile 25% = 65,5, Q2 median = 68, Q3 percentile 75%= 74]. Starting from this analysis of the values is possible to identify case studies on which we will focus a more detailed investigation. The case studies for the following phase have been identified according to the percentile data, so values inferior to first percentile ( $x < Q1 = 65,5$ ) and values superior to third percentile ( $x > Q3 = 74$ ) can be considered interesting because they represent a greater or lesser complexity within the sample. Among these

there are 3 cases: Narni (value 96), Matera (88) and Caldarola (58) (for a description of the three selected case studies see appendix at § 9).

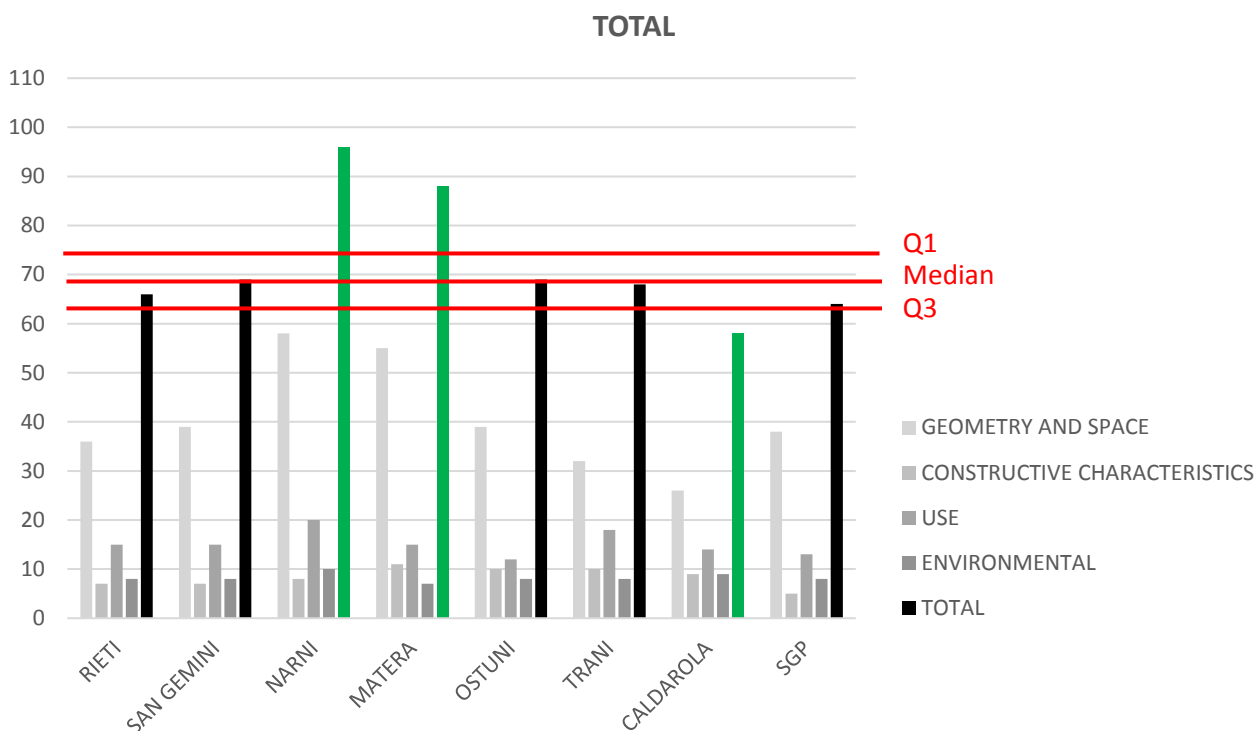


Figure 10: Chart of total values of AS survey.

Some limitations are highlightable in this approach. The main question regards the limited number of case studies selected for the validation of the survey form. Although the number is enough to elaborate a definitive structure of the form, that however it could be implemented in the next stages of research, it appears to be quite few to elaborate a significative data analysis. So, we can consider expanding the statistical sample for future development of this part of the research.

## 5. Conclusions

An expeditious survey form to evaluate Built Environment related to SUODs risk analysis has been carried out in the current D112 based on the theoretical assumption and the main literature collected in the previous deliverable.

The proposed methodology considers the features of the Areal Space of Italian historical centres developing the “Criteria for Be classification” (§3.3.2 in D1.1.1) with the aim of summarizing them in synthetic parameters for an assessment form according to several forms have already been developed in Italy (§2.1).

The analysis has been developed by steps in order to define an optimize survey form suitable with every different constructive peculiarities of BE, including a validation process aims at verifying the suitability of the form by applying it on eight Italian squares.

The collected data on the eight AS has been possible to select the most appropriate parameters responding all the aspects characterizing each case studies and systematize a good number of parameters to be able to describe the whole variety of Italian’s construction culture.

The methodological approach provides an effective expeditious tool for assessing the areal space in BE; moreover, the eight checked squares confirm the correctness of the proposed survey form and the report’s results have been led to obtain statistic considerations highlighting the three most significant case studies (i.e. Caldarola, Narni and Matera) which will be the subject of the next research activity.

## 6. Abbreviations

AS - Areal Spaces

BE - Built Environment

CRED - Centre for Research on the Epidemiology of Disasters

DRR – Disaster Risk Reduction

LS - Linear Spaces

SLOD - Slow-onset disaster

SUOD - Sudden-onset disasters

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## 8. Appendix: notation

Referring to § 2.1, Table 2, the notations introduced are defined as follow:

- **X**: for open spaces which are catalogued as “Tending to quadrangle” or “Elongated with parallel sides”, X indicates the length of a side of the open space; the dimension X is considered approximately perpendicular to dimension Y;
- **Y**: for open spaces which are catalogued as “Tending to quadrangle” or “Elongated with parallel sides”, Y indicates the length of a side of the open space; the dimension Y is considered approximately perpendicular to dimension X;
- **$\alpha$** : for open spaces which are catalogued as “Tending to triangular and funnel-shaped”,  $\alpha$  indicates the smallest acute angle of the triangular shape;
- **n**: for open spaces which are catalogued as “Trapezoidal and polygonal”, n indicates the number of regular sides of the polygonal open spaces.

## 9. Appendix: research material on the selected case studies

### 9.1 Narni

#### 9.1.1 Description of case study

Narni is an Italian town in the province of Terni, located along Via Flaminia. It is the first Umbrian for people coming from the south so to highlights and explains the important role that the city had over the years. It was founded at the beginning of the first millennium with the name of Nequinum.

In 300 BC it became a colony of the Roman Empire, as a road junction of fundamental importance for the control of the road network between Rome and the Adriatic Sea, linking its fortunes to this role for centuries and thus undergoing sieges and destructions that led to the formation of the current structure.

The elongated shape of the inhabited area is instead due to the morphological arrangement of the hill on which it is positioned (240 MAMSL), which also represents the border between the Lazio tuff and Umbrian limestone soil. Being a borderline at a territorial, historical and geological level, together with the presence of important connecting infrastructures, represent important elements of reflection for its enhancement.

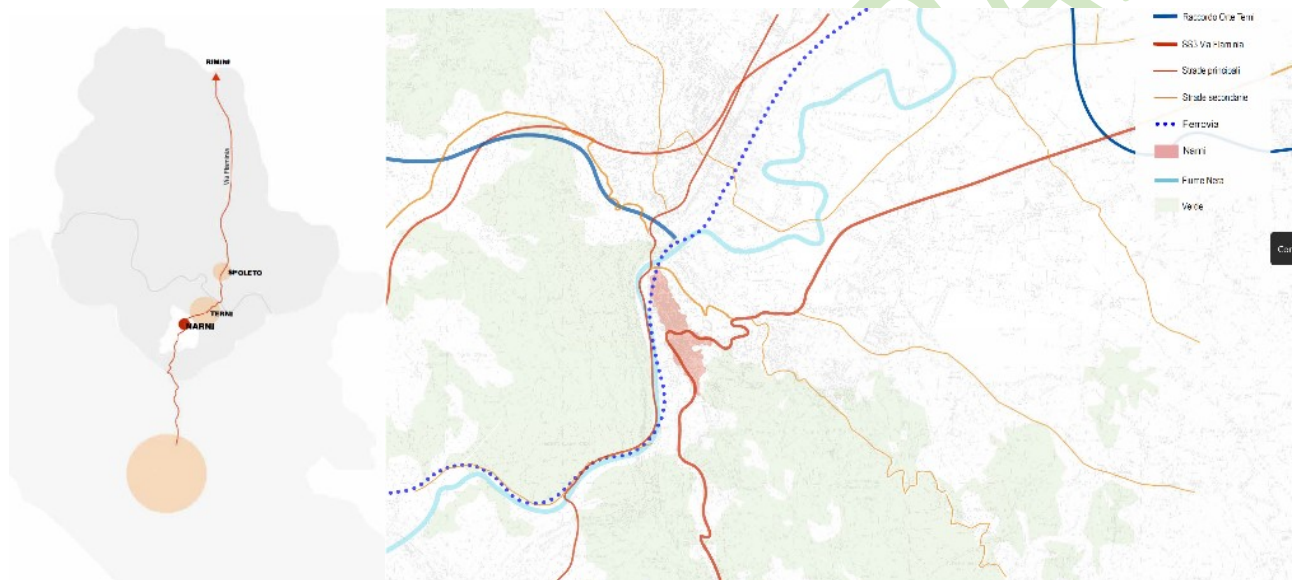


Figure 11: Narni Urban setting

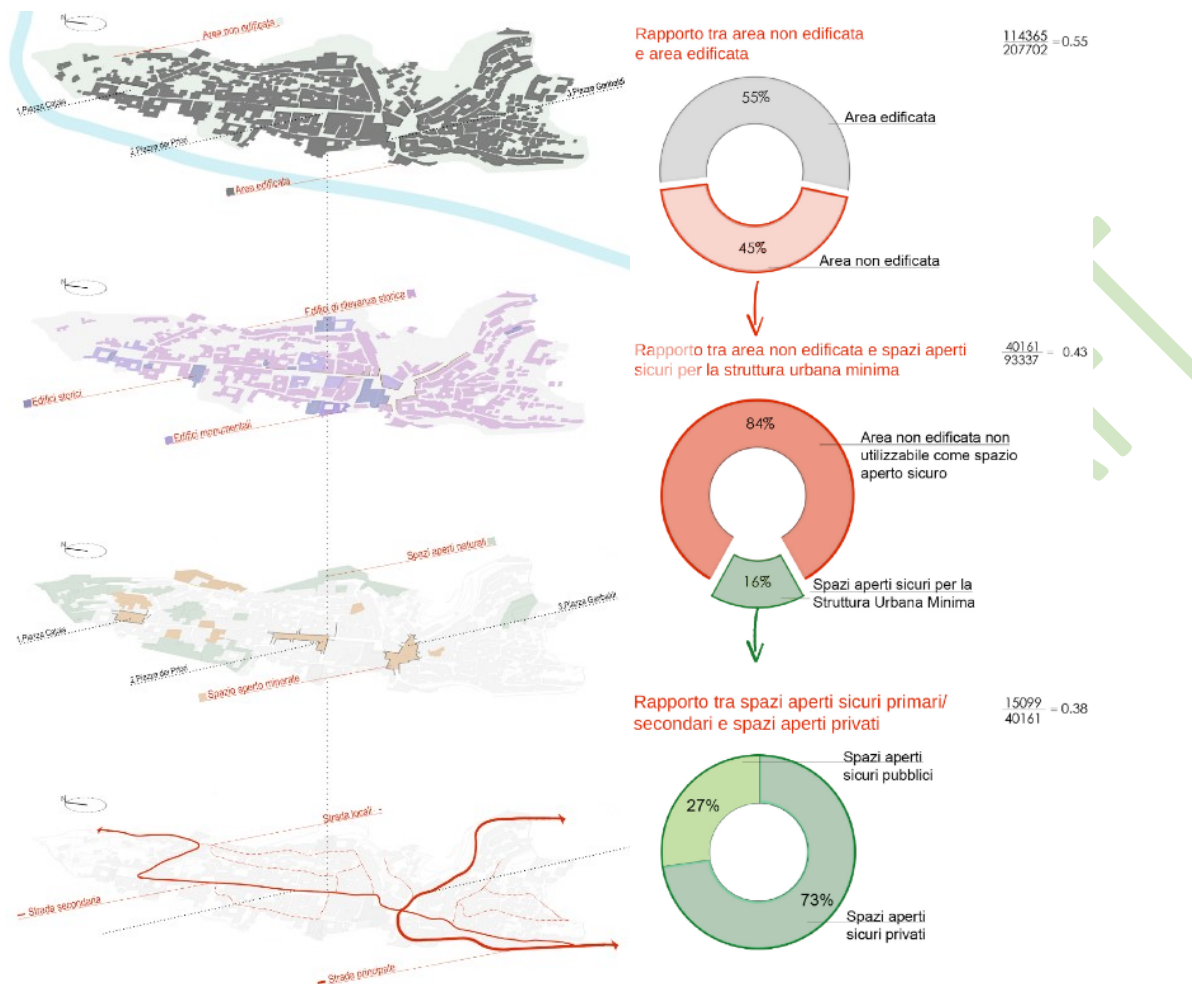


Figure 12: (on the left) Functional distribution of the built environment of Narni; (on the right from top) Ratio of undeveloped area and built-up area, Relationship between undeveloped area and open spaces safe for minimal urban structure, Relationship between primary secure open spaces /secondary and private open spaces



Figure 13: Narni Minimal Urban Structure

### 9.1.2 Description of the specific Built environment area for the SUOD risk analysis

The masonry construction of the ancient center of Narni presents constructive characteristics of extreme variety and richness especially in the use of materials. This peculiarity accounts for the long history of the city and the territory and reflects the stratification of the numerous interventions of reuse and transformation of ancient construction. This is particularly clear from the observation of the ancient fabric of the Terzieri of Fraporta and Santa Maria, especially along the main axis of the inhabited center, and of the Terziere Mezule in the band close to Piazza Garibaldi, the link between the two parts of the ancient city. Constructive wealth has been matched by a good level of attention to the control of different situations. We refer in particular to two issues that have always influenced Narni's "arte del costruire" and the importance of which still remains: the seismicity of the area and the construction on a slope.



