



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

# **Post-Earthquake Reconnaissance Report**

**Amatrice and Norcia, Italy**

**October 2016**

## Description

The purpose of the mission was to visit Amatrice, Norcia and other villages affected by the 24<sup>th</sup> August earthquake. The main motivation was to try to gather information on i) villages near the epicenter where most houses were strengthened a few decades ago and suffered little damage, and where there were no deaths during the August earthquake, and ii) make comparisons with the ones where there were more damages and victims.

Amatrice is now closed to the general public, due to the danger of new collapses. The entrance in the town can only be done jointly with a member of the Italian fire brigades. Therefore the date of the mission was determined by the availability of a member of the Italian fire brigades to lead the visit to Amatrice. The formalities to get the necessary permit for the members of the KnowRISK project enter Amatrice were done by the INGV members of the project. That date was set as 27<sup>th</sup> October.

The members of the KnowRISK team in this mission were:

IST – Mário Lopes, Mónica Amaral Ferreira and Francisco Mota de Sá

INGV – Fabrizio Meroni and Théa Squarcina

Prof<sup>a</sup> Cristina Oliveira, lecturer at Escola Superior de Tecnologia, Instituto Politécnico de Setúbal, Portugal, joined the IST team on this mission. Her travel and living expenses were provided by her School.

The description of the mission, day by day, is the following:

**25<sup>th</sup> October** – the IST team travelled from Lisbon to Norcia

**26<sup>th</sup> October** – in the morning there was a meeting between the IST team and the *Sindaco* (mayor) of Norcia. The main issues discussed were: why houses in Norcia received seismic strengthening, when did that started and why, details of the strengthening solutions, damage due to the earthquake of 24<sup>th</sup> August, priorities, financial support and legislation for enforcement of the seismic strengthening. It was agreed with the mayor that the IST team would return to Norcia on Friday or Saturday and that the mayor would try to provide drawings of the strengthening design of a house and visits to some houses where the seismic strengthening was more visible.



*Meeting at Centro Operativo Comunale di Norcia (COC ). From left to right: Francisco Mota de Sá, Cristina Oliveira, Mário Lopes, Mónica Amaral Ferreira, Sindaco Nicola Alemanno, Assessore alla Cultura Giuseppina Perla.*

After that and up to 3pm the group visited Norcia and after left to Rieti to meet the INGV team at the Civil Protection headquarters (Dicomac - Direzione di comando e controllo - Protezione Civile) in the region and get the permits that would allow the visit to Amatrice next day. At 7pm both groups were together doing the check-in at the hotel in Greccio (vicinity of Rieti) when the first earthquake of 26 October took place. After that the portuguese team sent information on the issue to the portuguese media, which started ringing soon.

**27<sup>th</sup> October** – Due to the earthquakes of the previous day (M 5.4 and M 5.9), the fireman that should have led the visit to Amatrice became unavailable and we could not enter in the “red zone”. Therefore this day was spent by both teams in the small villages around Amatrice (Petrana, Cornillo Vecchio, etc.) that were also strongly damaged during the 24<sup>th</sup> August earthquake. It is thought that in terms of the scientific interest maybe it was equivalent, as those villages were also “empty” of people and badly damaged, eventually not as much as Amatrice itself. The observed damages were registered in hundreds of photos.



*Left: Some localities visited by the KnowRISK Team. Right: Building demolition and debris removal*



*From left to right: Fabrizio Meroni, Théa Squarcina, Cristina Oliveira, Mário Lopes, Mónica Amaral Ferreira*

**28<sup>th</sup> October** – the INGV team returned to Milano and the IST team returned to Norcia, with 3 objectives:

- i) check if it was possible to visit houses where the strengthening was visible, even though due to the state of emergency in Norcia that would be extremely unlikely,
- ii) offer to help the Italian Civil Protection in inspections of houses to assess their state of damage and usability, and
- iii) offer help to inhabitants of Norcia that we had met on the previous stay, visiting some of their buildings and offering advice, as a way of thanking for their wonderful hospitality.

After arriving in Norcia, we went to the COC, and we realized, as expected, it was not feasible to do the planned visits to strengthened houses. Our offer to help on inspections was kindly

refused, as we are not certified and did not receive specific training to fill the inspections forms, as required by the Italian Civil Protection. Therefore, we ended up helping by visiting a building with strong non-structural damage, mainly to partition walls and ceiling, and giving technical advices on possible repair works. The building was relatively recent and has a reinforced concrete structure which is excessively flexible. The damage was due essentially to the large interstorey drifts. In this process we observed and registered some protective measures of non-structural elements, taken after the 24<sup>th</sup> August, that avoided more non-structural damage during the 26<sup>th</sup> October earthquakes. This example was already used in the classes to high school students in Portugal.



*Left: example of non-structural damage. Right: Protective solution - prevent television from turning*

At the end of the day we returned to Greccio, where we stayed up to Saturday, 29th October.

**29<sup>th</sup> October** – since the flight back to Portugal was schedule only for the 30st October, and we could not obtain more information in Norcia, on the 29<sup>th</sup> we visited the town of L'Aquila to follow the progress of the recovery process. The reason for this choice was to register the evolution of the town that 2 of the 3 members of the IST team had already visited after the 2009 earthquake. At the end of the day we went back to a hotel near the Fiumicino airport.

**30st October** – at 7h41m took place the last of the stronger earthquake (M6.5) that took place since the 24<sup>th</sup> August. Again the portuguese media contacted the portuguese team. All the team members gave interviews in Rome and after the return to Lisbon.

The objectives of the mission were only partially achieved, as the earthquakes of the 26st October made it impossible to obtain all the information about the strengthening of the houses of Norcia that we were looking for. However the meeting with the mayor of Norcia was extremely useful. There we learned that strengthening of the constructions of Norcia started in 1979, after an earthquake. It was implemented in all houses that are first houses, where people live permanently. Second houses (used essentially during holidays) were strengthened only in the cases in which they had common walls with first houses, because their safety would influence the safety of first houses. The State supported financially the rehabilitation in 40% to 50% of the cost. In some cases that the owners refused, the state enforced seismic

strengthening compulsorily. The main techniques applied in the seismic strengthening were to confined masonry walls on both faces with steel meshes inside a mortar layer. Both layers were connected through the thickness of the walls by means of steel cables anchored on both extremes, inside the mortar layer. Another common technique, used together with the previous one was the use of steel cables, anchored in the outside of parallel walls to prevent them from falling out-of-plane to the streets.

## Dissemination

The set of interviews of the IST team to the portuguese media, allowed to transmit to the portuguese public clear ideas about the importance of prevention, regarding structural and non-structural elements, and to explicitly refer the KnowRISK project. Those interviews are available on the KnowRISK site <http://knowriskproject.com/october-aftershocks/?lang=pt>

In Portugal, after our return, several public presentations were been made in order to share, alert and discuss with academic and general public problems and solutions related with seismic risk reduction: good practices and lessons learned.

The sessions were held at:

- November 2, 2016 – lecture to students of the civil engineering course at Instituto Superior Técnico, Lisbon
- November 2 – presentation and discussion at a meeting of PSD (Social Democratic Party), Lisbon
- November 14, 2016 - Instituto Politécnico de Setúbal, Barreiro
- November 17, 2016 – presentation and discussion at a meeting of the CDS (Cristian Democratic Party), Lisbon



The team has already received invitations of Oeiras and Cascais local authorities (Town Hall) to deliver presentations on the same subject.