Co-financed by the EC
DIRECTORATE-GENERAL HUMANITARIAN AID AND CIVIL PROTECTION – ECHO

AGREEMENT NUMBER - ECHO/SUB/2015/718655/PREV28

KnowRISK

Know your city, Reduce seISmic risK through non-structural elements

UE – Civil Protection Financial Instrument

Projects on Preparedness and Prevention

Deliverable Report

Deliverable D1 – Characterization of pilot-areas

Task D – Approaching target-communities

Deliverable/Task Leader: LNEC

Final

October, 2016

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1. DESCRIPTION OF THE DELIVERABLE

1.1 GENERAL INTRODUCTION

This report constitutes the deliverable of Task D, Action D1. This Task aims at being complementary to Task B, providing information that can support risk mapping process; and, also, to serve as a knowledge-base to support the planning and assessment of risk communication in schools and citizens, previewed under Task E.

Our aim is to provide a general overview of the selected pilot-areas in the three countries that form KnowRISK consortium – Italy, Portugal and Iceland. A description of urban and social fabric of each pilot-area will be pursued, jointly with an introduction of the schools where seismic risk communication will occur.

The description of each pilot-area, as it is presented in this report, has varying depth degrees and reflects the stage at which each country is in its own research-action process. Further analysis, jointly with the accomplishment of the intervention in each target area, will allow more depth in the description of each pilot-area.

The report is divided in three sections, each one corresponding to the pilot-area(s) of each country: Mt Etna and Northern Italy pilot-areas, in Italy; Alvalade parish in Lisbon, Portugal; and South Iceland Seismic Zone, in Iceland.

1.2 THE ITALIAN CASE

1.2.1. Introduction

In Italy recent earthquakes have had a strong impact in peoples lives all over the country, even where the shaking was not felt. The impact of the 2016 Amatrice sequence was smeared by the fact that its consequences hit life of people that are not necessarily residents in a hazard zone: "It can affect you just because you were on holiday".

Since medium size earthquakes in Italy may cause large damage and losses, the attention is mostly concentrated on structural damage while non-structural elements are often overlooked. Seismic hazard and risk are not the only parameters that need to be taken into account to implement efficient communication strategies. We need to know our recipients. To pursue this target we went deep into diagnosis of the local community, the identification and portrayal of vulnerable groups, patterns of social relationships and identification of most common community' meeting points.

The selection of pilot-areas was based on two criteria: i) areas affected by the most common non-structural vulnerability, on the basis of information gathered under Action C2; ii) areas where it was possible to have a high range of target public. On the basis of such criteria, two pilot-areas were chosen: Mt Etna volcano region and Northern Italy. In the southeastern flank of the Mt Etna volcano we have identified an area that covers about 23 municipalities. In the Northern Italy, risk communication focal points are the cities La Spezia, Laveno Mombello, a small town in the Varese province, and Ferrara.

In Italy, seismic regulation followed a path that need to be taken into account when discussing the actual situation of buildings and its seismic resistence. Between 1908 and 1974, seismic zonation was circumscribed to those that had experience damage. In 1984 only 45% of the Italian territory was classified and covered by specific earthquake building codes. It was only in 2002, in the sequence of an earthquake (St. Giuliano earthquake) that provoked a school collapse and the death of a whole classroom of young students that a change occurred. In 2003, entire Italian land was finally zonated and classified. Nonetheless we had to wait till 2009 to have a new building code enforced in the whole country. This slow, complicated and unfinished process had a reflection in the building sector which might have been built and retrofited disregarding safety criteria.

Construtive typologies in the pilot-areas cover a wide range of materials and techniques, many of which are considered inadequate nowadays and vulnerable to seismic action. At the same time, these constructions have often a high cultural heritage value and are part of cities and local communities.

An analysis of seismic history (e.g. http://emidius.mi.ingv.it/DBMI11) and the age structure of communities in pilot-areas (cf. Fig. 1) allows us to conclude that it is almost certain that inhabitants of these communities have felt earthquakes in their lives.

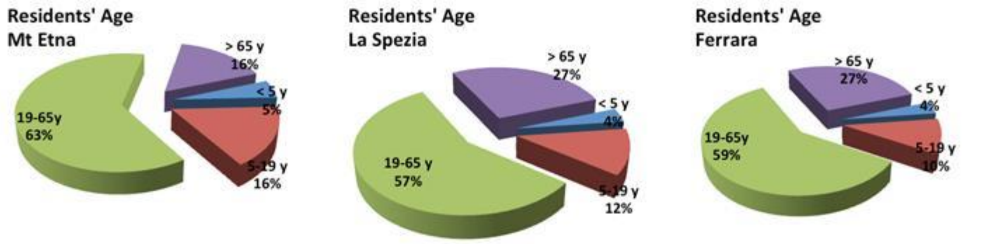


Figure 1. Population resident according to age in Mt Etna pilot area and in La Spezia and Ferrara pilot area. Data are from ISTAT census 2011.