Figure 14: Public aerial open spaces in Narni



### 9.1.3 Description of the potential SUODSs hazard and exposure of the specific BE area

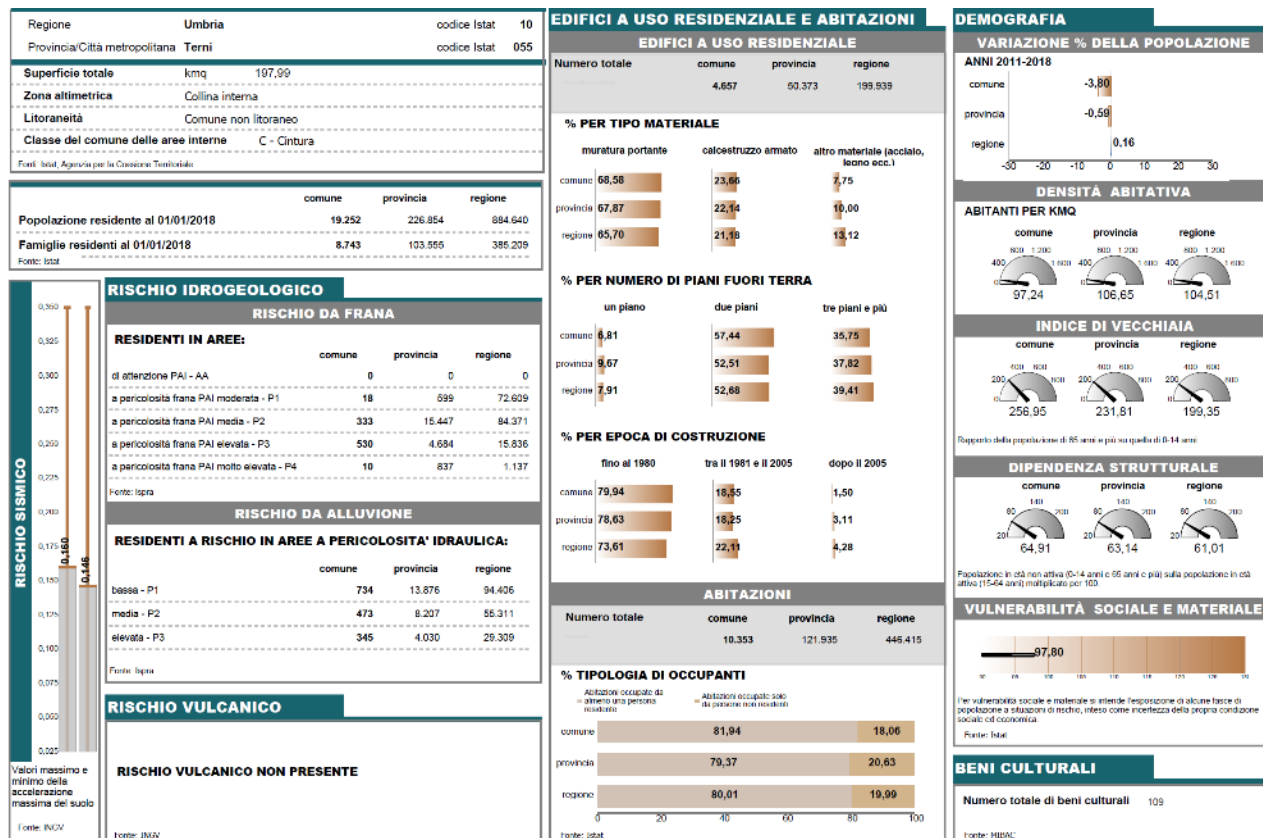


Figure 15: Narni ISTAT Risk indicators.

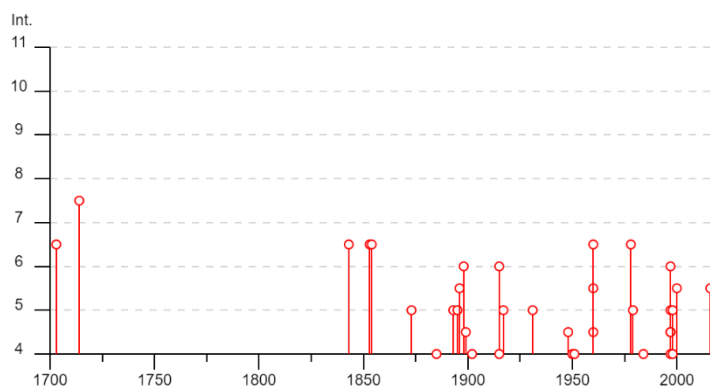


Figure 2: Seismic event in Narni from 1700 (DBMI15).

Narni territory is classified as seismic area graded with 2, having a maximum PGA of 0.16 g. Narni was repeatedly affected by earthquake as in 1899, 1896, 1854, 1853, 1843, 1714 when it was the epicenter of seismic event (INGV 2017). The most intense earthquake shown in Figure 2 was  $I_{max}$  7/8 in MCS scale.

The 2016 Central Italy earthquake hit 138 municipalities that are divided into four regions, spanning 8,000 square kilometers. Umbria region was highly affected by this earthquake that in Narni reached Int. 5/6.

#### 9.1.4 Aereal space description – Piazza dei Priori

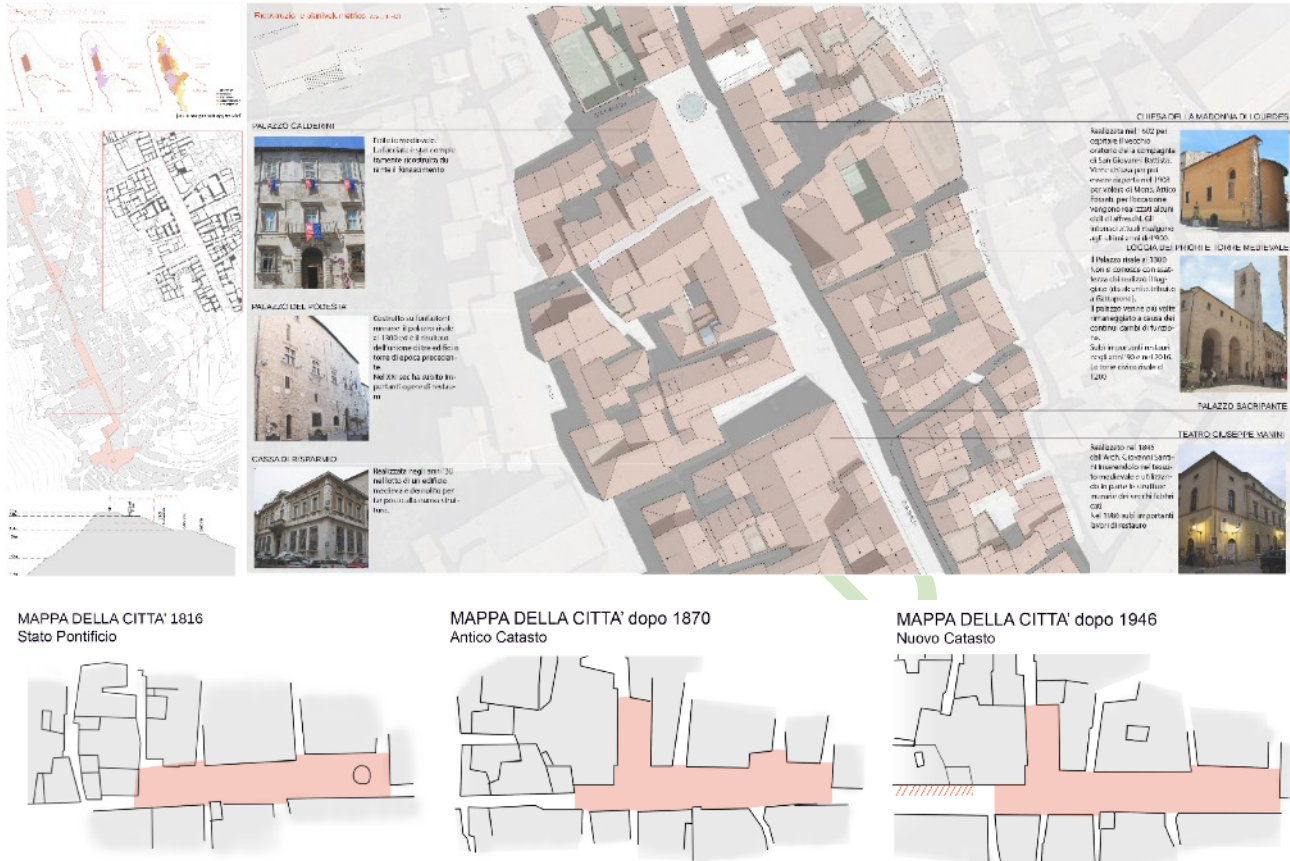


Figure 16: Evolution of the shape of Piazza dei Priori from 1816 to 1946.



Figure 17: Classification of buildings, uses and users in Piazza dei Priori.

From forum in Roman times, in medieval times Piazza dei Priori became the Platea Mayorum, the central, main and highest square of the city, where most of the main civic activities took place.

Medieval Narni was dotted with numerous stately towers, several of which, over the ancient square, had a defensive purpose and symbolized the power of the noble families who had erected them. Indeed, the civic tower dating from the first decades of X century is next to the Palazzo dei Priori. Many of these tower buildings have been joined or incorporated into building aggregates, while maintaining their original shape manifest as it is visible on the facade of the Town Hall. Around 1200-1300, in fact, the three towers were purchased and united to form the building that is still the town hall.

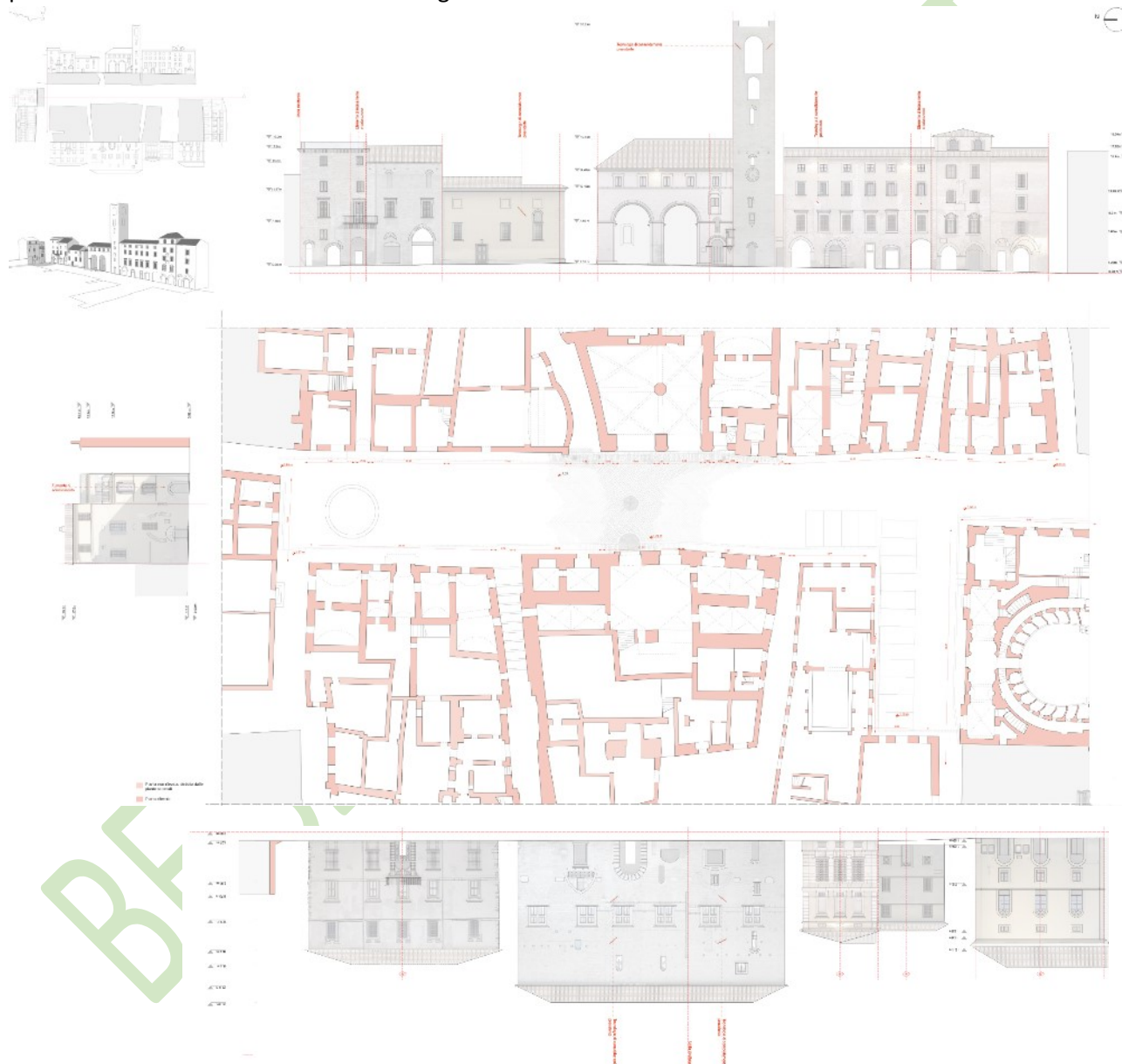


Figure 18: Plan and main fronts of Piazza dei Priori in Narni.



After fires, destruction and reconstructions, evidenced by recent findings, only in the 14th century the square reaches its current walking level. The town hall underwent numerous renovations until it assumed its current appearance. The facade of the Calderini palace has also been completely rebuilt. In 1845 the Municipal Theater was built on a medieval pre-existence, by Arch. Giovanni Santini. With Fascism and the Second World War, Piazza dei Priori undergoes important changes. In 1936 the Cassa di Risparmio was built, on an already existing portion of fabric, during the war important excavations were carried out for the construction of an anti-aircraft shelter and subsequently for the construction of the fountain's water system. After a period of neglect, numerous restorations and recoveries of the buildings overlooking the square were carried out from the 90s. In 1960 the Palazzo dei Priori was transformed into a shelter for the homeless, while in 1986 the Giuseppe Manini Theater was restored and reopened.

