WP 3 – TF No 2 SPB Seismic monitor

1. Title of monitoring

Ground screening of Strategic Public Building in Abruzzo

2. Type of monitoring

Human SPB Seismic Monitoring

3. Location and NUTS classification

Italy, Abruzzo, Teramo province ITF12

4. Description of monitoring

Two Monitoring Teams were formed with a Team Responsible and two Operators each.
All the members were Civil Engineerings experienced in structural designing and building works supervising and in SPBs' seismic monitoring and/or surveys for the assessment of buildings' seismic damages after the earthquakes in L'Aquila and in Emilia-Romagna.
They performed the pilot intervention on the identified Strategic Public Buildings in the municipalities of Teramo, Cellino Attanasio, Colonnella, Nereto, Roseto, Sant'Egidio alla Vibrata, Sant'Omero, Tortoreto in the Province of Teramo for a total of 10 buildings and carrying out the following Monitoring intervention's steps

Collection of graphic documentation.
The Monitoring Team required to the Municipal Administrations the graphic documentation of the buildings, derived from their construction and from any further restoration and structural changes.

Screening of the buildings
The Monitoring Team reported all the data, derivable from the technical documentation and cadastre on the "SVF-Seismic Verification Form For Strategic Public Buildings" and then got to the site, where it performed the visual and dimensional screening of the structural characteristics and conservation status of the building, according to the data requested by the SVF.
The data collected were keyed in the supplied tablet, which was used to detect the building's coordinates and to take pictures of the building.

Estimation of Seismic Structural Hazard Scale for each SPB
The Monitoring Team evaluated the Seismic Structural Hazard Scale for each SPB, on the base of the type of building (masonry, reinforced concrete, steel, wood, etc.) and the level of knowledge laid down by the LC1 regulation (without testing materials) and using appropriate calculation software, according to NTC 2008 rules.

Report on the suggested intervention to achieve the minimum level of seismic safety of the building
The Monitoring Team elaborated a plan of the interventions to carry out on the building (such as curbs, wooden roof, chains, underpinning, chains, reinforced plasters, carbon fibers, etc.), when the estimate SHHS overcomes the local SHR (seismic classification of the geographic area) in order to improve its seismic resistance until the minimum level of seismic safety (at least the 60 % of the applicable local coefficient).

5. Methods, processes, practices and technologies used in monitoring

Assessment of SPB Seismic monitoring

The evaluation of the seismic safety state of a building, also indicated as verification of seismic adequacy, has the purpose of determining the level of ground acceleration, for which a pre-established limit states are reached.
The above assessment takes place through a three steps process:

- Data collection and preliminary investigations;
- Definition of the model and evaluation of seismic resistance;
- Summary of the results.

Data collection and preliminary investigations

The data are collected by:
- Design documents with annexes geological reports, geotechnical, structural and structural charts, bills of quantities;
- Structural survey;
- On site survey;
- In situ and laboratory tests.

The collected data have to define the construction, the foundation structures, the soil category, the geometry and dimensions of the bearing structure, the mechanical properties of the structural parts, the intended use, any damage suffered previously and carried repairs

• Definition of the model and evaluation of seismic resistance;

The seismic resistance is conventionally referred to the $PGA_{co,}$ PGA_{ds}, PGA_{dl} values corresponding to the limit states of interest.
The seismic resistance evaluation carried out in Abruzzo on strategic public buildings are conducted with one of the linear analysis methods (Level 1), while on the hospitals those of Level 2 (dynamic analysis methods)
The above evaluation is different, depending on the type of building:

a) Reinforced concrete buildings

The verifications will be carried out using the limited knowledge level (LC1): geometric survey; in situ survey limited to construction details and in situ tests limited to material properties.
Usually linear static analysis is applied, in some cases linear dynamic analysis even.

b) Masonry buildings

It will proceed to the verifications using the limited knowledge level (LC1).

6. Number of SPB monitored/pilot action implemented

7. Description of outputs/results and lesson learned

outputs/results

Each SPB monitoring result has been reported in a final report consisting of specific documents and drawings that include:

- A summary form reporting the name and typology of the building, its assessment result and suggested restoration and mitigation intervention
- Administrative and technical history of the building, it describes the geometry and structural elements (dimensions, reinforcement, measured and adopted mechanical properties;
- photographic documentation;
- investigations carried out and results obtained (element sizes, thicknesses, reinforcement diameters, mechanical characteristics of materials, etc.);
- description of the adopted model and its level of analysis used with the characteristics of the used software;
- assessment of the resistance and corresponding risk indicator.

Learnt lessons

The pilot project highlighted some problems:

(a) the need for a periodic monitoring activity to guarantee a sufficient level of seismic resistance over time, actually human screening and next seismic safety assessment intervention provides an instantaneous indication of the degree of seismic vulnerability of the building. Such intervention should be repeated periodically, since seismic activity in high-risk areas is practically continuous, causing cumulative damage that, together with the natural degradation of the properties of building materials, cause changes in the level of vulnerability of buildings.

(b) the assessment of seismic safety and the drafting of projects for adaptation interventions require time, involvement of experinced engineers and architects and therefore high execution costs.

8. Relevance to p themes/ objectives/outputs

(themes)

(objectives)

Project specific objective 2: To establish crossborder model and pilot actions to monitor strategic and relevant public buildings

(outputs)

Instrumental and professional mixed SPB Seismic Monitoring procedure

9. Proposal for enhancement/adaptation measures of monitoring of SPBs

Combine the SPB Seismic Monitoring procedure with instrumental one (moreover experimented in other territories within the same HOLISTIC project) to carry out a Monitoring Campaign measuring SPBs vulnerability level over time and on widespread territory.

A new procedure that envisages periodical instrumental fast surveys of SPBs through passive measurements (Geologist teams) of SPB dynamic parameters and underlying soil to detect resonance mechanisms and identify “in danger of soil-structure resonance” SPBs.

Then Human ground screening (Engineer and Architect teams) limited to identified critical SPBs to evaluate their Seismic Structural Hazard Scale (SSHS) using specific software and finally, where SHHS overcomes the local Seismic Hazard Risk, a preliminary design of SPBs’ restoration interventions.

10. Source of data (*Project, Institution, Body who carried it out)*

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