

GPBE – OdE – ANIPB – UNL
International Seminar on Precast Concrete Structures
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PRECAST STRUCTURES AND L'AQUILA 2009 EARTHQUAKE

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DIPARTIMENTO DI INGEGNERIA
STRUTTURALE E GEOTECNICA



SAPIENZA
UNIVERSITÀ DI ROMA



the earthquake

Mainshock: 6 April 2009

Richter M_L 5.8

Moment M_W 6.3

Recorded PGA .67g

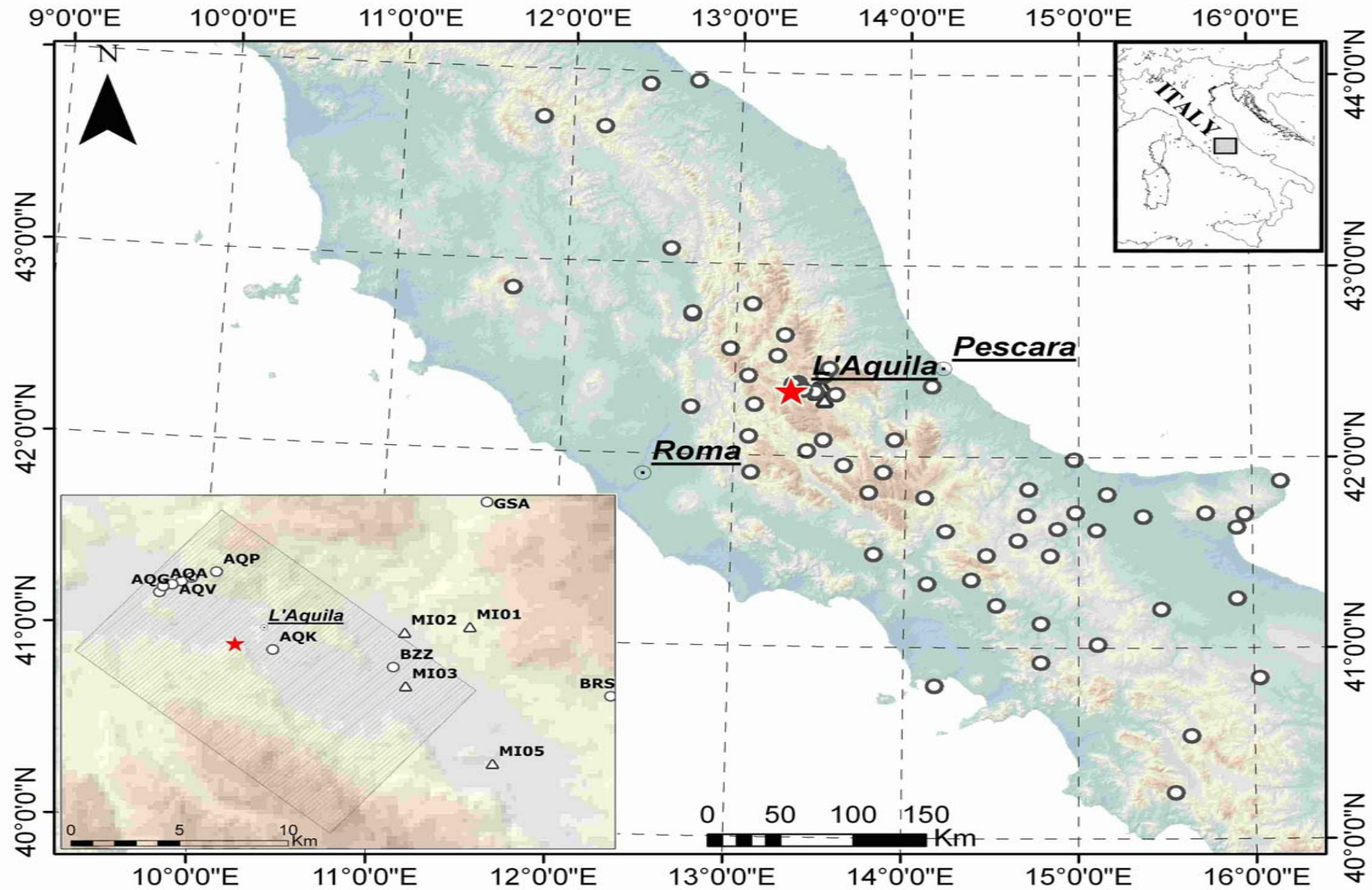
Mechanism of extensional type

In first month:

