AN EMERGENCY TECHNICAL OPERATION HANDBOOK FOR CIVIL PROTECTION OPERATIVE CENTERS BORN OF THE ITALIAN EXPERIENCE IN UMBRIA MARCHE AND POLLINO EARTHQUAKES

Riccardo COLOZZA, Mario BELLIZZI, Giancarlo MARINI, Filomena PAPA, Angelo G. PIZZA1 Giandomenico CIFANI, Giovanni CIALONE, Livio CORAZZA, Antonio MARTINELLI, Carlo MUTIGNANI, Aurelio PETRACCA2

SUMMARY

Technical activities, performed since very first moment after Umbria and Marche earthquake, September 1997, were founded, most of all, on GNDT and SSN technicians and researchers experience of previous quakes. The acquired know-how allowed to design procedures and technical tools mainly to perform a complete damage survey and safety assessment on buildings, both public (strategic) and private (residential). Churches survey was another goal, because the vulnerability and cultural worth of a very large number of this kind of constructions, most of all ancient, and because the people needs of prompt solace and gathering place. Technical tools, tested during the quake, show a good performance and a lot of data, collected on about 120,000 buildings, will help to improve the know-how in several applied research field. The experience was useful especially to improve the GNDT - SSN vulnerability and safety assessment form herself, barely ready for use in September 97. The improved tools and procedures allowed the SSN Emergency Office to promote a - ready for use – Operative Center Emergency technical operation handbook, made with the GNDT – L’Aquila Researchers Team usual sharing. Other forms yet in use for historical towns, hospitals functionality and landslide survey (last one product by Italian Geological Survey and National Research Council) were added in the Book. It, eventually, offers a set of advises to perform the survey in order of priority and coordination with the Operative Center other emergency function teams and authority. The Emergency operation handbook, in his first version, was used and further tested, a year later, during the September 1998 Pollino (Southern Italy) earthquake and in a new improved version it will eventually be the official Italian civil protection operational book for damage survey. Last but not least, the systematization of emergency operation will let national and local government to plan a better reconstruction intervention, assessing financial needs and defining design guidelines.

INTRODUCTION

Every post-earthquake situation, besides having its specific features according to the features of the event in terms of severity and territorial extension, has had, until Umbria and Marche earthquake, one of its individual characteristics which also depends on “local conditions”, that is to say from the particular training and organization of the various bodies involve, from the number and quality of the people involved as concerns their previous post-earthquake experiences or as previsional and preventional activities managed during seismic peace time. Hence it follows the necessity to define unified procedures to which, in future, everyone has to conform because all post-quake activities, from their first emergency and emergency phase, to the reconstruction phase, are all strictly tied and can’t be considered in isolation. All that is set out and carried out at the very beginning will condition all the following phases.

1 Presidenza del Consiglio dei Ministri, Dipartimento Servizi Tecnici Nazionali, Servizio Sismico Nazionale via Curtatone, 3 - 00185 Roma – Italy; fax +39.06.4466579; Email: colozza@ssn.dstn.pcm.it

2 Gruppo Nazionale Difesa dai Terremoti, GNDT-CNR, c/o Regione Abruzzo - Servizio Protezione Civile, via Leonardo da Vinci, 1 – 67100 L’Aquila – Italy; fax +39.0862-313524; Email: gndtaq@regione.abruzzo.it
The morning of September 26, 1997, SSN and GNDT experts were called up to support the National Civil Protection Department for most part of the technical operations due Umbria - Marche earthquake.

The impressive amount of buildings collapsed or damaged, caused a need of shelter for a thousand of city and village residents and worried the civil protection authorities because of the danger due to unsafe constructions. The authorities decided a complete damage survey in order to provide safety operations and called up SSN and GNDT teams to support the survey campaign. While the professional qualification and the main survey tools were available, the Operative Centers suffered because of the large amount of operations to solve and some lack of procedures. At the end of a four-month-damage-survey and safety assessment involving hundreds of technicians in about 120,000 construction safety evaluation, the participant experts decided to draw an Operative Handbook in order to collect all the material used and to define the main operations for the future. Actually the operative model was used and tested, a year later, on the 9th September 1998 earthquake in the Pollino area (Southern Italy).