Next, a general description of Mt Etna and Northern Italy pilot-ares urban and social fabric will be pursued. Afterwards, target-schools for risk communication will be characterized.

1.2.2. Mt Etna pilot-area

Mt Etna pilot-area is composed by 23 municipalities, located in southeastern flank of the volcano, and counts almost 20.000 residents. Action C2 assessed the sources of nonstructural earthquake damage that might occur for a D2 and D3 global damage index. The vulnerable groups of population are elderly people, which correspond to 16% of the total population, and children below 5 years old. There is a non-negligible percentage of population with low level of education (43%) and only 33% of inhabitants are employed (cf Fig.2). The level of unemployment gives insights on what might be felt as priority by the population.

In Catania the INGV hosts every year science outreach events that involve public from the City and all over the Mt Etna area. Schools are involved, and a wide range of stakeholders discuss with scientists issues concerning earthquakes

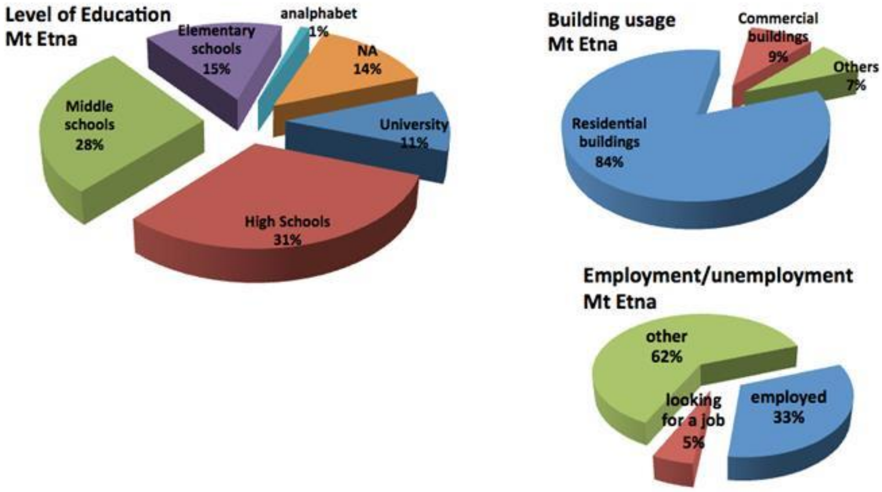


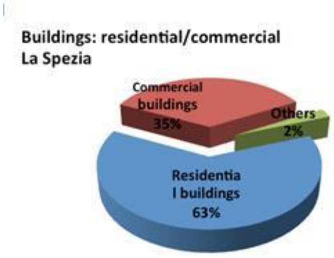
Figure 2. Main demographic characteristics and building usage in Mt Etna Pilot area

1.2.3. Northern Italy pilot-area

Norhern Italy pilot-area encompasses three cities: La Spezia, Laveno Mombello and Ferrara city. Risk communication covers two target-groups, respectively: i) students from a set of schools located in La Spezia and Laveno Mombello; ii) citizens living in Ferrara downtown historic center.

La Spezia is classified in Zone 3 (O. P.C.M. n. 3519/2006) where earthquakes may be strong but they are rare. Laveno Mombello is classified in Zone 4 (O. P.C.M. n. 3519/2006) where earthquakes are rare, low, but Seismic Building Code for public buildings (i.e schools) is enforced.

The city of La Spezia is located in the southern part of this pilot-area. It is the second most populated city of the Liguria region and it is one of the main Italian military and commercial harbours and hosts the arsenal of the Italian Navy. Building stock is diverse and comprising various typologies. In the historic down town roads can be narrow and composed by the so-called ligurian *Carrugi,* with 4 to 6 story buildings at both sides, stone balconies, shutters and various pendings that represent the most frequent architectural part non-structural elements (fig. 5).



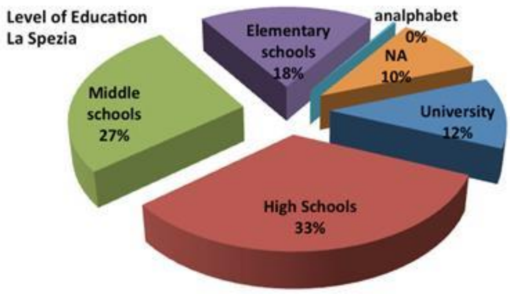


Figure 3. La Spezia buildings tipology (left) and level of education

Figure 4. A tipical landscape of La Spezia

Figure 5. Buildings in La Spezia center

Ferrara city is located in the Northeastern part of Italy, on the Po plain. It has been qualified by UNESCO as World Heritage Site. In the down town streets and places date the 14th and 15th centuries, when it hosted the court of the House of Este. Modern times have brought a renewal of industrial activity.

The town is still surrounded by ancient brick walls, mainly built in the 15th and 16th-centuries. In the center of the town the brick Castello Estense is iconic for Ferrara and its citizens.

