17th World Conference on Earthquake Engineering, 17WCEE
Sendai, Japan - September 13th to 18th 2020

THE RECONSTRUCTION OF RESIDENTIAL BUILDINGS OF HISTORICAL CENTRES DAMAGED BY L'AQUILA 2009 EARTHQUAKE

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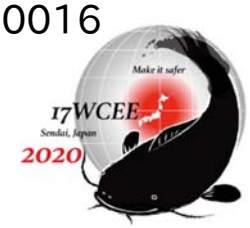
Abstract

The reconstruction process of residential buildings of historical centres damaged by L'Aquila 2009 earthquake started from August 2012 with the adoption of Law n.134/2012. With this law, the Special Offices for the Reconstruction of the city of L'Aquila (USRA) and the other affected municipalities (USRC) were issued. Each Office developed a parametric model to manage the reconstruction and to define the maximum public grant to repair and strengthen damaged buildings. The public grant was released according to funding requests from practitioners. The parametric models take into account the peculiarities of the buildings of the historical centres, which are grouped in such a way as to form complex building stocks, defined "building aggregates" (BA) consisting of Aggregate Minimum Units (namely AMU), in turn made by several buildings (B).
The paper deals with the reconstruction models adopted by the two Offices, the analysis of AMU characteristics and usability ratings as well as repair and retrofit cost data obtained by funding requests. Furthermore, a comparison between the main statistics related to masonry construction features, repair and retrofit cost data and peculiarities of residential buildings outside and inside historical centres is herein presented.

Keywords: post-earthquake reconstruction procedures; historical centres; building aggregates; reconstruction costs; vulnerability; empirical damage



1. Introduction

The Italian territory has been frequently hit by devastating earthquakes in the last century. At a national level, the policies adopted in the immediate post-earthquake phase refer to a consolidated approach. They aim at assessing the usability of the buildings affected by the seismic event. By contrast, there is no specific discipline for the policies and criteria to be followed for the reconstruction of the area affected by the earthquake. In this context, it is interesting to analyse the reconstruction process of private buildings of Abruzzi region damaged by the 2009 earthquake.

The 2009 L'Aquila (Abruzzi Region) earthquake affected 130 municipalities [1] and caused extensive damage to public and private structures, to artistic and cultural heritage of L'Aquila and relevant provinces with a huge number of homeless people. The maximum number of people assisted, in the days immediately following the main event on 6 April 2009, was 67,459 people, allocated in 171 tent camps and in hotels or other accommodation facilities located mostly on the Adriatic coast. In the immediacy of the event, temporary accommodation was realized to host population and essential public functions, such as schools [2].

Once the state of emergency was declared, the damage and usability assessment of the private and public buildings, under a central coordination, was activated in order to determine whether they could be safely used. Since the State Government intended to provide a considerable public financial support to the reconstruction process specific policies were adopted in the municipalities that experienced a macro-seismic intensity greater than VI, according to the MCS Scale, Mercalli-Cancani-Sieberg [3]: the so called “Crater” included L'Aquila and other 56 municipalities.

The reconstruction policies involved two different models in two different phases: the "analytical model" issued in the first phase of reconstruction from 2009 to 2013 for private buildings outside the historical centres (OHC) of Crater, and the "parametric model" adopted in a second stage for private buildings inside the historical centres (IHC).

The first phase was regulated by Law 77/2009 [4] and its management was entrusted to a proper committee, the so-called “*Filiera*” (i.e. an Italian word to indicate a supply chain mechanism) [5]. The “analytical model” was extended to the historical centres, but some problems emerged due to the complexity of masonry constructions IHC. Therefore, in a second stage of the reconstruction process, the parametric model was introduced with a simplified procedure for the reconstruction of IHC buildings. It was introduced by Law n. 134/2012 [6] and managed by Special Reconstruction Office of L'Aquila - USRA - for the reconstruction process of buildings IHC of L'Aquila, and the Special Reconstruction Office of the Crater Municipalities - USRC - for the reconstruction process of buildings IHC of other municipalities. The parametric model specifically accounts for the need to safeguard local architecture and craftmanship in the reconstruction process [7]. While looking at recent Italian post-earthquake reconstruction processes (e.g. 1997 Umbria-Marche and 2002 Molise), the public grant was only slightly affected by the presence of structural elements of the local architecture. The policy adopted after 1997 Umbria-Marche earthquake, provided an incentive of 10 % for preserving elements either of architectural or historical interest [8]. In case of the 2002 Molise earthquake, an increase in the involved the buildings of artistic - historical or monumental interest as a function of the level and extent of the damage (Decree of the Delegate Commissary n.52/2003) [9].