General design

The general idea was to define a “field operative route”, starting from the citizen survey request coming through the city major into the Operative Center. The major organizes people requests in three different files (residential houses, strategic buildings and churches), taking part in priority decisions and passing the requests to the Operative Center, where the survey manager sends a technicians’ team to assess the damage, eventually informing the major about situation and the needs for safety. The major plays a basic role in the operations flow, because he only (or his office) can collect different requests coming from residents in the same building, he can assure access for the survey teams, he eventually can decide the evacuation also providing provisional operations to assure safety. The construction were divided in three different typologies because strategic buildings needs the best priority and, often, specific experts’ teams (e.g. hospitals). Churches are a very widespread typology. Often ancient constructions with a historical, artistic and architectural peculiarity, also need special teams of experts. Besides, after an earthquake, people ask for churches because of their traditional role in the village as gathering and comforting place. Further, damaged buildings often threaten routes or other lifelines and so do landslides. Therefore other two “field operative routes” were designed, in order to assess these problems using composite teams of different professional fields experts.

Equipment and human resource

The Umbria Marche quake allowed to define resource and, after that, the Pollino quake confirmed the evaluation. The Operative Center layout, the equipment, the human resource were assessed. The operations need space to accommodate the managing group, to receive, train, sort and send teams, allowing meetings, etc... in different rooms, without any interference, considering the pressure situation in which operations are carried out. The managing group needs four/five people to manage about 400 survey a day. A non-trained person can input an average number of 60 survey forms each day or 100 request/team/survey result operations a day (from 50 to 100% less than the trained person). Teams perform (each team) survey assessment from 1 to 20 a day, training and assignment included, depending on the situation (experience, difficulties in survey, building complexity, or in finding address, in weather condition, in transport or others), on an average of 6/7 a day. Computers, copiers, faxes, modems, phones and other equipment needs are assessed. The request trend starts slowly with a massive climb after three/five days. During the first days is necessary to have a few well trained teams disposal, usually called up from different Regional and National Civil protection offices or from SSN and GNDT, to provide worst situations. After, when the request trend shows first increasing a general call up is needed, using both private professionals and civil service experts.

The technical tools

The Handbook collected a several different form created in order to perform survey. The most important (hardly ready in September 1997) is the damage and safety assessment form designed by SSN and GNDT. The first level form for damage evaluation, quick intervention and safety of buildings in a seismic emergency, is one of the tools being studied by a working group consisting of the GNDT and SSN. This working group was formed with the aim of inspecting and updating the approaches and procedures concerning general data collection for the damage study and the evaluation of the seismic vulnerability of buildings, regarding all forms of construction but particularly those in masonry. The work for the determination of a survey and safety evaluation form was still in progress when an earthquake struck the border area between Marche and Umbria and therefore was used in a real situation. In the days immediately following those of the two main tremors, the form was adopted by the National Department for Civil Protection and was also used by the fire department in an experimental way for
the damage survey and safety evaluation in the Marche region. In the setup of the new form, the authors tried to maintain the conceptual approach of an instrument (AMADEUS) [Gavarini, 1985] elaborated some years ago within the GNDT, that had identified the basic contents and proposed a logical-decisional model to be followed in the process of safety evaluation after an earthquake. Damage and safety assessment are:

- management instruments as regards some emergency aspects with particular reference to building safety and to the amount of people evacuated and the consequent needs of temporary shelter structures;
- instruments for the definition of damages and then of the necessary resources for restoration interventions;
- instruments for the setting out of reconstruction activities