Avenues, streets, alleys and pedestrian paths with squares placed on the main crossroads, describe the street hierarchies. Narrow roads, often stone paved, separate buildings: balconies, facades with terracotta decorations, parapets, canopies, marques, signs, tile veeners are typical of the downtown buildings.

The downtown is mostly pedestrian and has large squares that are the main meeting point (i.e.: il Listone, Piazza duomo and piazza Aristotea) for citizens, both youth and families (Fig. 6).

Figure 6. Ferrara old downtown

1.2.4. The schools

1.2.4.1 *General overview*

There are about 83.000 school buildings in Italy, public and private, and they host more than 10.6 million students. Most of these buildings are known to be vulnerable to non-structural elements failures even to static load.

According to the official registry database, more than a half of Italian schools (55%) were built before 1976 and around 30% were not originally built to function as schools. In 2015, public authorities approved a programme ("Good School campaign) directed to schools requalification (cf. Figure 3).

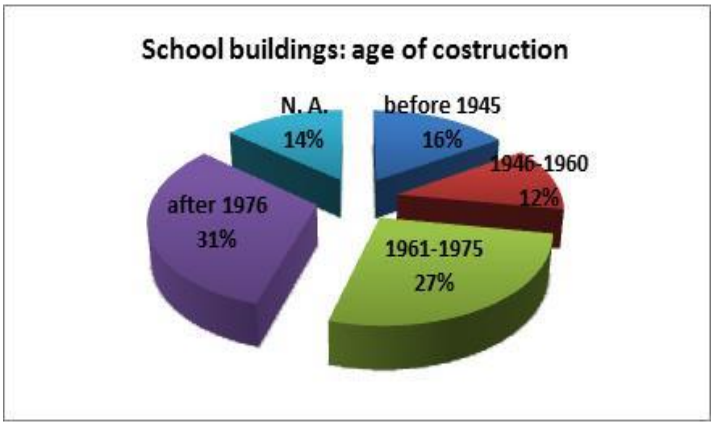


Figure 7. Age of construction of school buildings in Italy

Acording with the Italy's safety certification, there is a non negligible volume of schools (20%) that don't have an emergency plan in place. Fruthermore, static load certificate is only available for 49% of the schools (cf Table 1) and was only enforced for buildings built after 1971.

Table 1 – General safety certification for all school buildings in Italy (http://www.istruzione.it/edilizia_scolastica/anagrafe.shtml)

	yes	not requested	no	no info
Emergency plan	73%	0%	19%	8%
Risk assessment certificate	72%	0%	20%	8%
Static Load assessment	49%	7%	32%	12%
Abitability certificate	39%	4%	45%	12%
Fire Prevention certificate	21%	12%	54%	13%

In the pilot areas a large number of school buildings are built before 1975 and therefore do not have a static load assessment.