The analysis of the funding requests provided according to the analytical and parametric models is the goal of the present paper. In particular, the data collected on 5,763 masonry buildings located OHC and IHC are presented and discussed focusing on the main statistics related to masonry constructive characteristics as well as actual cost data for repair and strengthening interventions.

2. The reconstruction policies

The analytical model related to the reconstruction process of private buildings OHC damaged by L’Aquila earthquake of 6 April 2009 started once specific Ordinances of the President of the Council of Ministers (OPCM) were issued. Different rules were recognised as a function of usability rating to regulate the reconstruction process. The usability rating has been defined by means of the first level survey form for post-earthquake damage and usability assessment, the AeDES form [10]. This form has been filled by *in situ*

inspections of buildings, carried out by a team of experts to detect the type and extent of structural and non-structural damage and to assess whether the building could be safely used. Depending on the severity of structural damage detected, the team evaluates the risk conditions of the building, providing six possible outcomes: i) A – usable; ii) B temporarily unusable (partially or totally) but usable after short term countermeasures; iii) C - partially unusable; iv) D - temporarily unusable, requiring a more detailed investigation; v) E – unusable; vi) F - unusable due to external risk. Note that, the reconstruction process of residential buildings outside the historical centres involved only the buildings with B-C and E usability ratings. The reconstruction process was divided into two phases: i) light damage reconstruction; ii) heavy damage reconstruction. In the light damage reconstruction, the priority was given to B or C usability rating buildings in order to enable a fast re-occupancy of slightly damaged building. In the second phase, namely " heavy damage reconstruction ", the recovery involved E rating buildings.

According to the specific Ordinances, the repair costs to restore original condition of damaged structural or non-structural elements were fully covered by public grant. In addition, different thresholds were defined to cover costs related to strengthening interventions aimed at reducing the vulnerability of repaired buildings. The maximum grant for strengthening works was established as a function of the usability rating of buildings. It is referred to local strengthening intervention in case of B-C usability rating and global strengthening intervention in case of E usability rating, with a minimum safety goal of 60% (and no more than 80 %) with respect to the New Building Standard, NBS, at ultimate limit state according to Italian seismic code, DM 14.01.2008 [11]. In case of E buildings, the demolition and reconstruction can be also carried out if it resulted the most suitable strategy.

The public grant was quantified for each building by means of repair and strengthening intervention project carried out by practitioners engaged by owners. Each project and relevant grant required were approved by a proper committee, called “Filiera” after an administrative, technical and economical check.

At the end of 2013, the Filiera had examined 5,775 projects and approved 4,280 of them (3,734 related to buildings located OHC of L’Aquila and 546 related to buildings located OHC of the other municipalities of the Crater). The total allocated funds for residential buildings outside the historical centre of L'Aquila municipality until September 2013 was about 2,1 billion Euro and the total amount due to the activity of the Filiera can be estimated of the order of 2.6 billion euros. Details on the data related to both "light damage" and "heavy damage” reconstructions are reported in [12;13].

In order to start the reconstruction process of historical centres damaged by the 2009 L’Aquila earthquake, it was necessary to introduce a simplified procedure to easily take into account both the structural complexity of the historical centres and the territorial peculiarities (i.e. materials and construction techniques and valuable architectural components). Indeed, within historical centres, mostly made by Building Aggregates (BA), portions with homogeneous characteristics and with low or without mutual seismic dynamic interactions were identified: the so-called Aggregate Minimum Unit - AMU. Each AMU can be made of one or more buildings with the same or with different usability rating. They are also characterized by structural and non-structural elements typical of historical architecture, such as contrast arcs, vaults and loggias, whose behaviour and mutual interaction make their seismic response difficult to simulate and predict in numerical analyses. This, accounting also for the structural and architectural interventions carried out on the original structures over time, makes the design of the repair and strengthening interventions of BA difficult to analyse. Therefore, the implementation of a parametric model was essential to determine the maximum allowable public grant to restore the usability of damaged buildings and to increase their seismic safety.

According to DPCM February 4, 2013 [14], the analytical approach was replaced by the parametric one. It defined two different special reconstruction Offices: i) the Special Reconstruction Office of L’Aquila, USRA, for the reconstruction process of buildings in the IHC of L'Aquila; ii) the Special Reconstruction Office of the Crater Municipalities - USRC - for the reconstruction process of buildings in the IHC of other municipalities. The regional territory related to USRA (in yellow) and to USRC (in orange) is depicted in Fig. 1.

