



Analysis of the Reconstruction Process of the Historical Centres hit by the 2009 Abruzzi Earthquake: Intervention Costs and Analysis of the Grant Increases for Historic Traditional Buildings

Raffaello Fico¹, Rosanna Gualtieri¹, Dario Pecci¹, Antonio Mannella², Antonio Sabino², Adriana Marra², Marco Di Ludovico³ and Andrea Prota³

¹ Special Office for Reconstruction of Crater Municipalities, Piazza Gemona 1, 67020 Fossa (AQ), Italy

² Italian National Research Council, ITC, Via Giosuè Carducci 32, 67100 L'Aquila (AQ), Italy

³ Department of Structures for Engineering and Architecture, University of Naples Federico II, 80125, Naples (NA), Italy

Corresponding e-mail: antonio.mannella@itc.cnr.it

Abstract

Following 2009 Abruzzi Region earthquake, the reconstruction process of historical centres of towns and villages was managed by using the so-called "Integrated Model for Crater Cities (IMC)". This is a parametric model to define, through step by step and simple procedures, the allowable grant amount for repair works. The IMC model, consists of two distinct parts: the first one is a data sheet to calculate in a parametric way the maximum financial contribution on the basis of data related to the damage and vulnerability of structural units; the second one is an executive project of the repair/retrofit intervention and relevant costs. The simultaneous delivery of this documentation allows to assess the suitability of intervention and to verify that the requested grant is compliant with proper financial thresholds defined by post earthquake laws. Considering that the procedure is applied to buildings in historical centres, specific grant increases have been defined both to promote the preservation of the historical fabric and to prevent invasive interventions that could modify the architectural and structural peculiarities of the areas. The paper focuses on the analysis of the intervention costs with particular attention to the financial increase incidence and the intervention types.

Keywords: reconstruction, historical centres, public grants, grant increase factors.

1. Introduction

The post-earthquake reconstruction process in Abruzzo followed two different phases clearly distinguishable. The first phase, so-called "Emergency Phase", was regulated by Law 77/2009 [1] and several Ordinances of the President of the Council of Ministers (OPCM). This phase involved the reconstruction of residential buildings outside historic centres. The financial strategy of the Italian government was to fully cover the repair work costs to restore the usability of damaged buildings; furthermore, different financial thresholds were defined for strengthening interventions as a function of the usability rating of each building. The usability rating was determined by proper post-earthquake field inspections carried out by team of surveyors; the AeDES survey form [2] was adopted as a tool for the seismic damage and usability assessment. For each building, the repair and strengthening works and relevant costs were determined by practitioners engaged by owners.

At this stage the allowable grants was controlled by

the Municipalities with the support of the so-called "Filiere" [3] to carry out the necessary controls on the grant applications [4] [5].

The second phase of the reconstruction process, the "Post-Emergency Phase", was governed by Law 134/2012 [6] and involved historical centres of L'Aquila and other 56 municipalities. The Law 134/2012 introduced a parametric model, based on the analysis of the state of damage and vulnerability of buildings (Structural Units), to determine the maximum public grant eligible to restore the usability of damaged buildings.

2. The Integrated Model for the municipalities of the Crater

The parametric model adopted to determine the allowable grants to repair private buildings in historical centres damaged by the 2009 earthquake, consists of two parts:

a. the computation of the Allowable Grant for the interventions by means of a suitable form specifically set up to quickly define the building vulnerability class

and damage grade, the so called IMC form;
b. the executive project which fully identifies seismic retrofit and energy efficiency upgrade interventions and the bill of quantities.

The IMC form allows defining the grant that may be granted for the repair as provided in Article 4 of the O.P.C.M. of February 4, 2013 [7]. The simultaneous delivery of the executive project allows verifying whether the project costs of intervention falls within the limits of the allowable grant defined on parametric basis. If this occurs, the funding request is approved via simplified check. Otherwise, the executive project is analytically oversaw to verify the proposed project intervention eligibility and the special and exceptional conditions that prevent to fit the grant limits established by IMC form.

Via online application the practitioners are able to define the allowable grant and submit the application for founding with reference to: buildings (B); Building Aggregates (BA); Aggregate Minimum Unit (AMU), which are portions of the BA with homogeneous characteristics and with low or without mutual seismic dynamic interactions, identified to optimize execution of works.

The allowable grant, related to BA or AMU, is determined for each single building (B) according to the following procedure, which asks to determine:

- a. Intervention Unit Contribution (IUC) for each building. This is determined on the basis of usability results and the type of intervention, seismic repair and local or global seismic strengthening;
- b. Conventional Unit Cost (CUC), determined on the basis of the presence of facilities and equipment, their quality and the quality of finishes of each dwelling according to the declared use;
- c. Conventional Cost (CC), given by the sum of the products of the conventional Unit Cost of each building dwelling and common spaces (SIC), and total surface of each dwelling part of the building, Building Aggregates or Aggregate Minimum Unit;
- d. Allowable grant, given by the Conventional Cost, increased by increase factor if persist some particular conditions, specified in the next paragraph;
- e. Approved grant for works, resulting from bill of quantities of the executive project that generally results lower than or equal to the allowable grant.