The form is divided into sections: in section 1 there is the identification of the building (this occupies all the top part, then there is a space in which all the cartographic identifications are written on a plan). In section 2, the description of the building is reported; in section 3, the type; in section 4, there is the description of damage to structural elements and the most urgent interventions carried out; in section 5, damage to non-structural elements and, here too, the most urgent interventions carried out; in section 6 the external damage and in section 7 the geological-geotechnical situation. In section 8 there is the definition of risk levels: structural and non-structural, external and geotechnical with three evaluation possibilities: high, low with measures and low. This section constitutes a type of evaluation synthesis of the risk situation and through this synthesis the next phase is then directed towards results regarding safety. This phase is subdivided into five possibilities: safe building (A), safe building with intervention measures (B), partially unsafe (C), temporarily unsafe, to be re-examined carefully (D), and unsafe building (E). Section 9 is intended for notes that can be freely and opportunely expressed by the surveyor and that may prove very useful in clarifying specific situations. To fulfil the simplicity and rapidity requirements, data which are directly observed or easily available, have been included in the form; information which is nevertheless sufficient to give a minimum description of the building and is useful for various reasons after an earthquake. One of the first requirements is the identification of the building. This is a basic operation in this type of survey, however it requires particular attention in its organization so as to be easily feasible. Concerning the seismic risk of the construction, the building is basically a structural unity, eventually interacting with other adjacent units, to be considered in the safety evaluation. Since it is often difficult to identify this structural unity in historical towns, where buildings constructed in different periods and with different materials are inter-connected and grouped along streets and squares, the manual for the form compilation suggests some criteria, taking into account homogeneity in construction type and geometry (e.g. number of storeys). For easy use, the form adopts a filling-in system with choices on pre-classified information and with the possibility of multi-choice in some cases.

The form has been conceived and realized as a concise tool for easy data collection, concerning the structural and non-structural evaluation, for a typological and vulnerability judgement of the building and also to act as a guide in the safety evaluation. In the determination of type, and in particular of damage, the authors have tried to establish a comparative classification in terms of the European Macroseismic Scale [Grunthal 1993]. This allows for a conversion of the collected data to the scale and therefore, to progressively illustrate the macro-seismic picture with a more marked engineering characterization. The data can also be used for the approximate estimation of the costs necessary in order to activate intervention policies. This type of utilization has been tested through the establishment of an evaluation model for economic damage. The form has also been experimented through the realization of software, converting the data collected, within the form, into corresponding information from the GNDT first level masonry form rendering existing costs models utilisable [Angeletti, 1984; Benedetti & Petrini, 1984]. The conversion has provided the first cost estimates, which have been made available to the National Department for Civil Protection. The information has proved useful to the local authorities, who are currently involved in the organizational phase for the repair and restoration interventions. A new version of the form, recently produced by the working group, is presented in Appendix 1. Other forms are contained: a Churches, Landslides, etc., and a different managing sheets useful for follow the different field routes regarding the operations (Appendix 2). A Excel simple tool is enclosed, now implementing in a better visual basic tool, in order to insert it in a wide computer tool address to manage all emergency functions.

CONCLUSIONS

Now that a first complete and computerized version of the Emergency Handbook has been defined, the National Department of Civil Protection has started up Regions and with all the Bodies and Institutions involved, in order to arrange and definitively approve these standardized procedures. Besides, consequent training and informative activities at all levels are being programmed, so that in the event of future seismic events all the people involved in the emergency could be ready to face them using pre-defined procedures and by using a common language, assuming in this way a greater timeliness and efficiency.
### APPENDIX 1

**Presidenza del Consiglio dei Ministri**

**DIPARTIMENTO NAZIONALE DEI SERVIZI TECNICI NAZIONALI**

**Consiglio Nazionale delle Ricerche**

**GRUPPO NAZIONALE PER LA DIFESA DAI TERREMOTI**

**1st LEVEL FORM FOR DAMAGE EVALUATION, QUICK INTERVENTIONS AND USABILITY OF BUILDINGS IN THE SEISMIC EMERGENCY**

(Ver. 09/98)