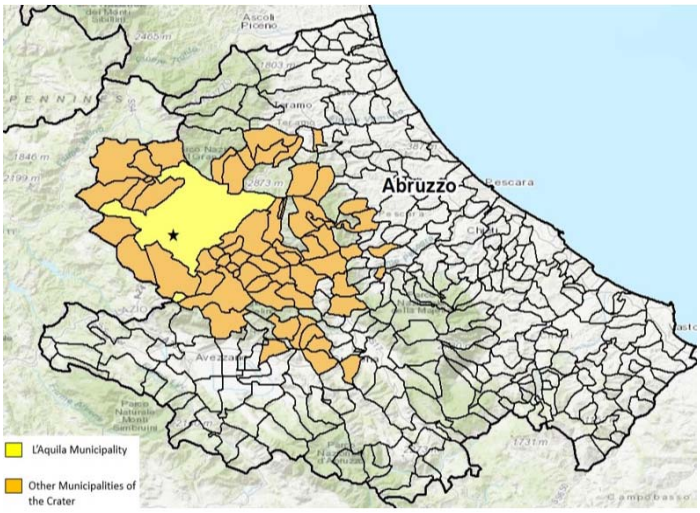


Fig. 1 - Municipalities in the Abruzzo region under the management of the Special Reconstruction Office of L'Aquila, USRA (yellow) and of the Special Reconstruction Office of the Crater Municipalities, USRC (orange).

Each Office developed a parametric model to manage the reconstruction process and to define the maximum public grant to repair and strengthen the damaged buildings [15, 16,17].
According to the parametric models, the grant was established by means of two main steps: i) definition of funding amount threshold (namely Allowable Grant) by means of parametric costs established as a function of building vulnerability class and damage level assessed through AeDES form; ii) definition of repair and strengthening intervention and relevant costs carried out by practitioners engaged by owners.
Both models fully cover not only the repair and strengthening costs to restore the usability buildings but also interventions to preserve the cultural and architectural heritage value of IHC buildings. Thus, grant increase were allowed to preserve and restore valuable elements in historical heritage buildings (maximum increase of 60% with respect to the allowable grant) or to carry out intervention on buildings regulated by specific heritage protection provisions (i.e. Legislative Decree n. 42/2004) [18], maximum increase of 100% with respect to the allowable grant.
The projects were designed for single AMU's, which may coincide with a single building (B) or with the entire aggregate or with the portion of the aggregate composed of one or more buildings. The funding requests were submitted by practitioners and were checked by the Special Offices. If the intervention costs were lower than AG, the Special Offices checked the funding request only from administrative point of view. In case of intervention costs greater than AG, an accurate check of funding requests from administrative, technical and economic point of view was carried out.
To date the reconstruction process of IHC residential buildings is still ongoing. At the end of 2019, 3,938 funding requests for repair and strengthening interventions on AMU's were submitted to USRA (1,581) and USRC (2,357). The Special Offices approved 1,170 funding requests (526by USRA and 644 by USRC). The total amount of public grant allocated for IHC residential buildings until December 2019 was about €1,9 billion (€1,15 billion by USRA and 0,75 billion by USRC).

3. Analysis of damaged buildings dataset

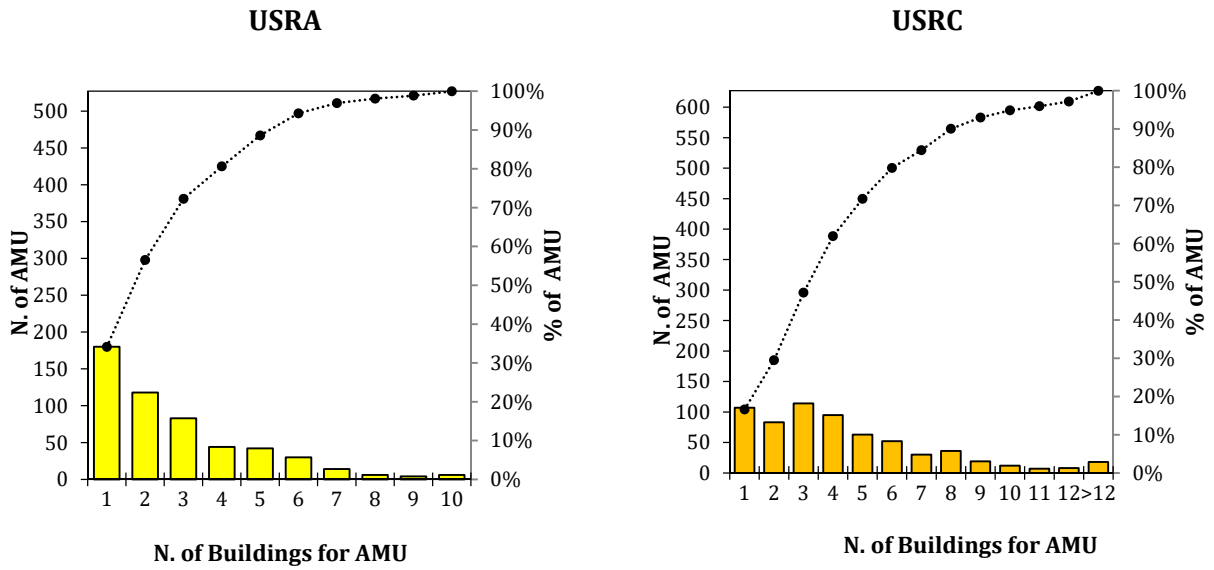
The analysis of the grant applications related to both analytical and parametric models allowed to collect a database with information on: i) building characteristics; ii) usability ratings; iii) type of valuable elements; iii) protection provisions for buildings; iv) repair and strengthening intervention costs.
The historical centres are mainly characterised by masonry buildings. Thus, the data processed by the Filiera on these buildings (analytical model) are only used for comparison with those provided by the parametric model. However, note that masonry buildings of historical centres are mainly characterised by rubble masonry, often made of materials with low mechanical properties and lacking of efficient earthquake-resistant structural detail.