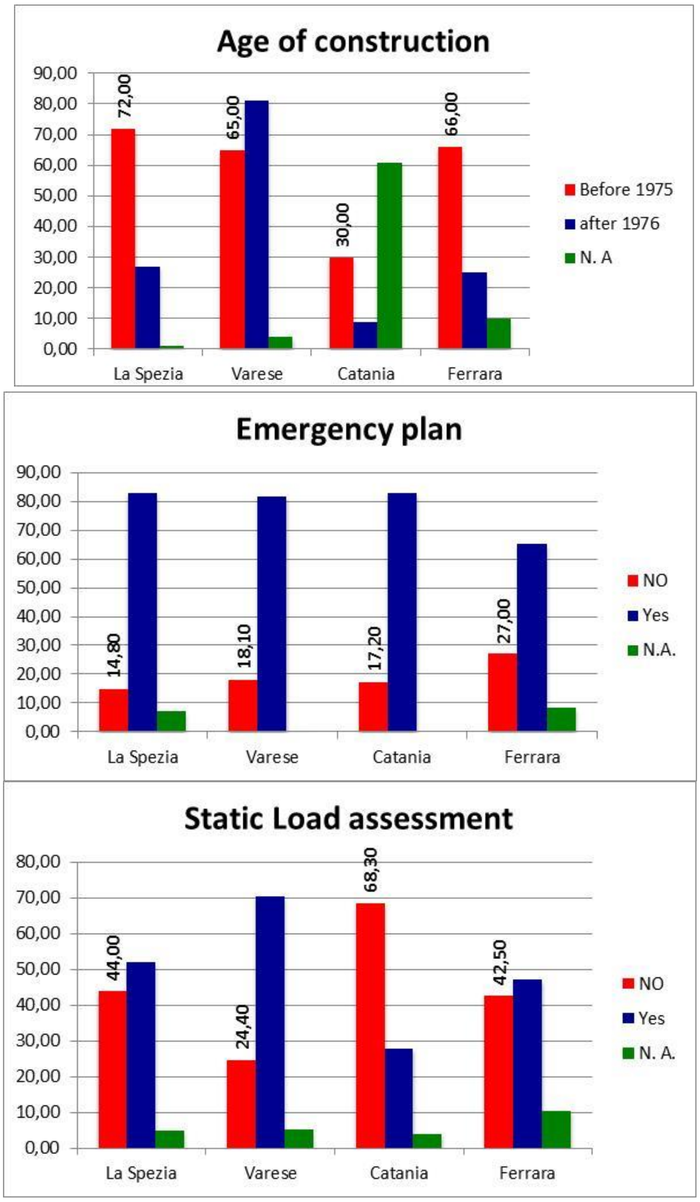


Figure 8. Indicators for school buildings within the pilot-areas

1.2.4.2 *La Spezia schools*

There are 106 schools located in the city and hosts a total student population of about 14.000 students. The schools involved in KnowRISK project were chosen because they are among the most active schools towards seismic hazard education. They are the following:

a) Secondary schools (Middle schools)

- 1) "Jean Piaget" of La Spezia (5 classes of 13 years old students) 3A 22 + 3B 22 + 3C 21 + 3D 22 + 3 E 16 = 103 students of III classes (299 are the students of the whole school);

- 2) "U. Mazzini"of La Spezia (4 classes of 13 years old students) 3A 28 + 3B 23 + 3C 20 + 3D 25 = 96 students of III classes (351 are the students of the whole school);

- 3) "F. Poggi" of LERICI and "P. Mantegazza" SAN TERENZO (ISA 10 – Lerici with 3 classes of 13 years old students of Lerici: 3A 21 + 3B 24 and one of San Terenzo: 3ST 21 = 66 students of III classes (199 are the students of the whole school);

- 4) "IC G.B. Monteggia" in Laveno Mombello: 6 classes, 13 years old students (about 130 students).

b) Secondary schools (high schools)

- Scientific Liceum "A. Pacinotti", La Spezia 81 students of IV classes (694 are the students of all the liceum).

- Scientific Liceum "T. Parentuccelli", Sarzana, 5 I classes (and 2 I classes of Classic Liceum "Arzelà", Sarzana).

1.2.4.3 *Laveno Mombello*

It is a small town located by the lake Maggiore, in the northern part of the pilot area and with 8813 inhabitants. There are 8 schools and a population of about 1330 students. Here we had schoolboard collaboration with the I° Secondary School.

1.2.5 Risk communication to citzens: Ferrara city

Risk communication intervention took place in the historic downtown which suffered high damages in the sequence of 2012 Emilia earthquake. Downtown buildings are mainly residential and approximatly 20.000 people live in this area. The knowledge spread among the population was that Ferrara was built upon sediments that would tend to attenuate seismic waves and therefore they thought they were safe from shaking.

Ferrara downtown concentrates a non-negligible volume of elderly (27%), of individuals with low level of education (19%) (cf. Fig. 7).