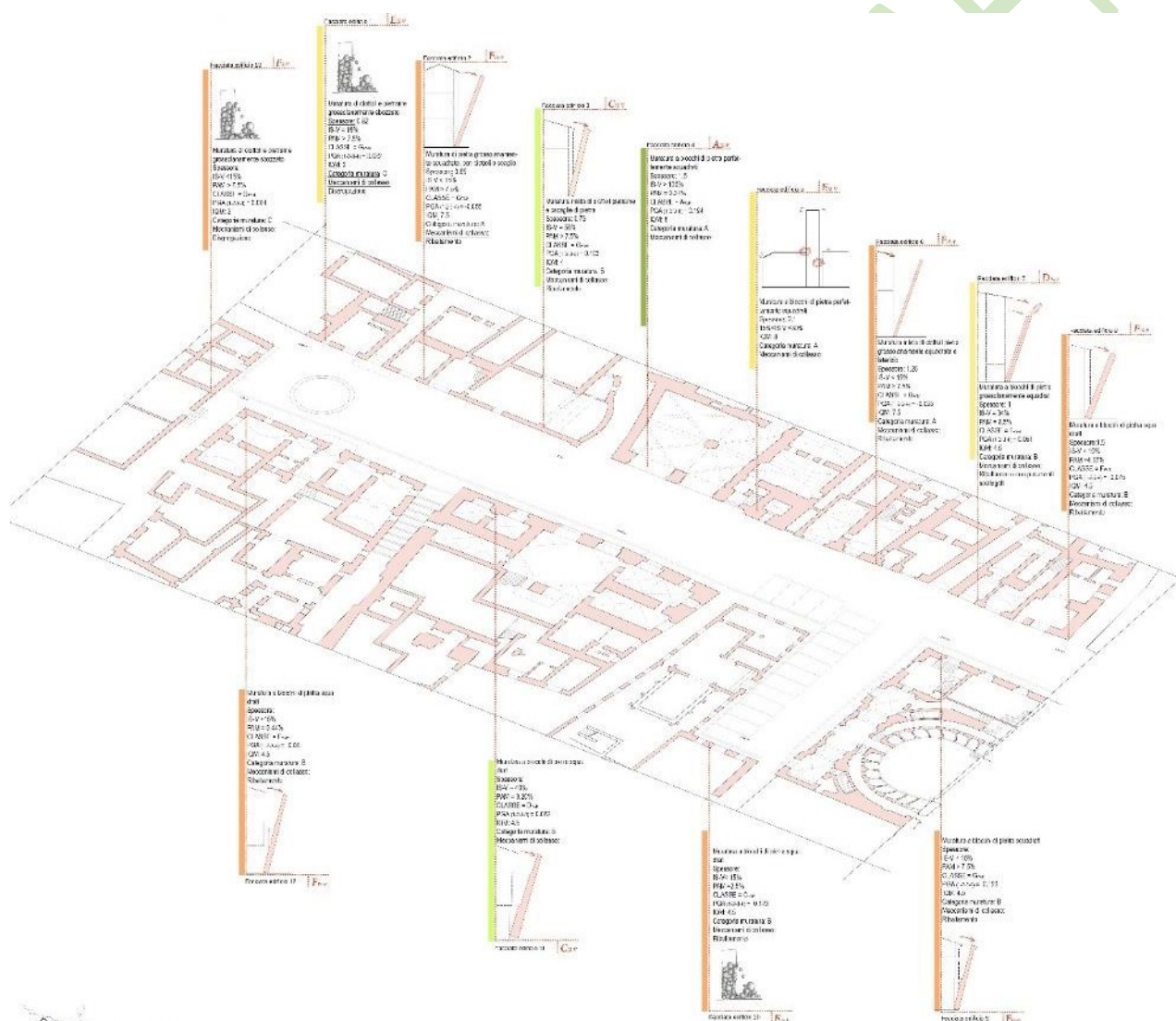


Figure 19:



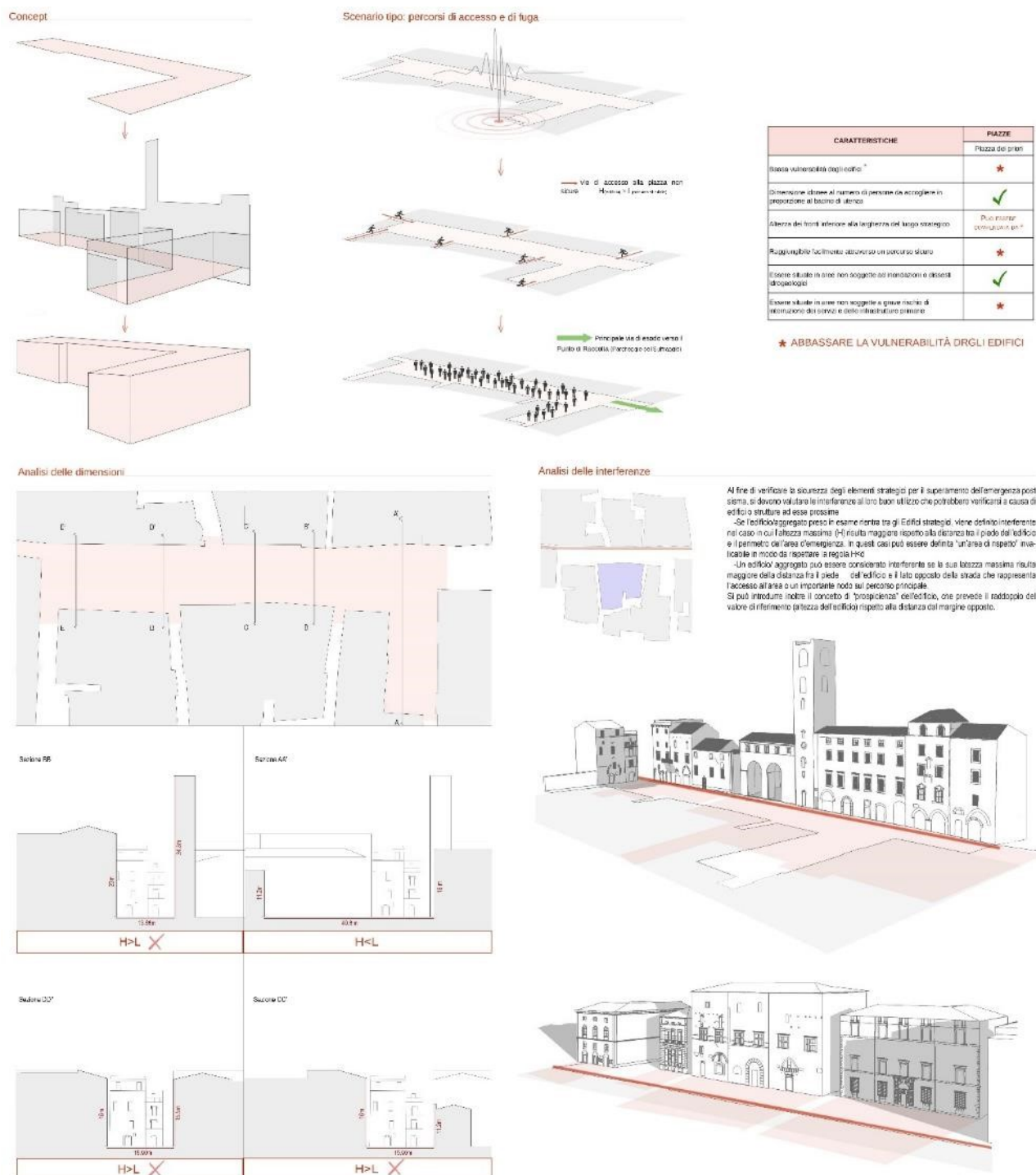


Figure 20:



Figure 21:

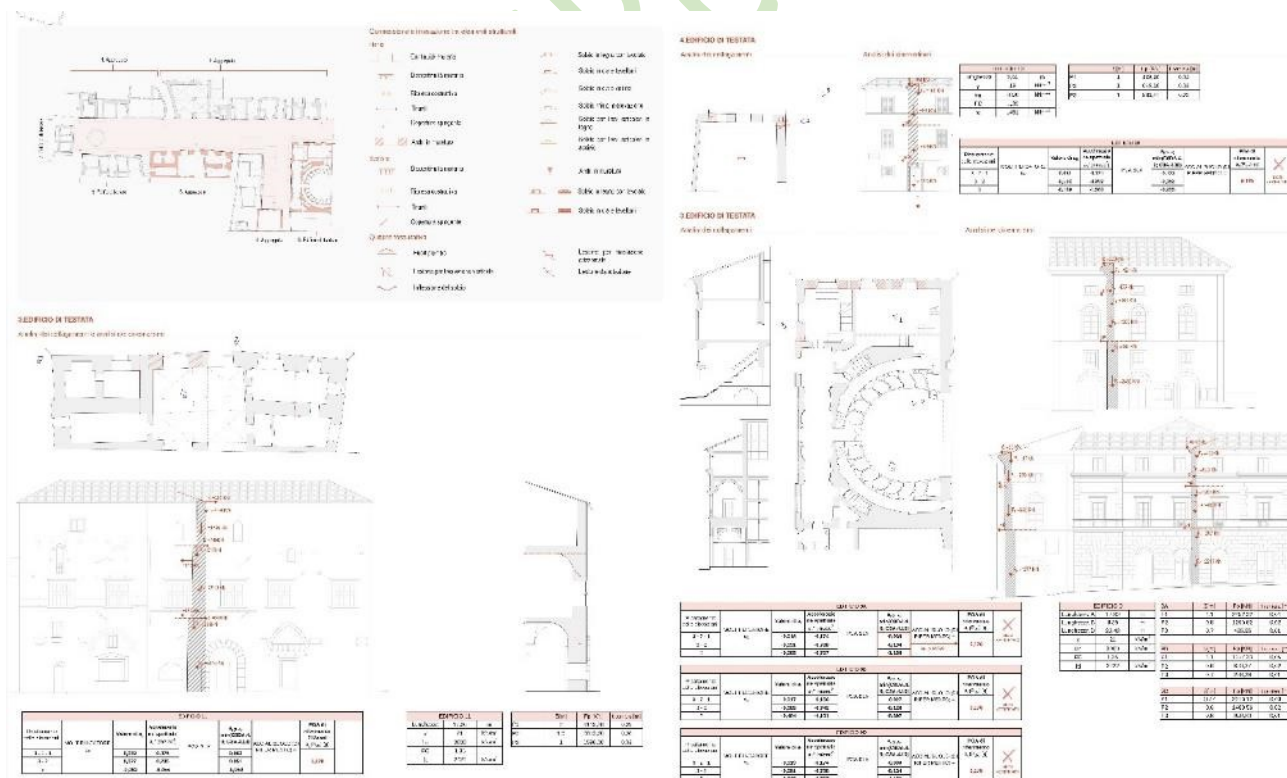


Figure 22:

## 9.2 Caldarola

### 9.2.1 Description of the case study

Caldarola is an Italian village located in the province of Macerata in the Marche region. It is well-known for the historical significance of its architecture: in 16<sup>th</sup> century a noble family, the Pallotta's, renovated completely the urban aspect of the whole centre according to Roman architecture and urbanism under Pope Sixtus V. That road pattern is still clearly visible and constitutes the main road network of the whole current urban settlement. During the same century, in Caldarola, was also born Simone De Magistris, famous artist who painted frescoes in Palazzo Pallotta (current City Hall).

Moreover, the Municipality of Caldarola is close to the Monti Sibillini National Park and its historical centre is located in a slope area that gives a charming landscape scenery.



Figure 23: Municipality of Caldarola and view on the Medieval Castle.

### 9.2.2 Description of the specific Built environment area for the SUOD risk analysis

The historic centre has a regular configuration arranged in buildings aggregates and narrow streets, whose layout follows the orography of the terrain. The medieval tissue is oriented perpendicular to contour lines, the others in parallel instead.

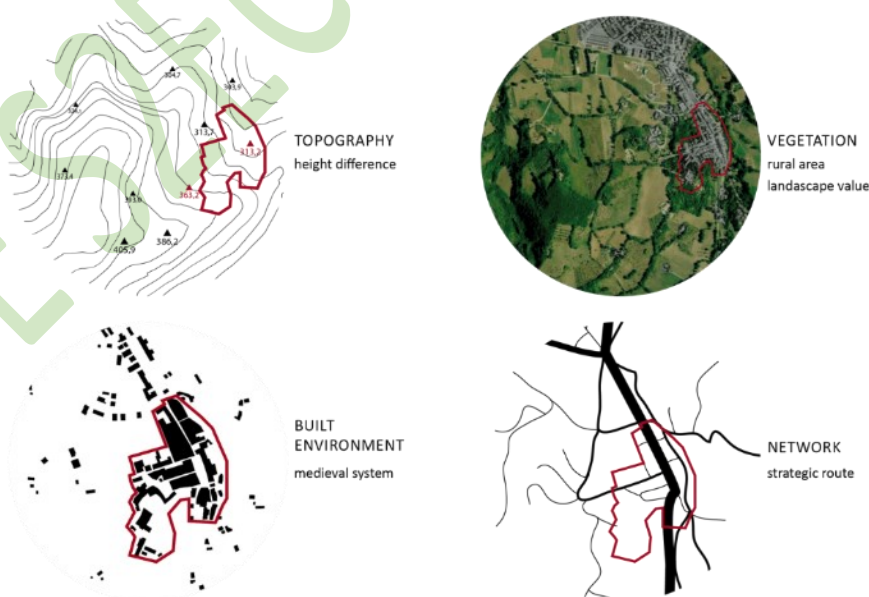


Figure 24: Geographical setting.

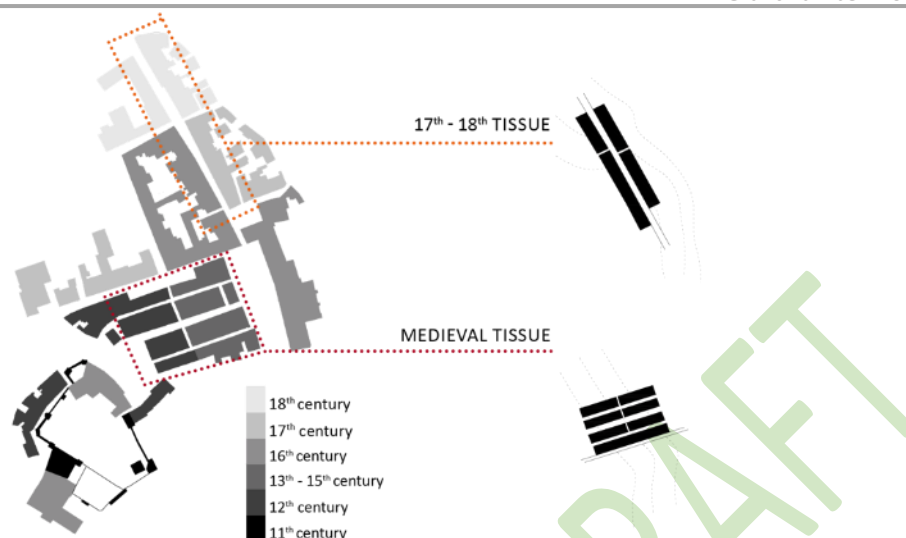


Figure 25: Transformation of urban tissue.

The medieval tissue where the Pallotta's Castle stands out and the Vittorio Emanuele square are at different height. So, we can suppose that the square's flat ground and buildings were built on a sloped lot leveling out the terrain for the foundation by retaining walls.



Figure 26: Urban section.

### 9.2.3 Description of the potential SUODSs hazard and exposure of the specific BE area

Its territory is classified as seismic area graded with 2, having a maximum PGA of 0.25g. Caldarola was repeatedly affected by earthquake (e.g. in 2016, in 1997, in 1936 was the epicenter of a seismic event).

The 2016 Central Italy earthquake hit 138 municipalities that are divided into four regions, spanning 8,000 square kilometers. The most affected region was the Marche region: widespread damage in 85 municipalities forced the 22,6% of regional residents to abandon their homes and carry on living in a different place. The seismic event on the 30<sup>th</sup> of October 2016 caused the collapse of the historical centre of Caldarola which led it to isolation because the access road was blocked from debris. Moreover, the historical centre was closed for two years due to security investigation on buildings.