150 shocks $3.0 < M_L < 4.0$

13 shocks $4.0 < M_L < 5.0$

3 shocks $M_L > 5.0$



fault area, recording stations, mainshock epicentre

performance of buildings

- Performance of most buildings was as it might have been predicted, given the intensity of the quake
experience of other similar events
theoretical understanding as matured in recent times
- Many suffered to structural and/or non-structural damage
- Some collapsed partially or totally
- Many withstood the shocks with only minor consequences

types of buildings: HERITAGE MASONRY BUILDINGS



size and shape critical

types of buildings: OLD MASONRY BUILDINGS



irregular
layout

types of buildings: **OLD MASONRY BUILDINGS**



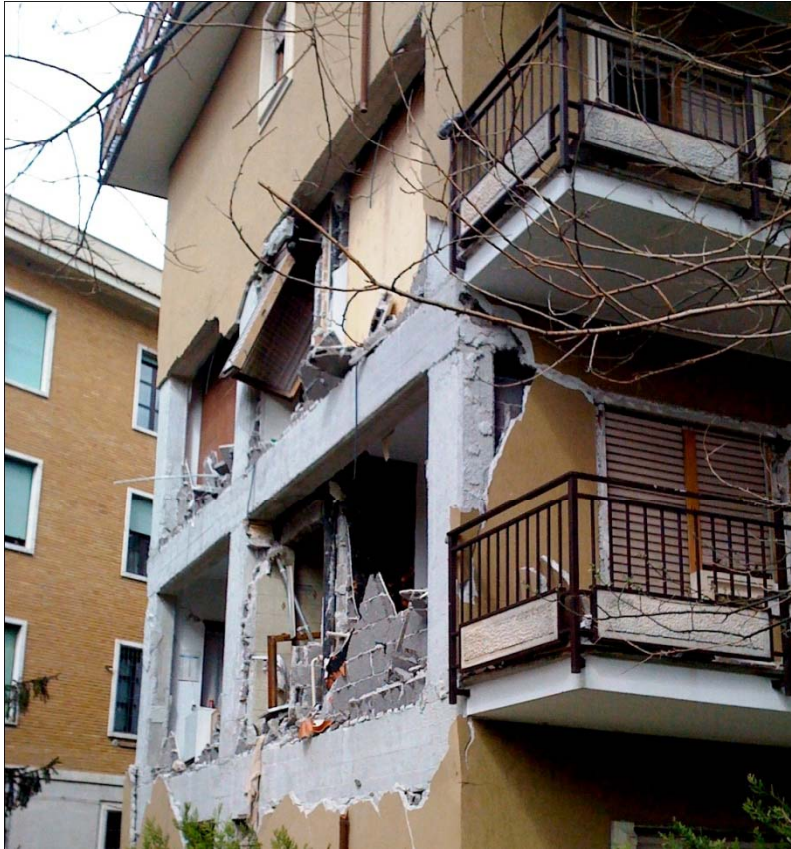
poor materials

types of buildings: OLD MASONRY BUILDINGS

poor maintenance



types of buildings: **CONCRETE BUILDINGS (c-i-s)**



“non-structural” damage
outer infill masonry expelled



types of buildings: CONCRETE BUILDINGS (c-i-s)



unwished parapet stiffening

types of buildings: **CONCRETE BUILDINGS (c-i-s)**



squeezed-in soft storey

unconnected diaphragms



types of buildings: **PRECAST CONCRETE BUILDINGS**

- Recently adopted in the area
for factory halls and warehouses
Generally one/two-storey structure, cantilever columns
hinged beams, double-tees or hollow-core floors
Façades of precast concrete non-structural panels
(so-called “architectural precast”).
- Design and construction consistent with modern criteria
- Many survived integer
- None collapsed as such

types of buildings: **PRECAST CONCRETE BUILDINGS**

- However,
due to “unforeseen” interaction
of nonbearing wall panels
with bearing frames
many lost entire façade claddings
- Behaviour important to discuss!