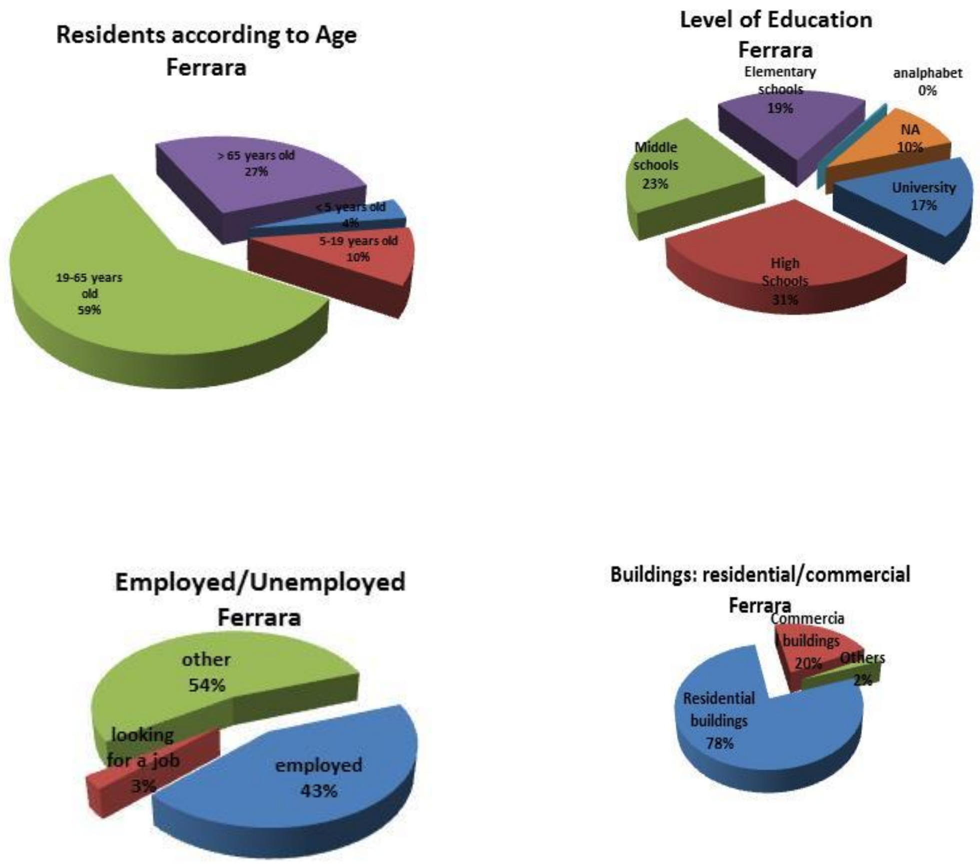


Figure 9. Demographic and building characteristics of Ferrara downtown

The assessment of attitudes towards seismic risk reduction is part of risk communication intervention, developed under Action E2.

1.3 THE PORTUGUESE CASE

1.3.1. Introduction

The Portuguese case-study differs from the other two, Italy and Iceland cases, by its low disaster experience. As long as inhabitants of Italy's and Iceland's pilot-areas have most certainly in their social memory recent direct or indirect experience of disaster, for the inhabitants of Lisbon seismic risk is something distant and with low degree of intrusiveness in their daily lives. Given this, the school community, our main target-group for risk communication (Task E), is most likely to be poorly aware of the seismic risk. Hypotetically, this community is composed by individuals:

- with a poor knowledge about Lisbon's seismic risk and about protection alternatives;
- with no perception about seismic risk or having perceptions based on beliefs that discourage the adoption of protective actions;
- who are poorly pro-active.

Activity under Task D initiated with the selection of schools where seismic risk communication would occur. The pilot-area would correspond to the area surrounding the targeted-schools. The selection of schools stood on two main criteria: i) schools that were seismic retrofitted under the 2009-2011 State Program of School rehabilitation; ii) schools that showed interest in knowRISK project.

In the year of 2011, Portuguese Government launched a program of rehabilitation of school facilities across the country and established that those settled in earthquake prone areas, amongst them Lisbon region, would be subject of seismic retrofitting (Parque escolar, 2011). Based on a pre-selection of Lisbon schools covered by this Program, a contact was established with the school board of set of schools in order to assess their openness to an earthquake risk communication pilot-intervention under KnowRISK. After a period of dialogue, two schools were selected: Secondary School Rainha D. Leonor and Secondary School Padre António Vieira. As we shall see bellow, both schools are settled in Alvalade parish, one of the 24 parishes that compose the city of Lisbon.

Next, a general description of Alvalade urban and social fabric will be pursued, contextualizing it in the city of Lisbon. Afterwards, Rainha D. Leonor and Padre António Vieira schools will be characterized. It should be emphasized this characterization has the unbalance proper of an ongoing task.

1.3.2. Alvalade pilot-area

Lisbon city has different constructive typologies, covering a wide range of materials and techniques, many of which are considered inadequate nowadays. These buildings are part of the identity of the city and are of immeasurable historical and cultural value, so the extent of their vulnerability to seismic action causes a great concern. Unreinforced masonry buildings (so called as "Placa" buildings) are one of the many constructive typologies found in Lisbon, representing 32% of all the city's edifices (INE, 2012).This typology dates from the 20th century, between the 1930's and the 1960's. "Placa" buildings can be found in diverse areas of Lisbon, with a larger incidence in the Alvalade district ("Bairro de Alvalade") and its surroundings.

As mentioned, Alvalade is one of the 24 parishes of Lisbon municipalities and is characterized by a mix of urban uses (housing, commerce, services, schools, public spaces) and socially diversified population (cf. Fig. 7).

Figure 10. Alvalade parish location in Lisbon municipality

Alvalade parish was planned in the 30's of the twentieth century as a consequence of Lisbon's expansion towards the North side of the city, in order to respond to housing problems within the city and to enable the de-centralization of services and population to the periphery. In 1938, in the time of "Estado Novo" (1933-1974) dictatorship, the General Plan for the city's expansion was approved. It was commonly called the De Gröer plan and included the urban ordered occupation of the "Sítio de Alvalade e Areeiro" (cf. Fig.8).

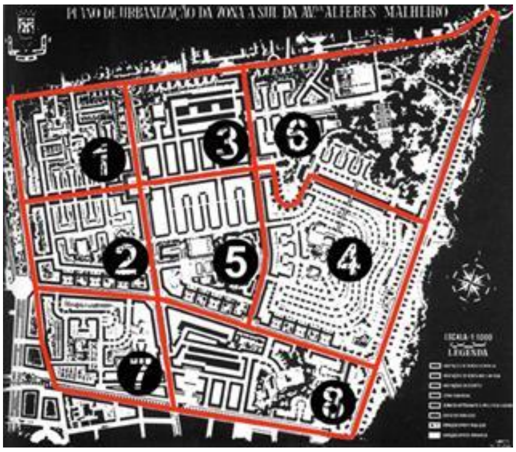


Figure 11. Alvalade parish

Alvalade's urban fabric is organized inprecise urban typologies. The street hierarchy is organized by avenues, streets, alleys and pedestrian paths, with squares placed on the main crossroads. The blocks are open inside, allowing space for gardens, parking and equipments. Also the hierarchies of the sidewalks reinterpret and adapt the image of the Corbusier's. The repetitive buildings in unity and architectonic order, with their controlled façades, are only emphasised in the crossroads, marking the intersection with squares and more visible spaces (Costa, 2009).