More details about parametric model for reconstruction and about the procedures for determining allowable grant can be found in Fico et al. 2015 [8], 2017 [9].

3. Grant increase factors for valuable elements

In order to preserve the territorial peculiarities, with reference to the materials and construction techniques and specific valuable architectural component, the conventional cost can be increased to cope the higher costs related to the conservation of architectural and structural peculiarities.

The increases can be applied to the single building or to the entire AMU or BA.

The increases applicable to the building are related to:

- a. Difficulties in construction sites installation, due to presence of narrow streets and absence of adequate storage areas;
- b. Presence of valuable elements as façade masonry, vaults, worked stones, etc;
- c. Engineering and architectural difficulties in reconstruction of partially collapsed buildings preserving residual structure;
- d. Removal of shores applied to buildings in danger of fault;
- e. Securing of parts considered “ruins” influencing the stability of the aggregate;
- f. Severe seismic actions related to local amplification.

There are “additional cost items” acknowledged on the base of detailed analysis. These are related to:

- i. works to the repair elements, even secondary or finishing, which are part of the aggregate, such as parts of walls, urban gates, rocky spurs and buttress, contrasting arches between buildings, fountains, seats;
- ii. restoration of common spaces, such as courtyards, presence of “a secco” walls, balustrades, historical floors, etc.;
- iii. contribution to specific cost relating to construction sites located in areas of archaeological interest;
- iv. contribution to the restoration of historical and artistic assets (frescoes, stuccoes, wall paintings, statues, etc.);
- v. consolidation of natural or anthropic caves below the buildings;
- vi. GEO-STRU investigation costs, technical and administrative costs, VAT.

In order to better define the increases to the conventional contribution and the additional items to the allowable grant, the Special Reconstruction Office of the Crater Municipalities (USRC) issued a proper technical document: “Guidelines for the identification of valuable elements and design of specific interventions in historical centres”. It defines requirements to assess if the typology and localization of element identified are valuable as an expression of construction techniques and representative of the local culture and therefore deserving of restoration.

Moreover, Guidelines allow identifying most suitable choices for design to preserve and improve building’s quality in the historical centres. The types of intervention to be implemented are identified in accordance with the existing urban planning tools and in particular with the Technical Implementation Rules of the Reconstruction Plans.

The introduction of increases for valuable elements

(b) also allows promoting restoration of architectural constitutive elements which, otherwise, would be lost.

4. Grant approved and analysis of interventions

The parametric model, described above, started to be effective since 2014. At the end of September 2017, 1138 parametric IMC requests have been submitted (related to 1138 AMU corresponding to 1063 BA and 5252 B). Out of 1138 IMC requests, 460 (corresponding to 460 AMU and 2005 B) have been already approved for a total grant amount of around 542 million of euros (about 40 % already payed off and referring to 106 AMU and 437 B with work completed, and others with works still ongoing). Out of 542 million of euros, approximately 422 million of euros are related to grant for works and 120 million of euros to other costs (professional expenses and taxes, etc.). In the following, we will refer to the 2005 B related to the 460 IMC requests approved.

According to the parametric model the practitioner engaged by owner can select the repair/strengthening intervention on each building; however, some grant increase are addressed to take into account specific cases of buildings in the historical centres. In particular, the IMC procedure allow a maximum grant increase for construction site installation difficulties of 16%. The effects of local amplification may allow a maximum grant increase of 10%. The procedure to evaluate maximum increase factor to preserve and restore valuable elements allows, for historical buildings without particular cultural or artistic relevance, to reach a maximum increase of 60%, summing specific increase concerning the possible presence of single type of valuable elements. Otherwise, the increase for the presence of valuable elements in historical heritage buildings, protected by the specific laws (Legislative Decree n. 42/2004) can reach the 100%.

With reference to the 422 millions of euros approved for repair/retrofit works, the amount related to the above mentioned increase factors is of about 99 million of euros, corresponding to about the 23% of total amount of approved grant for works. Furthermore, Figure 2 shows that about 62% (i.e. 61,4 million of euro) of such 99 millions of euros are related to the grant increase due to the presence of valuable elements. The types of valuable elements found in the buildings of AMU are also described and depicted in Figure 2.

A significant ratio of costs in the range of grant increase factors is due to the construction site installation difficulties (25% corresponding to 24,8 million of euro).

Figure 1 shows the percentage of buildings which have received a specific grant increase in the category of grant increase for valuable elements with respect the total number of buildings under investigation (i.e.

2005 B). It shows that the replacement of reinforced concrete roofs with a wood roof has been chosen in a significant ratio of the buildings' sample. Instead, the conservation of wooden roof affected only 17% of the buildings, although about 90% of them was equipped with a wooden roof. This is probably due to the decision to replace them with new wooden elements. Indeed, repair/retrofit intervention implied significant costs due to the aging of the wooden components.

This information can be related to the distribution of the roofs typology, indicated by orange bars, in the same line, from which it can be seen that almost all the concrete roofs have been replaced and that only a small portion of the existing wooden roofs have been maintained.