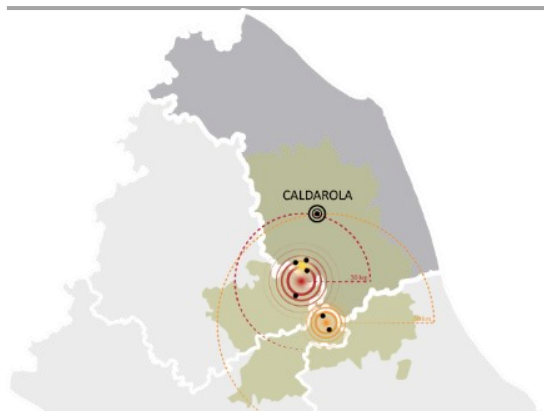


Figure 27: Areas affected by the 2016 central Italy earthquake and the case study.

## Caldarola (MC)

codice Istat 043006

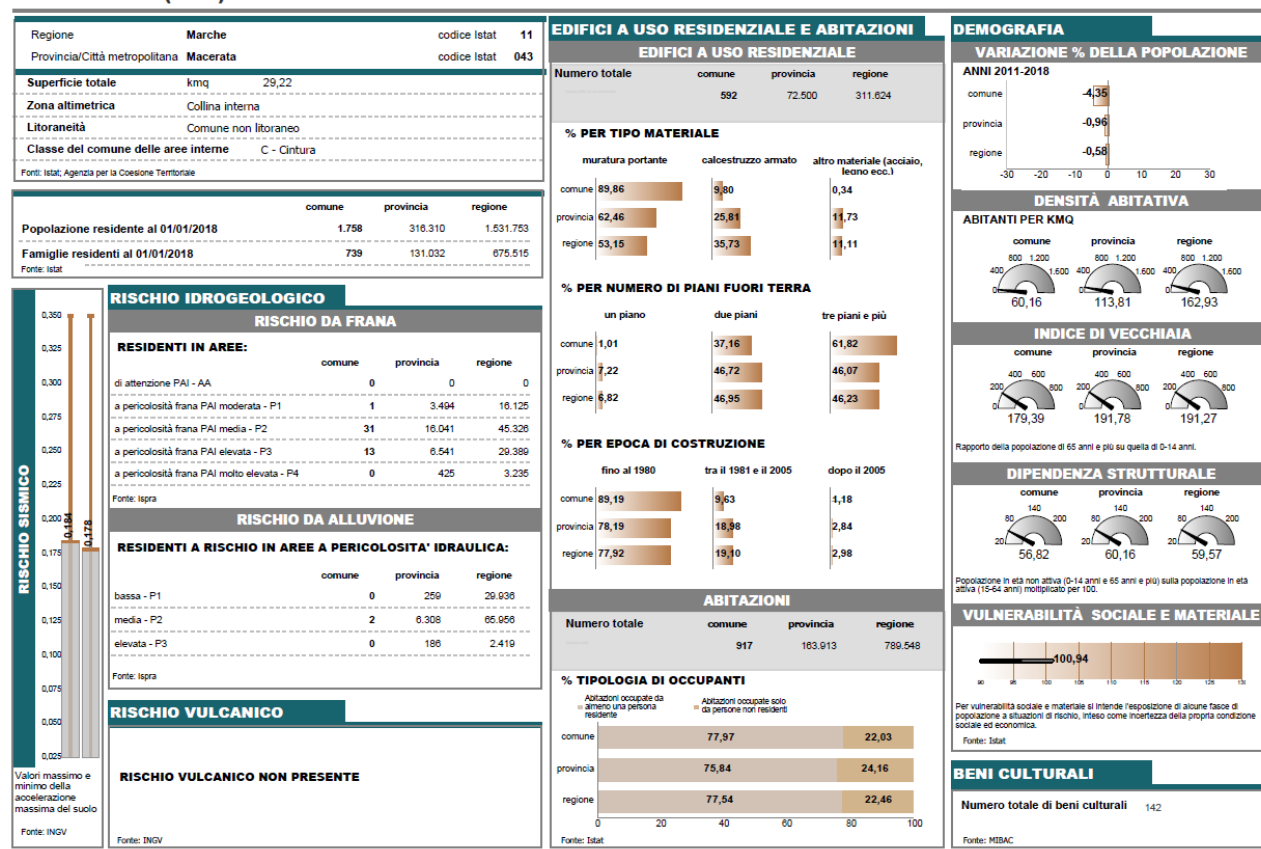




Figure 29: Network, nodes and areal space.

The buildings facing the square were built between the 15<sup>th</sup> and 16<sup>th</sup> centuries and they have different historical significance of their own constructive elements. On the East, there is a continuous built front composed of the current city hall (Palazzo Pallotta), the campanile tower and the San Martino Church; the West side, indeed, is occupied by four separated buildings part of structural aggregates instead. By considering the dimensional features of the areal space, the campanile tower is the only interfering element due to its about 30 metres of high.

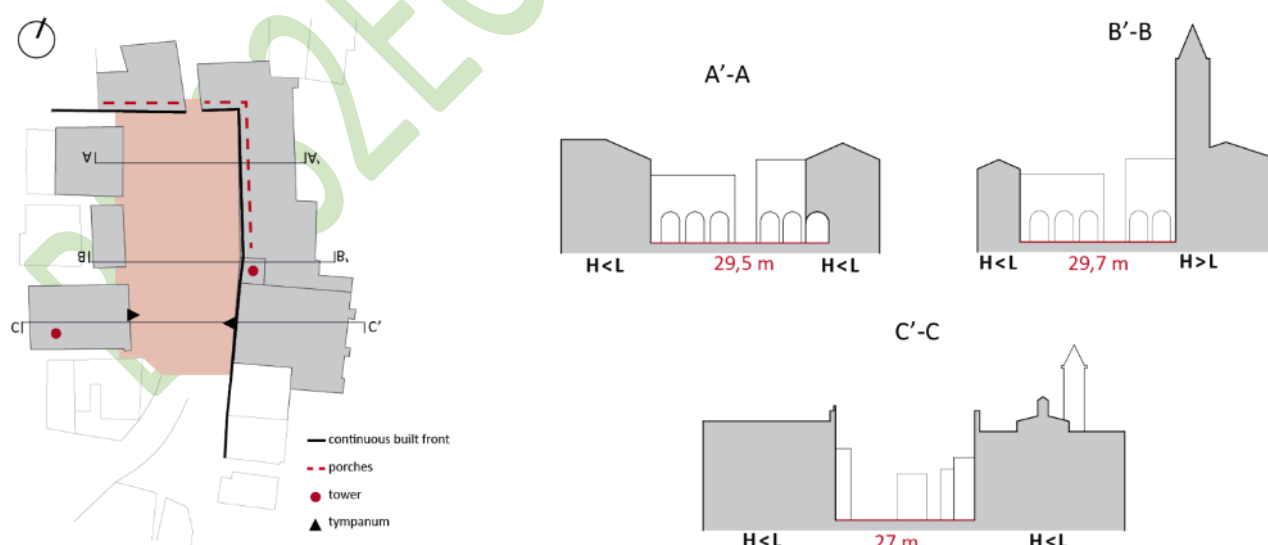


Figure 30:

The square is an attractive public space and includes different types of users in the social community life because of several building's uses (e.g. administrative, religious, commercial, touristic, residential). Buildings highlight in green have generally the commercial use on the ground floor and the residential on the upper. It also hosts the weekly urban market and annual cultural events such as historical re-enactments.



Figure 31:



Figure 32: View 1 and 2.

### 9.3 Matera

#### 9.3.1 Description of the case study

Matera, known as “underground city” or “city of Sassi”, represents a significant example of vernacular and troglodyte settlement, which have developed a harmonious balance between the housing vocation and the natural landscape. Located in the hinterland of the Lucan region, the historical town of Matera was erected on a rocky outcrop furrowed by a deep ravine (Gravina), being inhabited since the Paleolithic Age. The foundation nucleus of the town of Matera, known as “Civita”, rose up about in XIII century on a promontory named “Sperone Mediano”, surrounded by two valleys of fertile lands for agricultural activities. These valleys actually host the two other most ancient districts of the city, “Sasso Barisano” and “Sasso Caveoso”. The toponym derives from the Italian word “Sassi” meaning “rocks”, according to the typical caves excavated in the rock by the agricultural laborers for housing.

During the previous centuries, Matera became the focus of several recovery plans that excluded Sassi. Only since 1952, the site was considered by the public opinion as a national emergency. Since the '70, a large project of recovery of the Sassi started to be developed with the Special Law 771 of 1986. Such as a consequence, the Sassi of Matera and the Park of the Rupestrian Churches became part of “World Heritage List” by UNESCO since the 1993: defined as a millenary rock-cut settlement, they are perfectly integrated with the natural landscape, since ancient times. In the last decade, Matera has been characterized by a cultural reborn, thanks to the recovery of the Sassi area. In fact, the urban regeneration of the Sassi is still in progress, with several caves restored and re-used for commercial, touristic and residential activities.

Until 1986 the city of Matera developed, expanding on the upper land of Sassi, in the northern part and radially to the Sassi shape; strictly in adjacency with the Sassi district at North-East, the rest of the city developed until the end of 1800, according with the definition of City of Plan (because of the use of the territory featured by flat areas) Here, the historic districts suffered several plan of recovery and all the places that overlooked the Sassi were built, covering the elevate state of disrepair of traditional built. During the end of 1900 some transformations at historic districts allowed to open several overlooks and accesses on the Sassi that became the main Sights of Matera. In fact, because of the cultural relevance of Sassi, Matera actually represent one of the most visited areas in the South of Italy. Moreover, during last few years, Matera became the focus of Cultural tourist attractions because of the special candidacy to the 2019 European Capital of Culture.



*Figure 33: View of the Sassi of Matera furrowed by the ravine Gravina.*





Figure 34: Panoramic view of the rocky territory of the Sassi of Matera.

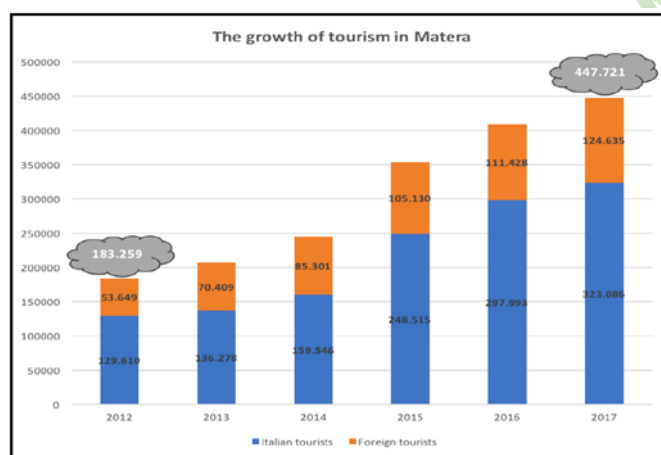


Figure 35: The growth of tourism in Matera before 2019 European Capital of Culture (Source: PROGRESS REPORT MATERA EUROPEAN CAPITAL OF CULTURE 2019 - MARCH 2018 – Available at: <https://www.matera-basilicata2019.it/en/component/phocadownload/category/1-documenti.html?download=1356:final-formal-monitoring-meeting-progress-report-of-matera-2019-en&Itemid=195>).

### 9.3.2 Description of the specific Built environment area for the SUOD risk analysis

The historic areas of Matera are representative of the largest period of their construction and geo-morphological characters of the site. The geo-morphological analysis has pointed out that the territory is mainly characterized by limestone rocks, which has undergone multiple fractures along the “Sassi” side, where a complex system of water flow paths has developed.

The typical house of the Sassi - known as “Lamione” - is represented by a cavern excavated into the calcarenitic rock with a closing stone masonry built with the limestone blocks dug from the site. The caves have few openings facing on an outer terrace or in courtyards, often shared by several houses and families. The urban structure of the Sassi developed on the concept of neighborhood, locally named “Vicinato”. In effect, the uncomfortable and narrow morphology of the caves forced the population to create a social connection with the community and to habit the external urban spaces.

The caves can be composed of different rooms excavated in the rock: primarily, a large room facing the outside hosts the living and the sleeping area; directly linked to this room, the cave often has a stable used

for the animal shelter, resulting in a critical sanitary condition. The urban complexity of the Sassi concerns also the overlapping of spaces and buildings along the valley. In some cases, the roof of some houses have become roads for other residential units located upstairs.

Despite the historical critical condition of life within the Sassi, their urban architecture has developed an equilibrium with the natural resources and environment. Firstly, the caves represent passive houses in terms of natural hygrometric and thermal performances. Secondly, the sustainability of the Sassi concerns the use of locally excavated materials for the building activity, as well as the capacity to take advantage of the natural ventilation and to collect the rainwater.

Near to the Sassi as the terrace above them, the main square - the Vittorio Veneto square – is the results of co-presence of buildings built during the 1200 and 1800 where the morphological configuration could not be associate to a specific tissue. However, the square is located above a complex system of cavities and undergrounded dwellings (Sassi) covered by the actual pavement. The presence of archeological site of Palombaro is a clear evidence of that feature.

Differences in state of maintenance exist between the main historic Vittorio Veneto square and Sassi: the latest are featured by a various level of state of disrepair caused by the current process of recovery by private citizen, while buildings along the square are in good state of maintenance due to the latest process of recovery in 1993.

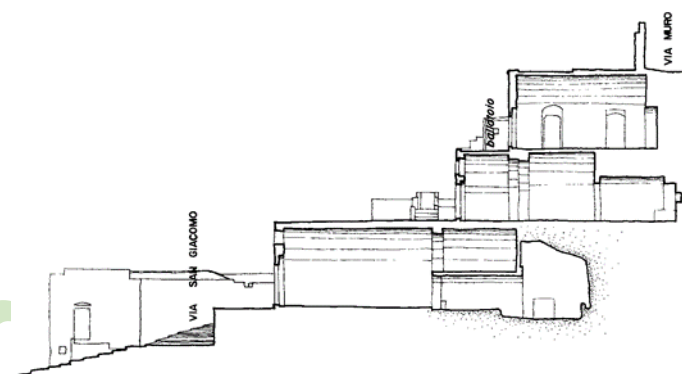


Figure 36: Section of Sasso Caveoso district, Matera (Source: Ufficio Sassi – Comune di Matera, Programma di Intervento di Edilizia Residenziale Pubblica per il Recupero del Patrimonio Edilizio Esistente, 1995).

### 9.3.3 Description of the potential SUODSs hazard and exposure of the specific BE area

The territory of Matera is classified as seismic area graded with 3 (Figure 34). Moreover, the geological stability of the area depends on the combination of the high exposure to hydrogeological risk (level R4) at Canyon level with a degraded limestone sublayer (Figure 35) as well as the presence of several cavities that featured the Sassi and Adjacent area (Figure 36).