According to 2011 Census (INE, 2012), Alvalade had in 2011 31,812 inhabitants, representing 5,8% of the total population of Lisbon municipality. It has a population density of 5957 inhabitants per km2, which is not high when compared with other parishes such as Arroios, São Vicente or Campo de Ourique (cf. Table 2).

Similarly to other Lisbon parishes, in 2011 Alvalade was a demographically aged area. Approximately 30% of Alvalade inhabitants were aged people (65 years old or more) whereas the young people didn't exceed the 12%. Nevertheless, there are, in recent years, signals of a slow demographic change. This area of the city has been subject of a process of gentrification, with young families moving to the neighbourhood. Along with such demographic transformation, urban requalification is gradually taking place.

Table 2 - Resident population in Lisbon municipality, by parish, according to 2011 Census

Parishes	Population		Area	Density
	n	%	em Km^2	hab/Km^2
Ajuda	15620	2,8	2,9	5424
Alcântara	13943	2,5	4,4	3169
Alvalade	31812	5,8	5,3	5957
Areeiro	20131	3,6	1,7	11570
Arroios	31634	5,7	2,1	14852
Avenidas Novas	21625	3,9	3,0	7232
Beato	12737	2,3	1,7	7537
Belém	16525	3,0	5,6	2946
Benfica	36985	6,7	8,0	4612
Campo de Ourique	22132	4,0	1,7	13413
Campolide	15460	2,8	2,8	5581
Carnide	19140	3,5	3,7	5187
Estrela	20116	3,6	2,7	7423
Lumiar	45683	8,3	6,6	6953
Marvila	37794	6,8	6,2	6066
Misericórdia	13041	2,4	1,1	11749
Olivais	33788	6,1	8,1	4177
Parque das Nações	21025	3,8	4,2	5066
Penha de França	27967	5,1	2,2	12712
Santa Clara	22480	4,1	3,4	6690
Santa Maria Maior	12765	2,3	1,5	8567
Santo António	11855	2,1	1,5	7956
São Domingos de Benfica	33043	6,0	4,3	7702
São Vicente	15339	2,8	1,3	12271
Lisboa (TOTAL)	**552640**	**100**	**85,9**	**6437**

1.3.2.1 *Building characterization, typologies and modern influences*

The so-called "Placa" buildings correspond to a typology which uses masonry as the main structural material, but with a small slab of reinforced concrete on the rear of the building-in more recent structures, entire slabs of reinforced concrete were used. During the time of construction, there were no existing regulations imposing the dimensioning of structural elements to resist horizontal stresses. The first modern Portuguese earthquake resistance regulation, the "Regulamento de Segurança das Construções contra os Sismos" was issued in 1958. As a result, many buildings were erected before without considering these stresses, having huge seismic vulnerability.

The rapid development of earthquake engineering and structural safety theory have made the substitution of the 1958 seismic code and in 1983 is published the RSA ("Regulamento de Segurança e Acções para Estruturas de Edifícios e Pontes"). According with latest statistics (INE, 2012), Alvalade parish presents 15% of housing stock built between 1919-1945 and 78% was built between 1946 and 1970.

1.3.3. The schools

As mentioned, two schools were selected as focal points for risk communication: Rainha D. Leonor Secondary School and Padre António Vieira Secondary School. Both schools were built in the late 50's of the twentieth century and were recently rehabilitated and seismically reinforced. Also, both schools encompass secondary education and each one has aprroximatelly 1000 students.

In the Portuguese case, risk communication was designed in order to be a pilot-intervention where the process and contents of communication will be tested and assessed. Two classes of the seventh and eight grade (middle/junior school) in each school were selected for risk communication aims. Classes comprehend students with ages between the 13 and 15 years old and have around thirty students per class.

In the following sections, a general description of the two schools will be purusued. It should be mentioned that Rainha D. Leonor description benefits from the results of a survey done to the school with the main aim of identyfing non-structural elements and assessing its vulnerabilities. This survey is planned to be pursued in Padre António Vieira in January 2017.

Figure 12. Alvalade square

Figure 13. One residential neighbourhood of Alavalade

1.3.3.1 Rainha D. Leonor School

As referred above, Rainha D. Leonor School was built in the late 50's and, since then, suffered two major interventions: an expansion in 1968; a rehabilitation and new expansion in 2011. Initially composed by two main blocks, with class rooms and a gymnasium, the school gained a third block in the late sixties, expanding the number of classrooms. In 2011 the school suffered a process of rehabilitation, which included seismic reinforcement and retrofitting, and new expansion with the aim of improving the links between blocks and gaining a new gymnasium and outdoor spaces.

