

*Special Session on Experience Sharing around the French Practical Approach of
Seismic Security Engineering and Risk Management*

French organisation for post-earthquake diagnostics.

Challenges and ongoing developments

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ABSTRACT:

In situations of post-earthquake emergency, the authorities need to review the damage level of a building in order to assess the immediate risk for people. Such diagnoses are technical support for the Authorities decision making process to ensure the safety of people. The results of diagnoses are considered for: information to the populations; authorization, prohibition or restriction relative to the use of damaged buildings by citizen; safety works or demolitions.

Few years ago, no national standard was available for post-earthquake diagnosis despite a proven seismic risk. That's why the French Association for Earthquake Engineering (AFPS) has decided to create a dedicated working group on "post-earthquake diagnosis". In September 2014, the technical and organizational approach proposed by AFPS obtained recognition by the Ministry in charge of civil protection. The organization and the technical tools are now available.

The next steps consist in a stabilization of procedures, an increase number of volunteers and a deployment of large-scale training. The actions require the support of various ministries and the involvement of local actors. Cross-border exchanges are also in progress (Italy, Switzerland, Spain).

Keywords: post-earthquake emergency, diagnosis of damaged building, national standard, France

1. The challenges facing emergency post-earthquake building diagnostics

The term "emergency diagnostics" applies to **the examination/inspection of damage degree suffered by buildings during an earthquake for an immediate post-earthquake situation of urgency.**

These diagnostics are used to issue an opinion/assessment of the risk entailed for people by the condition of the building works that were damaged by the quake. It represents an **opinion/information for the authorities so that they can make decisions to ensure the safety of people.**

It is especially on the basis of the results of these diagnostics that the authorities will base their actions for securing areas and make their decisions on whether or not to prohibit or limit access. These diagnostics will assist the authorities in:

- **Identifying building damages that shows, whether in whole or in part, an imminent hazard to population, and consequently help to:**
 - o Prescribe actions and works that are essential prior to any reuse,
 - o **Prohibit or restrict access to buildings** showing serious damages,
 - o **Identify those that may collapse** and that need to be demolished as a matter of urgency.
- **Identifying building works that do not present any risk to people** so as to:
 - o Authorize access and occupation,
 - o Facilitate a reuse to normal conditions in a part of the impacted territory.
- **Informing people** on condition of buildings and authorize occupants to return to them wherever this is possible,
- **Gaining a quick overview of damages amplitude**, so as to estimate the needs in terms of assistance and to size the resources to be mobilized.

Emergency diagnostics constitute assistance to decision making so as **to take emergency preservation measures**, established during the period when the territory is severely impacted. These measures take on a **temporary aspect**, while awaiting a return to a normal situation, or to limite operations across the territory so that it becomes possible to perform more conventional or contractual diagnostics as established by technical experts (engineering consultancies, technical inspectors, etc.).

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In terms of civil safety challenges set out above, it is essential **to secure, coordinate and trace the way the emergency diagnostics are undertaken**. To this end, any emergency diagnostics measure must:

- Fit into an **official framework** detailing its coverage and the terms of intervention,
- Be based on a **formal and shared organization and methodology**,
- Have dedicated **technical tools and resources**,
- Be managed through a **“quality” process** that enables the measures to maintain satisfactory performance as well as continual improvements based on progress in the state of the art and with feedback of experience.

Lastly, performing emergency diagnostics cannot be improvised and requires a minimum amount of anticipation and planning. To this end, it is essential that at the national level, the entire French territory area have unified and validated principles for undertaking such post-earthquake diagnostics.

2. Situation report on current national organisation for undertaking emergency diagnostics following an earthquake

Given the feedback from past earthquakes or exercises, should a destructive earthquake hit the nation today, **the necessity for emergency diagnostics would be unavoidable in the hours/days following the event**.

Facing such a need, the relevant civil security authorities would most likely call on building surveyors across the nation. As such, AFPS, just like other associations and groups of professional, would be called on to come up with volunteers ready to perform emergency diagnostics.

This situation is nuanced only by the thoughts and the actions undertaken to date in this field in the Antilles and on the French mainland, the absence of anticipation when it comes to activating any such mechanism as well as the absence of a technical reference database and dedicated resources. This would mean that the authorities would be confronted with multiple difficulties: speed and capacity to mobilize, action coordination and traceability, managing and securing the ways of undertaking diagnostics, heterogeneous diagnostics methodology, incomprehension, loss of confidence and discontent among the population... Feedback from the Lorca Spanish earthquake (2011) provides an illustration. The difficulties relating to the availability and the reliability of elements for assisting with decision making will constitute non negligible obstacles when it comes to achieving the goal of protecting and providing assistance to the population.

Observing the absence of any national method on how to undertake emergency diagnostics, AFPS has for some years now moved to form an “urgency” workgroup.

A precise target was set out: *“In an earthquake crisis situation, through its multidisciplinary organization, AFPS proposes to support its technical contribution to the public authorities so as to establish emergency diagnostics of damage to buildings with a view to assessing the immediate risk faced by people”*. The aim was therefore to design an organization, a method and the tools that would fit into the existing crisis management process (the ORSEC mechanism), without replacing it.

In September 2014, the technical and organizational approach proposed by AFPS obtained a national recognition of the device and a formalization of the AFPS executive framework by the Ministry in charge of civil protection. The organization and the technical tools are now available.