The database contains data related to 1,436 funding requests on buildings approved by the Filiera, and 526 and 644 AMU approved by USRA and USRC, respectively(Table 1). The funding requests approved by the Filiera corresponded to 899 buildings with B or C usability ratings and 537 with E usability ratings. The parametric model refers to AMU's which can be made of one or more buildings, each one with its own usability rating. In particular, the 526 funding requests on AMU's approved by USRA corresponded to 1,472 buildings and the 644on AMU's approved by USRC corresponded to 2,855 buildings. Thus, a dataset of 5,763 buildings is herein analysed.

Table 1–Funding requests and number of buildings

Reconstruction model	Committee	Number of AMU	Number of buildings
I – analytical model	FILIERA	-	1,436
II parametric model	USRA	526	1,472
	USRC	644	2,855

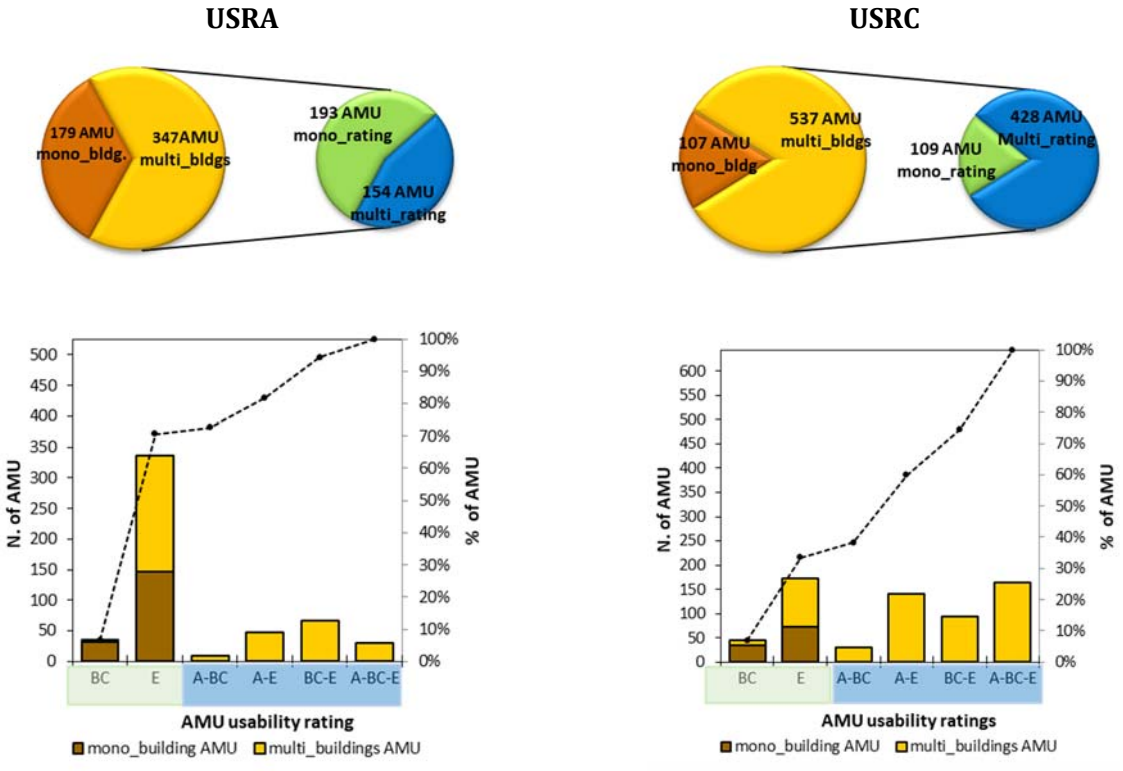
Fig. 2 depicts the frequency of AMU's with one or more buildings both for L'Aquila (USRA) and Crater municipalities (USRC) historical centres. It clearly comes out that the percentage of AMU's with one building only (namely mono-buildings AMU in the following) is significantly greater in the case of AMU processed by USRA (i.e. 180 AMU's, 34%) than for those by USRC (i.e. 107AMU, 17%). The sample of AMU's made by more than one building (namely multi-buildings AMU in the following) mostly consists of two, three or four buildings. On average the number of buildings for AMU is 2.8 and 4.4 for L'Aquila and Crater municipalities, respectively. In case the AMU of the other municipalities of the Crater this value become 4.4 due to the lowest percentage of AMU made of one building (only 17%).