Although built in a time when the country had already a seismic code in place, Rainha D. Leonor School was, at the beginning of this century, a structure with accumulated seismic vulnerabilities. These were envisaged as critical due to its educational and community functions and, also, due to its localization in a seismically prone city. School's rehabilitation was, in this context, taken has an opportunity for seismic retrofitting taking advantage of scientific and technical advances both in terms of earthquake engineering and building construction materials.

As mentioned above, the planning of the intervention at schools (Action E3) included a survey on non-structural vulnerabilities. Several visits were made to Rainha D. Leonor schools with the main aim of identifying non-structural vulnerabilities of the space. The most common ones are the following: i) Poor fixing of expositor panels; ii) access to electrical swichtboard blocked by furniture; iii) Poor fixing of heavy furniture; iv) room exits liable to permanent or temporary obstruction.

In approximately half of visited school spaces exit doorways presented risks of becoming obstructed. This was found in classrooms, laboratories, the library, the two gymnasiums, the sport storage rooms and in the auditorium. Poor fixing of expository panels and furniture was also common. This gained special relevance in the Library where shelves where located near the working tables and were not fixed. Besides de Library, this non-structural vulnerability was also found in classrooms and teachers' room. Finally, a set of emergency-related vulnerabilities was identified such as the hampered access to swichtboards in some spaces, the partial obstruction of stairs and emergency exits and the lack of extinguisher in two signalized places.

1.3.3.2 Padre António Vieira school

The Padre António School was inaugurated in 1965 and was designed for 700 students. The existing building is of exposed reinforced concrete and is divided into three large blocks in an 'H' layout with considerable volumetric variation. In 2009-2011 Padre António Vieira was rehabilitated and benefited of several improvements. Presently the school serves a population of 1000-1200 students and encompasses secondary and high scool levels.

1.4 THE ICELANDIC CASE

1.4.1 Introduction

The pilot-area in Iceland is South Iceland Seismic Zone (SISZ). In this area earthquakes tend to occur in sequences, typically every hundred years. One such sequence started in 1896, when five quakes of magnitude greater than six struck the area within two weeks (see, for example, Sigbjörnsson and Rupakhety, 2014), whereas the last one (Ms7.0) finishing the sequence occurred in 1912. A new sequence started in 2000 when two earthquakes of magnitude Mw6.5 struck on the 17th and 21st of June. They were followed by a third one, an Mw6.3 quake on May 29th, 2008.

Present day scenario in South Iceland is very different from that in 1896, both in terms of polulation density and building practice. The SISZ covers the largest the largest agricultural region in Iceland. Several small towns or villages, schools, medical centers, industrial plants, geothermal and hydropower plants, and several major bridges are within this area. In fact, it contains the entire infrastructure that characterizes modern society.

The school selected for risk communication is the Sunnulækjarskóli in Selfoss.

1.4.2 South Iceland Seismic Zone

1.4.2.1 General overview

The population in the South Iceland lowland is around 18,600 inhabitants (January 2008). Of these, about 14,160 live in the area close to the two causative faults of the Ölfus Earthquake (Sigbjörnsson et al, 2009), mostly in the small towns and villages of Selfoss (6,310), Hveragerdi (2,308), Thorlakshöfn (1,548), Eyrabakki (594), and Stokkseyri (513).

Most of the buildings are in-situ-cast reinforced concrete buildings or timber buildings, in which the lateral load-bearing system is dominated by structural walls with inherent lateral resistance. Typical South European-type masonry buildings or concrete frames with masonry infill are practically non-existent in the building stock. The majority of the buildings are low-rise single-family dwellings or townhouses, with one to two storeys being dominant. Very few buildings can be classified as multi-family apartment houses and of those, none is taller than five storeys.

In Iceland all buildings are registered in an official database which contains detailed information about the type of use, date of construction, number of storeys, building material, and geo-graphical location. In addition, it includes valuation, both for taxation and reconstruction insurance purposes (replacement value).

Bessason and Bjarnason (2016) conducted a detailed analysis of building stock in Iceland, focussing mainly in SISZ. The distribution of building typologies in SISZ is different from that in the capital city Reykjavik, which is the most populated city in Iceland. The vast majority of buildings in the study area are low-rise (1-3 storey) residential single family dwellings, and townhouses, and no building is taller than 5 storeys.

Bessason et al. (2014) analysed the building typologies and damage caused by the May 2008 Ölfus Earthquake. Of the low-rise buildings analysed by them, the following distribution was reported, based on the official property database. Timber houses were most common before 1940. Reinforced concrete and hollow pumice blocks gained popularity between 1940 and 1970. Most of the houses built in the SISZ after 1980 are made of timber.