---

**SECTION 1  Building identification**

- **Provincia:** ____________________________
- **Township:** ____________________________
- **Locality:** ____________________________
- **Address:**
  - **Street:** ____________________________
  - **Road:** ____________________________
  - **Square:** ____________________________
  - **Locality:** ____________________________
- **Position:**
  - **Isolated:**
  - **Internal:**
  - **End:**
  - **Corner:**
- **Istat Codes**
- **Locality Code:** ____________________________
- **Census section:** ____________________________
- **Land register:**
  - **Foglio:** ____________________________
  - **Mappale:** ____________________________
  - **Particelle:** ____________________________
- **Building name or owner of building:** ____________________________

---

**SECTION 2  Building description**

- **Metrical data**
  - **Average story height [m]:** ____________________________
  - **Average floor area [m^2]:** ____________________________
- **Age:** ____________________________
- **Use:**
  - **Use code:** ____________________________
  - **Building and strengthening:** ____________________________
  - **Use:** ____________________________
  - **Number of units in use:** ____________________________
  - **Utilisation percentage:** ____________________________
  - **Occupants:** ____________________________

---

(1) - including underground levels

---

Photocopy of structural aggregate with building location and identification code
### SECTION 3 Typology (multi-choice with max 2 options)

<table>
<thead>
<tr>
<th>Vertical Structures</th>
<th>Horizontal Structures</th>
<th>MASONRY STRUCTURES</th>
<th>OTHER STRUCTURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not identified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vault without tie-beams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vault with tie-beams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truss with deformable slabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truss with semirigid slabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truss with rigid slabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without tie-beams or string</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tie-beams or string</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SECTION 4 Damage to STRUCTURAL ELEMENTS and provisional interventions already carried out

<table>
<thead>
<tr>
<th>Level - extension</th>
<th>Structural - components</th>
<th>Pre-existing damage</th>
<th>DAMAGE (1)</th>
<th>MEASURES TAKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtain walls, partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-existing damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SECTION 5 Damages to NON STRUCTURAL ELEMENTS and provisional interventions already carried out

<table>
<thead>
<tr>
<th>Type of damage</th>
<th>Interventions</th>
<th>DAMAGE PRESENT</th>
<th>MEASURES TAKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detachment of plaster, coverings, false ceilings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall of roof tiles, chimneys...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall of cornices, parapets...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall of other internal or external objects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to plumbing, sewage or heating systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to electrical or gas system</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SECTION 6 External danger caused by other buildings and interventions already carried out

<table>
<thead>
<tr>
<th>Type of damage</th>
<th>Interventions</th>
<th>DANGER ON</th>
<th>MEASURES TAKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the collapse of other buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From the fall of elements of other buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SECTION 7 Land and foundation

<table>
<thead>
<tr>
<th>MORPHOLOGY OF THE SITE</th>
<th>SETTLEMENTS OF SOIL OR FOUNDATION PRESENT OR POSSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>1</td>
</tr>
</tbody>
</table>

2nd page
### SECTION 8  Safety assessment

#### RISK ASSESSMENT

<table>
<thead>
<tr>
<th>RISK</th>
<th>STRUCTURAL (Sect. 3 &amp; 4)</th>
<th>NON-STRUCTURAL (Sect. 5)</th>
<th>EXTERNAL (Sect. 6)</th>
<th>GEOTECHNICAL (sect. 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>LOW WITH MEASURES</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>HIGH</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
</tbody>
</table>

#### SAFETY RESULT

- **A**  SAFE building
- **B**  SAFE WITH QUICK INTERVENTIONS but temporarily not safe
- **C**  PARTIALLY UNSAFE building
- **D**  TEMPORARILY UNSAFE to be carefully reviewed
- **E**  UNSAFE building