By contrast, preservation or restoration of floors was preferred.

Figure 1. Percentage of buildings that have received a specific grant increase with respect the total number of buildings (Blue); distribution of floor and roof types (Orange) in the same sample.

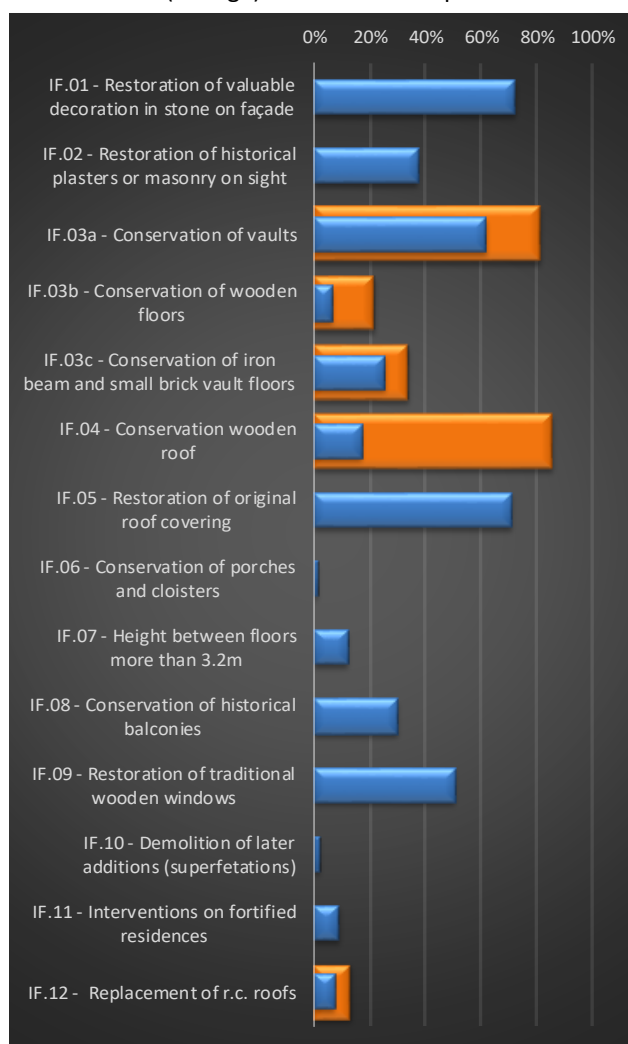
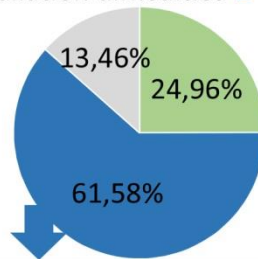



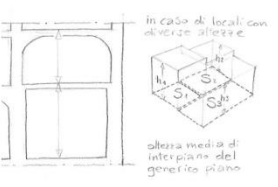












Figure 2. Increase factors percentage related to total cost of approved interventions

■ Construction sites installation difficulties ■ Valuable elements ■ Other



GRANT INCREASE FACTORS OF THE VALUABLE ELEMENTS

<p>IF.01 Restoration of valuable decoration in stone on façade</p> <p>Like stone portal, mouldings, cornices(in stone, brick, plaster or wood)</p>		<p>IF.06 Conservation of porches and cloisters</p> <p>Conservation and restoration of common spaces such as porches, entrance halls and cloisters</p>	
<p>IF.02 Restoration of historical plasters or masonry on sight</p>		<p>IF.07 Height between floors more than 3.2 m</p>	
<p>IF.03a Conservation of vaults</p>		<p>IF.08 Conservation of historical balconies with stone corbels and/or stone or iron balustrades</p>	
<p>IF.03b Conservation of wooden floors</p>		<p>IF.09 Restoration of traditional wooden windows or substitution of incongruous ones</p>	
<p>IF.03c Conservation of iron beams and small brick vault floors</p>		<p>IF.10 Demolition of later additions (superfetations)</p>	
<p>IF.04 Conservation of wooden roof</p>		<p>IF.11 Interventions on fortified residences (fortress-houses, tower-houses, etc.)</p>	
<p>IF.05 Restoration of the original roof covering</p> <p>Reintegration of roof covering with handmade tiles</p>		<p>IF.12 Replacement of r.c. roofs</p> <p>Replacement of reinforced concrete with wooden roofs, in according with local tradition</p>	

5. Conclusions

This memory describes the main aspects of the parametric procedure of the Integrated Model for the municipalities of the Crater (IMC), used since 2014 to define the public grant amount to restore private buildings in 56 historical centres close to L'Aquila city, after April 2009 earthquake that hit the Abruzzi Region in Italy.

An overview on the ongoing reconstruction process in the Crater area was made.

Furthermore, the main increase factors and their effects on the definition of the allowable grant has been reported. The results show that on average 23% the approved grant for works is due to the effects of the increase factors, which mainly concern the preservation of valuable elements (about 62%) and construction site installation difficulties (about 25%).

6. References

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