Table 3. Classification of buildings in SISZ based on construction material

Material	Percentage of houses
Reinforced concrete	45
Timber	48
Hollow pumice blocks	8

Bessason et al. (2014) classified buildings in SISZ into 5 categories, considering both the age and the construction material. Concrete and timber houses were classified into two categories each, old and new. The distinction between old and new was made not due to the age of an individual building, but rather based on the prevalent construction practice. This relates to the introduction of seismic design code in Iceland, which was in 1976. By 1980, all concrete houses were required to contain steel reinforcement in structural members. Around this time, concrete strength was also increased for improved weathering resistance. Bessason et al. (2014) therefore use the year 1980 to distinguish between old concrete houses and new concrete houses. Unlike concrete houses, timber houses did not undergo a significantly stringent design requirement, but have always been built as sturdy structures for wind resistance. The structural elements used for wind resistance provide resistance to seismic forces as well. Despite a lack of marked changed in construction practice, Bessason et al (2014) use the year 1980 to distinguish between old and new timber houses, while keep pumice houses in a single category as they were only popular during a short period of time, and are becoming less relevant now. The distribution of houses in these categories and their heights are presented in Table 4.

Table 4. Approximate number of houses in each building category in SISZ.

Category	Number of storeys				Total
	1	2	3	4	
Old concrete	833	336	144	24	1337
New Concrete	615	149	14	0	778
Old timber	490	123	92	4	709
New timber	1430	120	13	0	1563
Pumice	149	184	24	2	359

1.4.2.2 Experience from recent earthquakes: residential safety of occupants

Akason et al (2006) conducted a study on perceived and observed residential safety during the June 2000 earthquakes. According to their analysis, the victims of June 2000 South Iceland earthquakes, who were inside their residences during the earthquakes, generally found themselves in significant, deadly danger, at least in the epicentral areas, mostly owing to different loose or improperly fastened household articles. The authors claim that the low number of physical injury caused by the earthquake was due to the fortunate timing of the earthquake, when many people were outside of their houses.

The study showed that the following factors had a positive impact in residential safety:

- the authoritative instructions for the general public regarding earthquake safety measures disseminated by the National Civil Defence in the years and decades preceding the June 2000 earthquakes;
- the significantly high level of the victims' knowledge and awareness of these instructions before the earthquakes;
- many victims being able to apply these instructions during the earthquake to move to some kind of safe spots inside their dwellings.

However, Akason et al. (2006) also highlight the following issues that need to be better addressed.

- A significant number of victims reported having difficulty or feeling it impossible to move to a safe spot inside their dwellings. This was particularly significant within 20km of the earthquake epicentres, where modified Mercalli intensity was in the range of VII-IX.

- The potential danger due to “flying” loose household articles inside many houses was minimized because many residents were outside of their dwellings. Therefore, great importance needs to be placed on pre-earthquake arrangements for loose household articles (e.g., fastening down bookshelves, closets, loose and “poorly” fastened articles, etc.), as this will offer safety to at least those who are unable to move during an earthquake exposure.

Studies have shown that the instructions for earthquake safety provided by national authorities have been very useful in mitigating injury to residents. However, since significant movement and dislocation of heavy objects occurred inside houses, and many people felt unable to move during the ground shaking, the low number of physical injuries was fortunate, due to the residents being outside of their dwellings.

Although residents in SISZ have experience of past earthquakes and are well informed of actions to take during earthquakes, it appears awareness alone is not sufficient, as people are terrified during strong shaking, and have little time to move, are confused on the right actions to take, or are too shocked to act. In this context, and given the good structural performance of houses (resulting in very low probability of collapse), mitigation of seismic risk in SISZ can be very efficiently achieved by reducing vulnerability of non-structural components. Educating residents on vulnerable items and providing them when easy and affordable options to mitigate risks due to building contents will be very beneficial. In addition, damage to non-structural components has caused significant economic loss, and its mitigation will increase resident’s well being and resilience against earthquakes. The next stages of this task will address these issues.

1.5 CONCLUSION

This Deliverable describes urban and social fabric of selected pilot-areas in the three countries that form the knowRISK concortium. The main conclusions will be briefly summarized:

- KnowRISK pilot-areas are diverse in terms human occupation patterns and urbanity as well as demography;

- Italy pilot-areas include medium sized urban areas, while Portuguese pilot area is circumscribed to small area of Lisbon metropolis; Icelandic case comprehends rural and urban areas;

- Schools in all pilot-areas are secondary schools and target-students ages range from the age 12 years old to 15 years old;

- Pilot-areas have distinct histories of disaster experience and what stands out is the contrast between Portuguese case, where disaster experience is remote, and Italia and Iceland cases, where disaster experience has been intermittent in the past decade;

- Seismic regulation in Portugal and Italy has been a slow and complex process, although in recent years public initiatives of school seismic strenghning have taken place.

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