## Matera (MT)

codice Istat 077014

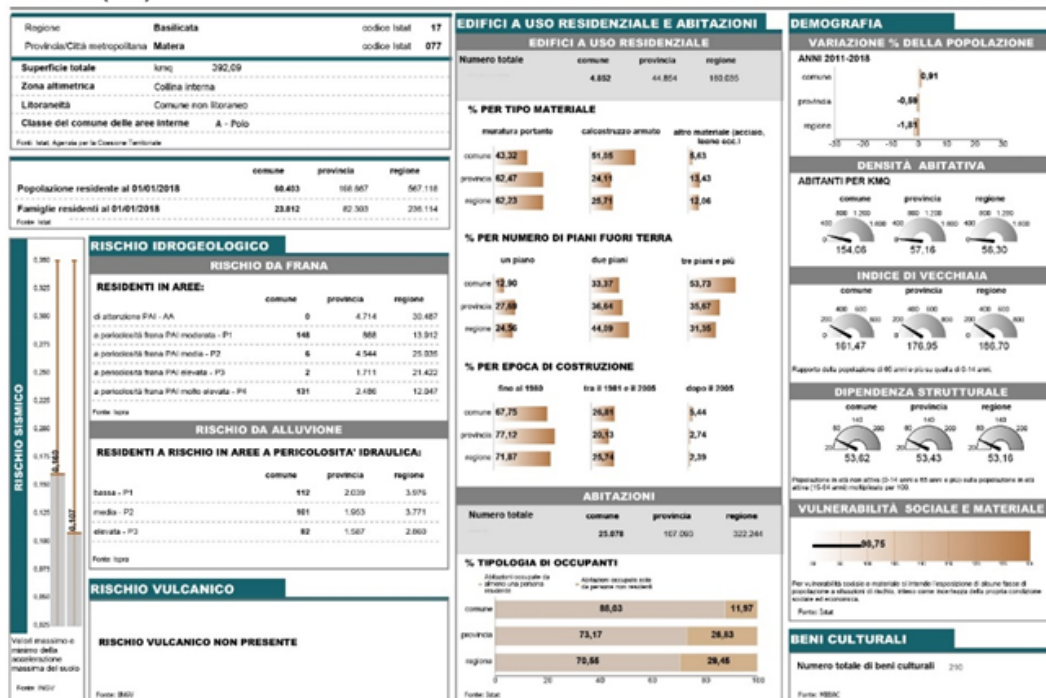


Figure 37: Matera STAT Risk indicators.

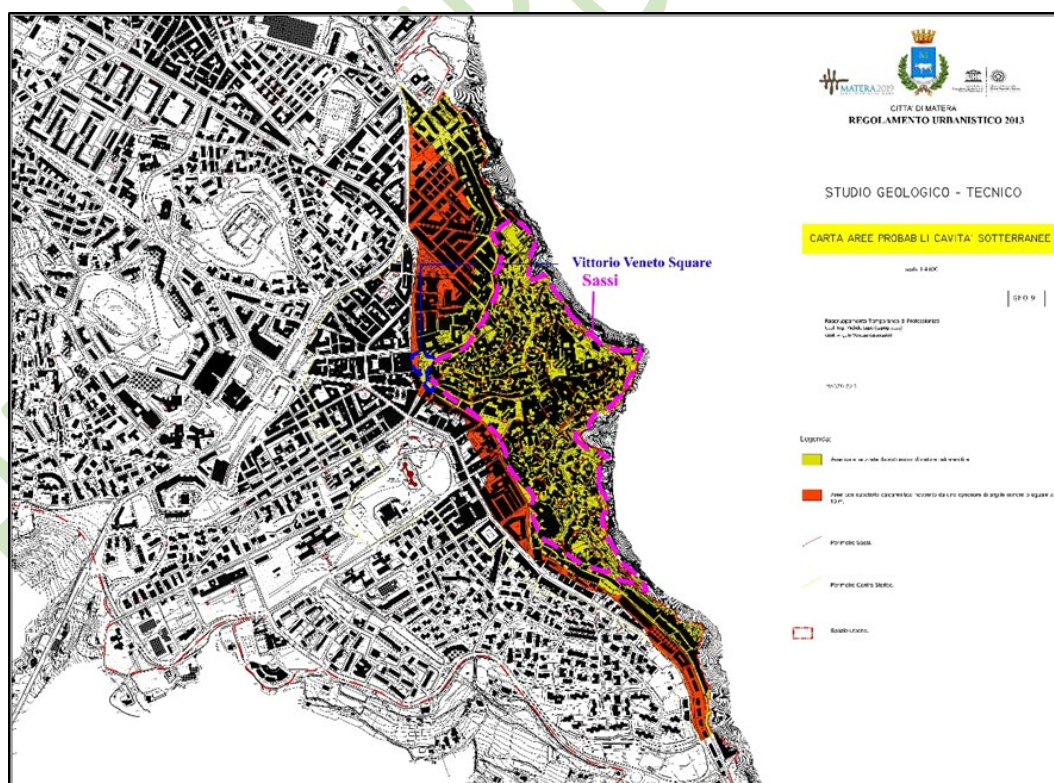


Figure 38: Map of underground cavities along the Sassi and adjacent areas.



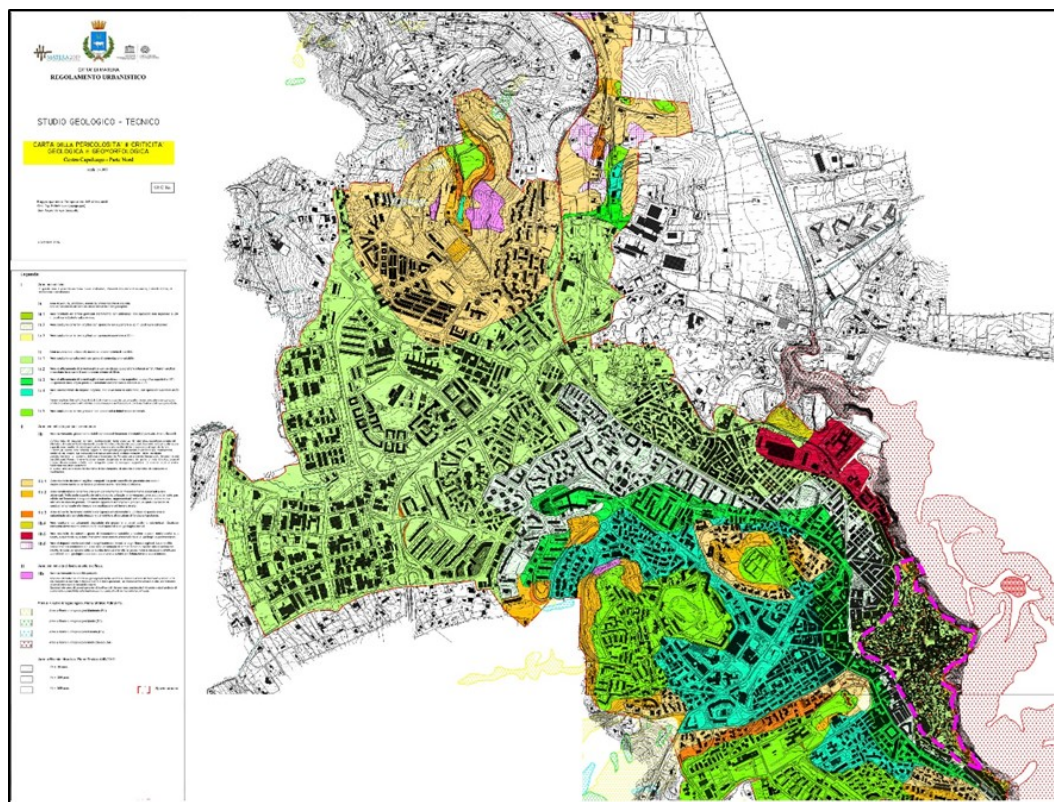


Figure 39: Map of Hydro-geological risk exposure of Matera.

#### 9.3.4 Areal space description – Vittorio Emanuele Square

Vittorio Emanuele Square is one of the terraced spaces above the Sassi. The square has an extension of 5000 mq. Its actual state is the result of the recovery activities in 1993, when the crossing street was delated and the archeological site was opened (Palombaro). As it was described in section 3.3.1, above the square is featured by a complex system of underground cavities.

On the touristic point of view, Vittorio Emanuele square represents the most representative square of Matera because of its panoramic position on the Sassi; moreover, because of its inherent features as a Sight for tourists, actually the square is not accessible to vehicles. Both narrow and large street reaching the square present restriction to vehicles as physical blocks or with the controlled traffic zone.

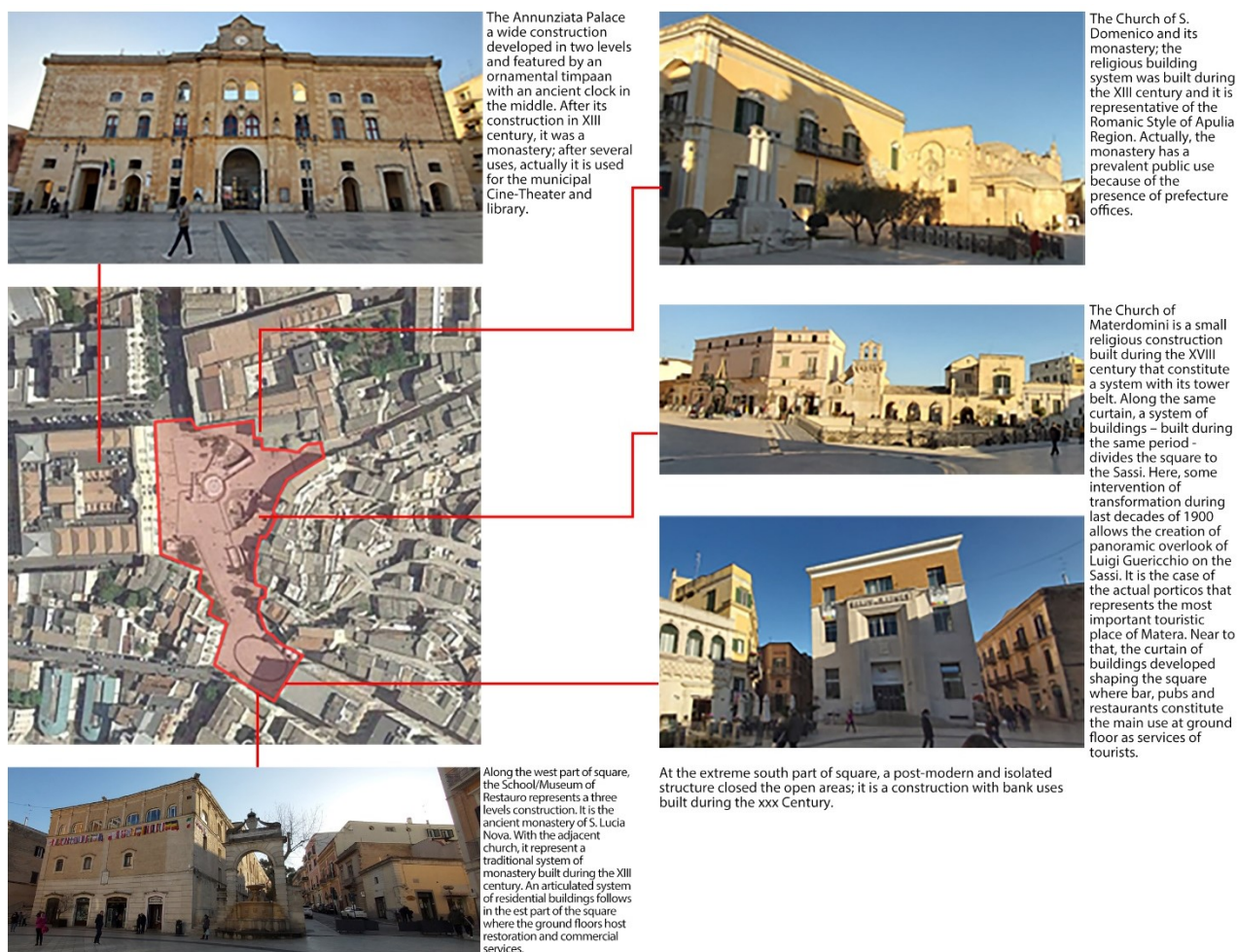


Figure 40: Building Constructions Vittorio Emanuele square.

Focus on the main built constructions, the square is delimited by several buildings featured by various uses, in detail:

- The Church of S. Domenico and its monastery; the religious building system was built during the XIII century and it is representative of the Romanic Style of Apulia Region. Actually, the monastery has a prevalent public use because of the presence of prefecture offices;
- The Church of Materdomini is a small religious construction built during the XVIII century that constitute a system with its tower belt. Along the same curtain, a system of buildings – built during the same period - divides the square to the Sassi. Here, some intervention of transformation during last decades of 1900 allows the creation of panoramic overlook of Luigi Guerichio on the Sassi. It is the case of the actual porticos that represents the most important touristic place of Matera. Near to that, the curtain of buildings developed shaping the square where bar, pubs and restaurants constitute the main use at ground floor as services of tourists;
- At the extreme south part of square, a post-modern and isolated structure closed the open areas; it is a construction with bank uses built during the 1930s;
- Along the west part of square, the School/Museum of Restauro represents a three levels construction. It is the ancient monastery of S. Lucia Nova. With the adjacent church, it represents a traditional system



of monastery built during the XIII century. An articulated system of residential buildings follows in the east part of the square where the ground floors host restoration and commercial services. At the end, the Annunziata Palace a wide construction developed in two levels and featured by an ornamental timpaan with an ancient clock in the middle. After its construction in XIII century, it was a monastery; after several uses, actually it is used for the municipal Cine-Theater and library.

Several cultural elements feature the Vittorio Emanuele square in addition to building constructions. Along the frontier the monumental “Ferdinandea” fountain built in 1832 is located near the Monastery of S. Lucia Nova; while, in the content, the Monument to the Dead of World War I is located in front of the Offices of Prefecture and near the Palombaro sites, the biggest cistern of Matera built above the square. It was excavated in the limestone sublayer is part of the representative system of cistern that features all the Sassi quartier. Actually, it is presented as a double system of open archeological sites, enclosed by railings. Finally, because of the specificity of the place, two system of stairs useful for the access to under-levelled district of Sassi are located into the square. Because of public security, stairs are actually closed and enclosed by railings. The complex system of uses and the high relevance of the square for tourism support the exposure to the terroristic attacks.

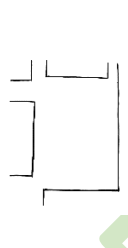
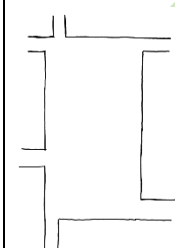

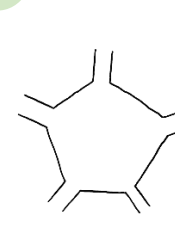
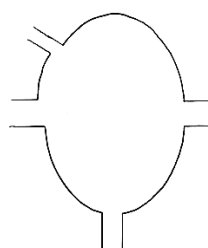
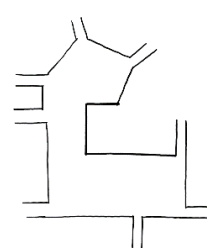


Figure 41: Classification of Building and urban elements for uses in Vittorio Emanuele square.