(a) (b)

Fig.2 Number of buildings for Aggregate Minimum Unit (AMU) of L'Aquila (a) and for the other municipalities of the Crater (b).

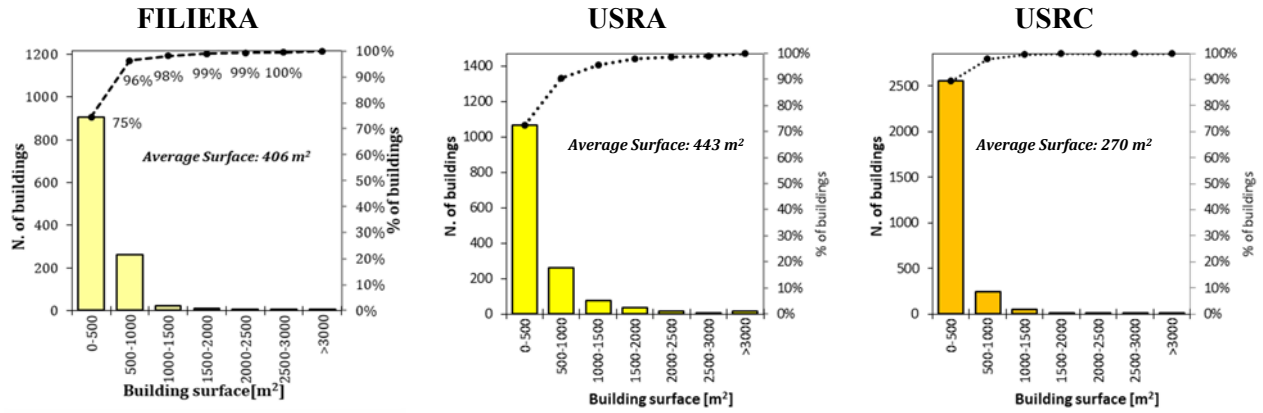
Fig. 3 depicts the distribution of mono or multi-building AMU's and, in the case of multi-building AMU's, the distribution of AMU's characterized by buildings with one usability rating only (namely mono-rating AMU in the following) or with different usability ratings (namely multi-rating AMU's in the following). In the latter case, the AMU usability ratings can be: A-BC; A-E; BC-E, A-BC-E. The figure shows that mono-rating AMU's are more common on USRA dataset rather than in the USRC one.



(a) (b)

Fig. 3 AMU usability ratings of the L'Aquila historical centre (a) and of the other historical centres in municipalities of the Crater (b)

Fig. 4 reports the distribution of buildings OHC or IHC of L'Aquila and other municipalities of the Crater as a function of building surface. It appears that the average building surface of masonry buildings (i.e. total gross floor area) of the Crater municipalities are lower than that of L'Aquila municipality both OHC and IHC. This result is coherent with the different typological features of buildings of the town of L'Aquila and the other s smaller municipalities of the Crater.



(a) (b) (c)

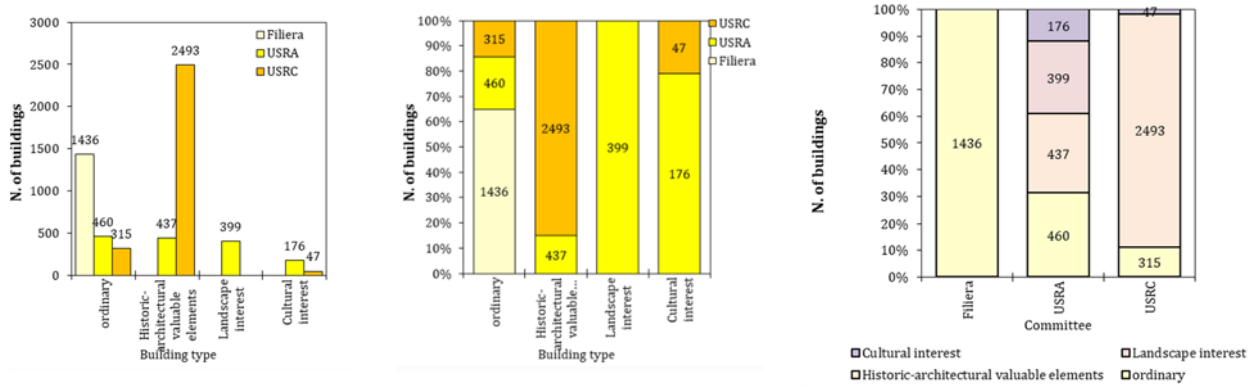
Fig. 4 –Building surface: OHC L'Aquila municipality (a); IHC of L'Aquila municipality (b); IHC of the Crater municipalities (c).