3. A mechanism founded on mobilising volunteers

The emergency building diagnostics process is based **on mobilizing volunteer inspectors through AFPS who will coordinate this organization**.

Volunteers are not necessarily AFPS members, they are “members” who have been trained by AFPS to emergency building inspection. **Their contribution is based on a voluntary principle**.

Candidates for training to become inspectors are recruited by AFPS from within the association but also from outside it, from among people **who work in professions relating to building engineering, crisis management or who have a knowledge of seismic and geotechnical phenomena in general**. **Volunteers may also be recruited from neighboring countries** (e.g. Switzerland and Italy, especially from among the teams of emergency inspectors in place in these countries). To date, **the target number for mainland France is to train 300 inspectors** and the figures are currently being defined for the Antilles area (most likely, at least **one hundred in Guadeloupe and one hundred in Martinique**).

Volunteers who can be mobilized must have attended all of the initial training modules put in place by AFPS. During this initial training, they receive a kit that is essential to their intervention. After completing their training, they also sign a formal commitment to comply with the instructions and procedures relating to the nationwide “emergency diagnostics” process. They will be called on to attend periodic follow-up courses.

The recruiting of candidates for training volunteers will soon be expanded by a promotion campaign and a call for candidates launched nationwide, once the methodology has been set-up, the training mechanism put in place and “Sécurité Civile” approval obtained.

Feedback from post-earthquake assignments show that although there is a very great need for volunteers to quickly undertake the emergency diagnostics after an earthquake, recruiting people with no particular building qualifications to produce emergency

diagnostics is not realistic. Emergency inspections must be performed by people with building knowledge who are trained up on the mechanism/methodology to guarantee the quality of these evaluations.

The position occupied by every volunteer at a time of crisis – coordinator, field inspectors, logistics specialists, etc. - will be defined on a daily basis by the coordinators.

It should be noted that when a crisis occurs, volunteers without specific building qualifications, but who wish to take part in the effort may come forward. These spontaneous volunteers will not perform diagnostics. They can however be usefully assigned to other tasks such as supplying the inspection teams with the resources essential to their assignment, overseeing compliance with the access and usage limitations placed on some damaged facilities, etc.

As part of their work, inspectors in France likely take **the status of “occasional public service collaborators”**. They are mobilized using a formal mobilization act.

4. The methodological approach

The methodological approach used has been developed by reference to the methods used by ATC and EERI (United States) and AEDES (Italy).

The following choices were made and targets set out:

- Undertaking a visual inspection
- Setting out a check-list of points to inspect
- Visually analyzing the damage
- Ensuring that the method can be used by people that are not building structure "experts"
- Implementing a field form describing the damage observed, comprising:
 - Methodology elements,
 - Traceability aspects,
 - Transmission modes.
- The form would come with an Inspector’s Manual to explain some aspects and ensure that the right method is applied.

The forms used for collecting data are destined for use in **performing large scale emergency diagnostics on conventional buildings**. They are not suitable for use in assessing the condition of strategic and sensitive buildings.

The form comprises 2 x 2 pages on two sheets:

- o Page 1 front: General descriptive data, results and transmission aspects (the only part handed over to the authorities),
- o Page 1 reverse: A general diagram and non-contractual explanation form,
- o Page 2 front: Damage typology and assessment,
- o Page 2 reverse: An explanation of the decision making matrix logic.

The image shows a detailed diagnostic form for post-earthquake emergency assessment. It is divided into several main sections:

- Top Section:** Includes a header with the title 'DIAGNOSTIC POST-SISMIQUE D'URGENCE' and a grid for 'NIVEAU DE DOMMAGE' (Damage Level) with a color-coded scale from 1 to 12.
- Left Column:** Contains administrative and identification fields such as 'NOM DE L'INSPECTEUR', 'N° de l'inspecteur', 'NOM DE LA VILLE', 'NOM DE LA RUE', 'NOM DE LA MAISON', 'NOM DE LA CITE', 'NOM DE LA ZONE', 'NOM DE LA VILLE', 'NOM DE LA RUE', 'NOM DE LA MAISON', 'NOM DE LA CITE', 'NOM DE LA ZONE'.
- Right Column:** Contains a large grid for 'NIVEAU DE DOMMAGE' (Damage Level) with a color-coded scale from 1 to 12.
- Bottom Section:** Contains a large grid for 'NIVEAU DE DOMMAGE' (Damage Level) with a color-coded scale from 1 to 12.

Data collection forms developed by AFPS for performing emergency diagnostics

Based on directives set out by the authorities, emergency building diagnostics results may trigger affixing a sticker summarizing the conclusions of the examination undertaken.



Stickers developed by AFPS to identify inspected buildings

The green sticker means that the building shows little damage. The building represents only a low risk to occupants and can therefore be reoccupied immediately.

The yellow sticker means that the building shows significant damage. The building represents a risk to occupants and it may only be entered, for short periods of time, at the people own responsibility. No one should stay in it.

The red sticker means that the building was severely damaged or that there is a significant risk in its surrounding environment. In all cases, any form of occupation is strictly forbidden.

5. Prospects

The next steps consist in:

- a stabilization of procedures
- an increase of the number of volunteers
- a deployment of large-scale training

The actions require the support of various ministries and the involvement of local actors. Cross-border exchanges are also in progress (Italy, Switzerland, Spain).

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