## 10. Appendix: validation of the preliminary survey form with suggestions and comments

Caldarola (Piazza Vittorio Emanuele II)



MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
	✓				

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	5
	✓	CBF (Continuous Built Front)	2
	✓	SU <sub>i</sub> (Interferent Structural Unit)	9
	✓	Access	7 (5 vehicular and 2 pedestrian)
	✓	Special building	4 (City Hall; 2 Churches; Tower)

	<input type="checkbox"/>	Town walls	-
	<input checked="" type="checkbox"/>	Porches	Loggias
	<input type="checkbox"/>	Water	-
	<input checked="" type="checkbox"/>	High difference / containment wall	Containment wall
	<input type="checkbox"/>	Green area	-
content	<input type="checkbox"/>	Special building	-
	<input type="checkbox"/>	Canopy	-
	<input type="checkbox"/>	Fontaine	-
	<input type="checkbox"/>	Monuments (obelisk)	-
	<input type="checkbox"/>	Slope / High difference	-
	<input type="checkbox"/>	Green area	-
	<input type="checkbox"/>	Underground park	-
	<input type="checkbox"/>	Underground cavities	-
	<input type="checkbox"/>		

CONSTRUCTIVE CHARACTERISTICS		(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input checked="" type="checkbox"/>	Yes
		<input type="checkbox"/>	No
	Homogeneity of constructive techniques	<input checked="" type="checkbox"/>	Yes
		<input type="checkbox"/>	No
content	Pavement materials and finishing	<input checked="" type="checkbox"/>	Slick
		<input type="checkbox"/>	Compact
		<input checked="" type="checkbox"/>	Disjointed
		<input checked="" type="checkbox"/>	Asphalted
	Urban furniture/obstacles	<input type="checkbox"/>	Benches
		<input type="checkbox"/>	Bumps
		<input type="checkbox"/>	Poles
		<input checked="" type="checkbox"/>	Flowerpot
		<input type="checkbox"/>	Railings
		<input type="checkbox"/>	Bike Rack
		<input type="checkbox"/>	Other: .....

CHARACTERISTICS OF USE		(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/>	Morning (6:00-12:00)
		<input checked="" type="checkbox"/>	Afternoon (12:00-18:00)
		<input checked="" type="checkbox"/>	Evening (18:00-24:00)
		<input checked="" type="checkbox"/>	Night (24:00-6:00)
	Crowding index		.....
	Special use	<input type="checkbox"/>	Concerts
		<input type="checkbox"/>	Theater
		<input checked="" type="checkbox"/>	Festivals
		<input checked="" type="checkbox"/>	Parking
		<input checked="" type="checkbox"/>	Strategic buildings



			Others: .....
Accessible to:	<input checked="" type="checkbox"/>	Vehicle	
	<input checked="" type="checkbox"/>	Pedestrian	
	<input checked="" type="checkbox"/>	Bike	
		Other: .....	
Vulnerable users		Tourists, aged people, children	
Sensitive targets to terroristic attack	<input checked="" type="checkbox"/>	Strategic buildings	
		Significative people	
		Other: .....	

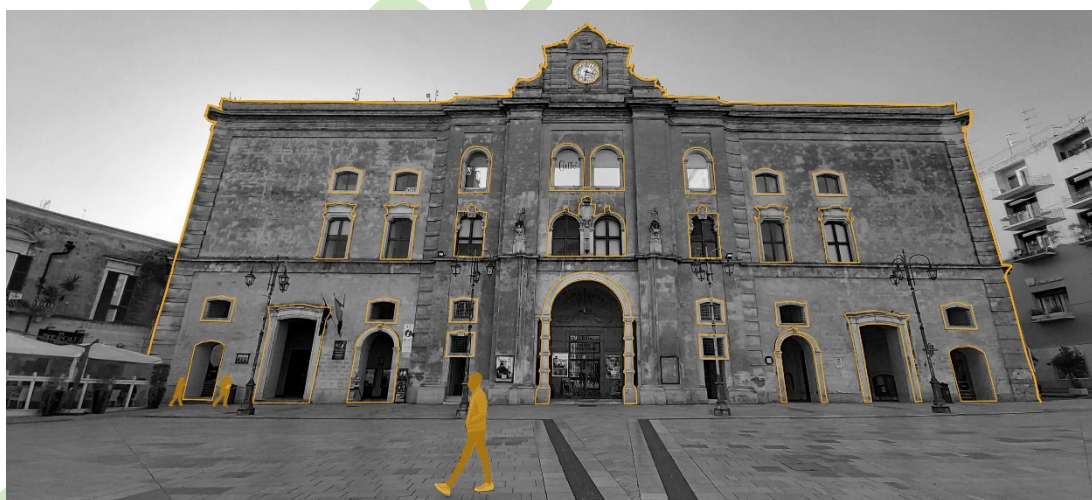
ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input checked="" type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input checked="" type="checkbox"/> High tension wire
	Underground cavities	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake (seismic zone: 2) <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input checked="" type="checkbox"/> Landslide <input checked="" type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

The square of Caldarola was an example that confirms the correctness of the form: all the aspects characterizing Vittorio Emanuele II square were already considered. Consequently, we report some considerations:

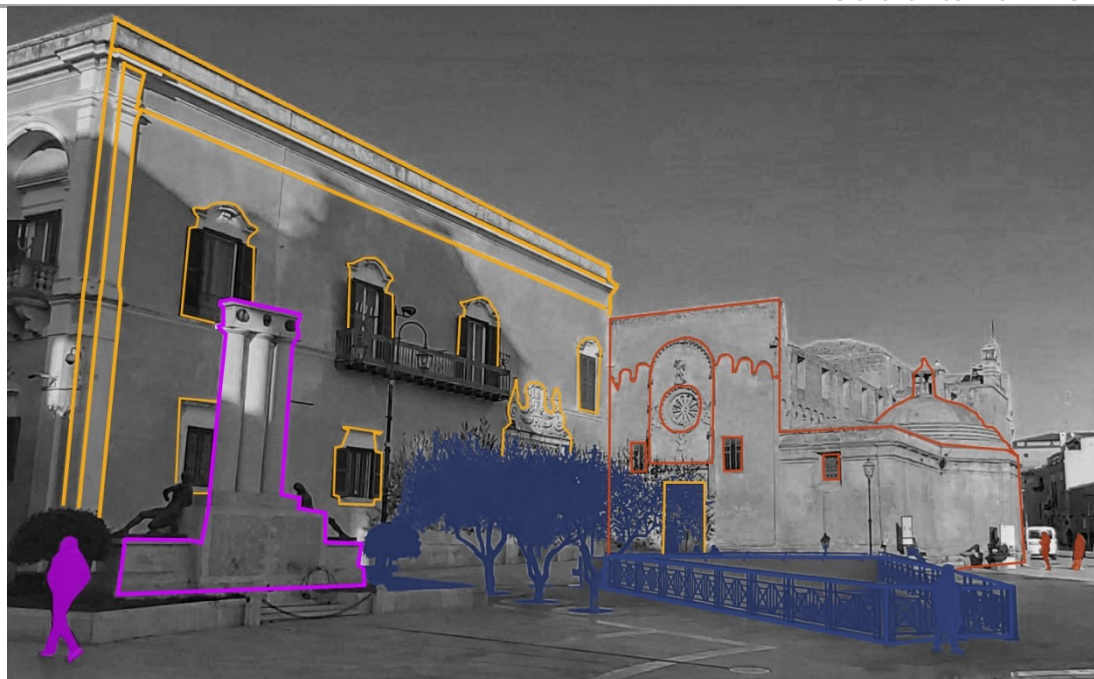
- **CHARACTERISTICS OF GEOMETRY AND SPACE:**  
Piazza Vittorio Emanuele II, located in the historical center of Caldarola, lies on a flat ground at the end of the sloped lot where medieval urban fabric was built.
- **CONSTRUCTIVE CHARACTERISTICS:**  
The square was created around the 15th and 16th centuries and it is therefore well-known for the historical significance of its architecture: on the East, there is a continuous built front composed of the current city hall (Palazzo Pallotta), the campanile tower and the San Martino Church; on the West, there is another historic church, the Santuario of Santa Maria del Monte.
- **CHARACTERISTICS OF USE:**
  - The other buildings facing the square have generally the commercial use on the ground floor and the residential on the upper. Moreover, the public space also hosts the weekly urban market and annual cultural events such as historical re-enactments. Considering these building's uses, different types of users crowd the square at all times for participating to the social community life and touristic events.
  - The accessibility is a crucial issue, because the square is crossed by a main road that gives access to the historical center and leads to surrounding municipalities; there are another tree vehicular and two pedestrian access for connecting different areas of the urban fabric.

**Matera (Piazza Vittorio Emanuele)**

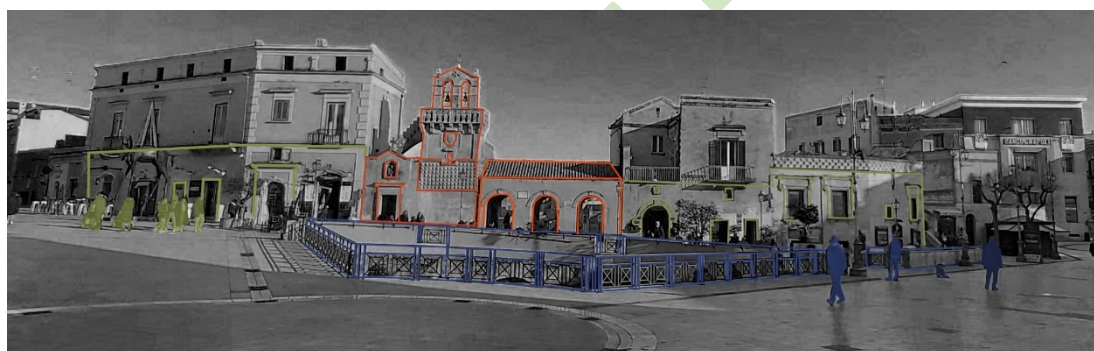


Point of view A





Point of view B

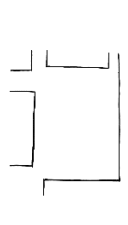
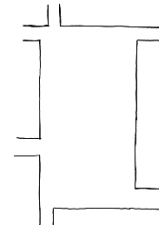
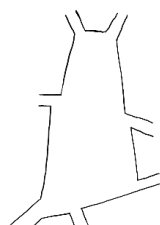
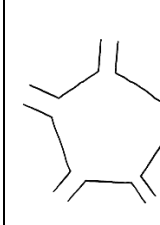
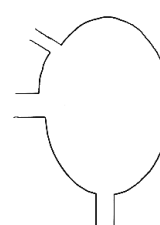



Point of view C



Point of view D

The characterization of the areal space identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	5 + 1 isolated
	✓	CBF (Continuous Built Front)	6
	✓	SU <sub>i</sub> (Interferent Structural Unit)	6
	✓	Access	6
	✓	Special building	6 (2 Churches; Prefecture; theatre + library; bank; school/museum)
		Town walls	-
	✓	Porches	As the access to the panoramic balcony (above the Sassi)
		Water	-
	✓	High difference / containment wall	2 (Panoramic balcony; stairs to access to the Sassi)
		Green area	-
content		Special building	-
		Canopy	
		Fontaine	
	✓	Monuments (obelisk)	Monument to the Dead of WW I
	✓	Slope / High difference	3 (2 archeological sites; stairs to access to the Sassi)
	?	Green area	(few trees and flowerpots)
		Underground park	-
		Underground cavities	-

CONSTRUCTIVE CHARACTERISTICS	(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
	Homogeneity of constructive techniques	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
content	Pavement materials and finishing	<input checked="" type="checkbox"/> Slick
		<input checked="" type="checkbox"/> Compact
		<input type="checkbox"/> Disjointed
		Other: .....
	Urban furniture/obstacles	<input checked="" type="checkbox"/> Benches
		<input type="checkbox"/> Bumps
		<input checked="" type="checkbox"/> Poles
		<input checked="" type="checkbox"/> Flowerpot
		<input checked="" type="checkbox"/> Railings
		<input type="checkbox"/> Bike Rack
		Other: .....

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input checked="" type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input type="checkbox"/> Night
	Crowding index	.....
	Special use	<input checked="" type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
	Accessible to:	<input checked="" type="checkbox"/> Others: tourism or sights
		<input type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
	Other: small electric scooter	<input type="checkbox"/> Other: small electric scooter
		<input type="checkbox"/> Other: small electric scooter
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		<input type="checkbox"/> Other: public services

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input checked="" type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input checked="" type="checkbox"/> Landslide <input type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

The square of Matera was an example of composite form. Some details related to obstacles in the geometry characters require some suggestions:

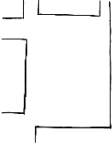
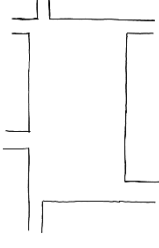
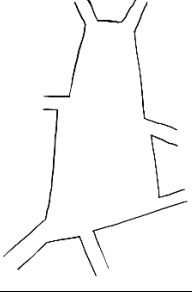
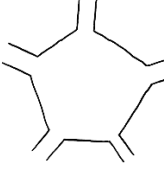
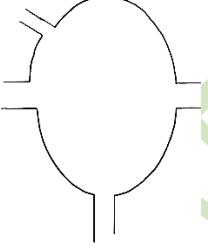
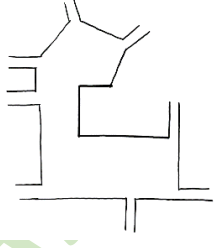
- **CHARACTERISTICS OF GEOMETRY AND SPACE:**
  - **Frontier:**
    - The presence of panoramic balcony and stairs could be indicated just as quote differences?
  - **Content:**
    - A further row should include *dehors*, temporary expansions of shops on the square.
    - The presence of stairs could be indicated just as quote differences?
- **CONSTRUCTION CHARACTERS IN THE FRONTIERS**
  - The presence of panoramic balcony and stairs determine the presence of special urban furniture also along the frontiers, as well as the presence of barriers for vehicles in dividing streets and squares (as a character of accessibility) both in frontiers and in content (see Trani).
- **CHARACTERISTICS OF USE**
  - The presence of sights could be described for touristic uses both in frontiers and contents.
  - Referring to the uses of the square, there is the necessity to insert the uses related to the public buildings that are along the frontier.
- **GENERAL SUGGESTION**
  - The accessibility to electric scooters could be useful?