4. Valuable elements

The reconstruction policy adopted by the Special Offices established strategies of urban reconstruction compatible with the different historical, cultural, natural, morphological and aesthetic value levels of historical centres with the aim of recovering the pre-existing values of the cultural heritage. To this aim different categories, depending on different valuable elements, have been defined; in particular, the USRA has identified the following three: i) building with historic-architectural valuable elements; ii) building with landscape interest; iii) building with specific heritage protection provisions (the so-called building of cultural interest). Conversely, the USRC has identified only two of them: the i) and iii) categories.
Buildings not included in previous categories are defined "ordinary". Note that the buildings analysed by the Filiera committee were all identified as ordinary, according to such assumption.
USRA and USRCR defined an inventory of valuable elements and percentage of grant increase were also defined in order to support their preservation. Similarly, grant increase was defined for further building categories [15, 16]. In particular, the increase was introduced within the following maximum limits:

- 60 % of the AG for building with historic-architectural valuable elements;
- 100 % of the AG for building with landscape interest;
- 100 % of the AG for building of cultural interest. The increase is realised by a fixed rate (60%) and an additional percentage depending on projects' features.

The analysis of the project attached to the funding requests provides information on valuable element types of 3,552 buildings (1,012 of L'Aquila historic centre and 2,540 of the historic centres of the other municipalities) which have received a specific grant increase.
Distribution of the number of buildings outside historical centre (Filiera) and the building located in the historic centre of L'Aquila (USRA) and other historic centres of the municipalities of the Crater (USRC) is illustrated in Fig. 5 as a function of the building type. In case of buildings without intervention on valuable elements (460 USRA and 315 USRC), the grant increase was not applied, therefore they are named ordinary in Fig. 5. It is noted that the USRC building sample have only 47 buildings of cultural interest, i.e. 2% of the sample. While176 buildings of cultural interest were in L'Aquila.



(a) (b) (c)

Fig. 5 –Building with valuable elements: number of buildings (a); percentage distribution (b); distribution of buildings as a function of the approval committee.

4. Repair and strengthening costs

The analysis of the funding requests related to repair and strengthening intervention costs or demolition and reconstruction costs of buildings or AMU's are herein presented.
The data related to the analytical model collect costs on 1,436 masonry buildings:899 with usability rating B-C with repair and local strengthening intervention, 313 with usability rating E with repair and global

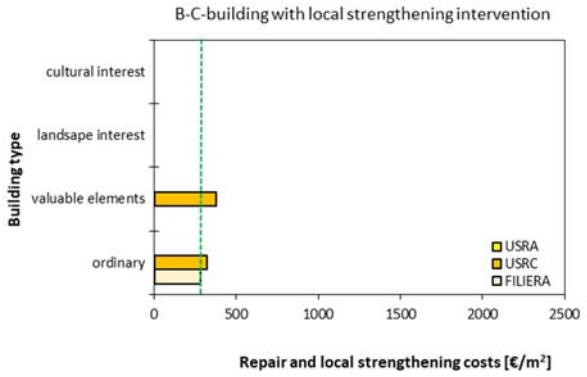
strengthening intervention (NBS> 60%) and 224 with usability rating E, demolished and reconstructed, the so-called E_{dem} buildings. All buildings do not have valuable elements and therefore are defined ordinary buildings, according to the above definitions. The costs are available separately for repair and retrofit interventions.
The repair costs include: building safety measures; demolition and removal, including transportation costs and landfill disposal; repair interventions; repair and finishing works relevant to strengthening interventions (only for E building); testing of facilities; technical works for health and hygiene improvement; technical works to improve facilities; construction and work safety costs; design and technical assistance of practitioners; furniture moving. Strengthening costs are inclusive of charges for the design and technical assistance of practitioners.
The comparison in terms of costs with data provided by the parametric model is performed with reference to a subset of data: 1,179 masonry buildings out of 1,472 for USRA; and 526 buildings out of 2,855 for USRC. Indeed, to correctly compare the data costs, buildings with no damage (A rating) have been excluded from the dataset. Furthermore, in case of USRC only mono-rating AMU's are considered because the costs provided by USRC are related to the whole AMU rather than to each building. The mean costs of repair and strengthening intervention costs are summarized in Table 2. The costs are expressed in euro per square meter of overall building gross surface area (i.e.the area of the building footprint).
The costs are inclusive of charges for the design and technical assistance of practitioners but does not include VAT (10% of costs for repair and local or global strengthening costs and 20% for the other costs).