#### UNSAFE UNITS, FAMILY AND PEOPLE EVACUATED

<table>
<thead>
<tr>
<th>N. of unsafe units</th>
<th>Families evacuated</th>
<th>N. of people</th>
</tr>
</thead>
</table>

**LIMITED (*) OR EXTENSIVE (**) MEASURES TAKEN TO (CASE B)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>⬜️</td>
<td>⬜️</td>
<td></td>
</tr>
</tbody>
</table>

- **MEASURES SUGGESTED**
  - Application of reinforcement
  - Repairs of light damage of curtain wall and partitions
  - Roofing restoration
  - Props on stairs
  - Removal of wallings, coverings, false ceilings
  - Removal of tiles, chimneys, parapets

- **MEASURES SUGGESTED**
  - Removal of cornices, parapets, projecting elements
  - Removal of internal and external objects
  - Barriers and passage protections
  - Repairs to systems

### SECTION 9  Other observations

- **Inspection accuracy**
  - 1  ☐  Outside only
  - 2  ☐  Partial
  - 3  ☐  Complete (> 2/3)

- **On the damage, on interventions, on usability, etc.**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **SURVEYOR (in block letters)**

**Signature**
APPENDIX 2
FORM LIST ENCLOSED IN THE TECHNICAL OPERATION HANDBOOK

Form I1 - Petition to the Mayor about inspection public, private, monumental and religious buildings
Form I2 - Petition to the Mayor about inspection for landslide phenomenon
Form I3 - Petition to the Mayor about joined inspection

Form R1 - Request to Operative Center about inspection private buildings
Form R2 - Request to Operative Center about inspection public buildings
Form R3 - Request to Operative Center about inspection monumental and religious buildings
Form R4 - Request to Operative Center about inspection about landslide phenomena
Form R5 - Request to Operative Center about joined inspection

Form A1 - Surveyor private data
Form A2 - Technical Coordination Group member private data
Form A3 - Composition Operative Center Technical Coordination Group
Form A4 - Technical team composition
Form A5 - Identity card
Form A6 - Transit permission in areas devastated by a quake
Form A7 - Permission for practicability inspections
Form A8 - Vademecum for the teams involved in building practicability survey

Form S1 - First level form about damage first aid practicability survey for ordinary building
  - Second level form both for masonry and concrete structure
Form S2 - First level form for building vulnerability survey
Form S3 - Form for churches seismic damages post quake emergency
Form S4 - Landslide phenomenon census paper
Form S5 - Joined survey statement

Form GP1 – Public, private, monumental, religious urgent measures
Form GP2 - Urgent landslide area measures

Form GE1 - Public, private, monumental, religious urgent safety account
Form GE2 – Account about landslide area inspections

Form G1 - Operative Center summary about council inspections – private buildings
Form G2 - Operative Center summary about council inspections – public buildings
Form G3 - Operative Center summary about council inspections – monumental and religious buildings
Form G4 - Operative Center summary about council inspections – landslide phenomena
Form G5 - Operative Center summary about council inspections – joined inspections
Form G6 – Daily summary about private building inspection activities
Form G7 - Daily summary about public building inspection activities
Form G8 - Daily summary about monumental and religious buildings inspection activities
Form G9 - Daily summary about landslide phenomenon inspection results
Form G10 – Daily statement scheme

Form GS1 – Inspection list about public buildings damaged by earthquake
Form GS1b – Special and strategic building list
Form GS2 - Inspection list about private buildings damaged by earthquake
Form GS3 - Inspection list about religious buildings damaged by earthquake
Form GS4 - Inspection list about landslide phenomena
Form GS5 – Joined inspection list
REFERENCES

Angeletti, P. 1984. Un modello per la valutazione dei costi di riparazione e adeguamento antisismico sulla base dei censimenti di danno e vulnerabilità, *Vulnerabilità e metodi per la riduzione del rischio sismico; Proc. synp.*, Noto (Sicilia).