types of buildings: PRECAST CONCRETE BUILDINGS



Building under construction: walls and TT slabs failed

types of buildings: PRECAST CONCRETE BUILDINGS



operating factory building: wall panels tilt off

types of buildings: PRECAST CONCRETE BUILDINGS



fallen façade of horizontal panels (right-hand side)

types of buildings: PRECAST CONCRETE BUILDINGS



Stiffening façade of the most deformable part fallen down

types of buildings: PRECAST CONCRETE BUILDINGS



corner panel failures of various degrees

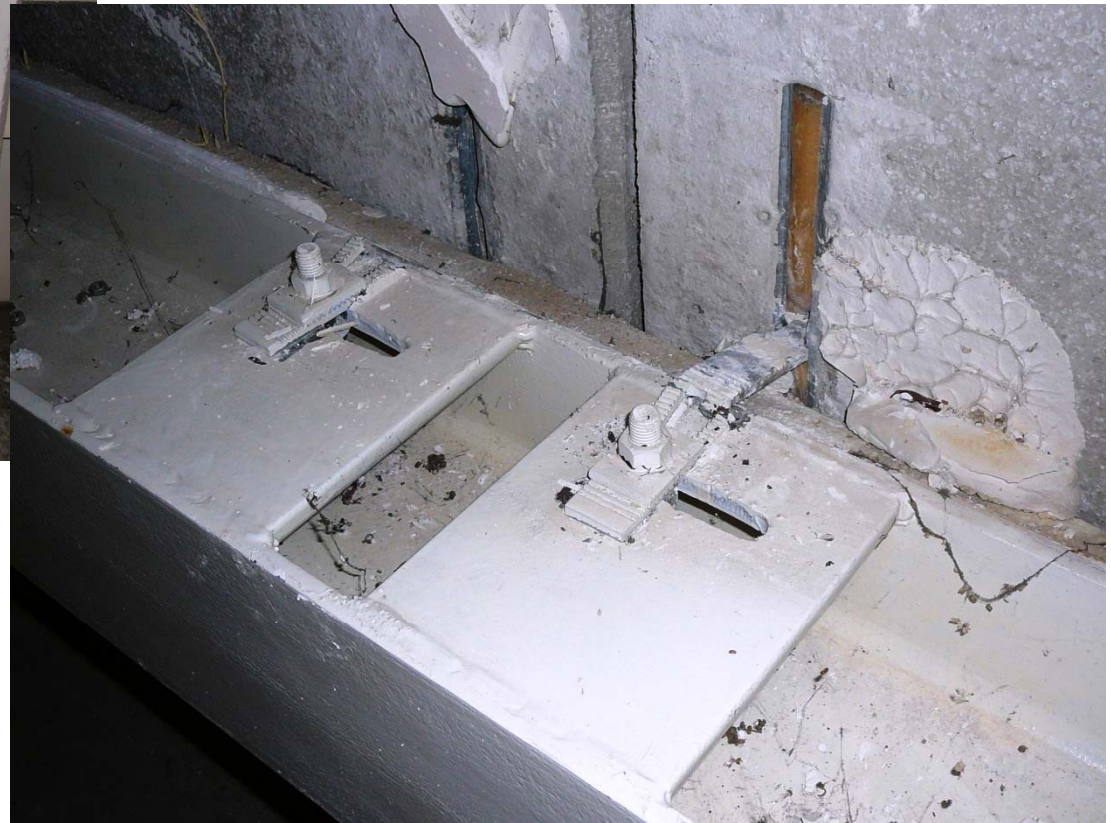


types of buildings: PRECAST CONCRETE BUILDINGS



wall panel retaining device

id.: close up



types of buildings: PRECAST CONCRETE BUILDINGS



Channel embedded in wall panel opened by unforeseen action

types of buildings: PRECAST CONCRETE BUILDINGS



Fastener plate of wall panel failed by unforeseen action

types of buildings: PRECAST CONCRETE BUILDINGS



Channel anchor bars rip in wall panel by unforeseen action

THE REACTION

- of people and authorities
immediate and effective
in emergency and post-emergency
- Rescue teams of Civil Protection started within few hours
working in the collapsed buildings
searching for people and shoring portions of the structures
installing tent cities on the spot and finding accommodations
12,000 personnel were involved
about 66,000 people assisted
- Evaluations on the state of usability of buildings

THE REACTION

**Immediate inspections
on monuments**



THE REACTION – the CASE Project



150 buildings / 16 types of structure
base-isolated on 20x60 m plates
furnished, turn key housing for 12,000
delivered within 2009



... the precast concrete solution

THANK YOU

for

YOUR KIND ATTENTION