Table 2 –Repair and strengthening costs per square meter of covered surface

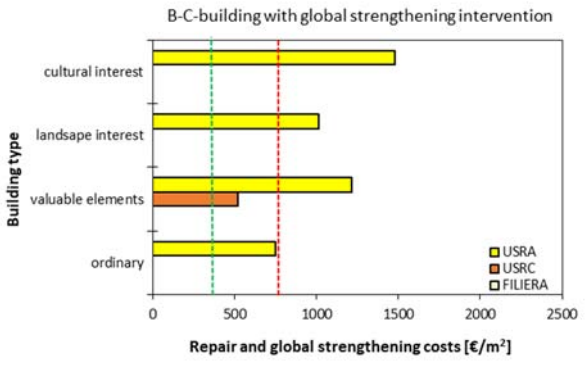
	Usability ratings	Intervention type	N. of buildings	Repair and retrofit costs [€/m^2]	Demolition and reconstruction costs
Filiera	B or C	Repair and local [global] strengthening	899	284.67	-
	E	Repair and global strengthening	313	767.98	-
	E	Demolition and reconstruction	224	-	1,169.85
USRC	B or C	Repair and local [global] strengthening	52 [6]	369.01 [532.01]	-
	E	Repair and global strengthening	435	1,053.71	
	E	Demolition and reconstruction	33	-	1,059.20
USRA	B or C	Repair and local [global] strengthening	132	[1,040.47]	-
	E	Repair and global strengthening	793	1,518.87	-
	E	Demolition and reconstruction	254	-	1,305.33

The repair and strengthening costs related to funding requests approved by Filiera on average were lower than those approved by USRA and USRC, independently from usability rating. The mean cost ratio between grants related to USRC and Filiera was 1,30 (1,87) for B or C building with repair and local (global) strengthening intervention and 1,37 for E building with repair and global strengthening intervention. The mean cost ratio between grants related to USRA and Filiera was 3,65 for B or C buildings with repair and strengthening intervention and 1,98 for E buildings with repair and global strengthening intervention. The reason of such cost increase is clearly related to the extra costs needed to preserve, restore or repair valuable elements on IHC. Furthermore, note that in some cases, for B and C rating IHC buildings, an extra cost has been requested to enhance the global seismic safety level NBS>60%, while local strengthening approach has resulted less expensive (see Table 3). Difficulties in construction site installation also strongly increase the intervention costs. In order to better understand the influence of valuable elements of IHC buildings with respect to OHC

buildings, Fig. 6 shows the cost data as a function of the building category (i.e. ordinary buildings, buildings with historic-architectural valuable elements, building with landscape interest building of cultural interest allocated) and for different usability ratings and relevant repair and strengthening works.
The green and red dashed lines of Fig. 6 represent the mean costs allocated by Filiera (i.e. ordinary masonry buildings OHC) for B-C, E or E_{dem}, respectively (see Table 2). The number of buildings for each category is reported in Table 3.
Fig. 6a shows that for buildings with usability rating B or C (repair and local strengthening intervention), the mean costs allocated by USRC are greater than those allocated by Filiera by percentage factors of 14% for ordinary buildings and 32% for buildings with valuable elements. Figure 6b shows that significant extra costs were sustained in case of the B or C IHC buildings with global strengthening intervention. In case of E buildings (repair and global strengthening intervention) the mean costs allocated by USRC and USRA are greater than those allocated by Filiera by percentage factors of 23% and 13% for ordinary buildings, 38% and 54% for buildings with valuable elements, 114% for building with landscape interest and 128% and 190% for buildings of cultural interest (Fig. 6c).



(a)



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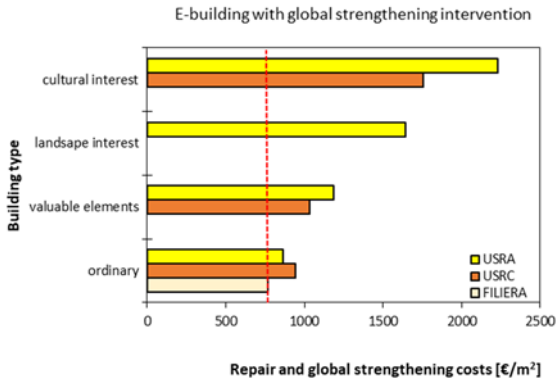

(c)

Fig. 6 – Mean repair and retrofit intervention costs per square meter of different building types allocated by Filiera, USRA and USRC for B-C buildings with local strengthening intervention (a), B-C buildings with strengthening intervention (b), E buildings with strengthening intervention (c).