**Narni (Piazza dei Priori)**



The characterization of the areal BE identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	8
	✓	CBF (Continuous Built Front)	10
	✓	SU <sub>i</sub> (Interferent Structural Unit)	17
	✓	Access	8
	✓	Special building	4 (Theatre; City Hall; Church; Tower)
		Town walls	-
	✓	Porches	Loggias
		Water	-
		High difference / containment wall	-
		Green area	-
content		Special building	-
		Canopy	-
	✓	Fontaine	1
		Monuments (obelisk)	-
		Slope / High difference	-
		Green area	-
		Underground park	-
	✓	Underground cavities	X

CONSTRUCTIVE CHARACTERISTICS		(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age		Yes
		✓	No
	Homogeneity of constructive techniques		Yes
		✓	No

content	Pavement materials and finishing	<input checked="" type="checkbox"/>	Slick
		<input type="checkbox"/>	Compact
		<input checked="" type="checkbox"/>	Disjointed
		<input type="checkbox"/>	Other: .....
	Urban furniture/obstacles	<input checked="" type="checkbox"/>	Benches
		<input type="checkbox"/>	Bumps
		<input type="checkbox"/>	Poles
		<input checked="" type="checkbox"/>	Flowerpot
		<input checked="" type="checkbox"/>	Railings
		<input type="checkbox"/>	Bike Rack
		<input type="checkbox"/>	Other: .....

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input type="checkbox"/> Night
	Crowding index	.....
	Special use	<input checked="" type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input checked="" type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
		Others: .....
	Accessible to:	<input checked="" type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
		Other: .....
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A
		<input type="checkbox"/> B
		<input type="checkbox"/> C
		<input checked="" type="checkbox"/> D
		<input type="checkbox"/> E
		<input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization

		<input checked="" type="checkbox"/>	Uncovered pipes
		<input checked="" type="checkbox"/>	High tension wire
Underground cavities		<input checked="" type="checkbox"/>	Yes
		<input type="checkbox"/>	No
Hazard assessment		<input checked="" type="checkbox"/>	Earthquake
		<input type="checkbox"/>	Tsunami
		<input type="checkbox"/>	Mass Movement (dry)
		<input type="checkbox"/>	Volcanic activity
		<input type="checkbox"/>	Storm/tornado
		<input checked="" type="checkbox"/>	Extreme temperature
		<input type="checkbox"/>	Flood
		<input checked="" type="checkbox"/>	Landslide
		<input type="checkbox"/>	Wildfire
		<input type="checkbox"/>	Chemical
		<input checked="" type="checkbox"/>	Explosion/fire
		<input checked="" type="checkbox"/>	Transport accident
		<input checked="" type="checkbox"/>	Terrorist attack
		<input type="checkbox"/>	Miscellaneous accident

## DISCUSSION

The square of Narni was an example that confirm the correctness of the form: all the aspects characterizing Piazza dei Priori square were already considered. Consequently, we report some considerations:

### - CHARACTERISTICS OF GEOMETRY AND SPACE:

- **Frontier:** the parameter "Structural aggregates" should be more detailed, i.e. indicated if there are any isolated blocks; the parameter "access" should be more detailed.
- **Content:** We should include the surface of the AS (m<sup>2</sup>), the perimeter (m), the length of CBF, the access width...)  
For the parameter *special building* we have different type of structure that could be better described (i.e. in Theatre and City Hall we could specify how big they are; for Church we could insert data as total high not connected with slab; for Tower we could specify the total high...);

### - CONSTRUCTIVE CHARACTERISTICS

- **Frontier:** *Homogeneity of built environment age* and *Homogeneity of constructive techniques* are too general to describe the historical evolution of the AS;
- **Content:** For *pavement materials and finishing* we should enter just the objective data of the type of flooring (materials and laying i.e. cobblestones, slabs ...) and consider a separate study on the effects of the material, without listing them directly on the form. In this way the correlation between material and effect on the evacuation can be updated with the development of the state of the art on the subject;

### - ENVIRONMENTAL CHARACTERISTICS

- We should insert seismic, hydrogeological, flood, volcanic risk classification and not only climatic one.
- The parameter "Underground cavities" is also in "Characteristics of geometry and space".
- The parameter "Crowding index" seems not appropriate in an expeditious survey.



**Grant number: 2017LR75XK**

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**Ostuni (Piazza della Libertà and Piazza St. Oronzo)**







Point of view A



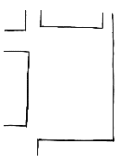
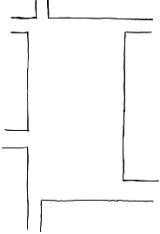
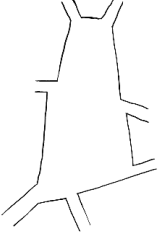
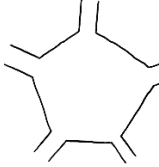
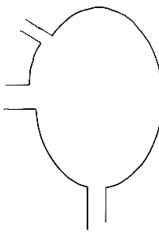
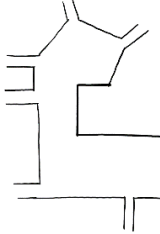
Point of view B



Point of view C

BE S²ECURE

The characterization of the areal space identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
		✓ tending to double triangle			✓ tending to double triangle

CHARACTERISTICS OF GEOMETRY AND SPACE	(parameters)	(sub-parameters)
frontier	<input checked="" type="checkbox"/> SA (Structural Aggregates) <input checked="" type="checkbox"/> CBF (Continuous Built Front) <input checked="" type="checkbox"/> SU <sub>i</sub> (Interferent Structural Unit) <input checked="" type="checkbox"/> Access <input checked="" type="checkbox"/> Special building <input type="checkbox"/> Town walls <input type="checkbox"/> Porches <input type="checkbox"/> Water <input checked="" type="checkbox"/> High difference / containment wall <input type="checkbox"/> Green area	8 + 1 isolated 6 9 8 (7 Vehicular + 1 Controlled traffic zone) 2 (Church; City hall) - - - 1 (Monsignor Don Elio Antelmi stairs) -
content	<input type="checkbox"/> Special building <input type="checkbox"/> Canopy <input type="checkbox"/> Fontaine <input checked="" type="checkbox"/> Monuments (obelisk) <input checked="" type="checkbox"/> Slope / High difference <input type="checkbox"/> <input type="checkbox"/> Green area <input type="checkbox"/> Underground park <input type="checkbox"/> Underground cavities	- Obelisk of St. Oronzo 3 (archeological site, stairs to access to the Libertà Square and stair to access to the Sant'Oronzo Square) - - -

CONSTRUCTIVE CHARACTERISTICS	(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
content	Homogeneity of constructive techniques	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
		<input checked="" type="checkbox"/> Slick
		<input checked="" type="checkbox"/> Compact
	Pavement materials and finishing	<input checked="" type="checkbox"/> Disjointed
		<input checked="" type="checkbox"/> Other: difference in materials (regular stones, Sanpietrini and asphalt)
		<input type="checkbox"/> Benches
		<input type="checkbox"/> Bumps
		<input checked="" type="checkbox"/> Poles
		<input type="checkbox"/> Flowerpot
	Urban furniture/obstacles	<input checked="" type="checkbox"/> Railings
		<input type="checkbox"/> Bike Rack
		<input type="checkbox"/> Other: .....

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input checked="" type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input checked="" type="checkbox"/> Night
	Crowding index	.....
	Special use	<input checked="" type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
		<input checked="" type="checkbox"/> Others: tourism or sights
	Accessible to:	<input checked="" type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
		<input checked="" type="checkbox"/> Other: small electric scooter?
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		<input type="checkbox"/> Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input checked="" type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input checked="" type="checkbox"/> Landslide <input type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

The square of Ostuni was a complex example between composite and triangle form (maybe double triangle form). Some details related to obstacles in the geometry characters require some suggestions:


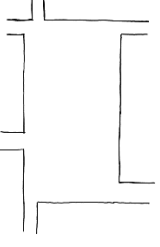
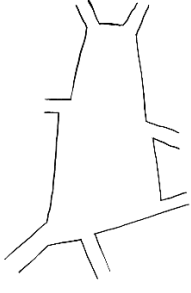
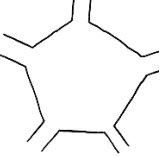
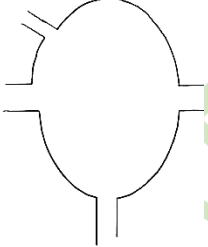
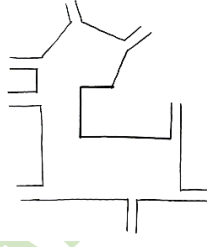
- **CHARACTERISTICS OF GEOMETRY AND SPACE:**
  - **Frontier:**
    - The presence of stairs could be indicated just as quote differences?
  - **Content:**
    - A further row should include *dehors*, temporary expansions of shops on the square.
    - The presence of stairs and an archaeological site could be indicated just as quote differences?
- **CONSTRUCTION CHARACTERS**
  - In the frontiers: the presence of balconies and stairs determine the presence of special urban furniture also along the frontiers
  - In content: difference in materials should be inserted as an option
- **CHARACTERISTICS OF USE**
  - The presence of sight could be described for touristic uses both in frontiers and contents.
  - Referring to the uses of the square, there is the necessity to insert the uses related to the public buildings, as well as for touristic one, that are along the frontier.
- **GENERAL SUGGESTION**
  - The accessibility to electric scooters could be useful?



**Rieti** (Piazza Vittorio Emanuele II, in the system of Piazza Mariano Vittori, Cesare Battisti, and Vittorio Emanuele II)



The characterization of the areal space identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	5
	✓	CBF (Continuous Built Front)	9
	✓	SU <sub>i</sub> (Interferent Structural Unit)	7
	✓	Access	5
	✓	Special building	4 (Church; Tower;)
		Town walls	-
	✓	Porches	Under the town hall and the tower
		Water	-
	✓	High difference / containment wall	Slope/containment wall
		Green area	-
content		Special building	-
		Canopy	-
	✓	Fontaine	1
		Monuments (obelisk)	-
	✓	Slope / High difference	Slope
		Green area	-
		Underground park	-
		Underground cavities	-

CONSTRUCTIVE CHARACTERISTICS	(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
	Homogeneity of constructive techniques	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
content	Pavement materials and finishing	<input checked="" type="checkbox"/> Slick
		<input checked="" type="checkbox"/> Compact
		<input type="checkbox"/> Disjointed
		Other: .....
	Urban furniture/obstacles	<input checked="" type="checkbox"/> Benches
		<input type="checkbox"/> Bumps
		<input checked="" type="checkbox"/> Poles
		<input checked="" type="checkbox"/> Flowerpot
		<input type="checkbox"/> Railings
		<input type="checkbox"/> Bike Rack
		Other: .....

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input type="checkbox"/> Night
	Crowding index	.....
	Special use	<input type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
	Accessible to:	Others: .....
		<input checked="" type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
	Other: .....	
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input checked="" type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input checked="" type="checkbox"/> Landslide <input type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

The square of Rieti was an example that confirm the correctness of the form: all the aspects characterizing Vittorio Emanuele II square were already considered. Consequently, we report some considerations:

### - CHARACTERISTICS OF GEOMETRY AND SPACE:

#### ○ Frontier:

- Piazza Vittorio Emanuele II is in a system of 3 squares. A further row in the form should define the boundaries of the case study, in order to focus the study on the single square. Indeed, the study of an entire system of squares in a single form does not allow a meaningful reading of data because the squares can be, as in the case of Rieti, with different frontiers and contents.
- *CBF (Continuous Built Front)*: the current definition does not consider the case in which there is a slight offset of two adjoining facades, which could be considered as additional CBF. An integration in the definition is proposed: if an offset between 2 fronts is less than  $1/x$  of the total front length (i.e.  $1/10$ ) or  $x$  meters, this offset should not be considered as an additional CBF.

#### ○ Content:


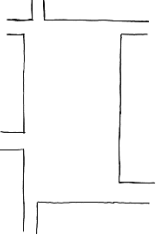
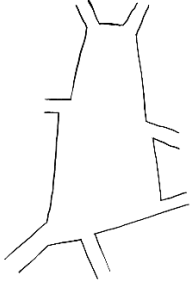
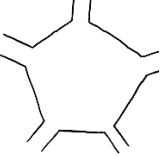
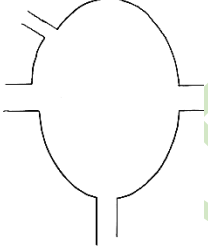
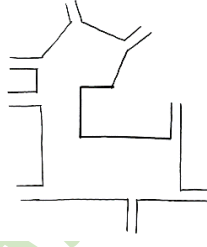
- A further row should include *dehors*, temporary expansions of shops on the square.



**San Gemini (Piazza San Francesco)**



The characterization of the areal space identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
✓					

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	3
	✓	CBF (Continuous Built Front)	6
	✓	SU <sub>i</sub> (Interferent Structural Unit)	7
	✓	Access	4
	✓	Special building	4 (Church; Police)
		Town walls	-
		Porches	-
		Water	-
	✓	High difference / containment wall	Slope and containment wall
		Green area	-
content		Special building	-
		Canopy	-
	✓	Fontaine	1
		Monuments (obelisk)	-
	✓	Slope / High difference	Slope and stairs
		Green area	-
		Underground park	-
	✓	Underground cavities	X



CONSTRUCTIVE CHARACTERISTICS	(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
	Homogeneity of constructive techniques	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
content	Pavement materials and finishing	<input checked="" type="checkbox"/> Slick
		<input checked="" type="checkbox"/> Compact
		<input type="checkbox"/> Disjointed
		Other: .....
	Urban furniture/obstacles	<input checked="" type="checkbox"/> Benches
		<input type="checkbox"/> Bumps
		<input type="checkbox"/> Poles
		<input checked="" type="checkbox"/> Flowerpot
		<input type="checkbox"/> Railings
		<input type="checkbox"/> Bike Rack
		Other: .....

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input type="checkbox"/> Night
	Crowding index	.....
	Special use	<input checked="" type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
	Accessible to:	Others: .....
		<input checked="" type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
	Other: .....	
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input checked="" type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input checked="" type="checkbox"/> Landslide <input type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

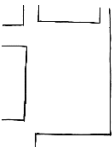
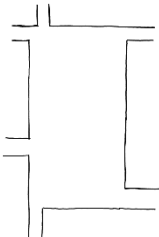
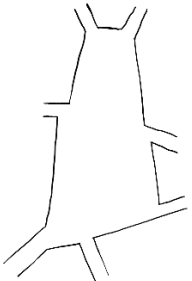
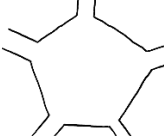
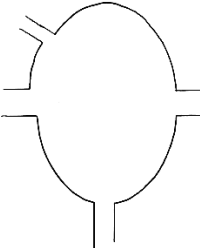
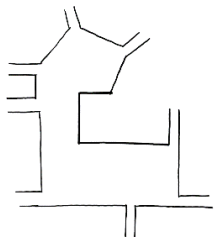
The square of San Gemini was an example that confirm the correctness of the form: all the aspects characterizing San Francesco square were already considered. Consequently, we report some considerations:

- **CHARACTERISTICS OF GEOMETRY AND SPACE:**
  - o **Content:** we could enter more options for *High Difference* (In San Gemini we have stairs and the whole square uphill)
- **CONSTRUCTIVE CHARACTERISTICS**
  - o **Content:** For *pavement materials and finishing* we should enter just the objective data of the type of flooring (materials and laying i.e. cobblestones, slabs ...) and consider a separate study on the effects of the material, without listing them directly on the form. In this way the correlation between material and effect on the evacuation can be updated with the development of the state of the art on the subject.
- **CHARACTERISTICS OF USE**
  - o We should give more importance to the *strategic building* row by bringing it from sub-parameter to parameter, replacing it with the *sensitive target* row that could be included in *vulnerable users*.

## San Giovanni in Persiceto (Piazza del Popolo)



### MAIN TYPES

Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
✓					

### CHARACTERISTICS OF GEOMETRY AND SPACE

#### frontier

#### (parameters)

#### (sub-parameters)

✓	SA (Structural Aggregates)	5
✓	CBF (Continuous Built Front)	2
✓	SU <sub>i</sub> (Interferent Structural Unit)	12
✓	Access	5 (4 vehicular and 1 pedestrian)
✓	Special building	5 (City Hall; Church; Tower; Bell tower; post office)
	Town walls	-
✓	Porches	Loggias on 4 built fronts
	Water	-
	High difference / containment wall	-

		Green area	-
content	<input checked="" type="checkbox"/>	Special building	2 (Church; Bell tower)
	<input type="checkbox"/>	Canopy	-
	<input type="checkbox"/>	Fontaine	-
	<input type="checkbox"/>	Monuments (obelisk)	-
	<input type="checkbox"/>	Slope / High difference	-
	<input type="checkbox"/>	Green area	-
	<input type="checkbox"/>	Underground park	-
	<input type="checkbox"/>	Underground cavities	-

CONSTRUCTIVE CHARACTERISTICS		(parameters)	(sub-parameters)
frontier		Homogeneity of built environment age	Yes
			<input checked="" type="checkbox"/> No
		Homogeneity of constructive techniques	Yes
			<input checked="" type="checkbox"/> No
content		Pavement materials and finishing	Slick
			<input checked="" type="checkbox"/> Compact: porphyry blocks
			<input type="checkbox"/> Disjointed
			<input type="checkbox"/> Asphalted
		Urban furniture/obstacles	<input type="checkbox"/> Benches
			<input type="checkbox"/> Bumps
			<input type="checkbox"/> Poles
			<input checked="" type="checkbox"/> Flowerpot
			<input type="checkbox"/> Railings
			<input type="checkbox"/> Bike Rack
			<input checked="" type="checkbox"/> Other: Dehors

CHARACTERISTICS OF USE		(parameters)	(sub-parameters)
		Daily crowding	<input checked="" type="checkbox"/> Morning (6:00-12:00)
			<input checked="" type="checkbox"/> Afternoon (12:00-18:00)
			<input checked="" type="checkbox"/> Evening (18:00-24:00)
			<input type="checkbox"/> Night (24:00-6:00)
		Crowding index	.....
		Special use	<input checked="" type="checkbox"/> Concerts
			<input type="checkbox"/> Theater
			<input checked="" type="checkbox"/> Festivals
			<input type="checkbox"/> Parking
			<input checked="" type="checkbox"/> Strategic buildings
			Others: .....
		Accessible to:	<input checked="" type="checkbox"/> Vehicle
			<input checked="" type="checkbox"/> Pedestrian
			<input checked="" type="checkbox"/> Bike
			Other: .....

Vulnerable users	Tourists, aged people, children
Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings <input type="checkbox"/> Significant people <input type="checkbox"/> Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
	Climate classification [DPR 412/1993]	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input checked="" type="checkbox"/> E <input type="checkbox"/> F
	Road network	
	Infrastructural network	<input checked="" type="checkbox"/> Primary urbanization <input type="checkbox"/> Uncovered pipes <input type="checkbox"/> High tension wire
	Underground cavities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Hazard assessment	<input checked="" type="checkbox"/> Earthquake (seismic zone: 3) <input type="checkbox"/> Tsunami <input type="checkbox"/> Mass Movement (dry) <input type="checkbox"/> Volcanic activity <input type="checkbox"/> Storm/tornado <input checked="" type="checkbox"/> Extreme temperature <input type="checkbox"/> Flood <input type="checkbox"/> Landslide <input checked="" type="checkbox"/> Wildfire <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Explosion/fire <input checked="" type="checkbox"/> Transport accident <input checked="" type="checkbox"/> Terrorist attack <input type="checkbox"/> Miscellaneous accident

## DISCUSSION

The main square of San Giovanni in Persiceto is an example confirming the correctness of the data sheet; all the aspects characterizing Vittorio Emanuele II square were already considered. A note can be made on the type of flooring, not easily identifiable among those proposed.

Consequently, we report some considerations:

- **CHARACTERISTICS OF GEOMETRY AND SPACE:**

Piazza del Popolo, located in the historical centre of San Giovanni in Persiceto, lies on a flat ground in the center of the particular round urban fabric characterizing the city layout.

- **CONSTRUCTIVE CHARACTERISTICS:**

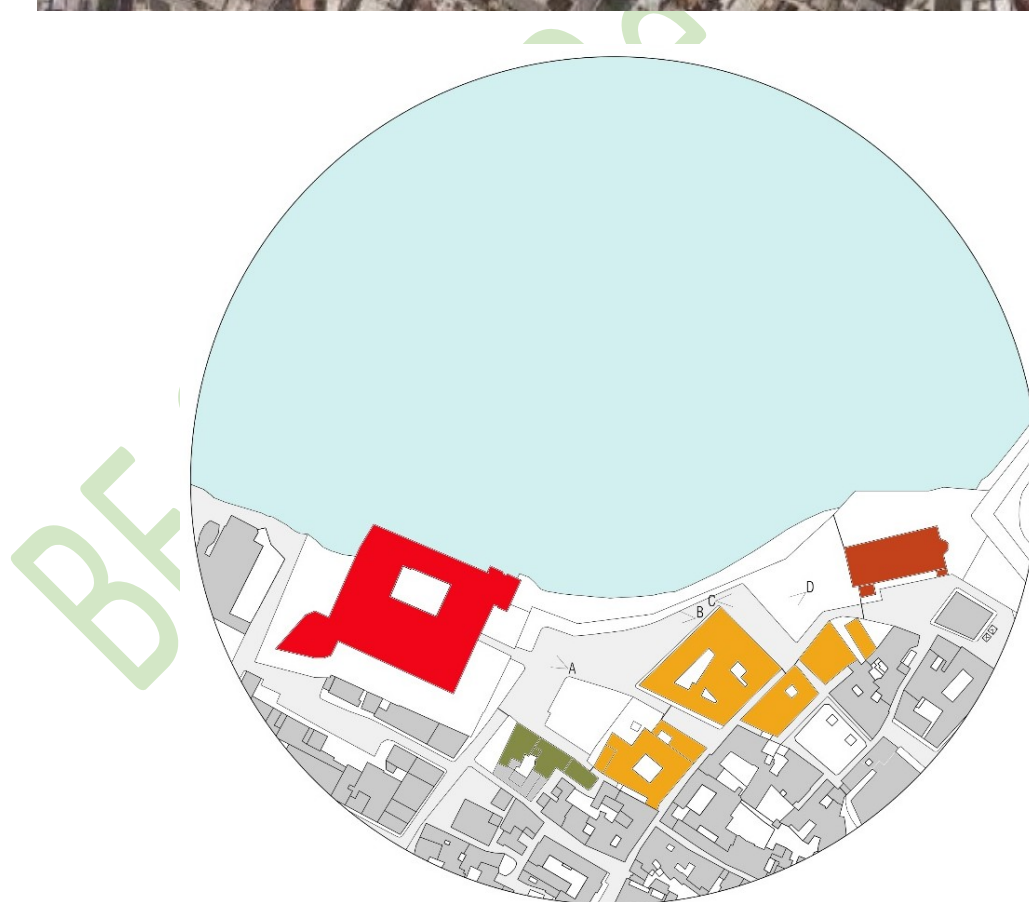
The square is delimited by buildings erected in different periods and with different uses; we can find the main church of the city with its bell tower, whose construction started in 1671, the municipal building and some residential aggregates dated back to medieval times having masonry structures. The post office on the north side of the square was erected during the 30's, using reinforced concrete techniques.

- **CHARACTERISTICS OF USE:**

- On the ground floor, buildings have commonly a commercial use, and a residential use on the upper floor. Public functions are hosted in the church, in the post office, in the municipal buildings and in a bank which is included in the aggregate buildings. During summer, some events take place in the square, and the number of users is consequently increased.
- Normally the accessibility is only pedestrian, but from 6 to 9 and from 14 to 16 access to cars is allowed. A path is exclusively pedestrian because of its width.



Trani (Piazza del Duomo and Piazza Re Manfredi)





Point of view A



Point of view B




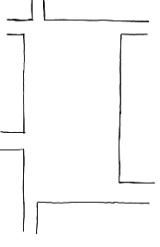
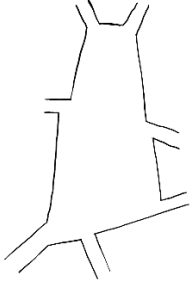
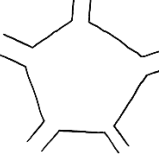
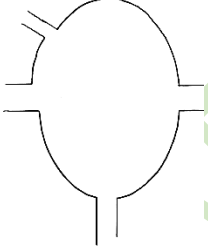
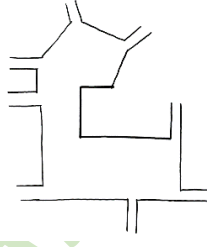


Point of view C



Point of view D

The characterization of the areal space identified as a case study is reported in the proposed form.

MAIN TYPES					
Tending to quadrangle	Elongated with parallel sides	Tending to triangular and funnel-shaped	Trapezoidal and polygonal	Tending to circular, ovoid and ellipsoid	Composite
					
					✓

CHARACTERISTICS OF GEOMETRY AND SPACE		(parameters)	(sub-parameters)
frontier	✓	SA (Structural Aggregates)	3 + 3 isolated
	✓	CBF (Continuous Built Front)	6
	✓	SU <sub>i</sub> (Interferent Structural Unit)	5 + 1 partially
	✓	Access	7 (4 Vehicular; 3 pedestrian)
	✓	Special building	7 (Cathedral; 2 Court; Public Prosecutor's office; Castle; 2 Museum)
		Town walls	-
		Porches	-
		Water	sea
		High difference / containment wall	2 (balcony of the seafront and Castle trench)
		Green area	-
content		Special building	-
		Canopy	-
		Fontaine	-
		Monuments (obelisk)	-
		Slope / High difference	Stairs in front of Cathedral
		Green area	-
		Underground park	-
		Underground cavities	-

CONSTRUCTIVE CHARACTERISTICS	(parameters)	(sub-parameters)
frontier	Homogeneity of built environment age	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
	Homogeneity of constructive techniques	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
content	Pavement materials and finishing	<input checked="" type="checkbox"/> Slick
		<input checked="" type="checkbox"/> Compact
		<input checked="" type="checkbox"/> Disjointed
		<input checked="" type="checkbox"/> Other: difference in materials (regular stones and Asphalt)
	Urban furniture/obstacles	<input type="checkbox"/> Benches
		<input type="checkbox"/> Bumps
		<input checked="" type="checkbox"/> Poles
		<input type="checkbox"/> Flowerpot
		<input type="checkbox"/> Railings
		<input type="checkbox"/> Bike Rack
		<input checked="" type="checkbox"/> Other: automatic systems for the vehicular access

CHARACTERISTICS OF USE	(parameters)	(sub-parameters)
	Daily crowding	<input checked="" type="checkbox"/> Morning
		<input checked="" type="checkbox"/> Afternoon
		<input checked="" type="checkbox"/> Evening
		<input checked="" type="checkbox"/> Night
	Crowding index	.....
	Special use	<input checked="" type="checkbox"/> Concerts
		<input type="checkbox"/> Theater
		<input checked="" type="checkbox"/> Festivals
		<input checked="" type="checkbox"/> Parking
		<input checked="" type="checkbox"/> Strategic buildings
		<input checked="" type="checkbox"/> Others: tourism or sights
	Accessible to:	<input checked="" type="checkbox"/> Vehicle
		<input checked="" type="checkbox"/> Pedestrian
		<input checked="" type="checkbox"/> Bike
		<input type="checkbox"/> Other: small electric scooter
	Vulnerable users	Tourists, aged people, children
	Sensitive targets to terroristic attack	<input checked="" type="checkbox"/> Strategic buildings
		<input type="checkbox"/> Significant people
		<input type="checkbox"/> Other: .....

ENVIRONMENTAL CHARACTERISTICS	(parameters)	(sub-parameters)
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Climate classification [DPR 412/1993]	<input type="checkbox"/>	A
	<input type="checkbox"/>	B
	<input checked="" type="checkbox"/>	C
	<input type="checkbox"/>	D
	<input type="checkbox"/>	E
	<input type="checkbox"/>	F
Road network		
Infrastructural network	<input checked="" type="checkbox"/>	Primary urbanization
	<input type="checkbox"/>	Uncovered pipes
	<input type="checkbox"/>	High tension wire
Underground cavities	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
Hazard assessment	<input checked="" type="checkbox"/>	Earthquake
	<input type="checkbox"/>	Tsunami
	<input type="checkbox"/>	Mass Movement (dry)
	<input type="checkbox"/>	Volcanic activity
	<input type="checkbox"/>	Storm/tornado
	<input checked="" type="checkbox"/>	Extreme temperature
	<input type="checkbox"/>	Flood
	<input checked="" type="checkbox"/>	Landslide
	<input type="checkbox"/>	Wildfire
	<input type="checkbox"/>	Chemical
	<input checked="" type="checkbox"/>	Explosion/fire
	<input checked="" type="checkbox"/>	Transport accident
	<input checked="" type="checkbox"/>	Terrorist attack
<input type="checkbox"/>	Miscellaneous accident	



## DISCUSSION

The square of Trani was an example of composite form. Some suggestions:

- **CHARACTERISTICS OF GEOMETRY AND SPACE:**
  - **Frontier:**
    - The presence of trench and balcony of the seafront could be indicated just as quote differences?
  - **Content:**
    - A further row should include *dehors*, temporary expansions of shops on the square.
    - The presence of stairs could be indicated just as quote differences?
- **CONSTRUCTION CHARACTERS**
  - In the frontiers: the presence of the balcony on the seafront determine the presence of special urban furniture also along the frontiers
  - In content: difference in materials should be inserted as an option
  - In content (in general also along the frontiers – see Matera): insert the option for the presence of barriers for vehicles in dividing streets and square or two adjacent squares (as a character of accessibility)
- **CHARACTERISTICS OF USE**

The presence of sights could be described for touristic uses both in frontiers and contents.
- **GENERAL SUGGESTION**
  - The accessibility to electric scooters could be useful?