Table 3– N. of buildings according to building category

Committee	Building category	N. of buildings B or C rating	N. of buildings B or C rating NBS> 60%	N. of buildings E rating NBS> 60%
Filiera	Ordinary	899	-	313
	Valuable elements	-	-	-
	Landscape interest	-	-	-
	Cultural interest	-	-	-
USRC	Ordinary	6	-	8
	Valuable elements	46	6	409
	Landscape interest	-	-	-
	Cultural interest	-	-	18
USRA	Ordinary	-	36	95
	Valuable elements	-	43	253
	Landscape interest	-	44	290
	Cultural interest	-	9	155

5. Conclusions

The main aspects of the reconstruction policies adopted after April 2009 earthquake that hit the Abruzzo Region in Italy have been reported and discussed in the paper. Two different funding models have been introduced in order to define the public grant amount to restore private buildings outside historical centres, OHC, (analytical model, managed by Filiera) and inside the historical centres, IHC, of L'Aquila and of the other 56 municipalities of the Crater (parametric model managed by USRA and USRC, respectively). The parametric model mainly involved buildings in aggregate and the relevant funding request were related to Aggregate Minimum Units (AMU's) made of one or more buildings.

The analysis of applications for funding of both analytical and parametric models made it possible to collect a database with information on 1,472 masonry buildings OHC of L'Aquila, 526 AMU's (1,472 buildings) IHC of L'Aquila and 644 AMU (2,855 buildings) IHC of Crater municipalities.

The main data provided by the analysis can be summarized as follows:

Outside Historical Centres (OHC) of L'Aquila and of other municipalities of the Crater (funding request managed by the Filiera):

- the sample is made of 899 buildings with B or C usability ratings and 537 buildings with E usability ratings;
- the average building surface is 406 m^2;
- on 899 B-C buildings funding requests deals with repair and local strengthening interventions, on 313 E buildings with repair and global strengthening interventions, and on 224 E buildings with demolition and reconstruction;
- the mean repair and strengthening costs are 284.67€/m^2 for buildings with B or C usability ratings, 767.98€/m^2 for buildings with E usability ratings and 1,169€/m^2 for E building with intervention of demolition and reconstruction;

Inside Historical Centre (IHC) of L'Aquila municipality (funding request managed by USRA):

- the sample consists of 526 AMU's, out of which 34% (180 AMU's) made of one building;
- on average the number of buildings per AMU is equal to 2.8;
- 71% (373 AMU) of the sample is made of buildings with the same usability rating (35 AMU's with usability rating B or C and 338 AMU's with usability rating E);
- the average building surface is 443m^2;

- the funding request deals with:460 ordinary buildings; 437 buildings with valuable elements, 399 buildings with landscape interest and 176 buildings of cultural interest;
- on 132 B or C buildings funding requests deals with repair and global strengthening interventions, on 793 E buildings with repair and global strengthening interventions and on 254 E buildings with demolition and reconstruction;
- the mean repair and strengthening costs are 1,040.47€/m^2 for B or C buildings with repair and global strengthening interventions, 1,518.87€/m^2 for E buildings with repair and global strengthening interventions and 1,305.33€/m^2 for E building with intervention of demolition and reconstruction.

Inside Historical Centres (IHC) of Crater municipalities (funding request managed by the USRC):

- the sample consists of 644 AMU, out of which 17% (107 AMU) made of one building;
- on average the number of buildings per AMU is equal to 4.4;
- 34% (216 AMU) of the sample is made of buildings with the same usability rating (44 AMU's with usability rating B or C and 172 AMU's with usability rating E);
- the average building surface is 270m^2;
- the funding request deals with: 315 ordinary buildings; 2,493 buildings with valuable elements and 47 buildings of cultural interest;
- on 52 B or C buildings funding requests deals with repair and local strengthening interventions, on 6 B or C buildings funding requests deals with repair and global strengthening interventions on 435 E buildings funding requests with repair and global strengthening interventions and on 33 E buildings with demolition and reconstruction;
- the mean repair and strengthening costs are 369.01€/m^2 (532.01€/m^2) for B or C AMU's with repair and local (global) strengthening interventions, 1,053.71€/m^2 for E buildings with repair and global strengthening interventions and 1,059.20€/m^2 for E building with intervention of demolition and reconstruction.

The data clearly show that significant extra costs needs to be accounted in the reconstruction process to preserve, restore and mitigate the seismic risk of historic-architectural valuable elements, buildings with landscape interest or buildings of cultural interest.

6. Acknowledgements

The authors would like to recognize the crucial role of the Special Offices for the Reconstruction of the city of L'Aquila (USRA) and the other affected municipalities (USRC) and, in particular, they would like to thank Eng. Cristiano Michele Fabrizio and Eng. Nicola Di Costanzo (USRA), and Eng. Dario Pecci and Eng. Rosanna Gualtieri (USRC), for their support and effort on the development of the activities.

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